



Remedial Design / Pre-Design Data
Acquisition Work Plan
Volume II of II

FINAL

North Industrial Corridor

Wichita, Kansas

APPROVED WITH COMMENTS
DATE(S) 06/05/14, 07/23/14, 07/29/14

Presented to:



City of Wichita
1900 E. Ninth Street
Wichita, KS 67214

Presented by:

SCS AQUATERRA
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September 2013
Revised March 2014
Revised June 2014
File Number 27213343.00

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APPENDIX A

RD/PDA QUALITY ASSURANCE AND FIELD SAMPLING PLAN



Quality Assurance – Field Sampling Plan

Pre-Design Data Acquisition Investigation and Data Summary

North Industrial Corridor Wichita, Kansas

Presented to:
City of Wichita – Public Works and Utilities
1900 E. Ninth Street
Wichita, KS 67214

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QUALITY ASSURANCE – FIELD SAMPLING PLAN

Pre-Design Data Acquisition Investigation and Data Summary

North Industrial Corridor

Wichita, Kansas

KDHE Case No. 95-E-0321

Presented To:

City of Wichita – Public Works and Utilities

Presented By:

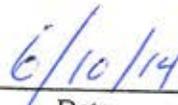
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This document has been prepared in general accordance with the *EPA Requirements for Quality Assurance Project Plans for Environmental Operations, EPA QA/R-5* (March 2001).

APPROVAL:



City of Wichita -Public Works and Utilities
Client Representative, Shawn Maloney, P.G.



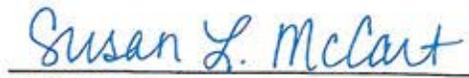
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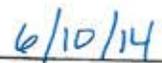
SCS Aquaterra
Project Manager, Monte Markley, P.G.



Date



SCS Aquaterra
Quality Assurance Manager, Susan McCart, P.E., P.G.



Date

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Acronyms and Abbreviations

1,1-DCA	1,1-Dichloroethane
bgs	Below Ground Surface
°C	Degrees Celsius
CAD	Corrective Action Decision
CFR	Code of Federal Regulation
Cis-1,2-DCE	Cis-1,2-Dichlorethene
COC	Chain of Custody
CQA	Construction Quality Assurance
CRDL	Contract Required Detection Limits
CRQL	Contract Required Quantitation Limits
DQI	Data Quality Indicators
DQOs	Data Quality Objectives
EPA	Environmental Protection Agency
FS	Feasibility Study
gpm	Gallons per Minute
GWU	Groundwater Unit
HAZWOPER	Hazardous Waste Operations and Emergency Response
IDW	Investigation Derived Waste
IM	Interim Measures
KDHE	Kansas Department of Health and Environment
MDL	Method Detection Limit
MNA	Monitored Natural Attenuation
MS/MSD	Matrix Spike / Matrix Spike Duplicate
NELAP	National Environmental Laboratory Accreditation Program
NIC	North Industrial Corridor
NIST-NVLAP	Standards and Technology National Voluntary Laboratory Accreditation Program
NTU	Nephelometric Turbidity Units
OSHA	Occupational Safety and Health Association
PDA	Pre-design Data Acquisition
POTW	Publically Owned Treatment Works
PPE	Personal Protective Equipment
QA	Quality Assurance
QA-FSP	Quality Assurance – Field Sampling Plan
QAM	Quality Assurance Manual
QAP	Quality Assurance Program
QA-SAP	Quality Assurance - Sampling and Analysis Plan
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RDW	Remediation Derived Wastes

RI	Remedial Investigation
RL	Reporting Limit
RSKs	Risk-Based Standards for Kansas
S.U.	Standard Units
SOPs	Standard Operating Procedures
SSHSP	Site-Specific Health and Safety Plan
TCE	Trichloroethene
TCL	Target Compound List
TSD	Treatment, Storage, and Disposal
ug/L	Micrograms per Liter
USEPA	United States Environmental Protection Agency
VC	Vinyl Chloride
VFA	Volatile Fatty Acids
VOC	Volatile Organic Compound
WP	Work Plan

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

The purpose of this Quality Assurance – Field Sampling Plan (QA-FSP) is to establish the policies, organization, objectives, and specific quality assurance (QA) and quality control (QC) measures and field sampling procedures to be used during implementation of the Remedial Design / Pre-Design Data Acquisition (RD/PDA) work plan (WP). The RD/PDA WP is the first regulatory deliverable for the Kansas Department of Health and Environment (KDHE) final Corrective Action Decision (CAD) for the North Industrial Corridor (NIC) site. As site location map identifying the NIC boundary is provided as **Figure 1**. The RD/PDA WP defines the remedial objectives for each Groundwater Unit (GWU) in the NIC site, and the necessary PDA data collection efforts required to support a design that meets the objectives outlined in the CAD. A map showing the location of the GWUs is provided as **Figure 2**. The CAD indicates five groundwater extraction wells will be located throughout the NIC project area, with six contingency locations for additional extraction wells. The well locations are primarily based on data collected within the project area through 2007 and 2008. Because this information is now four to five years old, PDA activities are intended to: confirm the plume delineation and migration of groundwater in units GWU-1 through GWU-4; confirm and/or determine appropriate locations for groundwater extraction wells; provide needed data for the design of groundwater extraction and treatment systems for GWU-2, GWU-3, and GWU-4; and, provide needed data for the design of a Monitored Natural Attenuation (MNA) Assessment.

1.2 DISTRIBUTION LIST

This QA-FSP, and any updates or amendments thereto, will be maintained by the City of Wichita (City) – Public Works and Utilities and the KDHE offices in Topeka, Kansas, as well as distributed to the following parties:

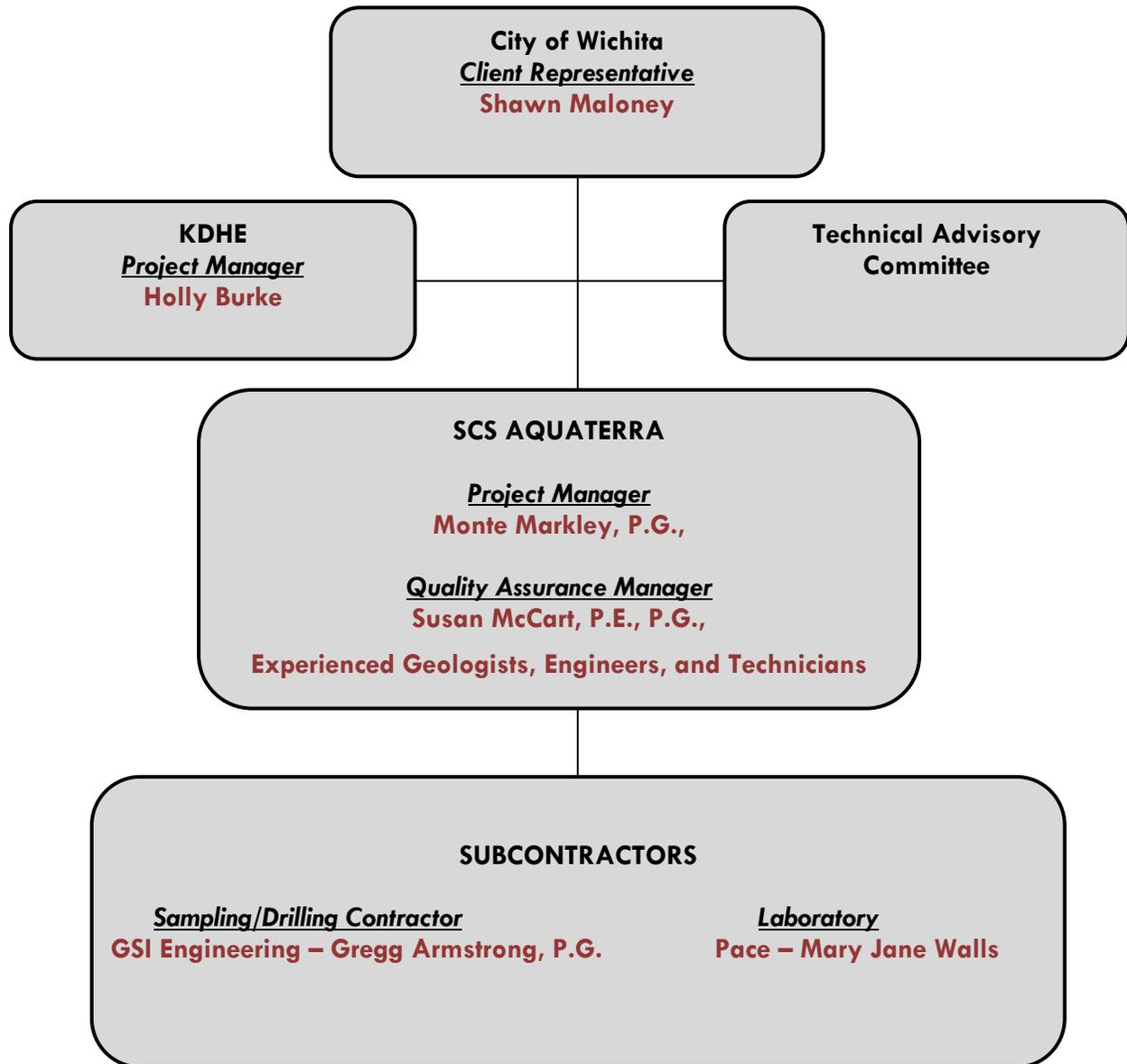
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Holly Burke – Project Manager KDHE –fd Environmental Remediation	785-296-6242 hburke@kdheks.gov
Monte Markley, P.G. – Project Manager SCS Aquaterra	316-315-4501 mmarkley@scsengineers.com
Susan McCart, P.E, P.G. - Quality Assurance Manager SCS Aquaterra	913-681-0030 smccart@scsengineers.com
Gregg Armstrong – Project Manager GSI Engineering	316-554-0725 garmstrong@gsinetwork.com

Mary Jane Walls – Project Manager
Pace Laboratories, Inc.

913-563-1401
mjwalls@pacelabs.com

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

This section describes the organization and responsibilities for project personnel. The organizational structure established for this project is depicted on the chart below and includes the City, Technical Advisory Committee (TAC), KDHE, SCS Aquaterra management and field staff, and select contractors. The lines of authority and the lines of communication for the project can be determined from this organizational structure.



2.1 CITY OF WICHITA

The City of Wichita will be responsible for providing project coordination with the KDHE, TAC, and SCS Aquaterra. Mr. Shawn Maloney will serve as the Primary Point of Contact. Contact information for Mr. Maloney is as follows:

Shawn Maloney, P.G.
316-268-8351
SMaloney@wichita.org

Wichita Department of Public Works
Office of Environmental Health
1900 E. Ninth Street
Wichita, Kansas 67214

2.2 KANSAS DEPARTMENT OF HEALTH AND ENVIRONMENT

The KDHE Bureau of Environmental Remediation (BER) is providing review and comments on project documents. KDHE will review the QA-FSP and provide comments to Ms. Holly Burke will serve as the KDHE Project Manager. Contact information for the KDHE Project Manager is as follows:

Holly Burke
785-296-6242
hburke@kdheks.gov

KDHE
Bureau of Environmental Remediation
1000 SW Jackson, Suite 410
Topeka, KS 66612

2.3 TECHNICAL ADVISORY COMMITTEE

The Technical Advisory Committee will provide review and comments on project documents to the City and SCS Aquaterra.

2.4 SCS AQUATERRA

SCS Aquaterra will have primary responsibility to prepare and execute project plans, investigations, and reports for the RD/PDA. While all personnel involved in a project are implicitly a part of the overall project and quality assurance program, certain individuals have specifically delegated responsibilities. Within SCS Aquaterra these are the Project Manager, Quality Assurance Manager, and Project Geologists, Engineers, Chemists and Technicians.

2.4.1 Project Manager

Mr. Monte Markley, P.G., is the Project Manager for this project. The Project Manager is an experienced manager and technical professional responsible for coordinating the various project tasks and maintaining day-to-day contact between the City, TAC, KDHE and the project team. It is the responsibility of the Project Manager to ensure that project personnel have a good understanding of the RD/PDA WP, QA-FSP, and Site Specific Health and Safety Plan (SSHSP)

and have an understanding of their respective roles relative to one another, and an appreciation of the importance of the roles to the overall success of the project. The Project Manager is responsible for control of the distribution and accountability of documents relating to the project. The Project Manager is to issue copies of documents relating to the above referenced plans, and revisions thereto, and will maintain a record of distribution. Contact information for the SCS Aquaterra Project Manager is as follows:

Monte Markley, P.G.
316-315-4501
mmarkley@scsengineers.com

SCS Aquaterra
11120 E. 26th St. N., Suite 1100
Wichita, KS 67226

2.4.2 Quality Assurance Manager

Ms. Susan M. McCart, P.E., P.G., will serve as the Quality Assurance Manager for this project. The Quality Assurance Manager is an experienced manager and technical professional responsible for reviewing project plans and recommending revisions to the plans, if necessary to maintain quality assurance and satisfy the data quality objectives. The Quality Assurance Manager is responsible for final analytical data quality review and is independent of laboratory operations. Contact information for the SCS Aquaterra Quality Assurance Manager is as follows:

Susan M. McCart, P.E., P.G.
913-681-0030
smccart@scsengineers.com

SCS Aquaterra
7311 W. 130th St., Suite 100
Overland Park, KS 66213

2.4.3 Project Geologist, Chemist, Surveyor, and Technicians

Field sampling, testing, and surveying tasks required by the RD/PDA WP will be conducted by or under the direction of experienced environmental geologists, chemists, and technicians.

2.4.3.1 Project Geologist

The Project Geologist will oversee geologic, hydrogeologic, and geotechnical testing and analysis; drilling and probing activities; and, the installation and development of wells. The Project geologist also coordinates data validation of geologic and hydrogeologic data. The Project Geologist is a Registered Geologist (RG) in the State of Kansas. The project geologist often serves as the point of contact for sampling technicians, subcontracted drillers, direct push contractors and geotechnical laboratories.

2.4.3.2 Project Chemist

The Project Chemist will oversee the activities involving the field procedures for chemical samples, laboratory analyses, chemical sample documentation procedures, and tracking of chemical samples. The Project Chemist also coordinates data validation of analytical laboratory

deliverables. The Project Chemist often serves as the point of contact for sampling technicians and subcontracted analytical laboratories.

2.4.3.3 Project Surveyor

The Project Surveyor will oversee the surveying of the surface/subsurface sampling locations, well installation, piezometers, and direct push boreholes using Global Positioning System (GPS) techniques and provide survey data necessary for the documentation of sample locations. Well locations will be surveyed by a registered land surveyor. The survey coordinate system used for documenting sample locations will be consistent with existing Site survey data to facilitate the use of Geographic Information System (GIS) capabilities, if required, for future data-handling needs.

2.5 LABORATORY ORGANIZATION AND RESPONSIBILITIES

Groundwater sample analysis will be completed by Pace Analytical Services, Inc. (Pace), located in Lenexa, Kansas. Pace is National Environmental Laboratory Accreditation Program (NELAP) and KDHE Laboratory certified. The Pace organization is designed to facilitate information exchange between the laboratory and the project manager. Information exchange specifically includes: sample identification, preservation procedures, sample container and requirements, decontamination materials, and sample labeling, packing, holding times and shipping. Roles and responsibilities for laboratory personnel at Pace are located in their Laboratory Quality Program. In general, the Pace laboratory program structure has been developed with the idea that the analyst is the most important component within the system. It is designed so that each analyst has as much authority as possible to do whatever is necessary to produce quality data in a timely manner. Personnel involved in the laboratory QA program include each analyst, the lab director, the QA manager and the QA assistant, as well as computer support staff and company officers. All analytical and operational activities of the laboratory are documented. This is a proactive program to detect improper actions through the use of proficiency testing, audits, and the use of standard operating procedures.

The Quality Assurance Manual (QAM) defines the overall policies, organization objectives, and functional responsibilities for achieving the laboratory's data quality goals. The laboratory's Quality Assurance Program (QAP) ensures that data produced conforms to the standards set by state and/or federal regulations. The program functions at the management level through company goals and management policies, and at the analytical level through Standard Operating Procedures (SOPs) and quality control. The laboratory's QAP is designed to minimize systematic error, encourage constructive, documented problem solving, and provide a framework for continuous improvement within the organization. The laboratory's QAM, QAP, and SOPs may be requested at any time. A copy of Pace's most recent QAM is included in **Appendix A-1**.

Pace typically provides analytical data within a standard 7- to 10-day turnaround time. Additionally, Pace has assigned one project manager, Ms. Mary Jane Walls, to work directly with SCS Aquaterra. Contact information for the Pace Project Manager is as follows:

Mary Jane Walls
913-563-1401
mjwalls@pacelabs.com

Pace Analytical Services, Inc.
9608 Loiret Blvd.
Lenexa, KS 66219

2.6 DRILLING, PROBING, AND SAMPLING RESPONSIBILITIES

GSI Engineering, LLC (GSI) will provide drilling, probing, sampling, and geotechnical testing services for the RD/PDA activities. GSI will be responsible for coordination with the property owner, utility owners, Wichita Public Works Department, and other agencies as needed to perform the activities described in the RD/PDA WP. GSI has the capabilities and knowledge to drill, install, develop, and sample wells; perform direct-push sampling services; and, perform geotechnical materials testing. GSI will meet health and safety requirements as specified in the Health and Safety Plan. Additionally, GSI has assigned one project manager, Mr. Gregg Armstrong, to work directly with SCS Aquaterra. Contact information for the GSI Project Manager is as follows

Gregg Armstrong, P.G.
316-554-0725
garmstrong@gsinetwork.com

GSI Engineering
4503 E. 47th Street S.
Wichita, KS 67210

3.0 PROJECT BACKGROUND AND OBJECTIVES

3.1 NIC SITE HISTORY

The NIC Site is an area of mixed industrial, commercial, residential, recreational, and agricultural properties located in north-central Wichita, Kansas. A long history of industrialization has left a legacy of volatile organic compounds (VOCs) in soil and groundwater throughout the area, including chlorinated solvents such as tetrachloroethene (PCE), trichloroethene (TCE), and carbon tetrachloride, as well as petroleum hydrocarbon-related contaminants, heavy metals, and others.

The United States Environmental Protection Agency (EPA) first identified VOCs in groundwater in 1983 in the vicinity of 29th Street and Mead Street in Wichita. Several environmental investigations were conducted in the 1980s which resulted in the Site being officially listed on the National Priorities List (NPL) as the 29th and Mead Superfund Site in February 1990. Additional investigations conducted by KDHE, the Wichita North Industrial District Group, and the City of Wichita identified contamination in other areas adjacent to the 29th and Mead Site (e.g., to the south in an area known as the 13th and Washington Site and to the northeast of the 29th and Mead Site). These additional areas were consolidated to form the NIC Site.

The NIC Site occupies approximately 4,011 acres in north-central Wichita. The NIC Site has been divided into six Groundwater Units (GWUs) to facilitate development and evaluation of remedial strategies for areas in close proximity with similar chemical and physical properties. The Site boundary and GWU boundaries are shown on **Figures 1 and 2**. Additional information regarding the status of various source area investigation and cleanup activities is available in the Remedial Investigation (CDM 2004, 2005) and Feasibility Study (CDM 2011).

In order to facilitate redevelopment of the NIC Site and removal of the site from the NPL, the City of Wichita and KDHE finalized a NIC Settlement Agreement in 1995. As a result of the Settlement Agreement, the 29th and Mead Superfund Site was officially delisted on April 29, 1996. The City created the NIC Tax Increment Finance District to fund assessment and remedial activities, and established a Certificate and Release Program to provide liability relief for innocent landowners. Local lending institutions have been encouraged to finance economic and industrial redevelopment and expansion for properties within the NIC Site. Meanwhile, the City and KDHE have systematically identified contaminant source areas and their degree of impact across the NIC Site. Many individual source areas have been identified and are in the cleanup process.

3.2 PROJECT OBJECTIVES

The RD/PDA WP provides a site-specific scope of work for RD/PDA activities with the project objective of obtaining the required data to optimize the selected/preferred remedial actions and to evaluate the need for contingency implementation. KDHE's Declaration of Corrective Action, states KDHE has determined that the selected remedial actions for GWU-1 through GWU-4, as described and evaluated in the CAD, meets the criteria for selection and will be protective of

human health and the environment; attain state, federal, and local requirements that are applicable or relevant and appropriate to this corrective action; and, provide cost-effective performance. The remedial actions will prevent exposure to groundwater that is contaminated above acceptable levels; prevent contaminant migration and reduce contaminant mobility; and restore groundwater to allow for its most beneficial use at the NIC site.

Specific RD/PDA activities consist of the following four activities: site-wide water level measurements, existing well groundwater sample collection, direct push groundwater sample collection, and aquifer pump testing activities.

- **Site-Wide Water Level Measurements**
Water level measurements will be collected from approximately 275 existing monitoring, observation, or private water well locations. The water level data will be used to prepare potentiometric surface maps of the aquifer.
- **Existing Well Groundwater Sample Collection**
Groundwater samples will be collected from approximately 175 existing monitoring, observation, or private water well locations. These samples will be collected and analyzed to verify lateral plume extent, location of the plume axis, and maximum contaminant concentrations for groundwater extraction well placement and treatment system design.
- **Direct Push Groundwater Sample Collection**
Direct push technology (Geoprobe®) will be utilized for the collection of additional groundwater samples at approximately 50 locations. Shallow (approximately 12 to 25 feet below ground surface (bgs)) and deep (approximately 30 to 40 feet bgs) groundwater samples will be collected at each probe location. These samples will be submitted for laboratory analysis to verify lateral extents of groundwater plumes, extraction well locations, and to fill observed “data gaps” in the existing monitoring well data set.
- **Aquifer Pump Testing Activities**
Aquifer tests will be conducted at five locations throughout the NIC site to confirm and/or determine groundwater extraction well locations and pumping rates identified in the CAD. One aquifer test will be performed within GWU-2; three aquifer tests will be performed within GWU-3, and one aquifer test will be performed within GWU-4. One (pilot) groundwater extraction well and three groundwater piezometers will be installed at each testing location as part of these activities. In addition, groundwater samples will be collected during the aquifer testing to provide geochemical characterization for the remedial system designs.

4.0 DATA QUALITY OBJECTIVES

Data Quality Objectives (DQOs) are qualitative and quantitative statements that clarify study objectives, define the type of data needed, and establish error limits for the quality and quantity of data needed to support decisions. DQOs are used to establish performance criteria, or measurement quality objectives, that take into account the purpose of data collection, the types of data needed, and tolerable limits for making decision errors (USEPA, 2006a). DQOs are developed through a seven-step process:

- Step 1: State the Problem
- Step 2: Identify the Goals of the Study
- Step 3: Identify Information Inputs
- Step 4: Define the Study Boundaries
- Step 5: Develop the Analytic Approach
- Step 6: Specify Performance or Acceptance Criteria
- Step 7: Develop the Plan for Obtaining Data

DQOs are revised and/or expanded, as needed, based on review of each data collection and analysis activity. The following sections present a discussion of DQO development as applied to the NIC site.

4.1 DQO STEP 1: STATE THE PROBLEM

The site-specific objective for the RD/PDA is to obtain the required data to optimize the selected/preferred remedial actions and to evaluate the need for contingency implementation. The purpose of this QA-FSP is to establish the policies, organization, objectives, and specific quality assurance (QA) and quality control (QC) measures to be used during implementation of the RD/PDA WP. The RD/PDA WP is the first regulatory deliverable for the KDHE final CAD for the NIC site. The RD/PDA WP defines the remedial objectives for each GWU in the NIC site, and the PDA data collection efforts required to support a design that meets the objectives outlined in the CAD. The CAD indicates five groundwater extraction wells will be located throughout the NIC project area, with six contingency locations for additional extraction wells. The well locations are primarily based on data collected within the project area through 2007 and 2008. Because this information is now four to five years old, PDA activities are intended to: confirm the plume delineation and migration of groundwater in units GWU-1 through GWU-4; confirm and/or determine appropriate locations for groundwater extraction wells; provide needed data for the design of groundwater extraction and treatment systems for GWU-2, GWU-3, and GWU-4; and, provide needed data for the design of a Monitored Natural Attenuation (MNA) Assessment.

4.2 DQO STEP 2: IDENTIFY THE GOALS OF THE STUDY

The purpose of the RD/PDA WP is to outline the tasks required to complete the design for the preferred and/or alternative corrective action measures presented in the CAD for the NIC site (KDHE, 2012). Information inputs consist of four activities described below.

4.3 DQO STEP 3: IDENTIFY INFORMATION INPUTS

The PDA field activities consist of the following four activities: site-wide water level measurements, existing well groundwater sample collection, direct push groundwater sample collection, and aquifer pump testing activities. These activities are described in Section 3.2.

4.4 DQO STEP 4: DEFINE THE STUDY BOUNDARIES

This step clarifies the characteristics the collected environmental data are intended to represent. The following activities are performed to define the study boundaries: define the population of interest; define the geographic area; as needed, divide the population into relatively homogeneous strata; determine the time frame to which the decision applies; determine the data collection time frame; define the scale of decision making; and identify constraints on the data collection. The following paragraphs address each of these items.

4.4.1 Population of Interest

Groundwater is the media of interest for this activity. The primary parameters of interest for both the Geoprobe® groundwater samples, existing groundwater well samples, and surface water samples are volatile organic compounds (VOCs). Some of the existing groundwater wells will be sampled for MNA parameters (alkalinity, carbon dioxide, chloride, methane, ethane, ethene, nitrate/nitrite, sulfate, sulfide, dissolved iron, dissolved manganese, dissolved arsenic, dissolved organic carbon, and volatile fatty acids). **Table A-1** presents the parameters, methodologies, and laboratory practical quantitation limit to be used. Parameters will be reported as indicated on **Table A-1**. Geotechnical information of interest includes grain size analysis throughout the aquifer thickness.

4.4.2 Geographic Area/Summary of Sample Locations

The North Industrial Corridor Site is located in Wichita, Kansas in Sedgwick County. The Site encompasses approximately 4,011 acres and is generally bounded by Waco and Market Streets to the west, Second Street North to the south, Hydraulic Street to the east, and Kansas Highway 254 to the north. The site is shown on **Figure 1**.

The NIC Site was divided into six groundwater units (GWUs) “to facilitate the development of feasible remediation strategies for areas with similar COC’s (chemicals of concern) and/or physical limitations” (CDM FS, 2011). GWU-1 is generally located in the northeast portion of the NIC Site extending from north of 37th Street North to the Coastal-Derby Refinery on the south and is generally defined by the MCL boundary for all COC’s observed from the northeast portion of the NIC site during the RI. GWU-2 is generally defined by Broadway to the west, GWU-1 to the east, the northern NIC Site boundary, and a diagonal line generally connecting 25th Street and Broadway to 17th Street and Cleveland at the southern extent. GWU-3 is generally defined as the area south of GWU-1 and GWU-2 bounded by Broadway to the west, Chisholm Creek to the east, and a line generally connecting Topeka and 2nd streets to Murdock and Hydraulic at the southern extent. GWU-4 is generally defined as the Apex Site/11th and

State Area and the Waco Handi-Wash contaminant plumes. The COC's of interest in GWUs 1-4 generally consist of PCE and TCE. GWU-5 consists of the Derby-Coastal Refinery and property to the south bounded by the East Branch Chisholm Creek to the east and Chisholm Creek to the west. The COCs of interest in GWU-5 consist of petroleum hydrocarbons from past refinery operations. GWU-6 is located north of GWU-1 and consists of the USD 259 source area and downgradient plume area. GWU-6 was established as the source area appears to be distinctly different than nearby source areas. The COC's of interest in GWU-6 are generally petroleum hydrocarbons and PCE and TCE. The GWUs are shown on **Figure 2**.

4.4.3 Site Stratification

The media of interest is surface water, shallow groundwater (near top of water table) and deep groundwater (bottom of aquifer).

4.4.4 Time Frame

A schedule for site activities is included in Figure 3 of the RD/PDA WP.

4.4.5 Constraints on Data Collection

Investigative and sampling activities may be delayed by excessive periods of precipitation that could create unsuitable site conditions for site activities and/or due to potential site access issues. Planned sample locations may be moved due to utility locations.

4.5 DQO STEP 5: DEVELOP THE ANALYTIC APPROACH

In Step 5, an approach is developed that will guide analysis of the data. A decision rule is developed that defines the conditions that would cause the decision maker to choose among alternative actions. Activities involved in Step 5 include: specify the statistical parameter that characterizes the population; specify an action level for the decision; confirm that detection limits will allow reliable comparison with the action level; and state the decision rule.

4.5.1 Statistical Parameters

Different data uses will result in the potential need to examine multiple statistical parameters for a given media and/or location. Depending on the end use of the data (i.e., source identification, determination of extent of contamination, risk assessment, etc.), any one of several statistical parameters could prove useful. For example, the use of the maximum concentration of a constituent in a given population is useful for identification of source areas. The difference between the maximum concentrations of a constituent at an area boundary versus background can be used for definition of the extent of contamination. Similarly, risk assessors often use the mean or 95 percent upper confidence limit of the concentrations of a constituent collected over a given area for purposes of their evaluation.

4.5.2 Action/Cleanup Level

Groundwater sample results will be compared to federally promulgated maximum contaminant level (MCL's) (USEPA, May 2009) where available and the *Risk-Based Standards for Kansas (RSKs)* (KDHE, October 2010) for COC's that the USEPA has not established MCL's.

An alternate treatment goal (ATG) of 21 ug/L has been established for TCE within the boundaries of the NIC site. Generally, areas within the NIC site that exceed the ATG will be targeted for active remediation i.e. groundwater extraction and treatment. Applicable cleanup levels are included for each parameter of interest on **Table A-1**.

4.5.3 Confirm Detection Limits

To the extent that it is technically feasible using routine analytical techniques, the reporting limits (RL) for critical parameters will be below cleanup levels. Typical RLs and method detection limits (MDL) for the parameters of interest are indicated on **Table A-1**. Interference and/or elevated concentrations of target and non-target constituents could necessitate sample dilution to mitigate these effects and minimize damage to laboratory instruments. This dilution could result in elevated reporting limits outside the control of the analytical laboratory. Therefore, automatic data rejection will not occur should a parameter's reporting limit exceed the screening value. Instead, the magnitude of the exceedance will be considered in conjunction with the intended use of the data to determine its overall impact upon decision making.

4.5.4 Decision Rule

Given the objectives of the PDA WP, groundwater analytical results will be compared to RSKs.

4.6 DQO STEP 6: SPECIFY PERFORMANCE OR ACCEPTANCE CRITERIA

Step 6 quantifies performance criteria for decision rules by expressing the probability limits on potential errors in decision making. The probability limits on decision errors specify the level of confidence desired in making conclusions regarding the data. The possibility of a decision study error exists due to the inherent variability in the sample collection and analysis process. The two main components of the "total study error" include the following:

- **Sampling Design Error** – Sampling design error is influenced by the sampling design, the number of samples collected, and the inherent variability of the media to be sampled. Sampling design error occurs when the collection program does not account for the variability within the media.
- **Measurement Error** – Measurement error is influenced by the sampling and analysis system. Errors are introduced into the system during sample collection, handling, preparation, analysis, and data reduction.

Two types of decision errors are common in environmental measurements. The first type of error is known as false rejection error, or Type I error. This occurs when the data lead the end user to conclude the baseline condition (for example, the site is contaminated) is false when it is really true. The consequence of the false rejection error (Type I error) is the contaminants of potential concern will not be remediated and will pose unacceptable risk to human health or the environment. False rejection errors (Type I errors) occur when the analytical data are biased low and/or exhibit non-detect results in error (i.e., false negative data).

The second type of error is known as false acceptance error, or Type II error. False acceptance errors occur when the data lead the end user to conclude the baseline condition (for example, the site is contaminated) is true when it is really false. The consequences of the false acceptance errors (Type II errors) will be unnecessary expenditure of resources to remediate a site that does not need remediation. False acceptance errors (Type II errors) occur when the analytical data are biased high and/or exhibit detections in error (i.e., false positive data). Because of the potential severity of the false rejection error (Type I error) consequences, the false acceptance error (Type II error) is more tolerable than the false rejection error (Type I error).

To minimize the possibility of decision errors, the components of the total study error are examined. Sampling design error can be minimized by collecting a larger number of samples, or in the case of resource limitations, using screening technologies to focus sampling on areas of potential concern. Measurement errors can be minimized by replicate analysis of the same sample or by selecting cleanup, preparation, and analysis methods that are best suited to the site matrix. Measurement errors will be assessed by reviewing several data quality indicators (DQIs) including precision, accuracy, representativeness, completeness, and comparability as presented below.

DQI	Definition	Determination Method
Precision	A measure of the reproducibility of measurements under a given set of conditions.	Duplicate samples- Field (minimum of one sample per 20 investigative samples) Duplicate samples – Laboratory (minimum of one sample per batch or one per 20 samples)
Accuracy	A measure of the bias that exists in a measurement system.	Matrix Spike Samples (performed by laboratory; one for every 20 samples) Trip Blanks (one per cooler accompanying samples for VOC analysis)
Representativeness	The degree to which sample data accurately and precisely represent selected characteristics.	Trip Blanks (as above) Equipment Rinsate Blanks (one per each sampling event)

DQI	Definition	Determination Method
Completeness	A measure of the amount of valid data obtained from the measurement system compared to the amount that is required.	Compare the number of samples analyzed with the performance criteria
Comparability	A measure of confidence with which one data set can be compared with another.	Compare sampling procedures and QA protocols
Sensitivity	The capability of an instrument to discriminate between measurement responses representing the variable of interest	Determine the minimum concentration that can be measured by a laboratory (quantitation limit)

4.7 DQO STEP 7: DEVELOP THE PLAN FOR OBTAINING THE DATA

The goal of Step 7 is to develop a resource-effective design for collecting and analyzing samples and generating other information needed to address the problem. The data from the FS is four to five years old and therefore the RD/PDA WP was developed to obtain the required data for the RD. The rationale for the sample collection activities is provided in the RD/PDA WP. Requirements for the analytical methods and limits are summarized on **Table A-1**, and QC requirements are further outlined in Sections 8.0 and 9.0.

4.8 MEASUREMENT QUALITY OBJECTIVES

An objective of the QA-FSP is to establish QA criteria and field sampling procedures for project activities so the data generated are scientifically valid and usable for the project objectives. To support this overall objective, the following management objectives have been established for the investigation:

- Sample analysis will be completed in accordance with the methods, or equivalent procedures discussed in **Section 4.0** and summarized on **Tables A-1** of this QA-FSP to provide supportable results.
- Analytical parameters will be reported as indicated on **Tables A-1**.
- To the extent it is technically feasible using routine analytical techniques, the RLs and/or MDLs for critical parameters should meet the RSKs.
- Data will be evaluated for achievement of method-specific QA/QC criteria. Data qualifiers, when appropriate, will be added to the data following guidelines in *Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods*

Data Review (USEPA, 2008c), and the *Contract Laboratory Program National Functional Guidelines for Superfund Inorganic Methods Data Review* (USEPA, 2010) as appropriate. Data that are rejected during validation due to problems with analytical quality or significant matrix-related interference will not be usable for purposes of the RD/PDA WP.

- Data will be reported in units consistent with environmental engineering, geologic, hydrogeologic, and analytical laboratory standards applicable for the data being collected.

A discussion of corrective action for not meeting DQOs for a particular indicator are presented in Section 8.8 of this QA-FSP.

5.0 DATA ACQUISITION

5.1 UTILITY CLEARANCE

Prior to intrusive activities, Kansas One Call (Call 811) will be contacted by the Geoprobe® or drilling contractor a minimum of three business days in advance of the work and informed of the intent to perform intrusive activities at the Site. This is initially applicable to Geoprobe® sampling and the installation of piezometers, monitoring wells, and pumping wells. Utility clearance activities, including the ticket number, utilities notified, and the names of all persons granting utility clearance will be recorded. Subsurface activities will not be conducted without clearance and marking of underground utilities. Due to the presence of underground or overhead utilities, it may be necessary to offset proposed boring locations. This will be done with the approval of the SCS Aquaterra Project Manager and documented in the project logbook(s).

Permits required for investigation and sampling activities are discussed in Section 2.3 of the RD/PDA WP.

5.2 SITE ACCESS AND SECURITY

The project team will be responsible for the implementation of field activities. The SCS Aquaterra Project Manager will be responsible for overall management of activities conducted at the site. The City of Wichita will assist SCS Aquaterra in obtaining site access to each field location. The SCS Aquaterra Project Manager, or his designee, will be responsible for ensuring that site access to each location has been obtained prior to commencing field activities. Advance notice of field activities will be provided to the City to allow for the City to coordinate site access and notification of site owners.

Because the site is located in an urban area with numerous individual property owners, sampling locations may be on unsecured public or private property. This presents the potential that SCS Aquaterra personnel may encounter threats from transients or other aggressive people or dogs. SCS Aquaterra personnel will follow specific site security and control procedures included in the SSHSP and special provisions outlined in access agreements negotiated with individual site owners.

5.3 GROUNDWATER LEVEL MEASUREMENTS

Groundwater levels will be measured in piezometers, monitoring wells, and pumping wells. Additionally total depth will be measured in monitoring wells when the wells are sampled. Groundwater levels will initially be measured within a 24-hour period at monitoring wells within the designated NIC site groundwater monitoring system. Additionally, groundwater level measurements will be made prior to collection of groundwater samples and during aquifer testing activities.

An electronic water level indicator will be used to collect groundwater level measurements.

Groundwater levels will be measured to the reference mark on the top of the riser pipe. If no mark or notch is present on the north side of the casing, a notch shall be made using a decontaminated metal file.

Equipment that may be needed for groundwater water level measurements is summarized below:

- Electronic water level indicator
- Interface probe
- Applicable decontamination equipment (refer to Table A-2)
- Applicable containers and equipment for investigation derived waste (IDW) (Section 5.10, Table A-2 and Table A-3)
- Applicable safety equipment (refer to SSHSP, SCS Aquaterra, 2013 and Table A-2)
- Project logbook and/or field information forms

The following procedure will be used to measure groundwater levels:

1. Decontaminate the cable and water level indicator as specified in Section 5.9 before the first measurement and then after each measurement.
2. Turn on the water level indicator and push the instrument test button to check the probe's batteries.
3. Lower the water level indicator into the well by pulling the cable from the hand-held reel until the indicator light or audible signal responds.
4. Move the cable up and down while observing the indicator. Note the exact length of cable extended from the tip of the water level indicator sensor to the reference point when the sensor indicates the fluid/air interface. Record the cable length to the nearest 0.01-foot, well number, time, and date of the measurement in the project logbook or field information form.
5. If applicable, measure the total well depth by lowering the water level indicator to the bottom of the well. Add the length of the distance between the end of the probe and the probe sensor to the total depth measurement. Record the total depth measured at the top of the well casing at the reference point to the nearest 0.01-foot.
6. Decontaminate the sensor and cable, as previously described, prior to measuring the next well.

The following procedure will be used in the event of encountering free phase product using an interface probe:

1. Follow Steps 1-3 above using an interface probe.
2. Move the cable up and down while observing the indicator. Note the exact length of cable extended from the tip of the interface sensor to the reference point when the

interface sensor indicates the product/air interface for LNAPL, or the fluid/product interface for DNAPL. Record the cable length to the nearest 0.01-foot, well number, time, and date of the measurement in the project logbook or field information form.

3. Decontaminate the interface probe and cable, as previously described, prior to measuring the next well.
4. If an interface probe is not available, and free phase product is observed on the well probe or other equipment, a dedicated poly bailer will be delivered and retrieved into the air/product interface for LNAPL, or the fluid/product interface for DNAPL, slowly. Bailers will not be allowed to strike the product surface with “falling” velocity to minimize the agitation of the product. The bailer will be lowered through the product thickness approximately three inches into the underlying groundwater for LNAPL and total depth for DNAPL. Once bailers are retrieved, the product thickness will be measured to the nearest 0.01-foot. If product thickness exceeds the length of the bailer, product thickness will be noted as estimated to an equal length of the bailer.
5. Containerize recovered free phase product in appropriate and properly labeled container for characterization, disposal, and/or recycling.
6. Discard bailer and twine.
7. Discard or recycle recovered free-phase product according to standard waste management practices.

5.4 GROUNDWATER SAMPLING PROCEDURES

The numbers of samples, locations, and justifications for each sample media to be collected are presented in the RD/PDA WP. In general, sample collection, handling, and custody will follow applicable KDHE guidance. A summary of Method, Sample Container, Preservative, and Holding Times for soil samples to be collected and analyzed for this project is included on **Table A-3**. Sample numbers, location identifier, time and date of collection and samplers signature will be filled out in the field. Sample container selection, preservation, and holding times will be according to appropriate method guidance. Data obtained from analyses conducted on samples after the specified holding time limit will be qualified by the laboratory in sample result documentation and discussed in the sampling report. A copy of the laboratory QAM is included in Appendix A-1.

Sampling activities will be directed by an experienced sampling technician or project professional. Nonstandard sampling activities are not planned. Detailed information regarding sample identification, sample collection procedures/methods, required equipment, decontamination of sampling equipment, and handling of investigation derived waste is included in this section. A summary of required sample containers, preservatives, and holding times is

provided on **Table A-3**. Also included in this Section are procedures for piezometer, monitoring well, and pumping well installation and development, fluid level measurements, and the pump testing procedures. In the event that free phase product is observed prior to or during groundwater sample collection, product thickness will be measured as specified in Section 5.3, sampling equipment will be removed, and sampling will be terminated.

5.4.1 Sample Identification

A sampling coding system will be used to identify each sample collected during this investigation. The coding system will create a unique identification for each sample collected to allow for ease of sample tracking and retrieval. Each sample will be identified by site number, sample media type, location type, depth interval (if applicable), and date. All samples collected will be identified by NIC, indicating that the samples are part of the North Industrial Corridor Site. Codes for sample media type designations will be as follows:

- GPW = Geoprobe® groundwater sample
- NMW = NIC Site Monitoring Well
- GW = Groundwater Sample
- SW = Surface Water Sample

- Quality control codes will be appended to the location/station identification where appropriate. The following QC codes will be used:
 - P = Performance evaluation check (blind standard)
 - M = Trip Blank
 - N = Equipment rinsate blank
 - K = Duplicate with KDHE
 - Q1 = Duplicate sample submitted to Pace (Intra-laboratory duplicate)
 - Q2 = Duplicate sample submitted to alternate outside laboratory (Inter-laboratory duplicate)
 - Q3 = Duplicate sample submitted to Property/Facility Owner

Typical sample numbers will be

<u>Site Id</u>	<u>Sample Media</u>	<u>Location No.</u>	<u>Depth</u>	<u>Date</u>
NIC	GW-	NMW-1		071013
NIC	GPW-	GP1-	15-	071513

Sample NIC-GW-NMW-1-091013 indicates that the groundwater sample was collected from well NMW-1 on September 10, 2013. Sample NIC-GWP-GP1-15-071513 indicates that a groundwater sample was collected from Geoprobe® location GP1 from a depth of 15 feet on July 15, 2013.

5.4.2 Direct-Push Groundwater Sampling

Groundwater samples for VOCs will be collected from approximately 50 Geoprobe® locations as shown on the RD/PDA WP figures. The samples will be collected using a groundwater sampling tool with a drop screen and an expendable point attached to the lead direct-push rod and driven to the desired depth. The groundwater sampling tool will then be opened, allowing groundwater to enter the sampling tool. Tubing will then be inserted into the rods, and a groundwater sample withdrawn. The groundwater sampling tool will then be brought up to near the top of the groundwater surface and another sample collected.

Equipment needed to collect groundwater samples from the direct-push boreholes includes:

- Sample containers
- Disposable polyethylene tubing
- Applicable decontamination equipment (refer to Section 5.9 and Table A-2)
- Applicable containers and equipment for IDW (refer to Section 5.9, Table A-2 and Table A-3)
- Applicable safety equipment (refer to SSHSP, SCS Aquaterra, 2013)

The location, depth, and time of collection for each direct-push groundwater sample will be documented in the project logbook or the boring log. Unique sample numbers will be assigned to each groundwater sample collected in accordance with procedures outlined previously in Section 5.4.1. Groundwater samples will be collected according to the following procedure:

1. Attach a groundwater sampling tool (drop screen with an expendable point) to the lead direct-push rod.
2. Drive the screen to the refusal (If refusal is met at an unexpected depth, abandon the borehole, offset 10 feet from the original borehole and re-drive the screen).
3. Retract the rods four feet to allow the screen to drop out of the rods.
4. Wait several minutes for the groundwater to enter the rods through the screen.
5. Cut an approximately 12-inch length of new silicone tubing to mount to the pump head.
6. Attach the silicone tubing to the pump head. Run a sufficient length of poly tubing from the discharge side of the peristaltic pump head to a graduated bucket to collect purge water.
7. Cut a sufficient length of new poly tubing to run from the ground surface up to the top of the probe rods and back down to the bottom of the screened interval. This will allow for operation of the pump at all possible water level conditions in the well.
8. Place one end of the poly tubing into the silicone tubing mounted on the pump head. Proper sizing of the poly tubing should allow for a snug fit of the poly tubing inside the silicone tubing. Place a decontaminated stainless steel check valve on the other end of the poly tubing.

9. Place the free end of the poly tubing with stainless steel check valve into the probe rods to total depth.
10. Turn on the pump to produce a vacuum on the probe side of the pump head and initiate purging.
11. Purge two liters of groundwater and containerize IDW. Attach discharge poly tubing to a flow through cell to collect the following field parameters: pH, temperature, specific conductivity, dissolved oxygen, ORP, and turbidity.
12. Stop pump, retract tubing, remove the check valve assembly, and decant groundwater from the bottom portion of the tubing into 40-mL vials for VOCs.
13. Collect additional samples as needed for QA/QC samples.
14. Dispose of tube in accordance with the procedures in accordance with IDW protocols.
15. Pull the rods and screen up to near the top of groundwater surface.
16. Repeat steps 7 through 14 to collect shallow groundwater sample.
17. In the event that free phase product is observed, the depth interval will be noted, sampling equipment will be pulled, and sampling will be terminated.
18. Abandon the borehole by backfilling with granular bentonite per Kansas Well Construction Rules. The bentonite will be installed and hydrated in 1-foot lifts.
19. Decontaminate the sampling equipment as specified in Section 5.9

5.4.3 Sampling Existing Groundwater Wells

5.4.3.1 Purging Procedures

Existing groundwater monitoring wells will be purged with a peristaltic pump using low-flow purging techniques.

1. Cut a sufficient length of poly tubing to run from the ground surface up to the top of the well casing and back down to the bottom of the well (approximately equal to the well depth plus an additional 10 feet). This will allow for operation of the pump at all possible water level conditions in the well.
2. Cut an approximately 12-inch length of silicone tubing to mount to the pump head.
3. Attach the silicone tubing to the pump head. Place one end of the poly tubing into the silicone tubing mounted on the pump head. Proper sizing of the poly tubing should allow for a snug fit of the poly tubing inside the silicone tubing.
4. Run a sufficient length of poly tubing from the discharge side of the peristaltic pump head to a graduated bucket to collect purge water.
5. Place the free end of the poly tubing into the well to the depth of approximately the middle of screened section.
6. Turn on the pump to produce a vacuum on the well side of the pump head and initiate purging.

7. Monitor drawdown in the well and adjust purging rate on the pump if the pumping rate exceeds the recovery rate of the well.
8. After approximately five minutes, monitor the purge water for stabilization of field parameters pH, temperature, and specific conductivity, dissolved oxygen, ORP, and turbidity. Continue monitoring field parameters every 3 to 5 minutes until the parameters stabilize. Stabilization has occurred when the following criteria are achieved:
 - pH varies by no more than 0.1 standard units (S.U.);
 - Temperature is within $\pm 3\%$ degrees Celsius ($^{\circ}\text{C}$);
 - Dissolved oxygen is within $\pm 10\%$ when measured in % saturation (± 0.3 mg/L);
 - Oxidation-Reduction potential (ORP) is within ± 10 millivolts (mV);
 - Specific conductivity is within $\pm 3\%$ milliSiemens/centimeter (mS/cm); and
 - Turbidity is < 10 nephelometric turbidity units (NTU). If natural turbidity is greater than 10 NTU, stabilization will be $\pm 10\%$.
9. Once stabilization has been achieved, samples may be collected. For the collection of VOCs, dissolved gases, and VFAs, stop the pump, retract tubing, remove the check valve assembly, and decant groundwater from the bottom portion of the tubing into containers. Remaining sample bottles will be filled directly from the tubing while the pump is in operation.

Purge water that is generated during purging activities shall be handled as outlined in Section 5.10.2.

5.4.3.2 Field Measurements

Field measurements of dissolved oxygen, pH, oxidation reduction potential, specific conductivity, temperature and turbidity will be collected during well purging and before the collection of samples for chemical analysis.

The pH, conductivity, turbidity, dissolved oxygen, and oxidation reduction potential sensors (Horiba U-50 Series) will be calibrated according to procedures outlined within the instruction manual. Calibration and calibration checks will be recorded in the field logbook or field calibration check forms. Extreme cold or hot weather is known to affect pH and conductivity meters. In these cases, the meters should be calibrated and checked for calibration more frequently.

The field sampling team will use the following procedure to collect field measurements during well purging activities:

1. Calibrate the meters according to manufacturer's guidelines; calibration should be recorded on the field forms or field logbook.

2. Remove the initial water from the well and pour into a sample cup, or pump into a flow through cell.
3. Read the temperature of the collected water immediately after the water is collected. Record the temperature in the field logbook or field information form to the nearest 0.1 degrees Celsius.
4. Measure the pH and record the measurement to two decimal places in the field logbook or field information form.
5. Measure the specific conductivity of the sample and record the measurement in the field logbook or field information form to three significant figures.
6. Measure the turbidity of the sample and record the measurement in the field logbook or field information form. Measure the DO of the sample and record the measurement in the field logbook or field information form to three significant figures in mg/L.
7. Measure the ORP of the sample and record the measurement in the field logbook or field information form in to the nearest mV.
8. After approximately five minutes, monitor the purge water for stabilization of field parameters pH, temperature, and specific conductivity, dissolved oxygen, ORP, and turbidity. Continue monitoring field parameters every 3 to 5 minutes until the parameters stabilize. Stabilization has occurred when the following criteria are achieved:
 - pH varies by no more than 0.1 standard units (S.U.);
 - Temperature is within $\pm 3\%$ degrees Celsius ($^{\circ}\text{C}$);
 - Dissolved oxygen is within $\pm 10\%$ when measured in % saturation (± 0.3 mg/L);
 - Oxidation-Reduction potential (ORP) is within ± 10 millivolts (mV);
 - Specific conductivity is within $\pm 3\%$ milliSiemens/centimeter (mS/cm); and
 - Turbidity is < 10 nephelometric turbidity units (NTU). If natural turbidity is greater than 10 NTU, stabilization will be $\pm 10\%$.
9. Purge the well until three consecutive readings has stabilized.
10. Record all field parameters in the field logbook or field information form as they are obtained.

The field sampling team will use the following procedure to collect field measurements during prior to surface water sampling and Geoprobe[®] groundwater sampling locations:

1. Calibrate the meters according to manufacturer's guidelines; calibration should be recorded on the field forms or field logbook.
2. Prior to collecting the sample, pour water from the sample location into a sample cup, or pump into a flow through cell.
3. Read the temperature of the collected water immediately after the water is collected. Record the temperature in the field logbook or field information form to the nearest 0.1 degrees Celsius.
4. Measure the pH and record the measurement to two decimal places in the field logbook or field information form.
5. Measure the specific conductivity of the sample and record the measurement in the field logbook or field information form to three significant figures.
6. Measure the turbidity of the sample and record the measurement in the field logbook or field information form.
7. Measure the DO of the sample and record the measurement in the field logbook or field information form to three significant figures in mg/L.
8. Measure the ORP of the sample and record the measurement in the field logbook or field information form in to the nearest mV.

5.4.3.3 Sampling Procedure

Samples will be collected using low flow-purging and sampling procedures. Gloves will be worn during all purging and sampling procedures.

Sample bottles should be filled in the order of the volatilization sensitivity of the parameters. Sample bottles should be filled in the following order.

- VOCs
- MNA Parameters (if required)
- Dissolved Gases
- Volatile Fatty Acids

- Metals
- Preserved inorganics
- Non-preserved inorganics

Table A-1 presents a list of groundwater sampling parameters and reporting limits. Required equipment is summarized in **Table A-2**. A summary of the analytical methods, preservatives, containers, and holding times is presented in **Table A-3**.

When filling the sample bottles, samplers should adhere to the following precautions:

1. Immediately prior to sample collection, measure and record field parameters of pH, specific conductivity, temperature, and turbidity.
2. Bottle caps should be removed carefully so that the inside of the cap is not touched. Caps must never be put on the ground.
3. The sampling team must wear appropriate gloves. Gloves should be changed between wells or on a more frequent basis.
4. VOC vials must be filled so that they are headspace-free. These sample bottles, therefore, need to be slightly overfilled (water tension will maintain a convex water surface in the bottle). The caps for these bottles should be replaced gently to eliminate any air bubbles in the sample. These bottles must then be checked by inverting them and tapping them sharply with a finger. If air bubbles appear, open the bottle, add more water, and repeat this process until all air bubbles are gone. Do not empty the bottle and refill it as VOC vials already include the proper amount of preservative.
5. Sample bottles or caps that fall on the ground before filling should be discarded.
6. In the event that an insufficient volume of water exists for collection of the requisite suite of samples, samples will be collected in the order specified above.
7. Under no circumstances should bottles or caps not supplied by the laboratory be used for sampling.
8. Sample coolers must be present at all sample locations and must be equipped with ice for immediate placement of sample bottles.
9. Sample bottles must not be opened after collection and preservation of the sample.
10. Each bottle for sample collection from the laboratory should be pre-preserved with the appropriate amount of preservative for the particular analysis. Alternatively, the laboratory may ship pre-measured amounts of preservative for addition to the sample in the field. Bottles should not be overfilled as this may cause loss of some of the preservative.

11. Each sample bottle should be clearly labeled with the sample point number, sample date and time, sampler's initials, and selected parameters.
12. A chain of custody (COC) is to be filled out for each sampling event and is to accompany the shipment of samples to the laboratory.
13. Bottle shipments are to be returned to the laboratory for analysis under standard COC procedures.

5.5 SURFACE WATER SAMPLING PROCEDURES

Prior to sample collection, characteristics of the surface water body (size, depth, flow direction) will be recorded on the field parameter form or in the field logbook. Sampling will be conducted from downstream locations to upstream locations to avoid effects of soil and water disturbance related to the sampling. Surface water samples will be collected prior to sediment samples if both are to be collected at the same location.

The preferred method of sample collection is by wading to the sample location and collecting the sample by hand. Whenever possible, sample containers will be filled directly and an intermediate container will not be utilized.

Unfiltered surface water samples will be collected according to the following procedure:

1. Submerge the sample container in the water with the cap in place, taking care to minimize surface disturbance.
2. With the open end of the bottle pointed in the upstream direction, remove the cap and allow the bottle to fill slowly and continuously using the cap to regulate the speed of water entering the bottle. Collect the water sample from within approximately 1 foot of the water surface. Replace cap after bottle is filled, prior to surfacing the sample bottle.
3. Retrieve the sample container from the surface water with minimal disturbance.
4. Samples for VOC analysis, dissolved gasses, and VFAs will be sent to the lab unpreserved, with a 7-day holding time.
5. Samples for remaining parameters requiring preservation will be preserved after sample collection.
6. Samples will be placed immediately in a cooler on ice.

Field measurements of temperature, pH, and specific conductance will be collected from the surface water body at each surface water sample location. Instruments will be calibrated daily.

The probes will be placed directly in the water rather than placing a sample of water in a clean container or sample cup.

If sample collection by the wading method is not possible due to lack of accessibility to the sampling location or water depth that prevents wading, samples will be collected via a clean bailer or with a peristaltic pump. Surface water sample collection via a bailer will be collected according to following procedure:

1. Slowly lower the bailer until it contacts the water surface.
2. Allow the bailer to sink and fill 1-2 feet below the water surface.
3. Retrieve the bailer from the surface water with minimal disturbance.
4. Tip the bailer to allow slow discharge directly into sample containers.
5. Samples for VOC analysis, dissolved gasses, and VFAs will be sent to the lab unpreserved, with a 7-day holding time.
6. Samples for remaining parameters requiring preservation will be preserved after sample collection.
7. Samples will be place immediately in a cooler on ice

5.6 SAMPLE CUSTODY AND DOCUMENTATION

Sample handling and custody encompasses procedures from filling sample containers through shipping the samples to the laboratory. Methods of sample collection, including filling sample containers, are specified in previously referenced project-specific procedures. Required sample volumes, preservation requirements, and holding times are specific to the media being analyzed and are identified in Table A-3. Some general requirements are discussed below.

5.6.1 Sample Containers and Laboratory Storage

- Sample containers, packaging, and preservatives will be supplied by the laboratory performing the analyses and prepared in accordance with procedures specified for the applicable analytical method.
- If any Regulatory Agency or authorized third party requests split samples, the third party will be required to provide the split sample containers.
- Sample storage by the laboratory will conform to procedures established by the most recent KDHE-approved laboratory QAM (Quality Assurance manual).

5.6.2 Sample Packaging and Shipping

1. Sample container lids will be screwed on firmly without dislodging the lid lining or over-tightening the lids.
2. Outside of the sample container will be wiped clean or, if necessary, will be rinsed clean with distilled water and dried.
3. Completed sample label will be attached to the sample container. Sample labels will specify:
 - Site name
 - Sample number
 - Name of sampler
 - Sample collection time and date
 - Analysis requested
 - Preservative added

Some information on the label may be pre-printed by the laboratory or SCS Aquaterra.

4. Samples will be segregated for shipment. Samples that are suspected to be highly contaminated will not be stored or shipped with less contaminated samples, especially water samples.
5. Glass sample container will be wrapped in bubble wrap or foam.
6. Coolers will be lined first with bubble wrap for insulation and a large trash bag to contain the samples.
7. Sample containers will be sealed inside plastic ziplock bags and then placed inside the trash bag in the cooler.
8. Ice will be placed on and around the containers for temperature control during shipment.
9. The trash bag will be sealed with tape and a custody seal.
10. COC will be completed and the portions to be shipped with the samples will be placed in a plastic bag and taped inside the lid of the cooler. The information to be provided on the chain-of-custody form is:
 - Company name and contact information (if laboratory COC is used).
 - Project name and number.
 - Name and signature of sampler.

- Sample identification numbers.
 - Sample types.
 - Number of containers associated with each sample.
 - Date and time sampled.
 - Analyses required.
 - Requested analytical data turnaround time.
 - Signatures of all individuals relinquishing or receiving the samples.
 - The date and time samples are relinquished or received.
11. Shipping container will be secured by making several revolutions with strapping tape or clear plastic tape on both ends. The cooler drain will be taped shut, if necessary.
 12. Custody seals will be placed over top front and top back (if not hinged) corners of the shipping container, such that the seals must be broken to get access to the inside of the shipping container. Seals will be covered with clear plastic tape.
 13. If shipped by courier, the laboratory will be contacted to inform them of the shipment and/or the airbill tracking number will be used to track delivery of samples to the laboratory. Samples will be shipped for overnight delivery to assure that holding times and sample preservation requirements are met. Samples shipped on Friday will be specified for Saturday delivery at the laboratory. The laboratory will be contacted to make sure that personnel are available to accept Saturday delivery.

5.6.3 Sample Custody

After samples are collected, they will be placed in a cooler or container that will remain in the custody of field personnel until the samples are shipped or taken to the laboratory.

The specific information contained in the logbook will depend on the project scope. However, the information should be sufficient to reconstruct the sampling activity without relying on the memory of field personnel.

5.7 AQUIFER TESTING

Aquifer testing is performed to enhance the hydrogeologic understanding of the site and to assist in the design of the extraction wells. An aquifer pumping test also provides actual drawdown data resulting from the diversion of groundwater from a well or wells in the aquifer. Unlike slug tests, an aquifer pumping test provides estimates of aquifer parameters over a larger area of the aquifer under actual pumping conditions, thereby providing more representative values for the aquifer in the area. Aquifer pumping tests will provide a basis for calculating the hydrogeologic parameters such as transmissivity (T), hydraulic conductivity (K), and storativity (S) (storage coefficient), specific capacity, well efficiency, and radius of influence (ROI) of the pumping wells.

Transmissivity is defined as the rate at which water is transmitted through a unit width of an aquifer under a unit hydraulic gradient. It is a function of the properties of the liquid, the porous media, and the thickness of the porous media. The K of the aquifer can be determined by dividing the transmissivity by the saturated thickness (m) of the aquifer ($K=T/m$).

Storativity is defined as the volume of water an aquifer releases from or takes into storage per unit surface area of the aquifer per unit change in head. It is equal to the product of specific storage and aquifer thickness. The range for an unconfined aquifer is 0.01 to 0.3 (unitless) and is equivalent to specific yield.

ROI is the horizontal distance from the center of the pumping well to the limit of the cone of depression. In effect, it is the maximum horizontal distance from the pumping well at which groundwater levels are influenced by pumping.

5.7.1 Pumping Test Well and Piezometer Installation

Prior to the installation of the pumping well, a Geoprobe® test hole will be advanced and continuously sampled to top of bedrock at the pumping well location. Geotechnical samples for grain size distribution will be collected for well screen design. Information including soil sampling information, soil description, and evidence of contamination will be recorded by the on-site geologist on a drilling log.

The pumping well will be drilled and installed at the top of bedrock. The well will be drilled using hollow-stem auger drilling equipment. The pumping well will be constructed of 4-inch, 6-inch, or 8-inch diameter Schedule 40 PVC casing with flush threaded connections. Well screens will be of matching diameter Schedule 40 PVC with factory slotting. Well screens may be upgraded to Vee-Wire or similar to improve open area and efficiency. Specifics of screen openings and screen length will be determined after collection and testing of geotechnical samples for grain size analysis from the Geoprobe® test hole.

Following installation, the pumping well will be developed by the drilling contractor to remove fines from the filter pack. The pumping wells will be developed by using a combination of pumping and surging. The wells will be developed until the turbidity is less than 10 NTUs and the fine sand is removed from the well.

The pumping well will have up to three temporary piezometers installed at distances of approximately 10 feet, 50 feet, and 100 feet. Nearby monitoring wells already present may also be used for measurements at greater distances from the pumping wells or instead of temporary piezometers. The temporary piezometer will be constructed in accordance with KDHE Standard Operating Procedures (KDHE-SOP) *BER-29: Installation of Direct-Push Monitoring Well*; however, no protective cover or well pad will be built. Screen slot size, length, and piezometer depth will be determined after completion of grain size analysis. The temporary piezometers will be installed using direct-push techniques. The temporary piezometers will be developed by using a combination of pumping or bailing and surging.

5.7.2 Step Drawdown Test Procedures

1. At the start of the drawdown step test for an individual well, an initial pumping rate of 50% of the anticipated yield will be used with the pump set near the bottom of the well to maximize available drawdown within the well. Drawdown in the well will be monitored until water levels either stabilize or the well becomes dewatered. If the water level stabilizes, the pumping rate will be increased to 75% and 100% of the anticipated yield in an attempt to maximize drawdown while maintaining a stabilized water level. Similarly, if the well goes dry at 100% of the anticipated yield, the pumping rate will be decreased until a near stabilized maximum pumping rate can be achieved. The pumping rate should be increased/decreased until the water level within the well stabilizes to an elevation near its maximum available drawdown level.
2. For multiple pumping wells that may be used in the study, the procedures outlined in step 1 above should be followed for each well. However, water level in each pumping well shall be stabilized in series until all wells are pumping at a stabilized rate (i.e., no wells are pumping dry). It is anticipated that stabilizing drawdown in each extraction well will take between 1 and 4 hours for each step.
3. Vented pressure transducers with data loggers will be used to monitor drawdown in select piezometers, monitoring, observation wells, and the pumping wells. Water level readings will be recorded based on the step linear measurement schedule detailed below, to the nearest 0.01 foot.

0 to 2 minutes: every 15 seconds,
2 to 5 minutes: every 30 seconds,
5 minutes to end of test: every 1 minute,

4. The monitoring wells and piezometers used for the test will be manually monitored for water levels about 24 hours before turning on the pump(s) for each aquifer test, and then at least daily during the drawdown test to assist in the evaluation of the data.
5. All wells and piezometers will be monitored manually for water levels at least daily and continually with pressure transducers for at least 6 hours, or until the water level has returned to static. Water level readings will be recorded to the nearest 0.01 foot.
6. Piezometers and observation/monitoring wells with a cap or J-plug, the cap (j-plug) will be removed a minimum of one day in advance of the pre-test water level measurements, to alleviate (stabilize) the rebounding of water levels due to the removal of the cap.
7. Barometric pressure will be tracked prior to and during the pilot study drawdown tests. These data will be obtained daily from the National Weather Service, located in Wichita, Kansas.

8. After the pumping well(s) has been pumped at its maximum test discharge rate for the appropriate period, the well should be shut down and allowed to recover to its static elevation
9. Power for the pumps will be supplied from a portable generator.
10. Water generated from the extraction well will be discharged to the sanitary sewer.

5.7.3 Constant Rate Pumping Procedures

1. At the start of the drawdown test, the pumping rates will be set as determined during the step test described above.
2. If a well goes dry during the drawdown test, that well's pumping rate shall be decreased to re-establish stabilization of the water level, and determine maximum sustained yield for each well. It is anticipated that the aquifer study will take between 24 and 72 hours, but will be extended if needed.
3. Vented pressure transducers with data loggers will be used to monitor drawdown in select piezometers, monitoring, observation wells, and the pumping wells. Water level readings will be recorded at 1 minute intervals during the drawdown test, to the nearest 0.01 foot.
4. The monitoring wells and piezometers used for the drawdown test will be manually monitored for water levels at least twice about 24 hours apart before turning on the pump(s) for each pilot test, and then daily during the drawdown test to assist in the evaluation of the data.
5. All extraction wells and piezometers will be monitored manually for water levels daily and on a 1 minute interval with pressure transducers for at least 6 hours or until groundwater has returned to static. Water level readings will be recorded to the nearest 0.01 foot.
6. The drawdown test will be completed following steps 6 – 10 as described above.

5.7.4 Discharge Water Handling

Groundwater produced during the aquifer testing is anticipated to exceed Tier 2 RSKs for at least one Chemical of Concern (COC) at each location. SCS Aquaterra proposes to discharge the groundwater to the City of Wichita's Publicly Owned Treatment Works (POTW) using a nearby sanitary sewer manhole. A discharge permit will be obtained from the City of Wichita POTW to dispose of the water generated during the aquifer testing.

5.7.5 Equipment

Equipment needed to procure for this test includes:

- Submersible pump(s) capable of pumping to 30 - 175 gpm at a hydraulic head of approximately 40 feet in a 6-inch diameter well,
- Check valve(s),
- In-line flow meter(s),

- Flow control valve(s),
- Pressure gauge(s),
- Pressure transducers with data logging capability,
- Water conveyance hose and/or piping, and
- Water level indicator.

5.8 EQUIPMENT OPERATION, MAINTENANCE, AND CALIBRATION

Table A-2 lists equipment expected to be utilized during site activities. Schedules for maintenance and calibration for some of the equipment items are included in Table A-4. Operation, maintenance, and calibration of equipment will be documented in the project logbook(s) and will be completed in accordance with manufacturer's recommendations.

5.9 EQUIPMENT DECONTAMINATION

The procedures for equipment decontamination will be implemented to avoid cross-contamination between subsurface strata and samples of various media¹. Field equipment and sampling tools will be thoroughly cleaned and decontaminated before initial use; between sampling locations (for equipment and materials that have come in contact with potentially contaminated media and will be re-used); and after sampling is completed. If disposable sampling equipment is used and discarded after each sampling location, decontamination of such equipment is unnecessary.

Drill rigs, probe rigs, excavators and other equipment and sampling tools will be decontaminated before they are brought to the site. In this phase, the equipment required to perform drilling and sampling will be thoroughly cleaned. Any encrusted soil, mud, or organic matter adhering to the equipment will be removed using a high-pressure potable water wash. The equipment and materials subjected to this decontamination phase will include, but not be limited to, the drill rig, pumps, drill rods, augers, drill bits, threads, temporary steel casing, sampling equipment, and other tools and materials required to complete the borings and monitoring wells and collect the samples.

If drilling or excavation will be performed at the site, a decontamination station will be constructed for decontamination of larger equipment and materials. This station will be constructed in a manner to contain potentially contaminated water and waste generated during the decontamination process. These materials will be collected and managed with other investigation-derived waste.

The following decontamination procedures will be followed for large equipment:

¹ Personnel decontamination will be addressed in the site-specific health and safety plan.

1. Wash with a high-pressure potable water wash.
2. Rinse with a high-pressure potable water wash.
3. If necessary to remove visible grease or oil, rinse with reagent-grade ethanol or isopropanol.
4. Rinse with potable water.

Smaller equipment and sampling tools may be decontaminated using spray bottles to apply solutions and small tubs to collect wash and rinse water. The collected water should be disposed of with the investigation-derived wastes.

The following decontamination procedure will be followed for smaller equipment and sampling tools:

1. Wash with a non-phosphate laboratory-grade detergent and potable water.
2. Rinse with potable water.
3. Rinse with reagent-grade ethanol or isopropanol, if necessary.
4. Rinse with distilled water.
5. Allow to air dry.

In the event equipment encounters source material that requires more intensive decontamination, Stoddard solvent may be used to remove visible contamination, followed by washing with detergent and rinsing.

Sensitive field equipment such as pH and conductivity probes will be rinsed with distilled water before and after each use. This equipment should not be used if nonaqueous phase liquid is present in the sample.

5.10 INVESTIGATION DERIVED WASTE

Data collection also involves appropriate handling, storage, and disposal of investigation derived wastes (IDW) such drill cuttings, well purge waters, decontaminations fluids, and contaminated personal protective and sampling equipment. Handling of IDW is described in the following sections. SCS Aquaterra will assist the City with the proper disposal of drill cuttings and other wastes generated during field activities, if necessary.

5.10.1 Well and Piezometer Installation

Soil cuttings will be generated during the installation of piezometers and groundwater wells. Soil cuttings will be collected in 55-gallon drums or roll-off boxes pending receipt of analytical

results. Grab samples of soil cuttings will be collected at a rate (i.e. one sample per) requested by the receiving landfill using similar protective equipment (ie gloves) as for groundwater sampling. Samples will be submitted to a KDHE approved laboratory for analysis of NIC COC's, and/or additional constituents at the request of the receiving landfill, utilizing laboratory methods listed in Table A-1. Sample collection and shipping will follow custody procedures previously discussed for groundwater sampling. Upon receipt of analytical results, soil cuttings will be disposed as special waste pending landfill and KDHE approval.

5.10.2 Existing Wells Purge Water

Purge water generated during groundwater sampling wells will be containerized in 55-gallon drums. Drums will be stored appropriately pending receipt of analytical results. Upon receipt of groundwater analytical results, appropriate disposal will be determined. It is likely that a majority of well purge water will be discharged to the sanitary sewer system via the local Publically Owned Treatment Works (POTW).

5.10.3 Decontamination Fluids

Decontamination fluids will be handled as outlined in Section 5.10.2. Fluids containing significant solids will be decanted prior to disposal. Solids material will be disposed as outlined in Section 5.10.1.

5.10.4 Personal Protective Clothing

Gloves, clothing, respirator cartridges, and other items will be contained in plastic trash bags and will be disposed appropriately as solid waste.

5.10.5 Free Phase Product

Generated free phase product will be stored in sealed containers. LNAPLs will be mixed with other LNAPLs and DNAPLs will be mixed with other DNAPLs. Product will be recycled when possible, and/or characterized for proper disposal following standard waste manifesting procedures if necessary.

6.0 SPECIAL TRAINING / CERTIFICATION

SCS Aquaterra technical/field personnel and the GSI personnel are required to have completed 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training and be familiar in the collection of groundwater samples.

National Environmental Laboratory Accreditation Program (NELAP) certification is required for the laboratory performing chemical analyses.

This information is documented in personnel files. The project manager or designee is responsible for appraising qualifications and ensuring that personnel assigned to this project have the required training. As appropriate, on-the-job training will be an acceptable method, provided such training is received through a qualified person.

7.0 DOCUMENTS AND RECORDS

The most current approved QA-FSP will be distributed to project staff by the Project Manager according to the Distribution List presented in Section 1.2. Documents to be retained in the SCS Aquaterra project file include but are not limited to: field notes, field logs, chain of custody forms, inspection or assessment reports, corrective action reports, interim progress reports, and final reports. Work plans and final reports will be generated and submitted to the City, TAC, and KDHE.

7.1 PROJECT LOGBOOKS

The project logbook is an important element in field investigation documentation. Logbooks provide a useful technical record of activities and observations and may be used in evidence in the event of litigation. The logbook should be complete, accurate, legible, and objective.

Each logbook will consist of consecutively numbered pages, and each page will be signed and dated by the individual recording the information it contains. Entries will be in waterproof ink and there will be no blank lines. Times of entries will be noted.

Examples of the type of information that should be recorded include:

- Date and environmental conditions.
- Field team members and visitors.
- Photographs (number and subject).
- Samples (identification number).
- Field changes (sample location, type, etc.)
- Field observations and measurements.
- Sketches of locations, etc.
- Equipment calibration and maintenance.
- Sample shipment.
- Investigation-derived waste documentation (drums, storage location, shipment/disposal).

7.2 QA/QC DOCUMENTATION

Field QA/QC documentation for reports should include the following details:

- Documentation of sample collection procedures;
- Description of variances made in the field to sampling plans or procedures;
- Sample labels and custody and transportation records;
- Documentation of sample preservation and handling procedures;
- Collection and recording of required duplicate, background, and trip blank samples; and
- Documentation of disposal of remediation-derived wastes.

Laboratory QA/QC documentation should include the following details:

- If the published analytical method used specifies QA/QC requirements within the method, those requirements must be met and the QA/QC data reported with the sample results;
- At a minimum, QA/QC samples must consist of the following items (where applicable): method/instrument blank, extraction/digestion blank, initial calibration information, initial calibration verification, continuing calibration verification, laboratory fortified blanks/laboratory control samples, duplicate, and matrix spikes/ matrix spike duplicates; and
- Documentation of appropriate instrument performance data such as internal standard and surrogate recovery.

8.0 DATA QUALITY CONTROL

8.1 SAMPLING PROCEDURES

The numbers of samples, locations, and justifications for each sample media to be collected are presented in the RD/PDA WP. General procedures associated with the collection of groundwater and surface water samples are included in **Section 5.0** of this QA-FSP.

In general, sample collection, handling, and custody will follow standard operating procedures and applicable KDHE guidance. A summary of Method, Sample Container, Preservative, and Holding Times for water (groundwater and surface water) and soil samples to be collected and analyzed for this project is included on **Table A-3**. Sample numbers, location identifier, time and date of collection and samplers signature will be filled out in the field. Sample container selection, preservation, and holding times will be according to appropriate method guidance. Data obtained from analyses conducted on samples after the specified holding time limit will be qualified by the laboratory in sample result documentation and discussed in the sampling report. A copy of the laboratory QAM is included in Appendix A-1.

8.2 LABORATORY ANALYTICAL PROCEDURES

Laboratory analytical procedures to be used are officially approved EPA procedures. The analytical methods which are to be used for the analysis of the sample media collected at the Site will be in accordance with *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Final Update IV* (SW-846 Methods) (USEPA, 2008a) and *Methods for Chemical Analysis of Water and Wastes* (USEPA, 1983). Methodologies to be used are summarized on **Table A-1**.

8.3 FIELD QUALITY CONTROL CHECKS

Field Quality Control Checks will be through the use of the following:

- Trip Blanks - These blanks consist of ultrapure, de-ionized water contained in each sample container. These blanks will accompany the samplers during the sampling process and will serve as QC checks on container cleanliness, external contamination, and the analytical method. Trip blanks will be submitted at a frequency of one per cooler for volatiles analysis for subsurface soil, surficial soil, and water samples.
- Equipment Rinsate Blank – If necessary, equipment rinsate blanks will be collected to assure that sampling equipment is clean and the potential for cross contamination has been minimized by the equipment decontamination procedures. Blanks will be collected by decontaminating the sampling device and then pouring ultrapure de-ionized water over the device. This rinsate water will be collected into a clean stainless steel bowl and then transferred to the appropriate sample containers. If necessary, one equipment rinsate blank will be collected for each non-dedicated sampling device. The equipment rinsate

blanks will be submitted for analysis of identical parameters as the samples. If dedicated or disposable sampling equipment is utilized, equipment blanks will not be collected.

- Duplicate Samples - Duplicate samples will be collected to allow determination of analytical and sampling precision. One duplicate sample for every 20 samples will be collected and submitted for the identical parameters as the true sample, unless an alternate frequency is specified in the RD/PDA WP.
- Matrix Spike Sample - Matrix spike/matrix spike duplicate (MS/MSD) samples will also be submitted as further QC checks. These samples will be spiked by the laboratory. These will be collected at the frequency of one MS and MSD for every 20 field samples (including trip blanks, equipment rinsate blanks, and duplicates). These will allow accuracy to be determined by the recovery rates of compounds (the matrix spike and/or surrogate spike compounds defined in the analytical methods). Precision will also be assessed by comparison of matrix spike and matrix spike duplicate recoveries. The purpose of these laboratory spikes is to monitor possible matrix effects specific to samples collected from the Site. The addition of known concentrations of compounds/constituents into the sample also monitors extraction/digestion efficiency.

8.4 LABORATORY CRITERIA

The laboratory will be expected (as an ideal objective) to report the contract required quantitation/detection limits (CRQL/CRDL) for all samples in the appropriate statistical reporting units for all analyses, as stated in the appropriate analytical methodologies. However, it should be noted that actual quantitation limits are sample specific and depend on variables such as dilution factors, sample matrices, percent moisture, and the specific analyte. Data reported at or near the CRQL/CRDL will be handled cautiously since the stated DQOs for accuracy and precision may not "translate" well in some situations (i.e., accuracy and precision suffer for results near the CRQL/CRDL).

8.5 INSTRUMENTATION AND EQUIPMENT

Field analytical or screening instruments used during this project will be maintained and calibrated according to instructions provided by the instrument manufacturer and other appropriate scientific and technical guidance and standards pertinent to the specific instrument in use. Any subcontractors assisting with project activities will be responsible for performing operation checks on field equipment prior to use in the field. An operational problem with field instrumentation will be noted in the project notebook(s). Daily or regular calibration of field instrumentation will be according to applicable standard operating procedures and manufacturer's instructions.

Fixed laboratory equipment for contract laboratories used for quantitative sample analysis will be tested, inspected, calibrated, and maintained according to the specific analytical equipment requirements as stated in the standard operating procedures of the laboratory, in accordance with

manufacturer-specified procedures or method-specified procedures, as appropriate. Records of calibration will be kept as part of the documentation records for the project.

8.6 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

Field materials and equipment will be inspected upon receipt for package seal. If the box is damaged or seal broken, the package will be rejected. In the field, containers and consumables (i.e. gloves) are inspected to ensure material integrity is sound. Sample bottles will be stored in a temperature stable area. The project environmental professionals are responsible for inspection of supplies and consumables prior to use, and documenting quality issues for the Project Manager to take to the vendor/supplier.

8.7 DATA MANAGEMENT QUALITY ASSESSMENT

As the analytical data generated from the subject investigation are validated, qualified, and submitted to the Project Manager, the quality of the data will be assessed from an overall management perspective by direct comparison of analytical results obtained from previous samplings. Information that can be obtained includes comparison of results obtained from samples taken within the same general vicinity, and the identification of missing data points. By examination of the data at the "back-end" of the process, the data quality can be assessed with respect to representativeness, precision, compatibility, and completeness.

8.8 CORRECTIVE ACTION

Documentation as to what, if any, corrective actions were initiated concerning the data evaluation will be described and reported to the SCS Aquaterra's Project Manager. Field quality assurance activities will also be reported to the SCS Aquaterra's Project Manager. The Project Manager will be responsible for initiating the corrective actions and for ensuring actions are taken in a timely manner and the desired results are produced. The Project Manager will report to the Quality Assurance Manager and project team on necessary corrective actions taken, the outcome of these actions, and their effect on data produced. Corrective action taken will be reported to KDHE.

8.9 ASSESSMENT AND OVERSIGHT

8.9.1 Overall Project Data Assessment

Overall data quality will be assessed by a thorough understanding of the DQOs which are stated during the design phase of the investigation. By maintaining thorough documentation of decisions made during each phase of sampling, performing field and laboratory activities, thoroughly reviewing (validating) the analytical data as it is generated by the laboratory, and providing appropriate feedback as problems arise in the field or at the laboratory, the Project Manager will closely monitor data accuracy, precision, and completeness.

8.9.2 Field Quality Assessment

To ensure that field data are collected accurately and correctly, specific written instructions will be issued to personnel involved in field data acquisition by the Project Manager. The evaluation of field QC samples, if applicable, will provide definitive indications of the data quality. If a problem arises which can be isolated, corrective actions can be instituted for future field efforts.

8.9.3 Quality Assurance Report to Management

The Project Manager, in conjunction with the Quality Assurance Manager, will include in the report submittal, a summary of applicable quality assurance activities. These summaries shall contain at least the following types of information:

- The status and coverage of various laboratory and field quality assurance project activities.
- Data quality assurance reviews including assessment of accuracy, precision, completeness, representativeness, and comparability.
- Significant quality assurance problems discovered, corrective actions taken, progress and improvements, plans, and recommendations for further implementation of updating of the investigative QA-FSP.
- Significant field observations noted in the field notebook during the sampling procedure.

9.0 DATA USABILITY AND VALIDATION

9.1 DATA VALIDATION

Data validation practices will be followed to ensure that raw data are not altered and that an audit trail is developed for those data which required reduction. Field data, such as those generated during field measurements, observations, and field instrument calibrations, will be entered directly into a bound field notebook, or onto project-specific data forms.

Upon receipt of the sample data packages, the laboratory data will be quantitatively and qualitatively validated by the laboratory's Quality Assurance Chemist.

It is anticipated that the laboratory's data reduction will be minimal and will consist primarily of tabulating laboratory analytical results onto summary tables through the use of computerized spreadsheet software. Analytical data will be provided in the form of electronic deliverables.

Raw field data will be summarized, reduced, or tabulated for use in the reports by the Project Manager, Geologist, or Technician, and reviewed by the Quality Assurance Manager. Laboratory analytical data will be summarized and tabulated upon receipt, validated, and qualified, and the final data submitted to the project team for use in the reports.

9.2 LABORATORY DATA VALIDATION

Analytical data generated during the project will undergo a rigorous laboratory data review. This review will be performed in accordance with the method requirements.

A preliminary review will be performed to verify all necessary paperwork (chain-of-custodies, traffic reports, analytical reports, laboratory personnel signatures) and deliverables as stated in the requirements are present.

A detailed quality assurance review will be performed by the laboratory Quality Assurance Chemist to verify the qualitative and quantitative reliability of the data as it is presented. This review will include a detailed review and interpretation of data generated by the laboratory. The primary tools which will be used by experienced data review chemists will be guidance documents, established (contractual) criteria, and professional judgment.

Based upon the review of the analytical data, an organic and inorganic quality assurance report will be prepared by the laboratory which will state in a technical, yet "user friendly" fashion, the qualitative and quantitative reliability of the analytical data. The report will consist of a general introduction section, followed by qualifying statements that should be taken into consideration for the analytical results to best be utilized. Based upon the quality assurance review, qualifier codes will be placed next to specific sample results on the sample data tables. These qualifier codes will serve as an indication of the qualitative and quantitative reliability of the data.

9.3 RECONCILIATION WITH USER REQUIREMENTS

Project results will be compared to the RD PDA-WP prepared for the NIC. Only data generated in association with QC results meeting DQOs will be considered useable for decision-making purposes. The data will be both qualitatively and quantitatively assessed by the Quality Assurance Manager.

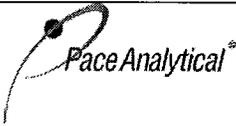
During the course of the data review, a support documentation package will be prepared which will provide the backup information that will accompany qualifying statements presented in the quality assurance review. Once the review has been completed, the Quality Assurance Manager will verify the accuracy of the review and will then submit these data to the Project Manager.

The PDA Report will document the correlation between user requirements and the contents of the report, and will include documentation for the activities performed beginning with site preparation and going through excavation backfilling. The PDA Report will include detailed explanations of deviations from the approved QA-FSP, including changes in key personnel, problems in the field or laboratory that affected data quality, and actions taken to correct these problems. Should issues arise, the Project Manager will work with the user to resolve the problem. The PDA Report will include a section on the limitations of use of the report data, and will be submitted to the KDHE.

10.0 REFERENCES

- CDM, 2004, *North Industrial Corridor (NIC) Site Remedial Investigation Report*, prepared on behalf of the City of Wichita, finalized and approved April 2007.
- CDM, 2005, *North Industrial Corridor (NIC) Site Remedial Investigation Report Addendum*, prepared on behalf of the City of Wichita, finalized and approved April 2007.
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Appendix A-1
Pace Quality Assurance Manual

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QUALITY ASSURANCE MANUAL

Quality Assurance/Quality Control Policies and Procedures

Pace Analytical Services – Kansas

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06.05.2012

Date

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Pace Analytical Services – Kansas

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1.0. INTRODUCTION AND ORGANIZATIONAL STRUCTURE

“Working together to protect our environment and improve our health”
Pace Analytical Services Inc. - Mission Statement

1.1. Introduction to PASI

1.1.1. Pace Analytical Services, Inc. (PASI) is a privately held, full-service analytical testing firm operating a nationwide system of laboratories. PASI offers extensive services beyond standard analytical testing, including: bioassay for aquatic toxicity, air toxics, industrial hygiene testing, explosives, dioxins and coplanar PCB’s by high resolution mass spectroscopy , radiochemical analyses, product testing, pharmaceutical testing, field services and mobile laboratory capabilities. PASI has implemented a consistent Quality System in each of its laboratories and service centers. In addition, the company utilizes an advanced data management system that is highly efficient and allows for flexible data reporting. Together, these systems ensure data reliability and superior on-time performance. This document defines the Quality System and QA/QC protocols.

1.1.2. Our goal is to combine our expertise in laboratory operations with customized solutions to meet the specific needs of our customers.

1.2. Statement of Purpose

1.2.1. To meet the business needs of our customers for high quality, cost-effective analytical measurements and services.

1.3. Quality Policy Statement and Goals of the Quality System

1.3.1. PASI management is committed to maintaining the highest possible standard of service for our customers by following a documented quality system. The overall objective of this quality system is to provide reliable data of known quality through adherence to rigorous quality assurance policies and quality control procedures as documented in this Quality Assurance Manual.

1.3.2. All personnel within the PASI network are required to be familiar with all facets of the quality system relevant to their position and implement these policies and procedures in their daily work. This daily focus on quality is applied with initial project planning, continued through all field and laboratory activities, and is ultimately included in the final report generation.

1.3.3. PASI management demonstrates its commitment to quality by providing the resources, including facilities, equipment, and personnel to ensure the adherence to these documented policies and procedures and to promote the continuous improvement of the quality system. All PASI personnel must comply with all current applicable state, federal, and industry standards, and are required to perform all tests in accordance with stated methods and customer requirements.

1.4. Core Values

1.4.1. **Integrity-** Pace personnel are required to abide by the PASI Code of Ethics and all Pace employees must go through Data Integrity/Ethics training upon initial orientation and as an annual refresher.

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1.4.2. **Value Employees-** Pace management views employees as our most important asset and communicates to them the relevance and importance of their activities within their job functions and how they contribute to the achievement of the objectives of the quality management system.

1.4.3. **Know Our Customers-** Pace makes every effort to know our customers and address their sampling and analytical needs. More information on this item can be found in section 2.0.

1.4.4. **Honor Commitments-** Pace labs focus on making solid commitments with regards to quality, capacity, and agreed upon turnaround time to our customers.

1.4.5. **Flexible Response To Demand-** Pace labs are equipped with both the material and personnel resources to enable them to be responsive to the demands of customers when situations or projects need change.

1.4.6. **Pursue Opportunities-** Pace is committed to pursuing opportunities for the growth of the company by constantly exploring markets and areas where we can expand.

1.4.7. **Continuously Improve-** Pace has committed much time and effort into establishing a continuous improvement program where company personnel meet on a regular basis to share ideas in cost reduction, production improvement and standardization in order to develop best practices. This information, as well as company financial and production metrics, are tracked, evaluated, and shared with each Pace facility.

1.5. Code of Ethics

1.5.1. PASI's fundamental ethical principles are as follows:

1.5.1.1. Each PASI employee is responsible for the propriety and consequences of his or her actions;

1.5.1.2. Each PASI employee must conduct all aspects of Company business in an ethical and strictly legal manner, and must obey the laws of the United States and of all localities, states and nations where PASI does business or seeks to do business;

1.5.1.3. Each PASI employee must reflect the highest standards of honesty, integrity and fairness on behalf of the Company with customers, suppliers, the public, and one another.

1.5.1.4. Each PASI employee must recognize and understand that our daily activities in environmental laboratories affect public health as well as the environment and that environmental laboratory analysts are a critical part of the system society depends upon to improve and guard our natural resources:

1.5.2. Strict adherence by each PASI employee to this Code of Ethics and to the Standards of Conduct is essential to the continued vitality of PASI and to continue the pursuit of our common mission to protect our environment and improve our health.

1.5.3. Failure to comply with the Code of Ethics and Standards of Conduct will result in disciplinary action up to and including termination and referral for civil or criminal prosecution where appropriate. An employee will be notified of an infraction and given an opportunity to explain, as prescribed under current disciplinary procedures.

1.5.4. Any Pace employee can contact corporate management to report an ethical concern by calling the anonymous hotline at 612-607-6431.

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1.6. Standards of Conduct

1.6.1. Data Integrity

1.6.1.1. The accuracy and integrity of the analytical results and its supporting documentation produced at PASI are the cornerstones of the company. Lack of data integrity is an assault on our most basic values putting PASI and its employees at grave financial and legal risk and will not be tolerated. Therefore, employees are to accurately prepare and maintain all technical records, scientific notebooks, calculations, and databases. Employees are prohibited from making false entries or misrepresentations of data for any reason.

1.6.1.2. Managerial staff must make every effort to ensure that personnel are free from any undue pressures that may affect the quality or integrity of their work including commercial, financial, over-scheduling, and working condition pressures.

1.6.2. Confidentiality

1.6.2.1. PASI employees must not use or disclose confidential or proprietary information except when in connection with their duties at PASI. This is effective over the course of employment and for an additional period of two years thereafter.

1.6.2.2. Confidential or proprietary information, belonging to either PASI and/or its customers, includes but is not limited to test results, trade secrets, research and development matters, procedures, methods, processes and standards, company-specific techniques and equipment, marketing and customer information, inventions, materials composition, etc.

1.6.3. Conflict of Interest

1.6.3.1. PASI employees must avoid situations that might involve a conflict of interest or could appear questionable to others. The employee must be careful in two general areas:

1.6.3.1.1. Participation in activities that conflict or appear to conflict with the employees' PASI responsibilities.

1.6.3.1.2. Offering or accepting anything that might influence the recipient or cause another person to believe that the recipient may be influenced to behave or in a different manner than he would normally. This includes bribes, gifts, kickbacks, or illegal payments.

1.6.3.2. Employees are not to engage in outside business or economic activity relating to a sale or purchase by the Company. Other problematic activities include service on the Board of Directors of a competing or supplier company, significant ownership in a competing or supplier company, employment for a competing or supplier company, or participation in any outside business during the employee's work hours.

1.6.4. Compliance

1.6.4.1. All employees are required to read, understand, and comply with the various components of the standards listed in this document. As confirmation that they understand their responsibility, each employee is required to sign an acknowledgment form annually that then becomes part of the employee's permanent record. Employees will be held accountable for complying with the Quality Systems as summarized in the Quality Assurance Manual.

1.7. Laboratory Organization

1.7.1. The PASI Corporate Office centralizes company-wide accounting, business development, financial management, human resources development, information systems, marketing, quality,

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safety, and training activities. PASI's Director of Quality is responsible for assisting the development, implementation and monitoring of quality programs for the company. See Attachment IIB for the Corporate Organizational structure.

1.7.2. Each laboratory within the system operates with local management, but all labs share common systems and receive support from the Corporate Office.

1.7.3. A Senior General Manager (SGM) oversees all laboratories and service centers in their assigned region. Each laboratory or facility in the company is then directly managed by an SGM, a General Manager (GM), an Assistant General Manager (AGM), or an Operations Manager (OM). Quality Managers (QM) or Senior Quality Managers (SQM) at each laboratory report directly to the highest level of local laboratory management, however named, that routinely makes day-to-day decisions regarding that facility's operations. The QMs and SQMs will also receive guidance and direction from the corporate Director of Quality.

1.7.4. The SGM, GM, AGM or OM, or equivalent functionality in each facility, bears the responsibility for the laboratory operations and serves as the final, local authority in all matters. In the absence of these managers, the SQM/QM serves as the next in command. He or she assumes the responsibilities of the manager, however named, until the manager is available to resume the duties of their position. In the absence of both the manager and the SQM/QM, management responsibility of the laboratory is passed to the Technical Director, provided such a position is identified, and then to the most senior department manager until the return of the lab manager or SQM/QM. The most senior department manager in charge may include the Client Services Manager or the Administrative Business Manager at the discretion of the SGM/GM/AGM/OM.

1.7.5. A Technical Director who is absent for a period of time exceeding 15 consecutive calendar days shall designate another full-time staff member meeting the qualifications of the technical director to temporarily perform this function. The laboratory SGM/GM/AGM/OM or SQM/QM has the authority to make this designation in the event the existing Technical Director is unable to do so. If this absence exceeds 35 consecutive calendar days, the primary accrediting authority shall be notified in writing.

1.7.6. The SQM/QM has the responsibility and authority to ensure the Quality System is implemented and followed at all times. In circumstances where a laboratory is not meeting the established level of quality or following the policies set forth in this Quality Assurance Manual, the SQM/QM has the authority to halt laboratory operations should he or she deem such an action necessary. The SQM/QM will immediately communicate the halting of operations to the SGM/GM/AGM/OM and keep them posted on the progress of corrective actions. In the event the SGM/GM/AGM/OM and the SQM/QM are not in agreement as to the need for the suspension, the Chief Operating Officer and Director of Quality will be called in to mediate the situation.

1.7.7. The technical staff of the laboratory is generally organized into the following functional groups:

- Organic Sample Preparation
- Wet Chemistry Analysis
- Metals Analysis
- Volatiles Analysis
- Semi-volatiles Analysis
- Radiochemical Analysis
- Microbiology

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1.7.8. Appropriate support groups are present in each laboratory. The actual organizational structure for PASI – Kansas is listed in Attachment IIA. In the event of a change in SGM/GM/AGM/OM, SQM/QM, or any Technical Director, the laboratory will notify its accrediting authorities and revise the organizational chart in the Quality Assurance Manual (QAM) within 30 days. For changes in Department Managers or Supervisors or other laboratory personnel, no notifications will be sent to the laboratory’s accrediting agencies; changes to the organizational chart will be updated during or prior to the annual review process. Changes or additions in these key personnel will also be noted by additional signatures on the QAM, as applicable. In any case, the QAM will remain in effect until the next scheduled revision.

1.8. Laboratory Job Descriptions

1.8.1. Senior General Manager

- Oversees all functions of all the operations within their designated region;
- Oversees the development of local GMs/AGMs/OMs within their designated region;
- Oversees and authorizes personnel development including staffing, recruiting, training, workload scheduling, employee retention and motivation;
- Oversees the preparation of budgets and staffing plans for all operations within their designated region;
- Ensures compliance with all applicable state, federal and industry standards;
- Works closely with Regional Sales Management.

1.8.2. General Manager

- Oversees all functions of their assigned operations;
- Authorizes personnel development including staffing, recruiting, training, workload scheduling, employee retention and motivation;
- Prepares budgets and staffing plans;
- Monitors the Quality Systems of the laboratory and advises the SQM/QM accordingly;
- Ensures compliance with all applicable state, federal and industry standards.

1.8.3. Assistant General Manager / Operations Manager

- In the absence of the SGM/GM, performs all duties as listed above for the SGM or GM;
- Oversees the daily production and quality activities of all departments;
- Manages all departments and works with staff to ensure department objectives are met;
- Works with all departments to ensure capacity and customer expectations are accurately understood and met;
- Works with SGM/GM to prepare appropriate budget and staffing plans for all departments;
- Responsible for prioritizing personnel and production activities within all departments;
- Performs formal and informal performance reviews of departmental staff.

1.8.4. Senior Quality Manager

- Provides quality oversight for multiple laboratories where there is not a local quality manager or for labs where there are multiple and separately distinct quality systems in the same facility;

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- Responsible for implementing, maintaining and improving the quality system while functioning independently from laboratory operations. Reports directly to the highest level of local laboratory facility management, however named, that routinely makes day-to-day decisions regarding laboratory operations, but receives direction and assistance from the Corporate Director of Quality;
- Ensures that communication takes place at all levels within the lab regarding the effectiveness of the quality system and that all personnel understand their contributions to the quality system;
- Monitors Quality Assurance/Quality Control activities to ensure that the laboratory achieves established standards of quality (as set forth by the Corporate Quality office). The Quality Manager is responsible for reporting the lab's level of compliance to these standards to the Corporate Director of Quality on a quarterly basis;
- Maintains records of quality control data and evaluates data quality;
- Conducts periodic internal audits and coordinates external audits performed by regulatory agencies or customer representatives;
- Reviews and maintains records of proficiency testing results;
- Maintains the document control system;
- Assists in development and implementation of appropriate training programs;
- Provides technical support to laboratory operations regarding methodology and project QA/QC requirements;
- Maintains certifications from federal and state programs;
- Ensures compliance with all applicable state, federal and industry standards;
- Maintains the laboratory training records, including those in the Learning Management System (LMS), and evaluates the effectiveness of training;
- Monitors correctives actions;
- Maintains the currency of the Quality Manual.

1.8.5. Quality Manager

- Responsible for implementing, maintaining and improving the quality system while functioning independently from laboratory operations. Reports directly to the highest level of local laboratory facility management, however named, that routinely makes day-to-day decisions regarding laboratory operations, but receives direction and assistance from the Corporate Director of Quality. They may also report to a Senior Quality Manager within the same facility;
- Ensures that communication takes place at all levels within the lab regarding the effectiveness of the quality system and that all personnel understand their contributions to the quality system;
- Monitors Quality Assurance/Quality Control activities to ensure that the laboratory achieves established standards of quality (as set forth by the Corporate Quality office). The Quality Manager is responsible for reporting the lab's level of compliance to these standards to the Corporate Director of Quality on a quarterly basis;
- Maintains records of quality control data and evaluates data quality;
- Conducts periodic internal audits and coordinates external audits performed by regulatory agencies or customer representatives;
- Reviews and maintains records of proficiency testing results;
- Maintains the document control system;
- Assists in development and implementation of appropriate training programs;

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- Provides technical support to laboratory operations regarding methodology and project QA/QC requirements;
- Maintains certifications from federal and state programs;
- Ensures compliance with all applicable state, federal and industry standards;
- Maintains the laboratory training records, including those in the Learning Management System (LMS), and evaluates the effectiveness of training;
- Monitors correctives actions;
- Maintains the currency of the Quality Manual.

1.8.6. Quality Analyst

- Assists the SQM/QM in the performance of quality department responsibilities as delegated by the SQM/QM;
- Assists in monitoring QA/QC data;
- Assists in internal audits;
- Assists in maintaining training records;
- Assists in maintaining the document control system;

1.8.7. Technical Director

- Monitors the standards of performance in quality assurance and quality control data;
- Monitors the validity of analyses performed and data generated;
- Reviews tenders, contracts and QAPPs to ensure the laboratory can meet the data quality objectives for any given project;
- Serves as the manager of the laboratory in the absence of the SGM/GM/AGM/OM and SQM/QM;
- Provides technical guidance in the review, development, and validation of new methodologies.

1.8.8. Administrative Business Manager

- Responsible for financial and administrative management for the entire facility;
- Provides input relative to tactical and strategic planning activities;
- Organizes financial information so that the facility is run as a fiscally responsible business;
- Works with staff to confirm that appropriate processes are put in place to track revenues and expenses;
- Provide ongoing financial information to the SGM/GM/AGM/OM and the management team so they can better manage their business;
- Utilizes historical information and trends to accurately forecast future financial positions;
- Works with management to ensure that key measurements are put in place to be utilized for trend analysis—this will include personnel and supply expenses, and key revenue and expense ratios;
- Works with SGM/GM/AGM/OM to develop accurate budget and track on an ongoing basis;
- Works with entire management team to submit complete and justified capital budget requests and to balance requests across departments;
- Works with project management team and administrative support staff to ensure timely and accurate invoicing.

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1.8.9. Client Services Manager

- Oversees all the day to day activities of the Client Services Department which includes Project Management and, possibly, Sample Control;
- Responsible for staffing and all personnel management related issues for Client Services;
- Serves as the primary senior consultant to customers on all project related issues such as set up, initiation, execution and closure;
- Performs or is capable of performing all duties listed for that of Project Manager.

1.8.10. Project Manager

- Coordinates daily activities including taking orders, reporting data and analytical results;
- Serves as the primary technical and administrative liaison between customers and PASI;
- Communicates with operations staff to update and set project priorities;
- Provides results to customers in the requested format (verbal, hardcopy, electronic, etc.);
- Works with customers, laboratory staff, and other appropriate PASI staff to develop project statements of work or resolve problems of data quality;
- Responsible for solicitation of work requests, assisting with proposal preparation and project initiation with customers and maintain customer records;
- Mediation of project schedules and scope of work through communication with internal resources and management;
- Responsible for preparing routine and non-routine quotations, reports and technical papers;
- Interfaces between customers and management personnel to achieve customer satisfaction;
- Manages large-scale complex projects;
- Supervises less experienced project managers and provide guidance on management of complex projects;
- Arranges bottle orders and shipment of sample kits to customers;
- Verifies login information relative to project requirements and field sample Chains-of-Custody.

1.8.11. Project Coordinator

- Responsible for preparation of project specifications and provides technical/project support;
- Coordinates project needs with other department sections and assists with proposal preparation;
- Prepares routine proposals and invoicing;
- Responsible for scanning, copying, assembling and binding final reports;
- Other duties include filing, maintaining forms, process outgoing mail, maintaining training database and data entry.

1.8.12. Department Manager/Supervisor

- Oversees the day-to-day production and quality activities of their assigned department;
- Ensures that quality assurance and quality control criteria of analytical methods and projects are satisfied;
- Assesses data quality and takes corrective action when necessary;

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- Approves and releases technical and data management reports;
- Ensures compliance with all applicable state, federal and industry standards.

1.8.13. Group Supervisor/Leader

- Trains analysts in laboratory operations and analytical procedures;
- Organizes and schedules analyses with consideration for sample holding times;
- Implements data verification procedures by assigning data verification duties to appropriate personnel;
- Evaluates instrument performance and supervises instrument calibration and preventive maintenance programs;
- Reports non-compliance situations to laboratory management including the SQM/QM.

1.8.14. Laboratory Analyst

- Performs detailed preparation and analysis of samples according to published methods and laboratory procedures;
- Processes and evaluates raw data obtained from preparation and analysis steps;
- Generates final results from raw data, performing primary review against method criteria;
- Monitors quality control data associated with analysis and preparation. This includes examination of raw data such as chromatograms as well as an inspection of reduced data, calibration curves, and laboratory notebooks;
- Reports data in LIMS, authorizing for release pending secondary approval;
- Conducts routine and non-routine maintenance of equipment as required;
- Performs or is capable of performing all duties associated with that of Laboratory Technician.

1.8.15. Laboratory Technician

- Prepares standards and reagents according to published methods or in house procedures;
- Performs preparation and analytical steps for basic laboratory methods;
- Works under the direction of a Laboratory Analyst on complex methodologies;
- Assists Laboratory Analysts on preparation, analytical or data reduction steps for complex methodologies;
- Monitors quality control data as required or directed. This includes examination of raw data such as chromatograms as well as an inspection of reduced data, calibration curves, and laboratory notebooks.

1.8.16. Field Technician

- Prepares and samples according to published methods, PASI Quality Assurance Manual and/or customer directed sampling objectives;
- Capable of the collection of representative environmental or process related air samples;
- Use computer software to compile, organize, create tables, create graphics and write test reports;
- Reviews project documentation for completeness, method compliance and contract fulfillment;

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- Train less experienced environmental technicians and provide guidance on sampling and analysis;
- Responsible for project initiation and contact follow-up;
- Develop sampling plans and prepare test plan documents.

1.8.17. Field Analyst

- Analyzes field samples according to published methods, PASI Quality Assurance Manual and/or customer directed sampling objectives,
- Capable of the collection and analysis of representative environmental or process related air samples,
- Proficient in a variety of analytical tests; specifically on-site gas-phase organic and inorganic compounds by extractive fourier transform infrared spectroscopy (FTIR),
- Train less experienced staff and provide guidance on FTIR sampling and analysis,
- Assist in reporting tasks and project management responsibilities, and
- Perform back-up support for manager tasks such as reporting needs and customer concerns.

1.8.18. Sample Management Personnel

- Signs for incoming samples and verifies the data entered on the Chain of custody forms;
- Enters the sample information into the Laboratory Information Management System (LIMS) for tracking and reporting;
- Stages samples according to EPA requirements;
- Assists Project Managers and Coordinators in filling bottle orders and sample shipments.

1.8.19. Systems Administrator or Systems Manager

- Assists with the creation and maintenance of electronic data deliverables (EDDs);
- Coordinates the installation and use of all hardware, software and operating systems;
- Performs troubleshooting on all aforementioned systems;
- Trains new and existing users on systems and system upgrades;
- Maintains all system security passwords;
- Maintains the electronic backups of all computer systems.

1.8.20. Safety/Chemical Hygiene Officer

- Maintains the laboratory Chemical Hygiene Plan;
- Plans and implements safety policies and procedures;
- Maintains safety records;
- Organizes and/or performs safety training;
- Performs safety inspections and provides corrective/preventative actions;
- Assists personnel with safety issues.

1.8.21. Program Director/Hazardous Waste Coordinator (or otherwise named)

- Evaluates waste streams and helps to select appropriate waste transportation and disposal companies;

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- Maintains complete records of waste disposal including waste manifests and state reports;
- Assists in training personnel on waste-related issues such as waste handling and storage, waste container labeling, proper satellite accumulation, secondary containment, etc.;
- Conducts a weekly inspection of the waste storage areas of the laboratory.

1.9. Training and Orientation

1.9.1. Training for Pace employees is managed through a web-based Learning Management System. After a new employee has been instructed in matters of human resources, they are given instructional materials for the LMS and a password for access.

1.9.2. A new hire training checklist is provided to the new employee that lists training items for the employee to work through either independently on LMS or with their supervisor or trainer. The training items that can be completed independently include:

- Reading through applicable Standard Operating Procedures;
- Reviewing the Quality Manual and Chemical Hygiene Plan;
- Core training modules such as quality control indicators, basic laboratory skills, etc.;
- Quality Systems training including traceability of measurements, method calibration, calibration verification, accuracy, precision and uncertainty of measurements, corrective actions, documentation, and root cause analysis;
- Data Integrity/Ethics training.

1.9.3. The new employee's Department Supervisor provides the employee with a basic understanding of the role of the laboratory within the structure of PASI and the basic elements of that individual's position. Supervised training uses the following techniques:

- Hands-on training
- Training checklists/worksheets
- Lectures and training sessions
- Method-specific training
- Conferences and seminars
- Short courses
- Specialized training by instrument manufacturers
- Proficiency testing programs.
- On-line courses

1.9.4. Group Supervisors/Leaders are responsible for providing documentation of training and proficiency for each employee under their supervision. The employee's training file indicates what procedures an analyst or a technician is capable of performing, either independently or with supervision. The files also include documentation of continuing capability, which are fully detailed in Section 3.4. Training documentation files for each person are maintained by the Quality Office either in hardcopy format or within the LMS.

1.9.5. All procedures and training records are maintained and available for review during laboratory audits. These procedures are reviewed/updated periodically by laboratory management. Additional information can be found in SOP S-ALL-Q-020 **Training and Employee Orientation** or its equivalent revision or replacement.

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1.10. Data Integrity System

1.10.1. The data integrity system at PASI provides assurances to management that a highly ethical approach is being applied to all planning, training and implementation of methods. Data integrity is crucial to the success of our company and Pace Analytical is committed to creating and maintaining a culture of quality throughout the organization. To accomplish this goal, PASI has implemented a data integrity system that encompasses the following four requirements:

1.10.1.1. A data integrity training program: standardized training is given to each new employee and a yearly refresher is presented to all employees. Key topics addressed by this training include:

- 1.10.1.1.1. Need for honesty and transparency in analytical reporting
- 1.10.1.1.2. Process for reporting data integrity issues
- 1.10.1.1.3. Specific examples of unethical behavior and improper practices
- 1.10.1.1.4. Documentation of non-conforming data that is still useful to the data user
- 1.10.1.1.5. Consequences and punishments for unethical behavior
- 1.10.1.1.6. Examples of monitoring devices used by management to review data and systems

1.10.1.2. Signed data integrity documentation for all employees: this includes a written quiz following the Ethics training session and written agreement to abide by the Code of Ethics and Standards of Conduct explained in the employee manual.

1.10.1.3. In-depth, periodic monitoring of data integrity including peer data review and validation, internal raw data audits, proficiency testing studies, etc.

1.10.1.4. Documentation of any review or investigation into possible data integrity infractions. This documentation, including any disciplinary actions involved, corrective actions taken, and notifications to customers must be retained for a minimum of five years.

1.10.2. PASI management makes every effort to ensure that personnel are free from any undue pressures that affect the quality of their work including commercial, financial, over scheduling, and working condition pressures.

1.10.3. Corporate management also provides all PASI facilities a mechanism for confidential reporting of data integrity issues that ensures confidentiality and a receptive environment in which all employees are comfortable discussing items of ethical concern. The anonymous message line is monitored by the Corporate Director of Quality who will ensure that all concerns are evaluated and, where necessary, brought to the attention of executive management and investigated. Any Pace employee can contact corporate management to report an ethical concern by calling the anonymous hotline at 612-607-6431.

1.11. Laboratory Safety

1.11.1. It is the policy of PASI to make safety and health an integral part of daily operations and to ensure that all employees are provided with safe working conditions, personal protective equipment, and requisite training to do their work without injury. Each employee is responsible for his/her own safety as well as those working in the immediate area by complying with established company rules and procedures. These rules and procedures as well as a more detailed description of the employees' responsibilities are contained in the corporate Safety Manual and Chemical Hygiene Plan.

1.12. Security and Confidentiality

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1.12.1. Security is maintained by controlled access to laboratory buildings. Exterior doors to laboratory buildings remain either locked or continuously monitored by PASI staff. Posted signs direct visitors to the reception office and mark all other areas as off limits to unauthorized personnel. All visitors, including PASI staff from other facilities, must sign the Visitor's Logbook maintained by the receptionist. A staff member will accompany them during the duration of their stay on the premises unless the SGM/GM/AGM/OM, SQM/QM, or Technical Director specify otherwise. In this instance, the staff member will escort the visitor back to the reception area at the end of his/her visit where he/she signs out. The last staff member to leave their department for the day should ensure that all outside access points to that area are secure.

1.12.2. Additional security is provided where necessary, (e.g., specific secure areas for sample, data, and customer report storage), as requested by customers, or cases where national security is of concern. These areas are lockable within the facilities, or are securely offsite. Access is limited to specific individuals or their designees. Security of sample storage areas is the responsibility of the Sample Custodian. Security of samples and data during analysis and data reduction is the responsibility of Group Supervisors. Security of customer report archives is the responsibility of the Client Services Manager. These secure areas are locked whenever these individuals or their designees are not present in the facility.

1.12.3. Access to designated laboratory sample storage locations is limited to authorized personnel only. Provisions for lock and key access are provided. No samples are to be removed without proper authorization. If requested by customer or contract, samples are not to be removed from secure storage areas without filling out an associated internal chain of custody.

1.12.4. Standard business practices of confidentiality are applied to all documents and information regarding customer analyses. Specific protocols for handling confidential documents are described in PASI SOPs. Additional protocols for sample identification by internal laboratory identification numbers only are implemented as required under contract specific Quality Assurance Project Plans (QAPPs).

1.12.5. All information pertaining to a particular customer, including national security concerns will remain confidential. Data will be released to outside agencies only with written authorization from the customer or where federal or state law requires the company to do so. Additional information can be found in SOP S-KS-Q-007 **Laboratory Security Procedures** or its equivalent revision or replacement.

1.13. Communications

1.13.1. Management within each lab bears the responsibility of ensuring that appropriate communication processes are established and that communication takes place regarding the effectiveness of the management/quality system. These communication processes may include email, regular staff meetings, senior management meetings, etc.

1.13.2. Corporate management bears the responsibility of ensuring that appropriate communication processes are established within the network of facilities and that communication takes place at a company-wide level regarding the effectiveness of the management/quality systems of all Pace facilities. These communication processes may include email, quarterly continuous improvement conference calls for all lab departments, and annual continuous improvement meetings for all department supervisors, quality managers, client services managers, and other support positions.

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2.0. SAMPLE CUSTODY

2.1. Sampling Support

2.1.1. Each individual PASI laboratory provides shipping containers, properly preserved sample containers, custody documents, and field quality control samples to support field-sampling events. Guidelines for sample container types, preservatives, and holding times for a variety of methods are listed in Attachment VIII. Note that all analyses listed are not necessarily performed at all PASI laboratories and there may be additional laboratory analyses performed that are not included in these tables. PASI - Kansas may provide pick-up and delivery services to their customers when needed.

2.2. Field Services

2.2.1. Pace Analytical has a large Field Services Division which is based in their Minneapolis facility as well as limited field service capabilities in some of our other facilities. Field Services provides comprehensive nationwide service offerings including:

- Stack Testing
- Ambient Air
- CEM Certification Testing
- Air Quality Monitoring
- Onsite Analytical Services- FTIR and GC
- Real-time Process Diagnostic/Optimization Testing
- Wastewater, Groundwater and Drinking Water Monitoring
- Storm Water and Surface Water Monitoring
- Soil and Waste Sampling
- Mobile Laboratory Services

2.2.2. Field Services operates under the PASI Corporate Quality System, with applicable and necessary provisions to address the activities, methods, and goals specific to Field Services. All procedures and methods used by Field Services are documented in Standard Operating Procedures and Procedure Manuals.

2.2.3. All sampling activities conducted by the laboratory's field personnel are conducted with the expectation that they will be made for routine monitoring purposes, unless specifically stated to the contrary prior to the field investigation. Therefore, the use of proper sampling procedures cannot be overemphasized. The collection of representative samples depends upon:

- Ensuring that the samples taken are representative of the material or medium being sampled.
- Using proper sampling, sample handling, preservation, and quality control techniques.
- Properly identifying the collected samples and documenting their collection in field records.
- Maintaining sample chain-of-custody.
- Protecting the collected samples by properly packing and transporting them to the laboratory for analysis.

Additional information can be found in the **Field Procedures Manual S-KS-F-001** or its equivalent revision or replacement.

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2.3. Project Initiation

2.3.1. Prior to accepting new work, the laboratory reviews its performance capability. The laboratory confirms that sufficient personnel, equipment capacity, analytical method capability, etc., are available to complete the required work. Customer needs, certification requirements, and data quality objectives are defined and the appropriate sampling and analysis plan is developed to meet the project requirements by project managers or sales representatives. Members of the management staff review current instrument capacity, personnel availability and training, analytical procedures capability, and projected sample load. Management then informs the sales and client services personnel whether or not the laboratory can accept the new project via written correspondence, email, and/or daily operations meetings.

2.3.2. The laboratory maintains records of all such reviews, including discussions with customers. Routine analytical project documentation of quotes, notes, dates, initials, and/or recordings is maintained in a project folder by project management. Conditions for new and more complex contracts are determined by the SGM/GM/AGM/OM and sales representatives. Quality Management is consulted on technical requirements and operations staff provides input on volume capacities. Evidence of these reviews is maintained in the form of awarded Request for Proposals (RFPs), signed quotes or contracts, and a Customer Relationship Management (CRM) database. If a review identifies a potential mismatch between customer requirements and laboratory capabilities and/or capacities, Pace will specify its level of commitment by listing these exceptions to the requirements within the RFP, quote or contract.

2.3.3. Additional information regarding specific procedures for reviewing new work requests can be found in SOP S-KS-Q-033 **Review of Analytical Requests** or its equivalent revision or replacement.

2.4. Chain of Custody

2.4.1. A chain of custody (COC) provides the legal documentation of samples from time of collection to completion of analysis. PASI has implemented Standard Operating Procedures to ensure that sample custody traceability and responsibility objectives are achieved for every project.

2.4.2. Field personnel or client representatives must complete a chain of custody for all samples that are received by the laboratory. The importance of completeness of COCs is stressed to the samplers and is critical to efficient sample receipt and to insure the requested methods are used to analyze the correct samples.

2.4.3. If sample shipments are not accompanied by the correct documentation, the Sample Receiving department notifies a Project Manager. The Project Manager then obtains the correct documentation/information from the customer in order for analysis of samples to proceed.

2.4.4. The sampler is responsible for providing the following information on the chain of custody form:

- Customer project name
- Project location or number
- Field sample number/identification
- Date and time sampled
- Sample matrix

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- Preservative
- Requested analyses
- Sampler signature
- Relinquishing signature
- Date and time relinquished
- Sampler remarks as needed
- Custody Seal Number if present
- Regulatory Program Designation
- The state where the samples were collected to ensure all applicable state requirements are met
- Turnaround time requested
- Purchase order number

2.4.5. The COC is filled out completely and legibly with indelible ink. Errors are corrected by drawing a single line through the initial entry and initialing and dating the change. All transfers of samples are recorded on the chain of custody in the “relinquished” and “received by” sections. All information except signatures is printed.

2.4.6. Additional information can be found in SOP S-KS-C-001 **Sample Management** and SOP S-KS-C-002 **Assembly of Sample Container Kits** or their equivalent revisions or replacements.

2.5. Sample Acceptance Policy

2.5.1. In accordance with regulatory guidelines, PASI complies with the following sample acceptance policy for all samples received.

2.5.2. If the samples do not meet the sample receipt acceptance criteria outlined below, the laboratory is required to document all non-compliances, contact the customer, and either reject the samples or fully document any decisions to proceed with analyses of samples which do not meet the criteria. Any results reported from samples not meeting these criteria are appropriately qualified on the final report.

2.5.3. All samples must:

- Have unique customer identification that is clearly marked on durable waterproof labels affixed to the sample containers that match the chain of custody.
- Have clear documentation on the chain of custody related to the location of the sampling site with the time and date of sample collection.
- Have the sampler’s name and signature.
- Have all requested analyses clearly designated on the COC.
- Have clear documentation of any special analytical or data reporting requirements.
- Be in appropriate sample containers with clear documentation of the preservatives used.
- Be correctly preserved unless the method allows for laboratory preservation.
- Be received within holding time. Any samples with hold times that are exceeded will not be processed without prior customer approval.
- Have sufficient sample volume to proceed with the analytical testing. If insufficient sample volume is received, analysis will not proceed without customer approval.
- Be received within appropriate temperature ranges - not frozen but $\leq 6^{\circ}\text{C}$ (See Note 1), unless program requirements or customer contractual obligations mandate otherwise (see Note 2). The

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cooler temperature is recorded directly on the COC and the SCUR. Samples that are delivered to the laboratory immediately after collection are considered acceptable if there is evidence that the chilling process has been started. For example, by the arrival of the samples on ice. If samples arrive that are not compliant with these temperature requirements, the customer will be notified. The analysis will NOT proceed unless otherwise directed by the customer. If less than 72 hours remain in the hold time for the analysis, the analysis may be started while the customer is contacted to avoid missing the hold time. Data associated with any deviations from the above sample acceptance policy requirements will be appropriately qualified.

Note 1: Temperature will be read and recorded based on the precision of the measuring device. For example, temperatures obtained from a thermometer graduated to 0.1°C will be read and recorded to ±0.1°C. Measurements obtained from a thermometer graduate to 0.5°C will be read to ±0.5°C. Measurements read at the specified precision are not to be rounded down to meet the ≤6°C limit

Note 2: Some microbiology methods allow sample receipt temperatures of up to 10°C. Consult the specific method for microbiology samples received above 6°C prior to initiating corrective action for out of temperature preservation conditions.

Note 3: Biological Tissue Samples must be received frozen at ≤0°C.

2.5.4. Upon sample receipt, the following items are also checked and recorded:

- Presence of custody seals or tapes on the shipping containers;
- Sample condition: Intact, broken/leaking, bubbles in VOA samples;
- Sample holding time;
- Sample pH and residual chlorine when required;
- Appropriate containers.

2.5.5. Samples for drinking water analysis that are improperly preserved, or are received past holding time, are rejected at the time of receipt, with the exception of VOA samples that are tested for pH at the time of analysis.

2.5.6. Additional information can be found in SOP S-KS-C-001 **Sample Management** or its equivalent revision or replacement.

2.6. Sample Log-in

2.6.1. After sample inspection, all sample information on the chain of custody is entered into the Laboratory Information Management System. This permanent record documents receipt of all sample containers including:

- Customer name and contact
- Customer number
- Pace Analytical project number
- Pace Analytical Project Manager
- Sample descriptions
- Due dates
- List of analyses requested

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- Date and time of laboratory receipt
- Field ID code
- Date and time of collection
- Any comments resulting from inspection for sample rejection

2.6.2. All samples received are logged into the LIMS within one working day of receipt. Sample login may be delayed due to customer clarification of analysis needed, corrective actions for sample receipt non-conformance, or other unusual circumstances. If the time collected for any sample is unspecified and Pace is unable to obtain this information from the customer, the laboratory will use 08:00 as the time sampled. All hold times will be based on this sampling time and qualified accordingly if exceeded.

2.6.3. The Laboratory Information Management System (LIMS) automatically generates a unique identification number for each sample created in the system. The LIMS sample number follows the general convention of BB-XXXXXX-YYY. The BB prefix represents the laboratory identification within Pace's laboratory network. The prefix 60 designates the PASI-Kansas laboratory region number. XXXXXX designates the project number, and is assigned in numerical order from 000001 to 999999 as a new project is created. The suffix YYY designates the sample number within a project, and is assigned in numerical order. In addition to the unique sample identification number, each sample container is also uniquely identified. Sample container identification consists of the LIMS sample number; the container type; and a container number such as 1 of Z, where Z is the total number of containers of a particular type. Together, the LIMS sample number and the sample container identification number are used to create a unique barcode encryption that can be linked to the sample analysis requested by the customer. These unique identifications are placed on the sample container as a durable label and becomes the link between the laboratory's sample management system and the customer's field identification; it will be a permanent reference number for all future interactions.

2.6.4. Current division codes are noted below. These division codes are used primarily for accounting purposes and LIMS sample identifications. More division codes may be added without updating this document.

10 = Minnesota; Montana; Virginia, MN	35 = Florida
92 = Asheville and Charlotte	20 = Gulf Coast
60 = Kansas	30 = Pittsburgh
50 = Indianapolis	40 = Green Bay
25 = Seattle	17 = Pace Life Sciences
51 = Columbus	65 = Schenectady, NY
75 = Dallas	36 = South Florida

2.6.5. Sample labels are printed from the LIMS and affixed to each sample container.

2.6.6. Samples with hold times that are near expiration date/time may be sent directly to the laboratory for analysis at the discretion of the Project Manager and/or SGM/GM/AGM/OM.

2.6.7. Additional information can be found in SOP S-KS-C-001 **Sample Management** or its equivalent revision or replacement.

2.7. Sample Storage

2.7.1. Storage Conditions

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2.7.1.1. Samples are stored away from all standards, reagents, or other potential sources of contamination. Samples are stored in a manner that prevents cross contamination. Volatile samples are stored separately from other samples. All sample fractions, extracts, leachates, and other sample preparation products are stored in the same manner as actual samples or as specified by the analytical method.

2.7.1.2. Storage blanks, consisting of two 40mL aliquots of reagent water, are stored with volatile samples and are used to measure cross-contamination acquired during storage. If applicable, laboratories must have documented procedures and criteria for evaluating storage blanks, appropriate to the types of samples being stored.

2.7.1.3. Additional information can be found in SOP S-ALL-Q-018 **Monitoring Storage Units** or its equivalent revision or replacement.

2.7.2. **Temperature Monitoring**

2.7.2.1. Samples are taken to the appropriate storage location immediately after sample receipt and check-in procedures are completed. All sample storage areas are located in limited access areas and are monitored to ensure sample integrity.

2.7.2.2. The temperature of each refrigerated storage area is maintained at $\leq 6^{\circ}\text{C}$ unless state or program requirements differ. The temperature of each freezer storage area is maintained at $< -10^{\circ}\text{C}$ unless state or program requirements differ. The temperature of each storage area is checked and documented each day of use (each calendar day). If the temperature falls outside the acceptable limits, the following corrective actions are taken and appropriately documented:

- The temperature is rechecked after two hours to verify temperature exceedance. Corrective action is initiated and documented if necessary.
- The SQM/QM and/or laboratory management are notified if the problem persists.
- The samples are relocated to a proper environment if the temperature cannot be maintained after corrective actions are implemented.
- The affected customers are notified.
- Documentation is provided on analytical report.

Additional information can be found in SOP S-ALL-Q-018 **Monitoring Storage Units** or its equivalent revision or replacement.

2.7.3. **Hazardous Materials**

2.7.3.1. Pure product or potentially heavily contaminated samples must be tagged as "hazardous" or "lab pack" and stored separately from other samples.

2.7.3.2. Additional information can be found in SOP S-KS-S-002 **Waste Handling** or its equivalent revision or replacement.

2.7.4. **Foreign/Quarantined Soils**

2.7.4.1. Depending on the soil disposal practices of the laboratory, foreign soils and soils from USDA regulated areas are adequately segregated to enable proper sample disposal. The USDA requires these samples to be incinerated or sterilized by an approved treatment procedure. Additional information regarding USDA regulations and sample handling can be found in applicable local laboratory SOPs.

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2.7.4.2. Additional information on sample storage can be found in SOPs S-KS-Q-020 **USDA Regulated Soil**, S-KS-C-001 **Sample Management**, and S-KS-S-002 **Waste Handling** or their equivalent revisions or replacements.

2.8. Sample Protection

2.8.1. PASI laboratory facilities are operated under controlled access protocols to ensure sample and data integrity. Visitors must register at the front desk and be properly escorted at all times.

2.8.2. Samples are removed from storage areas by designated personnel and returned to the storage areas, if necessary, immediately after the required sample quantity has been taken.

2.8.3. Upon customer request, additional and more rigorous chain of custody protocols for samples and data can be implemented. For example, some projects may require internal chain-of-custody protocols.

2.8.4. Additional information can be found in SOPs S-KS-C-001 **Sample Management** and S-KS-Q-007 **Laboratory Security Procedures** or their equivalent revisions or replacements.

2.9. Subcontracting Analytical Services

2.9.1. Every effort is made to perform all analyses for PASI customers within the laboratory that receives the samples. When subcontracting to a laboratory other than the receiving laboratory, whether inside or outside the PASI network, becomes necessary, a preliminary verbal communication with that laboratory is undertaken. Customers are notified in writing of the laboratory's intention to subcontract any portion of the testing to another laboratory. Work performed under specific protocols may involve special considerations.

2.9.2. Prior to subcontracting samples to a laboratory outside Pace Analytical, the potential subcontract laboratory will be pre-qualified by verifying that the subcontractor meets the following criteria:

- All certifications required for the proposed subcontract are in effect,
- Sufficient professional liability and other required insurance coverage is in effect, and
- Is not involved in legal action by any federal, state, or local government agency for data integrity issues and has not been convicted in such investigation at any time during the past 5 years.

2.9.3. The contact and preliminary arrangements are made between the PASI Project Manager and the appropriate subcontract laboratory personnel. The specific terms of the subcontract laboratory agreement include:

- Method of analysis
- Number and type of samples expected
- Project specific QA/QC requirements
- Deliverables required
- Laboratory certification requirement
- Price per analysis
- Turn-around time requirements

2.9.4. Chain of custody forms are generated for samples requiring subcontracting to other laboratories. Sample receiving personnel re-package the samples for shipment, create a transfer chain of custody form and record the following information:

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- Pace Analytical Laboratory Number
- Matrix
- Requested analysis
- Special instructions regarding turnaround, required detection or reporting limits, or any unusual information known about the samples or analytical procedure.
- Signature in "Relinquished By"

2.9.5. All subcontracted sample data reports are sent to the PASI Project Manager. Pace will provide a copy of the subcontractor's report to the client when requested.

2.9.6. Any Pace Analytical work sent to other labs within the PASI network is handled as subcontracted work and all final reports are labeled clearly with the name of the laboratory performing the work. Any non-TNI work is clearly identified. PASI will not be responsible for analytical data if the subcontract laboratory was designated by the customer.

2.9.7. Additional information can be found in SOPs S-KS-Q-040 **Vendor Qualification** and SOP S-KS-C-003 **Subcontracting Samples** or their equivalent revisions or replacements.

2.10. Sample Retention and Disposal

2.10.1. Samples, extracts, digestates, and leachates must be retained by the laboratory for the period of time necessary to protect the interests of the laboratory and the customer.

2.10.2. Unused portions of samples are retained by each laboratory based on program or customer requirements for sample retention and storage. The minimum sample retention time is 45 days from receipt of the samples. Samples requiring thermal preservation may be stored at ambient temperature when the hold time is expired, the report has been delivered, and/or allowed by the customer, program, or contract. Samples requiring storage beyond the minimum sample retention time due to special requests or contractual obligations may be stored at ambient temperature unless the laboratory has sufficient capacity and their presence does not compromise the integrity of other samples.

2.10.3. After this period expires, non-hazardous samples are properly disposed of as non-hazardous waste. The preferred method for disposition of hazardous samples is to return the excess sample to the customer. If it is not feasible to return samples, or the customer requires PASI to dispose of excess samples, proper arrangements will be made for disposal by an approved contractor.

2.10.4. Additional information can be found in SOPs S-KS-S-002 **Waste Handling** and S-KS-C-001 **Sample Management** or their equivalent revisions or replacements.

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3.0. ANALYTICAL CAPABILITIES

3.1. Analytical Method Sources

3.1.1. PASI laboratories are capable of analyzing a full range of environmental samples from a variety of matrices, including air, surface water, wastewater, groundwater, soil, sediment, biota, and other waste products. The latest valid editions of methodologies are applied from regulatory and professional sources including EPA, ASTM, USGS, NIOSH, Standard Methods, and State Agencies. Section 11 is a representative listing of general analytical protocol references. PASI discloses in writing to its customers and regulatory agencies any instances in which modified methods are being used in the analysis of samples.

3.1.2. In the event of a customer-specific need, instrumentation constraint or regulatory requirement, PASI laboratories reserve the right to use valid versions of methods that may not be the most recent edition available.

3.2. Analytical Method Documentation

3.2.1. The primary form of PASI laboratory documentation of analytical methods is the Standard Operating Procedure (SOP). SOPs contain pertinent information as to what steps are required by an analyst to successfully perform a procedure. The required contents for the SOPs are specified in the company-wide SOP for Preparation of SOPs (S-ALL-Q-001).

3.2.2. The SOPs may be supplemented by other training materials that further detail how methods are specifically performed. This training material will undergo periodic, documented review along with the other Quality System documentation.

3.3. Analytical Method Validation

3.3.1. In some situations, PASI develops and validates methodologies that may be more applicable to a specific problem or objective. When non-standard methods are required for specific projects or analytes of interest, or when the laboratory develops or modifies a method, the laboratory validates the method prior to applying it to customer samples. Method validity is established by meeting criteria for precision and accuracy as established by the data quality objectives specified by the end user of the data. The laboratory records the validation procedure, the results obtained and a statement as to the usability of the method. The minimum requirements for method validation include evaluation of sensitivity, quantitation, precision, bias, and selectivity of each analyte of interest.

3.3.2. Additional information can be found in SOP S-KS-Q-040 **Determination of Limit of Detection and Limit of Quantitation** or its equivalent revision or replacement.

3.4. Demonstration of Capability (DOC)

3.4.1. Analysts complete an initial demonstration of capability (IDOC) study prior to performing a method or when there is a change in instrument type, personnel, or test method, or at any time that a method has not been performed by the laboratory or analyst in a 12-month period. The mean recovery and standard deviation of each analyte, taken from 4 replicates of a quality control standard is calculated and compared to method criteria (if available) or established laboratory criteria for

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evaluation of acceptance. Each laboratory maintains copies of all demonstrations of capability, including those that fail acceptance criteria and corresponding raw data for future reference and must document the acceptance criteria prior to the analysis of the DOC. Demonstrations of capability are verified on an annual basis.

3.4.2. For Continuing Demonstrations of Capability, the laboratories may use Performance Testing (PT) samples in lieu of the 4-replicate approach listed above. For methods or procedures that do not lend themselves to the “4-replicate” approach, the demonstration of capability requirements will be specified in Section 13 – Method Performance of the applicable SOP. Drinking Water DOCs must be done at or below the MCL.

3.4.3. Additional information can be found in SOP S-ALL-Q-020 **Training and Employee Orientation** or its equivalent revision or replacement.

3.5. Regulatory and Method Compliance

3.5.1. PASI understands that expectations of our customers commonly include the assumption that laboratory data will satisfy specific regulatory requirements. Therefore PASI attempts to ascertain, prior to beginning a project, what applicable regulatory jurisdiction, agency, or protocols apply to that project. This information is also required on the chain of custody submitted with samples.

3.5.2. PASI makes every effort to detect regulatory or project plan inconsistencies, based upon information from the customer, and communicate them immediately to the customer in order to aid in the decision making process. PASI will not be liable if the customer chooses not to follow PASI recommendations.

3.5.3. It is PASI policy to disclose in a forthright manner any detected noncompliance affecting the usability of data produced by our laboratories. The laboratory will notify customers within 30 days of fully characterizing the nature of the nonconformance, the scope of the nonconformance and the impact it may have on data usability.

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4.0. QUALITY CONTROL PROCEDURES

Quality control data is analyzed and where they are found to be outside pre-defined criteria, planned action is taken to correct the problem in order to prevent incorrect results from being reported. Quality control samples are to be processed in the same manner as client samples.

4.1. Method Blank

4.1.1. A method blank is used to evaluate contamination in the preparation/analysis system and is processed through all preparation and analytical steps with its associated samples.

4.1.2. A method blank is processed at a minimum frequency of one per preparation batch. In the case of a method that has no separate preparation step, a method blank is processed with no more than 20 samples of a specific matrix performed by the same analyst, using the same method, standards, and reagents.

4.1.3. The method blank consists of a matrix similar to the associated samples that is known to be free of analytes of interest. Laboratories will characterize a representative matrix as “clean” if the matrix contains contaminants at less than ½ the laboratory’s reporting limit.

4.1.4. Method blanks are not applicable for certain analyses, such as pH, conductivity, flash point and temperature.

4.1.5. Each method blank is evaluated for contamination. The source of any contamination is investigated and documented corrective action is taken when the concentration of any target analyte is detected above the reporting limit and is greater than 1/10 of the amount of that analyte found in any associated sample. Corrective actions include the re-preparation and re-analysis of all the samples (where possible) along with the full set of required quality control samples. Data qualifiers must be applied to any result reported that is associated with a contaminated method blank.

4.1.6. Deviations made from this policy must be approved by the SQM/QM prior to release of the data.

4.2. Laboratory Control Sample

4.2.1. The Laboratory Control Sample (LCS) is used to evaluate the performance of the entire analytical system including preparation and analysis.

4.2.2. An LCS is processed at a minimum frequency of one per preparation batch. In the case of a method that has no separate preparation step, an LCS will be processed with no more than 20 samples of a specific matrix performed by the same analyst, using the same method, standards, and reagents.

4.2.3. The LCS consists of a matrix similar to the associated samples that is known to be free of the analytes of interest that is then spiked with known concentrations of target analytes.

4.2.4. The LCS contains **all** analytes specified by a specific method or by the customer or regulatory agency, which may include full list of target compounds, with certain exceptions. These exceptions may include analyzing only specific Aroclors when PCB analysis is requested or not spiking with all EPA Appendix IX compounds when a full Appendix IX list of compounds is requested. However, the lab must ensure that all target components in its scope of accreditation are included in the spike

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mixture for the LCS over a two (2) year period. In the absence of specified components, the laboratory will spike the LCS with the following compounds:

- For multi-peak analytes (e.g. PCBs, technical chlordane, toxaphene), a representative standard will be processed.
- For methods with long lists of analytes, a representative number of target analytes may be chosen. The following criteria is used to determine the number of LCS compounds used:
 - For methods with 1-10 target compounds, the laboratory will spike with all compounds
 - For methods with 11-20 target compounds, the laboratory will spike with at least 10 compounds or 80%, whichever is greater
 - For methods with greater than 20 compounds, the laboratory will spike with at least 16 compounds.

4.2.5. The LCS is evaluated against the method default or laboratory-derived acceptance criteria. For those methods that require laboratory-derived limits, method default control limits may be used until the laboratory has a minimum of 20, but preferably greater than 30, data points from which to derive internal acceptance criteria. Any compound that is outside of these limits is considered to be 'out of control' and must be qualified appropriately. Any associated sample containing an 'out-of-control' compound must either be re-analyzed with a successful LCS or reported with the appropriate data qualifier. When the acceptance criteria for the LCS are exceeded high, and there are associated samples that are non-detects, then those non-detects can be reported with data qualifiers, or when the acceptance criteria are exceeded low, those associated sample results may be reported if they exceed the maximum regulatory limit/decision level with data qualifiers.

4.2.6. For LCSs containing a large number of analytes, it is statistically likely that a few recoveries will be outside of control limits. This does not necessarily mean that the system is out of control, and therefore no corrective action would be necessary (except for proper documentation). TNI has allowed for a minimum number of marginal exceedances, defined as recoveries that are beyond the LCS control limits (3X the standard deviation) but less than the marginal exceedance limits (4X the standard deviation). The number of allowable exceedances depends on the number of compounds in the LCS. If more analyte recoveries exceed the LCS control limits than is allowed (see below) or if any one analyte exceeds the marginal exceedance limits, then the LCS is considered non-compliant and corrective actions are necessary. The number of allowable exceedances is as follows:

- >90 analytes in the LCS- 5 analytes
- 71-90 analytes in the LCS- 4 analytes
- 51-70 analytes in the LCS- 3 analytes
- 31-50 analytes in the LCS- 2 analytes
- 11-30 analytes in the LCS- 1 analyte
- <11 analytes in the LCS- no analytes allowed out)

4.2.7. A matrix spike (MS) can be used in place of a non-compliant LCS in a batch as long as the MS passes the LCS acceptance criteria (this is a TNI allowance). When this happens, full documentation must be made available to the data user. If this is not allowed by a customer or regulatory body, the associated samples must be rerun with a compliant LCS (if possible) or reported with appropriate data qualifiers.

4.2.8. Deviations made from this policy must be approved by the SQM/QM prior to release of the data.

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4.2.9. Additional information about the generation of control charts and control limits can be found in SOP S-ALL-Q-032 **Control Chart Generation and Trend Analysis** or its equivalent revision or replacement.

4.3. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

4.3.1. A matrix spike (MS) is used to determine the effect of the sample matrix on compound recovery for a particular method. The information from these spikes is sample or matrix specific and is not used to determine the acceptance of an entire batch unless the MS is actually used as the LCS.

4.3.2. A **Matrix Spike/Matrix Spike Duplicate (MS/MSD)** set is processed at a frequency specified in a particular method or as determined by a specific customer request. This frequency will be specified in the applicable method SOP or customer QAPP. In the absence of such requirements, an MS/MSD set is routinely analyzed once per every 20 samples per matrix per method.

4.3.3. The MS and MSD consist of the sample matrix that is then spiked with known concentrations of target analytes. Laboratory personnel spike customer samples that are specifically designated as MS/MSD samples or, when no designated samples are present in a batch, randomly select samples to spike that have adequate sample volume or weight. Spiked samples are prepared and analyzed in the same manner as the original samples and are selected from different customers if possible.

4.3.4. The MS and MSD contain all analytes specified by a specific method or by the customer or regulatory agency. In the absence of specified components, the laboratory will spike the MS/MSD with the same number of compounds as previously discussed in the LCS section. However, the lab must ensure that all targeted components in its scope of accreditation are included in the spike mixture for the MS/MSD over a two (2) year period.

4.3.5. The MS and MSD are evaluated against the method or laboratory derived criteria. Any compound that is outside of these limits is considered to be 'out of control' and must be qualified appropriately. Batch acceptance, however, is based on method blank and LCS performance, not on MS/MSD recoveries. The spike recoveries give the data user a better understanding of the final results based on their site specific information.

4.3.6. A matrix spike and sample duplicate will be performed instead of a matrix spike and matrix spike duplicate when specified by the customer or method.

4.3.7. Deviations made from this policy must be approved by the SQM/QM prior to release of the data.

4.3.8. Additional information about the generation of control charts and control limits can be found in SOP S-ALL-Q-032 **Control Chart Generation and Trend Analysis** or its equivalent revision or replacement.

4.4. Sample Duplicate

4.4.1. A sample duplicate is a second portion of sample that is prepared and analyzed in the laboratory along with the first portion. It is used to measure the precision associated with preparation and analysis. A sample duplicate is processed at a frequency specified by the particular method or as determined by a specific customer.

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4.4.2. The sample and duplicate are evaluated against the method or laboratory derived criteria for relative percent difference (RPD). Any duplicate that is outside of these limits is considered to be 'out of control' and must be qualified appropriately.

4.4.3. Deviations made from this policy must be approved by the SQM/QM prior to release of the data.

4.5. Surrogates

4.5.1. Surrogates are compounds that reflect the chemistry of target analytes and are typically added to samples for organic analyses to monitor the effect of the sample matrix on compound recovery.

4.5.2. Surrogates are added to each customer sample (for organics), method blank, LCS, and MS prior to extraction or analysis. The surrogates are evaluated against the method or laboratory derived acceptance criteria or against project-specific acceptance criteria specified by the client, if applicable. Any surrogate compound that is outside of these limits is considered to be 'out of control' and must be qualified appropriately. Samples with surrogate failures are typically re-extracted and/or re-analyzed to confirm that the out-of-control value was caused by the matrix of the sample and not by some other systematic error. An exception to this would be samples that have high surrogate values but no reportable hits for target compounds. These samples would be reported, with a qualifier, because the implied high bias would not affect the final results. For methods with multiple surrogates, documentation regarding acceptance and associated compounds will be found in the individual method SOPs.

4.5.3. Deviations made from this policy must be approved by the SQM/QM prior to release of the data.

4.6. Internal Standards

4.6.1. Internal Standards are method-specific analytes added to every standard, method blank, laboratory control sample, matrix spike, matrix spike duplicate, and sample at a known concentration, prior to analysis for the purpose of adjusting the response factor used in quantifying target analytes. At a minimum, the laboratory will follow method specific guidelines for the treatment of internal standard recoveries as they are related to the reporting of data.

4.6.2. Deviations made from this policy must be approved by the SQM/QM prior to release of the data.

4.7. Field Blanks

4.7.1. Field blanks are blanks prepared at the sampling site in order to monitor for contamination that may be present in the environment where samples are collected. These field quality control samples are often referenced as field blanks, rinsate blanks, or equipment blanks. The laboratory analyzes these field blanks as normal samples and informs the customer if there are any target compounds detected above the reporting limits.

4.8. Trip Blanks

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4.8.1. Trip blanks are blanks that originate from the laboratory as part of the sampling event and are used to monitor for contamination of samples during transport. These blanks accompany the empty sample containers to the field and then accompany the collected samples back to the laboratory. These blanks are routinely analyzed for volatile methods where ambient background contamination is likely to occur.

4.9. Limit of Detection (LOD)

4.9.1. PASI laboratories are required to use a documented procedure to determine a limit of detection for each analyte of concern in each matrix reported. All sample processing steps of the preparation and analytical methods are included in this determination including any clean ups. For any test that does not have a valid LOD, sample results below the limit of quantitation (LOQ) cannot be reported.

4.9.2. The LOD is initially established for the compounds of interest for each method in a clean matrix with no target analytes present and no interferences at a concentration that would impact the results. The LOD is then determined every time there is a change in the test method that affects how the test is performed or when there has been a change in the instrument that affects the sensitivity. If required by customer, method or accreditation body, the LOD will be re-established annually for all applicable methods.

4.9.3. Unless otherwise noted, the method used by PASI laboratories to determine LODs is based on the Method Detection Limit (MDL) procedure outlined in 40 CFR Part 136, Appendix B. Where required by regulatory program or customer, the above referenced procedure will be followed.

4.9.4. Where specifically stated in the published method, LODs or MDLs will be performed at the listed frequency.

4.9.5. The validity of the LOD must be shown by detection (a value above zero) of the analytes in a QC sample in each quality system matrix. The QC sample must contain the analyte at no more than 3X the LOD for a single analyte test and 4X the LOD for multiple analyte tests. This verification must be performed on each instrument used for sample analysis and reporting of data. The validity of the LOD must be verified as part of the LOD determination process. This verification must be done prior to the use of the LOD for sample analysis.

4.9.6. An LOD study is not required for any analyte for which spiking solutions or quality control samples are not available such as temperature.

4.9.7. The LOD, if required, shall be verified annually for each quality system matrix, technology and analyte. In lieu of performing full LOD (MDL) studies annually, the laboratory can verify the LOD (MDL) on an annual basis, providing this verification is fully documented and does not contradict other customer or program requirements that the laboratory must follow. The requirements of this verification are:

- The spike concentration of the verification must be no more than 3X times the LOD for single analyte tests and 4X the LOD for multiple analyte tests.
- The laboratory must verify the LOD on each instrument used for the reporting of sample data.
- The laboratory must be able to identify all target analytes in the verification standard (distinguishable from noise).

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4.9.8. Additional information can be found in SOP S-KS-Q-040 **Determination of Limit of Detection and Limit of Quantitation** or its equivalent revision or replacement.

4.10. Limit of Quantitation (LOQ)

4.10.1. A limit of quantitation (LOQ) for every analyte of concern must be determined. For PASI laboratories, this LOQ is referred to as the RL, or Reporting Limit. This RL is based on the lowest calibration standard concentration that is used in each initial calibration. Results below this level are not allowed to be reported without qualification since the results would not be substantiated by a calibration standard. For methods with a determined LOD, results can be reported out below the LOQ but above the LOD if they are properly qualified (e.g., J flag).

4.10.2. The LOQ must be higher than the LOD.

4.10.3. To verify the LOQ, the laboratory will prepare a sample in the same matrix used for the LCS. The sample will be spiked with target analytes at the concentration(s) equivalent to or less than the RL(s). This sample must undergo the routine sample preparation procedure including any routine sample cleanup steps. The sample is then analyzed and the recovery of each target analyte determined. The recovery for each target analyte must meet the laboratories current control limits for an LCS. The annual LOQ verification is not required if the LOD was determined or verified annually on that instrument.

4.10.4. Additional information can be found in SOP S-KS-Q-040 **Determination of Limit of Detection and Limit of Quantitation** or its equivalent revision or replacement.

4.11. Estimate of Analytical Uncertainty

4.11.1. PASI laboratories can provide an estimation of uncertainty for results generated by the laboratory. The estimate quantifies the error associated with any given result at a 95% confidence interval. This estimate does not include bias that may be associated with sampling. The laboratory has a procedure in place for making this estimation. In the absence of a regulatory or customer-specific procedure, PASI laboratories base this estimation on the recovery data obtained from the Laboratory Control Spikes. The uncertainty is a function of the standard deviation of the recoveries multiplied by the appropriate Student's t Factor at 95% confidence. Additional information pertaining to the estimation of uncertainty and the exact manner in which it is derived are contained in the SOP S-KS-Q-022 **Estimation of Measurement Uncertainty** or its equivalent revision or replacement.

4.11.2. The measurement of uncertainty is provided only on request by the customer, as required by specification or regulation and when the result is used to determine conformance within a specification limit.

4.12. Proficiency Testing (PT) Studies

4.12.1. PASI laboratories participate in the TNI defined proficiency testing program. PT samples are obtained from NIST and/or A2LA accredited approved providers and analyzed and reported at a minimum of two times per year for the relevant fields of testing per matrix.

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4.12.2. The PT studies are reported directly to the required accreditation agencies. A PT plan is required for A2LA and is maintained on file.

4.12.3. The laboratory initiates an investigation whenever PT results are deemed ‘unacceptable’ by the PT provider. All findings and corrective actions taken are reported to the SQM/QM or their designee. A corrective action plan is initiated and this report is sent to the appropriate state accreditation agencies for their review. Additional PTs will be analyzed and reported as needed for certification purposes.

4.12.4. PT samples are treated as typical customer samples, utilizing the same staff, methods, equipment, facilities, and frequency of analysis. PT samples are included in the laboratory’s normal analytical processes and do not receive extraordinary attention due to their nature.

4.12.5. Comparison of analytical results with anyone participating in the same PT study is prohibited prior to the close of the study.

4.12.6. Additional information can be found in SOP S-KS-Q-035 **Proficiency Testing Program** or its equivalent revision or replacement.

4.13. Rounding and Significant Figures

4.13.1. In general, the PASI laboratories report data to no more than three significant digits. Therefore, all measurements made in the analytical process must reflect this level of precision. In the event that a parameter that contributes to the final result has less than three significant figures of precision, the final result must be reported with no more significant figures than that of the parameter in question. The rounding rules listed below are descriptive of the LIMS and not necessarily of any supporting program such as Excel.

4.13.2. Data is compared to the reporting limits and MDLs to determine if qualifiers are needed before the rounding step occurs.

4.13.3. **Rounding:** PASI-Kansas follows the odd / even guidelines for rounding numbers:

- If the figure following the one to be retained is less than five, that figure is dropped and the retained ones are not changed (with three significant figures, 2.544 is rounded to 2.54).
- If the figure following the ones to be retained is greater than five, that figure is dropped and the last retained one is rounded up (with three significant figures, 2.546 is rounded to 2.55).
- If the figure following the ones to be retained is five and if there are no figures other than zeros beyond that five, then the five is dropped and the last figure retained is unchanged if it is even and rounded up if it is odd (with three significant figures, 2.525 is rounded to 2.52 and 2.535 is rounded to 2.54).

4.13.4. Significant Digits

4.13.4.1. PASI-Kansas follows the following convention for reporting to a specified number of significant figures. Unless specified by federal, state, or local requirements or on specific request by a customer, the laboratory reports:

Values > 10 – Reported to 3 significant digits
 Values ≤ 10 – Reported to 2 significant digits

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4.14. Retention Time Windows

4.14.1. When chromatographic conditions are changed, retention times and analytical separations are often affected. As a result, two critical aspects of any chromatographic method are the determination and verification of retention times and analyte separation. Retention time windows must be established for the identification of target analytes. The retention times of all target analytes in all calibration verification standards must fall within the retention time windows. If an analyte falls outside the retention time window in an ICV or CCV, new absolute retention time windows must be calculated, unless instrument maintenance fixes the problem. When a new column is installed, a new retention time window study must be performed.

4.14.2. One process for the production of retention time windows: Make 3 injections of all single component or multi-component analytes over a 72-hour period. Record the retention time in minutes for each analyte and surrogate to 3 decimal places. Calculate the mean and standard deviation of the three absolute retention times for each target analyte and surrogate. For multi-component analytes, choose 3-5 major peaks and calculate the mean and standard deviation for each of the peaks. If the standard deviation of the retention times of a target analyte is 0.000, the lab may use a default standard deviation of 0.01. The width of the retention time window for each analyte and surrogate and major peak in a multi-component analyte is defined as +/- 3 times the standard deviation of the mean absolute retention time established during that 72-hour period or 0.03 minutes, whichever is greater.

4.14.3. The center of the retention time window is established for each analyte and surrogate by using the absolute retention times from the CCV at the beginning of the analytical shift. For samples run with an initial calibration, use the retention time of the mid-point standard of the initial calibration curve.

4.14.4. For more information, please reference the local facility's analytical SOPs.

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5.0. DOCUMENT MANAGEMENT AND CHANGE CONTROL

5.1. Document Management

5.1.1. Additional information can be found in SOP S-ALL-Q-002 **Document Control and Management** or its equivalent revision or replacement. Information on Pace's policy for electronic signatures can also be found in this SOP.

5.1.2. Pace Analytical Services, Inc. has an established procedure for managing documents that are part of the quality system. The list of managed documents includes, but is not limited to, Standard Operating Procedures (both technical and non-technical), Quality Assurance Manuals, quality policy statements, training documents, work-processing documents, charts, posters, memoranda, notices, forms, software, and any other procedures, tables, plans, etc. that have a direct bearing on the quality system (including applicable data records and non-technical documents).

5.1.3. A master list of all managed documents is maintained at each facility identifying the current revision status and distribution of the controlled documents. This establishes that there are no invalid or obsolete documents in use in the facility. All documents are reviewed periodically and revised if necessary. Obsolete documents are systematically discarded or archived for audit or knowledge preservation purposes.

5.1.4. Each managed document is uniquely identified to include the date of issue, the revision identification, page numbers, the total number of pages and the issuing authorities. For complete information on document numbering, refer to SOP S-ALL-Q-003 **Document Numbering**.

5.1.5. SOPs, specifically, are available to all laboratory staff via the Learning Management System (LMS) which is a secure repository that is accessed through an internet portal. As a local alternative to the hard copy system of controlled documents, secured electronic copies of controlled documents may be maintained on the laboratory's local server. These document files must be read-only for all personnel except the Quality Department and system administrator. Other requirements for this system are as follows:

- Electronic documents must be readily accessible to all facility employees.
- Electronic documents must be locked from printing. All hardcopy SOPs must be obtained from the Quality Department.

5.1.6. **Quality Assurance Manual (QAM):** The Quality Assurance Manual is the company-wide document that describes all aspects of the quality system for PASI. The base QAM template is distributed by the Corporate Quality Department to each of the SQMs/QMs. The local management personnel modify the necessary and permissible sections of the base template and submit those modifications to the Corporate Director of Quality for review. Once approved and signed by both the CEO and the Director of Quality; the SGM/GM/AGM/OM, the SQM/QM, and any Technical Directors sign the Quality Assurance Manual. Each SQM/QM is then in charge of distribution to employees, external customers or regulatory agencies and maintaining a distribution list of controlled document copies. The Quality Assurance Manual template is reviewed on an annual basis by all of the PASI SQMs/QMs and revised accordingly by the Director of Quality.

5.1.7. **Standard Operating Procedures (SOPs)**

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5.1.7.1. SOPs fall into two categories: company-wide documents and facility specific documents. Company-wide SOPs start with the prefix S-ALL- and local SOPs start with the individual facility prefix.

5.1.7.2. The purpose of the company-wide SOPs is to establish policies and procedure that are common and applicable to all PASI facilities. Company-wide SOPs are document-controlled by the corporate quality office and signed copies are distributed to all of the SQMs/QMs. The local management personnel sign the company-wide SOPs. The SQM/QM is then in charge of distribution to employees, external customers, or regulatory agencies and maintaining a distribution list of controlled document copies.

5.1.7.3. Local PASI facilities are responsible for developing facility-specific SOPs applicable to their respective facility. The local facility develops these facility-specific SOPs based on the corporate-wide SOP template. This template is written to incorporate a set of minimum method requirements and PASI best practice requirements. The local facilities may add to or modify the corporate-wide SOP template provided there are no contradictions to the minimum method or best practice requirements. Facility-specific SOPs are controlled by the applicable SQM/QM according to the corporate document management policies.

5.1.7.4. SOPs are reviewed every two years at a minimum although a more frequent review may be required by some state or federal agencies or customers. If no revisions are made based on this review, documentation of the review itself is made by the addition of new signatures on the cover page. If revisions are made, documentation of the revisions is made in the revisions section of each SOP and a new revision number is applied to the SOP. This provides a historical record of all revisions.

5.1.7.5. All copies of superseded SOPs are removed from general use and the original copy of each SOP is archived for audit or knowledge preservation purposes. This ensures that all PASI employees use the most current version of each SOP and provides the SQM/QM with a historical record of each SOP.

5.1.7.6. Additional information can be found in SOP S-ALL-Q-001 **Preparation of SOPs** or its equivalent revision or replacement.

5.1.8. **Field Services Procedures Manual (FSM)**

5.1.8.1. The Field Services Procedures Manual is a document that describes all aspects of the field testing and sampling procedures performed by PASI-Kansas. This document is distributed to all field personnel and maintained by the Quality Assurance department.

5.2. **Document Change Control**

5.2.1. Changes to managed documents are reviewed and approved in the same manner as the original review. Any revision to a document requires the approval of the applicable signatories. After revisions are approved, a revision number is assigned and the previous version of the document is officially retired. Copies may be kept for audit or knowledge preservation purposes.

5.2.2. All controlled copies of the previous document are replaced with controlled copies of the revised document and the superseded copies are destroyed or archived. All affected personnel are advised that there has been a revision and any necessary training is scheduled.

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5.3. Management of Change

5.3.1. The process for documenting necessary changes within the laboratory network are not typically handled using the corrective or preventive action system as outlined in section 9.0. Management of Change is a proactive approach to dealing with change to minimize the potential negative impact of systematic change in the laboratory and to ensure that each change has a positive desired outcome. This process will primarily be used for the implementation of large scale projects and information system changes as a means to apply consistent systems or procedures within the laboratory network. The request for change is submitted by the initiator and subsequently assigned to an individual or team for development and planning. The final completion of the process culminates in final approval and verification that the procedure was effectively implemented. Additional information can be found in SOP S-KS-Q-034 **Management of Change** or its equivalent revision or replacement.

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6.0. EQUIPMENT AND MEASUREMENT TRACEABILITY

Each PASI facility is equipped with sufficient instrumentation and support equipment to perform the relevant analytical testing or field procedures performed by each facility. Support equipment includes chemical standards, thermometers, balances, disposable and mechanical pipettes, etc. This section details some of the procedures necessary to maintain traceability and to perform proper calibration of instrumentation and support equipment. See Attachment III for a list of equipment currently used at the PASI-Kansas facility.

6.1. Standards and Traceability

6.1.1. Each PASI facility retains all pertinent information for standards, reagents, and chemicals to assure traceability to a national standard. This includes documentation of purchase, receipt, preparation, and use.

6.1.2. Upon receipt, all purchased standard reference materials are recorded into a standard logbook or database and assigned a unique identification number. The entries include the facility's unique identification number, the chemical name, manufacturer name, manufacturer's identification numbers, receipt date, and expiration date. Vendor's certificates of analysis for all standards, reagents, or chemicals are retained for future reference.

6.1.3. Subsequent preparations of intermediate or working solutions are also documented in a standard logbook or database. These entries include the stock standard name and lot number, the manufacturer name, the solvents used for preparation, the solvent lot number and manufacturer, the preparation steps, preparation date, expiration dates, preparer's initials, and a unique PASI identification number. This number is used in any applicable sample preparation or analysis logbook so the standard can be traced back to the standard preparation record. This process ensures traceability back to the national standard.

6.1.4. All prepared standard or reagent containers include the PASI identification number, the standard or chemical name, the date of preparation, the date of expiration, the concentration with units, and the preparer's initials. This ensures traceability back to the standard preparation logbook.

6.1.5. For containers that are too small to accommodate labels that list all of the above information associated with a standard, the minimum required information will be PASI standard ID, concentration, and expiration date. This assures that no standard will be used past its assigned expiration date.

6.1.6. If a second source standard is required to verify an existing calibration or spiking standard, this standard should be obtained from a different manufacturer or from a different lot unless client specific QAPP requirements state otherwise.

6.1.7. Additional information concerning standards and reagent traceability can be found in the **A2LA Policy on Measurement Traceability (P102)** and in the SOPs **S-ALL-Q-025 Standard and Reagent Management and Traceability**, **S-KS-Q-026 Purchasing of Lab Supplies**, and **S-KS-Q-003 Receipt and Storage of Lab Supplies** or their equivalent revisions or replacements.

6.2. General Analytical Instrument Calibration Procedures

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6.2.1. All support equipment and instrumentation are calibrated or checked before use to ensure proper functioning and verify that the laboratory's requirements are met. All calibrations are performed by, or under the supervision of, an experienced analyst at scheduled intervals against either certified standards traceable to recognized national standards or reference standards whose values have been statistically validated.

6.2.2. Calibration standards for each parameter are chosen to establish the linear range of the instrument and must bracket the concentrations of those parameters measured in the samples. The lowest calibration standard is the lowest concentration for which quantitative data may be reported. Data reported below this level is considered to have less certainty and must be reported using appropriate data qualifiers or explained in a narrative. The highest calibration standard is the highest concentration for which quantitative data may be reported. Data reported above this level is considered to have less certainty and must be reported using appropriate data qualifiers or explained in the narrative. Any specific method requirement for number and type of calibration standards supersedes the general requirement. Instrument and method specific calibration criteria are explained within the specific analytical standard operating procedures for each facility.

6.2.3. Instrumentation or support equipment that cannot be calibrated to specification or is otherwise defective is clearly labeled as out-of-service until it has been repaired and tested to demonstrate it meets the laboratory's specifications. All repair and maintenance activities including service calls are documented in the maintenance log. Equipment sent off-site for calibration testing is packed and transported to prevent breakage and is in accordance with the calibration laboratory's recommendations.

6.2.4. In the event that recalibration of a piece of test equipment indicates the equipment may have been malfunctioning during the course of sample analysis, an investigation is performed. The results of the investigation along with a summary of the information reviewed are documented and maintained by the quality manager. If the investigation indicates sample results have been impacted, the customer is notified within 30 days. This allows for sufficient investigation and review of documentation to determine the impact on the analytical results. Instrumentation found to be consistently out of calibration is either repaired and positively verified or taken out of service and replaced.

6.2.5. Raw data records are retained to document equipment performance. Sufficient raw data is retained to reconstruct the instrument calibration and explicitly connect the continuing calibration verification to the initial calibration.

6.2.6. **General Organic Calibration Procedures**

6.2.6.1. Calibration standards are prepared at a minimum of five concentrations for organic analyses. Results from all calibration standards analyzed must be included in constructing the calibration curve with the following exceptions:

6.2.6.1.1. The lowest level calibration standard may be removed from the calibration as long as the remaining number of concentration levels meets the minimum established by the method and standard operating procedure. For multi-parameter methods, this may be done on an individual analyte basis. The reporting limit must be adjusted to the lowest concentration included in the calibration curve.

6.2.6.1.2. The highest level calibration standard may be removed from the calibration as long as the remaining number of concentration levels meets the minimum established by the method and standard operating procedure. For multi-parameter methods, this may be done on an individual analyte basis. The upper limit of quantitation must be adjusted to the highest concentration included in the calibration curve.

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6.2.6.1.3. Multiple points from either the high end or the low end of the calibration curve may be excluded as long as the remaining points are contiguous in nature and the minimum number of levels remains as established by method or standard operating procedure. The reporting limit or quantitation range, whichever is appropriate, must be adjusted accordingly.

6.2.6.1.4. Results from a concentration level between the lowest and highest calibration levels can only be excluded from an initial calibration curve for a documentable and acceptable cause with approval from the responsible department supervisor and the local SQM/QM or their designee. An acceptable cause is defined as an obvious sample introduction issue that resulted in no response, documentation of an incorrectly prepared standard, or a documented response of a single standard that is greater than 2X difference from the expected value of that standard. The results for all analytes are to be excluded and the point must be replaced by re-analysis. Re-analysis of this interior standard must occur within the same 12-hour tune time period for GC/MS methodologies and within 8 hours of the initial analysis of that standard for non-GC/MS methodologies. All samples analyzed prior to the re-analyzed calibration curve point must be re-analyzed after the calibration curve is completed and re-processed against the final calibration curve.

6.2.6.2. Initial calibration curves are evaluated against appropriate statistical models as required by the analytical methods. Curves that do not meet the appropriate criteria require corrective action that may include re-running the initial calibration curve. Rounding to meet initial calibration criteria is not allowed, that is, 15.3 cannot be rounded down to meet a $\leq 15\%$ RSD requirement. This also applies to linear and non-linear fit requirements. All initial calibrations are verified with an initial calibration verification standard (ICV) obtained from a second manufacturer or second lot from the same manufacturer if that lot can be demonstrated as prepared independently from other lots prior to the analysis of samples. Sample results are quantitated from the initial calibration unless otherwise required by regulation, method, or program.

6.2.6.3. The calibration curve is periodically verified by the analysis of a mid-level continuing calibration verification (CCV) standard during the course of sample analysis. Rounding to meet continuing calibration criteria is not allowed, that is, 15.3 cannot be rounded down to meet a $\leq 15\%$ D requirement. Continuing calibration verification is performed at the beginning and end of each analytical batch except if an internal standard is used, then only one verification at the beginning of the batch is needed, whenever it is expected that the analytical system may be out of calibration, if the time period for calibration has expired, or for analytical systems that have specific calibration verification requirements. This verification standard must meet acceptance criteria in order for sample analysis to proceed.

6.2.6.4. In the event that the CCV does not meet the acceptance criteria, a second CCV may be injected as part of the diagnostic evaluation and corrective action investigation. If the second CCV is acceptable, the analytical sequence may be continued. If both CCVs fail, the analytical sequence is terminated and corrective action is initiated. Sample analysis cannot begin until after documented corrective action has been completed and two consecutive passing CCVs have been analyzed. If required by specific state, program, or customer specification, the instrument is re-calibrated after two consecutive CCV failures. All samples analyzed since the last compliant CCV are re-analyzed for methodologies utilizing external calibration.

6.2.6.5. When instruments are operating unattended, autosamplers may be programmed to inject consecutive CCVs as a preventative measure against CCV failure with no corrective action. In this case, both CCVs must be evaluated to determine potential impact to the results. A summary of the decision tree and necessary documentation are listed below:

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- If both CCVs meet the acceptance criteria, the analytical sequence is allowed to continue without corrective action. The 12 hour clock begins with the injection of the second CCV.
- If the first CCV does not meet the acceptance criteria and the second CCV is acceptable, the analytical sequence is continued and the results are reported.
- If the first CCV meets the acceptance criteria and the second CCV is out of control, the samples after the out of control CCV must be re-analyzed in a compliant analytical sequence.
- If both CCVs are out of control, all samples since the last acceptable CCV must be re-analyzed in a compliant analytical sequence.

6.2.6.6. Some analytical methods require that samples be bracketed by passing CCVs analyzed both before and after the samples. This is specific to each method but, as a general rule, all external calibration methods require bracketing CCVs. Most internal standard calibrations do not require bracketing CCVs.

6.2.6.7. Some analytical methods require verification based on a time interval; some methods require a frequency based on an injection interval. The type and frequency of the calibration verifications is dependent on both the analytical method and possibly on the quality program associated with the samples. The type and frequency of calibration verification will be documented in the method specific SOP employed by each laboratory.

6.2.7. General Inorganic Calibration Procedures

6.2.7.1. The instrument is initially calibrated with standards at multiple concentrations to establish the linearity of the instrument's response. A calibration blank is also included. Initial calibration curves are evaluated against appropriate statistical models as required by the analytical methods. Rounding to meet initial calibration criteria is not allowed, that is, 15.3 cannot be rounded down to meet a $\leq 15\%$ RSD requirement. This also applies to linear and non-linear fit requirements. The number of calibration standards used depends on the specific method criteria or customer project requirements, although normally a minimum of three standards is used.

6.2.7.2. The ICP and ICP/MS can be standardized with a zero point and a single point calibration if:

- Prior to analysis, the zero point and the single point calibration are analyzed and a linear range has been established,
- Zero point and single point calibration standards are analyzed with each batch
- A standard corresponding to the LOQ is analyzed with the batch and meets the established acceptance criteria
- The linearity is verified at the frequency established by the method or manufacturer.

6.2.7.3. All initial calibrations are verified with an initial calibration verification standard (ICV) obtained from a second manufacturer or second lot from the same manufacturer if the lot can be demonstrated as prepared independently from other lots prior to the analysis of samples. Sample results are quantitated from the initial calibration unless otherwise required by regulation, method, or program.

6.2.7.4. During the course of analysis, the calibration curve is periodically verified by the analysis of calibration verification standards (CCV). A calibration verification standard is analyzed within each analytical batch at method/program specific intervals to verify that the initial calibration is still valid. The CCV is also analyzed at the end of the analytical batch.

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6.2.7.5. A calibration blank is also run with each calibration verification standard to verify the cleanliness of the system. All reported results must be bracketed by acceptable CCVs. Instrument and method specific calibration acceptance criteria are explained within the specific analytical standard operating procedures for each facility.

6.2.7.6. Interference check standards are also analyzed per method requirements and must meet acceptance criteria for metals analyses.

6.3. Support Equipment Calibration Procedures

6.3.1. All support equipment is calibrated or verified at least annually using NIST traceable references over the entire range of use. The results of calibrations or verifications must be within the specifications required or the equipment will be removed from service until repaired. The laboratory maintains records to demonstrate the correction factors applied to working thermometers.

6.3.2. On each day the equipment is used, balances, ovens, refrigerators (those used to keep samples and standards at required temperatures), freezers, and water baths are checked in the expected use range with NIST traceable references in order to ensure the equipment meets laboratory specifications and these checks are documented appropriately.

6.3.3. Analytical Balances

6.3.3.1. Each analytical balance is calibrated or verified at least annually by a qualified service technician. The calibration of each balance is verified each day of use with weights traceable to NIST bracketing the range of use. Calibration weights are ASTM Class 1 or other class weights that have been calibrated against a NIST standard weight and are re-certified every 5 years at a minimum against a NIST traceable reference. Some accrediting agencies may require more frequent checks. If balances are calibrated by an external agency, verification of their weights must be provided. All information pertaining to balance maintenance and calibration is recorded in the individual balance logbook and/or is maintained on file in the Quality department.

6.3.4. Thermometers

6.3.4.1. Certified, or reference, thermometers are maintained for checking calibration of working thermometers. Reference thermometers are provided with NIST traceability for initial calibration and are re-certified, at a minimum, every 3 years with equipment directly traceable to NIST.

6.3.4.2. Working thermometers are compared with the reference thermometers annually according to corporate metrology procedures. Each thermometer is individually numbered and assigned a correction factor based on the NIST reference source. In addition, working thermometers are visually inspected by laboratory personnel prior to use and temperatures are documented.

6.3.4.3. Laboratory thermometer inventory and calibration data are maintained in the Quality department.

6.3.5. pH/Electrometers

6.3.5.1. The meter is calibrated before use each day, using fresh buffer solutions.

6.3.6. Spectrophotometers

6.3.6.1. During use, spectrophotometer performance is checked at established frequencies in analysis sequences against initial calibration verification (ICV) and continuing calibration verification (CCV) standards.

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6.3.7. Mechanical Volumetric Dispensing Devices

6.3.7.1. Mechanical volumetric dispensing devices including bottle top dispensers, pipettes, and burettes, excluding Class A volumetric glassware, are checked for accuracy on a quarterly basis. The accuracy of glass microliter syringes is verified and documented prior to initial use.

6.3.7.2. Additional information regarding calibration and maintenance of laboratory support equipment can be found in SOP S-KS-Q-036 **Support Equipment** or its equivalent revision or replacement.

6.4. Instrument/Equipment Maintenance

6.4.1. The objectives of the Pace Analytical maintenance program are twofold: to establish a system of instrument care that maintains instrumentation and equipment at required levels of calibration and sensitivity, and to minimize loss of productivity due to repairs.

6.4.2. The Operations Manager and/or department manager/supervisors are responsible for providing technical leadership to evaluate new equipment, solve equipment problems, and coordinate instrument repair and maintenance. Analysts have the primary responsibility to perform routine maintenance.

6.4.3. To minimize downtime and interruption of analytical work, preventative maintenance is routinely performed on each analytical instrument. Up-to-date instructions on the use and maintenance of equipment are available to staff in the department where the equipment is used.

6.4.4. Department manager/supervisors are responsible for maintaining an adequate inventory of spare parts required to minimize equipment downtime. This inventory includes parts and supplies that are subject to frequent failure, have limited lifetimes, or cannot be obtained in a timely manner should a failure occur.

6.4.5. All major equipment and instrumentation items are uniquely identified to allow for traceability. Equipment/instrumentation is, unless otherwise stated, identified as a system and not as individual pieces. The laboratory maintains equipment records that include the following:

- The name of the equipment and its software
- The manufacturer's name, type, and serial number
- Approximate date received and date placed into service
- Current location in the laboratory
- Condition when received (new, used, etc.)
- Copy of any manufacturer's manuals or instructions
- Dates and results of calibrations and next scheduled calibration (if known)
- Details of past maintenance activities, both routine and non-routine
- Details of any damage, modification or major repairs

6.4.6. All instrument maintenance is documented in maintenance logbooks that are assigned to each particular instrument or system.

6.4.7. The maintenance log entry must include a summary of the results of that analysis and verification by the analyst that the instrument has been returned to an in-control status. In addition, each entry must include the initials of the analyst making the entry, the dates the maintenance actions were performed, and the date the entry was made in the maintenance logbook, if different from the date(s) of the maintenance.

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6.4.8. Any equipment that has been subjected to overloading or mishandling, or that gives suspect results, or has been shown to be defective, is taken out of service and clearly identified. The equipment shall not be used to analyze customer samples until it has been repaired and shown to perform satisfactorily.

6.4.9. Additional information regarding instrument transport can be found in SOP S-KS-Q-024 **Instrument Transport** or its equivalent revision or replacement.

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7.0. CONTROL OF DATA

Analytical results processing, verification, and reporting are procedures employed that result in the delivery of defensible data. These processes include, but are not limited to, calculation of raw data into final concentration values, review of results for accuracy, evaluation of quality control criteria and assembly of technical reports for delivery to the data user.

All analytical data undergo a well-defined, well-documented multi-tier review process prior to being reported to the customer. This section describes procedures used by PASI for translating raw analytical data into accurate final sample reports as well as PASI data storage policies.

7.1. Analytical Results Processing

7.1.1. When analytical, field, or product testing data is generated, it is either recorded in a bound laboratory logbook (e.g., Run log or Instrument log) or copies of computer-generated printouts that are appropriately labeled and filed. These logbooks and other laboratory records are kept in accordance with each facility's Standard Operating Procedure for documentation storage and archival. If the laboratory chooses to minimize or eliminate its paper usage, these records can be kept on electronic media. In this case, the laboratory must ensure that there are sufficient redundant electronic copies so no data is lost due to unforeseen computer issues.

7.1.2. The primary analyst is responsible for initial data reduction and review. This includes confirming compliance with required methodology, verifying calculations, evaluating quality control data, noting non-conformances in logbooks or as footnotes or narratives, and uploading analytical results into the LIMS. The primary analyst must be clearly identified in all applicable logbooks, spreadsheets and LIMS fields.

7.1.3. The primary analyst then compiles the initial data package for verification. This compilation must include sufficient documentation for data review. It may include standard calibrations, chromatograms, manual integration documentation, electronic printouts, chain of custody forms, and logbook copies.

7.1.4. Some agencies or customers require different levels of data reporting. For these special levels, the primary analyst may need to compile additional project information, such as initial calibration data or extensive spectral data, before the data package proceeds to the verification step.

7.1.5. Additional information regarding laboratory documentation requirements and the processing of analytical results can be found in the SOPs S-ALL-Q-009 **Laboratory Documentation** and S-KS-Q-005 **Data Reduction, Review, and Reporting** or their equivalent revisions or replacements.

7.2. Data Verification

7.2.1. Data verification is the process of examining data and accepting or rejecting it based on pre-defined criteria. This review step is designed to ensure that reported data are free from calculation and transcription errors, that quality control parameters are evaluated, and that any non-conformances are properly documented.

7.2.2. Analysts performing the analysis and subsequent data reduction have primary responsibility for quality of the data produced. The primary analyst initiates the data verification process by reviewing and accepting the data, provided QC criteria have been met for the samples being reported. Data review

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checklists, either hardcopy or electronic, are used to document the data review process. The primary analyst is responsible for the initial input of the data into the LIMS. The primary analyst and reviewer must be clearly identified on all applicable data review checklists.

7.2.3. The completed data package is then sent to a designated qualified reviewer (this cannot be the primary analyst). The following criteria have been established to qualify someone as a data reviewer. To perform secondary data reviewer, the reviewer must:

7.2.3.1. Have a current Demonstration of Capability (DOC) study on file and have an SOP acknowledgement form on file for the method/procedure being reviewed; or, ^{See Note}

7.2.3.2. Have a DOC on file for a similar method/technology (i.e., GC/MS) and have an SOP acknowledgement form on file for the method/procedure being reviewed; or, ^{See Note}

7.2.3.3. Supervise or manage a Department and have an SOP acknowledgment form on file for the method/procedure being reviewed; or,

7.2.3.4. Have significant background in the department/methods being reviewed through education or experience and have an SOP acknowledgment form on file for the method/procedure being reviewed.

7.2.4. **Note:** Secondary reviewer status must be approved personally by the SQM/QM or SGM/GM/AGM/OM in the event that this person has no prior experience on the specific method or general technology.

7.2.5. This reviewer provides an independent technical assessment of the data package and technical review for accuracy according to methods employed and laboratory protocols. This assessment involves a quality control review for use of the proper methodology and detection limits, compliance to quality control protocol and criteria, presence and completeness of required deliverables, and accuracy of calculations and data quantitation. The reviewer also validates the data entered into the LIMS.

7.2.6. Once the data have been technically reviewed and approved, authorization for release of the data from the analytical section is indicated by initialing and dating the data review checklist or otherwise initialing and dating the data (or designating the review of data electronically). The Operations or Project Manager examines the report for method appropriateness, detection limits and QC acceptability. Any deviations from the referenced methods are checked for documentation and validity, and QC corrective actions are reviewed for successful resolution.

7.2.7. The data verification procedures are further supplemented by the LIMS Data Checker program that was developed to review test results for chemical incongruence (e.g. Total Metals > Dissolved Metals) and quality control outliers. This evaluation is performed and summarized during the generation of the final report and reviewed by the Project Manager.

7.2.8. Additional information regarding data review procedures can be found in SOPs S-KS-Q-005 **Data Reduction, Review, and Reporting**, S-ALL-Q-016 **Manual Integration**, S-ALL-Q-030 **Operation of Data Checker** or their equivalent revisions or replacements.

7.3. Data Reporting

7.3.1. Data for each analytical fraction pertaining to a particular PASI project number are delivered to the Project Manager for assembly into the final report. All points mentioned during technical and QC reviews are included in a case narrative if there is potential for data to be impacted.

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7.3.2. Final reports are prepared according to the level of reporting required by the customer and can be transmitted to the customer via hardcopy or electronic deliverable. A standard PASI final report consists of the following components:

- 7.3.2.1. A title which designates the report as “Final Report”, “Laboratory Results”, “Certificate of Results”, etc.;
- 7.3.2.2. Name and address of laboratory (or subcontracted laboratories, if used);
- 7.3.2.3. Phone number and name of laboratory contact to where questions can be referred;
- 7.3.2.4. A unique identification number for the report. The pages of the report shall be numbered and a total number of pages shall be indicated;
- 7.3.2.5. Name and address of customer and name of project;
- 7.3.2.6. Unique identification of samples analyzed as well as customer sample IDs;
- 7.3.2.7. Identification of any sample that did not meet acceptable sampling requirements of the relevant governing agency, such as improper sample containers, holding times missed, sample temperature, etc.;
- 7.3.2.8. Date and time of collection of samples, date of sample receipt by the laboratory, dates of sample preparation and analysis, and times of sample preparation and analysis when the holding time for either is 72 hours or less;
- 7.3.2.9. Identification of the test methods used;
- 7.3.2.10. Identification of sampling procedures if sampling was conducted by the laboratory;
- 7.3.2.11. Deviations from, additions to, or exclusions from the test methods. These can include failed quality control parameters, deviations caused by the matrix of the sample, etc., and can be shown as a case narrative or as defined footnotes to the analytical data;
- 7.3.2.12. Identification of whether calculations were performed on a dry or wet-weight basis;
- 7.3.2.13. Reporting limits used;
- 7.3.2.14. Final results or measurements, supported by appropriate chromatograms, charts, tables, spectra, etc.;
- 7.3.2.15. A signature and title, electronic or otherwise, of person accepting responsibility for the content of the report;
- 7.3.2.16. Date report was issued;
- 7.3.2.17. A statement clarifying that the results of the report relate only to the samples tested or to the samples as they were received by the laboratory;
- 7.3.2.18. If necessary, a statement indicating that the report must not be reproduced except in full, without the written approval of the laboratory;
- 7.3.2.19. Identification of all test results provided by a subcontracted laboratory or other outside source;
- 7.3.2.20. Identification of results obtained outside of quantitation levels.

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In addition to the requirements listed above, final reports shall also contain the following items when necessary for the interpretation of results:

7.3.2.21. Deviations from, additions to, or exclusions from the test method, and information on specific test conditions, such as environmental conditions;

7.3.2.22. Where relevant, a statement of compliance/non-compliance with requirements and/or specifications (e.g., the TNI standard);

7.3.2.23. Where applicable, a statement on the estimated uncertainty of measurement; information on uncertainty is needed in test reports when it is relevant to the validity or application of the test results, when a customer's instruction so requires, or when the uncertainty affects compliance to a specification limit;

7.3.2.24. Where appropriate and needed, opinions and interpretations, which may include opinions on the compliance/non-compliance of the results with requirements, fulfillment of contractual requirements, recommendations on how to use the results, and guidance to be used for improvement;

7.3.3. Any changes made to a final report shall be designated as "Revised" or equivalent wording. The laboratory must keep sufficient archived records of all laboratory reports and revisions. For higher levels of data deliverables, a copy of all supporting raw data is sent to the customer along with a final report of results. When possible, the PASI facility will provide electronic data deliverables (EDD) as required by contracts or upon customer request.

7.3.4. Customer data that requires transmission by telephone, telex, facsimile or other electronic means undergoes appropriate steps to preserve confidentiality.

7.3.5. The following positions are the only approved signatories for PASI final reports:

- Senior General Manager
- General Manager
- Assistant General Manager
- Senior Quality Manager
- Quality Manager
- Client Services Manager
- Project Manager
- Project Coordinator

Additional information regarding data reporting can be found in SOP S-KS-Q-005 **Data Reduction, Review, and Reporting** or its equivalent revision or replacement.

7.4. Data Security

7.4.1. All data including electronic files, logbooks, extraction/digestion/distillation worksheets, calculations, project files and reports, and any other information used to produce the technical report are maintained secured and retrievable by the PASI facility.

7.4.2. Additional information regarding data security can be found in SOPs S-KS-Q-007 **Laboratory Security Procedures** and S-ALL-IT-001 **System Security and Integrity** or their equivalent revisions or replacements.

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7.5. Data Archiving

7.5.1. All records compiled by PASI are maintained legible and retrievable and stored secured in a suitable environment to prevent loss, damage, or deterioration by fire, flood, vermin, theft, and/or environmental deterioration. Records are retained for a minimum of five years unless superseded by federal, state, contractual, and/or accreditation requirements. These records may include, but are not limited to, customer data reports, calibration and maintenance of equipment, raw data from instrumentation, quality control documents, observations, calculations, and logbooks. These records are retained in order to provide for possible historical reconstruction including sampling, receipt, preparation, analysis, and personnel involved. TNI-related records will be made readily available to accrediting authorities. Access to archived data is documented and controlled by the SQM/QM or a designated Data Archivist.

7.5.2. Records that are computer generated have either a hard copy or electronic write protected backup copy. Hardware and software necessary for the retrieval of electronic data is maintained with the applicable records. Archived electronic records are stored protected against electronic and/or magnetic sources.

7.5.3. In the event of a change in ownership, accountability or liability, reports of analyses performed pertaining to accreditation will be maintained by the acquiring entity for a minimum of five years. In the event of bankruptcy, laboratory reports and/or records will be transferred to the customer and/or the appropriate regulatory entity upon request.

7.5.4. Additional information regarding data backup and data archiving and can be found in SOPs S-KS-Q-019 **Laboratory Data Filing and Archiving**, S-KS-IT-001 **Target Data Backup**, and S-KS-IT-002 **Server Backup** or their equivalent revisions or replacements.

7.6. Data Disposal

7.6.1. Data that has been archived for the facility's required storage time may be disposed of in a secure manner by shredding, returning to customer, or utilizing some other means that does not jeopardize data confidentiality. Records of data disposal will be archived for a minimum of five years unless superseded by federal, contractual, and/or accreditation requirements. Data disposal includes any preliminary or final reports that are disposed.

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8.0. QUALITY SYSTEM AUDITS AND REVIEWS

8.1. Internal Audits

8.1.1. Responsibilities

8.1.1.1. The SQM/QM is responsible for designing and/or conducting internal audits in accordance with a predetermined schedule and procedure. Since internal audits represent an independent assessment of laboratory functions, the auditor must be functionally independent from laboratory operations to ensure objectivity. The auditor must be trained, qualified, and familiar enough with the objectives, principles, and procedures of laboratory operations to be able to perform a thorough and effective evaluation. The SQM/QM evaluates audit observations and verifies the completion of corrective actions. In addition, a periodic corporate audit will be conducted. The corporate audits will focus on the effectiveness of the Quality System as outlined in this manual but may also include other quality programs applicable to an individual laboratory.

8.1.2. Scope and Frequency of Internal Audits

8.1.2.1. The complete internal audit process consists of the following four sections:

- Raw Data Review audits- conducted according to a schedule per local SQM/QM. A certain number of these data review audits are conducted per quarter to accomplish this yearly schedule;
- Quality System audits- considered the traditional internal audit function and includes analyst interviews to help determine whether practice matches method requirements and SOP language;
- Final Report reviews;
- Corrective Action Effectiveness Follow-up.

8.1.2.2. Internal systems audits are conducted yearly at a minimum. The scope of these audits includes evaluation of specific analytical departments or a specific quality related system as applied throughout the laboratory.

8.1.2.3. Where the identification of non-conformities or departures cast doubt on the laboratory's compliance with its own policies and procedures, the lab must ensure that the appropriate areas of activity are audited as soon as possible. Examples of system-wide elements that can be audited include:

- Quality Systems documents, such as Standard Operating Procedures, training documents, Quality Assurance Manual, and all applicable addenda
- Data records and non-technical documents
- Personnel and training files.
- General laboratory safety protocols.
- Chemical handling practices, such as labeling of reagents, solutions, and standards as well as all associated documentation.
- Documentation concerning equipment and instrumentation, calibration/maintenance records, operating manuals.
- Sample receipt and management practices.
- Analytical documentation, including any discrepancies and corrective actions.

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- General procedures for data security, review, documentation, reporting, and archiving.
- Data integrity issues such as proper manual integrations.

8.1.2.4. When the operations of a specific department are evaluated, a number of additional functions are reviewed including:

- Detection limit studies
- Internal chain of custody documentation
- Documentation of standard preparations
- Quality Control limits and Control charts

8.1.2.5. Certain projects may require an internal audit to ensure laboratory conformance to site work plans, sampling and analysis plans, QAPPs, etc.

8.1.2.6. A representative number of data audits are completed annually. Findings from these data audits are handled in the same manner as those from other internal and external audits.

8.1.2.7. The laboratory, as part of their overall internal audit program, ensures that a review is conducted with respect to any evidence of inappropriate actions or vulnerabilities related to data integrity. Discovery and reporting of potential data integrity issues are handled in a confidential manner. All investigations that result in findings of inappropriate activity are fully documented, including the source of the problem, the samples and customers affected the impact on the data, the corrective actions taken by the laboratory, and which final reports had to be re-issued. Customers must be notified within 30 days after the data investigation is completed and the impact to final results is assessed.

8.1.3. Internal Audit Reports and Corrective Action Plans

8.1.3.1. Additional information can be found in SOP S-ALL-Q-011 **Internal and External Audits** or its equivalent revision or replacement.

8.1.3.2. A full description of the audit, including the identification of the operation audited, the date(s) on which the audit was conducted, the specific systems examined, and the observations noted are summarized in an internal audit report. Although other personnel may assist with the performance of the audit, the SQM/QM writes and issues the internal audit report identifying which audit observations are deficiencies that require corrective action.

8.1.3.3. When audit findings cast doubt on the effectiveness of the operations or on the correctness of validity of the laboratory's environmental test results, the laboratory will take timely corrective action and notify the customer in writing within three business days, if investigations show that the laboratory results may have been affected.

8.1.3.4. Once completed, the internal audit report is issued jointly to the SGM/GM/AGM/OM and the manager(s)/supervisor(s) of the audited operation at a minimum. The responsible manager(s)/supervisor(s) responds within 14 days with a proposed plan to correct all of the deficiencies cited in the audit report. The SQM/QM may grant additional time for responses to large or complex deficiencies (not to exceed 30 days). Each response must include timetables for completion of all proposed corrective actions.

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8.1.3.5. The SQM/QM reviews the audit responses. If the response is accepted, the SQM/QM uses the action plan and timetable as a guideline for verifying completion of the corrective action(s). If the SQM/QM determines that the audit response does not adequately address the correction of cited deficiencies, the response will be returned for modification.

8.1.3.6. To complete the audit process, the SQM/QM performs a re-examination of the areas where deficiencies were found to verify that all proposed corrective actions have been implemented. An audit deficiency is considered closed once implementation of the necessary corrective action has been audited and verified. This is usually within 60-90 days after implementation. If corrective action cannot be verified, the associated deficiency remains open until that action is completed.

8.2. External Audits

8.2.1. PASI laboratories are audited regularly by regulatory agencies to maintain laboratory certifications and by customers to maintain appropriate specific protocols.

8.2.2. Audit teams external to the company review the laboratory to assess the effectiveness of systems and degree of technical expertise. The SQM/QM and other QA staff host the audit team and assist in facilitation of the audit process. Generally, the auditors will prepare a formalized audit report listing deficiencies observed and follow-up requirements for the laboratory. In some cases, items of concern are discussed during a debriefing convened at the end of the on-site review process.

8.2.3. The laboratory staff and supervisors develop corrective action plans to address any deficiencies with the guidance of the SQM/QM. The SGM/GM/AGM/OM provides the necessary resources for staff to develop and implement the corrective action plans. The SQM/QM collates this information and provides a written response to the audit team. The response contains the corrective action plan and expected completion dates for each element of the plan. The SQM/QM follows-up with the laboratory staff to ensure corrective actions are implemented and that the corrective action was effective.

8.3. Quarterly Quality Reports

8.3.1. The SQM/QM is responsible for preparing a quarterly report to management summarizing the effectiveness of the laboratory Quality Systems. This status report will include:

- Overview of quality activities for the quarter
- Certification status
- Proficiency Testing study results
- SOP revision activities
- Company-wide 3P Document implementation (internal program)
- External audit findings
- Internal audit (method/system) findings
- Manual integration audit findings (Mintminer)
- Raw Data and Final Report review findings
- MDL activities
- Corrective action activities
- Training activity status
- Other significant Quality System items

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8.3.2. The Corporate Director of Quality utilizes the information from each laboratory to make decisions impacting the quality program compliance of the company as a whole. Each SGM/GM/AGM/OM utilizes the quarterly report information to make decisions impacting Quality Systems and operational systems at a local level.

8.3.3. Additional information can be found in SOP S-ALL-Q-014 **Quality System Review** or its equivalent revision or replacement.

8.4. Annual Managerial Review

8.4.1. A managerial review of Quality Systems is performed on an annual basis at a minimum. This allows for assessing program effectiveness and introducing changes and/or improvements.

8.4.2. The managerial review must include the following topics of discussion:

- Suitability of quality management policies and procedures
- Manager/Supervisor reports
- Internal audit results
- Corrective and preventative actions
- External assessment results
- Proficiency testing studies
- Sample capacity and scope of work changes
- Customer feedback, including complaints
- Recommendations for improvement,
- Other relevant factors, such as quality control activities, resources, and staffing.

8.4.3. This managerial review must be documented for future reference by the SQM/QM and copies of the report are distributed to laboratory staff. Results should feed into the laboratory planning system and should include goals, objectives, and action plans for the coming year. The laboratory shall ensure that any actions identified during the review are carried out within an appropriate and agreed upon timescale.

8.4.4. Additional information regarding managerial review can be found in the SOP S-ALL-Q-015 **Review of Laboratory Management System** or its equivalent revision or replacement.

8.5. Customer Service Reviews

8.5.1. As part of the annual managerial review listed previously, the sales staff is responsible for reporting on customer feedback, including complaints. The acquisition of this information is completed by performing surveys.

8.5.2. The sales staff continually receives customer feedback, both positive and negative, and reports this feedback to the laboratory management in order for them to evaluate and improve their management system, testing activities and customer service.

8.5.3. In addition, the labs must be willing to cooperate with customers or their representatives to clarify customer requests and to monitor the laboratory's performance in relation to the work being performed for the customers. This cooperation may include providing the customer reasonable

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access to relevant areas of the lab for the witnessing of tests being performed; or the preparation of samples or data deliverables to be used for verification purposes.

8.5.4. Customer service is an important aspect to Pace's overall objective of providing a quality product. Good communication should be provided to the customer's throughout projects. The lab should inform the customer of any delay or major deviations in the performance of analytical tests.

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9.0. CORRECTIVE ACTION

Additional information can be found in SOPs S-ALL-Q-012 **Corrective and Preventive Actions**, S-ALL-Q-028 **Use and Operation of LabTrack**, and S-KS-Q-028 **Customer Complaint Resolution** or their equivalent revisions or replacements.

During the process of sample handling, preparation, and analysis, or during review of quality control records, or during reviews of non-technical portions of the lab, certain occurrences may warrant the necessity of corrective actions. These occurrences may take the form of analyst errors, deficiencies in quality control, method deviations, or other unusual circumstances. The Quality System of PASI provides systematic procedures for the documentation, monitoring, completion of corrective actions, and follow-up verification of the effectiveness of these corrective actions. This can be done using PASI's LabTrack system that lists among at a minimum, the deficiency by issue number, the deficiency source, responsible party, root cause, resolution, due date, and date resolved.

9.1. Corrective Action Documentation

9.1.1. The following items are examples of sources of laboratory deviations or non-conformances that warrant some form of documented corrective action:

- Internal Laboratory Non-Conformance Trends
- PE/PT Sample Results
- Internal and External Audits
- Data or Records Review (including non-technical records)
- Client Complaints
- Client Inquiries
- Holding Time violations

9.1.2. Documentation of corrective actions may be in the form of a comment or footnote on the final report that explains the deficiency (e.g., matrix spike recoveries outside of acceptance criteria) or it may be a more formal documentation (either paper system or computerized spreadsheet). This depends on the extent of the deficiency, the impact on the data, and the method or customer requirements for documentation.

9.1.3. The person who discovers the deficiency or non-conformance initiates the corrective action documentation on the Non-Conformance Corrective/ Preventative Action report and/or LabTrack. The documentation must include the affected projects and sample numbers, the name of the applicable Project Manager, the customer name, and the sample matrix involved. The person initiating the corrective action documentation must also list the known causes of the deficiency or non-conformance as well as any corrective/preventative actions that they have taken. Preventive actions must be taken in order to prevent or minimize the occurrence of the situation.

9.1.4. In the event that the laboratory is unable to determine the cause, laboratory personnel and management staff will start a root cause analysis by going through an investigative process. During this process, the following general steps must be taken into account: defining the non-conformance, assigning responsibilities, determining if the condition is significant, and investigating the root cause of the nonconformance. General non-conformance investigative techniques follow the path of the sample

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through the process looking at each individual step in detail. The root cause must be documented within LabTrack or on the Corrective/Preventative Action Report.

9.1.5. After all the documentation is completed, the routing of the Corrective/Preventative Action Report and /or LabTrack will continue from the person initiating the corrective action, to their immediate supervisor or the applicable Project Manager and finally to the SQM/QM, if applicable, who may be responsible for final review and signoff of corrective/preventative actions.

9.1.6. In the event that analytical testing or results do not conform to documented laboratory policies or procedures, customer requirements, or standard specifications, the laboratory shall investigate the significance of the non-conformance and document appropriate corrective actions. The proper level of laboratory management will review any departure from these requirements for technical suitability. These departures are permitted only with the approval of the SGM/GM/AGM/OM or the SQM/QM. Where necessary, Project Management will notify the customer of the situation and will advise of any ramifications to data quality (with the possibility of work being recalled). The procedures for handling non-conforming work are detailed in SOP S-ALL-Q-012 **Corrective and Preventive Actions** or its equivalent revision or replacement.

9.2. Corrective Action Completion

9.2.1. Internal Laboratory Non-Conformance Trends

9.2.1.1. There are several types of non-conformance trends that may occur in the laboratory that would require the initiation of a corrective action report. Laboratories may choose to initiate a corrective action for all instances of one or more of these categories if they so choose, however the intent is that each of these would be handled according to its severity; one time instances could be handled with a footnote or qualifier whereas a systemic problem with any of these categories may require an official corrective action process. These categories, as defined in the Corrective Action SOP are as follows:

- Login error
- Preparation Error
- Contamination
- Calibration Failure
- Internal Standard Failure
- LCS Failure
- Laboratory accident
- Spike Failure
- Instrument Failure
- Final Reporting error

9.2.2. PE/PT Sample Results

9.2.2.1. Any PT result assessed as “not acceptable” requires an investigation and applicable corrective actions. The operational staff is made aware of the PT failures and they are responsible for reviewing the applicable raw data and calibrations and list possible causes for error. The SQM/QM reviews their findings and initiates another external PT sample or an internal PT sample to try and correct the previous failure. Replacement PT results must be monitored by the SQM/QM and reported to the applicable regulatory authorities.

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9.2.3. Internal and External Audits

9.2.3.1. The SQM/QM is responsible for documenting all audit findings and their corrective actions. This documentation must include the initial finding, the persons responsible for the corrective action, the due date for responding to the auditing body, the root cause of the finding, and the corrective actions needed for resolution. The SQM/QM is also responsible for providing any back-up documentation used to demonstrate that a corrective action has been completed.

9.2.4. Data Review

9.2.4.1. In the course of performing primary and secondary review of data or in the case of raw data reviews (e.g., by the SQM/QM), errors may be found which require corrective actions. Any finding that affects the quality of the data requires some form of corrective action, which may include revising and re-issuing of final reports.

9.2.5. Client Complaints

9.2.5.1. Project Managers are responsible for issuing corrective action forms, when warranted, for customer complaints. As with other corrective actions, the possible causes of the problem are listed and the form is passed to the appropriate analyst or supervisor for investigation. After potential corrective actions have been determined, the Project Manager reviews the corrective action form to ensure all customer needs or concerns are being adequately addressed.

9.2.6. Client Inquiries

9.2.6.1. When an error on the customer report is discovered, the Project Manager is responsible for initiating a formal corrective action form that describes the failure (e.g., incorrect analysis reported, reporting units are incorrect, or reporting limits do not meet objectives). The Project Manager is also responsible for revising the final report if necessary and submitting it to the customer.

9.2.7. Holding Time Violations

9.2.7.1. In the event that a holding time has been missed, the analyst or supervisor must complete a formal corrective action form. The Project Manager and the SQM/QM must be made aware of all holding time violations.

9.2.7.2. The Project Manager must contact the customer in order that appropriate decisions are made regarding the hold time excursion and the ultimate resolution is then documented and included in the customer project file. The SQM/QM includes a list of all missed holding times in their Quarterly Report to the corporate quality office.

9.3. Preventive Action Documentation

9.3.1. Pace laboratories can take advantage of several available information sources in order to identify needed improvements in all of their systems including technical, managerial, and quality. These sources may include:

- Management Continuous Improvement Plan (CIP) metrics which are used by all production departments within Pace. When groups compare performance across the company, ways to improve systems may be discovered. These improvements can be made within a department or laboratory-wide.

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- Annual managerial reviews- part of this TNI-required and NVLAP-required review is to look at all processes and procedures used by the laboratory over the past year and to determine ways to improve these processes in the future.
- Quality systems reviews- any frequent checks of quality systems (monthly logbook reviews, etc.) can uncover issues that can be corrected or adjusted before they become a larger issue.

9.3.2. When improvement opportunities are identified or if preventive action is required, the laboratory can develop, implement, and monitor preventive action plans.

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10.0. GLOSSARY

The source of some of the definitions is indicated previous to the actual definition (e.g., TNI, DoD).

3P Program	The Pace Analytical continuous improvement program that focuses on Process, Productivity, and Performance. Best Practices are identified that can be used by all PASI labs.
Acceptance Criteria	TNI - Specified limits placed on characteristics of an item, process, or service defined in requirement documents.
Accreditation	TNI - The process by which an agency or organization evaluates and recognizes a laboratory as meeting certain predetermined qualifications or standards, thereby accrediting the laboratory.
Accrediting Authority	The Territorial, State or Federal agency having responsibility and accountability for environmental laboratory accreditation and which grants accreditation.
Accrediting (or Accreditation) Body	Authoritative body that performs accreditation.
Accuracy	TNI - The degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components that are due to sampling and analytical operations; a data quality indicator.
Aliquot	A discrete, measured, representative portion of a sample taken for analysis.
Analysis Code (Acode)	All the set parameters of a test, such as Analytes, Method, Detection Limits and Price.
Analysis Sequence	A compilation of all samples, standards and quality control samples run during a specific amount of time on a particular instrument in the order they are analyzed.
Analyst	TNI - The designated individual who performs the “hands-on” analytical methods and associated techniques and who is the one responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality.
Analyte	The specific chemicals or components for which a sample is analyzed; it may be a group of chemicals that belong to the same chemical family, and which are analyzed together.
Analytical Uncertainty	TNI- A subset of Measurement Uncertainty that includes all laboratory activities performed as part of the analysis.
Assessment	TNI - The evaluation process used to measure or establish the performance, effectiveness, and conformance of an organization and/or its system to defined criteria (to the standards and requirements of laboratory accreditation).
Atomic Absorption Spectrometer	Instrument used to measure concentration in metals samples.
Atomization	A process in which a sample is converted to free atoms.
Audit	TNI- A systematic and independent examination of facilities, equipment, personnel, training, procedures, record-keeping, data validation, data management, and reporting aspects of a system to determine whether QA/QC and technical activities are being conducted as planned and whether these activities will effectively achieve quality objectives.

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Batch	TNI - Environmental samples that are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A preparation batch is composed of one to 20 environmental samples of the same quality systems matrix, meeting the above-mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be 24 hours. An analytical batch is composed of prepared environmental samples (extracts, digestates or concentrates) which are analyzed together as a group. An analytical batch can include prepared samples originating from various quality system matrices and can exceed 20 samples.
Bias	TNI- The systematic or persistent distortion of a measurement process, which causes errors in one direction (i.e., the expected sample measurement is different from the sample's true value).
Blank	TNI - A sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sampling, transport, storage or analysis. The blank is subjected to the usual analytical and measurement process to establish a zero baseline or background value and is sometimes used to adjust or correct routine analytical results.
Blind Sample	A sub-sample for analysis with a composition known to the submitter. The analyst/laboratory may know the identity of the sample but not its composition. It is used to test the analyst's or laboratory's proficiency in the execution of the measurement process.
BNA (Base Neutral Acid compounds)	A list of semi-volatile compounds typically analyzed by mass spectrometry methods. Named for the way they can be extracted out of environmental samples in an acidic, basic or neutral environment.
BOD (Biochemical Oxygen Demand)	Chemical procedure for determining how fast biological organisms use up oxygen in a body of water.
Calibration	TNI - A set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material, and the corresponding values realized by standards. 1) In calibration of support equipment, the values realized by standards are established through the use of reference standards that are traceable to the International System of Units (SI); 2) In calibration according to test methods, the values realized by standards are typically established through the use of Reference Materials that are either purchased by the laboratory with a certificate of analysis or purity, or prepared by the laboratory using support equipment that has been calibrated or verified to meet specifications.
Calibration Curve	TNI- The mathematical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response.
Calibration Method	A defined technical procedure for performing a calibration.
Calibration Range	The range of values (concentrations) between the lowest and highest calibration standards of a multi-level calibration curve. For metals analysis with a single-point calibration, the low-level calibration check standard and the high standard establish the linear calibration range, which lies within the linear dynamic range.
Calibration Standard	TNI- A substance or reference material used for calibration.

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Certified Reference Material (CRM)	TNI- Reference material accompanied by a certificate, having a value, measurement uncertainty, and stated metrological traceability chain to a national metrology institute.
Chain of Custody	An unbroken trail of accountability that verifies the physical security of samples, data, and records.
Chain of custody Form (COC)	TNI - Record that documents the possession of the samples from the time of collection to receipt in the laboratory. This record generally includes: the number and type of containers; the mode of collection, the collector, time of collection; preservation; and requested analyses.
Chemical Oxygen Demand (COD)	A test commonly used to indirectly measure the amount of organic compounds in water.
Client (referred to by ISO as Customer)	Any individual or organization for whom items or services are furnished or work performed in response to defined requirements and expectations.
Code of Federal Regulations (CFR)	A codification of the general and permanent rules published in the Federal Register by agencies of the federal government.
Comparability	An assessment of the confidence with which one data set can be compared to another. Comparable data are produced through the use of standardized procedures and techniques.
Completeness	The percent of valid data obtained from a measurement system compared to the amount of valid data expected under normal conditions. The equation for completeness is: $\% \text{ Completeness} = (\text{Valid Data Points}/\text{Expected Data Points}) * 100$
Confirmation	TNI - Verification of the identity of a component through the use of an approach with a different scientific principle from the original method. These may include, but are not limited to: second-column confirmation; alternate wavelength; derivatization; mass spectral interpretation; alternative detectors; or additional cleanup procedures.
Conformance	An affirmative indication or judgment that a product or service has met the requirements of the relevant specifications, contract, or regulation; also the state of meeting the requirements.
Congener	A member of a class of related chemical compounds (e.g., PCBs, PCDDs).
Consensus Standard	A standard established by a group representing a cross-section of a particular industry or trade, or a part thereof.
Continuing Calibration Blank (CCB)	A blank sample used to monitor the cleanliness of an analytical system at a frequency determined by the analytical method.
Continuing Calibration Check Compounds (CCC)	Compounds listed in mass spectrometry methods that are used to evaluate an instrument calibration from the standpoint of the integrity of the system. High variability would suggest leaks or active sites on the instrument column.
Continuing Calibration Verification	The verification of the initial calibration that is required during the course of analysis at periodic intervals. Continuing calibration verification applies to both external and internal standard calibration techniques, as well as to linear and non-linear calibration models.
Continuing Calibration Verification (CCV) Standard	Also referred to as a CVS in some methods, it is a standard used to verify the initial calibration of compounds in an analytical method. CCVs are analyzed at a frequency determined by the analytical method.

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Continuous Emission Monitor (CEM)	A flue gas analyzer designed for fixed use in checking for environmental pollutants.
Contract Laboratory Program (CLP)	A national network of EPA personnel, commercial labs, and support contractors whose fundamental mission is to provide data of known and documented quality.
Contract Required Detection Limit (CRDL)	Detection limit that is required for EPA Contract Laboratory Program (CLP) contracts.
Contract Required Quantitation Limit (CRQL)	Quantitation limit (reporting limit) that is required for EPA Contract Laboratory Program (CLP) contracts.
Control Chart	A graphic representation of a series of test results, together with limits within which results are expected when the system is in a state of statistical control (see definition for Control Limit)
Control Limit	A range within which specified measurement results must fall to verify that the analytical system is in control. Control limit exceedances may require corrective action or require investigation and flagging of non-conforming data.
Corrective Action	The action taken to eliminate the causes of an existing non-conformity, defect, or other undesirable situation in order to prevent recurrence.
Corrective and Preventative Action (CAPA)	The primary management tools for bringing improvements to the quality system, to the management of the quality system's collective processes, and to the products or services delivered which are an output of established systems and processes.
Data Audit	A qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data are of acceptable quality (i.e. that they meet specified acceptance criteria).
Data Quality Objective (DQO)	Systematic strategic planning tool based on the scientific method that identifies and defines the type, quality, and quantity of data needed to satisfy a specified use or end user.
Data Reduction	TNI- The process of transforming the number of data items by arithmetic or statistical calculation, standard curves, and concentration factors, and collating them into a more usable form.
Definitive Data	Analytical data of known quality, concentration and level of uncertainty. The levels of quality and uncertainty of the analytical data are consistent with the requirements for the decision to be made. Suitable for final decision-making.
Demonstration of Capability	TNI- A procedure to establish the ability of the analyst to generate analytical results of acceptable accuracy and precision.
Detection Limit (DL)	The smallest analyte concentration that can be demonstrated to be different than zero or a blank concentration at the 99% level of confidence. At the DL, the false positive rate is 1%.
Diesel Range Organics (DRO)	A range of compounds that denote all the characteristic compounds that make up diesel fuel (range can be state or program specific).
Digestion	A process in which a sample is treated (usually in conjunction with heat) to convert the sample to a more easily measured form.
Document Control	The act of ensuring that documents (and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly and controlled to ensure use of the correct version at the location where the prescribed activity is performed.

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Dry Weight	The weight after drying in an oven at a specified temperature.
Duplicate (also known as Replicate or Laboratory Duplicate)	The analyses or measurements of the variable of interest performed identically on two subsamples of the same sample. The results of duplicate analyses are used to evaluate analytical or measurement precision but not the precision of sampling, preservation or storage internal to the laboratory.
Electron Capture Detector (ECD)	Device used in GC methods to detect compounds that absorb electrons (e.g., PCB compounds).
Electronic Data Deliverable (EDD)	A summary of environmental data (usually in spreadsheet form) which clients request for ease of data review and comparison to historical results.
Eluent	A solvent used to carry the components of a mixture through a stationary phase.
Elute	To extract, specifically, to remove (absorbed material) from an absorbent by means of a solvent.
Elution	A process in which solutes are washed through a stationary phase by movement of a mobile phase.
Environmental Data	Any measurements or information that describe environmental processes, locations, or conditions; ecological or health effects and consequences; or the performance of environmental technology.
Environmental Monitoring	The process of measuring or collecting environmental data.
Environmental Sample	<p>A representative sample of any material (aqueous, non-aqueous, or multimedia) collected from any source for which determination of composition or contamination is requested or required. Environmental samples can generally be classified as follows:</p> <ul style="list-style-type: none"> • Non Potable Water (Includes surface water, ground water, effluents, water treatment chemicals, and TCLP leachates or other extracts) • Drinking Water - Delivered (treated or untreated) water designated as potable water • Water/Wastewater - Raw source waters for public drinking water supplies, ground waters, municipal influents/effluents, and industrial influents/effluents • Sludge - Municipal sludges and industrial sludges. • Soil - Predominately inorganic matter ranging in classification from sands to clays. • Waste - Aqueous and non-aqueous liquid wastes, chemical solids, and industrial liquid and solid wastes
Equipment Blank	A sample of analyte-free media used to rinse common sampling equipment to check effectiveness of decontamination procedures.
Facility	A distinct location within the company that has unique certifications, personnel and waste disposal identifications.
False Negative	An analyte incorrectly reported as absent from the sample, resulting in potential risks from their presence.
False Positive	An item incorrectly identified as present in the sample, resulting in a high reporting value for the analyte of concern.
Field Blank	A blank sample prepared in the field by filling a clean container with reagent water and appropriate preservative, if any, for the specific sampling activity being undertaken.

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Field Measurement	Determination of physical, biological, or radiological properties, or chemical constituents that are measured on-site, close in time and space to the matrices being sampled/measured, following accepted test methods. This testing is performed in the field outside of a fixed-laboratory or outside of an enclosed structure that meets the requirements of a mobile laboratory.
Field of Accreditation	TNI- Those matrix, technology/method, and analyte combinations for which the accreditation body offers accreditation.
Finding	TNI- An assessment conclusion referenced to a laboratory accreditation standard and supported by objective evidence that identifies a deviation from a laboratory accreditation standard requirement.
Flame Atomic Absorption Spectrometer (FAA)	Instrumentation used to measure the concentration of metals in an environmental sample based on the fact that ground state metals absorb light at different wavelengths. Metals in a solution are converted to the atomic state by use of a flame.
Flame Ionization Detector (FID)	A type of gas detector used in GC analysis where samples are passed through a flame which ionizes the sample so that various ions can be measured.
Gas Chromatography (GC)	Instrumentation which utilizes a mobile carrier gas to deliver an environmental sample across a stationary phase with the intent to separate compounds out and measure their retention times.
Gas Chromatograph/Mass Spectrometry (GC/MS)	In conjunction with a GC, this instrumentation utilizes a mass spectrometer which measures fragments of compounds and determines their identity by their fragmentation patterns (mass spectra).
Gasoline Range Organics (GRO)	A range of compounds that denote all the characteristic compounds that make up gasoline (range can be state or program specific).
Graphite Furnace Atomic Absorption Spectrometry (GFAA)	Instrumentation used to measure the concentration of metals in an environmental sample based on the absorption of light at different wavelengths that are characteristic of different analytes.
High Pressure Liquid Chromatography (HPLC)	Instrumentation used to separate, identify and quantitate compounds based on retention times which are dependent on interactions between a mobile phase and a stationary phase.
Holding Time	TNI- The maximum time that can elapse between two specified activities. 40 CFR Part 136- The maximum time that samples may be held prior to preparation and/or analysis as defined by the method and still be considered valid or not compromised. For sample prep purposes, hold times are calculated using the time of the start of the preparation procedure. DoD- The time elapsed from the time of sampling to the time of extraction or analysis, or from extraction to analysis, as appropriate.
Homogeneity	The degree to which a property or substance is uniformly distributed throughout a sample.
Homologue	One in a series of organic compounds in which each successive member has one more chemical group in its molecule than the next preceding member. For instance, methanol, ethanol, propanol, butanol, etc., form a homologous series.

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Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES)	Analytical technique used for the detection of trace metals which uses plasma to produce excited atoms that emit radiation of characteristic wavelengths.
Inductively Coupled Plasma- Mass Spectrometry (ICP/MS)	An ICP-AES that is used in conjunction with a mass spectrometer so that the instrument is not only capable of detecting trace amounts of metals and non-metals but is also capable of monitoring isotopic speciation for the ions of choice.
Infrared Spectrometer (IR)	An instrument that uses infrared light to identify compounds of interest.
Initial Calibration (ICAL)	The process of analyzing standards, prepared at specified concentrations, to define the quantitative response relationship of the instrument to the analytes of interest. Initial calibration is performed whenever the results of a calibration verification standard do not conform to the requirements of the method in use or at a frequency specified in the method.
Initial Calibration Blank (ICB)	A blank sample used to monitor the cleanliness of an analytical system at a frequency determined by the analytical method. This blank is specifically run in conjunction with the Initial Calibration Verification (ICV) where applicable.
Initial Calibration Verification (ICV)	A standard obtained or prepared from a source independent of the source of the standards for the initial calibration. Its concentration should be at or near the middle of the calibration range. It is done after the initial calibration.
Inspection	An activity such as measuring, examining, testing, or gauging one or more characteristics of an entity and comparing the results with specified requirements in order to establish whether conformance is achieved for each characteristic.
Instrument Blank	A clean sample (e.g., distilled water) processed through the instrumental steps of the measurement process; used to determine instrument contamination.
Instrument Detection Limits (IDLs)	Limits determined by analyzing a series of reagent blank analyses to obtain a calculated concentration. IDLs are determined by calculating the average of the standard deviations of three runs on three non-consecutive days from the analysis of a reagent blank solution with seven consecutive measurements per day.
Interference, spectral	Occurs when particulate matter from the atomization scatters incident radiation from the source or when the absorption or emission from an interfering species either overlaps or is so close to the analyte wavelength that resolution becomes impossible.
Interference, chemical	Results from the various chemical processes that occur during atomization and later the absorption characteristics of the analyte.
Internal Standards	TNI - A known amount of standard added to a test portion of a sample as a reference for evaluating and controlling the precision and bias of the applied analytical method.
Intermediate Standard Solution	Reference solutions prepared by dilution of the stock solutions with an appropriate solvent.
International System of Units (SI)	The coherent system of units adopted and recommended by the General Conference on Weights and Measures.
Ion Chromatography (IC)	Instrumentation or process that allows the separation of ions and molecules based on the charge properties of the molecules.

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Isomer	One of two or more compounds, radicals, or ions that contain the same number of atoms of the same element but differ in structural arrangement and properties. For example, hexane (C ₆ H ₁₄) could be n-hexane, 2-methylpentane, 3-methylpentane, 2,3-dimethylbutane, 2,2-dimethylbutane.
Laboratory	A body that calibrates and/or tests.
Laboratory Control Sample (LCS)	TNI - (however named, such as laboratory fortified blank, spiked blank, or QC check sample): A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes and taken through all sample preparation and analytical steps of the procedure unless otherwise noted in a reference method. It is generally used to establish intra-laboratory or analyst-specific precision and bias or to evaluate the performance of all or a portion of the measurement system.
Laboratory Duplicate	Aliquots of a sample taken from the same container under laboratory conditions and processed and analyzed independently.
Laboratory Information Management System (LIMS)	A computer system that is used to maintain all sample information from sample receipt, through preparation and analysis and including sample report generation.
LabTrack	Database used by Pace Analytical to store and track corrective actions and other laboratory issues.
Learning Management System (LMS)	A training database used by Pace Analytical to train their employees. This system is a self-paced system which is capable of tracking all employee training requirements and documentation.
Legal Chain-of-Custody Protocols	TNI- Procedures employed to record the possession of samples from the time of sampling through the retention time specified by the client or program. These procedures are performed at the special request of the client and include the use of a Chain-of-Custody Form that documents the collection, transport, and receipt of compliance samples by the laboratory. In addition, these protocols document all handling of the samples within the laboratory.
Limit(s) of Detection (LOD)	TNI- A laboratory's estimate of the minimum amount of an analyte in a given matrix that an analytical process can reliably detect in their facility. DoD- The smallest amount or concentration of a substance that must be present in a sample in order to be detected at a high level of confidence (99%). At the LOD, the false negative rate is 1%.
Limit(s) of Quantitation (LOQ)	TNI- The minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence. DoD- The lowest concentration that produces a quantitative result within specified limits of precision and bias. For DoD projects, the LOQ shall be set at or above the concentration of the lowest initial calibration standard.
Laboratory Information Management System (LIMS)	A computer system that is used to maintain all sample information from sample receipt, through preparation and analysis and including sample report generation.
Learning Management System (LMS)	A web-based database used by the laboratories to track and document training activities. The system is administered by the corporate training department and each laboratory's learn centers are maintained by a local administrator.

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Lot	A quantity of bulk material of similar composition processed or manufactured at the same time.
Management	Those individuals directly responsible and accountable for planning, implementing, and assessing work.
Management System	System to establish policy and objectives and to achieve those objectives.
Manager (however named)	The individual designated as being responsible for the overall operation, all personnel, and the physical plant of the environmental laboratory. A supervisor may report to the manager. In some cases, the supervisor and the manager may be the same individual.
Matrix	TNI - The substrate of a test sample.
Matrix Duplicate	TNI- A replicate matrix prepared in the laboratory and analyzed to obtain a measure of precision.
Matrix Spike (MS) (spiked sample or fortified sample)	TNI- A sample prepared, taken through all sample preparation and analytical steps of the procedure unless otherwise noted in a referenced method, by adding a known amount of target analyte to a specified amount of sample for which an independent test result of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency.
Matrix Spike Duplicate (MSD) (spiked sample or fortified sample duplicate)	TNI - A replicate matrix spike prepared in the laboratory and analyzed to obtain a measure of the precision of the recovery for each analyte.
Measurement System	TNI - A test method, as implemented at a particular laboratory, and which includes the equipment used to perform the test and the operator(s).
Method	TNI- A body of procedures and techniques for performing an activity (e.g., sampling, chemical analysis, quantification), systematically presented in the order in which they are to be executed.
Method Blank	TNI - A sample of a matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses.
Method Detection Limit (MDL)	One way to establish a Detection Limit; defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte.
Method of Standard Additions	A set of procedures adding one or more increments of a standard solution to sample aliquots of the same size in order to overcome inherent matrix effects. The procedures encompass the extrapolation back to obtain the sample concentration.
MintMiner	Program used by Pace Analytical to review large amounts of chromatographic data to monitor for errors or data integrity issues.

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Mobile Laboratory	TNI- A portable enclosed structure with necessary and appropriate accommodation and environmental conditions for a laboratory, within which testing is performed by analysts. Examples include but are not limited to trailers, vans, and skid-mounted structures configured to house testing equipment and personnel.
National Institute of Standards and Technology (NIST)	TNI- A federal agency of the US Department of Commerce's Technology Administration that is designed as the United States national metrology institute (or NMI).
National Pollutant Discharge Elimination System (NPDES)	A permit program that controls water pollution by regulating point sources that discharge pollutants into U.S. waters.
Negative Control	Measures taken to ensure that a test, its components, or the environment do not cause undesired effects, or produce incorrect test results.
Nitrogen Phosphorus Detector (NPD)	A detector used in GC analyses that utilizes thermal energy to ionize an analyte. With this detector, nitrogen and phosphorus can be selectively detected with a higher sensitivity than carbon.
Nonconformance	An indication or judgment that a product or service has not met the requirement of the relevant specifications, contract, or regulation; also the state of failing to meet the requirements.
Not Detected (ND)	The result reported for a compound when the detected amount of that compound is less than the method reporting limit.
Performance Audit	The routine comparison of independently obtained qualitative and quantitative measurement system data with routinely obtained data in order to evaluate the proficiency of an analyst or laboratory.
Performance Based Measurement System (PBMS)	An analytical system wherein the data quality needs, mandates or limitations of a program or project are specified and serve as criteria for selecting appropriate test methods to meet those needs in a cost-effective manner.
Photo-ionization Detector (PID)	An ion detector which uses high-energy photons, typically in the ultraviolet range, to break molecules into positively charged ions.
Polychlorinated Biphenyls (PCB)	A class of organic compounds that were used as coolants and insulating fluids for transformers and capacitors. The production of these compounds was banned in the 1970's due to their high toxicity.
Positive Control	Measures taken to ensure that a test and/or its components are working properly and producing correct or expected results from positive test subjects.
Post-Digestion Spike	A sample prepared for metals analyses that has analytes spike added to determine if matrix effects may be a factor in the results.
Power of Hydrogen (pH)	The measure of acidity or alkalinity of a solution.
Practical Quantitation Limit (PQL)	Another term for a method reporting limit. The lowest reportable concentration of a compound based on parameters set up in an analytical method and the laboratory's ability to reproduce those conditions.
Precision	TNI - The degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance or range, in either absolute or relative terms.
Preservation	TNI- Any conditions under which a sample must be kept in order to maintain chemical and/or biological integrity prior to analysis.

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Procedure	TNI- A specified way to carry out an activity or process. Procedures can be documented or not.
Proficiency Testing	TNI - A means of evaluating a laboratory's performance under controlled conditions relative to a given set of criteria through analysis of unknown samples provided by an external source.
Proficiency Testing Program	TNI - The aggregate of providing rigorously controlled and standardized environmental samples to a laboratory for analysis, reporting of results, statistical evaluation of the results and the collective demographics and results summary of all participating laboratories.
Proficiency Testing Sample (PT)	TNI- A sample, the composition of which is unknown to the laboratory and is provided to test whether the laboratory can produce analytical results within the specified acceptance criteria.
Protocol	TNI - A detailed written procedure for field and/or laboratory operation (e.g., sampling, analysis) that must be strictly followed.
Quality Assurance (QA)	<p>TNI- An integrated system of management activities involving planning, implementation, assessment, reporting and quality improvement to ensure that a process, item, or service is of the type and quality needed and expected by the client.</p> <p>DoD- An integrated system of activities involving planning, quality control, quality assessment, reporting, and quality improvement to ensure that a product or service meets defined standards of quality with a stated level of confidence.</p>
Quality Assurance Manual (QAM)	A document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users.
Quality Assurance Project Plan (QAPP)	A formal document describing the detailed quality control procedures by which the quality requirements defined for the data and decisions pertaining to a specific project are to be achieved.
Quality Control (QC)	TNI- The overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer; operational techniques and activities that are used to fulfill requirements for quality; also the system of activities and checks used to ensure that measurement systems are maintained within prescribed limits, providing protection against "out of control" conditions and ensuring that the results are of acceptable quality.
Quality Control Sample (QCS)	TNI- A sample used to assess the performance of all or a portion of the measurement system. One of any number of samples, such as Certified Reference Materials, a quality system matrix fortified by spiking, or actual samples fortified by spiking, intended to demonstrate that a measurement system or activity is in control.
Quality Manual	TNI - A document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users.

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Quality System	TNI - A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required quality assurance and quality control activities.
Quality System Matrix	<p>TNI - These matrix definitions are to be used for purposes of batch and quality control requirements:</p> <ul style="list-style-type: none"> • Air and Emissions: Whole gas or vapor samples including those contained in flexible or rigid wall containers and the extracted concentrated analytes of interest from a gas or vapor that are collected with a sorbant tube, impinger solution, filter, or other device • Aqueous: Any aqueous sample excluded from the definition of Drinking Water or Saline/Estuarine. Includes surface water, groundwater effluents, and TCLP or other extracts. • Biological Tissue: Any sample of a biological origin such as fish tissue, shellfish or plant material. Such samples shall be grouped according to origin. • Chemical Waste: A product or by-product of an industrial process that results in a matrix not previously defined. • Drinking Water: Any aqueous sample that has been designated a potable or potentially potable water source. • Non-aqueous liquid: Any organic liquid with <15% settleable solids • Saline/Estuarine: Any aqueous sample from an ocean or estuary, or other salt water source such as the Great Salt Lake. • Solids: Includes soils, sediments, sludges, and other matrices with >15% settleable solids.
Quantitation Range	The range of values in a calibration curve between the LOQ and the highest successively analyzed initial calibration standard. The quantitation range lies within the calibration range.
Random Error	The EPA has established that there is a 5% probability that the results obtained for any one analyte will exceed the control limits established for the test due to random error. As the number of compounds measured increases in a given sample, the probability for statistical error also increases.
Raw Data	TNI- The documentation generated during sampling and analysis. This documentation includes, but is not limited to, field notes, electronic data, magnetic tapes, untabulated sample results, QC sample results, print outs of chromatograms, instrument outputs, and handwritten records.
Reagent Blank (method reagent blank)	A sample consisting of reagent(s), without the target analyte or sample matrix, introduced into the analytical procedure at the appropriate point and carried through all subsequent steps to determine the contribution of the reagents and of the involved analytical steps.
Reagent Grade	Analytical reagent (AR) grade, ACS reagent grade, and reagent grade are synonymous terms for reagents that conform to the current specifications of the Committee on Analytical Reagents of the American Chemical Society.

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Reference Material	TNI- Material or substance one or more of whose property values are sufficiently homogenized and well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials.
Reference Standard	TNI- Standard used for the calibration of working measurement standards in a given organization or at a given location.
Reference Toxicant	The toxicant used in performing toxicity tests to indicate the sensitivity of a test organism and to demonstrate the laboratory's ability to perform the test correctly and obtain consistent results.
Relative Percent Difference (RPD)	A measure of precision defined as the difference between two measurements divided by the average concentration of the two measurements.
Reporting Limit (RL)	The level at which method, permit, regulatory and customer-specific objectives are met. The reporting limit may never be lower than the Limit of Detection (i.e. statistically determined MDL). Reporting limits are corrected for sample amounts, including the dry weight of solids, unless otherwise specified. There must be a sufficient buffer between the Reporting Limit and the MDL. DoD- A client-specified lowest concentration value that meets project requirements for quantitative data with known precision and bias for a specific analyte in a specific matrix.
Reporting Limit Verification Standard (or otherwise named)	A standard analyzed at the reporting limit for an analysis to verify the laboratory's ability to report to that level.
Representativeness	A quality element related to the ability to collect a sample reflecting the characteristics of the part of the environment to be assessed. Sample representativeness is dependent on the sampling techniques specified in the project work plan.
Requirement	Denotes a mandatory specification; often designated by the term "shall".
Retention Time	The time between sample injection and the appearance of a solute peak at the detector.
Sample	Portion of material collected for analysis, identified by a single, unique alphanumeric code. A sample may consist of portions in multiple containers, if a single sample is submitted for multiple or repetitive analysis.
Sample Condition Upon Receipt Form (SCURF)	Form used by Pace Analytical sample receiving personnel to document the condition of sample containers upon receipt to the laboratory (used in conjunction with a COC).
Sample Delivery Group (SDG)	A unit within a single project that is used to identify a group of samples for delivery. An SDG is a group of 20 or fewer field samples within a project, received over a period of up to 14 calendar days. Data from all samples in an SDG are reported concurrently.
Sample Receipt Form (SRF)	Letter sent to the client upon login to show the tests requested and pricing.
Sample Tracking	Procedures employed to record the possession of the samples from the time of sampling until analysis, reporting and archiving. These procedures include the use of a Chain of custody Form that documents the collection, transport, and receipt of compliance samples to the laboratory. In addition, access to the laboratory is limited and controlled to protect the integrity of the samples.

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Sampling	TNI- Activity related to obtaining a representative sample of the object of conformity assessment, according to a procedure.
Selective Ion Monitoring (SIM)	A mode of analysis in mass spectrometry where the detector is set to scan over a very small mass range, typically one mass unit. The narrower the range, the more sensitive the detector.
Selectivity	TNI- The ability to analyze, distinguish, and determine a specific analyte or parameter from another component that may be a potential interferent or that may behave similarly to the target analyte or parameter within the measurement system.
Sensitivity	TNI - The capability of a method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest.
Serial Dilution	The stepwise dilution of a substance in a solution.
Shall	Denotes a requirement that is mandatory whenever the criterion for conformance with the specification requires that there be no deviation. This does not prohibit the use of alternative approaches or methods for implementing the specification as long as the requirement is fulfilled.
Should	Denotes a guideline or recommendation whenever noncompliance with the specification is permissible.
Signal-to-Noise Ratio	The signal carries information about the analyte, while noise is made up of extraneous information that is unwanted because it degrades the accuracy and precision of an analysis and also places a lower limit on the amount of analyte that can be detected. In most measurements, the average strength of the noise is constant and independent of the magnitude of the signal. Thus, the effect of noise on the relative error of a measurement becomes greater and greater as the quantity being measured (producing the signal) decreases in magnitude.
Spike	A known mass of target analyte added to a blank sample or sub-sample; used to determine recovery efficiency or for other quality control purposes.
Standard (Document)	TNI - The document describing the elements of a laboratory accreditation that has been developed and established within the consensus principles of standard setting and meets the approval requirements of standard adoption organizations procedures and policies.
Standard (Chemical)	Standard samples are comprised of a known amount of standard reference material in the matrix undergoing analysis. A standard reference material is a certified reference material produced by US NIST and characterized for absolute content, independent of analytical test method.
Standard Blank (or Reagent Blank)	A calibration standard consisting of the same solvent/reagent matrix used to prepare the calibration standards without the analytes. It is used to construct the calibration curve by establishing instrument background.
Standard Method	A test method issued by an organization generally recognized as competent to do so.
Standard Operating Procedure (SOP)	TNI- A written document that details the method for an operation, analysis, or action with thoroughly prescribed techniques and steps. SOPs are officially approved as the methods for performing certain routine or repetitive tasks.
Standard Reference Material (SRM)	A certified reference material produced by the US NIST or other equivalent organization and characterized for absolute content, independent of analytical method.

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Statement of Qualifications (SOQ)	A document that lists information about a company, typically the qualifications of that company to compete on a bid for services.
Stock Standard	A concentrated reference solution containing one or more analytes prepared in the laboratory using an assayed reference compound or purchased from a reputable commercial source.
Supervisor	The individual(s) designated as being responsible for a particular area or category of scientific analysis. This responsibility includes direct day-to-day supervision of technical employees, supply and instrument adequacy and upkeep, quality assurance/quality control duties and ascertaining that technical employees have the required balance of education, training and experience to perform the required analyses.
Surrogate	A substance with properties that mimic the analyte of interest. It is unlikely to be found in environmental samples and is added to them for quality control purposes.
Systems Audit	An on-site inspection or assessment of a laboratory's quality system.
Target Analytes	Analytes specifically named by a client (also called project-specific analytes).
Technical Director	Individual(s) who has overall responsibility for the technical operation of the environmental testing laboratory.
Technology	TNI- A specific arrangement of analytical instruments, detection systems, and/or preparation techniques.
Test	A technical operation that consists of the determination of one or more characteristics or performance of a given product, material, equipment, organism, physical phenomenon, process or service according to a specified procedure. The result of a test is normally recorded in a document sometimes called a test report or a test certificate.
Test Method	An adoption of a scientific technique for performing a specific measurement as documented in a laboratory SOP or as published by a recognized authority.
Test Methods for Evaluating Solid Waste, Physical/ Chemical (SW-846)	EPA Waste's official compendium of analytical and sampling methods that have been evaluated and approved for use in complying with RCRA regulations.
Total Petroleum Hydrocarbons (TPH)	A term used to denote a large family of several hundred chemical compounds that originate from crude oil. Compounds may include gasoline components, jet fuel, volatile organics, etc.
Toxicity Characteristic Leaching Procedure (TCLP)	A solid sample extraction method for chemical analysis employed as an analytical method to simulate leaching of compounds through a landfill.
Traceability	TNI- The ability to trace the history, application, or location of an entity by means of recorded identifications. In a calibration sense, traceability relates measuring equipment to national or international standards, primary standards, basic physical conditions or properties, or reference materials. In a data collection sense, it relates calculations and data generated throughout the project back to the requirements for the quality of the project. DoD- The property of a result of a measurement whereby it can be related to appropriate standards, generally international or national standards, through an unbroken chain of comparisons.

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Training Document	A training resource that provides detailed instructions to execute a specific method or job function.
Trip Blank	This blank sample is used to detect sample contamination from the container and preservative during transport and storage of the sample. A cleaned sample container is filled with laboratory reagent water and the blank is stored, shipped, and analyzed with its associated samples.
Tuning	A check and/or adjustment of instrument performance for mass spectrometry as required by the method.
Ultraviolet Spectrophotometer (UV)	Instrument routinely used in quantitative determination of solutions of transition metal ions and highly conjugated organic compounds.
Uncertainty Measurement	The parameter associated with the result of a measurement that characterized the dispersion of the values that could be reasonably attributed to the measurand (i.e. the concentration of an analyte).
Validation	The confirmation by examination and provision of objective evidence that the particular requirements for a specific intended use are fulfilled.
Verification	TNI - Confirmation by examination and objective evidence that specified requirements have been met. Note: In connection with the management of measuring equipment, verification provides a means for checking that the deviations between values indicated by a measuring instrument and corresponding known values of a measured quantity are consistently smaller than the maximum allowable error defined in a standard, regulation or specification peculiar to the management of the measuring equipment. The result of verification leads to a decision either to restore in service, to perform adjustment, to repair, to downgrade, or to declare obsolete. In all cases, it is required that a written trace of the verification performed shall be kept on the measuring instrument's individual record.
Whole Effluent Toxicity (WET)	The aggregate toxic effect to aquatic organisms from all pollutants contained in a facility's wastewater (effluent).
Work Cell	A well-defined group of analysts that together perform the method analysis. The members of the group and their specific functions within the work cell must be fully documented.

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11.0. REFERENCES

- 11.1. "Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act." Federal Register, 40 CFR Part 136.
- 11.2. "Test Methods for Evaluating Solid Wastes: Physical/Chemical Methods." SW-846.
- 11.3. "Methods for Chemical Analysis of Water and Wastes", EPA 600-4-79-020, 1979 Revised 1983, U.S. EPA.
- 11.4. U.S. EPA Contract Laboratory Program Statement of Work for Organic Analysis.
- 11.5. U.S. EPA Contract Laboratory Program Statement of Work for Inorganic Analysis.
- 11.6. "Standard Methods for the Examination of Water and Wastewater." Current Edition APHA-AWWA-WPCF.
- 11.7. "Annual Book of ASTM Standards", Section 4: Construction, Volume 04.04: Soil and Rock; Building Stones, American Society of Testing and Materials.
- 11.8. "Annual Book of ASTM Standards", Section 11: Water and Environmental Technology, American Society of Testing and Materials.
- 11.9. "NIOSH Manual of Analytical Methods", Third Edition, 1984, U.S. Department of Health and Human Services, National Institute for Occupational Safety and Health.
- 11.10. "Methods for the Determination of Organic Compounds in Finished Drinking Water and Raw Source Water", U.S. EPA, Environmental Monitoring and Support Laboratory – Cincinnati (September 1986).
- 11.11. Quality Assurance of Chemical Measurements, Taylor, John K.; Lewis Publishers, Inc. 1987.
- 11.12. Methods for Non-conventional Pesticides Chemicals Analysis of Industrial and Municipal Wastewater, Test Methods, EPA-440/1-83/079C.
- 11.13. Environmental Measurements Laboratory (EML) Procedures Manual, HASL-300, US DOE, February, 1992.
- 11.14. Requirements for Quality Control of Analytical Data, HAZWRAP, DOE/HWP-65/R1, July, 1990.
- 11.15. Requirements for Quality Control of Analytical Data for the Environmental Restoration Program, Martin Marietta, ES/ER/TM-16, December, 1992.
- 11.16. Quality Assurance Manual for Industrial Hygiene Chemistry, AIHA, 1988.
- 11.17. National Environmental Laboratory Accreditation Conference, Constitution, Bylaws, and Standards. Most recent version.
- 11.18. ISO/IEC 17025:2005, General requirements for the competence of testing and calibration laboratories.
- 11.19. Department of Defense Quality Systems Manual (QSM), version 4.2, October 25, 2010.
- 11.20. TNI (The NELAC Institute) Standards; most recent version.

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12.0. REVISIONS

The PASI Corporate Quality Office files both a paper copy and electronic version of a Microsoft Word document with tracked changes detailing all revisions made to the previous version of the Quality Assurance Manual. This document is available upon request. All revisions are summarized in the table below.

Document Number	Reason for Change	Date
Quality Assurance Manual 15.0	<p>General: reformatted and renumbered several sections.</p> <p>General: corrected names/numbers of corporate SOP references.</p> <p>General: changed General Manager to SGM/GM/AGM where applicable to account for changes in management structure in each lab.</p> <p>General: changed Quality Manager to SQM/QM where applicable to account for changes in management structure in each lab.</p> <p>Section 1.3.3: removed specific industry standards.</p> <p>Section 1.5.4: added section with current anonymous hotline number.</p> <p>Sections 1.7.3, 1.7.4, 1.7.5, 1.7.6, and 1.7.8: reworded to match changes in management structure.</p> <p>Section 1.8.4: added new job description for Senior Quality Manager.</p> <p>Section 1.8.5 (first bullet point): added language from DoD QSM gray box 4, added connection to the Director of Quality, and added new language regarding the QM reporting structure.</p> <p>Section 1.8.5: added new second bullet point from DoD QSM.</p> <p>Section 1.8.5 (third bullet point): added responsibility to do quarterly reports.</p> <p>Section 1.8.5 (twelfth bullet point): added language from DoD QSM.</p> <p>Section 1.8.6: added Quality Analyst job description.</p> <p>Section 1.10.3: added the current anonymous hotline number.</p> <p>Section 1.12.2: changed Sample Custodian to red text in case locally that is not the person responsible.</p> <p>Section 2.6.5: changed region codes to division codes and added division codes for Pompano Beach and Dallas and added in MT and VA, MN to code 10. Removed code 38 for PGH radiochem (all now under code 30).</p> <p>Section 3.4.2: added sentence about Drinking Water DOCs.</p> <p>Section 4.2.4: added specific TNI language for every target component to be spiked in LCS over a 2-year period (V1M4 1.7.3.2.3.b).</p> <p>Section 4.3.4: added specific TNI language for every target component to be spiked in the MS/MSD over a 2-year period (V1M4 1.7.3.3.1.c).</p> <p>Section 4.9.9: added DoD definition for LOD.</p> <p>Section 4.10.3: added caveat from TNI standard regarding LOQ verification (V1M4 1.5.2.2.e).</p> <p>Section 4.13.2: added new section to clarify when the rounding step occurs.</p> <p>Section 4.13.4: clarified the significant figure rules depending on the LIMS used.</p> <p>Section 4.14: added section on retention time windows.</p> <p>Section 5.1.3: added requirement from DoD QSM.</p> <p>Section 5.1.7.4: reworded for clarity.</p> <p>Section 6.2.6.1.4: reworded to match language in SW-846.</p> <p>Sections 6.2.6.2, 6.2.6.3 and 6.2.7.1: added language which prohibits rounding to pass calibration acceptance criteria.</p> <p>Section 6.2.6.4.1: added red section with language from 2010 DoD QSM (gray box 37).</p> <p>Section 6.3.3.1: changed weight calibration frequency to 5 years to match Support Equipment SOT.</p> <p>Section 6.4.7: removed language about instrument maintenance for clarity.</p> <p>Sections 7.1.2 and 7.2.2: added language regarding documentation of primary analyst and data reviewer.</p> <p>Section 7.3.2.25: removed section.</p>	06Feb2012

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Document Number	Reason for Change	Date
	<p>Section 7.3.7: Added AGM and SQM.</p> <p>Section 8.1.2.3: added clarifying language.</p> <p>Section 8.1.2.6: reworded for clarity.</p> <p>Section 8.5.3: added language from 2009 TNI standard (V1M2 4.7/ISO 4.7.1 note 1).</p> <p>Section 8.5.4: added new section with language from 2009 TNI standard (V1M2/ISO 4.7.1 note 2).</p> <p>Sections 9.1.5 and 9.1.6: reworded for clarity.</p> <p>Section 10: General- added indication of source of definitions within the chart (e.g., TNI, DoD, etc.) and added a sentence to that effect prior to the definition table.</p> <p>Section 10: Added clarification to the definition of 'batch' (TNI and DoD references) and corrected a couple of word deviations from previous version of QAM. Also added the 'batch' definition from the state of SC in red text based on their specific requirements.</p> <p>Section 10: revised definitions for accreditation, assessment, calibration curve, calibration standard, certified reference material, data reduction, finding, holding time (including caveat for prep start time), LCS, LOD, method, preservation, PT sample, protocol, quality system, raw data, reference material- per 2009 TNI standards (V1M2 section 3.1).</p> <p>Section 10: added definitions for measurement system, mobile laboratory, procedure, PT program, and technology- per 2009 TNI standards (V1M2 section 3.1).</p> <p>Section 10: added definitions for assessment, calibration curve, calibration standard, certified reference material, data reduction, demonstration of capability, finding, laboratory, matrix spike, preservation, PT sample, quality control, quality control sample, raw data, reference material, selectivity, SOP, and work cell- per 2010 DoD QSM 4.2 (Appendix B).</p> <p>Attachment VIII: completely revised the method/bottle/preservation table.</p> <p>Section 10: added definitions for facility, initial calibration blank, analysis sequence, serial dilution, post-digestion spike, and instrument detection limits- per review of document.</p> <p>Section 11.20: Added TNI standard reference.</p>	
Quality Assurance Manual 15.1	Section 2.10.2: Revised to allow samples requiring thermal preservation to be stored at ambient temperature when the hold time is expired, the report has been delivered, and/or allowed by the customer, program, or contract	15May2012
Quality Assurance Manual 15.2	Section 6.2.6.1.4: Edited acceptable cause to read, "An acceptable cause is defined as an obvious sample introduction issue that resulted in no response, documentation of an incorrectly prepared standard, or a documented response of a single standard that is greater than 2X difference from the expected value of that standard."	05Jun2012
Quality Assurance Manual 15.2 (Local Revisions)	General: Edited/Removed red text and added SOP references for local implementation. Section 2.2.3: added	05Jun2012

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ATTACHMENT I- QUALITY CONTROL CALCULATIONS

PERCENT RECOVERY (%REC)

$$\% REC = \frac{(MSConc - SampleConc)}{TrueValue} * 100$$

NOTE: The SampleConc is zero (0) for the LCS and Surrogate Calculations

PERCENT DIFFERENCE (%D)

$$\% D = \frac{MeasuredValue - TrueValue}{TrueValue} * 100$$

where:

TrueValue = Amount spiked (can also be the \overline{CF} or \overline{RF} of the ICAL Standards)

Measured Value = Amount measured (can also be the CF or RF of the CCV)

PERCENT DRIFT

$$\% Drift = \frac{CalculatedConcentration - TheoreticalConcentration}{TheoreticalConcentration} * 100$$

RELATIVE PERCENT DIFFERENCE (RPD)

$$RPD = \frac{|(R1 - R2)|}{(R1 + R2) / 2} * 100$$

where:

R1 = Result Sample 1

R2 = Result Sample 2

CORRELATION COEFFICIENT (R)

$$CorrCoeff = \frac{\sum_{i=1}^N W_i * (X_i - \overline{X}) * (Y_i - \overline{Y})}{\sqrt{\left(\sum_{i=1}^N W_i * (X_i - \overline{X})^2\right) * \left(\sum_{i=1}^N W_i * (Y_i - \overline{Y})^2\right)}}$$

With: N Number of standard samples involved in the calibration
i Index for standard samples
Wi Weight factor of the standard sample no. i
Xi X-value of the standard sample no. i
X(bar) Average value of all x-values
Yi Y-value of the standard sample no. i
Y(bar) Average value of all y-values

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ATTACHMENT I- QUALITY CONTROL CALCULATIONS (CONTINUED)

STANDARD DEVIATION (S)

$$S = \sqrt{\frac{\sum_{i=1}^n (X_i - \bar{X})^2}{(n-1)}}$$

where:

n = number of data points
 X_i = individual data point
 \bar{X} = average of all data points

AVERAGE (\bar{X})

$$\bar{X} = \frac{\sum_{i=1}^n X_i}{n}$$

where:

n = number of data points
 X_i = individual data point

RELATIVE STANDARD DEVIATION (RSD)

$$RSD = \frac{S}{\bar{X}} * 100$$

where:

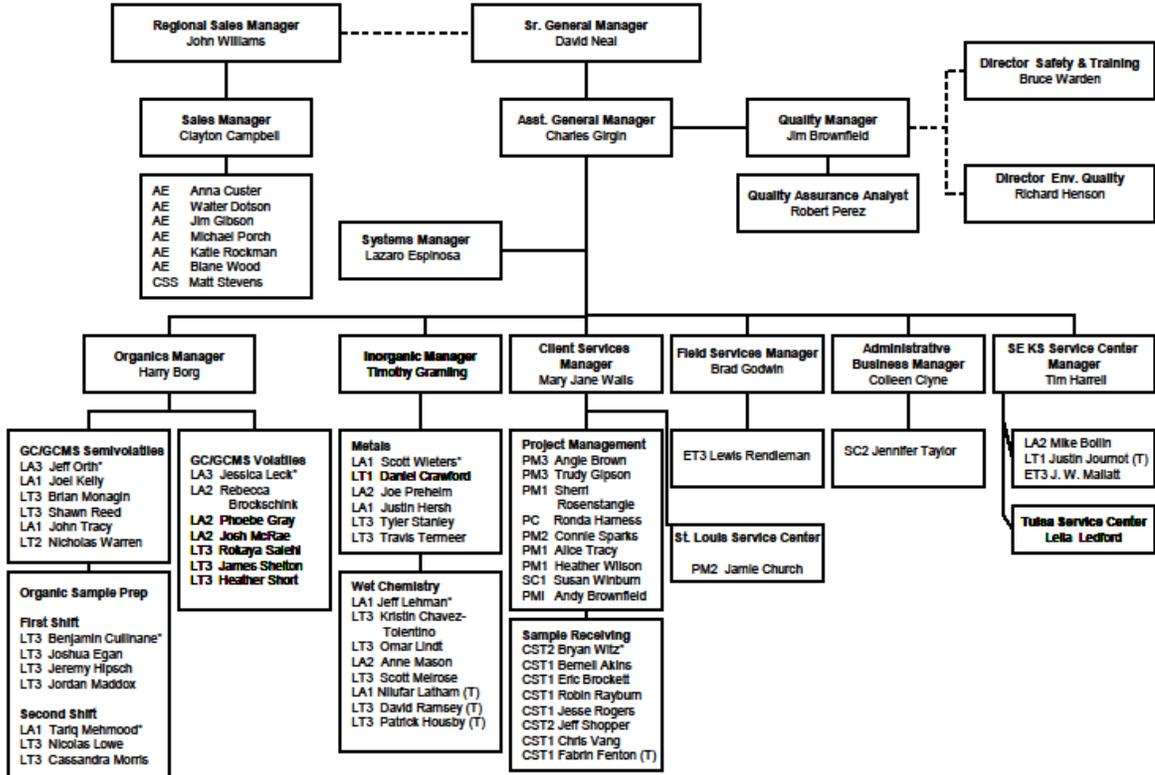
S = Standard Deviation of the data points
 \bar{X} = average of all data points

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ATTACHMENT IIA- PASI-KANSAS ORGANIZATIONAL CHART (CURRENT AS OF ISSUE DATE)

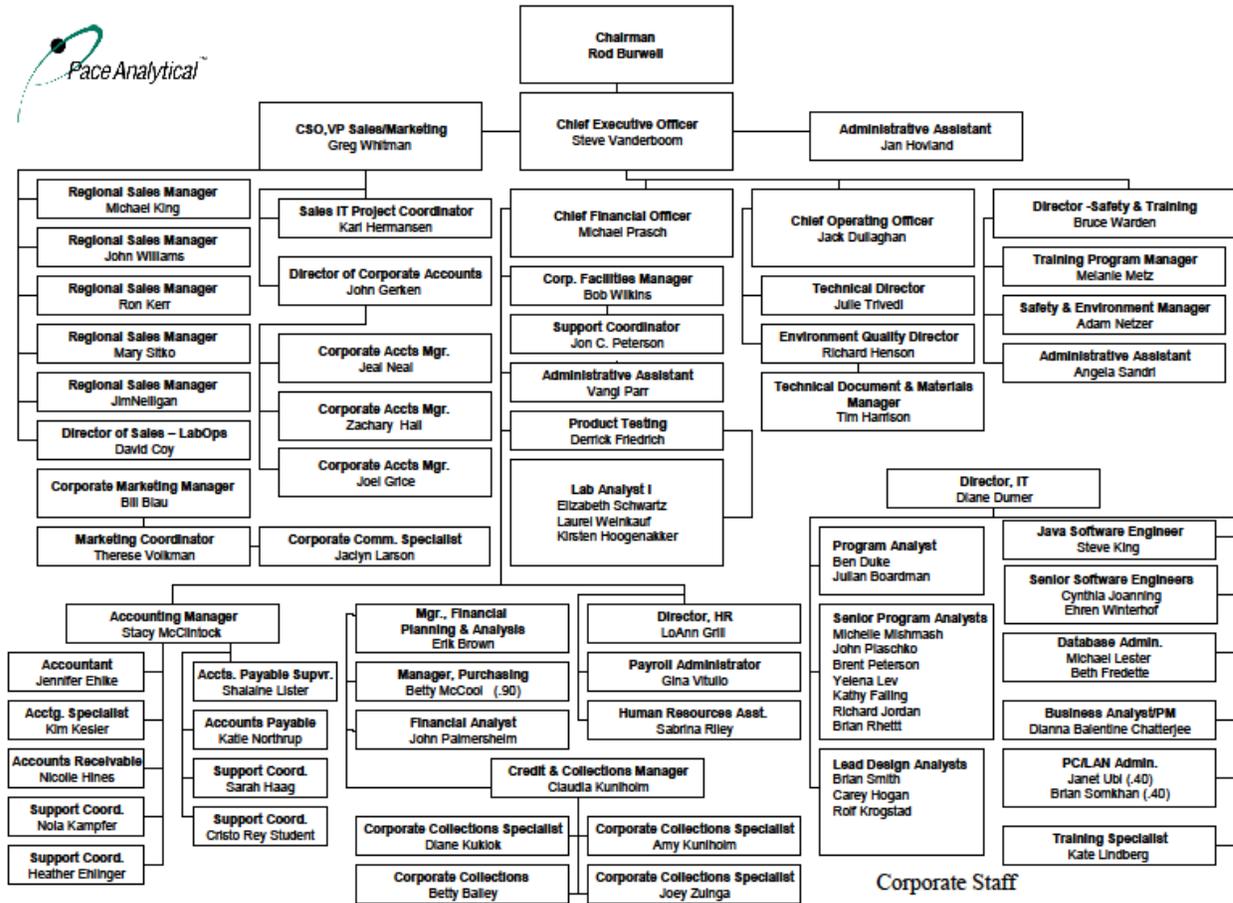
Pace Analytical Services, Inc.--Kansas



*Department /Shift Leader
Last Revised May 29, 2012
Last Reviewed May 29, 2012

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ATTACHMENT IIB- PASI-CORPORATE ORGANIZATIONAL CHART (CURRENT AS OF ISSUE DATE)



Corporate Staff
May 2012

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**ATTACHMENT III- EQUIPMENT LIST (CURRENT AS OF ISSUE DATE)
LENEXA, KANSAS LABORATORY**

Instrument ID	Age	Manufacturer	Instrument Description	Model #/Type	Software
60HG02	2007	PE	Mercury Analyzer FIMS	FIAS-400	Winlab32 for AA
60HG02	2007	PE	Autosampler	90	N/A
60HG03	2012	Cetac	Quicktrace Mercury Analyzer	M-7500	Quicktrace
60HG03	2012	Cetac	Autosampler	ASX-260	N/A
60ICM1	2011	Thermo	ICPMS	XSeries 2	Plasmalab
60ICM1	2011	ESI	Autosampler	sc4DX	N/A
60ICM1	2011	Neslab	Chiller	ThermoFlex 2500	N/A
60ICP3	2009	Thermo	ICP	iCAP6500	Iteva
60ICP3	2009	Cetac	Autosampler	ASX520	N/A
60ICP3	2009	Neslab	Chiller	ThermoFlex 900	N/A
60ICP4	2011	Thermo	ICP	6500 Duo	Iteva
60ICP4	2011	Cetac	Chiller	ThermoFlex 900	N/A
60ICP4	2011	ESI	Autosampler	SC-4DX	N/A
60AWET4	2002	Fisher	Block Digester	TKN/T Phos	N/A
60WET1	1998	Accumet	DO Meter	150	N/A
60WET3	1998	LaMotte	UV/VIS	Smart Spectro	N/A
60WET5	1994	Hach	Turbidimeter	43900	N/A
60WET6	1993	Hach	Chlorine Amperometric Titrator	AutoCAT 9000	AutoCAT
60WET6	2003	HACH	Amperometric Titrator	AutoCat9000	N/A
60WET9	1998	Fisher	Conductivity	09-328	N/A
60WETB	2010	Thermo Scientific	pH Meter	Orion 350	NA
60WETC	2011	Thermo Scientific	pH meter	Orion Star LogR	N/A
60WETO	1990	Pensky Martens	Flashpoint	Manual	N/A
60WTA0	2009	Lachat	Flow Injection Analyzer	QuikChem 8500	Omnion
60WTA0	2009	Lachat	Reagent Pump	RP-100	N/A
60WTA0	2009	Lachat	Dilutor	PDS200	N/A
60WTA0	2009	Lachat	Autosampler	ASX520	N/A
60WTA2	2008	Dionex	Ion Chromatograph	ICS-2000	Chromeleon and Target
60WTA2	2008	Dionex	Autosampler	AS	N/A
60WTA2	2008	Dionex	Conductivity Cell	D56	N/A
60WTA2	2008	Dionex	Chromatography Software	Chromeleon Release 6.8	N/A
60WTA4	1993	Radiometer	Autoburette	ABU93	N/A
60WTA4	1993	Radiometer	Autosampler	SAC90	N/A
60WTAB	2006	WEST CO	SMART Chem	c0084	Smartchem
60WTA9	2008	Shimadzu	UV-Vis Spectrophotometer	UV-1800	UV probe
60WTAA	2010	GE Sievers	TOC Analyzer	InnovOx	Sievers Innovoxlab
60WTAA	2010	GE Sievers	Autosampler	GE Autosampler	N/A
60WTAB	2011	Lachat	Flow Injection Analyzer	QuikChem 8500-Series 2	Omnion
60WTAB	2011	Lachat	Reagent Pump	RP-100	N/A
60WTAB	2011	Lachat	Autosampler	ASX520	N/A
60WTAC	2012	Dionex	Ion chromatograph	ICS1600	Chromeleon and Target
60WTAC	2012	Dionex	Autosampler	ASDV	N/A
60WTAD	2012	Dionex	Ion chromatograph	ICS1500	Chromeleon and Target
60WTAD	2012	Dionex	Autosampler	AS40	N/A
N/A	2002	Millipore	Milli-Q Water System	Synergy 185	N/A
60GCS1	1990	HP	GC ECD/ECD	5890 Series II	Turbochrom and Target
60GCS1	1990	HP	Autosampler & Injector	7673A	N/A
60GCS4	1991	HP	GC FID	5890 Series II	Turbochrom and Target
60GCS4	1991	HP	Autosampler & Injector	7673	N/A
60GCS6	1991	HP	GC FID	5890 Series II	Turbochrom and Target
60GCS6	1991	HP	Autosampler & Injector	7673A	N/A
60GCS8	2005	HP	GC ECD/ECD	6890	Chemstation and Target
60GCS8	2005	HP	Autosampler- Injector	5890 Series	N/A

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LENEXA, KANSAS LABORATORY EQUIPMENT LIST (CONTINUED)

Instrument ID	Age	Manufacturer	Instrument Description	Model #/Type	Software
60GCS8	2005	HP	Autosampler- tray	18596C	N/A
60GCS8	2005	HP	Autosampler-Controller	G1512A	N/A
60GCS9	2008	Agilent	GC FID/FID	7890A	Chemstation and Target
60GCS9	2008	Agilent	Autosampler- Injector	7683B	N/A
60GCS9	2008	Agilent	Autosampler- tray	G2614A	N/A
60GCSA	2009	Agilent	GC FID/FID	7890A	Chemstation and Target
60GCSA	2009	Agilent	Autosampler- Injector	G4513A	N/A
60GCSA	2009	Agilent	Autosampler- Injector	G4513A	N/A
60GCSA	2009	Agilent	Autosampler- tray	7693	N/A
60GCV2	2012	Agilent	GC PID/FID	6890	Chemstation and Target
60GCV2	2012	Tekmar	P&T Concentrator	3000	N/A
60GCV2	2012	Archon	Autosampler	Aquatek 70	N/A
60MSS2	2002	HP	GC MS	6890	Chemstation and Target
60MSS2	2002	HP	Mass Selective Detector	5973N	N/A
60MSS2	2002	HP	Autosampler- Injector	7683B	N/A
60MSS2	2002	HP	Autosampler- tray	G2614A	N/A
60MSS3	2007	Agilent	GC MS	7890A	Chemstation and Target
60MSS3	2007	Agilent	Mass Selective Detector	5975C	N/A
60MSS3	2007	Agilent	Autosampler- Injector	7683B	N/A
60MSS3	2007	Agilent	Autosampler- tray	G2614A	N/A
60MSS4	2009	Agilent	GC MS	7890A	Chemstation and Target
60MSS4	2009	Agilent	Mass Selective Detector	5975C	N/A
60MSS4	2009	Agilent	Autosampler- Injector	7683B	N/A
60MSS4	2009	Agilent	Autosampler- tray	G2614A	N/A
60MSS5	2010	Agilent	GC MS	7890A	Chemstation and Target
60MSS5	2010	Agilent	Mass Spectrometer	5975C	N/A
60MSS5	2010	Agilent	Autosampler- Injector	7683B	N/A
60MSS5	2010	Agilent	Autosampler- tray	G2614A	N/A
60MSV1	2009	Agilent	GC	6850	Chemstation and Target
60MSV1	2009	Agilent	Mass Selective Detector	5975B	N/A
60MSV1	2010	Tekmar	Autosampler/Concentrator	AtomX	N/A
60MSV2	2007	Agilent	GC MS	6850	Chemstation and Target
60MSV2	2007	Agilent	Mass Selective Detector	5975B	N/A
60MSV2	2007	Tekmar	Autosampler	Aquatek 70	N/A
60MSV2	2009	Tekmar	P&T Concentrator	LSC-3000	N/A
60MSV5	2002	HP	GC	6890	Chemstation and Target
60MSV5	2002	HP	Mass Selective Detector	5973	N/A
60MSV5	2007	Tekmar	P&T Concentrator	3100	N/A
60MSV5	2007	EST	Autosampler	Centurion	N/A
60MSV8	2007	Agilent	GC	6850	Chemstation and Target
60MSV8	2007	Agilent	Mass Selective Detector	5975B	N/A
60MSV8	2007	EST	Autosampler	Centurion	N/A
60MSV8	2007	EST	P&T Concentrator	EnCon	N/A
60MSV9	2008	Agilent	GC	6850	Chemstation and Target
60MSV9	2008	Agilent	Mass Selective Detector	5975C	N/A
60MSV9	2008	Tekmar	P&T Concentrator	LSC 3000	N/A
60MSV9	2009	Tekmar	Autosampler	Aquatek 70	N/A
60MSVA	2010	Agilent	GC MS	6850	Chemstation and Target
60MSVA	2010	Agilent	Mass Spectrometer	5975C	N/A
60MSVA	2010	Tekmar	Autosampler/Concentrator	AtomX	N/A
60MSVB	2010	Agilent	GC MS	6890	Chemstation and Target
60MSVB	2010	Agilent	Mass Selective Detector	5975C	N/A
60MSVB	2010	Tekmar	Autosampler/Concentrator	AtomX	N/A
60MARS1	2006	CEM Corp.	Microwave Solvent Extractor	907501	N/A

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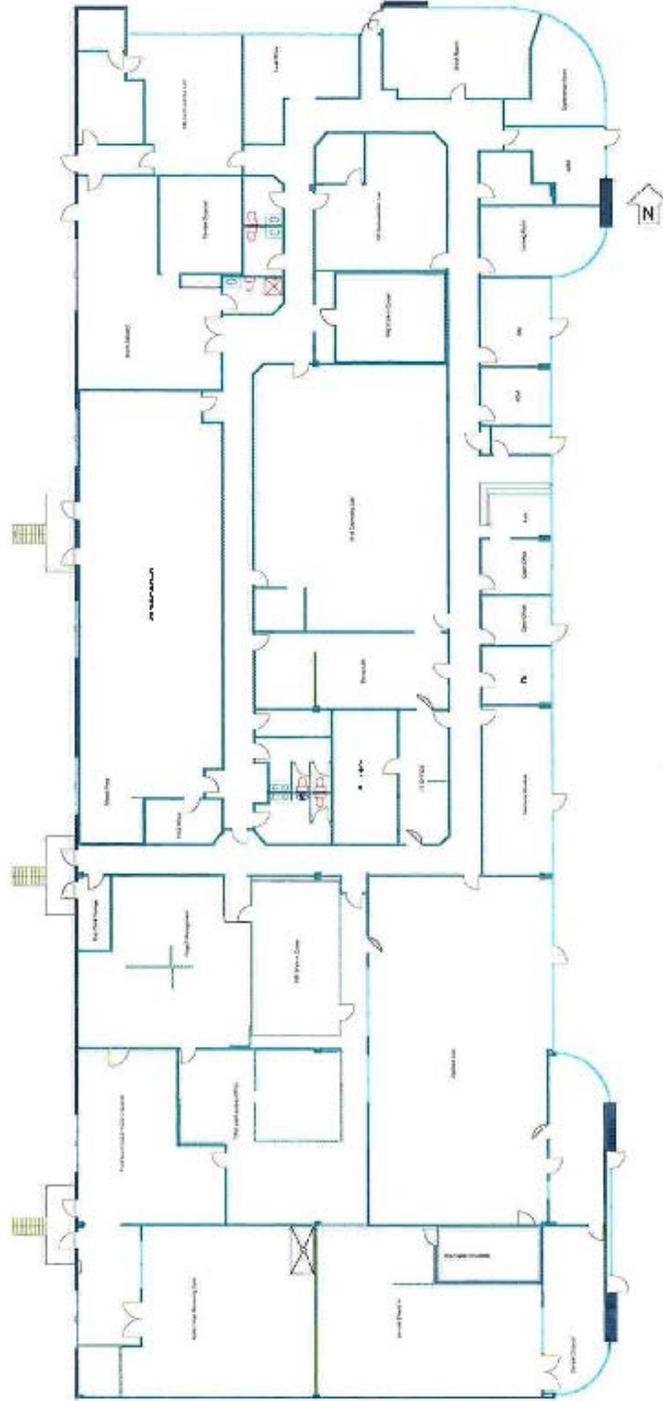
FRONTENAC, KANSAS LABORATORY EQUIPMENT LIST

Instrument	Age	Manufacturer	Model Number	Software
Ion Analyzer (pH)	2001	Accumet	AP61	N/A
Dissolved Oxygen	2006	YSI	550A	N/A
Conductivity Meter	2001	Accumet	AB30	N/A
Autoclave	2001	Tutnauer Brinkman	3870E	N/A
Incubator, water bath	2002	Precision	Precision	N/A
Incubator, thermal	1995	Equatherm	C1574	N/A
Bioassay Water Baths (Total of 5 units)	2001	ISO Temp	2100	N/A
Balance	1990	Metler	AE-240	N/A
Hach (pH, LDO, Cond)	2011	Hach	HQ40d	N/A

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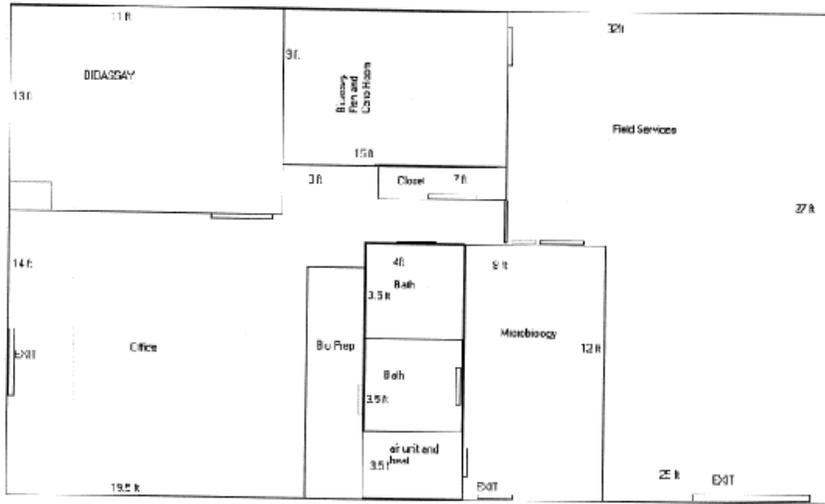
ATTACHMENT IV
LENEXA, KANSAS FLOOR PLAN (CURRENT AS OF ISSUE DATE)



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FRONTENAC KANSAS FLOOR PLAN (CURRENT AS OF ISSUE DATE)



- = eye wash
- = First aid kit
- = Door

All entrances to the level to outside environment

PACE ANALYTICAL SERVICES, INC.
 SOUTHEAST KANSAS SERVICE CENTER

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ATTACHMENT V- LABORATORY SOP LIST (CURRENT AS OF ISSUE DATE)

SOP Number	SOP Title
S-ALL-C-002-rev.3	BOTTLE ORDER DATABASE
S-ALL-C-005-rev.2	PACEPORT CUSTOMER FEEDBACK FORM
S-ALL-IT-001-rev.2	SYSTEM SECURITY AND INTEGRITY
S-ALL-Q-001-rev.9	PREPARATION OF SOPS
S-ALL-Q-002-rev.3	DOCUMENT MANAGEMENT
S-ALL-Q-003-rev.6	DOCUMENT NUMBERING
S-ALL-Q-007-rev.2	EPIC Pro: A CODE VALIDATION
S-ALL-Q-008-rev.2	EPIC Pro: A CODE ADDITION/MODIFICATION
S-ALL-Q-009-rev.4	LABORATORY DOCUMENTATION
S-ALL-Q-011-rev.3	AUDITS AND INSPECTIONS
S-ALL-Q-012-rev.2	CORRECTIVE AND PREVENTIVE ACTIONS
S-ALL-Q-014-rev.2	QUALITY SYSTEM REPORTING
S-ALL-Q-015-rev.0	REVIEW OF LABORATORY MANAGEMENT SYSTEM
S-ALL-Q-016-rev.4	MANUAL INTEGRATION
S-ALL-Q-018-rev.3	MONITORING STORAGE UNITS
S-ALL-Q-020-rev.4	TRAINING PROCEDURES
S-ALL-Q-021-rev.4	SUB-SAMPLING (SAMPLE HOMOGENIZATION)
S-ALL-Q-022-rev.3	3P PROGRAM: CONTINUOUS PROCESS IMPROVEMENT
S-ALL-Q-025-rev.4	STANDARD AND REAGENT PREPARATION AND TRACEABILITY
S-ALL-Q-028-rev.2	LABTRACK SYSTEM
S-ALL-Q-029-rev.2	MINTMINER® DATA FILE REVIEW
S-ALL-Q-030-rev.4	EPIC PRO: DATA CHECKER
S-ALL-Q-032-rev.0	CONTROL CHART GENERATION AND ANALYSIS
S-ALL-Q-034-rev.1	ANONYMOUS HOTLINE PROCEDURE
S-ALL-Q-035-rev.1	DATA RECALL
S-ALL-S-001-rev.3	TENTATIVELY IDENTIFIED COMPOUNDS
S-ALL-S-001-rev.3	HAZARD ASSESSMENT
S-KS-C-001-rev.3	SAMPLE MANAGEMENT
S-KS-C-002-rev.4	ASSEMBLY OF SAMPLE CONTAINER KITS
S-KS-C-003-rev.3	SUBCONTRACTING SAMPLES
S-KS-F-001-rev.3	FIELD MANUAL
S-KS-I-001-rev.7	ACIDITY
S-KS-I-002-rev.11	ALKALINITY
S-KS-I-003-rev.8	AMMONIA, NITROGEN BY 350.1
S-KS-I-004-rev.9	BOD/CBOD
S-KS-I-005-rev.8	CHEMICAL OXYGEN DEMAND
S-KS-I-006-rev.5	CHLORINE (AT)
S-KS-I-007-rev.9	CHLORINE(DPD)
S-KS-I-008-rev.11	HEXAVALENT CHROMIUM
S-KS-I-010-rev.8	DISSOLVED OXYGEN
S-KS-I-011-rev.4	FERROUS IRON
S-KS-I-013-rev.3	TKN BY 351.2
S-KS-I-014-rev.7	OIL AND GREASE/TPH BY 1664A
S-KS-I-015-rev.3	HEM/SGT-HEM BY 9071B MOD
S-KS-I-016-rev.10	TOTAL ORGANIC CARBON
S-KS-I-017-rev.5	TURBIDITY
S-KS-I-018-rev.8	pH IN WATER, SOIL AND WASTE
S-KS-I-019-rev.6	TOTAL RECOVERABLE PHENOLICS
S-KS-I-020-rev.10	TOTAL SOLIDS
S-KS-I-021-rev.11	TOTAL DISSOLVED SOLIDS
S-KS-I-022-rev.11	TOTAL SUSPENDED SOLIDS
S-KS-I-023-rev.7	SETTLABLE SOLIDS

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LABORATORY SOP LIST (CONTINUED)

SOP Number	SOP Title
S-KS-I-024-rev.8	VOLATILE AND FIXED SOLIDS
S-KS-I-025-rev.9	CONDUCTIVITY
S-KS-I-028-rev.7	SULFITE
S-KS-I-029-rev.9	METHYLENE BLUE ACTIVE SUBSTANCES
S-KS-I-030-rev.7	FLASHPOINT
S-KS-I-031-rev.6	REACTIVE SULFIDE
S-KS-I-032-rev.5	REACTIVE CYANIDE
S-KS-I-033-rev.6	PAINT FILTER LIQUIDS TEST
S-KS-I-036-rev.8	TOTAL AND AMENABLE CYANIDE
S-KS-I-037-rev.9	AUTOMATED CHLORIDE
S-KS-I-038-rev.4	ORTHOPHOSPHATE
S-KS-I-039-rev.10	NITRATE/NITRITE BY 353.2
S-KS-I-040-rev.4	TOTAL PHOSPHORUS
S-KS-I-043-rev.7	ANIONS BY IC
S-KS-I-044-rev.3	COLOR ANALYSIS
S-KS-I-045-rev.2	SPECIFIC OXYGEN UPTAKE RATE
S-KS-I-046-rev.2	TOTAL/VOLATILE/FIXED SOLIDS IN SLUDGES
S-KS-I-047-rev.0	SULFIDE BY METHYLENE BLUE METHOD (SM4500-S2 ⁻ D)
S-KS-I-048-rev.0	SULFIDE BY IODOMETRIC TITRATION (SM 4500-S2 ⁻ F)
S-KS-IT-001-rev.3	TARGET DATA BACKUP
S-KS-IT-002-rev.0	SERVER BACKUP
S-KS-M-001-rev.2	MICRODIGESTION BY 3010A
S-KS-M-002-rev.9	ACID DIGESTION OF WATERS
S-KS-M-003-rev.8	ACID DIGESTION OF SOILS
S-KS-M-004-rev.4	ACID DIGESTION OF WIPES
S-KS-M-005-rev.11	METALS BY ICP-AES
S-KS-M-006-rev.7	MERCURY PREPARATION AND ANALYSIS
S-KS-M-007-rev.4	CATION EXCHANGE CAPACITY
S-KS-M-008-rev.3	ICP METALS by 6010C
S-KS-M-009-rev.1	METALS BY ICPMS
S-KS-MB-001-rev.7	FECAL COLIFORM
S-KS-MB-003-rev.8	HETEROTROPHIC PLATE COUNT
S-KS-MB-006-rev.6	SUITABILITY TEST
S-KS-MB-007-rev.5	INHIBITORY RESIDUE TEST
S-KS-MB-008-rev.5	ACUTE AQUATIC TOXICITY
S-KS-MB-010-rev.5	CHRONIC AQUATIC TOXICITY
S-KS-MB-012-rev.5	PREPARING YCT
S-KS-MB-013-rev.5	CULTURING BRINE SHRIMP
S-KS-MB-018-rev.5	LIGHT INTENSITY/PHOTOPERIOD
S-KS-MB-019-rev.3	CULTURING C. DUBIA/HATCHING MINNOWS
S-KS-MB-021-rev.2	TOTAL COLIFORM AND E. COLI (COLILERT)
S-KS-MB-022-rev.0	BIOASSAY CHEMICAL TESTS
S-KS-O-001-rev.8	TCLP BY METHOD 1311
S-KS-O-002-rev.3	SPLP BY METHOD 1312
S-KS-O-003-rev.5	ORGANIC EXTRACTION SPIKE FORTIFICATION VERIFICATION
S-KS-O-004-rev.8	EDB/DBCP BY METHOD 8011
S-KS-O-005-rev.11	TPH-DRO BY MODIFIED 8015
S-KS-O-007-rev.9	PCBs IN WATER AND SOIL
S-KS-O-008-rev.8	PCBs in OIL AND WIPES
S-KS-O-012-rev.12	VOCs BY 8260B
S-KS-O-013-rev.11	BNAs BY METHOD 8270C
S-KS-O-014-rev.7	EPH BY METHOD OA-2

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SOP Number	SOP Title
S-KS-O-015-rev.7	EXTRACTABLE HYDROCARBONS BY OKLAHOMA DRO
S-KS-O-016-rev.4	PURGABLE HYDROCARBONS BY OKLAHOMA GRO
S-KS-O-017-rev.8	PERCENT MOISTURE IN SOIL
S-KS-O-018-rev.8	EDB/DBCP BY 504.1
S-KS-O-019-rev.8	VOCs IN WATER BY 602
S-KS-O-020-rev.6	PCBs BY METHOD 608
S-KS-O-022-rev.4	VOCs IN WATER BY 624
S-KS-O-023-rev.5	BNAs BY METHOD 625
S-KS-O-024-rev.4	TPH-DRO/ORO BY 8270C
S-KS-O-025-rev.3	TPH-GRO BY 8260B
S-KS-O-026-rev.2	VOLATILE AROMATICS/GRO BY 8021B AND 8015B/C
S-KS-O-027-rev.4	TPH-DRO BY METHOD 8015B/C
S-KS-O-028-rev.5	PAHs BY 8270C (SIM)
S-KS-O-029-rev.4	SEPARATORY FUNNEL EXTRACTION
S-KS-O-032-rev.3	MICROWAVE SOIL EXTRACTION
S-KS-O-033-rev.2	VPH BY OA-1
S-KS-O-035-rev.0	WASTE DILUTION
S-KS-O-036-rev.1	PCB EXTRACT CLEANUP
S-KS-O-037-rev.2	TPH BY TNRCC METHOD 1005/1006
S-KS-O-038-rev.1	SILICA GEL CLEANUP
S-KS-O-039-rev.0	MICROEXTRACTION OF AQUEOUS SAMPLES
S-KS-O-040-rev.0	SEPARATORY FUNNEL EXTRACTION (REDUCED VOLUME)
S-KS-Q-001-rev.6	LABORATORY GLASSWARE WASHING
S-KS-Q-005-rev.5	DATA REDUCTION, REVIEW AND REPORTING
S-KS-Q-006-rev.3	RECEIPT AND STORAGE OF LAB SUPPLIES
S-KS-Q-007-rev.6	LABORATORY SECURITY PROCEDURES
S-KS-Q-011-rev.4	REAGENT WATER QUALITY
S-KS-Q-012-rev.4	SIGNIFICANT FIGURES AND ROUNDING
S-KS-Q-018-rev.2	BP LaMP PROJECT MANAGEMENT
S-KS-Q-019-rev.3	LAB DATA FILING AND ARCHIVING
S-KS-Q-020-rev.3	USDA REGULATED SOIL
S-KS-Q-022-rev.2	ESTIMATION OF UNCERTAINTY
S-KS-Q-024-rev.2	INSTRUMENT TRANSPORT
S-KS-Q-025-rev.2	A2LA TERMS AND SYMBOLS
S-KS-Q-026-rev.4	PURCHASING OF LAB SUPPLIES
S-KS-Q-027-rev.1	SAMPLE COMPOSITING
S-KS-Q-028-rev.3	CUSTOMER COMPLAINT RESOLUTION
S-KS-Q-029-rev.1	LABORATORY HOUSEKEEPING
S-KS-Q-030-rev.0	MCL VIOLATION REPORTING
S-KS-Q-031-rev.0	SOFTWARE VALIDATION
S-KS-Q-032-rev.0	LIMIT OF DETECTION
S-KS-Q-033-rev.0	REVIEW OF ANALYTICAL REQUESTS
S-KS-Q-034-rev.0	MANAGEMENT OF CHANGE
S-KS-Q-035-rev.0	PROFICIENCY TESTING PROGRAM
S-KS-Q-036-rev.0	SUPPORT EQUIPMENT
S-KS-Q-040-rev.0	VENDOR QUALIFICATION
S-KS-S-002-rev.3	WASTE HANDLING
S-KS-S-003-rev.0	WASTE MGMT TRAINING REQUIREMENTS
S-KS-S-004-rev.1	WORKING ALONE

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ATTACHMENT VI- LABORATORY CERTIFICATION LIST (CURRENT AS OF ISSUE DATE)

Accrediting Authority	Program Category	Accrediting Agency	Certification #	Expiration Date
A2LA	Wyoming STR	A2LA	2456.01	7/31/2012
Arkansas	Hazardous Waste	Dept of Environmental Quality	02-019-0	2/2/2013
Arkansas	Waste Water	Dept of Environmental Quality	02-019-0	2/2/2013
Arkansas	Bioassay-WET	Dept of Environmental Quality	02-019-0	2/2/2013
Illinois	Hazardous Waste	Illinois EPA	002885	2/4/2013
Illinois	Waste Water	Illinois EPA	002885	2/4/2013
Iowa	Hazardous Waste	Dept of Natural Resources	118	7/1/2012
Iowa	Waste Water	Dept of Natural Resources	118	7/1/2012
Iowa	UST Program	Dept of Natural Resources	118	7/1/2012
Kansas	Drinking Water	Dept of Health & Environment	E-10116	4/30/2013
Kansas	Hazardous Waste	Dept of Health & Environment	E-10116	4/30/2013
Kansas	Microbiology	Dept of Health & Environment	E-10116	4/30/2013
Kansas	Waste Water	Dept of Health & Environment	E-10116	4/30/2013
Kansas	Bioassay-WET	Dept of Health & Environment	E-10116	4/30/2013
Louisiana	Hazardous Waste	Dept of Environmental Quality	03055	6/30/2012
Louisiana	Waste Water	Dept of Environmental Quality	03055	6/30/2012
Louisiana	Bioassay-WET	Dept of Environmental Quality	03055	6/30/2012
Minnesota	Bioassay-WET	Dept of Health	375495	12/31/12
Nevada	Waste Water	Division of Environmental Protection	KS000212011A	7/31/2012
Nevada	Hazardous Waste	Division of Environmental Protection	KS000212011A	7/31/2012
Oklahoma	Waste Water/Sludge	Dept of Environmental Quality	2011-066	8/31/2012
Oklahoma	Microbiology	Dept of Environmental Quality	2011-080	8/31/2012
Oklahoma	Bioassay-WET	Dept of Environmental Quality	2011-080	8/31/2012
Texas	Bioassay-WET	Texas Commission on Environmental Quality	T104704407-11-2	6/30/2012
Texas	Hazardous Waste	Texas Commission on Environmental Quality	T104704407-11-2	6/30/2012
Texas	Waste Water	Texas Commission on Environmental Quality	T104704407-11-2	6/30/2012
USDA	Foreign Soil Import	USDA	P330-12-00088	3/30/2015
Utah	Waste Water	Dept of Health	PASKS	4/30/13
Utah	Hazardous Waste	Dept of Health	PASKS	4/30/13
Utah	Bioassay-WET	Dept of Health	PASKS	4/30/13

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ATTACHMENT VIII- METHOD HOLD TIME, CONTAINER AND PRESERVATION GUIDE
(CURRENT AS OF ISSUE DATE)

Parameter	Method	Matrix	Container	Preservative	Max Hold Time
Acidity	SM2310B	Water	Plastic/Glass	≤ 6°C	14 Days
Actinides	HASL-300	Water		pH<2 HNO ₃	180 Days
Actinides	HASL-300	Solid		None	180 Days
Alkalinity	SM2320B/310.2	Water	Plastic/Glass	≤ 6°C	14 Days
Alkylated PAHs		Water		≤ 6°C; pH<2 1:1 HCl (optional)	14/40 Days preserved; 7/40 Days unpreserved
Alkylated PAHs		Solid		≤ 10°C	1 Year/40 Days
Total Alpha Radium (see note 3)	9315/903.0	Water	Plastic/Glass	pH<2 HNO ₃	180 days
Total Alpha Radium (see note 3)	9315	Solid		None	180 days
Anions (Br, Cl, F, NO ₂ , NO ₃ , o-Phos, SO ₄ , bromate, chlorite, chlorate)	300.0/300.1/SM4110B	Water	Plastic/Glass	≤ 6°C; EDA if bromate or chlorite run	All analytes 28 days except: NO ₂ , NO ₃ , o- Phos (48 Hours); chlorite (immediately for 300.0; 14 Days for 300.1). NO ₂ /NO ₃ combo 28 days.
Anions (Br, Cl, F, NO ₂ , NO ₃ , o-Phos, SO ₄ , bromate, chlorite, chlorate)	300.0	Solid	Plastic/Glass	≤ 6°C	All analytes 28 days except: NO ₂ , NO ₃ , o- Phos (48 hours); chlorite (immediately). NO ₂ /NO ₃ combo 28 days.
Anions (Br, Cl, F, NO ₂ , NO ₃ , o-Phos, SO ₄)	9056	Water/ Solid	Plastic/Glass	≤ 6°C	28 days
Aromatic and Halogenated Volatiles (see note 1)	8021	Solid	5035 vial kit	See note 1	14 days
Aromatic and Halogenated Volatiles	602/8021	Water	40mL vials	pH<2 HCl; ≤ 6°C; Na ₂ S ₂ O ₃ if Cl present	14 Days (7 Days for aromatics if unpreserved)
Acid Volatile Sulfide	Draft EPA 1629	Solid	8oz Glass	≤ 6°C	14 Days
Bacteria, Total Plate Count	SM9221D	Water	Plastic/WK	≤ 6°C; Na ₂ S ₂ O ₃	24 Hours
Base/Neutrals and Acids	8270	Solid	8oz Glass	≤ 6°C	14/40 Days
Base/Neutrals and Acids	625/8270	Water	1L Amber Glass	≤ 6°C; Na ₂ S ₂ O ₃ if Cl present	7/40 Days
Base/Neutrals, Acids &	525.2	Water	1L Amber	pH<2 HCl; ≤	14/30 Days

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Parameter	Method	Matrix	Container	Preservative	Max Hold Time
Pesticides			Glass	6°C; Na sulfite if Cl present	
Biomarkers		Water	≤ 6°C; pH<2 1:1 HCl (optional)	14/40 Days preserved; 7/40 Days unpreserved	≤ 6°C; pH<2 1:1 HCl (optional)
Biomarkers		Solid	≤ 10°C	1 Year/40 Days	≤ 10°C
BOD/cBOD	SM5210B	Water	Plastic/Glass	≤ 6°C	48 hours
BTEX/Total Hydrocarbons	TO-3	Air	Summa Canister	None	14 Days
BTEX/Total Hydrocarbons	TO-3	Air	Tedlar Bag or equivalent	None	48 Hours
Cation/Anion Balance	SM1030E	Water	Plastic/Glass	None	None
Cation Exchange	9081	Solid	8oz Glass	None	unknown
Chloride	SM4500Cl-C,E	Water	Plastic/Glass	None	28 Days
Chlorine, Residual	SM4500Cl-D,E,G/330.5/Hach 8167	Water	Plastic/Glass	None	15 minutes
Chlorophyll	SM10200H	Water	Opaque bottle or aluminum foil		
COD	SM5220C, D/410.4/Hach 8000	Water	Plastic/Glass	pH<2 H ₂ SO ₄ ; ≤ 6°C	28 Days
Coliform, Fecal	SM9222D	Water	100mL Plastic	≤ 6°C	6 Hours
Coliform, Fecal	SM9222D	Solid	100mL Plastic	≤ 6°C	6 Hours
Coliform, Total and Escherichla (E. coli)	SM9223B	Water	100mL Plastic	≤ 10°C	48 Hours after collection; results from samples analyzed 30-48 Hours after collection must be qualified as analyzed >30 hours
Color	SM2120B,E	Water	Covered Plastic/Acid Washed Amber Glass	≤ 6°C	24 Hours
Condensable Particulate Emissions	EPA 202	Air	Solutions	None	6 Months
Cyanide, Reactive	SW846 chap.7	Water	Plastic/Glass	None	28 Days
Cyanide, Reactive	SW846 chap.7	Solid	Plastic/Glass	None	28 Days
Cyanide, Total and Amenable	SM4500CN-A,B,C,D,E,G,I,N/9010/	Water	Plastic/Glass	pH≥12 NaOH; ≤	14 Days (24 Hours if

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Parameter	Method	Matrix	Container	Preservative	Max Hold Time
	9012/335.4			6°C; ascorbic acid if Cl present	sulfide present-applies to SM4500CN only)
Diesel Range Organics- Alaska DRO	AK102	Solid	8oz Glass	≤ 6°C	14/40 Days
Diesel Range Organics- Alaska DRO	AK102	Water	1L Glass	pH<2 HCl; ≤ 6°C	14/40 Days
Diesel Range Organics- TPH DRO	8015	Solid	8oz Glass Jar	≤ 6°C	14/40 Days
Diesel Range Organics- TPH DRO	8015	Water	1L Amber Glass	≤ 6°C; Na ₂ S ₂ O ₃ if Cl present	7/40 Days
Diesel Range Organics- TPH DRO	8015	Tissue	1L Amber Glass	≤ - 10°C	1 Year if frozen/40 Days
Diesel Range Organics- NwTPH-Dx	Nw-TPH-Dx	Solid	8oz Glass Jar	≤ 6°C	14/40 Days
Diesel Range Organics- NwTPH-Dx	Nw-TPH-Dx	Water	1L Amber Glass	pH <2 HCl; ≤ 6°C	14/40 Days; 7 Days from collection to extraction if unpreserved
Diesel Range Organics- Wisconsin DRO	WI MOD DRO	Solid	Tared 4oz Glass Jar	≤ 6°C	10/47 Days
Diesel Range Organics- Wisconsin DRO	WI MOD DRO	Water	1L Amber Glass	≤ 6°C	14/40 Days
Dioxins and Furans	1613B	Solid	8oz Glass	≤ -10°C	1 year
Dioxins and Furans	1613B	Water	1L Amber Glass	≤ 6°C; Na ₂ S ₂ O ₃ if Cl present	1 year
Dioxins and Furans	1613B	Fish/ Tissue	Aluminum foil	< -10°C	1 year
Dioxins and Furans	8290	Water	1L Amber Glass	≤ 6°C; Na ₂ S ₂ O ₃ if Cl present	30/45 Days
Dioxins and Furans	8290	Solid	8oz Glass	≤ 6°C	30/45 Days
Dioxins and Furans	8290	Fish/ Tissue	Not specified	< -10°C	30/45 Days
Dioxins and Furans	TO-9	Air	PUF	None	30/45 Days
EDB/DBCP (8011) EDB/DBCP/1,2,3-TCP (504.1)	504.1/8011	Water	40mL vials	≤ 6°C; Na ₂ S ₂ O ₃ if Cl present	14 Days
Explosives	8330/8332	Water	1L Amber Glass	≤ 6°C	7/40 Days
Explosives	8330/8332	Solid	8oz Glass Jar	≤ 6°C	14/40 Days
Extractable Petroleum Hydrocarbons (aliphatic and	MA-EPH	Water	1L Amber Glass	pH<2 HCl; ≤ 6°C	14/40 Days

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Parameter	Method	Matrix	Container	Preservative	Max Hold Time
aromatic)					
Extractable Petroleum Hydrocarbons (aliphatic and aromatic)	MA-EPH	Solid	4oz Glass Jar	$\leq 6^{\circ}\text{C}$	7/40 Days
Ferrous Iron	SN3500Fe-D	Water	Glass	None	Immediate
Flashpoint/Ignitability	1010	Liquid	Plastic/Glass	None	28 Days
Fluoride	SM4500Fl-C,D	Water	Plastic	None	28 Days
Gamma Emitting Radionuclides	901.1	Water	Plastic/Glass	$\text{pH}<2 \text{ HNO}_3$	180 days
Gasoline Range Organics	8015	Water	40mL vials	$\text{pH}<2 \text{ HCl}$	14 Days
Gasoline Range Organics	8015	Solid	5035 vial kit	See note 1	14 days
Gasoline Range Organics-Alaska GRO	AK101	Solid	5035 vial kit	See 5035 note*	28 Days if GRO only (14 Days with BTEX)
Gasoline Range Organics-Alaska GRO	AK101	Water	40mL vials	$\text{pH}<2 \text{ HCl}; \leq 6^{\circ}\text{C}$	14 Days
Gasoline Range Organics-NwTPH-Gx	Nw-TPH-Gx	Water	40mL vials	$\text{pH}<2 \text{ HCl}; \leq 6^{\circ}\text{C}$	7 Days unpreserved; 14 Days preserved
Gasoline Range Organics-NwTPH-Gx	Nw-TPH-Gx	Solid	40mL vials	$\leq 6^{\circ}\text{C};$ packed jars with no headspace	14 Days
Gasoline Range Organics-Wisconsin GRO	WI MOD GRO	Water	40mL vials	$\text{pH}<2 \text{ HCl}; \leq 6^{\circ}\text{C}$	14 Days
Gasoline Range Organics-Wisconsin GRO	WI MOD GRO	Solid	40mL MeOH vials	$\leq 6^{\circ}\text{C}$ in MeOH	21 Days
Gross Alpha (NJ 48Hr Method)	NJAC 7:18-6	Water	Plastic/Glass	$\text{pH}<2 \text{ HNO}_3$	48 Hrs
Gross Alpha and Gross Beta	9310/900.0	Water	Plastic/Glass	$\text{pH}<2 \text{ HNO}_3$	180 Days
Gross Alpha and Gross Beta	9310	Solid	Glass	None	180 Days
Haloacetic Acids	552.1/552.2	Water	40mL Amber vials	$\text{NH}_4\text{Cl}; \leq 6^{\circ}\text{C}$	14/7 Days if extracts stored $\leq 6^{\circ}\text{C}$ or 14/14 Days if extracts stored at $\leq -10^{\circ}\text{C}$
Hardness, Total (CaCO_3)	SM2340B,C/130.1	Water	Plastic/Glass	$\text{pH}<2 \text{ HNO}_3$	6 Months
Heterotrophic Plate Count (MPC)	SM9215B	Water	100mL Plastic	$\leq 6^{\circ}\text{C}$	24 Hours
Herbicides, Chlorinated	8151	Solid	8oz Glass Jar	$\leq 6^{\circ}\text{C}$	14/40 Days
Herbicides, Chlorinated	8151	Water	1L Amber Glass	$\leq 6^{\circ}\text{C};$ $\text{Na}_2\text{S}_2\text{O}_3$ if Cl present	7/40 Days
Herbicides, Chlorinated	515.1/515.3	Water	1L Amber Glass	$\leq 6^{\circ}\text{C};$ $\text{Na}_2\text{S}_2\text{O}_3$ if Cl present	14/28 Days
Hexavalent Chromium	7196/218.6/SM3500Cr-C,D	Water	Plastic/Glass	$\leq 6^{\circ}\text{C}$	24 Hours

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Parameter	Method	Matrix	Container	Preservative	Max Hold Time
Hexavalent Chromium	7196 (with 3060A)	Solid		≤ 6°C	24 Hours after extraction
Hydrogen Halide and Halogen Emissions	EPA 26	Air	Solutions	None	6 Months
Ignitability of Solids	1030	Non-liquid Waste	Plastic/Glass	None	28 Days
Lead Emissions	EPA 12	Air	Filter/Solutions	None	6 Months
Lipids	Pace Lipids	Tissue	Plastic/Glass	≤ -10°C	1 Year if frozen
Mercury, Low-Level	1631E	Solid			
Mercury, Low-Level	1631E	Water	Fluoropolymer bottles (Glass if Hg is only analyte being tested)	12N HCl or BrCl	48 Hours for preservation or analysis; 28 Days to preservation if sample oxidized in bottle; 90 Days for analysis if preserved
Mercury, Low-Level	1631E	Tissue	Plastic/Glass	≤ -10°C	28 Days if frozen
Mercury	7471	Solid	8oz Glass Jar	≤ 6°C	28 days
Mercury	7470/245.1/245.2	Water	Plastic/Glass	pH<2 HNO ₃	28 Days
Mercury	7471/245.6	Tissue	Plastic/Glass	≤ -10°C	28 Days if frozen
Metals (GFAA)	7000/200.9	Water	Plastic/Glass	pH<2 HNO ₃	6 Months
Metals (ICP)	NIOSH 7300A/7303	Air	Filters	None	6 Months
Metals (ICP/ICPMS)	6010/6020	Solid	8oz Glass Jar	None	6 months
Metals (ICP/ICPMS)	6010/6020/200.7/200.8	Water	Plastic/Glass	pH<2 HNO ₃	6 Months
Metals (ICP/ICPMS)	6020	Tissue	Plastic/Glass	≤ -10°C	6 Months if frozen
Methane, Ethane, Ethene	8015 modified	Water	40mL vials	HCl	14 Days
Methane, Ethane, Ethene	RSK-175	Water	40mL vials	HCl	14 Days
Methane, Ethane, Ethene	EPA 3C	Air	Summa Canister	None	14 Days
Methane, Ethane, Ethene	EPA 3C	Air	Tedlar Bag or equivalent	None	48 Hours
Methanol, Ethanol	8015 modified	Water	40mL vials	≤ 6°C	14 Days
Methanol, Ethanol	8015 modified	Solid	2oz Glass	≤ 6°C	14 Days
Nitrogen, Ammonia	SM4500NH3/350.1	Water	Plastic/Glass	pH<2 H ₂ SO ₄ ; ≤ 6°C	28 Days
Nitrogen, Kjeldahl (TKN)	351.2	Solid	Plastic/Glass	≤ 6°C	28 Days
Nitrogen, Kjeldahl (TKN)	SM4500-Norg/351.2	Water	Plastic/Glass	pH<2 H ₂ SO ₄ ; ≤ 6°C	28 Days
Nitrogen, Nitrate	SM4500-NO3/352.1	Water	Plastic/Glass	≤ 6°C	24 Hours preferred
Nitrogen, Nitrate & Nitrite combination	353.2	Solid	Plastic/Glass	≤ 6°C	28 Days
Nitrogen, Nitrate & Nitrite	SM4500-NO3/353.2	Water	Plastic/Glass	pH<2 H ₂ SO ₄ ;	28 Days

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Parameter	Method	Matrix	Container	Preservative	Max Hold Time
combination				≤ 6°C	
Nitrogen, Nitrite or Nitrate separately	SM4500-NO2/353.2	Water	Plastic/Glass	≤ 6°C	48 Hours
Nitrogen, Organic	SM4500-Norg/351.2	Water	Plastic/Glass	pH<2 H ₂ SO ₄ ; ≤ 6°C	28 Days
Non-Methane Organics	EPA 25C	Air	Summa Canister	None	14 Days
Non-Methane Organics	EPA 25C	Air	Tedlar Bag or equivalent	None	48 Hours
Odor	SM2150B	Water	Glass	≤ 6°C	24 Hours
Oil and Grease/HEM	1664A/SM5520B/9070	Water	Glass	pH<2 H ₂ SO ₄ or HCl; ≤ 6°C	28 Days
Oil and Grease/HEM	9071	Solid	Glass	≤ 6°C	28 Days
PBDEs	1614	Water	1L Amber Glass	≤ 6°C	1 Year/1 Year
PBDEs	1614	Solid	Wide Mouth Jar	≤ 6°C	1 Year/1 Year
PBDEs	1614	Tissue	Aluminum Foil	≤ -10°C	1 Year/1 Year
PCBs and Pesticides, Organochlorine (OC)	TO-4/TO-10	Air	PUF	None	7/40 Days
PCBs and Pesticides, Organochlorine (OC)	608	Water	1L Amber Glass		Pest: 7/40 Days; PCB: 1 Year/1 Year
Pesticides, Organochlorine (OC)	8081	Water	1L Amber Glass	≤ 6°C; Na ₂ S ₂ O ₃ if Cl present	7/40 Days
Pesticides, Organochlorine (OC)	8081	Solid	8oz Glass Jar	≤ 6°C	14/40 Days
Pesticides, Organochlorine (OC)	8081	Tissue	8oz Glass Jar	≤ -10°C	1 Year if frozen/40 Days
Pesticides, Organophosphorous (OP)	8141	Solid	8oz Glass Jar	≤ 6°C	14/40 Days
Pesticides, Organophosphorous (OP)	8141	Water	1L Amber Glass	pH 5-8 with NaOH or H ₂ SO ₄ ; ≤ 6°C; Na ₂ S ₂ O ₃ if Cl present	7/40 Days
PCBs (Aroclors)	8082	Water	1L Amber Glass	≤ 6°C; Na ₂ S ₂ O ₃ if Cl present	1 Year/1 Year
PCBs (Aroclors)	8082	Solid	8oz Glass Jar	≤ 6°C	1 Year/1 Year
PCBs (Aroclors)	8082	Tissue	Plastic/Glass	≤ -10°C	1 Year if frozen/1 Year
PCB Congeners	1668A	Water	1L Amber Glass	≤ 6°C but above freezing	1 Year/1 Year

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Parameter	Method	Matrix	Container	Preservative	Max Hold Time
PCB Congeners	1668A	Solid	4-8oz Glass Jar	≤ 6°C but above freezing	1 Year/1 Year
PCB Congeners	1668A	Tissue	4-8oz Glass Jar	≤ -10°C	1 Year/1 Year
Oil Range Organics- ORO					
Oxygen, Dissolved (Probe)	SM4500-O	Water	Glass	None	15 minutes
Paint Filter Liquid Test	9095	Water	Plastic/Glass	None	N/A
Particulates	PM-10	Air	Filters	None	6 Months
Permanent Gases	EPA 3C	Air	Summa Canister	None	14 Days
Permanent Gases	EPA 3C	Air	Tedlar Bag or equivalent	None	48 Hours
pH	SM4500H+B/9040	Water	Plastic/Glass	None	15 minutes
pH	9045	Solid	Plastic/Glass	None	
Phenol, Total	420.1/420.4/9065/9066	Water	Glass	pH<2 H ₂ SO ₄ ; ≤ 6°C	28 Days
Phosphorus, Orthophosphate	SM4500P/365.1/365.3	Water	Plastic	Filter; ≤ 6°C	Filter within 15 minutes, Analyze within 48 Hours
Phosphorus, Total	SM4500P/365.1/365.3/365.4	Water	Plastic/Glass	pH<2 H ₂ SO ₄ ; ≤ 6°C	28 Days
Phosphorus, Total	365.4	Solid	Plastic/Glass	≤ 6°C	28 Days
Polynuclear Aromatic Hydrocarbons (PAH)	TO-13	Air	PUF	None	7/40 Days
Polynuclear Aromatic Hydrocarbons (PAH)	8270 SIM	Solid	8oz Glass Jar	≤ 6°C	14/40 Days
Polynuclear Aromatic Hydrocarbons (PAH)	8270 SIM	Water	1L Amber Glass	≤ 6°C; Na ₂ S ₂ O ₃ if Cl present	7/40 Days
Polynuclear Aromatic Hydrocarbons (PAH)	8270 SIM	Tissue	Plastic/Glass	≤ -10°C	1 Year if frozen/40 Days
Radioactive Strontium	905.0	Water	Plastic/Glass	pH<2 HNO ₃	180 days
Radium-226	903.0/903.1	Water	Plastic/Glass	pH<2 HNO ₃	180 days
Radium-228 (see note 3)	9320/904.0	Water	Plastic/Glass	pH<2 HNO ₃	180 days
Radium-228 (see note 3)	9320	Solid			
Residual Range Organics- Alaska RRO	AK103	Solid	8oz Glass	≤ 6°C	14/40 Days
Saturated Hydrocarbons		Water	≤ 6°C; pH<2 1:1 HCl (optional)	14/40 Days preserved; 7/40 Days unpreserved	≤ 6°C; pH<2 1:1 HCl (optional)
Saturated Hydrocarbons		Solid	≤ 10°C	1 Year/40 Days	≤ 10°C
Silica, Dissolved	SM4500Si-D	Water	Plastic	≤ 6°C	28 Days
Solids, Settleable	SM2540F	Water	Glass	≤ 6°C	48 Hours

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Parameter	Method	Matrix	Container	Preservative	Max Hold Time
Solids, Total	SM2540B	Water	Plastic/Glass	≤ 6°C	7 Days
Solids, Total	SM2540G	Solid	Plastic/Glass	≤ 6°C	7 Days
Solids, Total (FOC, OM, Ash)	ASTM D2974	Solid	Plastic/Glass	≤ 6°C	7 Days
Solids, Total Dissolved	SM2540C	Water	Plastic/Glass	≤ 6°C	7 Days
Solids, Total Suspended	SM2540D/USGS I-3765-85	Water	Plastic/Glass	≤ 6°C	7 Days
Solids, Total Volatile	160.4/SM2540E	Water	Plastic/Glass	≤ 6°C	7 Days
Solids, Total Volatile	160.4	Solid	Plastic/Glass	≤ 6°C	7 Days
Specific Conductance	SM2510B/9050/120.1	Water	Plastic/Glass	≤ 6°C	28 Days
Stationary Source Dioxins and Furans	EPA 23	Air	XAD Trap	None	30/45 Days
Stationary Source Mercury	EPA 101	Air	Filters	None	6 Months, 28 Days for Hg
Stationary Source Metals	EPA 29	Air	Filters	None	6 Months, 28 Days for Hg
Stationary Source PM10	EPA 201A	Air	Filters	None	6 Months
Stationary Source Particulates	EPA 5	Air	Filter/Solutions	None	6 Months
Sulfate	SM4500SO4/9036/9038/375.2/ASTM D516	Water	Plastic/Glass	≤ 6°C	28 Days
Sulfide, Reactive	SW-846 Chap.7	Water	Plastic/Glass	None	28 Days
Sulfide, Reactive	SW-846 Chap.7	Solid	Plastic/Glass	None	28 Days
Sulfide, Total	SM4500S/9030	Water	Plastic/Glass	pH>9 NaOH; ZnOAc; ≤ 6°C	7 Days
Sulfite	SM4500SO3	Water	Plastic/Glass	None	15 minutes
Surfactants (MBAS)	SM5540C	Water	Plastic/Glass	≤ 6°C	48 Hours
Total Organic Carbon (TOC)	SM5310B,C,D/9060	Water	Glass	pH<2 H ₂ SO ₄ or HCl; ≤ 6°C	28 Days
Total Organic Carbon (TOC)	9060/Walkley Black	Solid	Glass	≤ 6°C	14 Days
Total Organic Halogen (TOX)	SM5320/9020/9021	Water	Glass; no headspace	≤ 6°C	14 Days
Tritium	906.0	Water	Glass	None	180 days
Turbidity	SM2130B/180.1	Water	Plastic/Glass	≤ 6°C	48 Hours
Total Uranium	908.0/ASTM D5174-97	Water	Plastic/Glass	pH<2 HCl	180 days
Volatile Petroleum Hydrocarbons (aliphatic and aromatic)	MA-VPH	Water	40mL vials	pH<2 HCl; ≤ 6°C	14 Days preserved
Volatile Petroleum Hydrocarbons (aliphatic and aromatic)	MA-VPH	Solid	4-8oz Glass Jar	≤ 6°C; packed jars with no headspace	7/28 Days
Volatiles	TO-14	Air	Summa Canister	None	30 Days

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Parameter	Method	Matrix	Container	Preservative	Max Hold Time
Volatiles	TO-14	Air	Tedlar Bag or equivalent	None	48 Hours
Volatiles	TO-15	Air	Summa Canister	None	30 Days
Volatiles	8260	Solid	5035 vial kit	See note 1	14 days
Volatiles	8260	Water	40mL vials	pH<2 HCl; ≤ 6°C; Na ₂ S ₂ O ₃ if Cl present	14 Days
Volatiles	8260	Conc. Waste	5035 vial kit or 40mL vials	≤ 6°C	14 Days
Volatiles	624	Water	40mL vials	pH<2 HCl; ≤ 6°C; Na ₂ S ₂ O ₃ if Cl present	14 Days (7 Days for aromatics if unpreserved)
Volatiles (see note 2)	524.2	Water	40mL vials (in duplicate)	pH<2 HCl; ≤ 6°C; Ascorbic acid or Na ₂ S ₂ O ₃ if Cl present ²	14 Days

¹ **5035/5035A Note:** 5035 vial kit typically contains 2 vials water, preserved by freezing **or**, 2 vials aqueous sodium bisulfate preserved at 4°C, **and** one vial methanol preserved at ≤6°C **and** one container of unpreserved sample stored at ≤6°C.

² Method 524.2 lists ascorbic acid as the preservative when residual chlorine is suspected, unless gases or Table 7 compounds are NOT compounds of interest and then sodium thiosulfate is the preservative recommended.

³ Methods 9315 and 9320 both state that if samples are unpreserved, the samples should be brought to the lab within 5 days of collection, preserved in the lab, and then allowed to sit for a minimum of 16 hours before sample preparation/analysis.

Appendix A-2

Tables

Table A-1
Analytical Parameters and Reporting Limits
RD/PDA QA-FSP
Wichita, Kansas

Parameter	CAS	Units	RSK	PQL	MDL
SW846 8260B					
1,1,1,2-Tetrachloroethane	630-20-6	ug/L	5.35	1.0	0.15
1,1,1-Trichloroethane	71-55-6	ug/L	200	1.0	0.11
1,1,2,2-Tetrachloroethane	79-34-5	ug/L	0.694	1.0	0.15
1,1,2-Trichloroethane	79-00-5	ug/L	5	1.0	0.20
1,1,2-Trichlorotrifluoroethane	76-13-1	ug/L	3940	1.0	0.34
1,1-Dichloroethane	75-34-3	ug/L	25	1.0	0.050
1,1-Dichloroethene	75-35-4	ug/L	7	1.0	0.20
1,1-Dichloropropene	563-58-6	ug/L	NA	1.0	0.090
1,2,3-Trichlorobenzene	87-61-6	ug/L	NA	1.0	0.12
1,2,3-Trichloropropane	96-18-4	ug/L	0.00468	2.5	0.19
1,2,4-Trichlorobenzene	120-82-1	ug/L	70	1.0	0.10
1,2,4-Trimethylbenzene	95-63-6	ug/L	8.44	1.0	0.090
1,2-Dibromo-3-chloropropane	96-12-8	ug/L	0.2	2.5	0.59
1,2-Dibromoethane	106-93-4	ug/L	0.05	1.0	0.17
1,2-Dichlorobenzene	95-50-1	ug/L	600	1.0	0.050
1,2-Dichloroethane	107-06-2	ug/L	5	1.0	0.12
1,2-Dichloroethene (Total)	540-59-0	ug/L	70	1.0	0.28
1,2-Dichloropropane	78-87-5	ug/L	5	1.0	0.16
1,3,5-Trimethylbenzene	108-67-8	ug/L	44	1.0	0.10
1,3-Dichlorobenzene	541-73-1	ug/L	NA	1.0	0.070
1,3-Dichloropropane	142-28-9	ug/L	NA	1.0	0.17
1,4-Dichlorobenzene	106-46-7	ug/L	75	1.0	0.060
1-Methylnaphthalene	90-12-0	ug/L	NA	5.0	0.23
2,2-Dichloropropane	594-20-7	ug/L	NA	1.0	0.19
2-Butanone	78-93-3	ug/L	4,920	10	0.59
2-Chloroethylvinyl ether	110-75-8	ug/L	NA	10	0.13
2-Chlorotoluene	95-49-8	ug/L	88.9	1.0	0.12
2-Hexanone	591-78-6	ug/L	NA	10	1.2
2-Methylnaphthalene	91-57-6	ug/L	16.7	5.0	0.23
4-Chlorotoluene	106-43-4	ug/L	NA	1.0	0.14
4-Methyl-2-pentanone	108-10-1	ug/L	1,020	10	0.42
Acetone	67-64-1	ug/L	11,500	10	1.9

CAS - Chemical Abstract Service Registry Number

RSK - Risk-Based Standard for Kansas

PQL - laboratory practical quantitation limit

MDL - laboratory method detection limit

mg/L - milligrams per liter

ug/L - micrograms per liter

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RD/PDA QA-FSP
Wichita, Kansas

Parameter	CAS	Units	RSK	PQL	MDL
SW846 8260B					
Acetonitrile	75-05-8	ug/L	NA	10	2.8
Acrolein	107-02-8	ug/L	0.0415	100	5.0
Acrylonitrile	107-13-1	ug/L	0.491	20	1.1
Benzene	71-43-2	ug/L	5	1.0	0.060
Bromobenzene	108-86-1	ug/L	NA	1.0	0.10
Bromochloromethane	74-97-5	ug/L	NA	1.0	0.15
Bromodichloromethane	75-27-4	ug/L	80	1.0	0.19
Bromoform	75-25-2	ug/L	80	1.0	0.070
Bromomethane	74-83-9	ug/L	7	5.0	0.16
Carbon disulfide	75-15-0	ug/L	716	5.0	0.12
Carbon tetrachloride	56-23-5	ug/L	5	1.0	0.18
Chlorobenzene	108-90-7	ug/L	100	1.0	0.21
Chloroethane	75-00-3	ug/L	14,000	1.0	0.15
Chloroform	67-66-3	ug/L	80	1.0	0.14
Chloromethane	74-87-3	ug/L	127	1.0	0.080
cis-1,2-Dichloroethene	156-59-2	ug/L	70	1.0	0.080
cis-1,3-Dichloropropene	10061-01-5	ug/L	NA	1.0	0.14
Dibromochloromethane	124-48-1	ug/L	80	1.0	0.21
Dibromomethane	74-95-3	ug/L	NA	1.0	0.18
Dichlorodifluoromethane	75-71-8	ug/L	366	1.0	0.21
Diethyl ether (Ethyl ether)	60-29-7	ug/L	NA	1.0	0.28
Diisopropyl ether	108-20-3	ug/L	NA	1.0	0.080
Ethylbenzene	100-41-4	ug/L	700	1.0	0.18

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RD/PDA QA-FSP
Wichita, Kansas

Parameter	CAS	Units	RSK	PQL	MDL
SW846 8260B					
Ethyl tert-butyl ether	637-92-3	ug/L	NA	1.0	0.10
Hexachloro-1,3-butadiene	87-68-3	ug/L	6.32	1.0	0.18
Iodomethane	74-88-4	ug/L	NA	10	0.050
Isopropylbenzene (Cumene)	98-82-8	ug/L	451	1.0	0.070
m,p-Xylene	179601-23-1	ug/L	10,000	2.0	0.27
Methylene chloride	75-09-2	ug/L	5	1.0	0.15
Methyl tert-butyl ether	1634-04-4	ug/L	133	1.0	0.060
Naphthalene	91-20-3	ug/L	1.11	10	0.16
n-Butylbenzene	104-51-8	ug/L	16.9	1.0	0.10
n-Heptane	142-82-5	ug/L	NA	10	0.34
n-Hexane	110-54-3	ug/L	316	10	0.24
n-Propylbenzene	103-65-1	ug/L	660	1.0	0.10
o-Xylene	95-47-6	ug/L	10,000	1.0	0.15
p-Isopropyltoluene	99-87-6	ug/L	NA	1.0	0.10
sec-Butylbenzene	135-98-8	ug/L	30.5	1.0	0.050
Styrene	100-42-5	ug/L	100	1.0	0.12
tert-Amyl methyl ether	994-05-8	ug/L	NA	1.0	0.12
tert-Butyl alcohol	75-65-0	ug/L	256	10	2.2
tert-Butylbenzene	98-06-6	ug/L	NA	1.0	0.34
Tetrachloroethene	127-18-4	ug/L	5	1.0	0.10
Toluene	108-88-3	ug/L	1000	1.0	0.17
trans-1,2-Dichloroethene	156-60-5	ug/L	100	1.0	0.20
trans-1,3-Dichloropropene	10061-02-6	ug/L	NA	1.0	0.12
trans-1,4-Dichloro-2-butene	110-57-6	ug/L	NA	20	0.30
Trichloroethene	79-01-6	ug/L	5	1.0	0.17
Trichlorofluoromethane	75-69-4	ug/L	1090	1.0	0.34
Vinyl acetate	108-05-4	ug/L	406	20	0.14
Vinyl chloride	75-01-4	ug/L	2	1.0	0.13
Xylene (Total)	1330-20-7	ug/L	10,000	3.0	0.42

CAS - Chemical Abstract Service Registry Number

RSK - Risk-Based Standard for Kansas

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Analytical Parameters and Reporting Limits
RD/PDA QA-FSP
Wichita, Kansas

Parameter	CAS	Units	RSK	PQL	MDL
EPA 353.2					
Nitrate (as N)	14797-55-8	mg/L	NA	0.1	0.028
Nitrite (as N)	14797-65-0	mg/L	NA	0.1	0.032
NO2 plus NO3 (as N)	multiple	mg/L	NA	0.1	0.014
EPA 300.0					
Chloride	16887-00-6	mg/L	NA	1.0	0.035
Sulfate	14808-79-8	mg/L	NA	1.0	0.10
SW846 6010B					
Dissolved Arsenic	7440-38-2	ug/L	10	10	4.6
Dissolved Calcium	7440-70-2	ug/L	NA	100	10
Dissolved Iron	7439-89-6	ug/L	NA	50	12
Dissolved Magnesium	7439-95-4	ug/L	NA	50	6.5
Dissolved Manganese	7439-96-5	ug/L	50	5.0	0.49
Dissolved Sodium	7440-23-5	ug/L	NA	500	22
Standard Methods 2320 B-1997					
Alkalinity	N/A	mg/L	NA	20	1.2
Standard Methods 4500-CO₂ D-1997					
Carbon Dioxide	124-38-9	mg/L	NA	20	1.2
Standard Methods 5310 C-2000					
Dissolved Organic Carbon	7440-44-0	mg/L	NA	1.0	0.12
Standard Methods 4500-S₂⁻ D-2000					
Sulfide	18496-25-8	mg/L	NA	0.1	0.016

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Analytical Parameters and Reporting Limits
RD/PDA QA-FSP
Wichita, Kansas

Parameter	CAS	Units	RSK	PQL	MDL
Standard Methods 4500-S²⁻ F-2000					
Sulfide	18496-25-8	mg/L	NA	0.5	0.2
Standard Methods 5560 C					
Volatile Fatty Acids	N/A	mg/L	NA	20.0	10.0
Standard Methods RSK 175 (Dissolved Gases)					
Methane	74-82-8	ug/L	NA	6.6	3.3
Ethane	74-84-0	ug/L	NA	6.2	0.86
Ethene	74-85-1	ug/L	NA	6.2	0.79
Standard Methods 2540 C-1997					
Total Dissolved Solids	N/A	mg/L	NA	5.0	5.0
Standard Methods 2540 B-1997					
Total Hardness	N/A	mg/L	NA	0.50	0.19

CAS - Chemical Abstract Service Registry Number

RSK - Risk-Based Standard for Kansas

PQL - laboratory practical quantitation limit

MDL - laboratory method detection limit

mg/L - milligrams per liter

ug/L - micrograms per liter

**Table A-2
Equipment Calibration and Maintenance
RD/PDA QA-FSP
Wichita, Kansas**

Equipment Item Description	Equipment Item Description
Health and Safety	Geoprobe Well Installation Equipment
PID	Geoprobe
Isobutylene Calibration Gas	Pipe
Respirator Cartridges (contingency plan only)	Silicone and poly tubing
Tyvek	Groundwater Points
Inner Gloves	1" PVC (piping, screen, risers)
Outer Gloves	PVC groundwater points
Steel Toe Boots	Decontamination and IDW Management Equipment
Hard hats	DOT approved 55-gallon drums
Safety Glasses	Wash Tubs
Ear Plugs	5-gallon buckets
Well Purging and Sampling Equipment	Large sprayers (lawn and gardent type)
Submersible Pumps	Spray Bottles
Generator/Power source	Brushes
Bailers	De-ionized water
Nylon string	Detergent (Alconox)
Temperature/pH/conductivity meters and calibration solutions	Large plastic trash bags
Water level indicators	Plastic sheeting
Surface Water Sampling Equipment	Field Documentation Equipment
Bailers	Project Logbooks
Nylon string	Ball point pens
Temperature/pH/conductivity meters and calibration solutions	Cameras
Peristaltic Pump	Reclosable plastic bags (quart and gallon size)
Waders	Boring Logs
Elbow Length Rubber Gloves	Monitoring well construction logs
Sample Collection and Documentation Equipment	Monitoring well development logs
Laboratory provided sample containers	Groundwater Well Redevelopment Equipment
Sample coolers	Bailers
Sample Labels	Nylon string
Indelible Ink Markers	Surge Block
Chain of Custody Forms	Submersible Pump
Custody Seals	Water level indicator
Packing Tape	Temperature/pH/conductivity meters and calibration solutions
0.45 micron filters	Aquifer Testing Equipment
Ice	Submersible Pump
	Check valve(s)
	In-line flow meter
	Flow control valve
	Pressure gauge
	Pressure transducers with data logging capability
	Water Storage Units
	Water level indicator

Table A-3
Sample Bottles, Preservatives, Holding Times
RD/PDA QA-FSP
Wichita, Kansas

Parameter	Method	Matrix	Container	Preservative	Holding Time
Volatile Organic Compounds	SW846 8260B	Water	40 mL vials	pH < 2 HCl; cool to ≤ 6 deg C	14 days preserved; 7 days unpreserved
		Soil	4 oz glass jars	cool to ≤ 6 deg C	14 days
		Free Phase Liquids	40 mL vials	cool to ≤ 6 deg C	14 days
TPH (GRO)	SW846 8015C	Soil	4 oz glass jars	cool to ≤ 6 deg C	14 days
		Free Phase Liquids	40 mL vials	cool to ≤ 6 deg C	14 days
TPH (DRO)	SW846 8015C	Soil	4 oz glass jars	cool to ≤ 6 deg C	14 days
		Free Phase Liquids	40 mL vials	cool to ≤ 6 deg C	14 days
Nitrate (as N)	EPA 353.2	Water	250 ml plastic	cool to ≤ 6 deg C	48 hours
Nitrite (as N)					
NO ₂ plus NO ₃ (as N)	EPA 353.2	Water	250 ml plastic	pH < 2 H ₂ SO ₄ ; cool to ≤ 6 deg C	28 days
Chloride	EPA 300.0	Water	250 ml plastic	cool to ≤ 6 deg C	28 days
Sulfate					
Dissolved Metals (arsenic, calcium, iron, manganese, magnesium, and sodium)	SW846 6010B	Water	250 ml plastic	pH < 2 HNO ₃	6 months
Alkalinity	Standard Methods 2320 B-1997	Water	250 ml plastic	cool to ≤ 6 deg C	14 days
Carbon Dioxide	Standard Methods 4500-CO ₂ D-1997	Water	calc. based on pH+Alk.	cool to ≤ 6 deg C	14 days
Dissolved Organic Carbon	Standard Methods 5310 C	Water	250 ml plastic	pH < 2 H ₂ SO ₄ ;	28 days
Sulfide	Standard Methods 4500-S ₂ ⁻ D-2000	Water	250 ml plastic	pH < 9 NaOH; ZnOAc; cool to ≤ 6 deg C	7 days
Sulfide	Standard Methods 4500-S ₂ ⁻ F-2000	Water	250 ml plastic	pH < 9 NaOH; ZnOAc; cool to ≤ 6 deg C	7 days
Volatile Fatty Acids	Standard Methods 5560 C	Water	500 mL Plastic	cool to ≤ 6 deg C	7 days
Methane, Ethane, Ethene	RSK 175	Water	40 mL vials	cool to ≤ 6 deg C	7 days

Table A-4
Equipment Calibration and Maintenance
RD/PDA SA-FSP
Wichita, Kansas

Instrument	Calibration Schedule	Maintenance Schedule
PID	Calibrate to 100 ppm isobutylene span gas prior to first use and daily thereafter.	Clean following use. Clean lamp if calibration difficulties arise. Recharge batteries daily.
pH/temperature/conductivity meter	Calibrate pH and conductivity meters prior to first use each day with standard solutions. Check calibration at least once each day with standard solution.	Decontaminate appropriately after each use. Replace batteries when required
Turbidity Meter	Calibrate with two solutions of known turbidity each day	Decontaminate appropriately after each use. Replace batteries when required
Dissolved Oxygen Meter	Check calibration daily with standard solution	Decontaminate appropriately after each use. Replace batteries when required
Multi-parameter meter with flow-through cell	Check calibration daily with standard solution	Decontaminate appropriately after each use. Replace batteries when required
Water Level Indicator	Check performance prior to use each day	Decontaminate appropriately after each use. Replace batteries when required
Submersible Pump	Check performance prior to use each day	Decontaminate appropriately after each use.

Appendix A-3

Example Forms

APPENDIX B

PDA SITE-SPECIFIC HEALTH AND SAFETY PLAN

**NOT APPROVED
OR REVIEWED BY KDHE**

Accepted Into
Administrative
Record File

Site-Specific Health and Safety Plan

North Industrial Corridor

Remedial Design/Pre-Design Data Acquisition Work Plan / 27213343.00

Rev. 0 – August 14, 2013

REQUIRED APPROVAL			
SCS Aquaterra OSHC:	Jason Franks	Date:	08/14/2013
SCS PM:	Monte Markley	Date:	08/14/2013

Project No.:	27213343.00
Project Name:	NIC RD-PDA
Site Address:	North Industrial Corridor, Wichita, Kansas
Client Contact:	Shawn Maloney, P.G.

EMERGENCY TELEPHONE NUMBERS	
Fire:	911/Non-Emergency (316) 268-4510
Police:	911/Non-Emergency (316) 350-3400
Hospital	Via Christi Hospital (316) 268-5150
Ambulance:	911
The directions and information on the nearest hospital are found on Page 2.	

Accepted Into
Administrative
Record File

**NOT APPROVED
OR REVIEWED BY KDHE**

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www.scsengineers.com

ACKNOWLEDGEMENT PAGE

“I have read the attached Health and Safety Plan for the North Industrial Corridor (NIC) Remedial Design/Pre-Data Acquisition (RD-PDA) Work Plan dated **August 14, 2013**. I have discussed any questions and/or concerns that I have regarding the contents of this document with the designated SCS Aquaterra project safety representative, and I understand its requirements.”

Name	Signature	Company	Date

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1 INTRODUCTION

At SCS, protection of human health and the environment is paramount. This Site-Specific Health and Safety Plan (SSHSP) provides information to identify hazards that may be present and/or introduced by project's activities onto SCS job sites, and details needed precautions that employees should follow to protect themselves. Tasks performed on site or during projects should be analyzed to determine if physical or chemical hazards requiring safeguards or additional Personal Protective Equipment (PPE) exist. This plan will be modified as necessary if any new hazards are identified during the project that require that additional safeguards be put in place.

PROJECT ORGANIZATION

Project or Site Team Leader:	Chad Milligan	316-706-1411
Primary Health and Safety Representative:	Jason Franks	913-302-3238
On-site Health and Safety Representative:	Kelly Hoyt	316-737-6922
Project Manager/Director:	Monte Markley	316-558-1414
Client Representative:	Shawn Maloney	316-268-8318

SCOPE OF WORK

The PD/PDA work plan is the first regulatory deliverable for the Kansas Department of Health and Environment (KDHE) final Corrective Action Decision (CAD) for the North Industrial Corridor (NIC) site. The RD/PDA work plan defines the remedial objectives for each Groundwater Unit (GWU) in the NIC site, and the necessary PDA data collection efforts required to support a design that meets the objectives outlined in the CAD. The CAD indicates five groundwater extraction wells will be located throughout the NIC project area, with six contingency locations for additional extraction wells. The well locations are primarily based on data collected within the project area through 2007 and 2008. Because this information is now four to five years old, PDA activities are intended to confirm the plume delineation and migration of groundwater units GWU-1 through GWU-4, confirm and/or determine appropriate locations for groundwater extraction wells, and provide needed data for the design of groundwater extraction and treatment systems.

The planned RD-PDA activities include the following:

1. Groundwater Level Measurements
2. Groundwater Sampling
3. Geoprobe® Sampling
4. Well Installation
5. Aquifer Testing

2 EMERGENCY RESPONSE AND MEDICAL TREATMENT PROCEDURES

EMERGENCY CONTACT AND NOTIFICATION INFORMATION

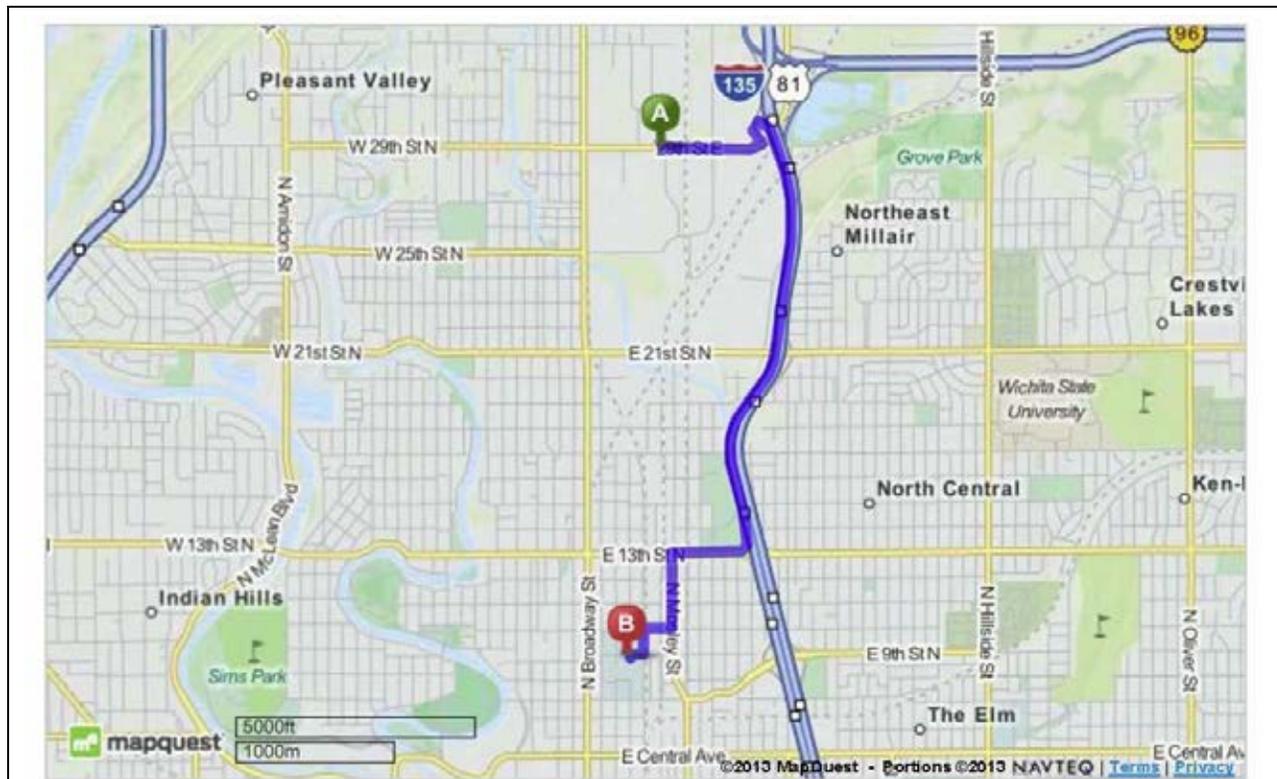


Figure 1. Map to Via Christi Hospital

Directions: From the area of 29th and Mead, travel east on 29th Street East and merge onto South I-135. In approximately 2.2 miles, take Exit 8 to 13th Street, and keep right. Travel west on East 13th Street North, and take left onto North Mosley Street. Take 2nd right onto East 10th Street North, and 2nd left onto North Santa Fe Street. Turn right onto East 9th Street North, and 1st left onto North Saint Francis Street. The medical center will be on the west side of North Saint Francis Street.

Nearest Hospital Address:

Via Christi Hospital
 929 North Saint Francis Street
 Wichita, Kansas 67214
 (316) 268-5150

ACCIDENT OR INCIDENT REPORTING SYSTEM

In the event of an emergency at the site, project personnel should call 911 for emergency assistance. After the immediate emergency situation has been addressed by emergency personnel, SCS Aquaterra project personnel should call the SCS Aquaterra Health and Safety Coordinator, supervisor, and project manager. The Health and Safety Coordinator and project manager will evaluate the nature and extent of the emergency and direct project personnel with appropriate actions. The project manager will notify the client contact and inform them of the situation.

NOTIFICATION PROCEDURES FOR INCIDENTS (CLIENT, LOCAL, STATE, OR FEDERAL)

Site personnel should contact their Health and Safety Coordinator and supervisor immediately when an accident or injury occurs, and provide any needed information so that additional notifications can be determined and completed as needed. Additionally, the client contact should be contacted and notified of any accidents or injuries that occur during excavation and construction by the SCS Aquaterra project manager.

METHODS TO SUMMON EMERGENCY RESPONSE TEAM

Emergency services can be summoned through 911, as this service is active in the area.

RESCUE AND MEDICAL TREATMENT REQUIREMENTS

SCS Aquaterra will have the authority to stop work as needed during all phases of this project. Stop work authority should be exercised when an injury or accident occurs. The appropriate emergency agency should be contacted and first aid administered, if possible. Contact the SCS Aquaterra Health and Safety Coordinator and project manager, as soon as possible; and for SCS Aquaterra personnel, if the injury is not life-threatening and does not require emergency response, contact WorkCare at (800) 455-6155. First aid kits and fire extinguishers are available in each SCS Aquaterra work truck. Additional first aid or medical support is available at the nearest hospital, see page 2 for directions.

3 SITE DESCRIPTION

LOCATION DESCRIPTION

The NIC site occupies approximately 4,011 acres in north-central Wichita, Sedgwick County, Kansas. The NIC is roughly bounded by East 39th Street North to the north; Union Pacific railway (north end) and Hydraulic Street (south end) to the east; East 2nd Street North to the south; and Broadway Street to the west, and is divided into six distinct groundwater units.

4 GENERAL FIELD SAFETY PROCEDURES

General Standard Operating Procedures (SOPs) and additional SCS Aquaterra Health and Safety procedures and requirements are included in the current SCS Aquaterra Injury Illness Protection Program (IIPP) and on the SCS Aquaterra intranet. These documents are considered a part of this plan.

APPLICABLE STANDARD OPERATING PROCEDURES (SOPS) AND PROGRAMS

	SOP Number and Name		Appendix Letter and Program Name
X	01 - General Code of Safe Work Practices	X	C - HAZWOPER
X	04 - JTSA and PPE Assessment Procedures	X	E - PPE Other Than Respiratory Protection
X	08 - Drilling and Well Installation Procedures	X	J - Excavation and Construction Earthwork Program
X	21 - Safe Procedures for Biological Hazards (Snakes, Insects, Vegetation, Bacteria)	X	O – Contractor Safety Management
X	25 - Avoidance and Prevention of Heat and Cold Stress, and Other Weather-Related Hazards		

JOB TASK SAFETY ANALYSIS (JTSA) AND PPE ASSESSMENT

JTSAs for activities performed at this site have been completed as indicated below and are included in **Appendix A**. A completed JTSA is required for all work tasks performed at the site. **JTSAs are designed to identify steps which involve potential hazards to employees and should be reviewed and understood (and signed providing evidence of understanding) before performing any task at the site. If additional steps or hazards are present, the JTSA**

should be revised (and the revision signed by all affected staff) to indicate that all items have been appropriately addressed and are understood before proceeding with the task.

Unless identified in an attached Job Task Safety Analysis (JTSA) form, all project tasks are anticipated to only require **Level D** PPE, as defined by the Occupational Safety and Health Administration (OSHA). Prior to working in a Level C or B environment, each employee is required to be medically qualified (by an approved SCS Aquaterra medical provider) and properly fit-tested for the needed respiratory protection defined in this plan. The projects designated will ensure that this is completed per SCS Aquaterra policy, with assistance, as needed, from the SCS Aquaterra Corporate Health and Safety Director (CHSD). IN ADDITION, ANY EMPLOYEE WORKING AT A SITE AS DEFINED IN 29 CFR 1910.120 (or applicable state OSHA standard) OR REQUIRED BY CONTRACT SHALL BE TRAINED IN ACCORDANCE WITH 29 CFR 1910.120(e) (24-hour or 40-hour HAZWOPER, as appropriate). Each employee will only perform tasks that they have been properly trained to perform. A copy of each employee’s training record is available through the SCS Aquaterra OSHC or designee.

Site-Specific JTSA List

X	JTSA-ES-01 GW Sampling	X	JTSA-20 Vehicle Operations
X	JTSA-15 Sample Collection (Groundwater/Leachate)	X	JTSA-21 Well Drilling

SAFE OBSERVATIONS

The SCS Aquaterra SAFE Observation Checklist will be used by field and project personnel. The goal is to make at least one (1) documented observation per quarter during site activities. The appropriate SCS Aquaterra SAFE Observation Checklist is included in Appendix A.

OTHER INSPECTION PROCEDURES

Periodic site inspections may be made by the Project Supervisor, Project Manager, and SCS Aquaterra Office Health and Safety Coordinator or Safety Specialist. There is also the potential for the client or regulatory agencies to visit and inspect the site. SCS Aquaterra personnel are to perform tasks in compliance with all contractual, regulatory, and company requirements at all times.

PPE/SAFETY EQUIPMENT

Various types of PPE are required depending on substances handled, existing conditions, and particular work activities. PPE includes a variety of specialty uniforms, hard hats, goggles, face shields, aprons, boots, gloves, safety vests, hearing protection, and respirators, all designed to protect against a variety of hazards. Selection of PPE will be based on the hazard assessment

prepared for a specific site or work effort, and will be the responsibility of the Field Health and Safety Supervisor and Project Manager.

Level D PPE includes:

- Steel toed safety boots/shoes
- Safety glasses or chemical splash goggles
- Hard hat
- High-visibility safety vest
- Hearing protection for two way communications may be required in special circumstances (if needed around heavy equipment)

Additional information on PPE is found in the Hazardous Waste and Emergency Response Operations (HAZWOPER) Program (Appendix C).

TAILGATE HEALTH AND SAFETY MEETINGS

Health and safety meetings at the site are called “tailgate” health and safety meetings. These meetings will be held at the outset of fieldwork, following any incident or emergency at the site, and prior to commencing each new phase of work. A short tailgate meeting will be held weekly while intrusive fieldwork is underway. Attendees should include all SCS Aquaterra and subcontractor staff who will be working on the project phase. During the meeting, project and site-specific health and safety procedures will be reviewed to familiarize everyone with the location of health and safety equipment and supplies, emergency communications, first aid, and similar matters. The meeting’s content and attendees will be documented in the project’s daily log or other project-specific document.

SITE CONTROL

The purpose of site control is to protect workers and members of the public from the site’s hazards, and to prevent vandalism. The approach to site control depends on site characteristics, size, the surrounding community, and contractual issues. Site control procedures will be established in the planning stages of a project, and modified if new information becomes available.

Where appropriate, SCS Aquaterra will establish work zones to reflect the health and safety procedures to be followed for various work tasks. Site control requirements may include:

- Using the buddy system, when necessary.
- Establishing site security measures.
- Setting up communication networks.
- Establishing zones of control.

SCS Aquaterra person(s) responsible for controlling the site should be identified prior to initiating project tasks. For construction projects, this individual is the general contractor or site owner/operator. SCS Aquaterra personnel must comply with the SSHSP for the project, and should review and comply with the general contractor's health and safety plan to the extent appropriate.

Significant Hazardous Substance Contamination Areas

Where significant hazardous substance contamination or similar site hazards are expected, work zones should be established on a Task basis. These will include an exclusion zone, where only those protected with appropriate PPE will be allowed; a decontamination reduction zone, restricted to those who are decontaminating after activities in the exclusion zone; and a support zone, where PPE is not necessary. Work zones will be noted on the site map and established using physical markers (e.g., fencing or tape) prior to work on individual site tasks. See Appendix C for additional guidance.

Work Zones

To prevent migration of contamination caused by personnel or equipment, work areas and personal protective equipment are clearly specified prior to beginning operations. Designated work areas or zones will be established and delineated, as suggested by the Occupational Health and Safety Guidance Manual for Hazardous Waste Site Activities. Each contaminated work area will be divided into three zones; and Exclusion Zone (EZ), a Contamination Reduction Zone (CRZ), and a Support Zone (SZ).

Exclusion Zone

The Exclusion Zone will consist of areas where inhalation, oral contact, or dermal contact with contaminants is considered to be possible. It is anticipated that the Exclusion Zone will encompass the immediate confines of the work area with a buffer zone that will vary from location to location. The Exclusion Zone boundary around each work area will be clearly and conspicuously marked using temporary fencing, boundary tape or safety fencing and signs. The signs will specify that only trained and authorized personnel are allowed to enter. Authorization is to be obtained from the foreman/site supervisor. A single entry and exit point will be established through the Contamination Reduction Zone. Entry will be limited to essential personnel or pre-approved visitors.

Decontamination Zone

The Decontamination Zone will be established between the Exclusion Zone and Support Zone. In this area, personnel will begin the sequential decontamination process required to exit the exclusion zone. To prevent off-site migration of contamination and to facilitate personnel accountability, all personnel will enter and exit the exclusion zone through the Decontamination Zone.

All waste materials generated in the Decontamination Zone will be collected and effectively contained through the use of drums, bags, plastic sheeting, and/or tanks. All waste materials will be labeled as such and properly disposed of according to their hazard classifications.

Support Zone

The Support Zone will consist of a clearly marked area where the office, break areas, and changing facilities are located. Drinking and eating will be allowed only in designated areas. Sanitation facilities (toilets, drinking and washing water) are provided in the Support Zone.

Lighting

All proposed work tasks will be conducted during daylight hours. Typical workday will be during the hours between 7 am and 6 pm. Available sunlight should be sufficient for the anticipated work tasks.

Areas with Electrocutation Hazards

Electric utilities and equipment also present electrocutation hazards. Precautions regarding locating and marking subsurface utilities are a matter of state law, and vary somewhat from state to state. SCS Aquaterra must abide by these laws. Electrical equipment should be presumed energized, unless a qualified person has tested and confirmed that this is not so. Special lockout and tagout procedures are followed to indicate that work is being conducted on a de-energized piece of equipment, and to warn against re-energizing such equipment (e.g., by closing a circuit breaker, or connecting a plug) while work is in progress.

Site Security

Our clients are responsible for providing SCS Aquaterra employees with safe site access, which includes sites that are free of threats from transients or other aggressive people or dogs. If an SCS Aquaterra employee encounters an aggressive person or dog, they should withdraw from the site, and contact the proper authorities, Site Representative, and project manager. The Site Owner is responsible for removing the threats, and SCS Aquaterra employees should not take any affirmative action of their own.

DECONTAMINATION PROCEDURES (RELATED TO HAZARDOUS WASTE)

All personnel must complete appropriate decontamination procedures prior to leaving the site in a manner that is responsive to actual site conditions. Each individual shall conduct proper hygiene which may include washing any exposed skin prior to eating, drinking, or leaving the site, consistent with site conditions.

If Level C protective equipment is selected, or if Level D is supplemented by additional personal protective equipment, a decontamination area will be set up at an appropriate site location adjacent to each active work area and decontamination procedures will be followed as described in the following section. Receptacles will be provided for all disposable clothing. They will consist of conventional trash cans lined with heavy-duty polyethylene trash bags. Washtubs containing an approved detergent-water solution and soft-bristle brushes will be used to decontaminate reusable personal protective clothing and boots. Following the detergent-water washing, clean potable water will be used for the rinsing. Spoiled water used during decontamination will be stored in sealed drums until it can be properly disposed.

Initial Decontamination

- Wash boots, gloves, and respirators (see below).
- Put respirators in separate baggy, if contaminated, and label.
- Remove boots, gloves, and disposable overalls
- Place disposable suits and any other disposable and/or uncleanable equipment in the proper receptacle on site. Check with HSO if uncertain.

Decontamination Procedures

Heavy equipment:

- Remove large accumulations of soil from all augers between boreholes.
- Remove large accumulations of soil from all heavy equipment prior to leaving the site.

Other equipment:

- Remove large accumulations of soil.
- Brush and scrub gloves and boots; then continue with decontamination solution and water, if required.

Rinse thoroughly. Use some disinfectant or alcohol wipes for inside of gloves. Hang boots and gloves to dry. Dry other equipment with paper towels. Equipment and tools will be decontaminated prior to demobilizing from the site. The exposed exterior of equipment will be cleaned until visible soil is removed. The decontamination area location will be determined during preconstruction/excavation activities. Investigation derived wastes (IDW), consisting of

disposal sampling equipment, personal protective equipment (PPE), and trash, will be placed in plastic bags and transported off site for disposal as municipal solid waste.

HANDLING OF HAZARDOUS MATERIALS, SAMPLES, CONTAINERS, AND DRUMS

Contaminated excavated soils and groundwater that may be handled and sampled during site activities may potentially be labeled as hazardous. Furthermore, sample containers may also contain preservatives, such as acids and methanol. Proper PPE will be required at all times while performing tasks that will bring site personnel in contact with impacted soil and groundwater. Contaminated soil and groundwater will be hauled off site and properly disposed of at approved facilities.

SITE-SPECIFIC TRAINING

SCS Aquaterra technical personnel are required to complete 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training and to be familiar with RCRA Interim Measures investigations and in the collection of samples for VOC analysis.

5 SITE HAZARDS

Below is a list of potential site hazards.

CHEMICAL AND PHYSICAL AGENT HAZARDS

The following chemical and physical hazards should be considered before performing any task or work at the site. The analysis will depend on a thorough understanding of the site's physical characteristics and the task(s) being performed.

Chemical Hazards

Soils/groundwater at this project site may be contaminated with petroleum hydrocarbons. Benzene is the most significant health hazard contained in petroleum blends and typically comprises less than 1% of regular grade gasoline. Specific health hazard information on petroleum compounds and their most health-significant volatile fractions are provided below. Additional health-hazard information may be found in the chemical product information sheets attached to this SHP. Personnel engaged in monitoring well sampling are advised that organic vapors from contaminated groundwater can collect in wells and be displaced by bailers. Monitor breathing zone upon opening wells and for the duration of sampling activities.

Table 1. Chemical Hazards and Air Monitoring Plan

Chemical/ Parameter	PEL	TLV	IDLH	Action Level	Monitoring Equipment	Sample Location and Frequency	Procedures When Action Levels Exceeded
Oxygen	19.5% to 23.5% accepted range	NA	NA	<19.5 & >23.5	Four-gas personal monitor	Before entry, at breathing level, in each space where potential for chemical hazards exist. Examples include manholes, vaults, enclosed flares, trenches and in the vicinity of open piping or wells. Use the personal four-gas meter at all times while on site.	Exit the area in an upwind direction and/or ventilate until levels fall below Action Level before reentering. Warning: Follow Confined Space Entry procedures where appropriate. Caution: Follow respiratory protection procedures to include fit testing and required medical exams when respiratory protection is used.
Methane	NA	1,000 ppm TWA (for aliphatic hydrocarbon gases)	50,000 ppm (100% of LEL)	>10% LEL	Four-gas personal monitor		
Carbon Monoxide	25 ppm TWA 200 ppm CEILING	125 ppm STEL	1,200 ppm	100 ppm	Four-gas personal monitor		
Hydrogen Sulfide	20 ppm CEILING	1 ppm TWA 5 ppm STEL	100 ppm	10 ppm	Four-gas personal monitor		
Flammable and explosive gases	NA	NA	100% of LEL		Four-gas personal monitor		
Methyl Mercaptan	0.5 ppm TWA 10 ppm CEILING	0.5 ppm TWA	150 ppm				
Benzene	1 ppm TWA 5 ppm STEL	0.5 ppm TWA 2.5 ppm STEL	500 ppm				
Chloroethene (Vinyl Chloride)	1 ppm TWA 5 ppm STEL	1 ppm TWA					
1,2 Dibromomethane (Ethylene Dibromide)	20 ppm TWA 30 ppm CEILING 50 ppm maximum peak above ceiling for 5-minute period in 8 hours	A3 carcinogen	100 ppm				
Dichloromethane (Methylene Chloride)	25 ppm TWA 125 ppm STEL	50 ppm TWA	2,300 ppm				

Chemical/ Parameter	PEL	TLV	IDLH	Action Level	Monitoring Equipment	Sample Location and Frequency	Procedures When Action Levels Exceeded
Tetrachloroethylene (Perchloroethylene)	100 ppm TWA 200 ppm CEILING 300 ppm maximum peak above ceiling for 5-minute period in any 3 hours)	25 ppm TWA 100 ppm STEL	150 ppm				
Tetrachloromethane (Carbon Tetrachloride)	10 ppm TWA 25 ppm CEILING 200 ppm maximum peak above ceiling for 5-minute period in any 3 hours)	5 ppm TWA 10 ppm STEL	200 ppm				
1,1,1-Trichloroethane (Methyl Chloroform)	350 ppm TWA	350 ppm TWA 450 ppm STEL	700 ppm				
Trichloroethylene	100 ppm TWA 200 ppm CEILING 300 ppm maximum peak above ceiling for 5-minute period in any 2 hours	10 ppm TWA 25 ppm STEL	1,000 ppm				
Trichloromethane (Chloroform)	50 ppm CEILING	10 ppm TWA	500 ppm				

Table Key:

PEL: OSHA (most stringent state OSHA value). Permissible Exposure Limits are specified legal employee exposure limits based on specified lengths of time (see Ceiling, TWA, and STEL).

TLV: Threshold Limit Values (TLV's) are guidelines (not standards) prepared by the American Conference of Governmental Industrial Hygienists, Inc. (ACGIH), to assist industrial hygienists in making decisions regarding safe levels of exposure to various hazards found in the workplace.

IDLH: An atmosphere that poses an immediate threat to life would cause irreversible adverse health effects, or would impair an individual's ability to escape from a dangerous atmosphere.

TWA: Time-Weighted Averages are the upper limit of a toxic material to which an average person in average health may be exposed on a day-to-day basis (40-hour work week, 8-hour work periods) with no adverse health effects.

STEL: Short-Term Exposure Limit is the maximum average chemical concentration in which an employee can be exposed for up to 15 minutes. At no time can the employee exposure concentration exceed the "Ceiling" limit.

Ceiling: The maximum instantaneous chemical concentration in which an employee can be exposed to at any time.

%: Percent gas by volume.

% LEL: Percent of the lower explosive limit.

PPM: Parts per million.

Note: Instrument alarm levels and required responses are defined in TSOP 207.

BENZENE**Permissible Exposure Limit**

1 ppm OSHA PEL

5 ppm OSHA 10 min Ceiling

0.5 ppm OSHA Action Level

Benzene is a central nervous system depressant and an eye and skin irritant. Poisoning may cause hemorrhages and immunosuppression. A relationship has been discovered between benzene exposure and leukemia. Benzene is regulated as an occupational carcinogen. Acute exposure may cause dizziness, excitation, weakness, headache, giddiness, breathlessness and chest constriction.

TOLUENE**Permissible Exposure Limit**

100 ppm OSHA PEL

150 ppm OSHA STEL

Toluene is an eye, skin and mucous membrane irritant and a central nervous system depressant. Poisoning may affect the liver and kidneys. Prolonged exposure may affect the heart and blood. The ingestion of alcoholic beverages may enhance the toxic effects of toluene. Symptoms of exposure include respiratory tract irritation, headache, dizziness and eye irritation.

ETHYL BENZENE**Permissible Exposure Limit**

100 ppm OSHA PEL

125 ppm OSHA STEL

Ethyl benzene is a skin, eye and mucous membrane irritant. It is moderately toxic by ingestion and slightly toxic by skin absorption. Ethyl benzene is a central nervous system depressant. Poisoning may affect the liver. Symptoms of exposure may include a sense of chest constriction and nervous disorders. Skin contact may result in first and second degree burns. The odor can be detected at 140 ppm and irritation occurs at 200 ppm.

XYLENE**Permissible Exposure Limit**

100 ppm OSHA PEL

150 ppm OSHA STEL

Xylene is a mild eye and mucous membrane irritant, primary skin irritant and a central nervous system depressant. Ingestion causes severe gastrointestinal upset and creates an aspiration hazard. Chronic inhalation results in symptoms resembling acute poisoning.

GASOLINE

Permissible Exposure Limit

300 ppm OSHA PEL

500 ppm OSHA STEL

Gasoline is irritating to the skin, eyes and mucous membranes. Dermatitis may result from prolonged contact with the liquid. Gasoline acts as a central nervous system depressant. Exposure may cause staggering gait, slurred speech and mental confusion. Gasoline exposure may affect the liver, kidneys and spleen. Absorption of alkyl lead antiknock compounds contained in many gasolines poses an additional health concern, especially where there is prolonged skin contact.

DIESEL FUEL (No. 2-D)

Permissible Exposure Limit

400 ppm OSHA PEL (As petroleum distillates/naphtha)

Diesel fuel is a skin and mucous membrane irritant and a central nervous system depressant. Poisoning may affect the liver and kidneys. Skin contact may result in drying and cracking of the skin.

FUEL OIL (No. 6)

Permissible Exposure Limit

400 ppm OSHA PEL (as petroleum distillates/naphtha)

Fuel oil No. 6, or "Bunker Fuel", may be irritating to the eyes and skin. Poisoning may affect the liver, kidneys and digestive system. This substance is likely to contain polynuclear aromatic hydrocarbons (PNA's) some of which are considered carcinogenic. PNA's present a skin contact hazard.

Toxic Compounds: Non-Methane Organic Compounds (NMOCs), as well as inorganic toxic contaminants such as mercury, and sometimes even radioactive contaminants such as tritium, may be present on a site. NMOCs include such toxic compounds as benzene, toluene, chloroform, vinyl chloride, carbon tetrachloride, and trichloroethane, which, although less than 1 percent by weight, are hazardous. These potential hazards should be evaluated on a case-by-case basis. Additional precautions will be established as needed in this plan.

Flammables: Fuel such as gasoline and diesel will be present at the site. Additionally, paint thinners or other flammable materials may be present. The primary risk associated with these materials is fire. Keep all ignition sources away from flammable materials. Do not smoke, unless in designated areas. Pay close attention to where you walk and what you touch such that

materials do not accidentally come into contact with skin, eyes, mouth, or clothing. Immediately remove any contaminated clothing, and wash with hot soapy water any skin that becomes contaminated. Avoid contact at all times.

Electrical Hazards

Overhead power lines, downed electrical wires, and buried cables all pose a danger of shock or electrocution if workers contact, sever them or come in close proximity during site operations. In order to prevent accidents caused by electric shock, the site personnel will inspect all electrical connections (if required) on a daily basis. They will shut down and lock out any equipment that is found to have frayed wiring or loose connections until a qualified electrician can be contacted and repairs effected. Electrical equipment will be de-energized and tested by an electrician before any electrical work is done. All equipment will be properly grounded prior to and during all work. Underground Service Alert will be notified at least two (2) working days prior to site activities in any area.

Ground fault circuit interrupters (GFCIs) will be installed whenever possible in each circuit between the power source and tool, unless the presence of a potentially explosive atmosphere precludes this procedure. In the event that generators are used to supply power, these generators will be equipped with GFCIs.

Physical Hazards

The following physical hazards should be considered before performing any task or work at the site. Depending on the task(s) being performed, any or all of these hazards may be present.

Steep and Uneven Terrain: Treacherous footing on slopes (i.e., sandy soil/clay), heavy equipment, or snakes and other animals that could be present on slopes or in bushes all present hazards at this site. Walking, driving, or operating heavy equipment on steep hills or uneven terrain can be dangerous. These areas should be avoided whenever possible. When it is necessary to walk or drive in such locations, great care should be taken. Move slowly and be aware of loose materials or holes that could be present. Sharp items or spilled materials may also exist there and should be avoided. When traversing steep terrain, drive straight up or down slopes to reduce the possibility of roll over. Holes, pits, and ditches may be present. Falling or driving into these hazards can be avoided by becoming familiar with the site. Tall grass or vegetation can hide these features.

Do not drive on areas with which you are not familiar. Discuss access routes and hazards with site personnel. A good rule of thumb for driving is: “When in doubt—get out.”

Lightning: The danger of lightning strike is increased when work occurs on the elevated surfaces and equipment. Lightning can strike miles ahead of a storm when no rain is present. All operations should be stopped immediately when lightning is visible or thunder is audible. All personnel should seek shelter and remain inside a building (primary) or vehicle (secondary) until the danger passes. Do not take shelter near tall objects such as power lines, trees, antennas, or the flare stack. Work can resume when the lightning is no longer visible and the thunder cannot be heard.

Heat-Related Injuries: Elevated body temperatures can cause serious injury or death. Working outdoors or in the sun increases the chance of heat-related injuries. This hazard is especially critical when PPE (such as coveralls or rain gear) is worn, since heat from the body becomes trapped inside clothing. Personnel should drink plenty of liquids and take breaks as needed. The following describes the various **Heat Disorders and Health Effects:**

- **Heat Stroke:** This disorder occurs when the body's system of temperature regulation (e.g., sweating and evaporation) fails and body temperature rises to critical levels. The condition is caused by a combination of highly variable factors, and its occurrence is difficult to predict. Heat stroke is a serious hazard, however. Primary signs and symptoms are confusion, irrational behavior, loss of consciousness, convulsions, a lack of sweating (usually), hot, dry skin, and an abnormally high body temperature. If a worker shows signs of possible heat stroke, call 911 to obtain **immediate** medical assistance. The worker should be placed in a shady area, and his or her outer clothing should be removed. The worker's skin should also be wetted and air movement around the body increased to improve evaporative cooling until professional methods of cooling are initiated and the seriousness of the condition can be assessed. Fluids should be replaced as soon as possible--by mouth only if the worker is conscious. The medical outcome of an episode of heat stroke depends on the victim's physical fitness and the timing and effectiveness of first aid treatment. Regardless of the worker's protests, **no** employee suspected of being ill from heat stroke should be sent home or left unattended unless a physician has specifically approved such an order.
- **Heat Exhaustion:** The signs and symptoms of heat exhaustion include clammy skin, headache, nausea, vertigo, weakness, thirst, and giddiness. Fortunately, heat exhaustion responds readily to prompt treatment. This condition, however, should not be dismissed lightly, for several reasons. One is that fainting associated with heat exhaustion can be dangerous because the victim may be operating machinery or controlling an operation that should not be left unattended. The victim could also be injured when he or she faints. While the signs and symptoms associated with heat exhaustion are similar to those of heat stroke, the notable difference (with heat exhaustion) is clammy skin. Workers suffering from heat exhaustion should be removed from hot environments and given fluid replacement, by mouth only if the workers are conscious. They should also be encouraged to get adequate rest.
- **Heat Rashes:** The most common problem occurring in hot work environments is heat rash. Prickly heat is manifested as red papules and usually appears in areas where the clothing is restrictive. As sweating increases, the papules give rise to a prickling sensation. Prickly heat occurs in skin that is persistently wetted by unevaporated sweat, and papules may become infected if they are not treated. In most cases, heat rash will disappear when the affected individual returns to a cool environment.
- **Heat Fatigue:** One factor that predisposes individuals to heat fatigue is the lack of acclimatization. Use of a program of acclimatization and training for work in hot environments are advisable. The signs and symptoms of heat fatigue include impaired performance of skilled sensorimotor, high-concentration, or high-vigilance

activities. The sole treatment available for heat fatigue is to remove heat stress and increase fluid replacement before a more serious heat-related condition develops.

Cold-Related Injuries: In winter weather conditions, there is a potential for injury from cold, including dehydration, frostbite, heavy shivering, excessive fatigue, drowsiness, irritability, and euphoria. If workers show these symptoms, work should cease and affected personnel rest in heated buildings or vehicles.

Biological Hazards

Rodents, poisonous insects, snakes, other animals and/or plants are a natural part of any ecosystem. They are sometimes difficult to eliminate or avoid on some sites because those sites are undeveloped or vacant. Employees should be aware of the potential for encountering these types of animals and plants. Where possible, nesting places should be removed or access to them should be limited. If several infestations occur, remedies should be discussed with a supervisor and the client (see **SCS IIPP, SOP-21**, for precautions and treatment for biological hazards). The following could be encountered in performance of the operation, maintenance, and monitoring functions of a project:

Hantavirus: Infection typically occurs by the inhalation of tiny airborne droplets of fresh or dried rodent excretions. Transmission to humans may also occur through direct contact with rodents or rodent-contaminated materials, and ingestion of contaminated food or water is also a possible route of transmission. Sweeping or “shaking out” rodent-contaminated materials should be avoided unless performed using respiratory protection. The early symptoms of hantavirus disease are flu-like (fever, chills, muscle aches). For a very short period of time, the infected person starts to feel better. Then, within 1 to 2 days, he or she may develop shortness of breath. The disease gets worse quickly and leads to respiratory failure, a condition known as Hantavirus Pulmonary Syndrome (HPS). About half of all HPS patients experience these symptoms, which usually occur 1 to 5 weeks from contracting the illness.

Lyme Disease: A tick-borne bacteria that causes a range of debilitating symptoms (i.e., flu-like discomfort, joint pain, fatigue, headache, lack of concentration, facial paralysis). The most outstanding symptom of the disease is a bulls-eye rash from the tick bite. Personnel should avoid areas known to harbor ticks, and use insect repellent containing DEET to limit the possibility of being bitten.

Africanized Honey Bees: This species of bee is aggressive and unpredictable. It responds quickly and stings in large numbers; senses threats from people or animals 50 feet or more from the nest; senses vibrations from power equipment 100 feet or more from the nest; swarms frequently to establish new nests; pursues an enemy 3 miles or more; and nests in small cavities and sheltered areas. Avoid areas known to contain bees.

Snakes: Rattlesnakes, vipers, and coral snakes are poisonous. Not all rattlesnakes give audible warning before they strike. Extra caution should be taken if tools or other materials are dropped in highly vegetated areas, around rocks, into stockpiles of pipe or other objects, or when walking through highly vegetated areas where visibility (of the ground) is limited. The most active times for rattlesnakes are morning, late afternoon, and early evening; however, encounters could

happen at any time of the day. Walking loudly, shuffling feet, or making noise while working is recommended. Boots that reach mid-calf or snake guards are recommended, and all personnel should have leather work gloves.

6 ADDITIONAL REQUIREMENTS

TASK-SPECIFIC HEALTH AND SAFETY PROCEDURES

The majority of tasks performed as part of the NIC RD/PDA WP will be performed under Level D PPE. Additional task specific health and safety procedures will be updated in this SSHSP as needed.

APPENDICES

APPENDIX A

General Standard Operating Procedures (SOPs), Job Task Safety Analysis (JTSA) & PPE Assessment

- SOP 01 – General Code of Safe Work Practices
- SOP 04 – PPE Assessment
- SOP 08 – Safe Procedures for drilling and Well Installation
- SOP 21 – Biological Hazards
- SOP 25 – Prevention of Heat and Cold Stress and other weather-Related Hazards
- JSTA 20 – Vehicle Operations
- JSTA ES-01 – Groundwater Sampling
- JSTA ES-10 – Groundwater Well Installation
- SAFE Observation Checklist Form

APPENDIX B- NOT APPLICABLE

APPENDIX C

- HAZWOPER

APPENDIX D- NOT APPLICABLE

APPENDIX E

- PPE Other Than Respiratory Protection

APPENDIX F- NOT APPLICABLE

APPENDIX G- NOT APPLICABLE

APPENDIX H- NOT APPLICABLE

APPENDIX I- NOT APPLICABLE

APPENDIX J- NOT APPLICABLE

APPENDIX K- NOT APPLICABLE

APPENDIX L - NOT APPLICABLE

APPENDIX M- NOT APPLICABLE

APPENDIX N- NOT APPLICABLE

APPENDIX O

- Contractor Safety Management

APPENDIX A

GENERAL STANDARD OPERATING PROCEDURES (SOP'S)

JOB TASK SAFETY ANALYSIS (JTSA)

&

**PERSONAL PROTECTIVE EQUIPMENT ASSESSMENT PROCEDURE
(PPE ASSESEMENT)**

SOP 1

GENERAL CODE OF SAFE WORK PRACTICES

PURPOSE AND SCOPE

This procedure outlines safe work practices that must be adhered to in the workplace. The procedure applies to all employees in all work areas.

GENERAL CODE OF SAFE WORK PRACTICES

Procedures for ensuring safe work practices are as follows:

General

- Read and become familiar with the following safety-related documents:
 - SCS Health and Safety Injury and Illness Prevention Plan.
 - Any site-specific, or task-specific, health and safety plans, programs, procedures or requirements published by SCS. See the SCS intranet or contact your supervisor for the latest versions. These materials must be understood before you report for work at a site or perform any field work.
- Participate in the SAFE process by making periodic observations using SAFE checklists and providing feedback to observed employee(s).
- Report all unsafe conditions to your supervisor, the OHSC, or the Health and Safety Director. Report all accidents, near misses, injuries, or occupational illnesses to your supervisor.
- When driving a vehicle or operating equipment, buckle the seat belt, pay attention, and observe traffic laws.
- Permit no horseplay or running at the job site. Do not throw rocks, tools, or any other item.
- Avoid awkward positions or twisting while lifting, pulling, or pushing. Pushing generally is better than pulling loads. Review ergonomic training material and apply knowledge to your work tasks. Use a lifting calculator, as outlined in **Attachment A, Appendix L**, to determine if lifts are safe.
- Comply with job site policies regarding health and safety (e.g., smoking policies, work permits required, and site entry/exit logs).
- Familiarize yourself with locations of first aid kit(s) and where to obtain first aid, emergency evacuation routes, and details of the emergency notification system.

- If you provide first aid or other assistance, avoid direct contact with blood or other bodily fluids, and wear appropriate gloves and other protective equipment. Follow the exposure control guidelines outlined in *Appendix I (Bloodborne Pathogens Exposure Control Program)*.
- Know locations of safety equipment (eye wash stations, emergency showers, fire extinguishers, etc.) how to use them. Do not operate, tamper with, or remove portable fire extinguishers, except in an emergency and in accordance with safety procedures. If a fire extinguisher is used, do not put it back on the hook. Instead, contact building maintenance or the OHSC. The fire extinguisher must be recharged.
- Always practice good housekeeping:
 - Keep floors clean and dry to prevent slipping hazards. Spills should be cleaned up immediately.
 - Do not permit trash, garbage, or waste containers to overflow.
 - Store environmental samples in a secure location, separate from food.
 - Decontaminate field equipment at the job site before bringing it back to the office.

Personal Office Space

- Read and understand your office or site-specific Health and Safety Plan, and follow it.
- Make sure your office furniture gives proper back support and keyboard elevations. Your mouse and keyboard should be situated on the same level, about “elbow high” as you are seated. *Exhibit L-1, Workstation Evaluation Checklist (see Appendix L)* will help you to evaluate your workstation and make modifications to meet checklist requirements.
- Take breaks from typing or other repetitive tasks as needed, including standing up, stretching in place, or walking around.
- Use equipment properly: pay attention when using items such as paper cutters and electric staplers, and do not use such equipment if guards or other safety features are broken or defective.
- Comply with fire codes. Keep hallways and exits clear, and familiarize yourself with proper fire response procedures and fire extinguisher locations.
- Do not block access to fire extinguishers, fire pull stations, or other firefighting equipment.
- Do not obstruct electrical control panels. Maintain at least 36 inches of clearance in front of this equipment.

- When storing materials of any description near the ceiling, allow at least 18 inches between the top of the storage and any fire sprinkler head.
- Do not leave file cabinets or desk drawers open. Do not fully open the top drawer of a file cabinet if it could tip over or become unstable as a result.
- Do not run electrical cords or any other cords, ropes, cables, or other trip hazards across aisles, walkways, corridors, passageways, stairways, or any other areas where people might walk.
- Do not tamper with or remove lights or lighting fixtures unless authorized. Building maintenance personnel will repair or adjust the lighting as needed.
- Be alert to prevent office crime. If you are working alone at night or on weekends, keep the main door to the office locked. If possible, leave the building in groups to maximize safety.
- Personal property (such as purses and briefcases) should be stored in locked cabinets or out of sight to avoid the risk of theft.

Field Locations

- Wear clothing that is appropriate to the job. Do not wear loose clothing near moving equipment or machinery.
- Never expose yourself to potentially hazardous conditions without appropriate protection.
- Wear Personal Protective Equipment (PPE) in all areas requiring PPE to be worn:
 - Hard hat, steel-toe safety boots, and high-visibility clothing (e.g., safety vest) are our uniform. Wear them proudly.
 - Respirator use is mandatory where required by site-specific programs; comply with the fit test and other requirements of the Respiratory Protection Program (*see Appendix F*).
 - Wear special clothing and gloves designated to protect against chemical exposure.
 - Wear eye protection (safety glasses or face shield) to protect against flying objects (chipped stones, metal shards, etc.) or other hazards (such as splashing contaminants).
- Use tools for the job as intended. Comply with all warning labels.

- Establish and comply with zones of control at contaminated sites:
 - No eating, drinking, smoking or any activity that increases hand-to-mouth contact within the contaminated zone.
 - Upon leaving the contaminated zone, wash hands and arms; after removing outer garments that may be contaminated, wash the entire body as soon as possible.
- Watch out for natural hazards. Avoid potentially dangerous animals where possible, and take steps to control or protect against stings and bites that may result despite precautions. Review safety procedures and training materials contained in *SOP 21 (Safe Procedures for Biological Hazards)*.
- Be familiar with site communications systems (hand signals, emergency signals, etc.).
- Locate wind direction indicators (e.g., flags, strips of surveyor's tape) strategically placed at job site. Be aware of weather conditions (wind direction, temperature, impending thunderstorms, etc.), and plan your work accordingly.
- If injured, call WorkCare (800-455-6155) or 911 as appropriate, and report the accident to your supervisor immediately.
- For short-term jobs, remote locations and when working alone, check in with your supervisor and/or the main office after arriving at the job site, periodically, and when you leave the site.
- When dismounting equipment, use the three-point contact rule. DO NOT jump off machinery.
- Observe the walking surface, especially in areas with heavy vegetation, and note potential for tripping, slipping, and falling, including such hazards as hidden holes or ditches. Wear boots with adequate ankle support.
- Read, or discuss with your site supervisor, the requirements of the Site Specific Health and Safety Plan and sign the plan upon your understanding of the site requirements before traveling to, or performing any field work on SCS project sites.

SOP 4

JOB TASK SAFETY ANALYSIS AND PERSONAL PROTECTIVE EQUIPMENT ASSESSMENT PROCEDURE

PURPOSE

The purpose of the Job Task Safety Analysis (JTSA) and Personal Protective Equipment (PPE) Assessment procedure is to identify job hazards, determine which PPE are necessary to perform work safely, and ensure that employees are properly trained to complete tasks. This procedure will help in maintaining compliance with PPE Assessment requirements of the Occupational Safety and Health Standard (OSHA), 29 CFR 1910.132.

SCOPE

This procedure applies to all employees performing potentially hazardous activities related to work in OM&M, Construction, Energy, and Engineering Services.

DEFINITIONS

- **Job:** A task that involves a series of steps. The term “job” does not refer to an occupation, but to a particular work task such as collecting groundwater samples, grading a road surface, or tuning a LFG extraction well.
- **Job Task Safety Analysis (JTSA):** A multi-step process designed to study and analyze a particular job task, and to break down the task into steps that provide a means of eliminating associated hazards. The JTSA results in a detailed written procedure for completing potentially hazardous portions of job tasks.
- **Personal Protective Equipment (PPE) Assessment:** An assessment of the task to determine if hazards are present, or are likely to be present, and necessitate the use of PPE. Hazards identified in the assessment will be used to select the proper type of PPE.

SELECTING JOB TASKS FOR ANALYSIS

Each Profit Center will develop a list of job tasks requiring a JTSA and PPE Assessment. These tasks will be selected based on the following factors:

- Tasks that have potential to cause serious injury or fatality, or that have produced serious injury or fatality in the past.
- Tasks that resulted in near misses or high numbers of injuries.

- New tasks or tasks involving the use of new equipment or processes.
- Tasks that field employees consider to be most hazardous.

The priority for analyzing job tasks should be based on the severity of potential or actual past injuries, the frequency with which job tasks are performed, and the probability that injury or illness may occur while performing tasks. Job tasks with the highest combination of severity, frequency, and probability should be analyzed first.

PERFORMING JTSA AND PPE ASSESSMENTS

A team of employees who perform or supervise the task being analyzed will complete the JTSA and PPE Assessment. The analysis team should consist of two or more employees and include at least one supervisor and one field employee who perform the task. The JTSA and PPE assessment should be documented using the form shown in *Exhibit SOP 4-1*. The steps for performing the JTSA and PPE Assessment are as follows:

- **Step 1** - Define the scope of the job being analyzed.
- **Step 2** - Arrange to meet with individuals involved.
- **Step 3** - Break down job task chronologically into steps.
- **Step 4** - Identify safety and environmental hazards involved with each job task step.
- **Step 5** - Identify personal hazards and potential exposures requiring additional PPE.
- **Step 6** - Develop safeguards to eliminate or control hazards identified, or choose additional PPE to eliminate personal hazards.
- **Step 7** - Review completed JTSA and PPE Assessment with all personnel involved.

Step 1 - Define the Scope of the Job Being Analyzed

Defining the scope of the analysis means determining where the job task to be reviewed begins and ends. The JTSA and PPE Assessment can be very broad and cover pre- and post-job supplementary tasks, such as selecting tools, spotting equipment, lockout/tagout, checking MSDS, performing monitoring, and decontamination. The JTSA and PPE Assessment can also be specific and focus only on parts relevant to the analysis or not covered by other procedures and work practices.

If a previous JTSA and PPE Assessment have been completed for a similar job task at another Profit Center or during another project, the analysis team can modify the assessment to fit any unique site conditions, or adopt it as-is if no additional hazards or steps have been identified.

A repository of JTSA and PPE Assessments is available on the company intranet site.

Step 2 - Arrange to Meet with Individuals Involved

The analysis team should meet either on site during a pre-job safety meeting, during the initial daily toolbox safety meeting, or off site during development of the Project or Site Health and Safety Plan. The JTSA and PPE Assessment will be a key component of Project and Site Health and Safety Plans, and must be attached to all of those plans.

The Regional Health and Safety Committees for OM&M, Energy, and Construction can perform JTSA for tasks related to those groups. The National Advisory Health and Safety Committee can perform JTSA and PPE Assessments for high-frequency tasks performed by Engineering Services.

Step 3 - Break down Job Task Chronologically into Steps

Breaking the job down into a chronological list of steps makes the JTSA process useful as a step-by-step work procedure. If this can be done in advance, the JTSA study will proceed more smoothly. Job steps should be documented in Column 1, the first column of *Exhibit SOP 4-1*.

Analysis begins with the first step of the job task, as defined by the scope, and continues chronologically until all steps are completed. Whether developing the JTSA during a project or a committee meeting, or conducting the analysis during an informal tool box safety meeting, an individual experienced in performing the job task should attend the meeting. A proper sequencing of tasks is imperative.

Step 4 - Identify Safety and Environmental Hazards Involved with Each Job Task Step

Identifying hazards involved in each task step is one of the main purposes of conducting a JTSA. Hazards are recorded in Column 2 of *Exhibit SOP 4-1*. This exhibit provides checklists to aid in analyzing and determining the hazards present. Though individuals on the team will offer diverse points of view regarding such hazards, all possibilities should be analyzed, even those posed by related work. Ergonomic hazards may be identified using the Ergonomic Hazard Checklist in *Exhibit L-2* (see *Appendix L*).

Step 5 - Identify Personal Hazards and Potential Exposures Requiring Additional PPE

A checklist is provided to assist in identifying hazards to the head, eye/face, hand/body, hearing, foot, or respiratory system that require additional PPE beyond a site's minimal requirements. If questions about hazards to hearing, respiratory systems, or air and noise monitoring arise, real-time or personal monitoring should be noted as a requirement and documented in the second column of the JTSA and PPE Assessment Form.

Step 6 - Develop Safeguards to Eliminate or Control Hazards Identified, or Choose Additional PPE to Eliminate Personal Hazards

This crucial step adds value to the analysis, and involves controlling hazards so that job steps will be performed safely. Safeguards should be documented in the third column of the JTSA and PPE Assessment Form. The process of controlling hazards should be carried out in the order

specified in *Exhibit 2.4-1*, Hierarchy of Controls for Hazard Reduction (see *Section 2.4 of the SCS Health and Safety Management System Plan*), as follows:

- Elimination of the hazard from the work area.
- Substitution of a less hazardous material, process, or equipment.
- Engineering controls (machine guarding, automatic shutdowns, and ventilation systems).
- Warnings (alarms and/or signs).
- Administrative controls (job rotation, limit time of exposure, barricades, and training).
- Personal protective equipment (hearing plugs/muffs, respirators, gloves, and safety glasses).

If additional PPE is required above the site minimum for performance of the task, PPE selected must be documented in the PPE Selection columns of the JTSA and PPE Assessment Form.

If none of these options eliminates or controls hazards so that the task can be performed safely, the task must not be performed. At this point, the JTSA Team Leader and discussion group will assess other options for performing the job without completing that particular task.

Step 7 - Review Completed JTSA and PPE Assessment with All Personnel Involved

After the analysis is finished, the JTSA and PPE Assessment Form should be reviewed for completeness and accuracy. Any steps omitted or incorrect should be noted and the document revised.

Personnel who perform the job task but were not able to attend the meeting must review and understand the completed JTSA and PPE Assessment. The form should be attached to the Site or Project Health and Safety Plan and/or work permit, and distributed to the site and/or project team members. It is the responsibility of the site or Project Manager or Superintendent to ensure that this review takes place. Persons who reviewed the assessment will be identified on the first page of *Exhibit SOP 4-1*.

Hazards that were not anticipated, and safeguards that did not work as well as intended, should be noted. The JTSA and PPE Assessment Form should be revised to reflect these observations.

EMPLOYEE TRAINING

All employees in OM&M, Construction, Energy, and Engineering Services will be trained to complete the procedure for hazardous job tasks.

Exhibit SOP 4-1. Job Task Safety Analysis and PPE Assessment Form

Job Task Safety Analysis Form				
Task Type (Check all that apply)	OM&M	Task Description (include estimate of task duration in hours/day):	Location or Project: NIC RD-PDA	
	Construction		Date Revised: July 29, 2013	
	Energy		Project #27213343.00/Revision #: 01	
	Engineering Services			
Analysis Team Member		Position Title	Reviewed by	Position Title
Monte Markley		Project Director	Jason Franks	SCS Aquaterra OHSC
Special Training Required				
Applicable SAFE Checklist(s): Specify type and category number				

This form is the certification that the hazard assessment has been performed for the workplace as required by 29 CFR 1910.132(d)(2).

Job Task Safety Analysis and PPE Assessment Form- Cont.			
Job Task Step	Potential Environmental and Personal Hazards ¹	Critical Actions	PPE Required
			Head Body Eye/face Foot Hand Respiratory Hearing

¹ See **Table SOP 4-1** (below) for examples of Environmental Hazards.

² See **Table SOP 4-2** (below) for examples of Personal Hazards.

Table SOP 4-1. Potential Environmental/Safety Hazards

Environmental Conditions	<ol style="list-style-type: none"> 1. Is there adequate lighting? Provide portable lighting, flashlights, and hardhats with light attachments. 2. Are there sources of heat or cold stress? Cold stress: use insulated coveralls or clothing; provide heaters or blankets. Heat stress: provide plenty of ice and fluids; monitor body temperature and pulse; provide cooling vests; provide cooling fans or mistifiers. 3. Are there any radiation sources? Provide radiation protection; monitor for radiation. 4. Is there adequate ventilation to remove air contaminants? Provide ventilation fans or blowers. 5. Is adequate air monitoring conducted? Conduct personal or real-time monitoring. 6. Are there any biological hazards, such as ticks, spiders, snakes, chiggers, etc., potentially present in the area? Use DEET or other tick or insect sprays; cover exposed skin areas with clothing; tuck in pant leggings into boots.
Injurious Contact	<ol style="list-style-type: none"> 1. Can an employee or clothing come in contact with, be struck by, or become caught between moving parts of machinery? Install guards or warning signs/barriers. 2. Are there any pinch points between two moving parts or objects? Provide guards, barriers, warning signs. 3. Is there sufficient room to work and not be in the line of fire or in a traffic area? Personnel provide traffic support, and use traffic cones. 4. Is there an object or machinery that can strike people? Provide barriers or use proper PPE. 5. Are energy sources controlled and subject to lockout/tagout? Provide lockout/tagout and check controls. 6. Are machines properly guarded? Use proper guards.
Overextension	<p>Exhibit L-2 evaluates ergonomic hazards such as awkward postures, lifting, high hand force, repetitive motion, and repeated contact.</p>
Slips, Trips, Falls	<ol style="list-style-type: none"> 1. Is there a chance that ice, oil, water, or other slick material will accumulate on the working surfaces? Use shoe overlays or slip-resistant boots, and absorbents. 2. Is the area clear of debris and litter? Provide proper housekeeping; inspect area before starting task. 3. Are there any walking obstructions such as hidden ditches or hoses on the ground? Identify obstructions with tape or other warning devices. 4. Does the job require stairs, ladders, or other elevated surfaces? Provide railings or fall protection. 5. Is there a chance of fall from an elevated level? Provide railing or fall protection.

Table SOP 4-1 (continued)

Other Safety Hazards	<ol style="list-style-type: none">1. Are correct tools for the job available? Evaluate tools required.2. Is proper equipment for lifting and moving objects available? Provide manlifts, hoists, or cranes for lifting.3. Is critical equipment maintained? Check maintenance records.4. Is communication between groups adequate to ensure safe performance? Provide radios or cell phones to employees.
Drilling, Excavation, Confined Space, Operation of Heavy Machinery, Operating Power Tools	See appropriate SAFE Checklist for safe behaviors for each category.

Table SOP 4-2. Personal Hazards and Guidance on PPE Selection

Personal System	Potential Hazards	Recommended PPE
Head	<ol style="list-style-type: none"> 1. Potential for falling overhead objects? 2. Potential for contact with electrical conductors coming into contact with head? 	Hardhats, ANSI Z-89.1 approved. Non-conductive Hardhats Class G or E, ANSI Z-89.1 approved.
Eye/Face	<ol style="list-style-type: none"> 1. Exposed to flying particles or objects that can impact eye or face? 2. Exposed to flying sparks or molten metal? 3. Exposed to corrosive vapors or liquids? 4. Exposed to optical radiation? 	Faceshield, ANSI-approved goggles; minimal protection is safety glasses with side shields. Faceshields or goggles. Faceshield or chemical splash-resistant goggles. Welder faceshield with adequate optical density shades.
Hand/Body	<ol style="list-style-type: none"> 1. Exposed to possible cuts or abrasions? 2. Exposed to hot surfaces or heat sources? 3. Exposed to hazardous chemicals through dermal route? 	Leather gloves or abrasion resistant gloves. Leather or other heat-resistant gloves/heat-reflective coveralls. Chemical-resistant gloves and coveralls appropriate for chemicals of concern.
Foot	<ol style="list-style-type: none"> 1. Potential for objects falling or rolling over foot? 2. Potential for objects piercing foot? 3. Feet exposed to dangerous or corrosive chemicals? 4. Feet exposed to electrical hazard? 5. Exposed to tripping hazards and uneven surfaces? 	Steel-toe boots, ASTM F2413-05 approved; metatarsal guards should be considered. Steel-toe and shank boots, ASTM F2413-05 approved. Chemical-resistant boots with steel-toe and shank. Non-conductive safety boots, ASTM F213-05 approved. Boots with high ankle support.
Hearing	<ol style="list-style-type: none"> 1. Exposed above 80 dBA? 	Hearing plugs or muffs with NRR sufficient to reduce exposures below 80 dBA.
Respiratory	<ol style="list-style-type: none"> 1. Oxygen deficient or IDLH atmosphere, or unknown atmosphere? 2. Below 50 times PEL; above 10 times PEL, or corrosive to eye/face? 3. Above 10 times PEL, but below 50 times PEL, non-corrosive to eyes/face? 	SCBA or supplied air with escape bottle. Full-face cartridge or filter respirators, PAPR. Half-face respirator.

SOP 8

SAFE PROCEDURES FOR DRILLING AND WELL INSTALLATION

PURPOSE AND SCOPE

This procedure outlines the safe work practices associated with well drilling and installation. The procedure applies to all SCS employees and contractors involved in these activities.

SAFE WORK PRACTICES

General

- Always complete a JTSA and PPE Assessment for drilling or well installation projects (see *SOP 4*).
- Excavation, well, or drilling permits may be required, and employees must comply with local requirements.
- The Construction Superintendent or Project Team Leader must determine safety precautions and PPE required. At a minimum, PPE Assessment will indicate that employees wear protective equipment such as hard hats, safety glasses, safety work boots, safety vests, gloves, respirators, or hearing protection, as required.
- Drilling equipment shall be operated only by qualified (by training and experience) personnel who are authorized by the contractor or SCS to operate subject equipment. The drilling equipment shall be operated, inspected, and maintained as specified in the manufacturer's operating manual.
- Drilling equipment shall be equipped with two easily accessible emergency shutdown devices, one for the operator and one for the helper. Fire extinguishers shall be available on the cab of the drilling machine and readily accessible by the ground drilling crew.
- NEVER approach an open borehole without appropriate fall protection. It is easy to lose your balance, particularly for holes on slopes—on a slope, approach the borehole from below the borehole (walking uphill).

Underground Utilities

- Underground utilities in the vicinity of the planned borehole or trench must be identified prior to commencement of drilling operations involving the drill rig and power augers.
- Locations that contain underground utilities should be drilled to a depth of 3 feet using a slam bar, hand auger, or post hole digger.

Above-Ground Utilities

- Above-ground utilities must be identified prior to commencing drilling activities.
- All operations must be cleared of power lines, telephone lines, video cables, guy wires, and other objects that may pose a hazard.

Moving Equipment

- Prior to bringing earth drilling equipment on the job site or before drilling equipment is moved, a survey shall be conducted to identify overhead electrical hazards and potential ground or terrain hazards, such as hazardous agents in the soil, or underground utilities. The location of any overhead or ground hazards shall be identified on a site layout plan of the project or site health and safety plan.
- Earth drilling equipment shall not be moved with the mast up.

Drilling Activity Setup

For boreholes greater than eighteen inches in diameter, the following requirements will apply:

- Create a controlled access zone no less than ten feet around the edge of the borehole. The controlled access zone shall be flagged or otherwise clearly marked with high-visibility material or barriers.
- Any person who enters inside the controlled access zone shall be required to wear a full-body harness with a lanyard that meets OSHA fall protection equipment requirements (see **SOP-10**). The lanyard must be connected to an anchorage point that is able to support at least 5,000 pounds per person attached. The lanyard shall be designed to prevent the employee from falling in the hole. A self-retracting lifeline is recommended for use as part of the fall protection equipment.
- Before a person is allowed in the controlled access zone, all machinery and equipment within the swing radius of lanyard must be removed or turned off to prevent any person from having their lanyard entangled or snared by moving or operating equipment.
- If the lanyards are attached to a vehicle or moving equipment, the equipment or vehicle will be locked out/tagged out to ensure that the equipment or vehicle is not accidentally started while the employee is anchored. Preferably, the vehicle keys should be in the possession of the person wearing the fall protection equipment.
- A safety grate that provides at least two feet of overlap over the borehole corners or edges and is designed and constructed to hold at least twice the weight of the materials and equipment (including piping clamped to the center of the grate) placed on the grate will be available at all times during drilling activities. The grate should be used to cover any open boreholes when persons are within the controlled access zone.

- Equipment shall be set-up on stable ground and maintained level. Cribbing shall be used when necessary. Outriggers shall be extended per the manufacturer's specifications.

Drilling Operations

- Weather conditions shall be monitored. Operations shall cease when electrical storms or high winds are imminent.
- Persons working near drilling equipment shall not wear loose clothing, jewelry, or equipment that might become caught in moving machinery.
- Auger guides shall be used on hard surfaces. (If impractical due to type of drill rig being used {full-size and/or crane-mount}, a risk assessment shall be performed by a qualified person, and documented in the JTSA as to why this requirement is not practical. additional precautions and/or controls shall be identified to insure an equal level of safety is being accomplished).
- The operator shall verbally alert employees and visually ensure employees are clear from dangerous parts of equipment before starting or engaging equipment.
- Hoists shall be used only for their designed intent and shall not be loaded beyond their rated capacity. Steps shall be taken to prevent two-blocking of hoists.
- The equipment manufacturer's procedures shall be followed if rope becomes caught in, or objects get pulled into, a cathead.
- Borehole depth measurements shall be collected when the drill bucket is located at the top of (but still within) the borehole.

Backfilling and Installation of Piping in Gas Wells

- Before installing piping or backfilling a gas well greater than eighteen inches in diameter, place a safety grate on top of the borehole. The safety grate shall be placed on the borehole by either of the following methods:
 - Placing the drilling bucket on top of the borehole, then have employees place the grate against the drilling bucket. Once the grate is placed against the drilling bucket, remove the drilling bucket slowly and allow the grate to fall on top of the borehole.
 - Use an extended forklift, or similar piece of equipment, to place the safety grate on top of the borehole.
- Move the backfill materials as close to the borehole as possible. Limit the amount of lifting required to backfilled the gas well or borehole by placing the materials at a height of between the knees and waist of the employees backfilling the gas well. Eliminate any twisting of the back when backfilling gas wells with Bentonite or other materials.

- Minimize the generation of Bentonite dust by pouring water at the same time as backfilling with the Bentonite materials, or mix the Bentonite with water and then backfill the gas well. Some form of respiratory protection may be necessary.
- Keep all employees at a safe distance when lowering the gas well piping into the borehole.
- If employees are required to work over the borehole (e.g. to place a pipe centralizer), use a safety grate and provide ventilations fans to limit their exposure to landfill gases.
- All unattended boreholes or boreholes not completed for the day will be covered by the following method:
 - Keep the safety grate on top of the borehole and place a piece of plywood on top of the grate, then
 - Put at least six inches of soil over the plywood and grate, and place the drilling bucket on top of the soil, plywood and grate.
- Remove any borehole cover with the drilling bucket, forklift or other types of heavy machinery; NEVER manually removed the cover unless using a lanyard and full-body harness as required for any entry into the controlled access zone.

Landfills and Other Areas Where Combustible Gas May Be Present

- NO SMOKING.
- Suspicious or dangerous cuttings, such as asbestos; unknown chemicals in containers punctured by drilling operations; military munitions; or medical wastes should always be noted during drilling projects. In such situations, PPE must be modified as directed by competent personnel. Solid waste or contaminated cuttings should never be handled with bare hands.
- Work areas should be periodically monitored for methane, hydrogen sulfide, or other chemicals of concern. If such chemicals are encountered, corrective measures (e.g., forced ventilation) must be taken, as necessary.
- Valves and/or pipes should be closed or capped at the end of each work day to control combustible gas emissions.

Drilling Equipment Checks

Drillers should visually inspect the following equipment at least daily:

- All control mechanisms, for adjustment, wear, and lubrication.
- Air and hydraulic systems, for deterioration or leakage.
- Rope and pulley function.
- Hoist brakes, clutches, and operating levers.
- Kill switches.

SOP 21

SAFE PROCEDURES FOR BIOLOGICAL HAZARDS

PURPOSE

The purpose of this section is to assist employees in recognizing natural biological hazards such as plants, animals, and insects. These include spiders, snakes, poisonous plants and vegetation, ticks, and rodent or animal droppings that could contain Hantavirus. The discussion offers guidance on how to avoid exposure to these hazards, as well as recommendations for treating illnesses or injuries associated with these hazards.

SCOPE

This discussion is applicable to all employees who may be exposed to biological hazards while working. Employees involved in field activities should become familiar with the basic natural hazards that can be encountered during investigations or other activities. With this knowledge, employees can better avoid dangerous situations. Examples of potential natural hazards are provided below.

Note that different types of biological hazards exist in different regions of the country. Although the examples provided in this SOP are common, they do not form an exhaustive list of every pest you may encounter.

INSECTS

- **Ticks:** Small arachnids that are larger than mites and come in a variety of forms and sizes. Ticks attach themselves to warm-blooded animals and extract blood from the host. It should be noted that ticks harbor at least two diseases:
 - **Rocky Mountain Spotted Fever** is carried by some ticks and can be fatal. Symptoms can include fever, headache, and chills, experienced a few days after being bitten by a tick. Wood ticks can carry this disease.
 - **Lyme Disease** is usually carried by the small deer tick. It may take as long as 72 hours of feeding to transmit infection, so brief contact with such ticks should not be cause for alarm. Symptoms may include red rash around the point of entry and/or flu-like ailments. Antibiotics are usually effective in relieving symptoms and in preventing progression of the disease to more serious stages. If left untreated for weeks or months, Lyme Disease can cause serious nerve and heart ailments, such as meningitis and myocarditis. Months or years after initial infection, affected people may develop arthritis that can last for years. If you are concerned about exposure to this disease, you can request that you be tested for this disease through your OHSC.

Ways to protect yourself from ticks:

- When in the woods, wear clothing that covers the skin and fits snugly around the wrists, ankles, and waist. In areas known to heavily infested, openings at the pant legs and wrists should be sealed with duct tape. Avoid contact with vegetation such as tall grasses and bushes as ticks may transfer from these locations on to you.
- Wear light-colored clothing to make it easier to spot ticks.
- Use tick repellents (DEET) when working in areas known or suspected to be tick-infested.
- Apply tick repellent to clothing, concentrating on areas most accessible to ticks (for example, shoe tops, socks, and pant cuffs).

After being in a tick-infested area, check closely for any small ticks on the skin (especially the scalp and hair) and clothing. Ticks not completely removed can increase the likelihood of infection. If you find an attached tick, remove it, exercising care not to squeeze the insect's abdomen, since this may cause expulsion of fluids into the wound. The following procedures can be effective in removing ticks:

- Use tweezers to **slowly** pull the tick out of the skin.
 - Grasp the tick as close to the skin as possible before removing.
 - **Do not** attempt to burn the tick off with matches or hot objects.
 - **Do not** attempt other home remedies, such as coating ticks with Vaseline.
 - Contact WorkCare (800.455.6155) if you have difficulty in removing the tick or at the first sign of symptoms.
- **Chiggers:** These are red six-legged mite larva approximately the size of a pinhead. Chiggers suck blood and cause intense itching or irritation. To eliminate chiggers, methods outlined above for protecting against ticks can be effective. Flowers of sulfur (sulfur powder sold in drugstores) are known to be chigger repellent.
 - **Fire Ants:** Any of a genus (*Solenopsis*) of fiercely stinging ants. Fire ants got their name because their sting literally burns like fire. Fire ant venom is much more potent than other insects' venom in that it contains a high concentration of piperidine, an alkaloid compound with a high pH that is 95% insoluble in water. Piperidine is related to piperine, the main active ingredient in black pepper. Fire ant venom also contains a smaller amount of protein than is normally found in stings.
 - Do not disturb any ant mounds or nests as the ants will leave the nest or mound and climb up anything they find.

- If fire ants do crawl onto your skin, they first bite with their mandibles in order to anchor for the thrust of the sting. As soon as you feel this pinching sensation, quickly sweep the ants off before they actually sting and you can avoid most of the damage from an ant sting. If you must work in proximity to fire ants, wear rubber boots and gloves powdered with talc.
- Immediately after being stung, wash off the area with alcohol, try not to scratch it so it doesn't get infected. Sometimes a white pustule will form the second day, but it will eventually be resorbed. Apply a hydrocortisone cream to the sting area to reduce inflammation. A thick paste of baking soda and water can also help right after the sting. Careful application of ice will help decrease pain, but can burn the skin if left on too long. If the pustule becomes infected, apply an antibiotic cream and keep the area clean and contact WorkCare (800.455.6155). Antihistamines may help with local reactions: burning and itching.
- If other reactions occur soon after the stings, i.e., difficulty breathing, itchy rash, loss of consciousness, etc., get the person to an emergency room immediately and then contact WorkCare (800.455.6155). About 1% of the population have the potential for serious and dangerous reaction to fire ants. A physician can prescribe a single dose epinephrine auto injector device to carry with you in case of subsequent ant stings and anaphylactic reaction.
- **Bees and Wasps:** Some people are highly allergic to stings from these insects (if so, those people should ask a physician for an emergency sting kit, and carry it at all times). The following are first aid procedures for bee or wasp stings:
 - Remove the stinger by scraping it out with the edge of a knife blade, tweezer tips, or similar device. **Do not** squeeze the stinger.
 - **Do not** use tweezers to grasp the stinger to remove it, as this may inject more poison.
 - Cover the wound, apply a cold pack, and watch for allergic reaction (note: stingers remaining in the body are a problem with respect to bee stings, but not wasp stings).
 - Contact WorkCare (800.455.6155) or seek medical attention if an allergic reaction occurs.
- **Spiders:** Venomous spiders indigenous to the United States include Black Widows and the Brown Recluse:
 - **Black Widows** are shiny black spiders with long legs, approximately 2 inches in size. Females have an hourglass-shaped red mark on the underside of their abdomens.

- **Brown Recluses** are brown spiders approximately 1 to 2 inches in size. They have long legs and a distinctive dark brown fiddle-shaped marking on the underside. These spiders produce a dangerous necrotizing agent.

Rule of thumb in relation to spiders: Avoid placing hands in dark holes or spaces. Wear protective gloves when working near such areas. Black widow and brown recluse spiders are usually found in holes or out-of-the-way places. Be alert to spider webs in the field, and try to avoid walking through them. If you think you have been bitten by a venomous spider:

- Remain calm. Too much excitement or movement will increase the flow of venom into the blood.
- Apply a cool, wet cloth to the bite, or cover the bite with a cloth and apply an ice bag to the bite.
- Do not apply a tourniquet. This may cause more harm than benefit.
- Try to positively identify the spider or catch it to confirm its type.

PREVENTION OF INSECT BITES

Insect repellent containing DEET is the most effective insect repellent. It is found in a variety of readily available products. There has been some concern about the negative effects of using this chemical, particularly for children, but none of the “natural plant” products (see below) are likely to be as reliable.

Essential oil of eucalyptus (*Eucalyptus globulus*) is a natural insect repellent. You can make a solution by adding five drops to a cup of water, and then dab it on the skin. Essential oil of citronella discourages insects when placed on exposed skin. A few drops of calendula (*Calendula officinalis*) ointment on the face, arms, and legs may keep insects away. It is also available as a commercially prepared product.

Other recommendations for avoiding insect bites are as follows:

- Apply insect repellent before going into the woods or other areas where you may come into contact with insects. Use insect repellents according to directions, particularly when applying the repellents to children.
- Apply repellents safely. Some insect repellents can only be applied safely to clothing rather than skin.
- Do not apply repellent near mouth, eyes, or openings in the skin. Wash hands following application to avoid accidental ingestion.
- Wash insect repellent off with soap and water after returning indoors.

- Wear light-colored, smooth-finished clothes that cover your body, such as long-sleeved shirts and long pants. Button long sleeves and tuck long pants inside boots. Avoid loose clothes that might entangle a biting or stinging insect.
- Always close vehicle windows when vehicle is parked or while driving through vegetation.
- Avoid flowering plants.
- If you have a severe allergic reaction (anaphylaxis) to insect bites or stings, have someone notify WorkCare (800.455.6155) and carry necessary antidote.
- Avoid swatting at insects or flailing your arms around them. Instead, retreat slowly and calmly when insects act threatening.
- Avoid wearing perfumed lotions, aftershave, or scented hair products during the warmer months.

POISONOUS PLANTS

Poison ivy, poison oak, and poison sumac cause a short-lived but extremely irritating allergic form of contact dermatitis. The leaves, stems, and roots of these plants contain the resin urushiol, even small amounts of which on exposed skin can trigger an inflammatory allergic reaction. Urushiol can be transferred by fingers or animal fur, and can remain on clothing, shoes, and tools for a number of months. Urushiol particles can also travel in the wind when the plant is burned in a fire. Scratching the rash does not spread the poison to other parts of the body, but can prolong discomfort and cause a secondary infection.

The rash from urushiol generally develops within 2 days, peaks after 5 days, and starts to decline after about a week or 10 days. While some people survive exposure without ill effects, complete immunity is unlikely. People who seem immune from poisonous plants at one time and place may find themselves vulnerable in other situations. Of primary concern are:

- **Poison Ivy:** A plant (*Rhus toxicodendron*) characterized by leaves arranged in threes, ranging from less than a foot to 5 feet in height when the plant is free-standing or taller when climbing. Poison ivy has greenish flowers and white berries, and its leaves turn yellow in the fall. When oils from the plant contact skin, they can produce a rash and intense dermal itching.
- **Poison Oak:** Characterized by alternate leaves with three or occasionally five veined, shiny leaflets, poison oak thrives throughout the United States. In autumn, the leaves turn a deep red color. Exposure to the oily sap contained in all



parts of the poison oak (roots, stem, leaves, flowers, and the fruit [berries]) may cause skin irritation ranging from mild to severe. Between 50 and 85 percent of the population is allergic to poison oak, resulting in a more severe reaction when exposed. Primary contamination results from contact with bruised or broken plant parts that release toxicodendrol, an oily resin containing urushiol. Because the lacquer-like resin does not dissolve in water, it is difficult to wash off and its toxicity persists for a long time.

- **Poison Sumac:** A shrub (*Toxicodendron vernix*) characterized by pinnate leaves that have red stems and leaf veins, clusters of greenish yellow flowers that produce ivory-white fruit with a fleshy outer skin, and poisonous oils that irritate the skin.



Treatment for Exposure to Poisonous Plants

If you think you have been exposed to poison ivy, oak, or sumac, wash all exposed areas thoroughly. If you can do this within 5 minutes of contact, you may often avoid allergic reaction.

You can also treat most cases of the rash with applications of calamine lotion, Burrow's Solution, or over-the-counter topical remedies containing antihistamines or hydrocortisone. Cold compresses--15 to 30 minutes several times a day--are useful for itching and blistering; cool showers are also effective. A cortisone shot may relieve the itching, particularly within 24 hours of exposure.

Oral corticosteroids or antihistamines may also relieve the symptoms, but both drugs can have unwanted side effects. If you have complications from a severe case, you may need to see a doctor.

If you do contact any of these poisonous plants, be sure to clean your clothing, tools, or any gear that you may have had with you. Because urushiol can remain on clothing or other items for extended periods of time, touching these items can cause reinfection at a later date.

Prevention of Exposure to Poisonous Plants

The best way to prevent exposure to poisonous plants is to learn to recognize these plants, and avoid contact with them.. Barrier ointments or lotions from outdoor suppliers help if you are working around heavy vegetation.

ANIMALS

- **Rabid Animals:** Some mammals may carry rabies, and rabid animals tend to approach people instead of avoiding them. Beware of nocturnal (night dwelling) animals (such as raccoons or opossums) active during the day.
- **Dogs:** Realize that dogs encountered in the wild tend not to be "man's best friend," even if they look like "Lassie." Two or more dogs together constitute a pack (with a tendency toward fierce behavior), and can pose significant threat. Roaming animals,

particularly large dogs that instinctively hunt by sight (such as collies or shepherds), are cause for concern. Some breeds (cocker spaniels and English Springer spaniels) are notorious for erratic fits of violent behavior. Other dogs are bred as guard dogs or fighting dogs (Dobermans, Rottweilers, Boxers, and Bulldogs). Dogs that are unconfined are more likely to contract rabies. Beware of dogs that foam at the mouth or show their teeth. Upon encountering such a dog, do not make any sudden moves. Do not make direct eye contact with the dog. Back slowly away from the animal, and never turn your back on unknown dogs

Prevention of Animal Bites

As a rule of thumb, it is a good idea to carry a large stick for self-defense (the stick can also serve as a hiking aid on some sites). Methods for preventing attack include:

- Do not disturb animals while they are eating, sleeping, or nursing. Animals that have given birth can be very aggressive when protecting their young.
- Do not approach or play with unfamiliar or stray pets.
- Do not run past a dog, because dogs naturally tend to chase and catch things.
- Many animals give warning before they attack. Be aware of unusual noises or growling from animals.
- Firearms should not be carried or used on the job site for protection against animals.

If you see a threatening dog:

- Notify animal control and, if possible, speak with the owners.
- Stay still. Do not run.
- Do not make direct eye contact with or stare at the dog. Staring may be interpreted by the dog as a threat and aggression.
- Do not smile at the dog, since showing your teeth may be taken as an aggressive action by the dog.
- Don't scream. If you say anything, speak calmly and firmly.
- If you fall or are knocked to the ground, curl into a ball with your hands over your head and neck. Protect your face.
- Do not touch wild animals or provoke them to attack.
- Do not handle sick or injured animals.

If you have a close encounter with a bear during field activities:

SNAKES AND LIZARDS

A bite from a poisonous snake or lizard requires emergency care. If you have been bitten by a snake or lizard that you know or suspect might be poisonous, **call 911 or other emergency services immediately and contact WorkCare (800.455.6155)**. Do not wait for symptoms to develop.

If you are not sure what type of snake or lizard bit you, **call the poison control center immediately (1-800-222-1222)** to help identify the snake or lizard and to determine the next steps to take. Medication to counteract the effects of the poison (antivenin) can save a limb or your life.

It is important to stay calm and lie still as much as possible after a suspected poisonous snake or lizard bite. Vigorous physical activity may increase the flow of venom to the bloodstream.

Poisonous snakes or lizards found in North America include pit vipers (family Crotalidae), such as copperheads, rattlesnakes, and water moccasins (also called the cottonmouth); coral snakes (family Elapidae); and the Gila monster and Mexican beaded lizard:

- The **Northern Copperhead** is characterized by a coppery-red head and an hourglass pattern consisting of dark chestnut crossbands that are wide at the sides and narrow at the center of the back. Small dark spots are frequently present between crossbands, and dark rounded spots exist between the crossbands at the base of the belly. Young Northern Copperheads are paler in color and have bright yellow tail tips. They also have a narrow dark line that extends from both sides of the eye and divides the dark head from the pale mouth. Rocky, wooded hillsides and mountainous areas are typical habitats. Abandoned and rotting slab (the outer strips of logs) or sawdust piles also attract these snakes.

The symptoms reported after a copperhead bite can include: pain and swelling in the area of the bite (swelling may take several hours to develop). The severity of the signs and symptoms developed after a bite varies with the amount of venom injected, size of the snake, age and size of the victim, prior health status of the victim, location of the bite, and the bacteria present in the snakes mouth. *The poison center should be contacted as soon as a suspected bite occurs.*

- The **Timber Rattlesnake** can have either one of two different color patterns:
 - **Yellow phase:** Black or dark brown crossbands on a ground color of yellow, brown, or gray; the crossbands, which may be V-shaped, break up anteriorly to form a row of dark spots down the back, plus a row along each side of the body.
 - **Black phase:** A heavy stippling of black or very dark brown hides much of the



Western diamondback rattlesnake

lighter pigment; completely black specimens are not unusual in the uplands of the Northeast.

Young rattlesnakes are always cross-banded, as in the yellow phase, but with darker colors.

The Timber Rattlesnake is the only rattlesnake in the populous Northeast. Although it is still common in some mountainous regions (for example, the Blue Ridge Mountains), it has almost completely disappeared from many places where it was once abundant (such as the Washington metropolitan area). As its name indicates, this is a snake of timbered terrain, preferring areas of secondary growth where rodents abound.

- The **Western Diamondback Rattlesnake** is the largest western rattlesnake. It has a plump body, a short tail, and a broad, triangular head that is very distinct from the body. This snake can be yellowish gray, pale blue, or pinkish, and has dark diamond shape marks down its back. There is also a rattle at the end of its tail.

The severity of a rattlesnake bite is gauged by how rapidly symptoms develop, which depends on how much poison was injected. Signs and symptoms of a pit viper bite include:

- Immediate and severe burning pain and swelling around the fang marks, usually within 5 minutes. The entire extremity generally swells within eight to 36 hours.
 - Purplish discoloration around the bite, usually developing within two to three hours.
 - Numbness and possible blistering around the bite, generally within several hours.
 - Nausea and vomiting.
 - Rapid heartbeat, low blood pressure, weakness, and fainting.
 - Numbness and tingling of the tongue and mouth.
 - Excessive sweating.
 - Fever and chills.
 - Muscular twitching.
 - Convulsions.
 - Dimmed vision.
 - Headache.
- The **cottonmouth** (or water moccasin) is a poisonous snake found in southeastern and south-central North America. Cottonmouths



Cottonmouth (water moccasin)

usually leave distinctive double fang marks on the skin, although on rare occasions they may produce one or three puncture marks. The physical characteristics of a water moccasin include:

- Distinctive white coloring inside the mouth.
- Pitlike depressions behind the nostrils.
- A triangular head with slit-shaped pupils and fangs.
- A single row of plates or scales on the undersurface of the snake.
- Length up to 6 feet (1.8 m).

Treatment of Snake Bites

If you are bitten by a snake or lizard that you know or suspect is poisonous, **call 911 or other emergency services immediately and contact WorkCare (800.455.6155)**. Do not wait for symptoms to develop. Symptoms may progress rapidly from mild to severe.

Medication (antivenin) to counteract the effects of the poison can save a limb or your life. Antivenin is given as soon as a health professional determines it is needed, usually within the first 4 hours following a bite. Antivenin may be effective up to 24 hours after the bite.

Immediate on-site treatment should not delay transport for emergency evaluation. Remain calm. Lie down and stay as quiet and still as possible after being bitten. Any physical activity may increase the flow of venom through the bloodstream.

If you are not sure which type of snake or lizard bit you, **call a poison control center immediately (1-800-222-1222)** to help identify the reptile and to determine the next steps to take. If signs of shock are present or the bite victim is not breathing, administer CPR.

Remove any jewelry on the bitten limb. The limb might swell, making it more difficult to remove the jewelry after swelling begins.

With a pen, mark the edge of the swelling around the bite every 15 minutes so that the progression of swelling can be evaluated.

Apply a splint to the arm or leg that was bitten to limit motion and the flow of venom into the bloodstream. If possible, keep the bitten area at or slightly lower than the level of the heart.

Drink fluids (not alcohol) in frequent, small amounts unless vomiting occurs. This will help to prevent dehydration and reduce the risk of shock.

Extraction Devices

Extraction devices are designed to remove snake venom with suction if the device is applied within 3 to 5 minutes after a bite. For best results, leave the device on for 30 minutes. When using an extraction device, **do not** cut the skin over the bite. Extraction devices are not likely to be beneficial if they are not placed within 3 to 5 minutes after a bite.

Extraction devices come with different-sized suction cups that attach to the barrel of a syringe. The suction cup is applied over the bite, and the vacuum suction of the syringe draws out fluid and venom. As the fluid and venom fill the syringe, suction is lost. These devices can be emptied and then reapplied during transport to emergency care.

Extraction devices may cause skin and tissue damage at the application site. Treatment may be needed to prevent infection.

Extraction devices are only a temporary first aid measure. Using an extraction device does not guarantee that venom will be removed. A person who has been bitten by a poisonous reptile still requires immediate transport to emergency care. If you were bitten by a known or suspected poisonous snake or lizard, **call 911 or other emergency services immediately**. Medication (antivenin) to counteract the effects of the poison can save a limb or your life.

Prevention of Snake or Lizard Bites

Many snake and lizard bites can be prevented. Find out which local snakes and lizards are common to your area. Learn what they look like, whether they are poisonous, and where you are most likely to encounter them.

If you see a snake or lizard, do not disturb it. Keep in mind that the striking range of a snake is about half its length.

Avoid picking up or handling snakes. Even a severed snakehead can release venom through reflexes for up to an hour after the snake dies.

Watch for snakes around wood or rock piles or caves. Wear protective shoes, boots, and clothing when you are working in areas with these types of hazards.

If you are frequently in an area where there are poisonous snakes, consider carrying an extraction device, an elastic rolled bandage, and splinting materials (such as a SAM splint) in the site's first aid kit. Also carry a cellular phone, if you have one available, to use in the event of an emergency.

ROUGH TERRAIN

Unstable footing can be created by a variety of conditions, such as steep slopes, wet rocks or leaves, uneven ground concealed by overgrown vegetation or leaves, and rapidly moving streams. Dense overgrowth may include briery plants and partially concealed vegetation, such as woody or briery vines, that can cause cuts and/or facilitate tripping, if not noticed.

SOP 25

AVOIDANCE AND PREVENTION OF HEAT AND COLD STRESS,
AND OTHER WEATHER-RELATED HAZARDS

PURPOSE

This section describes recommended methods to recognize, prevent, and measure heat and cold stress in the field, and engineering controls and work practices to avoid and prevent heat and cold stress. This procedure will also cover other weather-related hazards such as thunderstorms, tornados, and hurricanes. This discussion applies to all employees exposed to weather.

HEAT STRESS

Hazards of Heat Stress

Table 1 outlines the causes, symptoms and treatment methods for heat stress hazards encountered in hot environments.

Table 1. Heat Stress Hazards - Symptoms and Treatment

Heat Stress Hazard	Causes and Symptoms	Treatment
Sunburn	Mild sunburn is identified when exposed skin turns light pink. This can occur in a short period of time (as little as 15 minutes) in high UV conditions. As sunburn progresses skin turns a deeper pink to bright red and is hot and painful to touch. Blisters can occur in very severe cases.	Cover exposed skin to protect it from exposure from the sun. Wear a broad rimmed hat, ANSI approved sunglasses and work under cover when possible. Sunscreen that provides adequate protection against both UVA and UVB rays should be used. Sunscreen should be applied about a half hour before sun exposure, and again just before working in the sun. Studies have shown that most people apply far too little sunscreen. The SPF of sunscreen is reduced when it is applied too thinly. Personnel should reapply sunscreen periodically especially if you perspire a great deal.

Heat Stress Hazard	Causes and Symptoms	Treatment
Heat Rash	Excessive sweating which results in sweat ducts being plugged and resulting in skin inflammation. Symptoms include a prickly rash which can become infected.	<ul style="list-style-type: none"> • Rest in a cool area • Wash the skin • Allow skin to dry • Seek medical attention, if infected • Regularly bathe and dry skin
Fainting	Non-acclimated employee stands in heat for long periods of time that causes pooling of blood in lower extremities, which results in less blood flowing to the brain. The symptom includes sudden loss of consciousness.	<ul style="list-style-type: none"> • Rest in cool, shaded area for 5 minutes • Gradually adjust to working in heat • Move around to circulate blood
Heat Cramps	Occurs in tired muscles when the worker sweats profusely and drinks large quantities of water. Low salt level causes spasms, while high salt level causes cramps. Symptoms include painful cramping and spasms in the muscles.	<ul style="list-style-type: none"> • Rest in cool, shaded area for 5 minutes • Drink small quantities of water frequently • Drink up to 4 cups per hour • Avoid caffeinated beverages or alcohol
Heat Exhaustion	<p>Large amounts of fluid lost by sweating</p> <p>Symptoms resemble early heat stroke</p> <ul style="list-style-type: none"> – Physically weak, fatigued, or faint – Giddy, irritable, or mental confused – Nauseous – Headache, dizziness, and/or lightheadedness – Person continues to sweat and body temperature is normal – Skin is moist and clammy – Person may vomit or lose consciousness 	<ul style="list-style-type: none"> • Rest in shade or air conditioned vehicle or room for 15 minutes minimum • Drink plenty of fluids (at least 5-7 ounces per 15-20 minutes) • Seek medical attention, if severe • Use cooling vest or wet clothing if required, if needed

Heat Stress Hazard	Causes and Symptoms	Treatment
Heat Stroke	<p>This is a life-threatening condition in which the body's temperature regulatory system fails and sweating becomes inadequate. Symptoms include the following:</p> <ul style="list-style-type: none"> - Person's skin is hot and dry - Skin appears red in color - Body temperature is 103°F or higher - Person is mentally confused or delirious - Person can have convulsions or become unconscious 	<ul style="list-style-type: none"> • Call 911 or your local emergency number immediately. • Move the person to a cooler place. Quickly cool the body. Immerse the victim in a cool bath or briefly wrap wet sheets around the body and fan it. Wrapping the patient in wet towels or cloths can actually act as insulation and increase the body temperature, so avoid keeping them wrapped for prolonged periods. • Do not apply ice or very cold water to the victim's skin as this can cause vasoconstriction in the skin, preventing heat from escaping the body core. • Watch for signals of breathing problems. Keep the person lying down and continue to cool the body any way you can. If the victim refuses water or is vomiting or there are changes in the level of consciousness, do not give anything to eat or drink.

Preventive Measures

The following preventive measures and engineering controls shall be implemented when temperature exceeds 85 degrees Fahrenheit, or when the temperature exceeds 80 degrees Fahrenheit with relative humidity of 85 percent or more:

- Provide adequate supply of cool or iced water or sport drinks for each employee working in the hot environment. The amount of water or sports drinks available onsite should be adequate to provide each employee at least 24 to 32 ounces per hour.

- Supervisor/designated person will monitor water containers every hour, and employees are encouraged to report to supervisor/designated person low levels or dirty water.
- Supervisor will provide frequent reminders to employees to drink frequently, and more water breaks will be provided.
- Every morning there will be short tailgate meetings to remind workers about the importance of frequent consumption of water throughout the shift.
- Employees working in extreme heat conditions should avoid alcohol, caffeine, and heavy meals.
- Place water containers as close as possible to the workers, not away from them.
- Take frequent breaks in cool or shaded areas, or in air-conditioned vehicles. To determine whether the frequency of breaks are adequate, one or more of the following heat stress monitoring methods should be performed, especially when wearing Personal Protective Equipment that limits the evaporation of sweat:
 - **Heart rate-** count your heart beats for 30 seconds as soon as you stop working. If your heart beats exceeds 110 beats per minute, increase your rest period by 1/3. If your heart beat continues to exceed 100 beats per minute in the next rest period, stop work for at least one hour.
 - **Oral temperature-** Put a thermometer underneath your tongue for 3 minutes, if your temperature exceeds 99.6 degrees Fahrenheit; increase your rest period by 1/3rd. If your temperature exceeds 100.6 degrees Fahrenheit, rest for at least one hour.
 - **Body Water Loss-** Measure body weight during the day. If your weight loss has exceeded 1.5% of your body weight at the start of the day, increase your rest period and drink additional fluids
- Whenever possible, provide air-conditioned cabs for equipment operators, which will prevent heat stress and allow the operators to work for longer periods of time.
- When the temperature exceeds 100 ° F (or if the temperature exceeds 90 ° F with relative humidity over 70 percent), consider the use of PPE such as cooling vests, water cooled garments or wet clothing such as headbands or bandanas.

Acclimating to Heat

People need time for their bodies to adjust to working in the heat. This truth applies to employees (1) returning to work after a prolonged absence, (2) moving from a cool to a hot climate, or (3) working during the beginning stages of a heat wave. Just because you used to be able to work 10 hours in hot weather does not mean you still can if you have been out for a while. Help

your body acclimate to the heat—you may have to reduce your hours or increase your breaks for a few days.

Training

Employees who work in hot environments (exceeding 85° F, or exceeding 80° F with relative humidity of 85 percent or more) should be trained in heat stress recognition, measurement and prevention measures at least once every two years, to include the following elements:

1. Signs, symptoms and treatment of various heat related illnesses;
2. Procedures for acclimating
3. The need to drink water frequently
4. The need to take breaks out of the heat
5. How to contact emergency services and how to effectively report the work location to 911
6. The importance of choosing water instead of soda or other caffeinated beverages and avoiding alcoholic beverages all together during high heat.
7. Methods to measure heat stress such as heart rate, oral temperature, or weight loss.
8. PPE available to alleviate heat stress.

Anyone familiar with heat stress (and the eight elements listed above) can lead the training.

COLD STRESS

The hazards of cold weather may include freezing rain, sleet snow, frostbite, hypothermia, and dangerous driving conditions.

Cold Related Illness

When we work in cold temperatures; there is a potential for cold related illness to occur. There are several types of cold related illness and injury. These include frostbite and hypothermia. A description of each is listed below, along with basic first aid procedures that can be utilized for each illness.

Frostbite

Description: Frostbite is literally the freezing of body tissue (usually skin). Fingers, toes, ears, and the nose are the areas most vulnerable to frostbite.

There are three degrees of frostbite, including:

1. Frostnip, which usually affects the face, ears, or fingertips. While the skin may feel numb, frostnip does not lead to permanent tissue damage.
2. Superficial frostbite, in which the outer skin is affected.
3. Deep frostbite, in which the skin and underlying tissue freezes. Permanent damage is possible, depending on how long and how deeply the tissue is frozen.

Frostbite is caused by either prolonged exposure to cold temperatures or shorter exposure to very cold temperatures.

Many people with frostnip or frostbite experience numbness. “Pins and needles” sensations, severe pain, itching and burning are all common when the affected area is warmed and blood starts flowing again. Skin may look white, grayish-yellow, or even black (with severe frostbite), and it may feel hard, waxy, and numb. Blistering is also common.

Treatment and First Aid: Get out of the cold, get out of wet clothing as soon as possible, and remove all constrictive jewelry and clothing. Then immerse the affected area in warm, but not hot, water. If water is not available, warm the tissue with body heat. For example, warm your hands by tucking them into your armpits and warm your nose, ears, or face by covering them with dry hands.

Do not:

- Thaw the frostbitten tissue if there is a chance that it will refreeze before you get medical attention, as this increases the likelihood of permanent damage.
- Rub or massage frostbitten skin or disturb blisters, which can further damage tissue.
- Use direct dry heat, like heating pads or a campfire to thaw frostbitten tissue.

Many people with frostbite may also be experiencing [hypothermia](#) (body temperature that is too low), which can be deadly as described below. This is why it is so important to seek medical attention immediately.

Hypothermia

Description: Hypothermia can occur in cold work environments. Prolonged exposure to cold temperatures can cause the body’s core temperature to drop. Blood flow to the outer limbs is reduced as the body attempts to keep the core warm.

Treatment and First Aid: Treatment and First Aid for Hypothermia include the following:

- The patient should be removed from the cold environment and placed in a warm shelter away from the wind. Wet clothing should be removed and replaced with a warm, dry covering including head covering.
- Emergency medical services should be activated (call 911 if available) as soon as possible.
- The patient's breathing should be monitored, and if it becomes dangerously slow or stops, CPR should be initiated.
- Rough handling or jerking of the patient should be minimized if the person is lethargic or unconscious. This may cause an irritable heart to develop abnormalities (e.g., a heart attack).
- Rewarming should be started by applying warm compresses to the chest, neck, and groin. Hot water should not be used. Because there may be associated frostbite, direct heat should not be applied to the body. Instead, warm blankets and body to body contact may be needed as a first aid measure.
- The severity of hypothermia and the patient's mental status and ability to function will determine what further treatment is necessary. Passive rewarming with warm clothing in a warm environment may be all that is required for a conscious person who is shivering.
- Active rewarming may be considered for those who are colder, or show signs of confusion. Warmed intravenous fluids, warming blankets, and warmed humidified air may be provided in the hospital.

Preventive Measures

The following measures should be taken to prevent cold stress ailments:

1. Wear appropriate clothing for the weather. When appropriate, wear insulated coveralls with hat.
2. Prepare for the worst when performing outdoor tasks if cold weather is a possibility.
3. Wear mittens or protective gloves, or wear mittens alone if protective gloves are not required. Wearing two pairs of socks is advised, with wool recommended for the outer layer.
4. Move your body or perform warm-up exercises. Increasing physical activity will help your body stay warm. Wiggle fingers and toes if they start to feel numb.
5. Don't smoke. Smoking constricts blood vessels and increases the risk for frostbite.

Training

Employees who work in cold environments should be trained in the recognition, treatment and prevention of cold stress. Anyone familiar with cold stress symptoms, first aid and prevention can lead the training, which can be conducted as a part of a project tailgate safety session (e.g., when cold weather is expected).

OTHER WEATHER-RELATED SAFETY ISSUES

Weather-related safety issues can arise from thunderstorms, lightning, tornados, high winds, and floods. The following precautions should be followed when thunderstorms, lightning, heavy winds or flooding are encountered.

Thunderstorms and Lightning

- **Postpone activities.** Before working outdoors, check the forecast for thunderstorms. Consider postponing activities to avoid being caught in a dangerous situation.
- **Monitor the weather.** Look for signs of a developing thunderstorm such as darkening skies, flashes of lightning or increasing wind.
- **Get to a safe place.** If you hear thunder, even a distant rumble, immediately move to a safe place. When thunder roars, go indoors! **REMEMBER, IF YOU CAN HEAR THUNDER, YOU CAN BE STRUCK BY LIGHTNING!** Fully enclosed buildings with wiring and plumbing provide the best protection. Sheds, picnic shelters, tents or covered porches do not protect you from lightning. If a sturdy building is not nearby, get into a hard-topped metal vehicle and close all the windows. Stay inside until 30 minutes after the last rumble of thunder.
- **Keep away from electrical equipment, wiring and water pipes.** Sensitive electronics should be unplugged well in advance of thunderstorms.
- If you are caught outdoors during a thunderstorm, adhere to the following rules:
 - **Avoid open areas and stay away from isolated tall trees, towers, or utility poles.** Do not be the tallest object in the area. Lightning tends to strike the taller objects in the area. If you are stuck in a thunderstorm, crouch with feet together and hands on knees.
 - **Stay away from metal conductors such as wires or fences.** Ungrounded metal does not attract lightning, but lightning can travel long distances through it.

Tornadoes and High Winds

- The safest place to be is an underground shelter, basement, or safe room.
- If no underground shelter or safe room is available, a small, windowless interior room or hallway on the lowest level of a sturdy building is the safest alternative.

- Mobile trailers are not safe during tornadoes. Abandon mobile trailers and go to the nearest sturdy building or shelter immediately.
- If you are caught outdoors, seek shelter in a basement, shelter or sturdy building. If you cannot quickly walk to a shelter:
 - • Immediately get into a vehicle, buckle your seat belt and try to drive to the closest sturdy shelter.
 - • If flying debris occurs while you are driving, pull over and park. Now you have the following options as a last resort:
 - • Stay in the car with the seat belt on. Put your head down below the windows, covering with your hands and a blanket if possible.
 - • If you can safely get noticeably lower than the level of the roadway, exit your car, and lie in that area, covering your head with your hands.
- Drilling activities and the use of manlifts shall not be conducted when sustained wind speeds exceed 25 miles per hour, or when wind gusts threaten stability of the equipment.

Flash Floods

- Avoid driving, walking, or swimming in flood waters.
- Stay away from water, storm drains, ditches, ravines, or culverts during flash flood warnings. Moving water only six inches deep can knock you off your feet.
- If you come upon flood waters, turn around and travel to higher ground or find an alternative route.

Job Task Safety Analysis Form				
Task Type (Check all that apply)	OM&M -	Task Description : Vehicle Operations (Cars and trucks < 10,000 lbs GVW)	Location or Project: NIC RD-PDA	
	Construction -		Date: July 29, 2013	
	Energy -		Project #27213343.00/Revision #: 01	
	Engineering Services - X			
Analysis Team Member		Position Title	Reviewed by	Position Title
Monte Markley		Project Director	Jason Franks	SCS Aquaterra OHSC
Special Training Required		Valid Drivers License		
		<i>Note – This JTSA does not address the requirements for the operation of vehicles in excess of 10,000 pounds Gross Vehicle Weight (GVW). If the total weight f the vehicle and trailer exceed 10,000 lbs. additional requirements are necessary.</i>		
Applicable SAFE Checklist(s): Specify type and category number		Weekly Vehicle Inspection Form		

Job Task Safety Analysis Form			
Job Task Step	Potential Environmental and Personal Hazards¹	Critical Actions	PPE Required
Perform Vehicle Safety Inspection	<p>Do not pinch fingers/ hands in hood</p> <p>Do not smoke near flammable liquids</p> <p>Use caution/ watch for traffic</p>	Do not have keys in ignition while checking under hood	<p>Head</p> <p>Body</p> <p>Foot</p> <p>Hand</p> <p>Respiratory</p> <p>Hearing</p>
Ensure all equipment & materials are properly secured	<p>Watch for slip, trip and fall hazards</p> <p>Do not contact sharp corners/ items</p> <p>Do not crush hands/ feet under or between moving items</p>	Watch for unstable equipment/ items	<p>Head</p> <p>Body</p> <p>Foot-non slip/ as needed</p> <p>Hand-as needed for sharp items</p> <p>Eyes – safety glasses as needed</p> <p>Hearing</p>
Adjust seat, mirrors, and fasten seat belt	Do not pinch hands or skin in seat belt	Perform these actions before starting and moving vehicle	<p>Head</p> <p>Body</p> <p>Foot</p> <p>Hand</p> <p>Respiratory</p> <p>Hearing</p>
Activate “hand-free” & (cell phone) and GPS devices	Set volume at appropriate level so that driver will not be startled	Perform these actions before starting and moving vehicle	<p>Head</p> <p>Body</p> <p>Foot</p> <p>Hand</p> <p>Respiratory</p> <p>Hearing</p>

Job Task Step	Potential Environmental and Personal Hazards ¹	Critical Actions	PPE Required
Start vehicle	<p>Ensure hood is closed and that no foreign objects are in engine compartment</p> <p>Keep others away from outside of vehicle</p>	<p>Ensure personnel are clear of vehicle and exhaust when starting</p>	<p>Head Body Foot Hand Respiratory Hearing</p>
Drive/ operate vehicle	<p>Follow speed limit, road signs and traffic laws. Use directional signals when changing lanes or turning. Be courteous to other drivers.</p> <p>If driving off-road, pay attention to tilt angles and terrain conditions.</p> <p>Drive straight up and down slopes to reduce chances of roll-over.</p> <p>Avoid mud and water.</p> <p>If lost, pull into safe area to ask directions or revise route.</p>	<p>Check blind spots</p> <p>When in doubt get out and look to ensure safe passage is possible</p> <p>Increase following distance as needed for load and road and weather conditions</p>	<p>Head Body- seat belt Foot-non slip/ as needed Hand-as needed for sharp items Eyes – safety glasses as needed Hearing</p>
Stop and park vehicle	<p>Do not park in road or in a manner that blocks other needed access points/ areas (set park brake)</p> <p>Turn off lights and lock all compartments as needed</p>	<p>Park in safe, well lighted and designated area</p>	<p>Head Body Foot Hand Respiratory Hearing</p>
Properly, store valuables (computer, GPS, GEM etc.)	<p>Use proper lifting techniques</p>	<p>Do not carry too much at one time</p>	<p>Head Body</p>

		Do not leave items in plain view	Foot Hand Respiratory Hearing
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² See **Table SOP 4-2** (below) for examples of Personal Hazards.

Job Task Safety Analysis Form (JTSA-ES-01)			
Task Type (Check all that apply)	Engineering Services -	Task Description : Sample Collection (Groundwater/Leachate)	Location or Project: NIC RD-PDA
			Date: July 29, 2013
			Project #27213343.00/Revision # 01
Analysis Team Member	Position Title	Reviewed by	Position Title
Monte Markley	Project Director	Jason Franks	SCS Aquaterra OHSC
Special Training Required	On-the-job training with more experienced employee.		
Applicable SAFE Checklist(s): Specify type and category number	Engineering SAFE observation checklist		

Job Task Step	Potential Environmental and Personal Hazards ^{1,2}	Critical Actions	PPE Required
1. Review & Sign SSHSP/SOP/JTSA		Determine potential hazards at sampling locations.	None
2. Unpack lab packs, check inventory, review laboratory instructions.	Sample bottles may contain acid preservative. Any free liquid encountered in a cooler should be considered to be an acid.	Check for leaking containers. Ensure you have everything you need to complete the task.	Hand – Chemical resistant gloves Eyes – Safety glasses
3. Clean and calibrate field sampling equipment.	Splash hazard	Ensure sampling equipment is clean and probes, meters and instruments are calibrated per manufacturer's instructions.	Head – Hard hat, if necessary per HASP Body – High visibility vest or shirt Foot- Steel-toe ANSI boots Hand – Chemical resistant gloves Eyes – Safety glasses Hearing protection - None
4. Travel to monitoring well location.	Snakes, spiders, ticks; slip/trip hazards; barb wire; animals	Use snake guards for high grass areas. Only use non-synthetic bug repellants (NO DEET), such as Repel Lemon-Eucalyptus repellent, for tick infested areas.	Head – Hard hat, if necessary per HASP Body – High visibility vest or shirt Foot- Steel-toe ANSI boots Hand – Chemical resistant gloves Eyes – Safety glasses as needed Hearing protection - None

Job Task Step	Potential Environmental and Personal Hazards ^{1,2}	Critical Actions	PPE Required
		Use spike overlays for snow or icing conditions, use boots that are slip resistant and provide good ankle support. Use leather gloves when working with barbed wire.	
5. Assess and open (unlock) the well or probe.	Snakes, spiders, ticks, bees, hornets, wasps; slip/trip hazards; landfill gas, H ₂ S, and pressure. Leachate sumps may be under pressure and will often have LFG and H ₂ S hazards.	Avoid spider webs and avoid sticking hands into dark / blind spaces. Look for honey combs and insect nests. Use care in opening leachate sumps, ensure 4 gas personal monitor is used if opening leachate sump.	Head – Hard hat, if necessary per HASP Body – High visibility vest or shirt Foot- Steel-toe ANSI boots Hand - Chemical resistant gloves Eyes – Safety glasses Hearing protection – None Atmospheric monitoring – 4 gas personal monitor (if opening leachate sump).
6. Measure the depth to water level.	Splash hazard, overextension. Electrical Hazards (Decontaminate liquid level probe before and after use. LO/TO pump (if leachate sump	Head – Hard hat, if necessary per HASP Body – High visibility vest or shirt Foot- Steel-toe ANSI boots Hand - Chemical resistant gloves Eyes – Safety glasses

Job Task Step	Potential Environmental and Personal Hazards ^{1,2}	Critical Actions	PPE Required
		application). Hold liquid level equipment close to body, not at arms length.	Hearing protection - None
7. Purge the well by hooking up nitrogen bottle hose to controller.	Splash hazard, overextension. 100-125 psi on hose	Ensure pump or bailer is clean before and after use. Keep arms close to body when lifting. Ensure hose connections are tight and inspect condition of the hose	Head – Hard hat, if necessary per HASP Body – High visibility vest or shirt Foot- Steel-toe ANSI boots Hand - Chemical resistant gloves Eyes – Safety glasses Hearing protection - None
8. Label containers and collect samples.	Splash hazard, overextension.	Ensure pump or bailer is clean before and after use. Keep arms close to body when lifting. Seal sample containers immediately and store properly. Fill out sample log.	Head – Hard hat, if necessary per HASP Body – High visibility vest or shirt Foot- Steel-toe ANSI boots Hand - Chemical resistant gloves Eyes – Safety glasses Hearing protection - None
9. Securely reseal, cover, lock well /	Be careful not to get fingers pinched.	Ensure cover is	Head – Hard hat, if necessary

Job Task Step	Potential Environmental and Personal Hazards ^{1,2}	Critical Actions	PPE Required
probe covers.	Electrical Hazard.	secured. Use care in reenergizing pumps (if applicable).	per HASP Body – High visibility vest or shirt Foot- Steel-toe ANSI boots Hand – As needed. Eyes – Safety glasses Hearing protection - None
10. Prepare samples to be shipped to lab.	Take care in handling samples.	Follow proper guidelines for shipping samples.	None
End of JTSA			

¹ See SCS Injury Illness and Prevention Plan Table SOP 4-1 for examples of Environmental Hazards.

² See SCS Injury Illness and Prevention Plan Table SOP 4-2 for examples of Personal Hazards.

Job Task Safety Analysis and PPE Assessment Form: FORM- ES-10

Job Task Safety Analysis Form			
Task Type: Engineering Services	Task Description Installation of vapor extraction or groundwater wells	Location or Project: Various sites	
		Date Revised: July 29, 2013	
		Project # 27213343.00/ Revision # 01	
Analysis Team Member	Position Title	Reviewed by	Position Title
Monte Markley	Project Director	Jason Franks	SCS Aquaterra OHSC
Special Training Required:	None		
Applicable SAFE Checklist(s):	ES SAFE Observation Report		

This form is the certification that the hazard assessment has been performed for the workplace as required under 29 CFR 1910.132.

Job Task Step	Potential Environmental and Personal Hazards ¹	Critical Actions	PPE Required
1. Review & Sign SSHSP/JTSA	None	None	None
2. Mark drilling locations	Traffic hazards; slip/trip hazards	Watch for slip/trip hazards such as potholes, hidden logs under heavy vegetation Set up traffic cones or barriers if working near traffic or heavy machinery	Head: Hard hat Body: Hi-vis shirt or vest Foot: Steel-toe boots Hand: Leather gloves available Respiratory: None Hearing: None Eye/face: Safety glasses
3. Call Dig Alert or local utility and pipeline locator and locate utilities and piping	Electrical hazards; gas/sewer lines rupturing if piping and utilities not properly located	Ensure all piping and utilities are properly marked and located. Gather any available location diagrams	Head: Hard hat Body: Hi-vis shirt or vest Foot: Steel-toe boots Hand: None Respiratory: None Hearing: None Eye/face: Safety glasses
4. Driller mobilization of equipment	Overhead power lines; steep slopes or hills	Identify smooth path of travel to each drilling location Maintain required distance between drilling machine and overhead power lines (at least 10 feet for conventional power lines), increase distance if wet or humid conditions	Head: Hard hat Body: Hi-vis shirt or vest Foot: Steel-toe boots Hand: Leather gloves Respiratory: None Hearing: None Eye/face: Safety glasses

Job Task Step	Potential Environmental and Personal Hazards ¹	Critical Actions	PPE Required
5. Delineation of work zone	Traffic hazards	Set up barricade fencing or traffic cones around drilling location	Head: Hard hat Body: Hi-vis shirt or vest Foot: Steel-toe boots Hand: Leather gloves available Respiratory: None Hearing: None Eye/face: Safety glasses
6. Drilling vapor extraction or groundwater well	Flying particles; organic vapors; chlorinated solvents; noise	Monitor for air contaminants as specified in H&S plan. Use PID for organic and chlorinated solvents, and color indication tube if benzene may be present.	Head: Hard hat Body: Hi-vis shirt or vest Foot: Steel-toe boots Hand: Leather gloves available Respiratory: None, APR available if action levels of air monitoring devices are exceeded Hearing: Earplugs or ear muffs when within 10' of the operating drilling machine Eye/face: Safety glasses
7. Collect geological sample or soil/vapor sample	Moving machinery; organic or chlorinated hydrocarbon vapors.	Monitor for organic vapors or other site contaminants as specified in H&S plan. Stay upwind of any vapors Avoid getting hit by drill rod or drilling machine, allow machine to stop before collecting sample. Wear gloves when collecting soil sample.	Head: Hard hat Body: Hi-vis shirt or vest Foot: Steel-toe boots Hand: Leather gloves available Respiratory: None, APR available if action levels of air monitoring devices are exceeded Hearing: Earplugs or ear muffs when within 10' of the operating drilling machine Eye/face: Safety glasses
End of JTSA Form ES-10			

SAFE Observation Form for Environmental Services/Engineering/Solid Waste Staff Field Activities

I. General Information:		
Date _____	Project Number/Name _____	Office/Profit Center _____
Location of Observations _____	Observed By _____	Check if Self-Observation <input type="checkbox"/>

For the following sections, provide clear, concise, and complete responses. Each observation should answer the following questions: Who, What, When, Where, Why, How.

II. General Description of Observed Activity(ies) or Work Conducted (as identified under Specific Project Tasks on Page 2): _____ _____ _____

III. Describe <u>SAFE</u> Behavior(s)/Procedure(s) Observed (as identified on Page 2): _____ _____ _____
--

IV. Describe <u>AT-RISK</u> Behavior(s)/Procedure(s)/Condition(s) Observed (as identified on Page 2): _____ _____ _____

V. Describe Immediate Corrective Action(s) Taken or Note Estimated Completion Date(s):
<input type="checkbox"/> Corrected on the spot: _____ _____ _____
<input type="checkbox"/> Corrective action(s) to be completed (include estimated completion date[s]): _____ _____ _____

► **Specific Project Tasks – Check ONLY those that are applicable to this evaluation:**

- Site assessments and inspections
- Manual sampling – soil, soil vapor, groundwater, surface water, leachate, air, etc
- Excavations, borings, sampling, and well construction – soil, soil vapor, groundwater, LFG, etc
- Asbestos, lead-based paint, mold, etc inspections, sampling, & abatement
- Underground storage tanks
- Landfill investigations and waste sorts
- Confined space
- Construction Quality Assurance (CQA)
- Geotechnical sampling and measurements
- Soil Vapor Extraction (SVE) systems installation, operation, & maintenance
- Compressed gas cylinders – proper transport, use, and storage
- All-terrain vehicles, utility vehicles, and watercraft
- Other (List): _____

► **Critical Behaviors – Check ONLY those applicable behavior(s) actually observed during this evaluation:**

1. Driving

Yes No

- Inspects vehicle before leaving
- Drives in safe manner (seat belts, following distances, alertness, traffic and pedestrians, lane changes, mirrors, etc)
- Pulls over to use cell phone for calls or texts and avoids other distractions (eating, reading, GPS, etc)

2. Safety Preparation

- Reviews HASP, JTSAs, & hospital route
- Evaluates capability to safely complete tasks, obtains assistance as necessary
- Attends site safety briefings & tailgate meetings
- Establishes and reviews hand signals
- Wears hardhat, safety boots, and safety vest
- Wears other PPE appropriate for site conditions (safety glasses, earplugs, etc)
- Is an Exposure Assessment necessary?

3. Site Conditions

- Prepares for weather conditions (hot, cold, wet, storms, snow, etc)
- Drinks plenty of liquids and takes adequate breaks
- Watches for hazardous wildlife (snakes, bees, spiders, scorpions, insects, bears, etc)
- Checks for hazardous vegetation (poison ivy, oak, sumac, etc)
- Checks for slip, trip, & fall hazards and watches footing
- Uses care walking or driving in areas where the ground surface is obscured by vegetation
- Uses air monitoring devices to check levels of suspected contaminants or combustible vapors
- Assesses site security for potential hazards (hostile people, dogs, crime, etc), works in pairs, gets police checks, etc
- Is aware of and prepares for regional health hazards (ticks, mosquitoes, rodent droppings, etc)
- In traffic areas, sets up necessary traffic controls; faces traffic; wears appropriate reflective vest; uses vehicle signals, strobe, and/or reflective triangles

4. Ergonomics

- Uses equipment appropriate for the tasks and uses ergonomic tools
- Takes frequent breaks and performs stretches to relieve stress from repetitive motion
- Stops repetitive motion or physical activities if pain is experienced to prevent injury
- Uses proper lifting techniques & gets help where appropriate
- Carries equipment without straining, uses a cart for heavy equipment, and/or obtains assistance

5. Site Investigation/Remediation/Oversight/CQA

- Public and private subsurface utilities are located and work areas checked for overhead obstructions
- Checks for vehicle and equipment traffic
- Sets up and maintains exclusion zones as appropriate
- Makes eye contact with operators of heavy equipment before approaching, stays out of the swing radius of excavators and other heavy machinery, stays back from operating drilling equipment
- Works uphill or cross-grade, never downhill, and upwind from heavy equipment
- Stays out of trenches >5 ft deep unless there is proper sloping, shoring, or shielding, egress is available, and a Competent Person is in charge
- Stays away from edges of excavations and borings, makes sure spoils and equipment are 2+ feet away from edge
- Backfills or properly secures borings, excavations, etc if not in use or if left open overnight (fencing, covers, etc)
- Follows safe ladder procedures
- Uses fall protection harness tied to a secure spot where there are fall hazards (borings, excavations, etc); uses covers/grates over borehole openings or excavations
- Has been trained to perform in special site conditions (confined space, landfills, asbestos, etc.) if required. List below:

APPENDIX B
NOT APPLICABLE

APPENDIX C

HAZWOPER

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Appendix C

Hazardous Waste Operations and Emergency Response (HAZWOPER) Program

PURPOSE AND SCOPE

This section describes how SCS will participate in the HAZWOPER program, in response to Occupational Safety and Health Administration (OSHA) regulation 29 CFR 1910.120. The program applies to employees whose work has been determined by the Office Director (OD), with the approval of the Corporate Health and Safety Director (CHSD), to be affected by the aforementioned regulation. **Attachment A (located at the end of this section)** can help to decide which employees are covered by the OSHA standard.

TRAINING PROGRAM ELEMENTS

Federal regulations (29 CFR 1910.120(e)) require that all SCS personnel who are involved in cleanup operations, and who may be exposed to hazardous materials at levels of concern, complete a 40-hour training course, a minimum of 3 days of actual field experience under the direct supervision of a trained, experienced supervisor, and annual 8-hour refresher training. The 8-hour refresher can be completed by attending a series of safety training sessions or meetings led by a qualified instructor who discusses critical safety procedures or programs applicable to the employees' duties and potential for exposure to physical and health hazards in the field.

Training elements for this course will include:

- Names of personnel and alternates responsible for site safety and health.
- Safety, health, and hazards present on typical work sites.
- Use of Personal Protective Equipment (PPE).
- Work practices by which employees can minimize risks from hazards.
- Safe use of engineering controls and equipment on typical work sites.
- PPE to be used by employees for tasks and operations being conducted as required by the PPE program (see below).
- Medical surveillance requirements.
- Frequency and types of air monitoring, personnel monitoring, and environmental sampling techniques and instrumentation to be used, including methods of maintenance and calibration of monitoring and sampling equipment.
- Site control measures in accordance with the site control program.

- Decontamination procedures.
- Requirements of an emergency response plan to ensure safe and effective response to emergencies, including necessary PPE and other equipment.
- Confined space entry procedures.
- Spill containment program requirements, including drum and container handling procedures.
- Discussion of health and safety procedures and programs described in the **SCS Health and Safety Injury and Illness Prevention Plan**, which are applicable to the employees' work duties.

Personnel involved in occasional cleanup operations for specific, limited tasks (such as groundwater or landfill gas monitoring, land surveying, or geophysical surveying), who are unlikely to be exposed to hazardous substances at levels of concern, must complete a 24-hour training course, a minimum 1-day field experience under direct supervision of trained supervisors, and an annual 8-hour refresher course. Training elements are similar to topics outlined for the 40-hour training session.

Initial training includes discussion of regulatory requirements, recognition of job hazards, standard work practices, and procedures for emergencies (alarms, response, rescue, etc.), use of field equipment, management of hazardous materials used for sampling and decontamination, and use and limitations of PPE. Employees who received initial training while employed elsewhere, including supervised actual field experience, fulfill the initial training requirements if they can provide documentation of prior training. Those individuals, however, should be instructed regarding Codes of Safe Practice that are followed by SCS.

Refresher training normally includes a review of SCS Safe Operating Procedures and health and safety programs found in the appendices of the **SCS Health and Safety Injury and Illness Prevention Plan**, which are applicable to the employee's job duties (as listed in the Job Training Matrix); a review of incidents and lessons learned during the past year; and changes or improvements in the initial training elements described above.

Field Supervisors responsible for health and safety at hazardous materials sites must complete an additional 8-hour supervisor training. Supervisor training will include management of site operations, management of work zones, and effective communication with staff, other contractors, client representatives, media, and members of the public.

SITE CHARACTERIZATION AND HAZARD IDENTIFICATION

For HAZWOPER projects, a qualified individual must evaluate planned site activities and site characteristics before work begins. Such an evaluation can be based on discussions with people knowledgeable of site conditions, records research, and/or reconnaissance of the perimeter. Where appropriate, SCS personnel should follow client-established health and safety procedures (including standard procedures at operational client facilities).

On-site characterization and hazard identification are detailed below, including information on the following subjects applicable to HAZWOPER operations:

- Work plans and Standard Operating Procedures (SOPs).
- Tailgate health and safety meetings.
- Air monitoring.
- PPE.
- Site control.
- Decontamination.
- Handling of hazardous materials, samples, containers, and drums.
- Site emergencies.
- Sanitation.

Work Plans and Standard Operating Procedures

OSHA regulations (29 CFR 1910.120(b)(1)(ii)(F)) require that health and safety programs include SOPs. Common sense also suggests that standard, proven, safe approaches to work performed be followed. Use of SOPs helps to simplify training, encourages safe teamwork, and ensures that staff from all SCS offices follow the same procedures while performing tasks. All Site-Specific Health and Safety Plans (SSHSPs) will note those SOPs that are applicable to a given project.

Appendices A through L of the Health and Safety Program Manual provide safety procedures and programs possibly applicable to job sites. Additionally, other task-oriented SOPs used by SCS are found in the following references:

- Current version of SCS's Quality Assurance Guidance Document for Field Activities, including SOPs incorporated by reference therein.
- Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities (National Institute for Occupational Safety and Health, October 1985).
- A Compilation of Landfill Gas Field Practices and Procedures (Solid Waste Association of North America, August 2011).

SOPs set forth in SSHSPs must be followed. If no SOP has been developed for a specific task, or if available SOPs need modification under the circumstances of a specific project (e.g., due to advances in technology or specific site limitations), then new or modified SOPs should be prepared following consultation with the CHSD and Quality Assurance.

Tailgate Health and Safety Meetings

Health and safety meetings at the site are called "tailgate" health and safety meetings. These meetings should be held at the outset of fieldwork, following any incident or emergency at the site, and prior to commencing each new phase of work. It is a good idea to have short tailgate meetings periodically (e.g., at least weekly) while intrusive fieldwork is underway. Attendees should include all SCS and subcontractor staff who will be working on the project phase. During

the meeting, project or site-specific health and safety procedures will be reviewed to familiarize everyone with the location of health and safety equipment and supplies, emergency communications, first aid, and similar matters. The meeting's content and attendees will be documented in the project's daily log or other project-specific document.

Air Monitoring

In accordance with 29 CFR 1910.120(h)(1)(i), SCS requires air monitoring when "...there may be a question of employee exposure to hazardous concentrations of hazardous substances in order to assure proper selection of engineering controls, work practices and personal protective equipment so that employees are not exposed to levels which exceed permissible exposure limits or published exposure levels for hazardous substances." SSHSPs must provide specific requirements of monitoring.

Guidelines for Assessing Airborne Hazards

Guidelines for assessing airborne hazards are shown in **Table SOP C-1**.

Table SOP C-1. Guidelines for Assessing Airborne Hazards

Guideline	Explanation	Sources for Limits
Permissible Exposure Limit (PEL)	Time-weighted average and ceiling concentrations currently enforced by OSHA. Similar to (and, in many cases, derived from) the threshold limit values published in 1968.	OSHA
Threshold Limit Value-Time Weighted Average (TLV-TWA)	The time-weighted average concentration for a normal 8-hour workday and 40-hour work week to which nearly all workers may be repeatedly exposed without adverse effect. Should be used as an exposure guide rather than an absolute threshold.	ACGIH
Threshold Limit Value-Short-Term Exposure Limit (TLV-STEL)	A 15-minute time-weighted average exposure that should not be exceeded at any time during the work day.	ACGIH
Threshold Limit Value-Ceiling (TLV-C)	The concentration that should not be exceeded even instantaneously.	ACGIH
Recommended Exposure Limit (REL)	Time-weighted averages and ceiling concentrations based on	NIOSH

Table SOP C-1. Guidelines for Assessing Airborne Hazards

Guideline	Explanation	Sources for Limits
	NIOSH evaluations. Generally lower than OSHA PELs.	
Immediately Dangerous to Life or Health (IDLH)	The maximum level from which a worker could escape without any escape-impairing symptoms or any irreversible health effects.	NIOSH

Supplemental information is available in **Appendix D, Exposure Assessment**. Contact your OHSC or the CHSD for clarification.

Personal Protective Equipment

Various types of PPE are required depending on substances handled, existing conditions, and particular work activities. PPE includes a variety of specialty uniforms, hard hats, goggles, face shields, aprons, boots, gloves, safety vests, hearing protection, and respirators, all designed to protect against a variety of hazards. Selection of PPE will be based on the hazard assessment prepared for a specific site or work effort, and will be the responsibility of the Field Health and Safety Supervisor and PM.

For sites covered under the HAZWOPER program, a PPE program will be developed as part of the SSHSP. This program will include descriptions of the following:

- PPE selection, based on site hazards.
- Use and limitations of equipment.
- Work mission duration.
- Maintenance and storage.
- Decontamination and disposal.
- Training and proper fitting of equipment.
- PPE donning and doffing procedures.
- Inspection procedures prior to, during, and after use.
- Evaluation of the effectiveness of the PPE program.
- Limitations during temperature extremes, heat stress, and other appropriate medical considerations.

Table SOP C-2 describes protective equipment levels for work at Levels A through D.

Table SOP C-2. Protective Equipment Levels

Recommended Level of Protective Equipment	Protection Provided
<p>Level A</p> <ul style="list-style-type: none"> • Pressure-demand, full-facepiece SCBA or pressure-demand supplied-air respirator with escape SCBA. • Fully encapsulating, chemical-resistant suit. • Inner chemical-resistant gloves. • Chemical-resistant safety boots/shoes. • Hard hat. • Two-way communications. • Hearing protection for two-way communications. 	<p>The highest available level of respiratory, skin, and eye protection. Moderate hearing protection.</p>
<p>Level B</p> <ul style="list-style-type: none"> • Pressure-demand, full-facepiece SCBA or pressure-demand supplied-air respirator with escape SCBA. • Chemical-resistant clothing. • Inner and outer chemical-resistant gloves. • Chemical-resistant safety boots/shoes. • Hard hat. • Two-way communications. • Hearing protection for two-way communications. 	<p>The same level of respiratory protection, but less skin protection than Level A. Moderate hearing protection.</p>
<p>Level C</p> <ul style="list-style-type: none"> • Full- or half-facepiece, air-purifying canister, or cartridge-equipped respirator. • Chemical-resistant clothing. • Inner and outer chemical-resistant gloves. • Chemical-resistant boots/shoes. • Hard hat. • Two-way communications. • Hearing protection for two-way communications. 	<p>The same level of skin protection as Level B, but a lower level of respiratory protection. Moderate hearing protection.</p>
<p>Level D</p> <ul style="list-style-type: none"> • Coveralls. • Safety boots/shoes. • Safety glasses or chemical splash goggles. • Hard hat. • Safety vest. • Hearing protection for two-way communications. 	<p>No respiratory protection, minimal skin protection, and moderate hearing protection.</p>

For detailed information regarding selection and use of PPE, see **Appendix E**.

Employees who may be required to wear a respirator are covered under a **Respiratory Protection Program** described in **Appendix F**.

Employees who may be exposed to elevated levels of noise (>85 decibels or dBA) are required to review **Appendix H, Hearing Conservation**.

Site Control

The purpose of site control is to protect workers and members of the public from the site's hazards, and to prevent vandalism. The approach to site control depends on site characteristics, size, the surrounding community, and contractual issues (such as the amount of SCS control over the site). Site control procedures should be established in the planning stages of a project, and modified if new information becomes available.

Where appropriate, SCS will establish work zones to reflect the health and safety procedures to be followed for various work tasks. Site control requirements may include:

- Using the buddy system, when necessary.
- Establishing site security measures.
- Setting up communication networks.
- Establishing zones of control.

On all SCS field projects, person(s) responsible for controlling the site should be identified. For construction projects, this individual is the general contractor or site owner/operator. SCS personnel must comply with the SSHSP for the project, and should review and comply with the general contractor's health and safety plan to the extent appropriate.

Significant Hazardous Substance Contamination Areas

Where significant hazardous substance contamination or similar site hazards are expected, work zones should be established. These will include an exclusion zone, where only those protected with appropriate PPE will be allowed; a decontamination reduction zone, restricted to those who are decontaminating after activities in the exclusion zone; and a support zone, where PPE is not necessary. Work zones will be noted on the site map and established using physical markers (e.g., fencing or tape).

Confined Spaces

Confined spaces can be hazardous due to the lack of breathable air and the potential for dangerous vapors to collect in the space. No one may enter a confined space without first adhering to requirements set forth in **Appendix K (Confined Space Entry Program)**. This means that confined space must be identified, evaluated, and access-controlled using a permit system, as necessary, to comply with the program.

Trenches and Earthwork

Excavations and trenches present numerous hazards to workers involved in the excavation, as well as to those working outside the project. **Appendix J (Excavation and Construction Earthwork Program)** describes procedures to be followed during such operations.

Areas with Electrocuting Hazards

Electric utilities and equipment also present electrocution hazards. Precautions regarding locating and marking subsurface utilities are a matter of state law, and vary somewhat from state to state. SCS must abide by these laws. Electrical equipment should be presumed energized, unless a qualified person has tested and confirmed that this is not so. Special lockout and tagout procedures are followed to indicate that work is being conducted on a de-energized piece of equipment, and to warn against re-energizing such equipment (e.g., by closing a circuit breaker, or connecting a plug) while work is in progress. Personnel must comply with lockout/tagout procedures specified in the SSHSP (see **SOP 15**).

Decontamination

Decontamination is the process of cleaning equipment and clothing to reduce the possibility of spreading contaminants at project sites. Routine decontamination of equipment, vehicles, and clothing following planned tasks, and emergency decontamination following unplanned events (splashing chemicals onto skin or eyes, etc.), helps to minimize environmental and personal hazards.

Decontamination procedures are to be addressed in SSHSPs. Plans may include the use of disposable PPE and equipment (e.g., single-use bailers), followed by secure collection and disposal. Alternatively, the use of multiple decontamination stations arranged to provide a specific sequence of decontamination activities may be recommended. Note that decontamination procedures are important not only for maintaining health and safety, but for quality assurance (including minimizing cross-contamination and assuring the reliability of data).

Handling Hazardous Materials, Samples, Containers, and Drums

SCS personnel encounter a variety of potentially hazardous materials, some of which have been dumped at uncontrolled waste disposal sites. Sometimes, unexpected materials (e.g., buried drums) are found during investigations or other response work. SCS also uses small amounts of hazardous material (acids and solvents) when collecting and processing environmental samples, or cleaning equipment. It is important to understand safe procedures for handling and managing hazardous materials.

Site Emergencies

Field staff must know how to respond in emergency situations. All SCS personnel must be familiar with SSHSP provisions concerning:

- How to communicate the emergency (e.g., five or more rapid blasts of a vehicle horn) to fellow workers.

- Whom to summon for help (fire/rescue, HAZMAT emergency response team).
- How to summon help (location of nearest telephone, emergency telephone numbers).
- The location of emergency response and emergency first aid equipment at the project site.
- A route to the nearest medical facility.

Sanitation

A basic logistical consideration while performing field work is the availability of potable and non-potable water, as well as toilet and washing/decontamination facilities. OSHA's 29 CFR 1910.120(n) and (k) provide specific guidance for making these items available at work sites involving cleanup operations. Normally, SCS's work at a site is temporary, and is performed by mobile crews. Temporary toilets are not required for such work. Longer-term assignments may justify (or require) provision of toilet facilities on site (see **SOP 19** for requirements related to site sanitation).

NEW TECHNOLOGY PROGRAM

The Health and Safety Director will periodically evaluate new technologies, equipment, or control measures available to the industry, such as the use of foams, absorbents, adsorbents, neutralizers, or other means to suppress the level of air contaminants while excavating the site or implementing spill control. Such an evaluation will be done to determine the effectiveness of new methods, materials, or equipment before implementing their use on a large scale. Information and data from manufacturers or suppliers will be used as part of the Health and Safety Director's evaluation effort. The Health and Safety Director will train and inform employees regarding effective new technologies as part of the 8-hour refresher course curriculum.

Attachment A

Decision Tree for Determining HAZWOPER Applicability

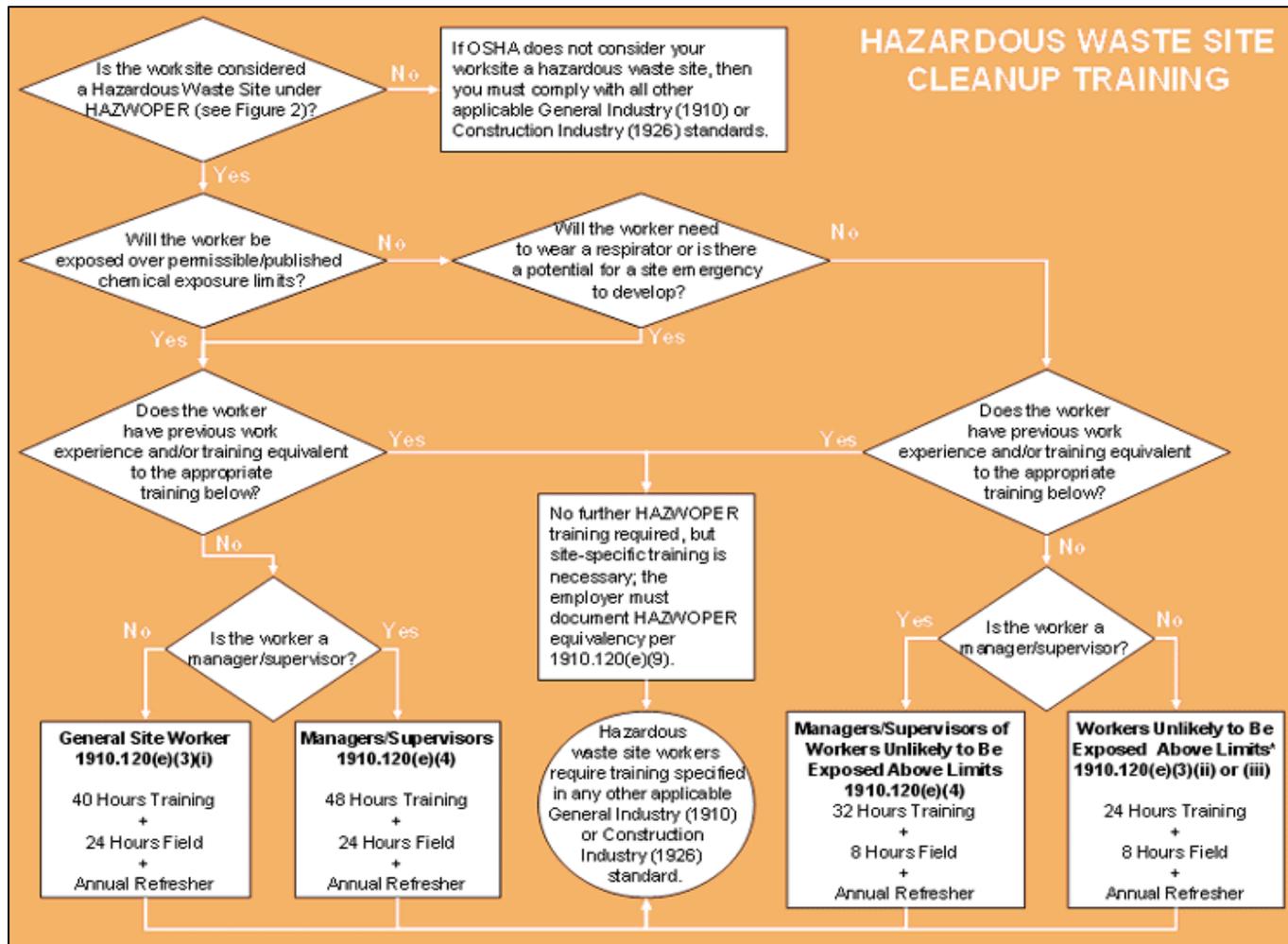


Figure C-1. Hazardous Waste Site Cleanup Training Requirements

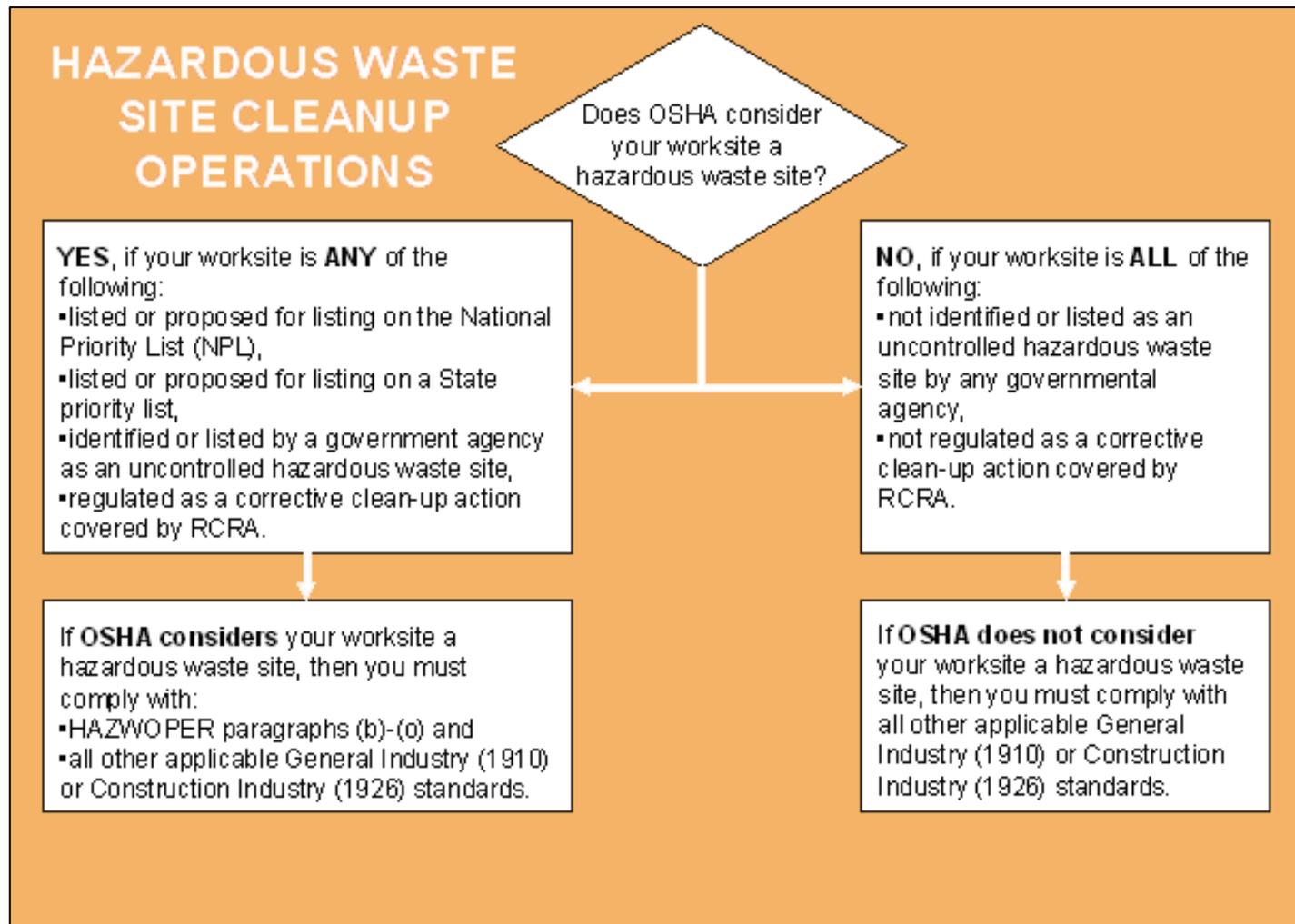


Figure C-2. Definition of Hazardous Waste Site Cleanup Operations

APPENDIX D
NOT APPLICABLE

APPENDIX E

**PERSONAL PROTECTIVE EQUIPMENT
OTHER THAN RESPIRATORY PROTECTION**

Appendix E - Personal Protective Equipment (Other Than Respiratory)

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Appendix E

Personal Protective Equipment (Other Than Respiratory)

PURPOSE AND SCOPE

This program is established to ensure that Personal Protective Equipment (PPE), manufactured with safe design and durable construction, is provided for work that requires PPE. The program addresses equipment intended to protect the head, face, eyes, ears, hands, feet, and entire body. Employees required to wear this equipment will receive training in its proper use, selection, limitations, care, maintenance, and disposal. This discussion applies to all personnel for whom this equipment has been prescribed.

HAZARD ASSESSMENT

On projects or sites involving fieldwork, a Job Task Safety Analysis (JTSA) and PPE Assessment must be completed (see *SOP 4*). This analysis, provided for each task, will determine whether or not PPE is required. The JTSA and PPE Assessment forms will document that hazard assessments are being performed and certified.

PROTECTION OF THE HEAD

Hardhats must be worn whenever the potential of being struck on the head by falling or flying objects or debris, or by overhead piping, occurs. Possible electrical shock and exposure of the head to sources of electricity are further reasons for the mandatory wearing of hardhats. Examples of work requiring hardhats are landfill construction, excavation and trenching operations, activities involving heavy machinery such as forklifts, confined space entry, and monitoring at facilities with overhead piping. In addition, many sites require the wearing of hardhats as policy and regardless of conditions. Hardhats must meet the requirements of **ANSI Z89.1-2003, "American National Standard for Personnel Protection-Protective Headwear for Industrial Workers - Requirements**. Hardhats meeting this requirement are distinctively marked with the ANSI insignia.

Hardhats are divided into two types and three industrial classes:

- **Type I-** hardhats offer impact resistance from objects that strike the hardhat vertically or on the top of the head.
- **Type II** hardhats offer impact resistance from objects that strike the head vertically and laterally (including the rear). These hardhats usually have a foam inner liner.
- **Class G** hardhats provide impact and penetration resistance, along with limited voltage protection (up to 2,200 volts).

- **Class E** hardhats provide the greatest protection against electrical hazards, with high-voltage shock and burn protection as well (up to 20,000 volts). They also provide protection from impact and penetration hazards by flying or falling objects.
- **Class C** hardhats provide lightweight comfort and impact protection, but offer no protection from electrical hazards.

Class G or E hardhats must be used whenever potential contact of the head with electrical conductors is present.

Employees must follow the manufacturer's information with regard to tightening the head band to achieve proper fit for the helmet. Most suspension systems do not allow for adjustment, but if provided, the required distance between the webbing and the shell of the helmet should be maintained. Suspension systems from other manufacturers should not be used, nor should the system be turned around to allow hat to be worn other than as specified by the manufacturer.

Employees must inspect the hardhat shell for cracks, dents, cuts, holes, burns, or other material damage. Webbing, headband, and suspension attachment points should also be inspected for signs of cuts, tears, and frayed material. Any hardhats that are not in good condition will be discarded. The manufacturer's recommendations for cleaning should be followed (most manufacturers recommend using soap and water only).

EYE AND FACE PROTECTION

Eye and face protection must be used whenever hazards, or potential hazards, are present during work. *Table E-1* lists some of these hazards by task.

Table E-1. Hazards and Tasks

Hazard Type	Examples of Hazard	Common Related Tasks
Impact	Flying objects, such as large chips, fragments, particles, sand, and dirt.	Chipping, grinding, machining, masonry work, woodworking, sawing, drilling, chiseling, powered fastening, riveting, and sanding.
Heat	Anything emitting extreme heat.	Furnace operations, pouring, casting, hot dipping, and welding.
Chemicals	Splash, fumes, vapors, and irritating mists.	Acid and chemical handling, condensate and leachate treatment system maintenance, degreasing, plating, and working with blood.
Dust	Harmful dust.	Woodworking, buffing, and general dusty conditions.
Optical Radiation	Radiant energy, glare, and intense light.	Welding, torch-cutting, brazing, soldering, and laser work.

The Occupational Safety and Health Administration (OSHA) offers guidance regarding proper face and eye protection at http://www.osha.gov/SLTC/eyefaceprotection/hazards_solutions.html. Faceshields are considered secondary protection, and must be used in addition to primary protection such as safety glasses with sideshields or goggles.

When protecting against liquid splashes or caustic liquids, safety goggles that are indirectly ventilated or non-ventilated must be worn. Direct-ventilated goggles protect only against flying particles or dust, and should not be used as protection against liquid or caustic splashes.

Employees exposed to eye or face hazards while wearing prescription lenses must use eye protection that incorporates the prescription into its design or that can be worn over prescription lenses. All eye and face devices must comply with **ANSI Z87.1-1989 “USA Standard for Occupational and Educational Eye and Face Protection”** requirements. Those that meet these requirements are distinctively marked with the ANSI Z87.1-1989 insignia.

Fitting, Storage, and Cleaning of Eye Protection

Eye glasses or shields that are pitted and scratched and significantly impair vision must not be used and should be disposed of. Eye and face devices should be cleaned and disinfected before each use. Warm water or antiseptic wipes will disinfect and clean these devices. Eye and face devices must be stored in a clean, non-dusty environment that protects against direct sunlight. They must be reasonably comfortable when worn under designated conditions, fit snugly, and not unduly interfere with the movements of the wearer.

HEARING PROTECTION

Refer to Appendix H Hearing Conservation Program for specific information regarding proper for hearing protection.

HAND AND BODY PROTECTION

Hand protection will be provided for all tasks presenting the following hazards:

- Skin absorption of harmful substances.
- Severe cuts or lacerations.
- Severe abrasions.
- Punctures.
- Thermal burns.
- Chemical burns.
- Harmful temperature extremes.

- Biological hazards

Table E-2 lists gloves that can protect against the hazards listed above.

Table E-2. Glove Selection for Physical Hazards

Physical Hazard	Required Performance Characteristics	Glove Type	Typical Activities Applicable to Glove Type
Severe cut or laceration	Cut resistance	Metal mesh, aromatic polyamide fiber	Operating power saws, using hand saws for cutting pipe
Punctures	Puncture resistance	Leather; thick elastomer	Handling pipe, using power tools
Thermal burns	Insulating value	Heavy cotton or other heavy fabrics	Pipe fusion, working near hot surfaces, engine overhauls
Chemical burns	Permeation resistance	Rubber, neoprene or VITON gloves	Gluing pipe, handling corrosive leachate, water or liquid sampling, engine overhauls
Harmful temperature extremes	Insulation and flame resistance	Aluminized gloves, NOMEX or other fire-retardant fabric	Engine repairs, vessel repairs, welding

When selecting gloves or other bodily protection against liquids with the potential to absorb into or irritate the skin, the following factors should be considered:

- Identification of all hazards that may require hand protection. This should include a list of the chemicals involved as well as physical hazards such as abrasion, tearing, puncture and temperature. The kind of hazards will also affect the decisions to use other chemical protective clothing, in addition to gloves.
- Duration of exposure.
- Permeation rate of the chemical through the glove or clothing material.
- Breakthrough time of the chemical through the glove or clothing material.
- Type of potential exposure (occasional contact, splash protection, or continuous immersion of hands). This will also determine the length of glove required.
- Flexibility and touch sensitivity needed for the task. This need may significantly limit the thickness of glove material that can be used. The requirement for texture or non-slip surfaces to improve grip must be considered.

Permeation rates and breakthrough times of chemicals relative to glove materials can be found in the following references:

- **“Guidelines for the Selection of Chemical Protective Clothing,” American Conference of Governmental Industrial Hygienists**
- At the following website: <http://www.labsafety.com/refinfo/ezfacts/ezf166.htm>

These references are available from the corporate Health and Safety Director. Glove materials must have a breakthrough time exceeding the duration of the task. For materials with similar breakthrough times, those with the lowest permeation rates will be selected.

FOOT PROTECTION

Employees must wear foot protection to guard against hazards related to feet, including falling, rolling, or piercing objects, exposure to dangerous or corrosive chemicals, exposure to electrical charges, tripping, or uneven surfaces. *Table E-3* lists protection required for some of these hazards.

Table E-3. Foot Protection Selection Guidelines

Hazard	Boot Selection
Potential for objects falling or rolling over foot	ASTM F2412, ASTM F2413-05 approved boot
Exposed to tripping hazards and uneven surfaces	Footwear with high ankle support
Potential for objects piercing foot	ASTM F2412, ASTM F2413-05 approved boot
Feet exposed to dangerous or corrosive chemicals	Chemical resistant footwear or booties
Feet exposed to electrical hazard	Non-conductive ASTM F2412, ASTM F2413-05 approved boot

Footwear meeting the requirements of ASTM F2412, ASTM F2413-05 does not have to be constructed with a *steel* toe or shank. Materials such as fiberglass, and other lighter-weight materials capable of passing the compression and impact tests required by the ASTM F2412, ASTM F2413-05 standard, are acceptable. Footwear passing mandatory ASTM tests will be marked on the boots as having met these standard requirements.

Footwear protecting against chemical hazards will be selected based on the same performance criteria as hand and body protection, including chemical permeation rates, breakthrough times of chemicals through the footwear materials, and task duration.

APPENDIX G
NOT APPLICABLE

APPENDIX F
NOT APPLICABLE

APPENDIX H
NOT APPLICABLE

APPENDIX I
NOT APPLICABLE

APPENDIX J
NOT APPLICABLE

APPENDIX K
NOT APPLICABLE

APPENDIX L
NOT APPLICABLE

APPENDIX M
NOT APPLICABLE

APPENDIX N
NOT APPLICABLE

APPENDIX O
CONTRACTOR SAFETY MANAGEMENT

Appendix O

Contractor Safety Management

INTRODUCTION

The SCS contractor safety management program is written to help identify and mitigate project safety hazards when SCS work involves the use of contractors. The objective is to assist with developing safety awareness and hazard recognition/mitigation responsibility for contractors that have been selected to perform work with SCS. Compliance by contractors and/or their representatives to applicable federal, state, and local environmental/occupational health and safety regulations is not an option; it is a requirement.

The regulatory references detailed in this document are intended only as a guide or reference for contractors and are not intended to be inclusive of all the rules and regulations that might affect the subject matter and/or the contractor's scope of work. It will be the specific responsibility of the contractor to communicate to its employees all applicable regulations and information provided to them by SCS.

The effectiveness of this program depends upon the active support and involvement of all project employees. SCS's goal is that all contractor work practices are carried out safely, minimizing the possibility of injury or illness to the contractor and SCS employees. Contractors, however, remain responsible for performing their day-to-day operations safely with all due regard for people, property and the environment.

This document establishes uniform requirements for contractor safety orientation, coordination, communication and administration. It also provides structure for ensuring all applicable safety plans, policies, and procedures can be communicated universally between SCS and the contractor. Information and guidance provided by SCS is intended to supplement, not replace, the contractor's environmental/occupational health and safety policies and programs.

CONTRACTOR PRE-QUALIFICATION

The safety of our employees and contractors is a core value at SCS. As such, the following criteria will be evaluated by SCS to verify that selected contractors have an acceptable commitment to safety:

- Contractor's employee injury records such as Experience Modification Rate (EMR) for the previous three years and the contractor's past safety record in performing jobs of a similar nature.
- OSHA 300 Logs, which include the number of lost work day cases; number of recordable cases; number of restricted work day cases; and number of fatalities for the current and previous three years.

- Incident rates for lost-time accidents and OSHA recordable injuries/illnesses for the past three years.
- Evidence of required workers' compensation insurance coverage naming SCS as an additional insured.
- Written safety (Injury and Illness Prevention Program, or equivalent) and training program elements with documented instructional records for employees assigned to the project.
- Copies of any Notices of Violation as issued by a federal, state, or local regulatory agency for the last three years.
- Copies of any permits, licenses, and/or certifications, required to perform the work in question—examples include, but are not limited to, forklift operators, respirator users, etc.

RESPONSIBILITIES

SCS

When hiring contractors, include the following steps:

- Have contractor review the site layout and scope of work to become aware of potential hazards related to the project site and the scope of work.
- Review information regarding the contractor's safety performance and programs.
- Periodically audit and review contractor's safety performance during the project.

Before the contract work begins, SCS will:

- Designate a representative to provide the contractor with the SCS Job Site Safety Analysis (JSSA [see **Attachment A**]). The designated representative will receive the completed JSSA, with all applicable documentation, signed by the contractor, and include it in the project file. The designated representative will also verify with the contractor that they understand the JSSA requirements.
- Coordinate contractor's review and signature of the project's site-specific health and safety plan (SSHSP).
- Inform the contractor of any existing emergency signals and procedures that may be put into operation in areas where the contractor's employees are working.
- Conduct an inspection of the proposed worksite, with the contractor's representative, before any field work begins so any known information about the on-site hazards, particularly hazards that are not easily noticed, are documented, by the contractor, on

- the JSSA. Inform contractor's designated representative of the required response to employee alarms and furnish the contractor with a demonstration or description of the alarms.
- Communicate thoroughly with the contractor's designated representative any safety and health hazards (particularly any chemical and hazard communication issues) known to be associated with the work, including those in areas adjacent to the worksite.
 - Inform the contractor it is their responsibility to convey specific site hazards and health and safety requirements to their employees and any subcontractors.
 - Identify connect-points for all temporary services, such as steam, gas, water, electricity, etc. Define any limitations on use of such services.

During the contract work, SCS will:

- Conduct safety meetings and document them in the project records (diary, etc.).
- Bring to the attention of the contractor's designated representative, unsafe work practices of which we become aware. If an unsafe act or a condition is identified that creates an imminent danger of serious injury, immediate steps should be taken with the contractor's designated representative, or in their absence, the contractor's employees to stop the unsafe act or condition.
- Bring to a stop any work that is in violation of a regulation.
- Not loan any tools and/or equipment to outside contractors and their subcontractors. The contractor is required to provide the necessary tools and equipment.
- Obtain a copy of each OSHA recordable injury report from the contractor and/or subcontractor. Investigate and report to the owner's representative all personal injuries to contractor and subcontractor employees.
- Investigate and report any property losses to the owner's representative.
- Maintain a contractor accident report file in the project file.
- After conclusion of the contract work, the Corporate Health and Safety Director will conduct a post-project assessment of the contractor's safety performance for the project. This assessment may be used for future contractor evaluations.

CONTRACTOR RESPONSIBILITIES

Contractors must perform their work safely. Contractors often perform very specialized and potentially hazardous tasks, such as confined space entry activities and non-routine repair

activities. Contractor responsibilities when accepting contracts with SCS include the following listed steps. The contractor will:

- Review and acknowledge the requirements of the project's JSSA and SSHSP and require that all on-site employees or its subcontractors are informed of the information in those documents.
- Immediately report all occupational injuries and illnesses, requiring medical attention beyond first aid, sustained by contractor or its subcontractor personnel to the designated SCS representative.
- It is the responsibility of the contractor to report all OSHA serious occupational injuries and/or occupational illnesses, involving contractor personnel, to the applicable OSHA office and within the required time frame.
- Ensure that all the contractor employees are trained in the work practices necessary to safely perform their job.
- Document all contractor employee training that takes place during the scope of the project and provide documentation of that training to SCS for inclusion into the project file.
- Abide by the facility smoking rules. Contractor will get verification of acceptable smoking areas before allowing contractor employees to smoke while on the project site.
- Provide all necessary tools and equipment to complete their project scope of work.

Before the contract work begins, the contractor will:

- Designate a representative to coordinate all safety and health issues and communicate with SCS's designated representative.
- Complete and sign the project JSSA and submit a copy to the SCS designated representative.
- Review and sign the project SSHSP.
- Communicate to the SCS representative any hazards, resulting from the contractor's work tasks and the performance thereof that may adversely affect the project site's air quality, groundwater, and/or any other participant or staff person on the project site.
- Communicate to its employees any and all safety and hazard information.
- Provide documentation required by the project JSSA to the SCS designated representative.
- Obtain from SCS any site-specific safety rules in effect at the site.

- Keep the SCS designated representative fully informed of any work that may affect the safety of their employees or property. This includes complying with the state and federal right-to-know legislation, Proposition 65 (CA work only), and providing the designated representative appropriate safety data sheets (SDSs) or other required information about chemicals the contractor will or may bring onto the site.
- Know who to call and what to do in emergency situations, including where first-aid and medical services are located and train employees on this.

During the contract work, the contractor will:

- Participate in the project safety meetings.
- Have a designated site safety coordinator present and attentive to the work being carried out at all times and verify that its subcontractors are complying with requirements of the project JSSA and SSHSP.
- Communicate to its employees any and all safety and hazard information made known to the contractor by SCS.
- Communicate to SCS any hazards resulting from the contractor's work tasks and the performance thereof that may adversely affect the project site's air quality, groundwater, and/or any other participant or staff on the project site.
- Make sure that any equipment, chemicals, or procedures used by the contractor to perform contracted work meet all applicable federal or state OSHA requirements.
- Be responsible and accountable for any losses or damages that the contractor or its employees suffer as a result of contractor negligence.
- Only use the designated project site entrance and follow the site's access control practices. Provide all tools and equipment for the work that the contractor performs, including personal protective equipment (PPE), and ensure the equipment is in proper working order and contractor employees are instructed in its proper use.
- Maintain good housekeeping at the project site.
- Provide and maintain fire extinguishing equipment for contractor activities at the project site.
- Follow specific instructions supplied by SCS or the Owner's representative should emergency alarms be activated.
- Notify SCS immediately of any OSHA recordable injury or illness to contractor employees or subcontractor employees occurring while on the project site.
- Provide a copy of each accident report to SCS's designated representative.

- Not allow any type of fighting, horseplay, or any other type of negative activity that might result in injuries at the job site.
- After conclusion of the contract work, the contractor is responsible for cleaning all work areas and disposing discarded materials in a proper and legal manner.

TRAINING

SCS employees on the project site receive instruction on all hazards to which they may be introduced by a specific contractor's work tasks. These hazards must be communicated to SCS by the contractor via the JSSA before beginning those work tasks and/or as soon as the contractor becomes aware of the hazard(s).

Additionally, the contractor is responsible for providing all applicable health and safety training and/or certification for its employees, and/or representatives, specific to the job tasks to be performed on the project site. The following training requirements apply:

- It is the contractor's sole responsibility to convey to its employees any health, safety or environmental information provided by SCS to the contractor.
- Train all contractor employees on all safety and health hazards and provisions applicable to the type of work being done and provide documentation of such training to SCS's designated representative.
- Provide documentation to SCS's designated representative for all applicable health and safety training given to contractor employees while performing work at the project site.

RECORD KEEPING

The designated SCS representative will keep the following records in the project file:

- A copy of the project specifications, JSSA (signed), and SSHSP (signed). The designated SCS representative will be thoroughly familiar with the contents of these documents.
- Training done with SCS or other project-site staff regarding safety hazards that exist due to the activities of the contractor.
- Copies of incident investigation reports for all incidents that occur in the course of the project.
- Daily logs regarding pre-work start-up inspection findings.
- Records of all documentation of any type given by the contractor, including records of training done, SDSs, accident reports, etc.

- Documentation of all discussions, letters, memos, or other communications made to the contractor regarding safety issues, including place, time, and names of people involved.

The contractor will:

- Maintain the original JSSA, and associated documents, generated for the project.
- Keep copies on file of all forms or statements related to the contract that are required by SCS to be filled out before or during contract work.
- Have on file the telephone numbers of the nearest hospital, ambulance service, and fire department.
- Keep copies of incident investigation reports for all incidents that occur in the course of the project.

Attachment A

SCS Job Site Safety Analysis

SCS JOB SITE SAFETY ANALYSIS

The completion of this document is intended to help identify and mitigate site safety hazards as required in applicable federal and state OSHA regulations. SCS Engineers requests its contractors to complete this document, review it with their on-site personnel, and return the completed document to the designated SCS representative prior to initiation of any field work.

Project Name: _____

Project Number: _____

SCS Project Superintendent (PS) or Manager (PM): _____

Scope of Work: _____

Subcontractor PM Contact Information: (____) ____ - ____ / (____) ____ - ____ (Cell)

Note: Additional subcontractors may be listed on *Page 4* of this document.

Date of Analysis: ____ / ____ / ____

Estimated Job Completion Date: ____ / ____ / ____

Next Review Due: ____ / ____ / ____

Site Hazards			
Item	Expectation	Applicability	
		Yes	No
General Site Hazards	Hard hats and safety glasses are expected to be used. All chemical handling shall be performed using safety goggles and/or face shields. No smoking in any process or construction areas.		
Confined Space	Any entry into these areas will be performed as a permit-required confined space. Any subcontractor will provide SCS with a copy of its Confined Space Entry Permit prior to entry.		
Uncontrolled Hazardous Energy	Work on equipment or in areas where energy sources are accessible will require proper isolation and verification by the subcontractor. Types of energy sources include hydraulic, electrical, pneumatic, mechanical, chemical, radiation, gravity and thermal.		

Site Hazards			
Item	Expectation	Applicability	
		Yes	No
Working at Heights (unprotected above 48 inches)	Work involving removal of handrails or accessing elevated positions may create a potential fall hazard. Plan for and use appropriate fall protection.		
Slippery Surfaces	Wet surfaces may result in slippery walking conditions.		
Chemical Usage	Applicable Safety Data Sheets (SDSs) shall be readily available at the project site. All subcontractors must provide a chemical product inventory, with SDSs, to SCS prior to commencement of work.		
On-Site Bulk Chemical Storage	Storage areas within 100 feet of the project site will be identified on the project's site-specific health and safety plan (SSHSP).		
Traffic Control Required	Address traffic control issues created by project activities. Specify if traffic control measures involve vehicle and /or pedestrian traffic.		
Noise: Over 85 Decibels (dBA)	Noise levels above 85 dBA in the project site area will require use of hearing protection.		
Radiation	Determine if the scope of work includes any area where radioactive materials are in use.		
Hazardous Classified Locations for Electrical Installations	Determine if the scope of work requires being in a classified hazardous location(s). Intrinsically safe equipment (non-sparking) and/or a hot work permit is required when working in these locations.		
Emergencies: General or Medical	In the event of an emergency, call 9-1-1 or the designated emergency phone number detailed in the project HASP. If the emergency involves a serious illness or injury, it is required to engage the 9-1-1 system.		
Emergencies: Chemical Spills	If a chemical release is observed notify the SCS site representative immediately.		
Illumination Proper for the Task	Supplemental lighting may be required for certain work areas. Determine if the work area(s) requires intrinsically safe lighting.		
General Housekeeping	Maintain an orderly worksite.		
Biological Hazards	Determine if any plant and/or animal life related to the project site creates a potential hazard to site personnel.		

Contractor Introduced Hazards			
Activity	Applicability		Requirement
	Yes	No	
Hot Work			Hot Work Permit required for any spark or flame generating activities in area where flammable gases or vapors are/may be present.
Chemical Usage			Any chemical brought on site must have an SDS's readily available to site personnel.
Proposition 65 (CA Work Only)			Chemicals brought on site that trigger Proposition 65 warnings, will require sufficient postings near storage and work areas.
Respiratory Protection			Determine if any task requires the use of respirators. Subcontractor use of respirators will require their respiratory protection program be submitted to SCS.
Excavation or Trenching			Determine if a competent person is required for the project. Determine if a state-specific permit (e.g., CA) is required and ensure it is completed and kept with the project file. SCS must receive the name(s) of the competent person(s) and the permits as required prior to initiation of any applicable excavation.
Crane Operations			Equipment certification and inspection records and operator licensing records must be provided to SCS prior to initiation of crane operations.
Motor Vehicle Operations			Obey the posted speed limit(s) throughout the job site. If it is not posted, do not exceed 15 mph.
First Aid/Sanitary Facilities			Make provisions for First Aid and washing facilities for project employees.
Extension Cords/GFCI			All extension cords are required to have GFCI, and be free of any non-standard or non-compliant repairs to the outer sheath.
Ladders: Fixed or Portable Access\Egress Issues			Use appropriate access equipment and securing techniques.
Hazardous Energy Control (HEC)			Determine if the project scope requires isolation of hazardous energy for in-place or new installations. If applicable, subcontractor written HEC program/procedures must be submitted to SCS prior to commencement of work.
Entry into Confined Space			Determine if the project scope requires confined space entry (CSE) work. If applicable, subcontractor written CSE program must be submitted to SCS prior to commencement of work.
Hazardous Waste			All Hazardous Waste generated from project activities shall be handled and disposed of in compliance with all applicable regulations and project specifications. Subcontractors will review all hazardous wastes generated with the owner and SCS with respect to characterization, storage, proposed treatment method, transportation, and documentation.

Safety Program Administration			
Topic	Implementation	Reviewed	
		Yes	No
Site Emergencies	In the event of an emergency, project personnel are expected to adhere to the requirements detailed in the SSHSP.		
Project Accident/Incident Reports	Submit a report of all near misses, accidents, property damage, or unsafe conditions. Subcontractors shall use their own form for reporting accidents. If the subcontractor does not have one, SCS will provide our form. It is available from the SCS project superintendent.		
Regulatory Agency Inspection	Provide notice of all <i>scheduled</i> regulatory inspections at least 48 hours in advance. Unscheduled inspections must be communicated to the project manager or superintendent who will immediately contact the client/owner and the Corporate Health and Safety Director as soon as the regulatory agency agent arrives at the job site.		
Imminent Hazards: Work Stoppage Around the Unsafe Activity	Work deemed to be unsafe will be stopped until the unsafe conditions are corrected.		
Training Records (Subcontractors Only)	SCS may request a review of certificates of training required by site requirement, statute, or regulation (e.g., OSHA, EPA, etc.) for subcontractors. Expired or unavailable records will result in individuals being prohibited from performing those tasks until certificates are received.		
General Construction Rules	Reviewed with all SCS, subcontractors, and site visitors prior to accessing the project site.		

Subcontractors (List company name and project superintendent and/or foreman):

Qualified Person for Cranes (include company): _____

Competent Person for Excavations (include company): _____

Qualified Person for Scaffolding (include company): _____

Documentation of the experience or qualifications of the above named individuals may be requested.

This completed document is an attempt to identify recognizable hazards associated with existing project site(s) and on the initial scope of work. Additional hazards may become present during the course of work. SCS and subcontractors will work cooperatively to identify these hazards. Change orders to the scope of work may change the hazards present on the job site as identified in this document. The documents indicated below are to be submitted to SCS as designated below, prior to the initial start of applicable work. The control measures designated below are to be completed prior to the start of the applicable work activity.

SCS Representative Date

Subcontractor Representative Date

Subcontractor Representative Date

Subcontractor Representative Date

Control Measures		Information to Client/Owner	
Hot Work Permit Required		SSHSP	
Chemical Storage Required		H&S Programs Required (list):	
Traffic Control Plan Required		Confined Space Entry	
Other (list as required):		Hazardous Energy Control	
		Respiratory Protection	
		Other (list as required):	
		Chemical Inventory and SDSs	
		Training/Permit Documentation Requested:	

Chemical Storage Requirements		
Project Name:	Project No.:	
Job Location:	Storage Location:	
Contact Person:	Cell: ()	
Material Name (Denote with an “S” If Stored by a Subcontractor)	Volume to Be Stored on Site	Container Type (Drum, Tote, Tank)
<p>Chemical Storage Requirements:</p> <ol style="list-style-type: none"> 1. Every chemical shall have a Safety Data Sheet (SDS) readily available for all project personnel. SDSs for chemicals proposed for storage by a subcontractor(s) shall be provided to SCS prior to placement on the job site. 2. All above-ground storage tanks and drums must have secondary containment. 3. All flammable liquids must be stored in flammable liquid lockers/containers. 4. All other hazardous materials shall be stored in appropriate/compatible lockers/containers. 5. An SCS representative has the right to inspect chemical storage areas at any time for spills, leaks or open containers. 6. All flammable material dispensing operations must be bonded and grounded. 7. All chemicals must be labeled in accordance with applicable federal or state OSHA requirements. 8. The use of corrosive materials requires an approved eyewash station be installed at the project site. 9. Pesticide usage shall be performed in compliance with the federal Fungicide, Insecticide, and Rodenticide Act or applicable state pesticide regulations, including operator certifications. 10. All hazardous waste shall be managed in compliance with applicable federal and state regulations. The disposal of hazardous waste shall be reviewed with the SCS project representative and the owner. 		
<p>Additional Comments:</p> 		
<p>Subcontractor Representative:</p>		<p>Date:</p>

Safety Awareness for Everyone

General Safety Rules

SCS has established a set of generic safety rules that apply to all employees, visitors, and subcontractors on construction project sites. Violators of these rules can be subject to disciplinary action or contract termination.

1. Subcontractors must provide their own equipment, supplies, means and methods to accomplish the contract without SCS materials. This includes but is not limited to ladders, aerial devices, forklifts, material handling equipment or safety equipment.
2. Maintain work area(s) in an orderly condition.
3. Ensure that a Safety Data Sheet is on site and available for any hazardous material or substance used in the completion of the contract scope. Unless directed otherwise in writing by the Owner, hazardous materials used during the course of work will be removed from the project site at the completion of the contract.
4. Spill of oil, grease, paint and other slippery substances are to be cleaned up immediately.
5. Report all unsafe conditions to the project superintendent or designee.
6. Report all accidents to your supervisor, regardless of severity of the accident.
7. Aisles and walkways are to be kept clear of tripping hazards and obstructions at all times.
8. Do not operate tools or equipment that you have not been trained to operate.
9. Engaging in horseplay or scuffling with fellow employees is prohibited at all times.
10. Pay close attention to your surroundings and do not read while walking.
11. When working in elevated locations (unprotected rooftops), **do not back up**. Always look in the direction of travel.
12. Employees using prescription medication shall inform their supervisor of the medication use, type, and possible effects when they report to work.
13. Be aware of unsafe walking surfaces on the project site. Be aware of equipment and on-site operations.
14. Do not block access to safety equipment, electrical panels, fire extinguishers, etc.
15. Do not disconnect or over ride any machines interlock device.
16. Do not walk around barricades, tape or other devices being used to block access to unsafe conditions.

17. There is **absolutely no smoking, except in designated areas with signage**, on a project site.
18. Do not smoke, use open flames, or use spark-producing equipment in any area which has been designated a “NO SMOKING” area.
19. Heed all “CAUTION” and “DANGER” signs throughout the job site.
20. In vehicles so equipped, the use of seat belts is mandatory.
21. Adhere to all posted speed limit signs on any project site. If no speed limit is posted do not exceed 15 mph.
22. Ladders are to be properly secured prior to use. When a ladder cannot be secured, a fellow employee must hold it.
23. All ladders must have a safety zone created and maintained around the working base of the ladder.
24. Operation of equipment or machinery without proper guards and/or signaling devices is prohibited.
25. The unauthorized removal of guards or disconnecting of signaling devices is prohibited.
26. Personal protective equipment, safety glasses, hard hats, hearing protection, etc, shall be worn in all areas where required.
27. Extension cords shall be inspected for defects prior to use. Do not use visibly damaged or defective extension cords.
28. Do NOT use cell phones on the project site except for emergencies or as an approved communication device for specified project operations.
29. Always use the proper tool for the job.