



November 15, 2013

Ms. Pamela Green  
Kansas Department of Health and Environment  
Bureau of Environmental Remediation  
1000 SW Jackson Street, Suite 410  
Topeka, Kansas 66612

Re: Soil Vapor Extraction Pilot Test Work Plan  
NuStar Andover Quail Crossing  
Andover, Kansas  
1641-04

Dear Pamela:

Enclosed, please find the Soil Vapor Extraction Pilot Test Work Plan. As discussed during our September 2013 meeting, this Work Plan was prepared on behalf of NuStar Pipeline Operating Partnership L.P. (NuStar) as part of a continuing response to the release of gasoline from a pipeline in the Quail Crossing Neighborhood.

If you have any questions or would like to discuss this further, please contact me at (503) 924-4704 ext. 111

Sincerely,

A handwritten signature in blue ink, appearing to read 'S. Jackson', is written over a light blue circular stamp.

Sam Jackson  
Associate Engineer

**ATTACHMENT**

Soil Vapor Extraction Pilot Test Work Plan

cc: Ms. Renee Robinson, NuStar Energy, L.P. (electronic deliverable)



*Soil Vapor Extraction Pilot Test Work Plan  
Quail Crossing Neighborhood  
Andover, Kansas*

Prepared for:  
NuStar Pipeline Operating Partnership, L.P.

November 15, 2013  
1641-04



*Soil Vapor Extraction Pilot Test Work Plan  
Quail Crossing Neighborhood  
Andover, Kansas*

Prepared for:  
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1641-04

A handwritten signature in blue ink, appearing to read 'S. Jackson', positioned above a horizontal line.

*Sam Jackson  
Associate*



A handwritten signature in black ink, appearing to read 'Chris Breemer', positioned above a horizontal line.

*Chris Breemer, P.G.  
Principal*

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## **1.0 Introduction**

This Soil Vapor Extraction Pilot Test Work Plan (Work Plan) was prepared on behalf of NuStar Pipeline Operating Partnership L.P. (NuStar) as part of a continuing response to the release of gasoline from a pipeline in the Quail Crossing Neighborhood in Andover, Kansas, and in accordance with the joint NuStar and Kansas Department of Health and Environment (KDHE) project discussion that was conducted on September 11, 2013.

Separate-phase petroleum hydrocarbons (SPH) were discovered in an irrigation well at 2006 Colt Court on June 9, 2012. Since that discovery, NuStar has completed the following activities: located and repaired the affected portion of pipeline; excavated approximately 16 cubic yards of soil within the pipeline corridor; conducted SPH recovery activities on the affected irrigation well at 2006 Colt Court; and performed a subsurface investigation in two phases. The subsurface investigation included the installation of 16 monitoring wells and collection of groundwater samples from the 16 monitoring wells and 15 nearby irrigation wells. Data collected through October 2013 indicate that petroleum hydrocarbons are present in soil and groundwater in the area surrounding the affected portion of the pipeline.

During the second phase of investigation activities, conducted in September 2013, four soil vapor extraction (SVE) wells (SVE-1 through SVE-4) were installed adjacent to the pipeline in the investigation area. These wells were installed for future remediation pilot testing. Consequently, the pilot testing described herein is intended to evaluate the feasibility of SVE technology for remediating residual gasoline-range hydrocarbons in the subsurface.

### **1.1 Objectives**

The objectives of the work proposed herein are to:

- Perform an SVE pilot test using the existing SVE test well and monitoring well network;
- Assess the viability of SVE technology for treatment of gasoline impacts at the site; and
- Obtain information that may be useful for designing an interim remedial action for the site.

### **1.2 Work Plan Organization**

This Work Plan is organized as follows:

Background (Section 2) – A description of the Site, geology and hydrogeology, and a discussion of recent subsurface data.

Recent Activity (Section 3) – A description of interim remedial measures and investigations performed in July – October 2013.

Soil Vapor Extraction Pilot Test (Section 4) – The scope and approach for the proposed SVE pilot test.

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Reporting and Schedule (Section 5) – A timeline for the implementation of the Work Plan and associated reporting.

## **2.0 Background**

This section discusses the Site setting, geology, and hydrogeology.

### **2.1 Site Description**

The Site is located in the northern portion of the City of Andover, in Butler County, Kansas (Figure 1), approximately 1/3 mile southeast of the intersection of North 159th Street East and West 21st Street. Land use at and surrounding the Site is residential. A stormwater pond is located approximately 250 feet south of the pipeline.

Residents in the Neighborhood use municipal water for domestic purposes. In addition to the municipal water supply, some residents in the Neighborhood have irrigation water wells that are used for outdoor irrigation and landscape purposes. Available information reviewed by Apex indicates that the irrigation wells range in total depth from approximately 80 to 116 feet below the ground surface (bgs). In most irrigation wells, the screened interval extends from total well depth to approximately 40 feet bgs; gravel filter packs typically extend from the total well depth to approximately 20 feet bgs.

### **2.2 Geology and Hydrogeology**

This section describes the geologic setting and site lithology.

#### **2.2.1 Regional Geology**

The regional geology in Butler County consists of unconsolidated sediments, including Tertiary and Quaternary alluvium and Quaternary loess at the ground surface, overlying lower Permian limestone and shale of the Council Grove and Chase Groups (Aber, 1991).

#### **2.2.2 Site Lithology and Hydrogeology**

The following summary of subsurface conditions is based on Neighborhood irrigation well construction logs (surface to 116 feet bgs) and borings advanced by Apex during the July to September 2013 investigation activities (surface to 65 feet bgs). Drilling during the July – September 2013 investigation was performed using air rotary and solid stem auger methods; therefore, the borings were logged using cuttings and driller observations.

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At the site, clay (loess) is generally encountered from the surface to a depth of approximately 12 to 35 feet bgs. Clay with gravel and gravelly clay generally underlies the clay to the total depths explored. Driller observations suggest that soil becomes notably denser below approximately 20 feet bgs. Boring logs and well completion diagrams for monitoring wells that will be used for the pilot test are included in Appendix A. Logs and well completion forms for the remaining borings that were advanced during the July through September 2013 investigation will be included in the forthcoming Comprehensive Investigation (CI) Report.

Between August and October 2013, groundwater levels in monitoring wells at the Site varied from approximately 13 to 45 feet bgs. Well logs for irrigation wells indicate that static water levels varied from approximately 14 to 40 feet bgs when those wells were installed (1998 to 2011). The groundwater gradients at the Site appear variable, and may be affected by pumping from irrigation wells and by water stage in the nearby stormwater retention pond. NuStar is currently performing weekly groundwater gauging events to further evaluate groundwater conditions at the Site.

A more detailed summary of the area geology and hydrogeology and site-specific lithology will be included in the forthcoming CI Report, which will be submitted to KDHE in January 2014.

### **3.0 Recent Activity**

This section summarizes interim remedial measures and investigation activities that have been performed at the Site in response to the discovery of petroleum hydrocarbons in the subsurface.

#### **3.1 Interim Remedial Measures**

In response to the discovery of SPH in the irrigation well at 2006 Colt Court, the following interim measures were conducted between June 2012 and November 2013: (1) hydrotesting the affected portion of the pipeline; (2) collection and analyses of SPH and water samples from the irrigation well at 2006 Colt Court; (3) excavation of impacted soil along a 45-foot section of the NuStar pipeline and replacement of a portion of the pipeline; (4) vacuum removal of SPH and water from the irrigation well at 2006 Colt Court; (5) manual removal of SPH and water from the irrigation well at 2006 Colt Court with bailers; (6) collection and analyses of SPH samples from the NuStar pipeline; and (7) deactivation of the irrigation well at 2006 N Colt Court, and connection of the associated system to the municipal water supply. Ongoing remedial measures include weekly vacuum removal of SPH from the irrigation well at 2006 Colt Court. Selected irrigation wells located within the investigation area have been deactivated to allow the groundwater to return to ambient conditions.

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## 3.2 Previous Investigations

In addition to the activities outlined in Section 3.1, NuStar performed two phases of investigation at the Site between July and October 2013 to evaluate the nature and extent of petroleum hydrocarbons in the subsurface. The scope of both phases of investigation was developed in coordination with KDHE and is generally described in the Groundwater Investigation Work Plan (Apex, 2012) and in follow-up correspondence (Apex, 2013).

Subsurface investigation activities included:

- Collection and laboratory analysis of soil samples from one soil boring;
- Installation of 16 monitoring wells;
- Installation of four SVE test wells (SVE-1 through SVE-4);
- Installation of three soil vapor monitoring points;
- Collection and analysis of water samples from the 16 monitoring wells and 15 Neighborhood irrigation wells;
- Collection and analysis of soil vapor samples from the three soil vapor monitoring points; and
- Abandonment of one soil boring.

The locations of the wells listed above are shown on Figures 2 and 3; and NuStar has provided preliminary summaries of the site investigation data to KDHE. The methods and results of the investigations will be described in detail in the forthcoming CI Report, which will be submitted to KDHE in January 2014.

Briefly, the data collected during the July-September 2013 investigations, indicate that soil and groundwater in the area surrounding the affected portion of the pipeline are impacted by gasoline-range hydrocarbons and associated constituents (benzene, toluene, ethylbenzene, xylenes [BTEX], 1,2-dichloroethane, naphthalene, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, n-butylbenzene, and n-propylbenzene). The concentrations of gasoline-range hydrocarbons and constituents in various soil and groundwater samples exceed KDHE Tier 2 Risk-Based Screening Values (RBSVs).

In an effort to expedite remediation efforts, NuStar performed a preliminary evaluation of remedial technologies that may be effective for addressing the contaminants of interest, within the limitations imposed by geological and hydrogeological conditions and residential land uses at the Site. SVE was identified as a potentially effective technology based on its proven effectiveness treating volatile organic compounds (VOCs) under conditions similar to those observed at the Site. The following section presents the proposed approach for performing a pilot test to further assess the effectiveness of SVE technology at the Site.

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## **4.0 Vapor Extraction Pilot Test**

In accordance with the September 2013 joint project discussion with KDHE, an SVE pilot test will be performed to evaluate whether SVE is a feasible remedial technology for the Site and to determine appropriate SVE system design parameters. In general, the pilot test will include: (1) the connection of a temporary blower unit to two selected SVE pilot test wells to induce vacuum in the subsurface; (2) measurement of vacuum pressure at selected monitoring points (SVE pilot test wells SVE-1, SVE-2, SVE-3, and/or SVE-4, and monitoring wells MW-3 and MW-9) until the vacuum pressures stabilize (for several SVE removal flow rates); and (3) evaluation of the pilot test data. The air flow and pressure data will be evaluated to assess the site-specific relationship between SVE air flow, vacuum pressure, and the effective radius of influence (ROI). For the purposes of this evaluation, the definition of the ROI will be a minimum pore-space air velocity of 0.001 cm/sec (as per the design guidance prepared by the U.S. Army Corps of Engineers [USACE], 2002).

The pilot test will be performed in general accordance with *KDHE Standard Operating Procedure 15 - Conducting Soil Vapor Extraction Tests* (KDHE, 2011). A Sampling and Analysis Plan (SAP) is included as Appendix B. A Quality Assurance Project Plan (QAPP) is included in Appendix C; a Health and Safety Plan (HASP) and Analytical Laboratory Quality Assurance Manual are included as attachments to the QAPP.

### **4.1 SVE Test Wells**

SVE pilot test wells were installed in September 2013. As shown on Figure 3, the SVE pilot test wells (and nearby groundwater monitoring wells) are located in a petroleum-impacted area, approximately 140 to 200 feet southeast of the pipeline release location. Wells SVE-1, SVE-2, and SVE-4 are arranged in a linear pattern on the north side of the NuStar pipeline, with approximately 6 feet between the wells; well SVE-3 is located on the south side of the NuStar pipeline, approximately 15 feet from SVE-4. Groundwater monitoring wells MW-3 and MW-9 are approximately 25 and 45 feet from well SVE-4, respectively.

Soil boring logs for SVE-1 through SVE-4, MW-3 and MW-9 are included in Appendix A. The SVE pilot test wells are 30 feet deep with screen intervals between approximately 15 and 30 feet bgs in test well SVE-2, and between 20 and 30 feet bgs in test wells SVE-1, SVE-3, and SVE-4. Monitoring well MW-3 is 60 feet deep with screen interval from 40 to 60 feet bgs; monitoring well MW-9 is 34 feet deep with screen interval from 19 to 34 feet bgs. Wells SVE-1 through SVE-4, MW-3, and MW-9 are constructed using 2-inch diameter polyvinyl chloride (PVC) casing.

Groundwater is present at the base of some SVE pilot test wells; however, based on October 23, 2013 water level measurements, no more than two feet of the screen intervals in SVE pilot test wells are submerged, indicating that the SVE test wells are sufficient for pilot testing purposes.

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## 4.2 Vapor Extraction Pilot Test

For the SVE system pilot test, a trailer-mounted regenerative blower system (GAST Model SDR6P) will be used to induce vacuum pressures in the subsurface. A schematic showing the SVE pilot test system is shown on Figure 4 and equipment specifications are provided in Appendix D. The selected blower system will be capable of generating: vacuum pressures of at least 90 inches of water at a minimum air flow of 10 cubic feet per minute (cfm); and vacuum pressures of at least 60 inches of water at a minimum air flow of 20 cfm). The blower will be connected to the casings of the extraction test wells with 3-inch-diameter flexible hosing suitable for high-vacuum applications. An air/water separator (knockout drum) will be installed between the extraction well and the temporary blower.

During the pilot test, the following parameters will be measured and recorded: (1) the air flow rate from each extraction well; (2) the vacuum pressures in each extraction well; and (3) vacuum pressure in each of the monitoring points. The air flow rate will be measured with an in-line air flow meter. Vacuum pressures will be measured using suitably-scaled vacuum gauges (in the piping connected to the extraction well and at the casing of each monitoring point). Vacuum relief (with a bypass valve) will be provided at the blower unit as necessary to maintain safe operation of the equipment.

The test will be performed at two flow rates to determine the relationship between the extraction flow rates and the resulting vacuum pressure distribution. For each flow rate, the blower will be operated for a period adequate to allow vacuum pressures to stabilize in the monitoring points (expected to require less than eight hours for each test). The two operating test flow rates will be determined in the field based on the maximum safe operating pressures developed by the site-specific conditions (nominally 100% and 50% of the maximum safe operating pressure). The blower flow rate will be adjusted by opening a bypass valve at the system to reduce flow derived from the extraction well.

### 4.2.1 SVE Extraction Wells

Vacuum will be induced in SVE test wells SVE-1, SVE-2, SVE-3, and/or SVE-4, which are located adjacent to the pipeline, as shown on Figure 3. The specific wells used for extraction will be determined in the field based on pilot test performance. These proposed wells are appropriate for pilot testing because: (1) they are close to known impacted soil; and (2) they are accessible for pilot testing equipment (with minimal disturbance to Neighborhood residents); and (3) it appears feasible to integrate these wells into a full-scale SVE system, if necessary.

### 4.2.2 SVE Observation Wells

As shown on Figure 3, wells MW-3, MW-9, SVE-1, SVE-2, SVE-3, and/or SVE-4 will be utilized as SVE monitoring points. Depending on the selected extraction well, monitoring points will be available within 6 to 50 feet away from the extraction well. These wells are proposed for SVE monitoring because they provide

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adequate coverage of the subsurface pressure field (such that at least one monitoring point is within the expected minimum ROI for the SVE pilot test system, based on the soil types encountered at the Site).

### **4.3 Air Quality Monitoring**

At intervals during the pilot test, VOC concentrations will be measured at the blower exhaust using a photoionization detector (PID). In addition, two samples of the system effluent will be collected and submitted for laboratory analysis of VOCs (benzene, 1,2-dichloroethane, ethylbenzene, naphthalene, toluene, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, xylenes, n-butylbenzene, and n-propylbenzene) using EPA Method TO-15. One laboratory sample will be collected at the initiation of the pilot test and a second laboratory sample will be collected at the conclusion of the test period. These data will be used to assess the effectiveness of the pilot test system, the anticipated mass loading rate, and the need for vapor treatment on a full-scale system.

### **4.4 Data Analysis**

Following the collection of the flow and pressure data, an analytical model (i.e., Air2D) will be used to determine the intrinsic air permeability of the formation. Using these calculated permeabilities, the model will be used to assess the relationship between air flow (and the resultant vacuum pressure) and the potential ROI (a pore-space air velocity of 0.001 cm/sec). This relationship will be used to evaluate proper SVE blower sizing and extraction well spacing.

Air quality data from the summa cans and PID will be used to evaluate the options for SVE effluent treatment.

## **5.0 Reporting and Schedule**

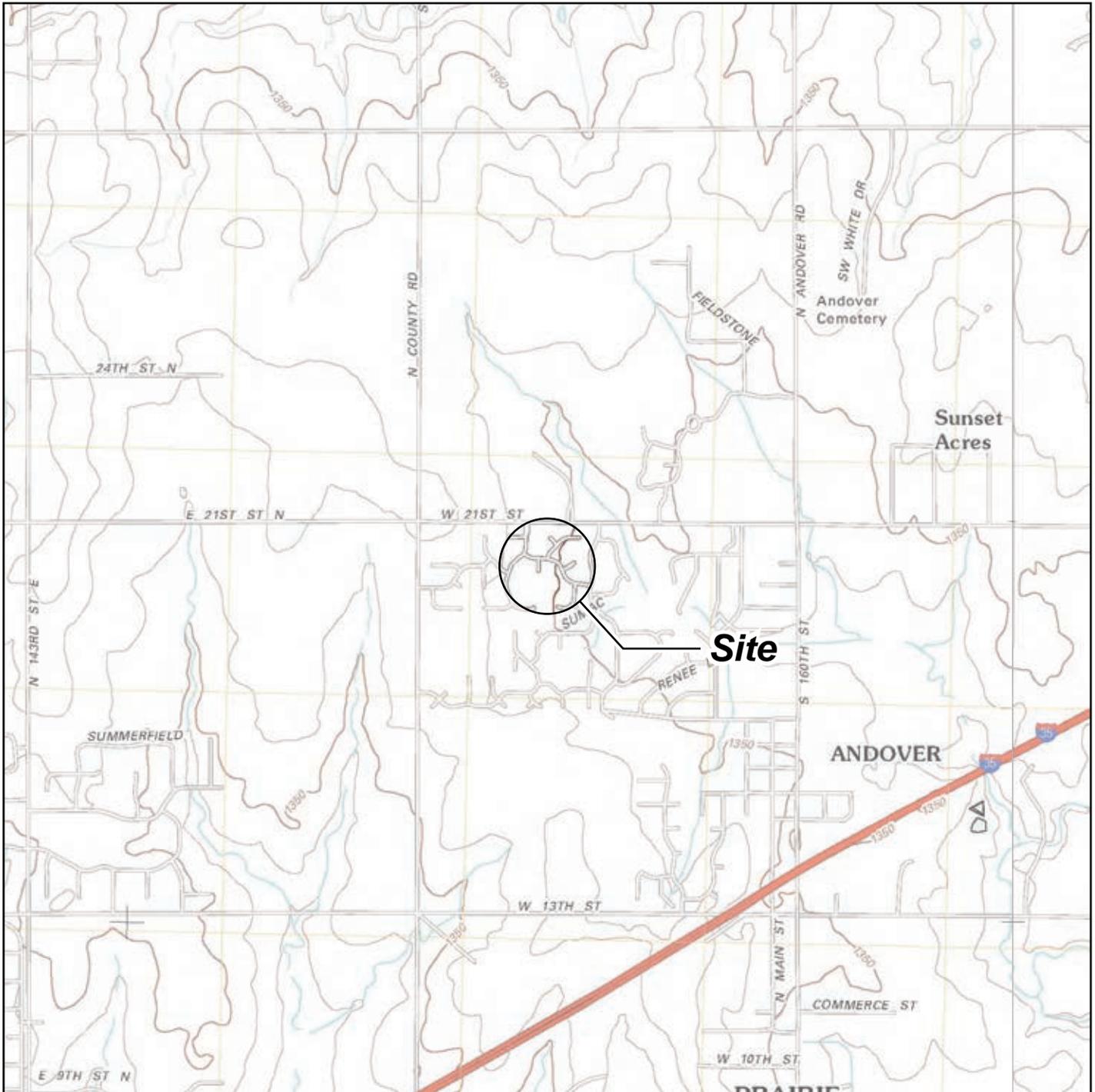
The work described herein will be initiated in December 2013, pending KDHE's approval of this Work Plan and barring delays beyond the control of NuStar.

The results of work described herein will be submitted to KDHE within 60 days following receipt of analytical data. The report will provide a discussion about feasibility of SVE at the site and, if applicable, general design criteria such as SVE blower sizing and extraction well spacing, and options for SVE effluent treatment. Additionally, the report may include a proposed timeline for implementation of a full-scale SVE system, which will be performed in coordination with KDHE and public input.

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## **6.0 References**

- Aber, J.S., 1991. *Surficial Geology of Butler County, Kansas, Final Report*. Earth Science Department, Emporia State University, KGS Open-File Report 1991-48. April 26, 1991.
- Apex, 2013. *Groundwater Investigation Work Plan. Quail Crossing Neighborhood, Andover, Kansas*. September 9, 2012.
- Apex, 2013. *Revised Vapor Intrusion Work Plan. Easter Addition Neighborhood, Andover, Kansas*. March 3, 2013.
- Apex, 2013. *Revised Groundwater Investigation Work Plan. Quail Crossing Neighborhood, Andover, Kansas*. July 2, 2013.
- KDHE, 2011. *Standard Operating Procedure 15 - Conducting Soil Vapor Extraction Tests*. January 1, 2011.
- USGS, 1997. *AIR2D - A Computer Code to Simulate Two-Dimensional, Radially Symmetric Airflow in the Unsaturated Zone*. File Report 97-588, 106 p. by Craig J. Joss and Arthur L. Baehr.
- USACE, 2002. *Engineering and Design. Soil Vapor Extraction and Bioventing*. Manual No. 1110-1-4001. June 3, 2002.



**Note:** Base map prepared from USGS 7.5-minute quadrangles of Andover and Santa Fe Lake, KS, dated 2009 as provided by USGS.gov.



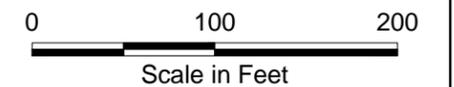
<h2 style="margin: 0;">Site Location Map</h2> <p style="margin: 0;">Soil Vapor Extraction Pilot Test Work Plan NuStar Pipeline Operating Partnership L.P. Andover, Kansas</p>		
 <p style="margin: 0;">Apex Companies, LLC 3015 SW First Avenue Portland, Oregon 97201</p>	Project Number	1641-04
	November 2013	



**Legend:**

- MW-1 Monitoring Well Location
- Irrigation Well
- VP-1 Soil Vapor Monitoring Point
- Soil Vapor Extraction Pilot Test Location (See Figure 3)
- Property Line
- Pipeline
- Pipeline Easement Boundary
- HOA Lot Owned by Quail Crossing Homeowner's Association

NOTE: A well survey has been performed to identify irrigation wells shown on this map; however, additional irrigation wells may be present.



**Site Exploration Plan**

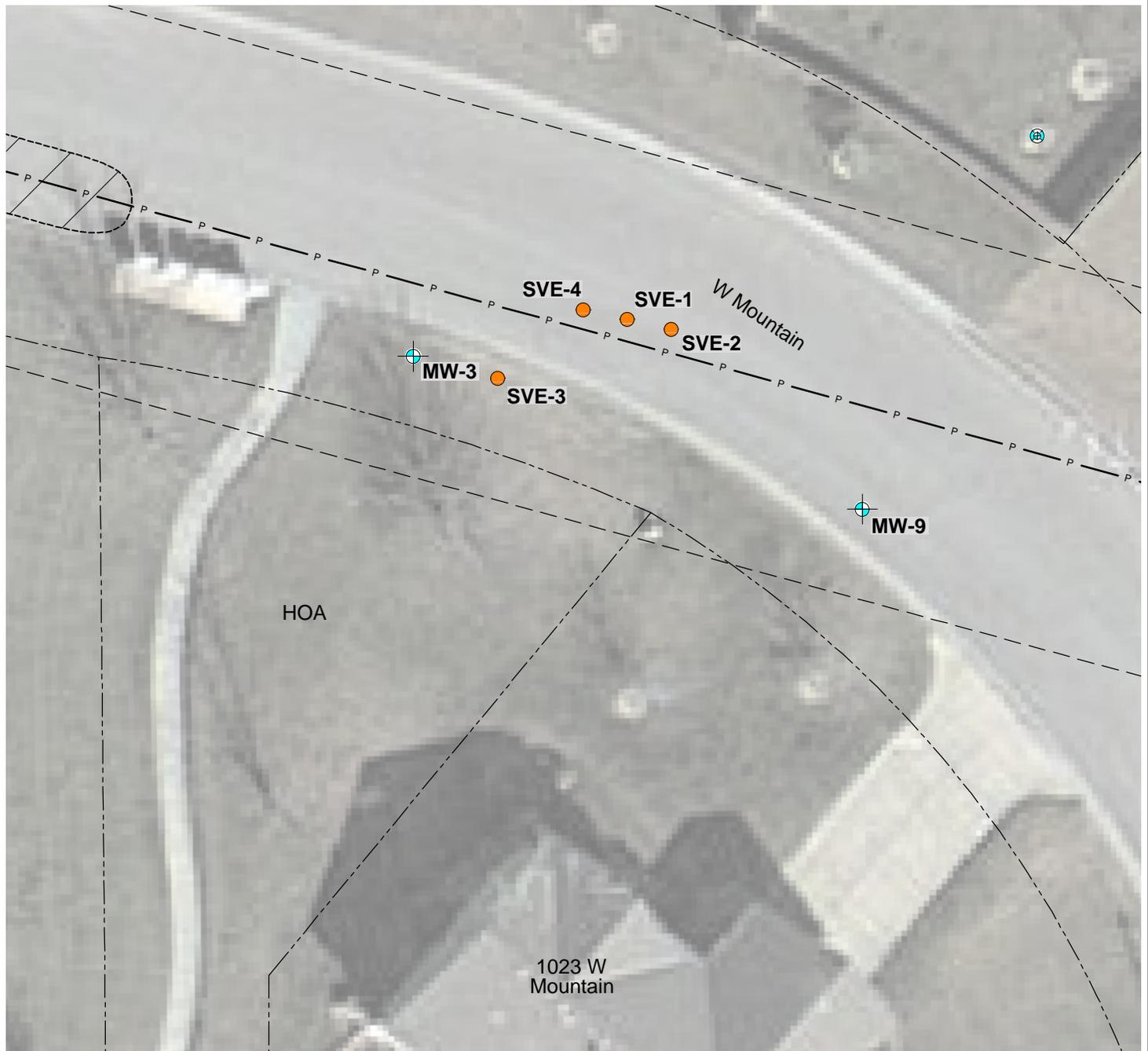
Soil Vapor Extraction Pilot Test Work Plan  
 NuStar Pipeline Operating Partnership L.P.  
 Andover, Kansas

Apex Companies, LLC  
 3015 SW First Avenue  
 Portland, Oregon 97201

Project Number	1641-04
November 2013	

Figure  
**2**

Aerial photograph provided by Google  
 Maps.com (dated February 25, 2012).



**Legend:**

MW-1  Monitoring Well Location

 Irrigation Well

SVE-1  Soil Vapor Extraction Pilot Test Well

----- Property Line

— P — Pipeline

- - - - Pipeline Easement Boundary

HOA Lot Owned by Quail Crossing Homeowner's Association



## Soil Vapor Extraction Test Well Locations

Soil Vapor Extraction Pilot Test Work Plan  
NuStar Pipeline Operating Partnership L.P.  
Andover, Kansas

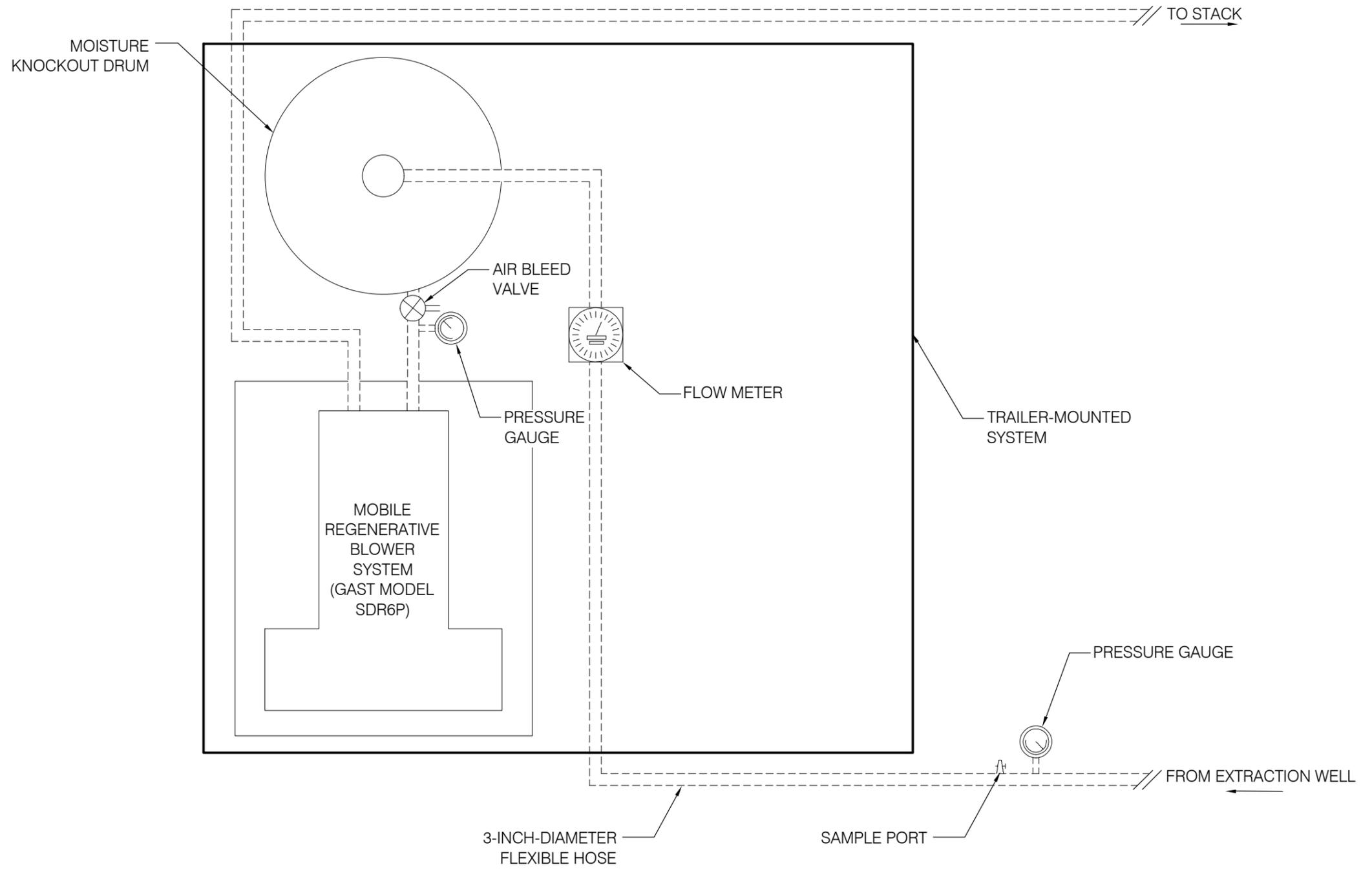
 Apex Companies, LLC  
3015 SW First Avenue  
Portland, Oregon 97201

Project Number 1641-04

November 2013

Figure

**3**



### SVE Pilot Test Schematic

Soil Vapor Extraction Pilot Test Work Plan  
 NuStar Pipeline Operating Partnership L.P.  
 Andover, Kansas

**APEX** Apex Companies, LLC  
 3015 SW First Avenue  
 Portland, Oregon 97201

Project Number	1641-04
November 2013	

Figure  
**4**

***Appendix A***

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**Soil Boring Logs and Well Completion Reports**

## Sample Descriptions

Classification of soils in this report is based on visual field and laboratory observations which include density/consistency, moisture condition, and grain size, and should not be construed to imply field nor laboratory testing unless presented herein. Visual-manual classification methods of ASTM D 2488 were used as an identification guide.

Soil descriptions consist of the following:

MAJOR CONSTITUENT with additional remarks; color, moisture, minor constituents, density/consistency.

## Density/Consistency

Soil density/consistency in borings is related primarily to the Standard Penetration Resistance. Soil density/consistency in test pits and push probe explorations is estimated based on visual observation and is presented parenthetically on test pit and push probe exploration logs.

SAND and GRAVEL	Standard Penetration Resistance in Blows/Foot	SILT or CLAY	Standard Penetration Resistance in Blows/Foot	Approximate Shear Strength in TSF
<u>Density</u>		<u>Density</u>		
Very loose	0 - 4	Very soft	0 - 2	<0.125
Loose	4 - 10	Soft	2 - 4	0.125 - 0.25
Medium dense	10 - 30	Medium stiff	4 - 8	0.25 - 0.5
Dense	30 - 50	Stiff	8 - 15	0.5 - 1.0
Very dense	>50	Very Stiff	15 - 30	1.0 - 2.0
		Hard	>30	>2.0

## Moisture

Dry	Little perceptible moisture.
Sl. Moist	Some perceptible moisture, probably below optimum.
Moist	Probably near optimum moisture content.
Wet	Much perceptible moisture, probably above optimum.

## Minor Constituents

Minor Constituents	Estimated Percentage
Not identified in description	0 - 5
Slightly (clayey, silty, etc.)	5 - 12
Clayey, silty, sandy, gravelly	12 - 30
Very (clayey, silty, etc.)	30 - 50

## Sampling Symbols

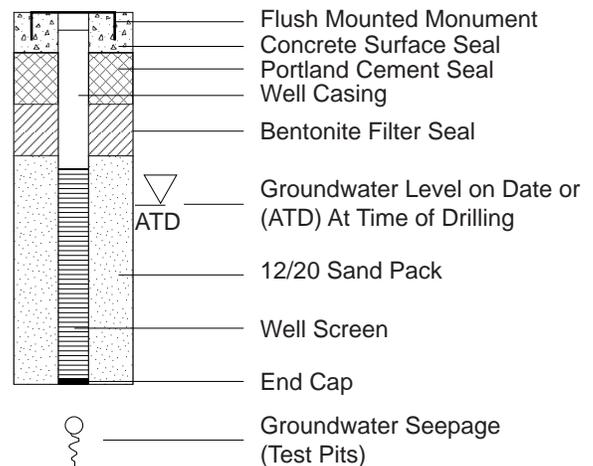
### BORING AND PUSH-PROBE SYMBOLS

	Recovery
	No Recovery
	Cuttings
	Temporarily Screened Interval
PID	Photoionization Detector Reading
W	Water Sample
	Sample Submitted for Chemical Analysis
NS	No Sheen
SS	Slight Sheen
MS	Moderate Sheen
HS	Heavy Sheen
BF	Biogenic Film

### TEST PIT SOIL SAMPLES

	Grab (Jar)
	Bag
	Shelby Tube

## Groundwater Observations and Monitoring Well Construction



## Key to Exploration Logs

Colt Court/Quail Crossing Neighborhood  
NuStar Pipeline Operating Partnership L.P.  
Andover, Kansas



Apex Companies, LLC  
3015 SW First Avenue  
Portland, Oregon 97201

Project Number	1641-04
November 2013	

Figure  
**Key**



Apex Companies, LLC  
3015 SW First Avenue  
Portland, Oregon 97201

Colt Court/Quail Crossing Neighborhood  
NuStar Pipeline Operating Partnership L.P.  
Andover, Kansas

Boring Number: **MW-3**

Project Number: **1641-04**

Logged By: **M. Whitson**

Date: **July 22-24, 2013**

Site Conditions: **Partly Cloudy, 80s (°F)**

Drilling Contractor: **Geocore**

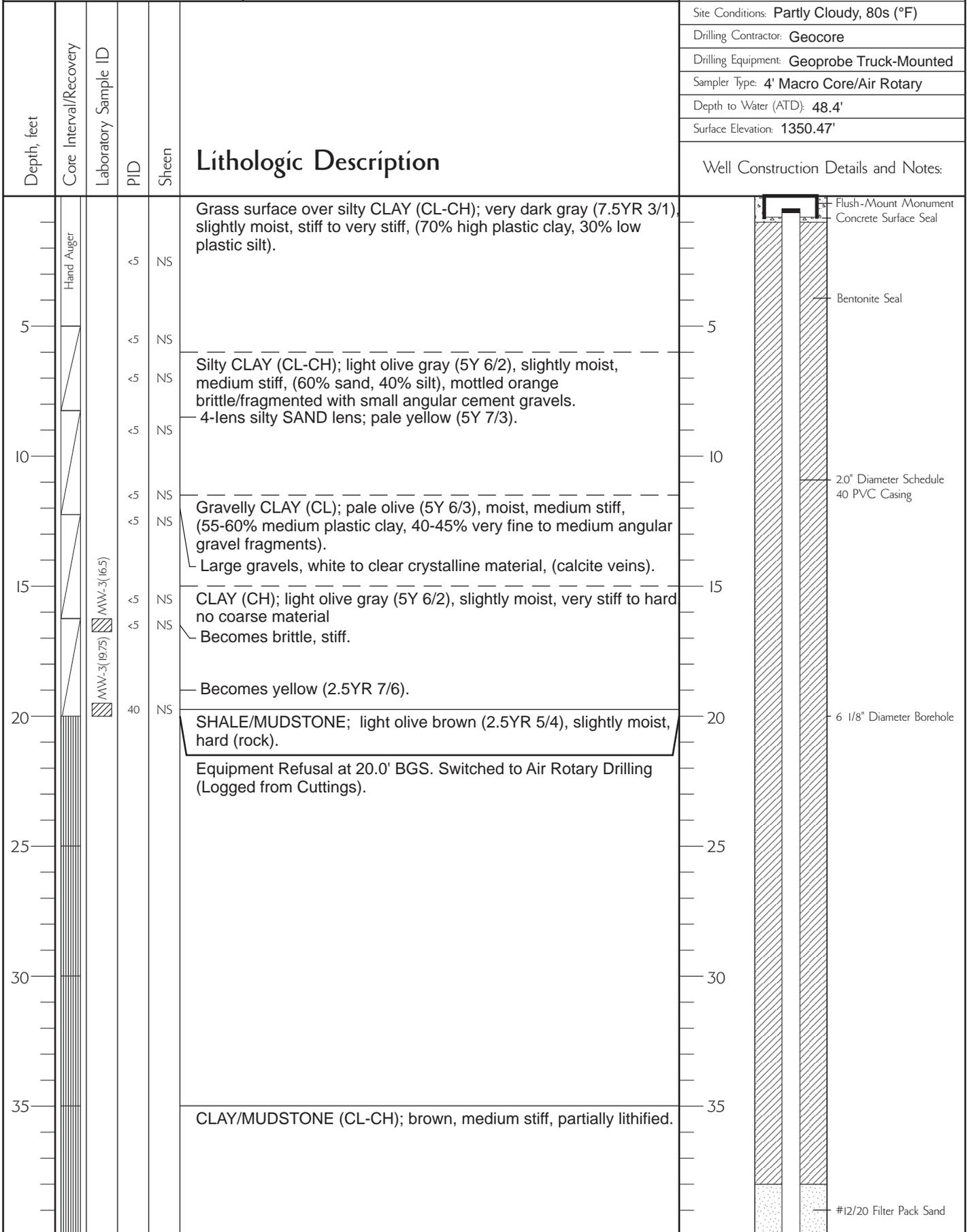
Drilling Equipment: **Geoprobe Truck-Mounted**

Sampler Type: **4' Macro Core/Air Rotary**

Depth to Water (ATD): **48.4'**

Surface Elevation: **1350.47'**

Well Construction Details and Notes:





Apex Companies, LLC  
3015 SW First Avenue  
Portland, Oregon 97201

Colt Court/Quail Crossing Neighborhood  
NuStar Pipeline Operating Partnership L.P.  
Andover, Kansas

Boring Number: **MW-3**

Project Number: **1641-03**

Logged By: **M. Whitson**

Date: **July 22-24, 2013**

Site Conditions: **Partly Cloudy, 80s (°F)**

Drilling Contractor: **Geocore**

Drilling Equipment: **Geoprobe Truck-Mounted**

Sampler Type: **4' Macro Core/Air Rotary**

Depth to Water (ATD): **48.4'**

Surface Elevation: **1350.47'**

Well Construction Details and Notes:

Depth, feet	Core Interval/Recovery	Laboratory Sample ID	PID	Sheen	Lithologic Description	Well Construction Details and Notes
45			<5	NS	Gravelly CLAY/MUDSTONE (CL); brownish gray, stiff to hard, lithified fragments of mudstone/shale.	<p>2.0" Diameter Schedule 40 PVC Screen (0.010-Inch Slot Size)</p> <p>#12/20 Filter Pack Sand</p> <p>End Cap</p> <p>Native Material</p>
50			<5	NS	MUDSTONE; light brown with clay.	
55					CLAY with gravel (CL-CH); brownish gray, soft, (75% medium plastic clay, 25% fine angular gravel).	
60					GRAVEL with clay (GP); light brown, loose, (85% very fine to medium subangular gravel, 15% clay/fines).	
65					SAND with gravel(SP); light reddish brown, loose (85% fine to coarse sand, 15% very fine subangular gravel, trace fines).	
70					Bottom of Boring at 66.0' BGS.	
75						



Apex Companies, LLC  
3015 SW First Avenue  
Portland, Oregon 97201

Colt Court/Quail Crossing Neighborhood  
NuStar Pipeline Operating Partnership L.P.  
Andover, Kansas

Boring Number: **MW-9**

Project Number: **1641-04**

Logged By: **M. Whitson**

Date: **July 31, 2013**

Site Conditions: **Clear, 80s/90s (°F)**

Drilling Contractor: **Geocore**

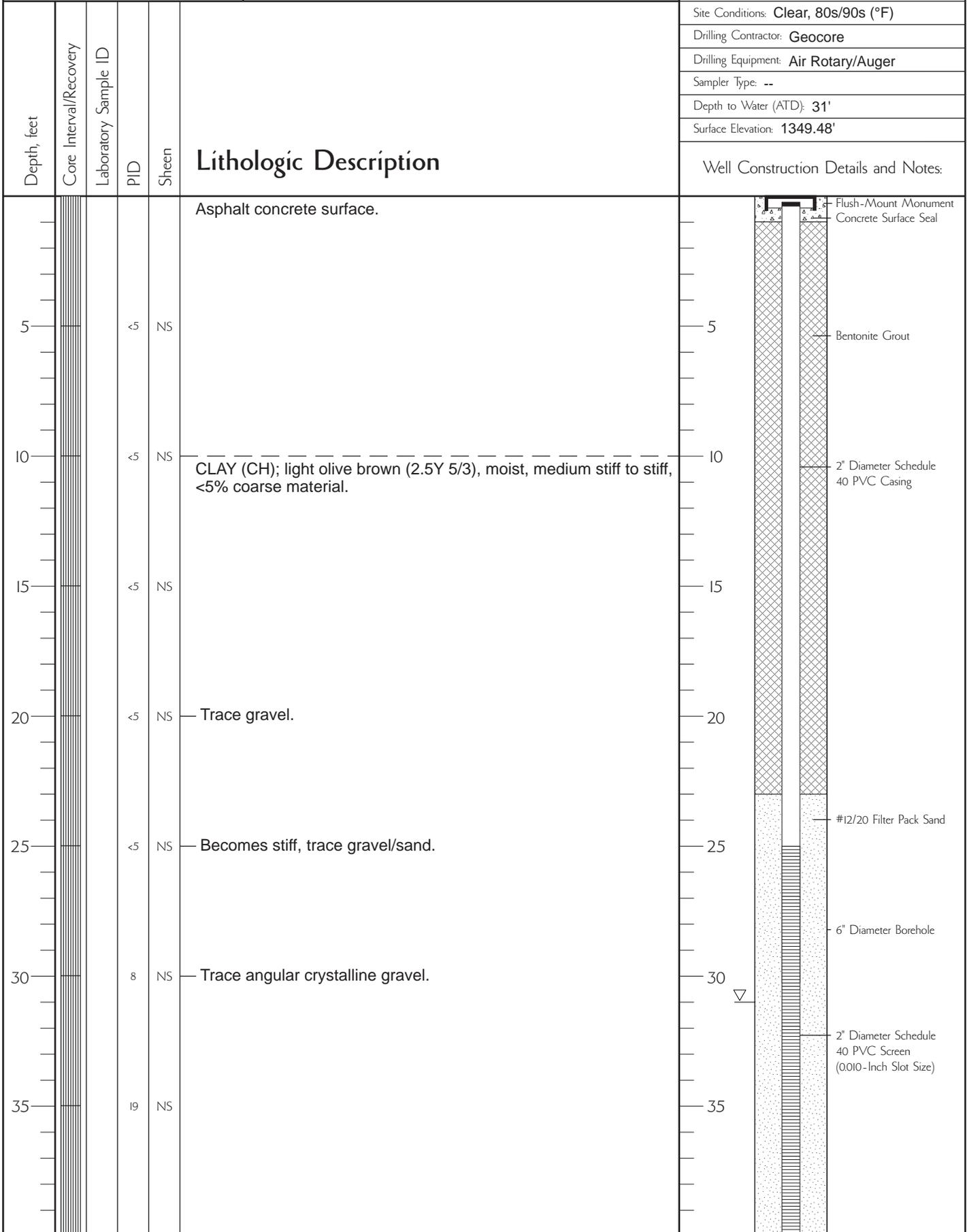
Drilling Equipment: **Air Rotary/Auger**

Sampler Type: **--**

Depth to Water (ATD): **31'**

Surface Elevation: **1349.48'**

Well Construction Details and Notes:





Apex Companies, LLC  
3015 SW First Avenue  
Portland, Oregon 97201

Colt Court/Quail Crossing Neighborhood  
NuStar Pipeline Operating Partnership L.P.  
Andover, Kansas

Boring Number: **MW-9**

Project Number: **1641-04**

Logged By: **M. Whitson**

Date: **July 31, 2013**

Site Conditions: **Clear, 80s/90s (°F)**

Drilling Contractor: **Geocore**

Drilling Equipment: **Air Rotary/Auger**

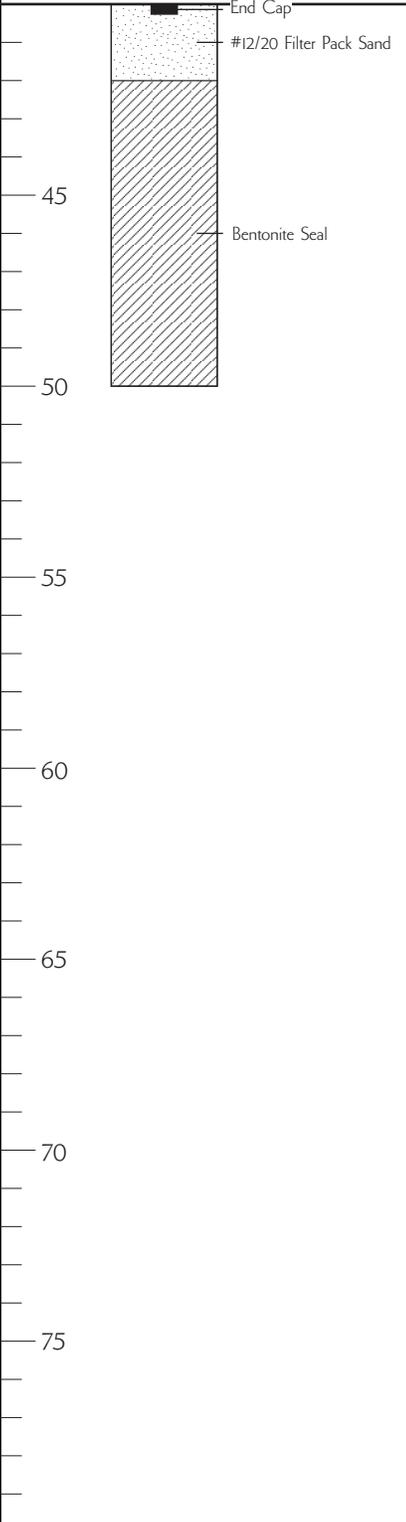
Sampler Type: **--**

Depth to Water (ATD): **31'**

Surface Elevation: **1349.48'**

Well Construction Details and Notes:

Depth, feet	Core Interval/Recovery	Laboratory Sample ID	PID	Sheen	Lithologic Description
			20	NS	
45		6	NS		Saturated.
50					Bottom of Boring at 50.0' BGS.





Apex Companies, LLC  
3015 SW First Avenue  
Portland, Oregon 97201

Colt Court/Quail Crossing Neighborhood  
NuStar Pipeline Operating Partnership L.P.  
Andover, Kansas

Boring Number: **SVE-1**

Project Number: **1641-04**

Logged By: **M. Whitson**

Date: **September 24, 2013**

Site Conditions: **Partly Cloudy, Windy, 70s (°F)**

Drilling Contractor: **Geocore**

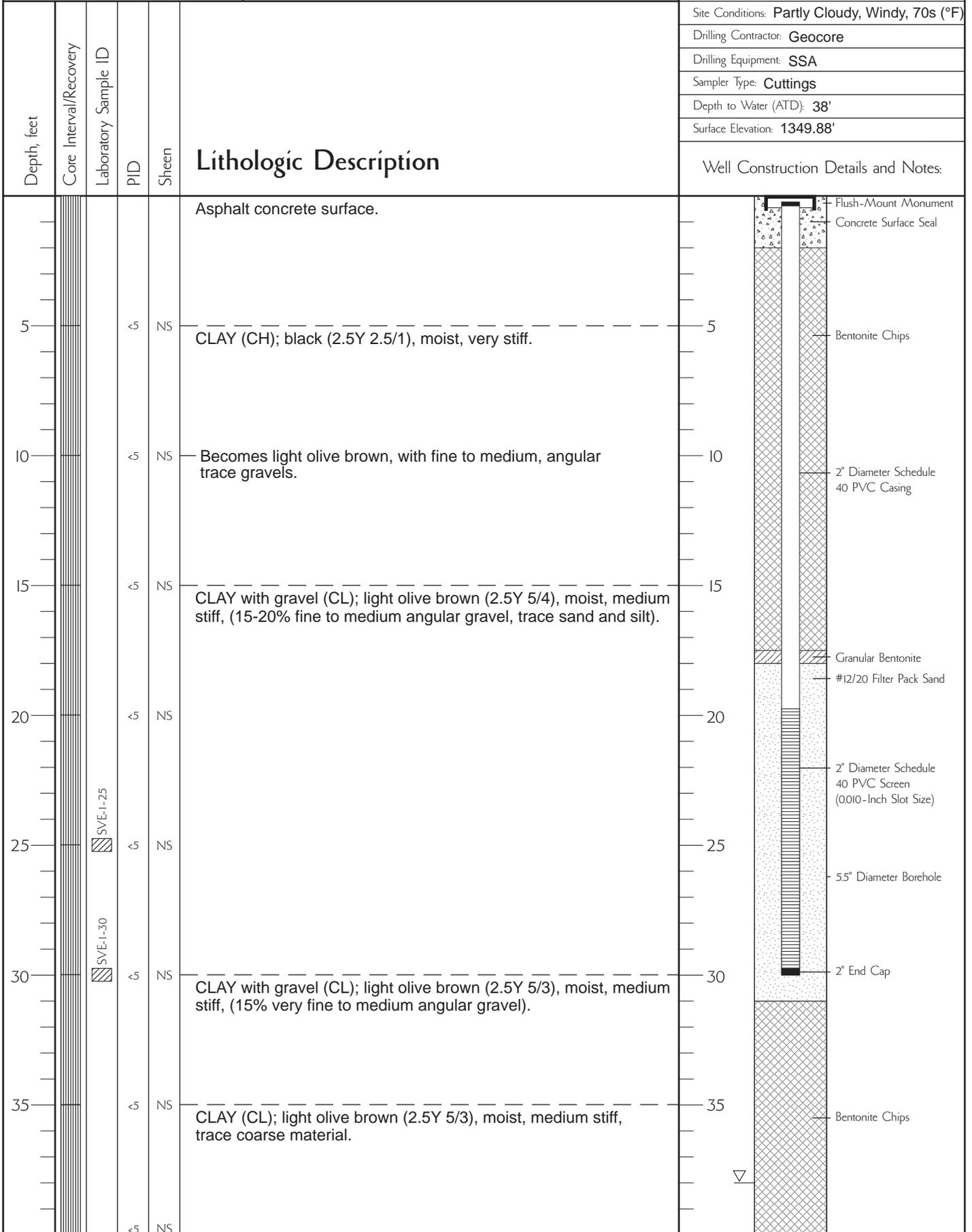
Drilling Equipment: **SSA**

Sampler Type: **Cuttings**

Depth to Water (ATD): **38'**

Surface Elevation: **1349.88'**

Well Construction Details and Notes:



Bottom of Boring at 40.0' BGS.



Apex Companies, LLC  
3015 SW First Avenue  
Portland, Oregon 97201

Colt Court/Quail Crossing Neighborhood  
NuStar Pipeline Operating Partnership L.P.  
Andover, Kansas

Boring Number: **SVE-2**

Project Number: **1641-04**

Logged By: **M. Whitson**

Date: **September 24, 2013**

Site Conditions: **Clear, Calm, 70s (°F)**

Drilling Contractor: **Geocore**

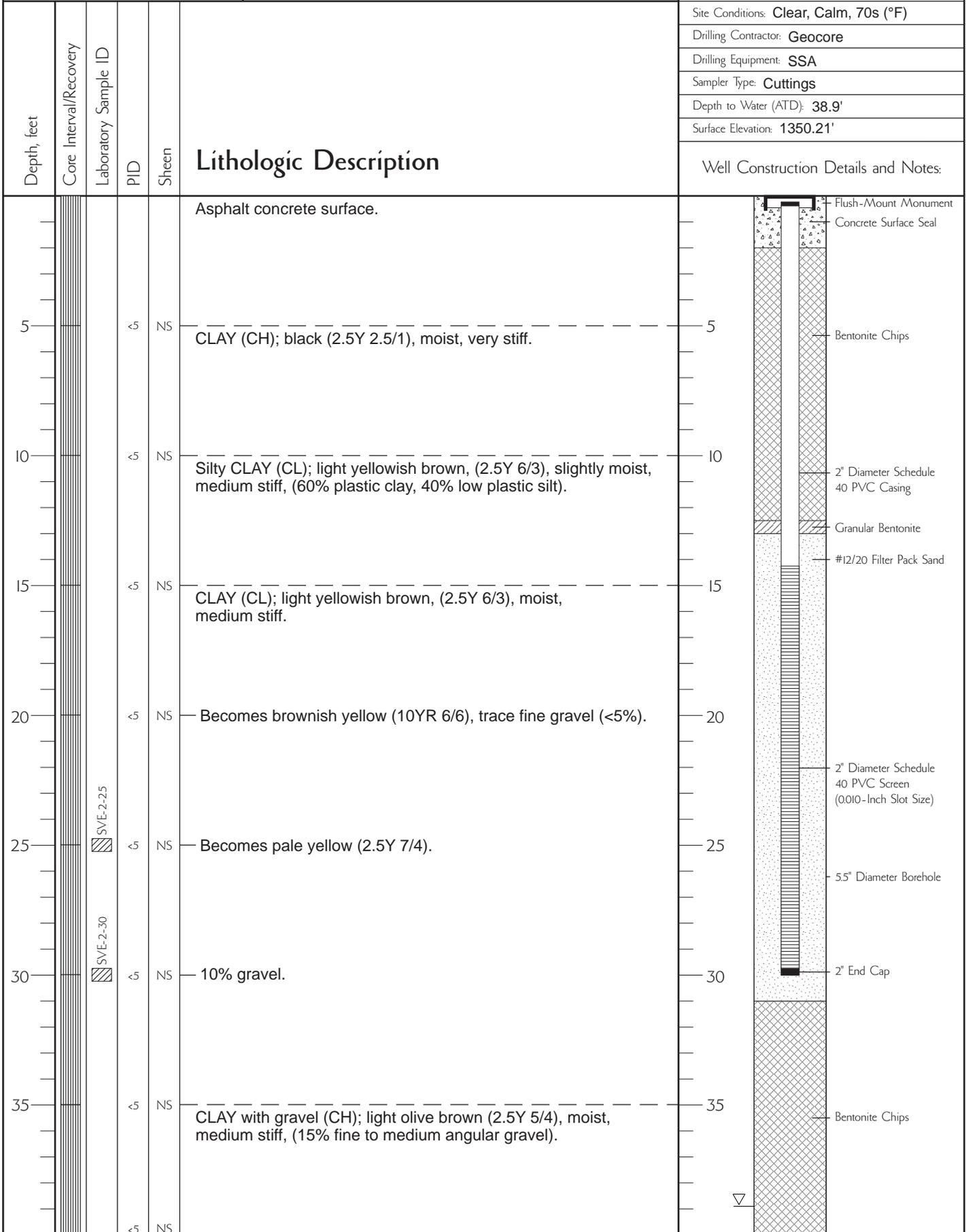
Drilling Equipment: **SSA**

Sampler Type: **Cuttings**

Depth to Water (ATD): **38.9'**

Surface Elevation: **1350.21'**

Well Construction Details and Notes:



Bottom of Boring at 40.0' BGS.



Apex Companies, LLC  
3015 SW First Avenue  
Portland, Oregon 97201

Colt Court/Quail Crossing Neighborhood  
NuStar Pipeline Operating Partnership L.P.  
Andover, Kansas

Boring Number: **SVE-3**

Project Number: **1641-04**

Logged By: **M. Whitson**

Date: **September 24, 2013**

Site Conditions: **Clear, 70s/80s (°F)**

Drilling Contractor: **Geocore**

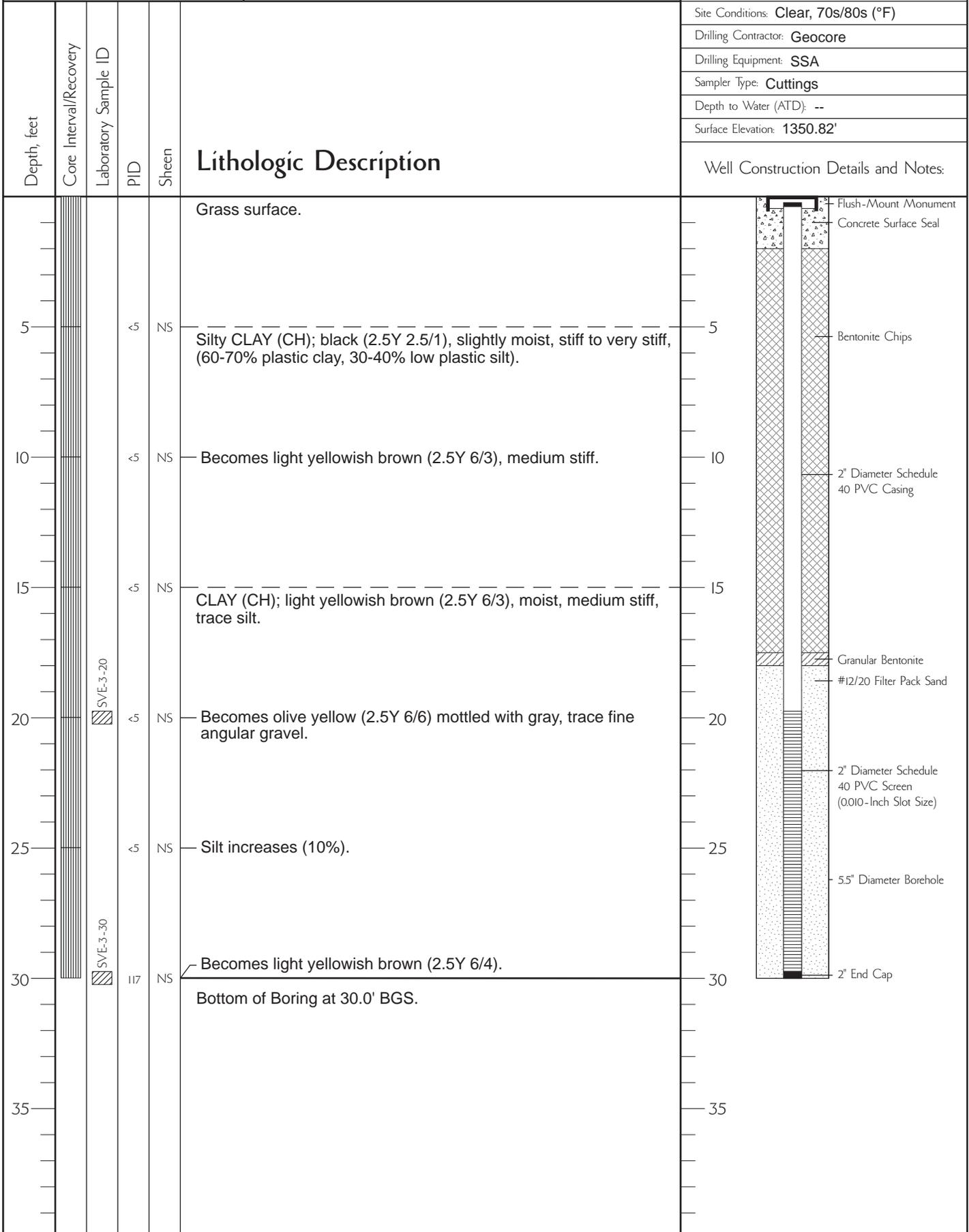
Drilling Equipment: **SSA**

Sampler Type: **Cuttings**

Depth to Water (ATD): **--**

Surface Elevation: **1350.82'**

Well Construction Details and Notes:





Apex Companies, LLC  
3015 SW First Avenue  
Portland, Oregon 97201

Colt Court/Quail Crossing Neighborhood  
NuStar Pipeline Operating Partnership L.P.  
Andover, Kansas

Boring Number: **SVE-4**

Project Number: **1641-04**

Logged By: **M. Whitson**

Date: **September 24, 2013**

Site Conditions: **Clear, 70s/80s (°F)**

Drilling Contractor: **Geocore**

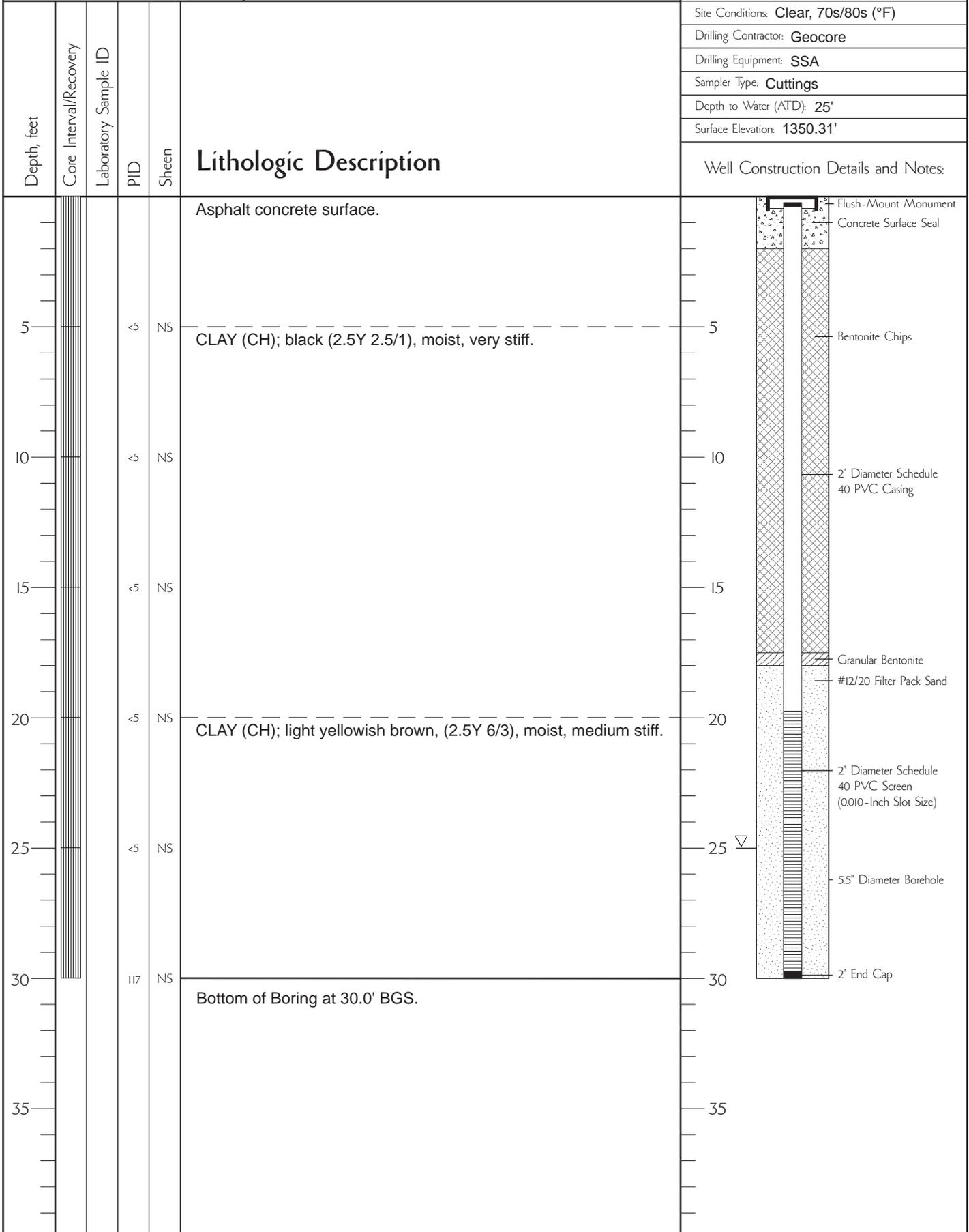
Drilling Equipment: **SSA**

Sampler Type: **Cuttings**

Depth to Water (ATD): **25'**

Surface Elevation: **1350.31'**

Well Construction Details and Notes:



***Appendix B***

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**Sampling and Analyzing Plan**

# ***Appendix B – Sampling and Analysis Plan: SVE Pilot Test***

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## **1.0 Introduction**

This sampling and analysis plan (SAP) presents the field and sampling procedures and the analytical testing program that will be used to perform a soil vapor extraction (SVE) pilot test in the Quail Crossing Neighborhood near Andover, Kansas (the Site). Quality assurance and quality control (QA/QC) procedures are also discussed in this appendix.

## **2.0 Field and Sampling Procedures**

The scope of work includes implementation of an SVE pilot test. Data from these activities will be used to evaluate the feasibility of SVE technology for remediating petroleum hydrocarbons in the subsurface at the Site. The field and sampling procedures include:

- Using mobile equipment to induce vacuum in the subsurface and monitor conditions in the vicinity;
- Collection of two SVE effluent samples;
- Field screening of SVE effluent; and
- Handling of investigation-derived waste (IDW), consisting of knock-out water.

### **2.1 Preparatory Activities**

**Property Access.** The pilot test will be performed within the NuStar Pipeline right of way (ROW) and City of Andover ROW. NuStar has obtained a Right of Way Use Agreement with the City of Andover.

**Property Owner Notification.** The owners of properties in the Quail Crossing Neighborhood will be notified of field activities a minimum of one week in advance of field work.

**Health and Safety Plan.** A Health and Safety Plan (HASP) has been prepared and is included as an attachment to the Quality Assurance Project Plan (QAPP). A copy of the HASP will be maintained on site during field activities.

### **2.2 Sample Methodology and Management**

Samples of SVE vapor effluent locations will be collected to evaluate concentrations of volatile organic compounds (VOCs) in the effluent. The pilot test equipment discharge stack will be partially closed to force the effluent into a Summa canister through the sample port.

## ***Appendix B – Sampling and Analysis Plan: SVE Pilot Test***

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**Air Containers.** Clean sample containers (6-liter Summa canisters) will be provided by the analytical laboratory, ready for sample collection. Each sample container will be laboratory-evacuated until the canister vacuum is equivalent to approximately 30 inches mercury. In the field, each container will be filled so that residual vacuum is equivalent to approximately one to five inches of mercury.

**Labeling Requirements.** A sample label will be affixed to each sample container before sample collection. All containers will be marked with the project number, a sample number, date and time of collection, pre-sampling vacuum, post-sampling vacuum, and the sampler's initials.

**Sample Storage and Shipment.** Air samples will be stored at ambient temperatures. The samples will be sent via overnight courier to the analytical laboratory for chemical analysis. Chain of custody will be maintained and documented.

**Field Screening.** The effluent air stream will be field screened regularly during collection of the air samples and throughout the SVE Pilot Test. Field screening data, along with sample data, will be used to estimate effluent VOC concentrations during the SVE Pilot Test.

### **2.3 Pilot Test Location**

The pilot test will be performed at SVE pilot test wells SVE-1 through SVE-4 and at selected groundwater monitoring wells (for vacuum monitoring only).

### **2.4 Handling of Investigation-Derived Waste**

IDW may include water entrained in the SVE effluent (i.e., knock-out water). If water is generated, it will be placed in Department of Transportation (DOT)-approved containers. Each container will be labeled with the project name, general contents, and date. The drummed IDW will be stored at the Site pending proper disposal. Arrangements with a waste disposal subcontractor will be made to dispose of the IDW after proper characterization has been completed.

Disposable items, such as sample tubing, gloves, paper towels, etc., will be placed in plastic bags after use and deposited in trash receptacles for disposal.

## **3.0 Analytical Testing Program**

An analytical testing program will be performed to assess the concentrations of chemicals in vapor samples collected during this project. Analytical laboratory QA/QC procedures are discussed in Section 4 of this appendix.

## ***Appendix B – Sampling and Analysis Plan: SVE Pilot Test***

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**Air Samples.** Air samples will be analyzed for VOCs by EPA Method TO-15. Specific container and storage requirements for samples will be discussed with the analytical laboratory prior to sample collection and will be in accordance with the container requirements presented in Table B-1. Table B-2 lists the proposed analytical methods, detection limit goals, and the anticipated number of air samples. Samples will be collected and handled using methods described in Section 2 of this appendix.

Each air sample will be transported to the analytical laboratory at ambient temperature. Chain of custody will be maintained and documented.

### **4.0 Quality Assurance Program**

#### **4.1 Quality Assurance Objectives for Data Management**

The general QA objectives for this project are to develop and implement procedures for evaluating air analytical data. To collect such information, analytical data must have an appropriate degree of accuracy and reproducibility, samples must be representative of actual field conditions, and samples must be collected and analyzed using unbroken chain-of-custody procedures (see Section 4.3).

The detection limits listed in Table B-2 are the expected detection limits, based upon laboratory calculations and experience.

The specific QA objective is to establish sampling and monitoring techniques that will produce analytical data representative of soil vapor effluent.

Precision, accuracy, representativeness, completeness, and comparability parameters used to indicate data quality are defined below.

##### **4.1.1 Precision**

Precision is a measure of the reproducibility of data under a given set of conditions. Specifically, it is a quantitative measure of the variability of a group of measurements compared to their average value. For duplicate measurements, precision can be expressed as the relative percent difference (RPD). Consistent with KDHE guidance for SVE pilot testing (KDHE, 2011), field duplicate samples will not be collected during this SVE pilot test.

## **Appendix B – Sampling and Analysis Plan: SVE Pilot Test**

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### **4.1.2 Accuracy**

Accuracy is the measure of error between the reported test results and the true sample concentration. True sample concentration is never known due to analytical limitations and error. Consequently, accuracy is inferred from the recovery data from spiked samples.

Because of difficulties with spiking samples in the field, the laboratory will spike samples. The laboratory shall perform sufficient spike samples of a similar matrix to allow the computation of the accuracy. For analyses of less than five samples, matrix spikes (MS) may be performed on a batch basis.

Perfect accuracy is 100 percent recovery.

### **4.1.3 Representativeness**

Representativeness is a measure of how closely the results reflect the actual concentration of the chemical parameters in the medium sampled. Sampling procedures as well as sample-handling protocols for storage, preservation, and transportation are designed to preserve the representativeness of the samples collected. Proper documentation will confirm that protocols are followed. This helps to assure sample identification and integrity.

Laboratory method blanks will be run in accordance with established laboratory protocols to ensure samples are not contaminated during sample preparation in the laboratory.

### **4.1.4 Completeness**

Completeness is defined as the percentage of measurements made which are judged to be valid. The completeness goal is essentially that a sufficient amount of valid data be generated to meet the closure requirements.

### **4.1.5 Comparability**

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another. The objective of this QA program is to assure that data developed during the investigation are comparable. Comparability of the data will be assured by using EPA-defined procedures which specify sample collection, handling, and analytical methods.

### **4.1.6 Documentation**

The level of documentation is generally considered legally defensible and consists of the following:

## **Appendix B – Sampling and Analysis Plan: SVE Pilot Test**

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- Holding times;
- Laboratory method blank data;
- Sample data; and
- Matrix/surrogate spike data.

### **4.2 Sampling Procedures**

Sampling procedures for the SVE pilot test effluent are presented above in Section 2 of this appendix. These procedures are designed to ensure:

- Samples are collected consistent with project objectives; and
- Samples are identified, handled, and transported in a manner that does not alter the representativeness of the data from the actual Site conditions.

QA objectives for sample collection will be accomplished by evaluating the following item:

- Laboratory QA. Samples will be analyzed by ALS Laboratories, a KDHE-certified laboratory. The ALS Quality Assurance Manual is included as an attachment to the QAPP (Appendix B).

### **4.3 Sample and Document Custody Procedures**

The various methods used to document field sample collection and laboratory operations are presented below.

#### **4.3.1 Field Chain-of-Custody Procedures**

Sample chain of custody refers to the process of tracking the possession of a sample from the time it is collected in the field through the laboratory analysis. A sample is considered to be under a person's custody if it is:

- In a person's physical possession;
- In view of the person after possession has been taken; or
- Secured by that person so no one can tamper with the sample, or secured by that person in an area restricted to authorized personnel.

A chain-of-custody form is used to record possession of a sample and to document analyses requested. Each time the sample bottles or samples are transferred between individuals, both the sender and receiver sign and date the chain-of-custody form. When a sample shipment is transported to the laboratory, a copy of the chain-of-custody form is included in the transport container.

## **Appendix B – Sampling and Analysis Plan: SVE Pilot Test**

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The chain-of-custody forms are used to record the following information:

- Sample identification number;
- Sample collector's signature;
- Date and time of collection;
- Description of sample;
- Analyses requested;
- Shipper's name and address;
- Receiver's name and address; and
- Signatures of persons involved in chain of custody.

### **4.3.2 Laboratory Operations**

The analytical laboratory has a system in place for documenting the following laboratory information:

- Calibration procedures;
- Analytical procedures;
- Computational procedures;
- QC procedures;
- Bench data;
- Operating procedures or any changes to these procedures; and
- Laboratory notebook policy.

Laboratory chain-of-custody procedures provide the following:

- Identification of the responsible party (sample custodian) authorized to sign for incoming field samples and a log consisting of sequential lab tracking numbers; and
- Specification of laboratory sample custody procedures for sample handling, storage, and internal distribution for analysis.

### **4.3.3 Corrections to Documentation**

Original data are recorded in field notes and on chain-of-custody forms using indelible ink. Documents will be retained even if they are illegible or contain inaccuracies that require correction.

## **Appendix B – Sampling and Analysis Plan: SVE Pilot Test**

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If an error is made on a document, the individual making the entry will correct the document by crossing a line through the error, entering the correct information, and initialing and dating the correction. Any subsequent error discovered on a document is corrected, initialed, and dated by the person who made the entry.

### **4.4 Equipment Calibration Procedures and Frequency**

Instruments and equipment used during this project will be operated, calibrated, and maintained according to the manufacturer's guidelines and recommendations. Operation, calibration, and maintenance will be performed by laboratory personnel fully trained in these procedures.

### **4.5 Analytical Procedures**

Samples will be analyzed using VOCs by EPA Method TO-15. Table B-2 lists analytical parameters and test methods.

### **4.6 Data Reduction, Validation, and Reporting**

The Project Manager will assure validation of the analytical data. The laboratory generating analytical data for this project will be required to submit results that are supported by sufficient backup and QA/QC data to enable the reviewer to determine the quality of the data. Validity of the laboratory data will be determined based on the objectives outlined in Section 4.1 (above). Data validity will also be determined based upon the sampling procedures and documentation outlined in Sections 4.2 and 4.3 of this SAP. Upon completion of the review, the Project Manager will be responsible for preparing a QA/QC report for the analytical data. Data will be stored and maintained according to the standard procedures of the laboratory. The method of data reduction will be described in the final report.

### **4.7 Performance Audits**

Performance audits are an integral part of an analytical laboratory's SOPs and are available upon request.

### **4.8 Corrective Actions**

If the QC audit detects unacceptable conditions or data, the Project Manager will be responsible for developing and initiating corrective action. The Project Manager will be notified if the nonconformance is significant or requires special expertise. Corrective action may include the following:

- Reanalyzing the samples, if holding time criteria permit;
- Resampling and analyzing;

## ***Appendix B – Sampling and Analysis Plan: SVE Pilot Test***

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- Evaluating and amending sampling and analytical procedures; and
- Accepting data and acknowledging level of uncertainty or inaccuracy by flagging the data.

### **4.9 Quality Assurance Reports**

The Project Manager will prepare a QA/QC evaluation of the data collected during the investigation field activities for inclusion in the final report. In addition to an opinion regarding the validity of the data, the QA/QC evaluation will address the following:

- Adverse conditions or deviations from this SAP;
- Assessment of analytical data for precision, accuracy, and completeness;
- Significant QA problems and recommended solutions; and
- Corrective actions taken for any problems previously identified.

Table B-1 — Analytical Methods - Sample Container Requirements  
 NuStar Andover Pipeline Release Site  
 Andover, Kansas

Analysis	Method	Container	Sample duration	Flow rate (ml/min)	Number of Containers	Preservative	Storage Temperature	Holding Time
<i>Vapor Samples</i>								
VOCs	TO-15	1L Summa	30 seconds	2000	2	none	ambient	30 days

*Notes:*

1. VOCs = Volatile organic compounds.
2. ml/min = Milliliters per minute.

Table B-2 — Analytical Methods, Anticipated Sample Number,  
and Detection Limit Goals  
NuStar Andover Pipeline Release Site  
Andover, Kansas

Analyte	Method	Anticipated Number of Samples	Units	Detection Limit Goal <sup>5.</sup>
<b>Volatile Organic Compounds (VOCs)</b>				
Benzene	TO-15	2	µg/m <sup>3</sup>	3.12
Ethylbenzene	TO-15	2	µg/m <sup>3</sup>	9.73
Toluene	TO-15	2	µg/m <sup>3</sup>	5210
Xylenes, Total	TO-15	2	µg/m <sup>3</sup>	104
Naphthalene	TO-15	2	µg/m <sup>3</sup>	0.716
n-butylbenzene	TO-15	2	µg/m <sup>3</sup>	36.5
1,2-Dichloroethane	TO-15	2	µg/m <sup>3</sup>	0.936
1,3,5-trimethylbenzene	TO-15	2	µg/m <sup>3</sup>	37
1,2,4-trimethylbenzene	TO-15	2	µg/m <sup>3</sup>	7
n-Propylbenzene	TO-15	2	µg/m <sup>3</sup>	1040

**Notes:**

1. µg/m<sup>3</sup> = Micograms per cubic meter.

***Appendix C***

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**Quality Assurance Project Plan**

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**Attachments**

- A Site Health and Safety Plan
- B Field Forms
- C ALS Laboratory Group QA Manual

## **Appendix C – Quality Assurance Project Plan**

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### **1.0 Project Description**

This Quality Assurance Project Plan (QAPP) summarizes the organization, objectives, quality assurance (QA) and quality control (QC) activities associated with the proposed soil vapor extraction (SVE) pilot test at the Quail Crossing Neighborhood (the Neighborhood) in Andover, Kansas (the Site; Figure 1). The proposed SVE pilot test is being performed on behalf of the NuStar Pipeline Operating Partnership L.P. (NuStar). This QAPP is being submitted as an Appendix to the *Soil Vapor Extraction Pilot Test Work Plan* for the Site.

This QAPP describes specific protocols for the soil vapor sampling, sample handling and storage, chain of custody, and laboratory (and field) analyses. QA/QC procedures will be conducted in accordance with regulatory guidelines, technical standards, and Site-specific project objectives.

### **2.0 Program Organization and Responsibility**

Project personnel are identified below.

#### **2.1 General Project Management**

**Technical Management.** Apex Companies, LLC (Apex) is the primary environmental/technical consultant for the investigation/remediation activities at the Site and will have the overall responsibility for implementing the SVE pilot test.

Principal: Chris Breemer

Project Manager: Sam Jackson

Health and Safety Officer: Adam Reese

Apex's Principal has the overall responsibility for ensuring that the project meets the requirements outlined by NuStar and the Kansas Department of Health and Environment (KDHE). The Project Manager will supervise day-to-day activities, including budgets, schedules, staffing, and quality objectives; and is responsible for the preparation, quality, and completeness of all deliverables.

**Regulatory Management.** The regulatory contact for the Site is:

Pamela Green, Environmental Scientist  
KDHE, Bureau of Environmental Remediation  
Site Restoration Unit

## **Appendix C – Quality Assurance Project Plan**

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### **2.2 Field Responsibilities**

**Field Manager.** Apex will have the overall responsibility for the SVE pilot test. Apex will supervise all field activities. The majority of field activities will be conducted by a subcontractor (GeoCore, Inc.), who will serve as Field Manager, and report directly to the Apex Project Manager. The Project Manager will be responsible for monitoring and sampling activities; collecting environmental documentation; and ensuring chain-of-custody protocols with the analytical laboratory are followed.

**Health and Safety Officer.** The Health and Safety Officer (HSO) will be responsible for ensuring:

- Project personnel maintain appropriate levels of training, as specified by Occupational Safety and Health Act (OSHA) protocols;
- Health and Safety Plans (HASPs) are prepared and maintained in accordance with OSHA protocols;
- Field operations are conducted using health and safety protocols that are appropriate and protective; and
- Subcontractors have HASPs relative to their respective responsibilities.

The HASP for the Site is included as Attachment A of this QAPP.

**Quality Assurance Officer.** The Quality Assurance Officer (QAO) responsibilities will include monitoring project QA procedures to ensure compliance with this QAPP.

Apex Quality Assurance Officer: Sam Jackson (or designated alternate)

**Laboratory Project Manager.** The analytical laboratory will be provided a copy of this QAPP and a statement binding the laboratory to adhere to this QAPP. Any exceptions identified by the laboratory will be reviewed by the Project Manager and/or QAO to assess whether the exception will result in a significant deficiency. If possible, corrective action will be taken.

ALS Laboratory Group (ALS) Project Manager: Samantha Henningsen (or designated alternate)

### **3.0 Data Quality Objectives**

To achieve project objectives, data quality objectives (DQOs) have been established to ensure that the data collected are sufficient and of adequate quality for their intended uses. DQOs include both quantitative and qualitative statements that are derived from the outputs of the seven-step DQO process.

## ***Appendix C – Quality Assurance Project Plan***

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The seven-step DQO process includes:

- 1) State the problem
- 2) Identify the decision
- 3) Identify inputs to the decision
- 4) Define the boundaries of the study
- 5) Develop a decision rule
- 6) Specify limits on decision errors
- 7) Optimize the design for obtaining data

The details of the DQO process for this project are provided below.

SPH and dissolved-phase hydrocarbons have been identified in Neighborhood irrigation wells and in monitoring wells. Concentrations of contaminants in the SVE effluent will be measured to evaluate the feasibility of SVE technology for addressing contamination at the Site.

The decision is to determine if SVE is a feasible remedial technology for the Site and to determine appropriate SVE system design parameters. The study boundaries include the areas within the radius of influence of the extraction wells.

The applicable COCs identified in the Work Plan include gasoline-range organics (GRO); benzene, toluene, ethylbenzene, and xylenes (BTEX); n-butylbenzene, 1,3,5-trimethylbenzene, and 1,2,4-trimethylbenzene and naphthalene.

SVE effluent concentrations will be used to estimate contaminant mass removal rates and need for SVE effluent treatment. Additional data regarding effluent and subsurface conditions may be necessary following completion of the proposed pilot test.

The sampling program is designed to obtain data needed to evaluate SVE technology feasibility and to design an effective remediation system in a resource-effective manner. The scope of work (SOW) for the SVE Pilot Test is provided in the SVE Pilot Test Work Plan, which is being submitted concurrently with this QAPP. A sampling and analysis plan is also included as an appendix to the SVE Pilot Test Work Plan.

### **4.0 Measurement and Data Acquisition**

#### **4.1 Laboratory Analytical Methods**

Appropriate analytical methods were selected based on requirements described in *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air (EPA, 1999)*.

In accordance with the above-referenced document, effluent vapor samples will be analyzed for select VOCs using EPA Method TO-15.

#### **4.2 Calibration Procedures**

The following subsection describes calibration procedures for both field instrumentation and laboratory analytical equipment

##### ***4.2.1 Calibration of Field Instruments/Equipment***

A calibration program will be implemented to ensure that routine calibration is performed on all field instruments. The calibration of all equipment will be performed in accordance with manufacturer recommendations and the frequency of calibration will vary depending on analyses required. The program will be conducted by the Field Manager. All field personnel will be familiar with all field instruments. In general, all field equipment will be operated according to manufacturers instructions. If field equipment should fail, the Project Manager will be contacted immediately and will either have the malfunction repaired immediately or will provide replacement equipment.

##### ***4.2.2 Calibration of Laboratory Instruments***

ALS will be responsible for the calibration of the GC/MS used for analyses of air samples. The calibration procedures to be followed by the laboratory are provided in their QA Manual. The manual meets all EPA requirements for analyses being performed by the laboratory.

### **5.0 Internal Quality Control**

#### **5.1 Field QA/QC Samples**

Consistent with KDHE Guidance, QC blanks or duplicate samples are not required for SVE pilot tests.

#### **5.2 Laboratory QC Analyses**

The laboratory will perform the internal QC checks that are specified by EPA Method TO-15. The QC checks include the following: matrix spikes (MS), surrogate spikes, referenced samples, laboratory control

## ***Appendix C – Quality Assurance Project Plan***

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samples (LCS), and/or method blanks. Additionally, as specified in the analytical method, laboratory duplicates may be collected on one or more of these lab QC samples in order to verify the precision of the analysis. The frequency of QC samples, the compounds to be used for spikes, and the QC acceptance criteria are described in the EPA method and in the laboratory QA manual provided in Attachment C of this QAPP. The laboratory will document that both initial and ongoing instrument calibration and analytical QC criteria have been met.

### ***6.0 Data Reduction, Validation, and Reporting***

This section describes the reduction, validation, and reporting of field and/or laboratory analytical data.

#### **6.1 Data Reduction**

The laboratory will perform the data reduction in accordance with procedures outlined in the ALS QA manual, provided in Attachment C of this QAPP. The data reduction will serve to ensure that the actual quantities reported are accurate and qualified as appropriate.

#### **6.2 Data Validation**

The laboratory will validate the data in terms of identifying and flagging QC outliers in accordance with the specific analytical method used. The laboratory will also evaluate its internal QC programs, such as spike recoveries, surrogate recoveries, establishing quantitation limits, evaluating precision and accuracy controls, and maintaining records of instrument calibration. The Apex Project Manager will be responsible for reviewing all sample collection procedures and laboratory reports to ensure that the field and laboratory QA/QC requirements established in this QAPP are met.

Field data validation process should evaluate that properly calibrated instruments have been used; that appropriate standard operating procedures (SOPs; in most cases, adhering to equipment manufacturer's operating instructions) have been followed; and that accurate records of field activities have been maintained.

#### **6.3 Data Reporting**

The laboratory is responsible for reporting all analytical data to Apex. Apex is responsible for reporting all data to KDHE once the data validation has been reviewed and approved. The QA/QC review will document the quality of the data being reported and serves to evaluate the results against the DQOs defined in this QAPP.

The analytical reports will address, at a minimum, the following items:

## ***Appendix C – Quality Assurance Project Plan***

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- Chain-of-custody documentation
- Sample data (to include matrix, field ID number, laboratory ID number, date of sampling, date of extraction, and date of analysis)
- Holding times
- Instrument calibration
- Method detection limits (MDLs)
- Blank analysis:
  - Method
- Quality control:
  - Accuracy:
    - Spike recovery (matrix, surrogate)
  - Precision:
    - Lab duplicates
- Data use and limitations.

***Attachment A***

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**Site Health and Safety Plan**

# **Attachment A – Site-Specific Health and Safety Plan**

## **1.0 Introduction**

This Health and Safety Plan includes both site-specific information (including site-specific activities, health hazards, route to hospital, and toxicity information) and information from the Apex's general Health and Safety Plan.

### **1.1 Emergency Contact Summary**

<b>SITE LOCATION</b>	Quail Crossing Neighborhood, Andover, Kansas
<b>NEAREST HOSPITAL</b>	Kansas Medical Center 1124 West 21st Street Andover, KS 67002 (See Figure HSP-1) Telephone..... (316) 300-4000
<b>EMERGENCY RESPONDERS</b>	Police Department ..... 911 Fire Department ..... 911 Ambulance ..... 911
<b>EMERGENCY CONTACTS</b>	Apex Companies, LLC ..... (503)924-4704 National Response Center ..... (800)424-8802 Poison Control Center ..... (800)222-1222 Chemtrec ..... (800)424-9300

In the event of an emergency, call for help as soon as possible. Give the following information:

- WHERE the emergency is - use cross streets or landmarks
- PHONE NUMBER you are calling from
- WHAT HAPPENED - type of injury
- HOW MANY persons need help
- WHAT is being done for the victim(s)
- YOU HANG UP LAST - let the person you called hang up first

## **2.0 Corporate Health and Safety Plan**

The Apex General Health and Safety Plan, together with the included site-specific information, cover each of the 11 required plan elements as specified in Occupational Safety and Health Administration (OSHA)

## **Attachment A – Site-Specific Health and Safety Plan**

1910.120, and meet all applicable regulatory requirements. The reader is advised to thoroughly review the entire plan.

### **3.0 Site Specific Health and Safety Plan**

#### **3.1 Site Location and Description**

LOCATION: Quail Crossing Neighborhood in Andover, Kansas.

LAND USE OF AREA SURROUNDING FACILITY: Residential

#### **3.2 Site Activity Summary**

SITE ACTIVITIES: Soil vapor extraction pilot test.

PROPOSED DATE OF ACTIVITY: December 2013.

POTENTIAL SITE CONTAMINANTS: Benzene, toluene, ethylbenzene, xylenes (BTEX), 2-butanone, gasoline-range organics (GRO), and other volatile organic compounds (VOCs).

POTENTIAL ROUTES OF ENTRY: Skin contact with soil and groundwater, incidental ingestion of soil and groundwater, and inhalation of dust and volatiles.

PROTECTIVE MEASURES: Engineering controls, safety glasses, safety boots, hard hat, gloves, protective clothing (including fire-resistant clothing), and respirators, as necessary.

MONITORING EQUIPMENT: Photoionization detector (PID) with 10.2 eV lamp and olfactory indications.

#### **3.3 Chain of Command**

The chain of command for Health and Safety in this project involves the following individuals:

CORPORATE H&S MANAGER: Adam Reese

PROJECT MANAGER: Sam Jackson

PROJECT H&S OFFICER: Sam Jackson

FIELD H&S MANAGER: Paul Ward

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## **3.4 Hazard Analysis and Applicable Safety Procedures**

The following work tasks will be performed:

- Soil vapor extraction pilot test

The hazards associated with the activities listed above are discussed in detail below.

### **3.4.1 Soil Vapor Extraction Pilot Test**

Pilot test activities will be conducted with appropriate protection, as discussed under personal protective equipment requirements. Employees are cautioned to stand clear of all equipment. The Field Manager will confirm that hose connections are solid, blower electrical system is functioning properly, and that equipment is in good working order. Noise protection must also be available and used in high noise environments. In addition, exclusion zones will be established for worker and public protection.

Soil vapor extraction effluent will be vented through a discharge stack. Employees will remain outside the discharge area. If necessary, respiratory protection will be used. Air quality data will be monitored outside of the exclusion zone to confirm protectiveness of public health.

Never continue to work in an area, even if PID readings, LEL, and/or hydrogen sulfide tests are acceptable, if you begin to notice strange odors or symptoms of overexposure (such as dizziness, nausea, tearing of the eyes, etc.). Do not resume work until testing shows the hazard has been removed.

**Slips, Trips, and Falls.** The work area will include uneven surfaces, surfaces with limited traction, and debris may be present. Caution will be used to avoid slips, trips and falls.

### **3.4.2 Air Monitoring and Action Levels**

Air monitoring will be conducted to determine possible hazardous conditions and to confirm the adequacy of personal protection equipment. The results of the air monitoring will be used as the basis for specifying personal protective equipment and determining the need for upgrading protective measures.

Air monitoring equipment will be calibrated prior to use (where applicable) as specified by the instrument manuals and results will be documented in the instrument log. All equipment will be maintained as specified by the manufacturer or more frequently as required by use conditions. Repair records will be maintained with the instrument log.

**PID Monitoring.** Air monitoring will be conducted with a PID with 10.2 eV lamp, or equivalent, to measure organic vapor concentrations during site work activities. Background PID measurements will be taken prior

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to the start of activities to quantify levels associated with the ambient air space in the vicinity of the site. After the completion each portion of the pilot test, a separate PID measurement will be collected from the breathing space to quantify VOCs. If any of these workspace PID measurements are elevated relative to the previously measured background levels, then detector tube readings will be collected from the breathing space (described below). If the detector tube readings exceed the National Institute for Occupational Safety and Health (NIOSH) recommended exposure limit (REL) concentrations then site workers exposed to these levels will use air purifying respirators as appropriate. If detector tubes readings are below the REL concentrations, then a PID measurement will be collected from the breathing space. If PID measurements are elevated in the breathing zone above background concentrations, then site workers exposed to these levels will use air purifying respirators as appropriate. If measured concentrations exceed immediately dangerous to life and health (IDLH) concentrations, site work will cease and personnel will vacate the work area pending re-evaluation of the situation by the Health and Safety Manager.

**Detector Tubes.** If VOCs are detected as described above, VOC concentrations in work area breathing space will be further evaluated using detector tubes.

**Olfactory.** If olfactory senses detect any unfamiliar odor, work will stop until an assessment can be made to determine whether the need exists to upgrade protective measures.

### **3.5 Chemicals of Concern**

Based on site information gathered to date, the following chemicals may be present at this site:

- GRO; and
- VOCs.

#### **3.5.1 Toxicity Information**

Pertinent toxicological properties of these chemicals are discussed below. This information generally covers potential toxic effects which may occur from relatively significant acute and/or chronic exposures, and is not meant to indicate that such effects will occur from the planned site activities. In general, the chemicals which may be encountered at this site are not expected to be present at concentrations which could produce significant exposures. The types of planned work activities should also limit potential exposures at this site. Furthermore, appropriate protective and monitoring equipment will be used as discussed below to further minimize any exposures which might occur.

Standards for occupational exposures to these chemicals are included where available. Site exposures are generally expected to be of short duration and well below the level of any of these exposure limits. These standards are presented below:

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- PEL Permissible exposure limit (OSHA).
- REL Recommended exposure limit (NIOSH).
- IDLH Immediately dangerous to life and health (NIOSH)
- TWA Time-weighted average exposure limit for any 8-hour work shift of a 40-hour work week.
- STEL Short term exposure limit expressed as a 15-minute time-weighted average and not to be exceeded at any time during a work day.
- C Ceiling exposure limit not to be exceeded at any time during a work day.

**Total Petroleum Hydrocarbons.** Total petroleum hydrocarbons (TPH) is a term used to describe a broad family of several hundred chemical compounds that originally come from crude oil. In this sense, TPH is really a mixture of chemicals. They are called hydrocarbons because almost all of them are made entirely from hydrogen and carbon. Crude oils can vary in how much of each chemical they contain, and so can the petroleum products that are made from crude oils. Most products that contain TPH will burn. Some are clear or light-colored liquids that evaporate easily, and others are thick, dark liquids or semi-solids that do not evaporate. Many of these products have characteristic gasoline, kerosene, or oily odors. Because modern society uses so many petroleum-based products (for example, gasoline, kerosene, fuel oil, mineral oil, and asphalt), contamination of the environment by them is potentially widespread. Contamination caused by petroleum products will contain a variety of these hydrocarbons. Because there are so many, it is not usually practical to measure each one individually. However, it is useful to measure the total amount of all hydrocarbons found together in a particular sample of soil, water, or air.

TPH can enter and leave your body when you breathe it in air; swallow it in water, food, or soil; or touch it. Most components of TPH will enter your bloodstream rapidly when you breathe them as a vapor or mist or when you swallow them. Some TPH compounds are widely distributed by the blood throughout your body and quickly break down into less harmful chemicals. Others may break down into more harmful chemicals. Other TPH compounds are slowly distributed by the blood to other parts of the body and do not readily break down. When you touch TPH compounds, they are absorbed more slowly and to a lesser extent than when you breathe or swallow them. Most TPH compounds leave your body through urine or when you exhale air containing the compounds.

The compounds in different TPH fractions affect the body in different ways. Some of the TPH compounds, particularly the smaller compounds such as benzene, toluene, and xylene (which are present in gasoline), can affect the human central nervous system. If exposures are high enough, death can occur. Breathing toluene at concentrations greater than 100 parts per million (ppm) for more than several hours can cause fatigue, headache, nausea, and drowsiness. When exposure is stopped, the symptoms will go away. However, if someone is exposed for a long time, permanent damage to the central nervous system can

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occur. One TPH compound (n-hexane) can affect the central nervous system in a different way, causing a nerve disorder called "peripheral neuropathy" characterized by numbness in the feet and legs and, in severe cases, paralysis. This has occurred in workers exposed to 500–2,500 ppm of n-hexane in the air. Swallowing some petroleum products such as gasoline and kerosene causes irritation of the throat and stomach, central nervous system depression, difficulty breathing, and pneumonia from breathing liquid into the lungs. The compounds in some TPH fractions can also affect the blood, immune system, liver, spleen, kidneys, developing fetus, and lungs. Certain TPH compounds can be irritating to the skin and eyes. Other TPH compounds, such as some mineral oils, are not very toxic and are used in foods. One TPH compound (benzene) has been shown to cause cancer (leukemia) in people. The International Agency for Research on Cancer (IARC) has determined that benzene is carcinogenic to humans (Group 1 classification). Some other TPH compounds or petroleum products, such as benzo(a)pyrene and gasoline, are considered to be probably and possibly carcinogenic to humans (IARC Groups 2A and 2B, respectively) based on cancer studies in people and animals. Most of the other TPH compounds and products are considered not classifiable (Group 3) by IARC.

Although there are no federal regulations or guidelines for TPH in general, the government has developed regulations and guidelines for some of the TPH fractions and compounds. These are designed to protect the public from the possible harmful health effects of these chemicals. To protect workers, the OSHA has set a legal limit of 500 ppm in the workplace.

EPA regulates certain TPH fractions, products, or wastes containing TPH, as well as some individual TPH compounds. For example, there are regulations for TPH as oil; these regulations address oil pollution prevention and spill response, stormwater discharge, and underground injection control. EPA lists certain wastes containing TPH as hazardous. EPA also requires that the National Response Center be notified following a discharge or spill into the environment of 10 pounds or more of hazardous wastes containing benzene, a component in some TPH mixtures.

Nearly all states have cleanup standards for TPH or components of TPH (common cleanup standards are for gasoline, diesel fuel, and waste oil). Analytical methods are specified, many of which are considered to be TPH methods.

**Benzene.** Benzene, also known as benzol, is a colorless liquid with a sweet odor. Benzene evaporates into air very quickly and dissolves slightly in water. Benzene is highly flammable. Most people can begin to smell benzene in air at 1.5–4.7 ppm and smell benzene in water at 2 ppm. Most people can begin to taste benzene in water at 0.5–4.5 ppm. Benzene is found in air, water, and soil.

Benzene found in the environment is from both human activities and natural processes. Benzene was first discovered and isolated from coal tar in the 1,800s. Today, benzene is made mostly from petroleum

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sources. Because of its wide use, benzene ranks in the top 20 in production volume for chemicals produced in the United States. Various industries use benzene to make other chemicals, such as styrene (for Styrofoam® and other plastics), cumene (for various resins), and cyclohexane (for nylon and synthetic fibers). Benzene is also used for the manufacturing of some types of rubbers, lubricants, dyes, detergents, drugs, and pesticides. Natural sources of benzene, which include volcanoes and forest fires, also contribute to the presence of benzene in the environment. Benzene is also a natural part of crude oil and gasoline and cigarette smoke.

Most people are exposed to a small amount of benzene on a daily basis. You can be exposed to benzene in the outdoor environment, in the workplace, and in the home. Exposure of the general population to benzene is mainly through breathing air that contains benzene. The major sources of benzene exposure are tobacco smoke, automobile service stations, exhaust from motor vehicles, and industrial emissions. Vapors (or gases) from products that contain benzene, such as glues, paints, furniture wax, and detergents, can also be a source of exposure. Auto exhaust and industrial emissions account for about 20% of the total nationwide exposure to benzene. About 50% of the entire nationwide exposure to benzene results from smoking tobacco or from exposure to tobacco smoke. The average smoker (32 cigarettes per day) takes in about 1.8 milligrams (mg) of benzene per day. This is about 10 times the average daily intake of nonsmokers.

Measured levels of benzene in outdoor air have ranged from 0.02 to 34 parts of benzene per billion parts of air (ppb; 1 ppb is 1,000 times less than 1 ppm). People living in cities or industrial areas are generally exposed to higher levels of benzene in air than those living in rural areas. Benzene levels in the home are usually higher than outdoor levels. People living around hazardous waste sites, petroleum refining operations, petrochemical manufacturing sites, or gas stations may be exposed to higher levels of benzene in air.

Benzene can enter your body through your lungs when you breathe contaminated air. It can also enter through your stomach and intestines when you eat food or drink water that contains benzene. Benzene can enter your body through skin contact with benzene-containing products such as gasoline.

When you are exposed to high levels of benzene in air, about half of the benzene you breathe in leaves your body when you breathe out. The other half passes through the lining of your lungs and enters your bloodstream. Animal studies show that benzene taken in by eating or drinking contaminated foods behaves similarly in the body to benzene that enters through the lungs. A small amount will enter your body by passing through your skin and into your bloodstream during skin contact with benzene or benzene-containing products. Once in the bloodstream, benzene travels throughout your body and can be temporarily stored in the bone marrow and fat. Benzene is converted to products, called metabolites, in the liver and bone marrow. Some of the harmful effects of benzene exposure are believed to be caused by

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these metabolites. Most of the metabolites of benzene leave the body in the urine within 48 hours after exposure.

After exposure to benzene, several factors determine whether harmful health effects will occur, and if they do, what the type and severity of these health effects might be. These factors include the amount of benzene to which you are exposed and the length of time of the exposure. Most data involving effects of long-term exposure to benzene are from studies of workers employed in industries that make or use benzene. These workers were exposed to levels of benzene in air far greater than the levels normally encountered by the general population. Current levels of benzene in workplace air are much lower than in the past. Because of this reduction, and the availability of protective equipment such as respirators, fewer workers have symptoms of benzene poisoning.

Brief exposure (5–10 minutes) to very high levels of benzene in air (10,000–20,000 ppm) can result in death. Lower levels (700–3,000 ppm) can cause drowsiness, dizziness, rapid heart rate, headaches, tremors, confusion, and unconsciousness. In most cases, people will stop feeling these effects when they stop being exposed and begin to breathe fresh air.

Eating foods or drinking liquids containing high levels of benzene can cause vomiting, irritation of the stomach, dizziness, sleepiness, convulsions, rapid heart rate, coma, and death. The health effects that may result from eating foods or drinking liquids containing lower levels of benzene are not known. If you spill benzene on your skin, it may cause redness and sores. Benzene in your eyes may cause general irritation and damage to your cornea.

Benzene causes problems in the blood. People who breathe benzene for long periods may experience harmful effects in the tissues that form blood cells, especially the bone marrow. These effects can disrupt normal blood production and cause a decrease in important blood components. A decrease in red blood cells can lead to anemia. Reduction in other components in the blood can cause excessive bleeding. Blood production may return to normal after exposure to benzene stops. Excessive exposure to benzene can be harmful to the immune system, increasing the chance for infection and perhaps lowering the body's defense against cancer.

Benzene can cause cancer of the blood-forming organs. The Department of Health and Human Services (DHHS) has determined that benzene is a known carcinogen. IARC has determined that benzene is carcinogenic to humans, and the EPA has determined that benzene is a human carcinogen. Long-term exposure to relatively high levels of benzene in the air can cause cancer of the blood-forming organs. This condition is called leukemia. Exposure to benzene has been associated with development of a particular type of leukemia called acute myeloid leukemia (AML).

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Exposure to benzene may be harmful to the reproductive organs. Some women workers who breathed high levels of benzene for many months had irregular menstrual periods. When examined, these women showed a decrease in the size of their ovaries. However, exact exposure levels were unknown, and the studies of these women did not prove that benzene caused these effects. It is not known what effects exposure to benzene might have on the developing fetus in pregnant women or on fertility in men. Studies with pregnant animals show that breathing benzene has harmful effects on the developing fetus. These effects include low birth weight, delayed bone formation, and bone marrow damage.

The health effects that might occur in humans following long-term exposure to food and water contaminated with benzene are not known. In animals, exposure to food or water contaminated with benzene can damage the blood and the immune system and can even cause cancer.

EPA has set the maximum permissible level of benzene in drinking water at 5 ppb. Because benzene can cause leukemia, EPA has set a goal of 0 ppb for benzene in drinking water and in water such as rivers and lakes. EPA estimates that 10 ppb benzene in drinking water that is consumed regularly or exposure to 0.4 ppb benzene in air over a lifetime could cause a risk of one additional cancer case for every 100,000 exposed persons. EPA recommends a maximum permissible level of benzene in water of 200 ppb for short-term exposures (10 days) for children.

EPA requires that the National Response Center be notified following a discharge or spill into the environment of 10 pounds or more of benzene.

OSHA regulates levels of benzene in the workplace. The maximum allowable amount of benzene in workroom air during an 8-hour workday, 40-hour workweek is 1 ppm. Since benzene can cause cancer, the NIOSH) recommends that all workers likely to be exposed to benzene wear special breathing equipment.

**Toluene.** Toluene is a clear, colorless liquid with a distinctive smell. It is added to gasoline along with benzene and toluenylene. Toluene occurs naturally in crude oil and in the tolu tree. It is produced in the process of making gasoline and other fuels from crude oil, in making coke from coal, and as a by-product in the manufacture of styrene. Toluene is used in making paints, paint thinners, fingernail polish, lacquers, adhesives, and rubber and in some printing and leather tanning processes. It is disposed of at hazardous waste sites as used solvent (a substance that can dissolve other substances) or at landfills where it is present in discarded paints, paint thinners, and fingernail polish. You can begin to smell toluene in the air at a concentration of 8 ppm, and taste it in your water at a concentration of 0.04–1 ppm. (One ppm is equivalent to 1 minute in 2 years.)

Toluene can enter your body when you breathe its vapors or eat or drink contaminated food or water. When you work with toluene-containing paints or paint thinners, the toluene can also pass through your skin into

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your bloodstream. You are exposed to toluene when you breathe air containing toluene. When this occurs the toluene is taken directly into your blood from your lungs. Where you live, work, and travel and what you eat affect your daily exposure to toluene. Factors such as your age, sex, body composition, and health status affect what happens to toluene once it is in your body. After being taken into your body, more than 75% of the toluene is removed within 12 hours. It may leave your body unchanged in the air you breathe out or in your urine after some of it has been chemically changed to make it more water soluble. Generally, your body turns toluene into less harmful chemicals such as hippuric acid.

A serious health concern is that toluene may have an effect on your brain. Toluene can cause headaches, confusion, and memory loss. Whether or not toluene does this to you depends on the amount you take in and how long you are exposed. Low-to-moderate, day-after-day exposure in your workplace can cause tiredness, confusion, weakness, drunken-type actions, memory loss, nausea, and loss of appetite. These symptoms usually disappear when exposure is stopped. Researchers do not know if the low levels of toluene you breathe at work will cause any permanent effects on your brain or body after many years. You may experience some hearing loss after long-term daily exposure to toluene in the workplace.

If you are exposed to a large amount of toluene in a short time because you deliberately sniff paint or glue, you will first feel light-headed. If exposure continues, you can become dizzy, sleepy, or unconscious. You might even die. Toluene causes death by interfering with the way you breathe and the way your heart beats. When exposure is stopped, the sleepiness and dizziness will go away and you will feel normal again.

If you choose to repeatedly breathe in toluene from glue or paint thinners, you may permanently damage your brain. You may also experience problems with your speech, vision, or hearing, have loss of muscle control, loss of memory, poor balance, and decreased mental ability. Some of these changes may be permanent.

Toluene may change the way your kidneys work, but in most cases, the kidneys will return to normal after exposure stops. If you drink alcohol and are exposed to toluene, the combination can affect your liver more than either compound alone. This phenomenon is called synergism. Combinations of toluene and some common medicines like aspirin and acetaminophen may increase the effects of toluene on your hearing. In animals, the main effect of toluene is on the nervous system. Animals exposed to moderate or high levels of toluene may also show slightly adverse effects in their liver, kidneys, and lungs.

Several studies have shown that unborn animals were harmed when high levels of toluene were breathed in by their mothers. When the mothers were fed high levels of toluene, the unborn animals did not show any structural birth defects, although some effects on behavior were noted. We do not know if toluene would harm your unborn child if you drink water or breathe air containing low levels of toluene, because studies in people are not comprehensive enough to measure this effect. However, if you deliberately breathe in large

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amounts of toluene during your pregnancy, your baby can have neurological problems and retarded growth and development.

Studies in workers and in animals exposed to toluene indicate that toluene does not cause cancer. IARC and DHHS have not classified toluene for carcinogenic effects. The EPA has determined that toluene is not classifiable as to its human carcinogenicity.

The federal government has developed regulatory standards and guidelines to protect you from the possible health effects of toluene in the environment. OSHA has set a limit of 100 ppm of toluene for air in the workplace, averaged for an 8-hour exposure per day over a 40-hour work week. The American Conference of Governmental Industrial Hygienists (ACGIH) and NIOSH have recommended that toluene in workplace air not exceed 100 ppm (as an average level over 8 hours).

EPA recommends that drinking water should not contain more than 20 ppm for 1 day, 3 ppm for 10 days, or 1 ppm for lifetime consumption. Any release of more than 1,000 pounds of this chemical to the environment must be reported to the National Response Center.

**Ethylbenzene.** Ethylbenzene is a colorless liquid that smells like gasoline. You can smell ethylbenzene in the air at concentrations as low as 2 ppm. It evaporates at room temperature and burns easily. Ethylbenzene occurs naturally in coal tar and petroleum. It is also found in many products, including paints, inks, and insecticides. Gasoline contains about 2 percent (by weight) ethylbenzene. Ethylbenzene is used primarily in the production of styrene. It is also used as a solvent, a component of asphalt and naphtha, and in fuels. In the chemical industry, it is used in the manufacture of acetophenone, cellulose acetate, diethylbenzene, ethyl anthraquinone, ethylbenzene sulfonic acids, propylene oxide, and -methylbenzyl alcohol. Consumer products containing ethylbenzene include pesticides, carpet glues, varnishes and paints, and tobacco products. In 1994, approximately 12 billion pounds of ethylbenzene were produced in the United States. Ethylbenzene is most commonly found as a vapor in the air. This is because ethylbenzene moves easily into the air from water and soil. Once in the air, other chemicals help break down ethylbenzene into chemicals found in smog. This breakdown happens in less than 3 days with the aid of sunlight. In surface water such as rivers and harbors, ethylbenzene breaks down by reacting with other compounds naturally present in the water. In soil, the majority of ethylbenzene is broken down by soil bacteria. Since ethylbenzene binds only moderately to soil, it can also move downward through soil to contaminate groundwater. Near hazardous waste sites, the levels of ethylbenzene in the air, water, and soil could be much higher than in other areas.

When you breathe air containing ethylbenzene vapor, it enters your body rapidly and almost completely through your lungs. Ethylbenzene in food or water can also rapidly and almost completely enter your body through the digestive tract. It may enter through your skin when you come into contact with liquids

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containing ethylbenzene. Ethylbenzene vapors do not enter through your skin to any large degree. People living in urban areas or in areas near hazardous waste sites may be exposed by breathing air or by drinking water contaminated with ethylbenzene. Once in your body, ethylbenzene is broken down into other chemicals. Most of it leaves in the urine within 2 days. Small amounts can also leave through the lungs and in feces. Liquid ethylbenzene that enters through your skin is also broken down. Ethylbenzene in high levels is broken down slower in your body than low levels of ethylbenzene. Similarly, ethylbenzene mixed with other solvents is also broken down more slowly than ethylbenzene alone. This slower breakdown will increase the time it takes for ethylbenzene to leave your body.

At certain levels, exposure to ethylbenzene can harm your health. People exposed to high levels of ethylbenzene in the air for short periods have complained of eye and throat irritation. Persons exposed to higher levels have shown signs of more severe effects such as decreased movement and dizziness. No studies have reported death in humans following exposure to ethylbenzene alone. However, evidence from animal studies suggests that it can cause death at very high concentrations in the air (about 2 million times the usual level in urban air). Whether or not long-term exposure to ethylbenzene affects human health is not known, because little information is available. Short-term exposure of laboratory animals to high concentrations of ethylbenzene in air may cause liver and kidney damage, nervous system changes, and blood changes. The link between these health effects and exposure to ethylbenzene is not clear because of conflicting results and weaknesses in many of the studies. Also, there is no clear evidence that the ability to get pregnant is affected by breathing air or drinking water containing ethylbenzene, or coming into direct contact with ethylbenzene through the skin. Two long-term studies in animals suggest that ethylbenzene may cause tumors. One study had many weaknesses, and no conclusions could be drawn about possible cancer effects in humans. The other, a recently completed study, was more convincing, and provided clear evidence that ethylbenzene causes cancer in one species after exposure in the air to concentrations greater than 740 ppm that were approximately 1 million times the levels found in urban air. At present, the federal government has not identified ethylbenzene as a chemical that may cause cancer in humans. However, this may change after consideration of the new data.

There are no reliable data on the effects in humans after eating or drinking ethylbenzene or following direct exposure to the skin. For this reason, levels of exposure that may affect your health after eating, drinking, or getting ethylbenzene on your skin are estimated from animal studies. There are only two reports of eye or skin exposure to ethylbenzene. In these studies, liquid ethylbenzene caused eye damage and skin irritation in rabbits. More animal studies are available that describe the effects of breathing air or drinking water containing ethylbenzene.

The federal government develops regulations and recommendations to protect public health. Regulations can be enforced by law. Federal agencies that develop regulations for toxic substances include the EPA, OSHA, and the Food and Drug Administration (FDA). Recommendations provide valuable guidelines to

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protect public health but cannot be enforced by law. Federal organizations that develop recommendations for toxic substances include the Agency for Toxic Substances and Disease Registry (ATSDR) and NIOSH.

Regulations and recommendations can be expressed in not-to-exceed levels in air, water, soil, or food that are usually based on levels that affect animals; then they are adjusted to help protect people. Sometimes these not-to-exceed levels differ among federal organizations because of different exposure times (an 8-hour workday or a 24-hour day), the use of different animal studies, or other factors.

Recommendations and regulations are also periodically updated as more information becomes available. For the most current information, check with the federal agency or organization that provides it. Some regulations and recommendations for ethylbenzene include the following:

The federal government has developed regulatory standards and guidelines to protect you from possible health effects of ethylbenzene in the environment. EPA's Office of Drinking Water (ODW) set 700 ppb (this equals 0.7 milligrams ethylbenzene per liter of water or mg/L) as the acceptable exposure concentration of ethylbenzene in drinking water for an average weight adult. This value is for lifetime exposure and is set at a level that is expected not to increase the chance of having (noncancer) adverse health effects. The same EPA office (ODW) set higher acceptable levels of ethylbenzene in water for shorter periods (20 ppm or 20 mg/L for 1 day, 3 ppm or 3 mg/L for 10 days). EPA has determined that exposures at or below these levels are acceptable for small children. If you eat fish and drink water from a body of water, the water should contain no more than 1.4 mg ethylbenzene per liter.

EPA requires that a release of 1,000 pounds or more of ethylbenzene be reported to the federal government's National Response Center in Washington, D.C.

OSHA set a legal limit of 100 ppm ethylbenzene in air. This is for exposure at work for 8 hours per day.

NIOSH also recommends an exposure limit for ethylbenzene of 100 ppm. This is for exposure to ethylbenzene in air at work for up to 10 hours per day in a 40-hour work week. NIOSH also set a limit of 125 ppm for a 15-minute period.

**Xylenes.** There are three forms of xylene in which the methyl groups vary on the benzene ring: meta-xylene, ortho-xylene, and para-xylene (m-, o-, and p-xylene). These different forms are referred to as isomers. The term total xylenes refers to all three isomers of xylene (m-, o-, and p-xylene). Mixed xylene is a mixture of the three isomers and usually also contains 6–15% ethylbenzene. Xylene is also known as xylol or dimethylbenzene. Xylene is primarily a synthetic chemical. Chemical industries produce xylene from petroleum. Xylene also occurs naturally in petroleum and coal tar and is formed during forest fires. It is a colorless, flammable liquid with a sweet odor.

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Xylene is one of the top 30 chemicals produced in the United States in terms of volume. It is used as a solvent (a liquid that can dissolve other substances) in the printing, rubber, and leather industries. Along with other solvents, xylene is also used as a cleaning agent, a thinner for paint, and in varnishes. It is found in small amounts in airplane fuel and gasoline. Xylene is used as a material in the chemical, plastics, and synthetic fiber industries and as an ingredient in the coating of fabrics and papers. Isomers of xylene are used in the manufacture of certain polymers (chemical compounds), such as plastics.

Xylene evaporates and burns easily. Xylene does not mix well with water; however, it does mix with alcohol and many other chemicals. Most people begin to smell xylene in air at 0.08–3.7 ppm and begin to taste it in water at 0.53–1.8 ppm.

Xylene is most likely to enter your body when you breathe xylene vapors. Less often, xylene enters the body through the skin following direct contact. It is rapidly absorbed by your lungs after you breathe air containing it. Exposure to xylene may also take place if you eat or drink xylene-contaminated food or water. The amount of xylene retained ranges from 50% to 75% of the amount of xylene that you inhale. Physical exercise increases the amount of xylene absorbed by the lungs. Absorption of xylene after eating food or drinking water containing it is both rapid and complete. Absorption of xylene through the skin also occurs rapidly following direct contact with xylene. Absorption of xylene vapor through the skin is lower than absorption of xylene vapor by the lungs. However, it is not known how much of the xylene is absorbed through the skin. At hazardous waste sites, breathing xylene vapors, drinking well water contaminated with xylene, and direct contact of the skin with xylene are the most likely ways you can be exposed. Xylene passes into the blood soon after entering the body.

In people and laboratory animals, xylene is broken down into other chemicals especially in the liver. This process changes most of the xylene that is breathed in or swallowed into a different form. Once xylene breaks down, the breakdown products rapidly leave the body, mainly in urine, but some unchanged xylene also leaves in the breath from the lungs. One of the breakdown products of xylene, methylbenzaldehyde, is harmful to the lungs of some animals. This chemical has not been found in people exposed to xylene. Small amounts of breakdown products of xylene have appeared in the urine of people as soon as 2 hours after breathing air containing xylene. Usually, most of the xylene that is taken in leaves the body within 18 hours after exposure ends. Storage of xylene in fat or muscle may prolong the time needed for xylene to leave the body.

Short-term exposure of people to high levels of xylene can cause irritation of the skin, eyes, nose, and throat; difficulty in breathing; impaired function of the lungs; delayed response to a visual stimulus; impaired memory; stomach discomfort; and possible changes in the liver and kidneys. Both short- and long-term exposure to high concentrations of xylene can also cause a number of effects on the nervous system, such

## ***Attachment A – Site-Specific Health and Safety Plan***

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as headaches, lack of muscle coordination, dizziness, confusion, and changes in one's sense of balance. People exposed to very high levels of xylene for a short period of time have died. Most of the information on long-term exposure to xylene is from studies of workers employed in industries that make or use xylene. Those workers were exposed to levels of xylene in air far greater than the levels normally encountered by the general population. Many of the effects seen after their exposure to xylene could have been caused by exposure to other chemicals that were in the air with xylene.

Results of studies of animals indicate that large amounts of xylene can cause changes in the liver and harmful effects on the kidneys, lungs, heart, and nervous system. Short-term exposure to very high concentrations of xylene causes death in animals, as well as muscular spasms, incoordination, hearing loss, changes in behavior, changes in organ weights, and changes in enzyme activity. Long-term exposure of animals to low concentrations of xylene has not been well studied.

Information from animal studies is not adequate to determine whether or not xylene causes cancer in humans. Both the IARC and EPA have found that there is insufficient information to determine whether or not xylene is carcinogenic and consider xylene not classifiable as to its human carcinogenicity.

Exposure of pregnant women to high levels of xylene may cause harmful effects to the fetus. Studies of unborn animals indicate that high concentrations of xylene may cause increased numbers of deaths, decreased weight, skeletal changes, and delayed skeletal development. In many instances, these same concentrations also cause damage to the mothers. The higher the exposure and the longer the exposure to xylene, the greater the chance of harmful health effects. Lower concentrations of xylene are not so harmful.

EPA estimates that, for an adult of average weight, exposure to 10 mg/L (equal to 10 ppm) of water each day for a lifetime (70 years) is unlikely to result in harmful noncancerous health effects. For a long-term but less than lifetime exposure (about 7 years), 27.3 ppm is estimated to be a level unlikely to result in harmful health effects in an adult.

Exposure to 12 ppm xylene in water for 1 day or to 7.8 ppm of xylene in water for 10 days or longer is unlikely to present a health risk to a small child. EPA has proposed a recommended maximum level of 10 ppm xylene in drinking water.

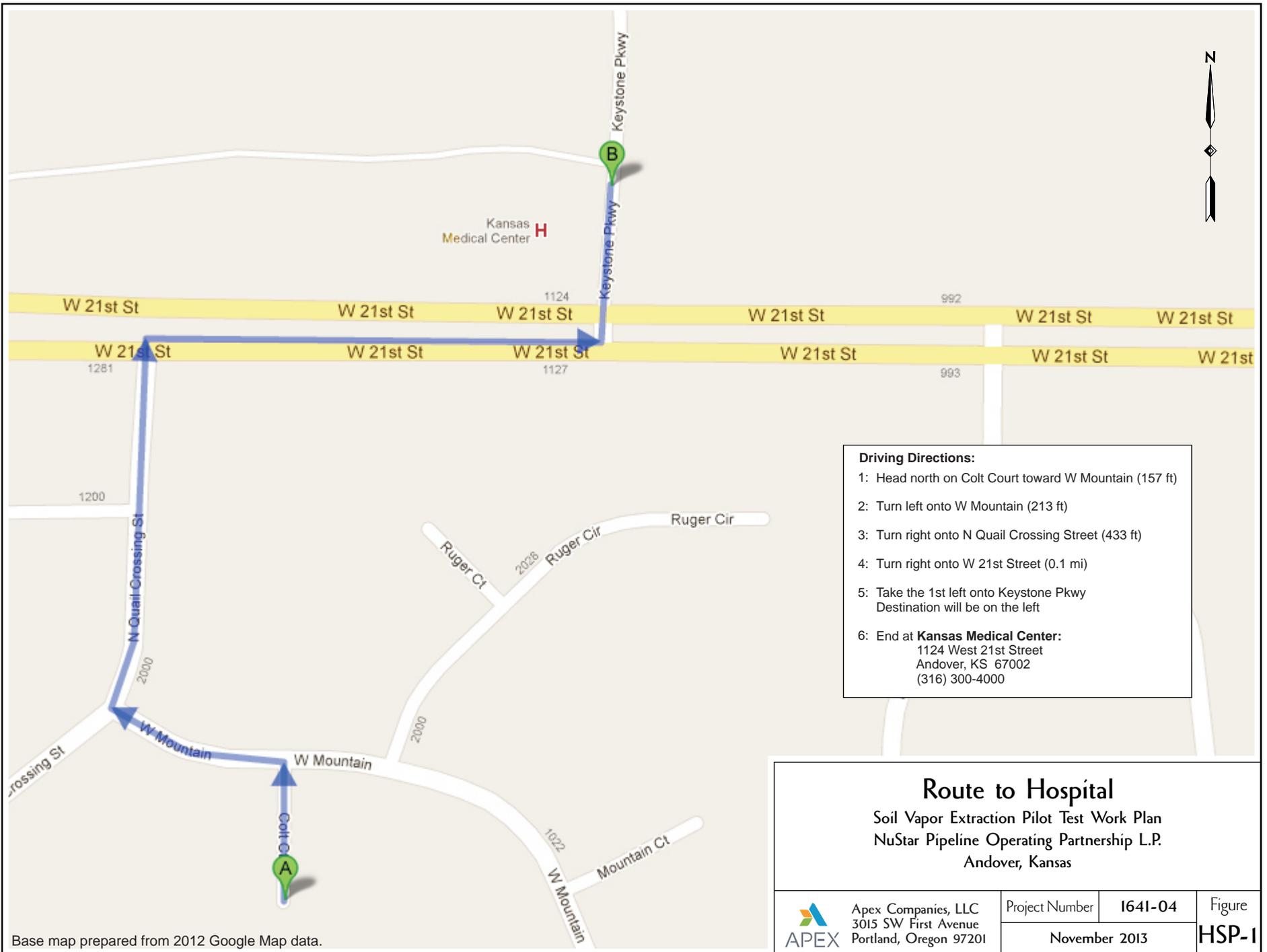
To protect people from the potential harmful health effects of xylene, EPA regulates xylene in the environment. EPA has set a legally enforceable maximum level of 10 mg/L (equal to 10 ppm) of xylene in water that is delivered to any user of a public water system. OSHA has set an occupational exposure limit of 100 ppm of xylene in air averaged over an 8-hour workday and a 15-minute exposure limit of 150 ppm. These regulations also match recommendations (not legally enforceable) of the American Conference of Governmental Industrial Hygienists. NIOSH has recommended an exposure limit (not legally enforceable)

## **Attachment A – Site-Specific Health and Safety Plan**

of 100 ppm of xylene averaged over a workday up to 10 hours long in a 40-hour workweek. NIOSH has also recommended that exposure to xylene not exceed 150 ppm for longer than 15 minutes. NIOSH has classified xylene exposures of 10,000 ppm as immediately dangerous to life or health.

EPA and the FDA specify conditions under which xylene may be used as a part of herbicides, pesticides, or articles used in contact with food. The EPA has a chronic drinking water health advisory of 27.3 ppm for an adult and 7.8 ppm for a 10-kilogram child.

EPA regulations require that a spill of 1,000 pounds or more of xylene or used xylene solvents be reported to the Federal Government National Response Center.



Base map prepared from 2012 Google Map data.

**Driving Directions:**

- 1: Head north on Colt Court toward W Mountain (157 ft)
- 2: Turn left onto W Mountain (213 ft)
- 3: Turn right onto N Quail Crossing Street (433 ft)
- 4: Turn right onto W 21st Street (0.1 mi)
- 5: Take the 1st left onto Keystone Pkwy  
Destination will be on the left
- 6: End at **Kansas Medical Center:**  
1124 West 21st Street  
Andover, KS 67002  
(316) 300-4000

<h2 style="margin: 0;">Route to Hospital</h2> <p style="margin: 0;">Soil Vapor Extraction Pilot Test Work Plan NuStar Pipeline Operating Partnership L.P. Andover, Kansas</p>			
 <p style="margin: 0; font-size: small;">Apex Companies, LLC 3015 SW First Avenue Portland, Oregon 97201</p>	Project Number	<b>I641-04</b>	Figure
	November 2013		<b>HSP-1</b>

## ***Attachment B***

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**Field Forms**





***Attachment C***

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**ALS Laboratory Group QA Manual**



**ALS Laboratory Group**  
ANALYTICAL CHEMISTRY & TESTING SERVICES

---

# Quality Assurance Manual

ALS Laboratory Group  
Holland Facility  
3352 128<sup>th</sup> Avenue  
Holland, Michigan 49424  
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616-399-6185 (F)

[www.alsglobal.com](http://www.alsglobal.com)

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**Section 1 – Signature Page**

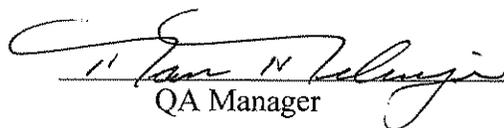
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Laboratory Director

07-31-2008

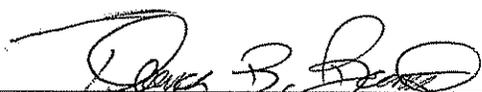
Date



QA Manager

7.31.08

Date



Technical Director (Client Services)

07/31/08

Date



Technical Director (Metals)

7/31/08

Date



Technical Director (Organics)

7/31/08

Date



Technical Director (Wet Chemistry)

7/31/08

Date

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## **SECTION 3 – INTRODUCTION**

The purpose of this *Quality Assurance Manual* is to outline the quality system for the ALS Laboratory Group. This manual defines the policies, procedures, and documentation that: (1) assures analytical services continually meet a defined standard of quality, (2) provides clients with data of known documented quality, and (3), where applicable, demonstrates regulatory compliance. The Quality Assurance Manual sets the standard under which all laboratory operations are performed including the laboratory's organization, objectives, and operating philosophy.

### 3.1 Scope of Testing

ALS Laboratory Group is a professional analytical service laboratory providing analytical services for a variety of matrices including, but not limited to, aqueous, solid, hazardous waste, and air. Analytical services are based upon EPA approved methods and/or other promulgated protocols. Refer to Section 25 (Appendices) for a list of analytical capabilities and corresponding NELAC accreditation status.

### 3.2 References

This *Quality Assurance Manual* uses references from the 2003 NELAC Standard, Chapter 5, Appendix A. The following additional sources of method references used at ALS Laboratory Group in completion of this manual and/or Standard Operating Procedures (SOPs) include:

- USEPA SW-846 *Test Methods for Evaluating Solid Waste*, 3<sup>rd</sup> Edition, through Updates III and IV, and published new methods from SW-846 (e.g. SW8000C).
- Selected USEPA Approved *Methods, as referenced in the "Methods Update Rule" (MUR)*, 40 CFR, Part 136, Table 1B, changes in the published March 12, 2007.
- APHA, AWWA, and WEF *Standard Methods for the Examination of Water and Wastewater*, 18<sup>th</sup> through 21<sup>st</sup> Editions, (1995-2005).
- USEPA Methods published in Appendix A, B and C of 40 CFR, Part 136.
- Selected USEPA Drinking Water methods published by the USEPA Office of Ground Water and Drinking Water
- State approved UST methods for TPH (e.g. TPH by TCEQ1005, Rev 3, June 2001).
- Department of Defense Quality Service Manual, Version 3, May 2005
- The NELAC Institute (TNI) Quality Manual Template

### 3.3 Acronyms

#### 3.3.1 Acronyms

AA	Accrediting Authority
ANSI	American National Standards Institute
ASQC	American Society for Quality Control
ASTM	American Society for Testing and Materials
Blk	Blank
°C	degrees Celsius
cal	calibration
CAS	Chemical Abstract Service
CCV	Continuing calibration verification
COC	Chain of custody
DO	Dissolved oxygen
DOC	Demonstration of Capability
EPA	Environmental Protection Agency
g/L	grams per liter
GC/MS	gas chromatography/mass spectrometry
ICP-MS	inductively coupled plasma-mass spectrometry
ICV –	Initial calibration verification
ISO/IEC	International Organization for Standardization/International Electrochemical Commission
lb/in <sup>2</sup>	pound per square inch
LCS	Laboratory control sample
LFB	Laboratory fortified blank
LOD	Limit of detection
LOQ	Limit of quantitation
MDL	method detection limit
MQL	method quantitation limit
mg/Kg	milligrams per kilogram
mg/L	milligrams per liter
MS	matrix spike
MSD	matrix spike duplicate
NELAC	National Environmental Laboratory Accreditation Conference
NELAP	National Environmental Laboratory Accreditation Program
NIST	National Institute of Standards and Technology
PT	Proficiency Test(ing)
PTOB	Proficiency Testing Oversight Body
PTPA	Proficiency Testing Provider Accreditor
QA	Quality Assurance
QC	Quality Control
QAM	Quality Assurance Manual
RL	Reporting level
RPD	Relative percent difference
RSD	Relative standard deviation
SOPs	Standard Operating Procedures
spk	spike
std	standard
TNI	The NELAC institute
ug/L	micrograms per liter
UV	Ultraviolet
VOC	Volatile organic compound
WET	Whole effluent toxicity

## **SECTION 4 – ORGANIZATIONAL ROLES AND RESPONSIBILITIES**

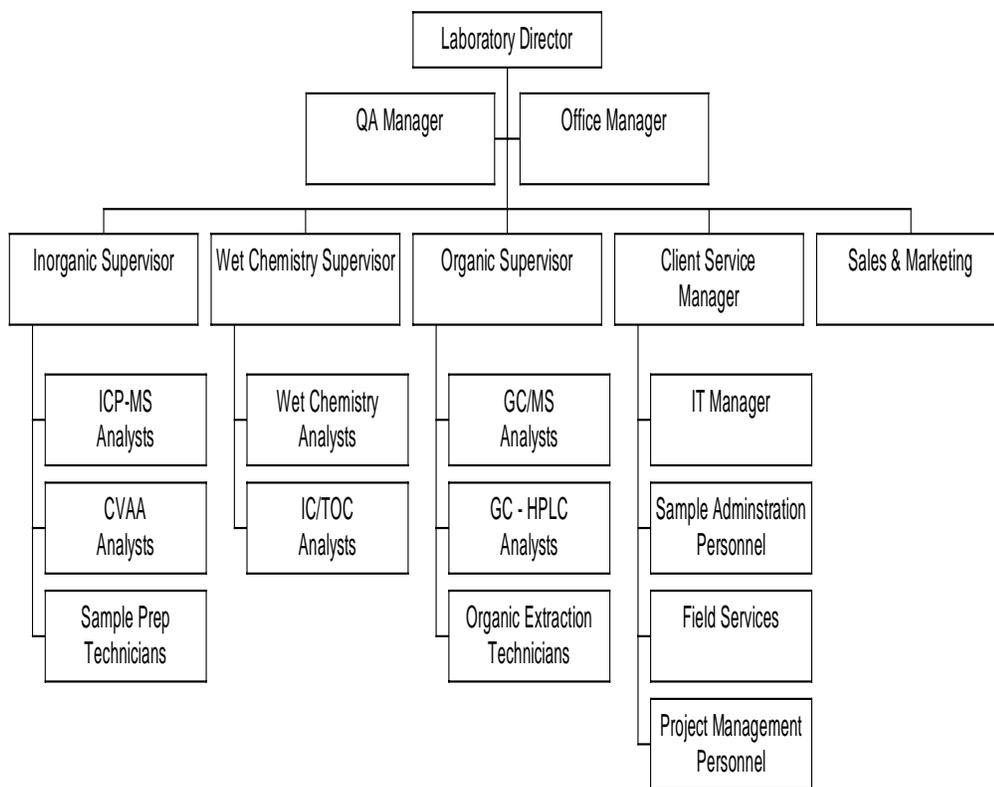
ALS Laboratory Group is a legally identifiable organization. Through the application of the policies and procedures outlined in this manual, the laboratory assures that it is impartial and that personnel are free from undue (1) commercial, (2) financial, or (3) other pressures that might influence their technical judgment.

The laboratory is responsible for conducting analytical activities that meet the requirements of the NELAC Standard as well as the needs of the client.

### 4.1 Laboratory Organizational Structure

ALS Laboratory Group is a commercial laboratory serving the environmental community. The facility operates at 3352 128<sup>th</sup> Ave, Holland, MI. The laboratory's tax ID number is available upon request.

The organizational structure indicated below minimizes the potential for conflicting or undue interests that might influence the technical judgment of analytical personnel.



## 4.2 Responsibility and Authority

The laboratory management team includes the Laboratory Director, Technical Director or Directors (however named), and the Quality Assurance Manager. This management group has overall responsibility for technical operations and the authority needed to generate/maintain the defined level of quality. Management's commitment to quality and to the Quality System is stated in Section 5.1 (Quality Policy) of this document and is upheld through the application of related policies and procedures. Management ensures technical competence of personnel operating equipment, performing tests, evaluating results, or signing reports, and limits authority to perform laboratory functions to those appropriately trained and/or supervised.

The assignment of responsibilities, authorities, and interrelationships of the personnel who manage, perform, or verify work affecting the quality of environmental tests is documented in Section 4.3 of this document. Management is responsible for defining the minimal level of education, qualifications, experience, and/or skills necessary for completion of the assigned responsibilities.

Management bears specific responsibility for maintenance of the Quality System. This includes defining roles and responsibilities of personnel, approving documents, and providing training. Training is kept up to date as described in Section 17.4 of this document.

Management also bears responsibility for ensuring that audit findings and/or corrective actions are addressed and/or completed within required time frames. Designated alternates are appointed by management during the absence of the Laboratory Manager, Technical Director(s) or the Quality Manager, and always if the absence is more than 15 days.

## 4.3 Job Descriptions and Qualifications

### 4.3.1 Laboratory Director

The Laboratory Director is responsible for all laboratory activities as the highest-level manager. He/she provides administrative, operational, and technical leadership through planning, allocation, management of personnel, and management of resources. He/she approves the Quality Assurance Manual and provides resources for implementation of the QA program. The Laboratory Director position requires a BS or BA degree in Science, Engineering, or Management with five-years supervisory experience in environmental laboratory operations.

### 4.3.2 Technical Director

The Technical Director(s) reports directly to the Laboratory Director and is responsible for day-to-day supervision of technical laboratory operations. The Department Supervisor shall serve as the Technical Director for each applicable analytical area. He/she assures production of reliable data through the monitoring of analytical procedures, corroborating analysis performed, and approving staff capability. He/she certifies that personnel with appropriate educational and/or technical background perform all tests for which the lab is accredited according to SOP specifications. He/she reviews and implements new methodologies, provides training, and supervisors individuals participating in this effort. In the absence of the Technical Director, the Laboratory Director or Quality Assurance Manager shall maintain these duties. The Technical Director position requires a BS or BA degree in Science, Engineering, or Management with five-years experience in environmental laboratory operations.

#### 4.3.3 Client Services Manager

The Client Services Manager reports directly to the Laboratory Director and is responsible for the Project Management Group. He/she coordinates client requirements with laboratory capacity and capability, and in conjunction with the Technical Director and/or QA Manager, provides technical expertise to the client. In the absence of the Client Services Manager, the Laboratory Director (or designate) shall maintain these duties. The Client Service Manager position requires a BS or BA degree in Science, Engineering, or Management with five-years experience in environmental laboratory operations.

#### 4.3.4 Quality Assurance Manager

The Quality Assurance (QA) Manager is responsible for ensuring that the quality system is documented, implemented, and adhered to in all facets of laboratory operations. He/she has direct access to the Laboratory Director and is independent of daily laboratory operations. He/she is tasked with: (1) overseeing quality control data, (2) evaluating data, (3) performing assessments without managerial influence, (4) conducting internal audits, (5) arranging for external audits, (6) monitoring corrective actions, and (7) notifying management of any deficiencies and/or opportunities for improvement in laboratory operations. Additionally, he/she is responsible for maintaining (1) the Quality Assurance Manual, (2) quality assurance records, and (3) laboratory accreditations. The QA Manager shall perform a QA Management System review annually according to SOP HN-QS-017, *QA Management Review*. He/she has the authority to place a stop work order on any non-compliant work area. In the absence of the QA Manager, the QA Assistant or Technical Director (most senior if more than one) shall maintain these duties. The Quality Assurance Manager position requires a BS or BA degree in Science, Engineering, or Management with a minimum of five-years experience in environmental laboratory operations and two-years experience in quality system management.

#### 4.3.5 Information Technology Manager

The Information Technology (IT) Manager reports directly to the Laboratory Director and is responsible for maintaining the Laboratory Information Management System (LIMS) as well as laboratory related computer hardware and/or software. He/she is tasked with (1) maintaining the laboratory's computer network, (2) educating staff in the use of installed hardware/software, (3) developing and/or implementing software, (4) implementing data back-up or archival procedures, and (5) maintaining Electronic Data integrity. In the absence of the IT Manager, the Client Service Manager (or designate) shall maintain these duties. The IT Manager position requires an associates degree in Information Systems or Computer Science with five-years experience in computer/network related system hardware and software.

#### 4.3.6 Project Manager

The Project Manager (PM) reports to the Client Service Manager and is responsible for ensuring that analyses performed by the laboratory meet all project, contract, and/or regulatory-specified requirements. The PM is tasked with (1) relaying project requirements to the staff, (2) review of sample log in information, (3) monitoring/communicating project progress, and (4) reviewing/issuing final reports to the client. In the absence of the Project Manager, the Client Service Manager (or designate) shall maintain these duties. The PM position requires a BS or BA in Science, Engineering, or Management with five-years experience in environmental laboratory operations.

#### 4.3.7 Safety Officer

The Safety Officer reports to the Laboratory Director and is responsible for administration of the laboratory's safety program. He/she is tasked with (1) implementing safety policies, (2) reviewing accidents and/or incidents, (3) monitoring hazardous waste disposal, and (4) conducting routine safety inspections. In the absence of the Safety Officer, the Laboratory Director (or designate) shall maintain these duties. The Safety Officer position requires a high school diploma, completion of a 40-hour OSHA safety course, and two-years experience in the environmental laboratory.

#### 4.3.8 Technical Supervisor

The Technical Supervisor reports to the Laboratory Director and is responsible for technical supervision of their laboratory operation. He/she is a full-time staff member tasked with assuring the production of reliable data through the monitoring of analytical procedures, corroborating analysis performed, and

approving staff capability. He/she certifies that personnel with appropriate educational and/or technical background perform all tests for which the lab is accredited according to SOP specifications. He/she reviews and implements new methodologies, provides/certifies training, and supervises individuals participating in this effort. The Technical Supervisor may serve as the Technical Director of their respective operational area. The Laboratory Director shall designate an alternate to assume these duties in the absence of the Technical Supervisor. The Technical Supervisor position requires a BS or BA in Science, Engineering, or Management with five-years technical experience and two-years supervisory experience in environmental laboratory operations.

#### 4.3.9 Client Service Supervisor

The Client Service Supervisor reports to the Client Service Manager and is responsible for supervision of sample receipt operations. He/she is tasked with (1) sample receipt and log in (2) maintaining sample custody, (3) sample storage /disposal, and (5) bottle / cooler disposition. In the absence of the Client Service Supervisor, the Client Service Manager (or designate) shall assume these duties. The Client Service Supervisor position requires a high school diploma with two-years experience in environmental laboratory operations.

*(Note: In lieu of formal education requirements, three years experience may be considered equivalent to one year formal education.)*

## **SECTION 5 – QUALITY SYSTEMS**

The laboratory's Quality System is documented in this *Quality Manual* and associated quality system documents. Together they describe the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of the organization for ensuring quality in its work processes, products, and services.

### 5.1 Quality Policy Statement

The objective of the quality system and the commitment of management is to consistently provide our customers with data of known and documented quality that meets their requirements. Our policy is to (1) use good laboratory practices, (2) maintain high quality standards, (3) uphold the highest level of service, and (4) comply with the NELAC standard. The laboratory ensures that personnel are free from any commercial, financial, or other undue pressures that might adversely affect the quality of work. This policy is implemented and enforced through the unequivocal commitment of management at all levels to the Quality Assurance principles and practices outlined in this manual. The primary responsibility for quality rests with each individual within the laboratory organization. Accordingly, every laboratory employee must ensure that the generation and reporting of quality analytical data is a fundamental priority. Every laboratory employee is required to familiarize him or herself with the quality documentation and to implement the policies and procedures in their work. All employees are trained annually on the ethical principles and procedures surrounding the generation of data. The laboratory maintains a strict policy of client confidentiality and holds all employees to this policy.

### 5.2 Quality Assurance Manual

Laboratory management ensures that the laboratory's policies and objectives for quality are documented by reference or by inclusion in the *Quality Assurance Manual*, and that the *Quality Assurance Manual* is communicated to, understood by, and implemented by all personnel concerned. Where the *Quality Manual* documents laboratory requirements, a separate SOP or policy is not required.

The Quality Assurance Manual is maintained current and up-to-date by the quality assurance department. All employees must complete a read-receipt form stating they (1) have read the Quality Assurance Manual, (2) understand the contents, and (3) will adhere to the stated policies. The completed read-receipt form is kept on file by the quality assurance department.

### 5.3 Data Integrity System

The data integrity system employed at the laboratory is an integrated approach designed to ensure the production of defensible and quality data. The overall

system consists of a three-tier approach as documented in SOP HN-QS-015, *Data Integrity System*.

System policy is based upon criteria specified by ISO 17025, US EPA and (if required) project specific criteria. System programs to support this policy include documentation (Standard Operating Procedures), employee training, internal/external assessment, and annual management review. Within each system program, critical components of data integrity are employed. These components include defined data quality objectives, data generation procedures, verification, and data validation. Specifics of these components are detailed in individual documents (see 5.4). Prior to final release, validated data is compared to data quality objectives in order to assure its worthiness.

#### 5.4 Standard Operating Procedures

Standard Operating Procedures (SOPs) are written procedures that describe in detail how to conduct laboratory processes, and are of two types: 1) test method SOPs, which have specifically required details, and 2) general use SOPs which document administrative, quality, or broad spectrum laboratory procedures. SOPs are used to ensure consistent application and performance of laboratory procedures. SOPs, regardless of type, are maintained such that:

- (1) Copies of all SOPs are accessible to all personnel, and
- (2) Each SOP has a unique identifier, revision number, effective date, and approval signatures.

The laboratory maintains SOPs for all accredited test methods, and for procedures that support these test methods. Support procedures include, but are not limited to, quality assurance, information technology, sample management, health / safety, and general laboratory practices. SOPs are prepared and managed in accordance with the specifications documented in HN-GEN-001, *SOP Preparation & Management*.

## **SECTION 6 – DOCUMENT MANAGEMENT**

The purpose of document management is to preclude the use of invalid and/or obsolete documents. The following guidelines are used for laboratory document management, which include controlling, distributing, reviewing, and accepting modification.

### 6.1 Document Type

The laboratory manages three types of documents, 1) controlled, 2) approved, and 3) obsolete. All documents that affect the quality of laboratory data are managed appropriate to the scope and depth required.

#### 6.1.1 Controlled

A Controlled Document is one that is uniquely identified, issued, tracked, and maintained as part of the quality system. Controlled documents may be internal or external in nature. Controlled internal documents are uniquely identified with 1) effective date, 2) revision number, 3) page number, 4) the total number of pages, and 5) the signatures of the issuing authority (i.e. management).

#### 6.1.2 Approved

An approved document is one that has been reviewed, and either signed / dated or acknowledged via secure electronic means by the issuing authority.

#### 6.1.3 Obsolete

An obsolete document is one that has been superseded by a more recent version or that reflects a discontinued practice. Original obsolete documents are maintained in archived storage according to SOP HN-QS-011, *Record Archival*.

### 6.2 Document Approval, Review, and Distribution

#### 6.2.1 Approval

All documents that affect the generation and reporting of laboratory data will be approved, at a minimum, by the Lab Director, QA Manager, and Technical Director. All documents that affect quality assurance, administrative, general, and/or health & safety programs will be approved, at a minimum, by the Lab Director and QA Manager.

#### 6.2.2 Review

Documents are reviewed, at a minimum, biennially to ensure their contents are in compliance with the current quality system requirements, and accurately reflect current operations.

#### 6.2.3 Distribution

- 6.2.3.1 Approved copies of all documents are stored on the server in a secure (Adobe) format and are available to all personnel.
- 6.2.3.2 The QA department maintains the original copy of any internally generated/approved documents.
- 6.2.3.3 Procedures for the distribution of documents are located in SOP HN-QS-014, *Document Control & Laboratory Records*.

#### 6.3 Document Management

- 6.3.1 The QA Manager (or designee) maintains a master list of controlled documents referencing the document's identification and location.
- 6.3.2 The QA Manager (or designee) shall update the master list whenever documents are revised/retired or annually, whichever occurs first.
- 6.3.3 Management of documents at ALS Laboratory Group is conducted according to the specifications documented in HN-QS-014, *Document Control & Laboratory Records*.

#### 6.4 Changes to Documents

##### 6.4.1 Document Changes (Hardcopy)

All document changes are reviewed prior to promulgation and approved by the Technical Director and/or Lab Director and QA Manager. Minor modifications may be handwritten on the current revision. All other modifications, additions, and/or changes are incorporated into a new revision. All changed documents are copied and distributed with the corresponding removal of the obsolete document. The QA Manager (or designee) is responsible for maintaining hardcopy formats.

##### 6.4.2 Document Changes (Electronic)

All document hardcopy changes are stored electronically in a secure format and are available to all employees. Obsolete electronic formats are removed from service and placed in an archived folder. The QA Manager (or designee) is responsible for maintaining electronic formats.

##### 6.4.3 Procedures

Procedural processes for modifications and changes to controlled documents are specified in SOPs HN-QS-014, *Document Control & Records*, and HN-GEN-001, *SOP Preparation & Management*.

#### 6.5 Obsolete Documents

All obsolete documents are removed from general distribution, or otherwise prevented from unintended use, and archived for a period of no less than five (5) years. Procedural processes for archival of obsolete documents are specified in SOP HN-QS-011, *Record Archival*.

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## **SECTION 7 – REVIEW OF REQUESTS, TENDERS AND CONTRACTS**

All new work is reviewed prior to acceptance in order to assure that (1) requirements are clearly defined, (2) the laboratory has adequate resources and capability, and (3) the test method is applicable to the customer's needs. This process assures that all work will be given adequate attention without shortcuts that may compromise data quality. Contracts for new work may be presented as formal bids, signed documents, or verbal / electronic inquiries.

### 7.1 Procedure for the Review of Work Requests

7.1.1 Review of work requests is conducted according to the guidelines specified in SOP-HN-GEN-006, *Resource Review*.

7.1.2 The Project Manager (or Sales Representative in case of bid), in conjunction with the Lab Director, QA Manager and Technical Director(s) determines if the laboratory has the necessary accreditations and resources to meet the work request.

7.1.3 The Project Manager (or Sales Representative) will:

7.1.3.1 Provide the perspective client with the requested bid information if laboratory capability / capacity meets project requirements, or

7.1.3.2 Inform the perspective client of any potential conflict or inability to complete the work per specification.

7.1.3.3 Resolve any differences between the initial request and final contract prior to sample receipt or commencement of work.

7.1.4 Changes to the Scope of Work initiated after commencement of work will be subjected to the same review process.

### 7.2 Documentation of Review

7.2.1 Executed contracts are copied and the originals maintained in a secure area designated by the Lab Director.

7.2.2 Additional records are maintained for every contract or work request, as appropriate. This includes pertinent discussions with a client relating to the client's requirements or the results of the work during the period of execution of the contract.

## **SECTION 8 – SUBCONTRACTING OF TESTS**

A subcontract laboratory is defined as a laboratory external to this facility that performs analyses for the laboratory. When subcontracting analytical services, the laboratory assures work requiring accreditation is placed with an appropriately accredited laboratory or one that meets applicable statutory and regulatory requirements for performing the tests.

### 8.1 Procedure for Subcontracting

- 8.1.1 Subcontracting is conducted according to the procedures documented in SOP HN-GEN-007, *Sample Sub-Contracting*.
- 8.1.2 The client must be notified of the laboratory's intent to subcontract prior to sample receipt and acknowledgement of client acceptance should be maintained with the bid or work order information.
- 8.1.3 The laboratory, to which samples are subcontracted, must maintain all appropriate accreditations relative to client requirements.
- 8.1.4 The QA department shall maintained a list of subcontracted laboratories and, whenever possible, copies of their respective quality assurance protocols.
- 8.1.5 Final reports must identify all test results from subcontracted laboratories.

## **SECTION 9 – SERVICES AND SUPPLIES**

The laboratory ensures that purchased supplies and services affecting the quality of environmental tests are of the required or specified quality by using approved suppliers and products. Upon receipt, traceability of reagents, chemicals, and standards is maintained throughout the analytical process.

### 9.1 Purchasing Supplies and Services

- 9.1.1 Purchasing of supplies and services is conducted according to the guidelines specified in SOP-HN-GEN-010, *Procurement*.
- 9.1.2 Specifications for the receipt, storage, and tracking of reagents, chemicals, and standards are documented in SOP-HN-QS-001, *Reagent & Standard Tracking*.
- 9.1.3 Specifications for specific reagents, chemicals, and standards shall be documented in the applicable method SOP.
- 9.1.4 A list of approved vendors shall be maintained within LIMS. The Lab Director and/or QA Manager shall review and approve suppliers for inclusion to the approved vendor list.
- 9.1.5 The Technical Director(s) shall ensure that supplies are of the appropriate quality and/or purity prior to ordering.

## **SECTION 10 – CLIENT SERVICE**

The laboratory collaborates with clients and/or their representatives in clarifying their requests and in monitoring laboratory performance relative to their work. Each request is reviewed to determine the laboratory's ability to comply with the request within the confines of prevailing statutes and/or regulations (Section 7.1) without risk to the confidentiality of other clients.

### 10.1 Client Confidentiality

- 10.1.1 The laboratory confidentiality policy is to not divulge or release any information to a third party without proper authorization.
- 10.1.2 All electronic data are kept confidential, based on technology and laboratory limits, as required by client or regulatory specifications.
- 10.1.3 Procedure(s) for maintaining confidentiality requirements are documented in SOP-HN-GEN-004, *Client Confidentiality*.

## **Section 11 - Customer Complaint**

### 11.1 Procedures for Handling Customer Complaints

- 11.1.1 The Project Manager must ensure that all customer complaints are documented and, as necessary, corrected. This also applies to requests for report and/or data verification.
- 11.1.2 Procedure(s) for handling customer complaints are documented in SOP-HN-ADM-004, *Complaint Resolution*.
- 11.1.3 The QA Manager shall review and institute a corrective action (Section 13) for any investigation that indicates laboratory error.

## **SECTION 12 – CONTROL OF NON-CONFORMING WORK**

Non-conforming work is work that does not meet specified acceptance criteria or requirements. Non-conformances can include unacceptable quality control results, departures from standard operating procedures, or test method modification. Requests for departures from laboratory procedures are reviewed, approved, and documented by the Lab Director or QA Manager. The policy for control of non-conforming work is to identify the non-conformance, determine if it will be permitted, and take appropriate action. All employees have the authority to stop work on samples when any aspect of the process does not conform to laboratory requirements. Requests for departures from laboratory procedures are reviewed, approved, and documented by the Lab Director, Technical Director(s), or QA Manager.

### 12.1 Evaluation & Management of Non-Conforming Work

- 12.1.1 Guidelines for evaluating batch QC parameters are documented in SOP-HN-QS-020, *Batch QC Data Evaluation*. Specific information is documented in each applicable analytical SOP.
- 12.1.2 Procedures for the management of non-conforming work are detailed in SOP-HN-GEN-005, *Departures from Documented Procedures*.
- 12.1.3 The laboratory must evaluate the significance of all non-conformances. If data integrity issues are indicated or suspected, corrective action must be taken prior to reporting or continuation of analytical work.
- 12.1.4 If non-conformances are discovered after work completion and reporting, the client must be notified of the impacted data.

## **SECTION 13 – CORRECTIVE ACTION**

Corrective action is the action taken to eliminate the cause(s) of an existing nonconformity, defect, or other undesirable situation in order to prevent recurrence. Deficiencies cited in external assessments, internal quality audits, data reviews, complaint resolution, and/or managerial reviews are documented and require corrective action. Corrective actions taken are appropriate for the magnitude of the problem and the degree of risk.

### 13.1 Procedure for Corrective Action

- 13.1.1 Procedures and guidelines for the corrective action process are specified in SOP-HN-QS-003, *Non-Conformance & Corrective Action Reporting*.
- 13.1.2 The Department Supervisor, QA Manager, and/or Lab Director are responsible for initiating applicable corrective actions (dependent upon initial catalyst).
- 13.1.3 All deficiencies must be investigated. A corrective action plan must be developed and implemented if determined necessary.
- 13.1.4 The QA Manager is responsible for recording and monitoring on-going corrective action.

### 13.2 Selection/Implementation of Corrective Actions

- 13.2.1 Once a non-conformance is noted, the event must be reviewed to determine if it is indicative of a procedural or systemic deficiency resulting from a primary cause.
- 13.2.2 If a procedural or systemic deficiency is indicated, a CAR must be initiated and the root cause identified.
- 13.2.3 Root cause is the condition or event that, if corrected or eliminated, would prevent the recurrence of the deficiency.
- 13.2.4 In the event of uncertainty regarding the best approach for analysis/correction of the root cause, the Department Supervisor, QA Manager, or Lab Director will recommend the best approach to be initiated.
- 13.2.5 The Technical Director ensures that corrective actions are discharged within the agreed upon time frame.

### 13.3 Monitoring of Corrective Action

- 13.3.1 The QA Manager monitors implementation and documentation of the corrective action to assure that the corrective action(s) were effective.

13.4 Exceptionally Permitting Departures from Documented Policies and Procedures

- 13.4.1 The laboratory allows the release of non-conforming data only with approval by the appropriate Technical Director (or their designee) on a case-by-case basis.
- 13.4.2 Departures from specified policy and procedure are documented on data quality checklists and narrated.
- 13.4.3 Planned departures from procedures or policies do not require audits or investigations.

## **SECTION 14 – PREVENTIVE ACTION**

Preventive action, rather than corrective action, aims at minimizing or eliminating inferior data quality or other non-conformance through scheduled maintenance and review, before the non-conformance occurs.

### 14.1 Procedures for Preventive Action

- 14.1.1 Review of QC data to identify quality trends
- 14.1.2 Regularly scheduled staff quality meetings
- 14.1.3 Annual budget reviews
- 14.1.4 Annual managerial reviews
- 14.1.5 Routine instrument maintenance
- 14.1.6 Running computer system modification in tandem with the old system to assure at least one working system

### 14.2 Responsibility and Authority

- 14.2.1 All employees have the authority to recommend preventive action procedures.
- 14.2.2 Management is responsible for reviewing recommended procedures and for implementing preventive action.

## **SECTION 15 – CONTROL OF RECORDS**

Records are a subset of documents, usually data recordings that include annotations, such as daily refrigerator temperatures posted to a laboratory form, lists, spreadsheets, or analyst notes on a chromatogram. Records may be on any form of media, including electronic and hard copy. Records allow for the historical reconstruction of laboratory activities related to sample handling, processing, and analysis. The laboratory retains all original observations, calculations, derived data, calibration records, and test reports for a minimum of five years.

### 15.1 Records Management and Storage

- 15.1.1 Guidelines for the management of records are documented in SOP-HN-QS-014, *Laboratory Record Procedures*.
- 15.1.2 Guidelines for the archival of records are documented in SOP-HN-QS-011, *Record Archival*.
- 15.1.3 Records are maintained for a period of no less than 5 years.
- 15.1.4 Archived records are indexed to include:
  - 15.1.4.1 Storage identification
  - 15.1.4.2 Archived material identification
  - 15.1.4.3 Date range of archived material

### 15.2 Legal Chain of Custody Records

- 15.2.1 Procedures for evidentiary sample custody (if applicable) are documented in SOP-HN-SM-001, *Sample Receipt & Log In Procedures*.

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## **SECTION 16 – AUDITS AND MANAGEMENT REVIEW**

AUDITS measure laboratory performance and verify compliance with accreditation/certification and project requirements. Audits specifically provide management with an on-going assessment of the quality system. They are also instrumental in identifying areas where improvement in the quality system will increase the reliability of data. Audits are of four main types: internal, external, performance, and system.

In the event that analytical anomalies are identified after completion of any analyses, the client must be notified within two working days (48 hours) of any deviations that cast doubt on the validity of previously reported results.

### 16.1 Internal Audits

- 16.1.1 Internal audit procedures are documented in SOP-HN-QS-012, *Internal Audits*.
- 16.1.2 The laboratory shall conduct an annual internal audit of its quality system.
- 16.1.3 The audit shall be scheduled by the QA Manager and include but not be limited to:
  - 16.1.3.1 Employee training
  - 16.1.3.2 Data integrity
  - 16.1.3.3 Equipment & facility maintenance
  - 16.1.3.4 Sample handling & record keeping procedures
- 16.1.4 The QA Manger shall schedule department specific audits, at a minimum, annually.
- 16.1.5 Method specific audits shall be conducted, at a minimum, biennially for major analytical offerings. These audits shall include but not be limited to:
  - 16.1.5.1 SOP review
  - 16.1.5.1 Procedural compliance with the SOP
  - 16.1.5.2 Verification of ancillary LIMS functions
  - 16.1.5.3 Verification of automated algorithms
- 16.1.6 Personnel may not audit their own activities unless approved by the lab director.
- 16.1.7 A corrective action must be instituted as specified in Section 13 for areas found to be non-compliant.
- 16.1.8 After completion of the corrective action, re-auditing of the affected area must be performed as verification.

## 16.2 External Audits

It is the laboratory's policy to encourage, cooperate and assist with all external audits, whether performed by clients or an accrediting authority.

- 16.2.1 Management must ensure that all applicable areas of the laboratory are accessible to auditors and that the appropriate personnel are available to assist in the audit.
- 16.2.2 The QA department shall ensure that any noted deficiencies are assigned to an appropriate corrective action(s) and tracked to closure.
- 16.2.3 Recommendations, which may be presented as a result of an external audit, are:
  - 16.2.3.1 Reviewed by the QA Department and Technical Director
  - 16.2.3.2 Submitted to the Lab Director with recommendation for acceptance/rejection.

## 16.3 Performance Audits

Performance audits may be Proficiency Test Samples, internal single-blind samples, double-blind samples through a provider or client, or anything that tests the performance of the analyst and method.

- 16.3.1 NELAC Proficiency Test (PT) samples shall be scheduled biannually per field of accreditation per matrix.
- 16.3.2 PT samples shall be purchased from a NELAC approved provider.
- 16.3.3 All analysis and reporting of PT samples shall utilized the same staff and methods as used for routine sample analysis.
- 16.3.4 Laboratory staff may not collaborate with the PT supplier and/or any outside laboratory (including other ALS Laboratory Group facilities) in the determination, assignment, or verification of PT values.
- 16.3.5 The QA department is responsible for submitting PT results to the provider, monitoring results, and initiating any associated corrective actions.
- 16.3.6 Finalized corrective action for any PT results outside of acceptance criteria must be submitted to all associated accrediting authorities.

## 16.4 System Audits and Management Reviews

An overall quality system evaluation shall be performed annually by the QA Manager and submitted to the Laboratory Director. This evaluation includes findings from internal audits, external audits, performance evaluation results, and client assessments.

- 16.4.1 QA Management Review procedures are documented in SOP-HN-QS-017, *QA Management Review*.
- 16.4.2 Based upon the review, the Lab Director shall review the status of the laboratory's quality system and provide comments/guidance to the QA Manager.
- 16.4.3 The QA Manager must institute corrective action whenever objective evidence indicates that the quality system is not functioning properly.

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## **SECTION 17 – PERSONNEL TRAINING AND DATA INTEGRITY**

Data integrity is the result of multiple processes, as documented in SOP-HN-QS-015 *Data Integrity System*, that together assure the production of valid data with known and documented quality. Data integrity and ethics procedures in the laboratory include training, signed and dated integrity documentation for all laboratory employees, periodic monitoring of data integrity, and documented data integrity procedures. Department supervisors uphold the spirit and intent of data integrity by supporting integrated QA procedures, approving staff training, and continuously monitoring their department's performance.

Employees are required to understand, through training and review of quality systems documentation, that any infractions of the laboratory data integrity procedures will result in a detailed investigation that could lead to very serious consequences such as immediate termination, or civil/criminal prosecution.

The mechanism for confidential reporting of ethics and data integrity issues is (1) unrestricted access to senior management, (2) an assurance that personnel will not be treated unfairly for reporting instances of ethics and data integrity breaches, and (3) anonymous reporting. Any potential data integrity issue is handled confidentially until a follow-up evaluation, full investigation, or other appropriate actions have been completed and the issues clarified. Inappropriate activities are documented, including disciplinary actions, corrective actions, and notifications of clients, if applicable. These documents are maintained for a minimum of 5 years.

### 17.1 Data Integrity and Ethics Training

- 17.1.1 Data integrity training is provided for all employees initially upon hire and annually thereafter.
- 17.1.2 Guidelines for Laboratory Ethics, Accountability, and Responsibility are documented in SOP-HN-GEN-002, *Laboratory Ethics*. This document defines employee responsibility with the following being required of all personnel:
  - 17.1.2.1 ALS Laboratory Group employees shall at all times conduct themselves and the business of the Company in an honest and ethical manner.
  - 17.1.2.2 ALS Laboratory Group employees shall comply with the terms of the ethics agreement
  - 17.1.2.3 The willful act of improper manipulation or falsification of data will not be tolerated and is grounds for immediate dismissal and subsequent legal action.
  - 17.1.2.4 Observance of unethical behavior shall be immediately reported to a supervisor, the QA Manager, or the Lab Director. Failure to report such activity is considered to be in

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- support of the unethical activity and shall be dealt with in those terms.
- 17.1.1.2.5 Unauthorized release of confidential information about the Company or its customers shall be subject disciplinary action up to and including dismissal and subsequent legal action.
- 17.1.3 Training is conducted initially for all new hires.
- 17.1.4 Refresher training is conducted annually thereafter.
- 17.1.5 The QA department ensures that training records are completed and maintained for all staff members.
- 17.1.6 The Technical Director, QA Manager, and Lab Director are (1) responsible for ensuring that contract personnel are trained in the laboratory's data integrity procedures, (2) competent to perform their assigned task, and (3) provided appropriate supervision.

## 17.2 General Training

All personnel must (1) be appropriately trained and (2) demonstrate competency in their assigned tasks before they can contribute independently to functions that can affect data quality.

- 17.2.1 Procedures for Employee Training are documented in SOP-HN-QS-013, *Employee Training*.
- 17.2.2 New staff members are given introductory training/orientation upon arrival. Training is documented by signature sheet and includes:
- 17.2.2.1 Laboratory Ethics, Responsibility, and Accountability
  - 17.2.2.2 Quality Assurance Manual
  - 17.2.2.3 Standard Operating Procedures
  - 17.2.2.4 Material Safety Data Sheets & Safety Equipment
  - 17.2.2.5 Chemical Hygiene & Safety Plan
- 17.2.3 Only trained personnel are authorized to perform specific tasks.
- 17.2.4 Training records are maintained for each employee. These records include:
- 17.2.4.1 New hire training
  - 17.2.4.2 Initial demonstration of competency (method specific)
  - 17.2.4.3 Attendance for annual training sessions
  - 17.2.4.4 On-going demonstration of competency

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## **SECTION 18 – ACCOMODATIONS & ENVIRONMENTAL CONDITIONS**

Laboratory facilities are designed and organized to facilitate testing of environmental samples. Environmental conditions are monitored to ensure that conditions do not invalidate results or adversely affect the required quality of any measurement. Access to, and use of areas affecting the quality of the environmental tests is controlled by restriction of areas to authorized personnel only.

Separate work areas (departments) are designated by application within the facility. The workspace is complimented by dedicated air handling systems, central gas supply, sophisticated instrumentation with computer hardware, and a sophisticated data management system. The volatile organic work area is segregated from other work areas in order to minimize background contaminates. The floor design allows for separate secure storage of samples, solvents, laboratory inventory, and hazardous waste.

The laboratory security features provide for sample integrity and storage. Access to the facility is limited to the front door and the receiving door. During working hours, all are monitored. Guests are escorted/monitored while in the facility. Refrigerated sample storage monitoring is performed according to SOP-HN-EQ-002, *Thermometer Calibration and Temperature Monitoring*. Separate storage areas are maintained for sample requiring volatile organic analysis.

The current floor plan and listing of equipment is documented in the appendix section of this manual.

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## **SECTION 19 – METHOD VALIDATION, UNCERTAINTY, AND DATA CONTROL**

All methods must be validated before being put into use. All methods are published or documented. The following elements of method validation are employed at ALS Laboratory Group: (1) Initial Demonstration of Capability, (2) On-Going Demonstration of Capability, (3) Initial Test Method Evaluation, and (4) Estimation of Uncertainty.

### 19.1 Initial Demonstration of Capability (IDC)

Individual analysts must document an ability to generate data of acceptable accuracy and precision for their assigned analysis through an Initial Demonstration of Capability (IDC). The IDC must consist of four replicates spiked with the analyte(s) of interest and carried throughout the entire preparative/analytical process. The resulting accuracy and precision must fall within proscribed criteria. After successful completion of the IDC, certifications statements are prepared and maintained in the employees training file.

An example of the IDC certificate is located in appendices. The Technical Director and QA Manager must sign certificates, at a minimum. For analytes that do not lend themselves to spiking, the IDC may be performed using a quality control sample.

### 19.2 On-Going (or Continued) Proficiency

After the demonstration of capability is completed, on-going proficiency is maintained and demonstrated at least annually through the analysis of either single-blind samples, performing another DOC, or use of four consecutive laboratory control samples. On-going demonstrations of capability are documented in the training file of each analyst or maintained by the QA department as a separate document.

### 19.3 Initial Test Method Evaluation

For chemical analyses, the INITIAL TEST METHOD EVALUATION involves the determination of the Limit of Detection (LOD), Limit of Quantitation (LOQ), acceptance criteria for precision/bias, and analyte selectivity.

- 19.3.1 Procedures for the determination of the LOD and LOQ are documented in SOP-HN-QS-006, *Determination of Method Detection Limits, Quantitation, and Reporting Limits*.
- 19.3.2 The LOD is a statistical determination of the minimum amount of a substance that an analytical process can reliably detect.
- 19.3.3 The LOQ is established at 250% the LOD or no lower than the lowest non-zero calibration curve standard for the determinative method, whichever is greater.

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- 19.3.4 Precision is the degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform. Precision is usually expressed as standard deviation, variance, or range, in either absolute or relative terms. Bias is the systematic error that contributes to the difference between the mean of a significant number of test results and the accepted reference value. Precision and bias are established for both standard and non-standard methods.
  - 19.3.5 Precision and bias acceptance criteria are based upon method specifications, program specifications, control charting, or a combination thereof. Precision and bias criteria are periodically reviewed and updated as necessary.
  - 19.3.6 Selectivity is the capability of a test method or instrument to respond to a target substance or constituent in the presence of non-target substances. The laboratory evaluates selectivity through procedures defined in the test method SOP(s) such as use of dual columns, interference checks, and analysis of method required QC samples.

#### 19.4 Estimation of Uncertainty

Estimation of uncertainty consists of the sum (combining the components) of the uncertainties of the numerous steps of the analytical process, including, but not limited to, sample plan variability, spatial and temporal sample variation, sample heterogeneity, calibration/calibration check variability, extraction variability, and weighing variability.

- 19.4.1 Procedures for estimating uncertainty are documented in SOP-HN-QS-022, *Measurement Uncertainty*.
- 19.4.2 Procedures are based upon the QC-based Nested Hierarchical Approach as available through the US Navy laboratory website.

#### 19.5 Data Control

All calculations and relevant data are subject to appropriate checks in a systematic manner as addressed in the following SOPs.

- 19.5.1 Procedures for the validation of software applications associated with data acquisition, calculation, and reporting are document in SOP-HN-QS-009, *LIMS Raw Data and Data Integrity*.
- 19.5.2 Procedures for ensuring that reported data are free from transcription and calculation errors are documented in SOP-HN-QS-009, *Data Reduction, Review, and Validation*.
- 19.5.3 Procedures for ensuring proper batch QC data evaluation are documented in SOP-HN-QS-020, *Batch QC Data Evaluation*.
- 19.5.4 Procedures for manual integration are documented in SOP-HN-QS-016, *Manual Integration Policy*.

- 19.5.5 Procedures for ensuring computer and software validation as well as data integrity, confidentiality, and security are documented in SOP-HN-IT-002, *Computer Software Installation and Maintenance*.

## **SECTION 20 – EQUIPMENT**

The laboratory provides all the necessary equipment required for the correct performance of the scope of environmental testing presented in this Quality Manual and associated appendices. All equipment and software used for testing and sampling is capable of achieving the accuracy required and complies with the specifications of the environmental test method as specified in the laboratory SOP. Only trained and authorized personnel operate equipment.

### 20.1 General Equipment Procedures

- 20.1.1 Routine preventative maintenance procedures are document in SOP-HN-EQ-004, *Preventative Maintenance*. All major equipment is covered either under warranty or service contract.
- 20.1.2 Laboratory personnel maintain equipment and instruction manuals for use.
- 20.1.3 Procedures for validating laboratory equipment to ensure that it meets laboratory and method specifications prior to placing into service are documented in SOP-HN-QS-005, *Validation of New Instrumentation and New Methods*.
- 20.1.4 Procedures for ensuring test equipment (hardware and software) are protected from adjustments that may invalidate test results are documented in SOP-HN-IT-003, *IT System Security*.
- 20.1.5 Equipment that has been shown or is suspected to be defective is:
  - 20.1.5.1 Removed from service
  - 20.1.5.2 Isolated or clearly labeled as “Out of Service”
  - 20.1.5.3 Repaired or replaced
  - 20.1.5.4 Validated according to Section 20.1.3
  - 20.1.5.5 Returned to service
  - 20.1.5.6 If shown that previous tests have been affected, procedures for non-conforming work must be followed.
- 20.1.6 Maintenance logbooks are assigned to each piece of equipment used to generate test results in accordance with SOP-HN-EQ-004, *Preventative Maintenance*. Maintenance logbooks document:
  - 20.1.6.1 Identity of equipment
  - 20.1.6.2 Manufacturer, type, and serial number (or unique identifier)
  - 20.1.6.3 Records of preventative maintenance
  - 20.1.6.4 Any modification(s) to the instrument
  - 20.1.6.5 Any malfunction of the instrument and associated repair
- 20.1.7 A separate LIMS module documents the following instrument information:
  - 20.1.7.1 Date place acquired and placed in service

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- 20.1.7.2 Condition, if known (new, used, refurbished)
  - 20.1.7.3 Applicable service contract

## 20.2 Support Equipment

- 20.2.1 Support equipment includes, but is not limited to: balances, ovens, refrigerators, freezers, incubators, water baths, temperature measuring devices, volumetric dispensing devices, and thermal/pressure sample preparation devices.
- 20.2.2 All support equipment is maintained in proper working order, and all raw data records are retained to document equipment performance.
- 20.2.3 All support equipment is calibrated or verified annually using NIST traceable references where available.
- 20.2.4 Support equipment such as balances, ovens, refrigerators, freezers, and water baths are checked with a NIST traceable reference if available, each day prior to use, to ensure they are operating within specific criteria.
- 20.2.5 Mechanical volumetric dispensing equipment, including burettes (except Class A glassware), are checked for accuracy quarterly.
- 20.2.6 Glass micro-liter syringes have a certificate attesting to the established accuracy. If the certificate of accuracy for glass micro-liter syringes is not available, the accuracy of the syringe is demonstrated upon receipt and documented.
- 20.2.7 For chemical tests that use autoclaves, the temperature, cycle time, and pressure is documented by use of chemical indicators or temperature recorders and pressure gauges.
- 20.2.8 For microbiology analyses, records for autoclaves used in the laboratory document the following:
  - 20.2.8.1 Temperature demonstration of sterilization continuous monitoring device or maximum registering temperature
  - 20.2.8.2 For each sterilization cycle the (1) record date, (2) contents, (2) maximum temperature reached, (3) pressure, (4) cycle time, and (5) analysts initials
  - 20.2.8.3 Quarterly check of autoclave timing device
  - 20.2.8.4 Annual maintenance check to include a pressure check and calibration of temperature device
- 20.2.9 Various other types of support equipment have requirements based upon application. Refer to the appendix section for specifics.

## 20.3 Instrument Calibration

A summary of calibration procedures by analytical method is located in the appendix section.

### 20.3.1 Initial Instrument Calibration

Initial instrument calibration and continuing instrument calibration verification are an important part of ensuring data of known and documented quality. In general, all initial calibrations are according to method specified criteria documented in the method SOP. The SOPs specify the calibration criteria and require the use of a second source calibration standard for verification. The following guidelines must be followed for all multi-point initial calibrations:

- 20.3.1.1 Unless specified otherwise by the method SOP, a minimum of five calibration levels (six for quadratic regression) will be used.
- 20.3.1.2 Individual calibration points may not be dropped from the middle of the curve.
- 20.3.1.3 The low or high calibration level may be dropped if non-linear. However, the LOQ or UQL must be adjusted accordingly.
- 20.3.1.4 The low calibration must be equal to less than the LOQ.
- 20.3.1.5 Quantitation of results is always determined from the initial calibration unless the test method (or applicable regulation) requires the use of the continuing calibration.
- 20.3.1.6 Reported results falling below the LOQ must be qualified or documented in the case narrative.
- 20.3.1.7 Results greater than the UQL must be diluted or must be considered estimated if reported. If the latter, they must be qualified and documented in the case narrative.
- 20.3.1.8 Sufficient raw data records are retained to allow reconstruction of instrument specific initial calibrations.

### 20.3.2 Continuing Instrument Calibration

The validity of the initial calibration is verified prior to sample analysis through analysis of continuing calibration verification (CCV) standards. Method SOPs specify the calibration criteria and acceptance limits. The following general guidelines apply to continuing calibration verifications:

- 20.3.2.1 Continuing calibration verification is performed at the beginning and end of each analytical batch except for instance where an internal standard is used.
- 20.3.2.2 For methods employing internal standards, continuing verification is performed at the beginning of the analytical batch.
- 20.3.2.3 Continuing calibration verifications are performed at specified time intervals.
- 20.3.2.4 Continuing calibration verifications are performed for all analytical systems that have calibration verification requirements.

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- 20.3.2.6 Calibration is verified for each compound element or other discrete chemical species.
  - 20.3.2.7 Continuing calibration verifications are performed when it is suspected that the analytical system may be out of calibration or may not meet verification acceptance criteria.
  - 20.3.2.8 Calculations and associated statistics for continuing calibration verification are included or referenced in the test method SOP.
  - 20.3.2.9 Sufficient raw data records are retained to reconstruct the continuing calibration verification to the initial calibration.

### 20.3.3 Unacceptable Continuing Instrument Calibration Verifications

- 20.3.3.1 If routine corrective action for continuing instrument calibration verification fails to produce an acceptable consecutive (immediate) verification, a new calibration is performed or acceptable performance is demonstrated after corrective action with two consecutive calibration verifications. For samples analyzed on a system with an unacceptable calibration, results may be reported under the following conditions:
  - 20.3.3.1.1 If the acceptance criteria are exceeded high (high bias) and the associated samples are below detection, the sample results that are non-detects may be reported as non-detects.
  - 20.3.3.1.2 If the acceptance criteria are exceeded low (low bias) and there are samples that exceed the maximum regulatory limit, the sample results exceeding the regulatory limit may be reported.

## **SECTION 21 – MEASUREMENT TRACEABILITY**

Measurement quality assurance comes in part from traceability of standards to certified materials. To ensure traceability of measurements, procedures for tracking of standards are documented in SOP-HN-QS-001, *Reagent and Standard Tracking*.

### 21.1 Purchased Standards

21.1.1 Assignment of a unique tracking ID

21.1.2 Documentation as to:

- Manufacturer or Vendor
- Certification of Analysis
- Lot number
- Receipt date
- Data opened
- Expiration date

21.1.3 Storage requirements (if applicable) are specified in the method SOP.

### 21.2 Prepared Standards

21.2.1 Assignment of unique tracking ID

21.2.2 Documentation as to:

- Tracking IDs of standards & reagents used in preparation
- Amounts and concentrations of standards used
- Final volume and concentration
- Assignment of applicable expiration data
- Identification of analyst association with preparation

21.2.3 Storage requirements (if applicable) are specified in the method SOP.

### 21.3 Metrology Equipment

#### 21.3.1 Balances

21.3.1.1 Procedures for traceability of analytical balances are documented in SOP-HN-QS-001 *Use and Maintenance of Balances*.

21.3.1.2 Balances are serviced and calibrated annually by an independent, approved vendor.

21.3.1.3 ASTM Class 1 weights are used for daily calibration verifications of analytical balances.

21.3.1.4 ASTM Class 1 weights are verified for accuracy by a NVLAP calibration laboratory every five years or less.

### 21.3.2 Thermometers

- 21.3.2.1 Procedures for traceability of temperature measurements are documented in SOP-HN-QS-002, *Thermometer Calibration and Temperature Monitoring*.
- 21.3.2.2 Thermometers are calibrated annually using an ASTM reference thermometer.
- 21.3.2.3 The ASTM thermometer is calibrated every five years or less by a NVLAP calibration laboratory.

*Note: When traceability to SI units is not possible, evidence for correlation of results through inter-laboratory comparisons, performance evaluation data, or independent analysis may be provided.*

## **SECTION 22 – SAMPLE MANAGEMENT**

## 22.1 Sample Receipt

When samples are received at the laboratory, their condition is checked and documented. They are assigned unique identifiers via LIMS and logged into the sample tracking system. In the event of any confusion or noted anomalies, the appropriate Project Manager contacts the client for clarification.

## 22.2 Sample Acceptance

22.2.1 The minimum conditions a sample must meet on receipt are documented in SOP-HN-SM-001 *Sample Receipt and Log-In*.

22.2.2 The following preservation checks are performed and documented upon receipt.

### 22.2.2.1 Thermal preservation:

- a) For temperature preservation, the temperature must be within  $\pm 2^{\circ}\text{C}$  unless otherwise stated.
- b) For samples that require preservation at  $4^{\circ}\text{C}$ , the acceptable range is "from just above freezing to  $6^{\circ}\text{C}$ ".
- c) Samples that are delivered to the lab by courier as they are collected are likely not to have reached a fully chilled temperature. This is acceptable if there is evidence that chilling has begun.
- d) Record on the receipt form if ice is present and the temperature.

### 22.2.2.2 Chlorine checks in microbiological samples from chlorinated water systems are not required if:

22.2.2.2.1 Sufficient sodium thiosulfate is present (to neutralize 5mg/L chlorine for drinking water and 15 mg/L chlorine for wastewater).

22.2.2.2.2 Chlorine residual is checked in the field and documented.

### 22.2.2.3 pH checks

22.2.2.3.1 The pH of samples requiring acid/base preservation is checked upon sample receipt or upon completion of analysis.

22.2.3 If the checks performed upon sample receipt indicate the criteria are not met, then:

- 22.2.3.1 The sample is rejected as agreed with the client,
- 22.2.3.2 The decision to proceed is documented and agreed upon with the client,
- 22.2.3.3 The condition is noted on the Chain of Custody form and/or lab receipt documents, and
- 22.2.3.4 The data are qualified or narrated in the report.

- 22.2.4 Sample submission sheets from the field are maintained by the applicable Project Manager and scanned in Adobe format on the server.
- 22.2.5 Sample acceptance policy is provided to all field crews and is documented as an attachment in the above referenced SOP.

### 22.3 Sample Identification

Samples (including sub-samples, extracts, and digestates) are uniquely identified in a permanent electronic record in order to protect sample integrity and to document receipt of all sample containers.

- 22.3.1 Samples are assigned sequential numbers that reference more detailed information. This information is maintained in the LIMS database and includes:
  - a) Client or project name
  - b) Date and time of sampling
  - c) Date and time of receipt at lab
  - d) Unique laboratory identification number
  - e) Unique field identification
  - f) Initials of recorder
  - g) Analyses requested
  - h) Comments regarding rejection (if any).

### 22.4 Sample Storage

- 22.4.1 Storage conditions are monitored for any required criteria, verified, and the verification recorded in logbooks.
- 22.4.2 Samples are held secure.
- 22.4.3 Samples are stored apart from standards, reagents, food or potentially contaminating sources such that cross-contamination is minimized.
- 22.4.4 All portions of samples, including extracts, digestates, and leachates is maintained according to the required conditions.

### 22.5 Sample Disposal

- 22.5.1 Procedures for sample disposal are documented in SOP-HN-SAF-001, *Waste Disposal Procedures*.
- 22.5.2 Samples are disposed of according to Federal, State, and/or local regulations.

## 22.6 Sample Transport

- 22.6.1 Samples that are transported under the responsibility of the laboratory, where necessary, are done so safely and according to storage conditions. Specific safety operations are addressed outside of this document.

## 22.7 Sampling Records

- 22.7.1 Procedures for sub-sampling within the laboratory are documented in SOP-HN-QS-008, *Sub-Sampling*.
- 22.7.2 If field sampling is completed by laboratory personnel
  - 22.7.2.1 Sampling is based, whenever reasonable or requested by the client, with appropriate statistical methods.
  - 22.7.2.2 Sampling is performed according to the applicable sampling method or relevant SOP
  - 22.7.2.3 Records are maintained of the procedure used, the environmental condition where applicable, sampling location, and identity of field personnel.

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## **SECTION 23 – QUALITY OF TEST RESULTS**

### 23.1 Essential Quality Control Procedures

- 23.1.1 The quality control procedures specified in the test methods are followed by laboratory personnel. In cases where multiple controls are documented, the most stringent are used.
- 23.1.2 Control criteria are based upon guidance documents published by the EPA, Department of Defense, state programs, or contractual obligation.
- 23.1.3 The Holland facility uses the Department of Defense Quality Systems Manual for Environmental Laboratories whenever possible for defined acceptance criteria.
- 23.1.3 For test methods where no acceptance or regulatory criteria exist, acceptance criteria are developed.
- 23.1.4 Control limits that are developed are based upon EPA guidelines (i.e. mean value  $\pm$  3 standard deviations).
- 23.1.5 All essential quality control elements are collected and assessed on an on-going basis.
- 23.1.6 Test results within LIMS are recorded in such a way that trends can be detected.
- 23.1.7 Validity of tests results are continuously monitored through utilization of:
  - 23.1.7.2 Use of certified reference materials or internal secondary reference materials.
  - 23.1.7.2 Participation in proficiency testing programs
  - 23.1.7.3 Replicate testing using the same method
  - 23.1.7.4 Retesting of retained samples (at client request)
- 23.1.8 Written procedures for monitoring quality control, including acceptance criteria, are documented in method SOPs and include:
  - 23.1.8.1 Use of reagents and standards of appropriate quality.
  - 23.1.8.2 Measures to monitor test method capability such as limit of detection, limit of quantitation, and linearity.
  - 23.1.8.3 Use of calibrations, calibration verification, continuing calibrations, and reference materials to monitor accuracy of the test method.
  - 23.1.8.4 Use of laboratory control samples to monitor accuracy and bias of laboratory performance.
  - 23.1.8.5 Use of regression analysis or internal/external standards to reduce instrument output to final results.
  - 23.1.8.6 Use of sterility checks and positive/negative controls for microbiological analyses.

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- 23.1.8.7 Measures to assure constant test parameters such as temperature, humidity, rotation, time, etc. when required by the test method.

## 23.2 Internal Quality Control Practices

Analytical data is generated in unison with specified QC samples that must fall within prescribed acceptance limits in order to be considered acceptable (In Control). QC samples that fall outside the defined limits indicate that the test method is non-conforming (out of control) and that corrective action is required or that the data are qualified.

- 23.2.1 Detailed QC procedures and QC limits are included in text method standard operating procedures (SOPs) and in test code set-up.
- 23.2.2 All QC samples are assessed and evaluated on an on-going basis.
- 23.2.3 The following general controls are used through out the laboratory process.

### 23.2.3.1 Positive and Negative Controls

- 23.2.3.1.1 Blanks (negative)
- 23.2.3.1.2 Blank spikes (positive)
- 23.2.3.1.3 Sterility and culture checks (microbiological)

### 23.2.3.2 Selectivity

- 23.2.3.2.1 Chromatographic retention times (absolute & relative)
- 23.2.3.2.2 Dual column confirmation for non-specific detectors
- 23.2.3.2.3 Method specified tuning criteria
- 23.2.3.2.4 Utilization of accepted methodologies
- 23.2.3.2.5 Utilization of reference cultures (microbiological)

### 23.2.3.3 Accuracy, Variability, and Consistency

- 23.2.3.3.1 Monitoring and control of environmental conditions
- 23.2.3.3.2 Proper installation/operation of instruments
- 23.2.3.3.3 Utilization of appropriate reagent and standard quality
- 23.2.3.3.4 Utilization of properly cleaned and dried glassware
- 23.2.3.3.5 Adherence to SOPs
- 23.2.3.3.6 Defined acceptance criteria for accuracy
- 23.2.3.3.7 Defined acceptance criteria for variability

### 23.2.3.4 Method Capability

- 23.2.3.4.1 Annual verification for limit of detection where appropriate

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- 23.2.3.4.2 Defined method reporting limit
  - 23.2.3.4.3 Established range of applicability (linearity)

#### 23.2.3.5 Data Reduction

- 23.2.3.5.1 Utilization of appropriate algorithm for data reduction
- 23.2.3.5.2 Peer review of data reduction process
- 23.2.3.5.3 Periodic audits of data reduction process

### 23.3 Method Blanks

Blank acceptance criteria are defined in the test method SOPs or laboratory documentation. Samples associated with a contaminated blank are evaluated as to the appropriate corrective action for the samples (e.g. reprocessing or data qualification).

23.3.1 Blank contamination is identified when analyte results are:

- 23.3.1.1 Greater than the reporting limit, or
- 23.3.1.2 Greater than 5% of the sample concentration or
- 23.3.1.3 Greater than 5% of the regulatory limit

23.3.2 When blank contamination is determined, the cause must be investigated and corrective action taken to eliminate the problem.

23.3.3 Data that are unaffected by the blank contamination are reported unqualified.

23.3.4 Data that are suspect due to blank contamination are reanalyzed or qualified.

### 23.4 Laboratory Control Samples

Laboratory Control Samples (LCS) are prepared from an analyte free matrix, and spiked with a known amount of analyte for the purpose of establishing precision or bias measurements within the laboratory environment. Laboratory control samples are analyzed at a frequency specified by the SOP, mandated by regulation, or requested by the client whichever is more stringent.

23.4.1 Results of laboratory control samples (LCS) are calculated in percent recovery.

23.4.2 Calculations for percent recovery determination are documented in the method SOP.

23.4.3 If recovery criteria are not achieved, the cause must be investigated and corrective action taken to eliminate the problem.

23.4.4 Data that are unaffected by the recovery failure (as specified in the method SOP) are reported unqualified.

- 23.4.5 Data that are suspect due to recovery failure are reanalyzed or qualified.

### 23.5 Matrix Spikes and Matrix Spike Duplicates

Matrix spikes (MS and MSD) are environmental samples fortified with a known amount of analyte to help assess the affect of the matrix on method performance.

- 23.5.1 Laboratory procedure for MS/MSD are documented in the applicable SOP and includes spiking of appropriate analytes at appropriate concentrations, calculating percent recoveries, calculating relative percent difference (RPD), and evaluating results.
- 23.5.2 Acceptance criteria are developed from control charting, program recommendation, or regulatory criteria.
- 23.5.3 MS/MSD accuracy measurements falling outside acceptance criteria do not require corrective action.
- 23.5.4 MS/MSD precision measurements falling outside acceptance criteria require investigation and corrective action to eliminate the problem.
- 23.5.5 Data that are suspect due to MS/MSD precision failure are reanalyzed or qualified.

### 23.6 Surrogate Spikes

Surrogates are substances with chemical properties and behaviors similar to the analytes of interest that are used to assess method performance in individual samples.

- 23.6.1 Surrogates are added to all samples (where surrogate use is appropriate) prior to sample preparation or extraction.
- 23.6.2 Surrogate recovery results are compared to the acceptance criteria as published in the mandated test method.
- 23.6.3 Surrogate results falling outside established criteria are evaluated to determine the impact on results and if any further action is required.

### 23.7 Proficiency Test Samples

The laboratory participates in proficiency test (PT) programs approximately every six (6) months. Results are evaluated independently.

- 23.7.1 Samples submitted for Proficiency Testing are treated as typical samples in the normal production process.
- 23.7.2 The laboratory does not communicate with other laboratories and does not attempt to obtain the assigned values of any PT sample from the provider.
- 23.7.3 The laboratory institutes corrective action procedures for failed PT samples.

## 23.8 Data Review

The laboratory reviews all data generated in the laboratory for compliance with method, laboratory and, where appropriate, client requirements. All data review is documented through the use of data checklists.

- 23.8.1 The primary analyst reviews data for acceptability of quality control measures and accuracy of the final result(s).
- 23.8.2 A peer analyst reviews all manual transfers, calculations of data, and electronic transfers of data.
- 23.8.3 Final reports are reviewed for comparison to historical data and client specification prior to release.
- 23.8.4 Procedures for data review are documented in SOP-HN-QS-009 *Data Review and Validation*.

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## **SECTION 24 – REPORTING OF RESULTS**

The result of each test carried out is reported accurately, clearly, unambiguously, and objectively. Data are reported without qualification if they are: (1) greater than the lowest calibration standard, (2) lower than the highest calibration standard, and (3) without compromised sample or method integrity. Report formats are designed to accurately report each type of test performed and to minimize potential for misunderstanding or misuse.

### 24.1 Test Reports

24.1.1 Procedures for the formatting of test results are documented in SOP-HN-ADM-005, *Report Formatting*.

24.1.2 Each test report contains the following information

- 24.1.2.1 Report Title
- 24.1.2.2 Name and address of the laboratory
- 24.1.2.3 Name and telephone of the laboratory contact
- 24.1.2.4 Total number of pages with unique identification of each page
- 24.1.2.5 Name and address of the client
- 24.1.2.6 Project identification
- 24.1.2.7 Client sample identification
- 24.1.2.8 Laboratory sample identification
- 24.1.2.9 Date and time of sample collection
- 24.1.2.10 Date of sample receipt
- 24.1.2.11 Date of sample analysis
- 24.1.2.12 Identification of sampling method (if applicable)
- 24.1.2.13 Any deviations or anomalies that affect quality of the reported results.
- 24.1.2.14 Definitions of flags and/or qualifiers
- 24.1.2.15 Measurement results with appropriate units
- 24.1.2.16 Notation as to wet or dry weight basis
- 24.1.2.17 Clear identification of results provided by outside sources
- 24.1.2.18 Signature and title of PM responsible for issuing the report
- 24.1.2.19 Date of issue
- 24.1.2.20 Statement that results relate only to items tested or received by the laboratory
- 24.1.2.21 Statement that the report shall not be reproduced except in entirety w/o written approval of the laboratory
- 24.1.2.22 Identification of NELAC approval where applicable

### 24.2 Supplemental Test Report Information

24.2.1 When necessary for interpretation of the results or when requested by the client, test reports include the following additional information. This

information may be in the case narrative or provided as a report addition.

- 24.2.1.1 Deviations from, additions to, or exclusions from the test method that may have affected the quality of the results, and any information on the use of associated data qualifiers.
- 24.2.1.2 A statement of compliance/non-compliance when requirements of the quality systems are not met, including identification of test results that did not meet NELAC sample acceptance requirements, such as holding time, preservation, etc.
- 24.2.1.3 Where applicable and if requested, a statement on the estimated uncertainty of the measurement.

### 24.3 Test Reporting from Subcontractors

- 24.3.1 Test results obtained from test performed by subcontractors are clearly identified on the test report.
- 24.3.2 Test results from subcontractors are reported in writing or electronically with a copy of the subcontractor's report attached.

### 24.4 Electronic Transmission of Results

- 24.4.1 All test results transmitted by telephone, fax, telex, e-mail, or other electronic means comply with the requirements of SOP-HN-GEN-004, *Client Confidentiality* to protect the confidentiality and proprietary rights of the client.

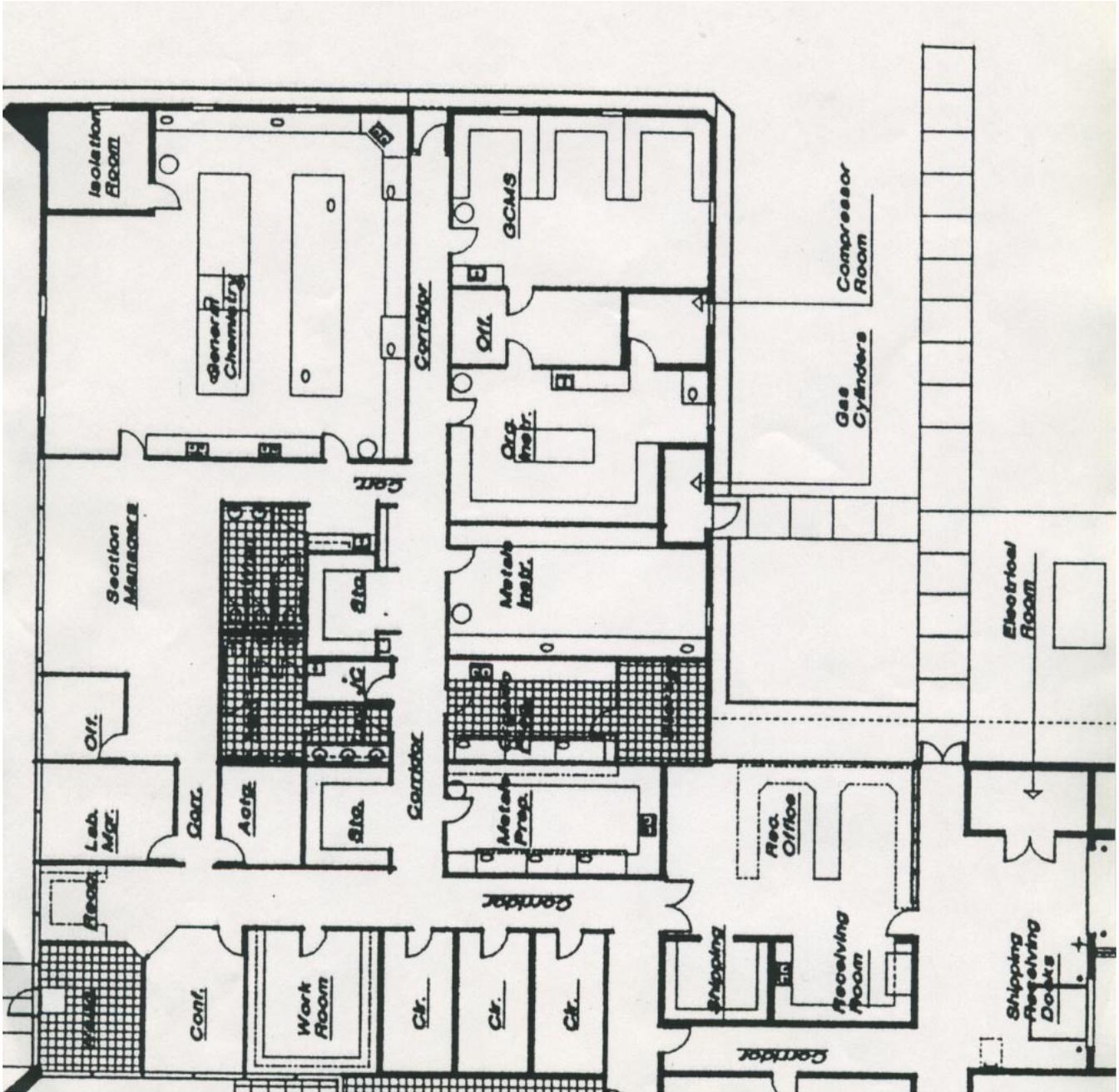
### 24.5 Amendments to Test Reports

- 24.5.1 Material amendments to a test report after it has been issued are made only in the form of another document or data transfer.
- 24.5.2 Supplemental reports meet all the requirements for the initial report and the requirements of this Quality Manual.
- 24.5.3 Amended reports are clearly labeled to ensure that they can be clearly identified from the original.
- 24.5.4 If necessary to issue a new report, the report is clearly identified and references the original.

**SECTION 25 - APPENDICES**

Floor Plan  
Equipment Listing  
Preventative Maintenance  
Calibration & Maintenance Schedule  
Standard Operation Procedures  
Containers, Preservation, & Holding Times  
QC Summary  
External Documents  
Internal Documents  
Analytical Method Listing

## Appendix A: Holland, MI Floor Plan



## Appendix B: Holland, MI Equipment Listing

Item Description	Manufacturer/Serial Number	Laboratory Location
GC with FID/NPD	Agilent / US10207072	SeHN-Volatile Lab
GC with ECD/ECD	Agilent / US10203042	SeHN-Volatile Lab
GC with ECD/ECD	Agilent / CN10637072	SeHN-Volatile Lab
GC/MSD (VMS1)	HP / 3234A03769	Volatile Lab
Archon Autosampler	OI / 89-051B	Volatile Lab
Velocity P&T Concentrator	OI / 90-601F	Volatile Lab
GC/MSD (VMS5)	Agilent / US81221566	Volatile Lab
Archon Autosampler	Tekmar / US02101014	Volatile Lab
Velocity P&T Concentrator	Tekmar / US02168011	Volatile Lab
GC/MSD (VMS6)	Agilent / 3034A12794	Volatile Lab
Archon Autosampler	Tekmar / 98215003	Volatile Lab
Velocity P&T Concentrator	Tekmar / 98117007	Volatile Lab
GC/MSD (SMS4)	Agilent / US81221553	Semi-Volatile Lab
GC/MSD (SMS5)	Agilent / US21842869	Semi-Volatile Lab
HPLC	HP / 3040A00683	Semi-Volatile Lab
Soxtec Extraction Units (2)	Foss	Organic Extraction Lab
Turbo-Vap (2)	Zymark	Organic Extraction Lab
UV/VIS (2)	GenSys 20	General Chemistry
IC with Autosampler	Dionex / 00120650	General Chemistry
TOC Analyzer	OI / B335751301	General Chemistry
QuikChem 8500	Lachat / 050800000185	General Chemistry
Karl Fischer Apparatus	Metrohm 787 / 11230249	General Chemistry
AOX Analyzer (ECS 1200)	Thermo / 2005.0266	General Chemistry
Available Cyanide (FS3100)	OI/816831310	General Chemistry
ICP-MS	Agilent / JP14100998	Metals
ICP-MS	Agilent / JP51202032	Metals
Mercury Analyzer	CETAC / 10002MAS	Metals
Flash Point (closed cup)	Boekel 152800	General Chemistry
Hot Block Digesters (6)	Environmental Express / CPI	General & Metal Digestion Lab
Analytical balances (4)	Mettler (2), Ohaus (1), Sartorius (3)	Various

Item Description	Manufacturer/Serial Number	Laboratory Location
Specific Ion/pH Meter (2)	Orion & Oakton	General Chemistry
Top Loading balance (2)	Ohaus	General & Organic Extraction
Ovens (4)	Various	General Chemistry
Incubators (2)	Various	General Chemistry
Autoclave	National – SterilQik	General Chemistry
8'x10' Walk-in Refrigerator (3)	KolPak	Sample Receiving
Refrigerators (4)	Various	Volatile Lab
DI Water System	Continental Water System	General & Extraction Labs
LIMS Database	Khemia Omega II	Information Technology
Computer Servers (1)	Dell	Information Technology

## Appendix C: Preventative Maintenance

Instrument	Activity	Frequency	Service Contract/Warranty
Refrigerators and Coolers	Record temperature	Daily	Service contract on Walk-in Coolers only
	Clean coils	Annually	
	Check coolant	Annually or if temperature outside limits	
Vacuum Pumps	Clean and change pump oil	Every 6 months or as needed	No
Fume Hoods	Face velocity measured	Annually	Service Contract
	Sash operation	As needed	
	Certified	Annually	
Autoclave	Check Door Gasket	Each Day of Use	No
	Replace Door Gasket	Annually or as needed	
	Check Timing Device	Quarterly	
	BT Sure® Sterilization Check	Monthly	
Ovens	Clean	As needed or if temperature outside limits	No
Analytical Balances	Check alignment	Before every use	No
	Check calibration	Before every use	
	Clean pans and compartment	After every use	
	Certified	Annually	
Gas Chromatographs/ Mass Spectrometers	Check gas supplies	Daily, replace when pressure reaches 100 psi	Service Contract
	Change in-line filters	Quarterly or after 30 tanks of gas	
	Change septum	Daily	
	Change injection port liner/gold seal	Weekly or as needed	
	Clip first foot of capillary column	As needed	
	Change guard column	As needed	
	Replace analytical column	As needed when peak resolution fails	
	Clean Source	As needed when tuning problems	
	Change pump oil	Every six months	
Oil wick	Every six months		
ICP-MS	Check Argon supply	Daily	Service Contract & Warranty

<b>Instrument</b>	<b>Activity</b>	<b>Frequency</b>	<b>Service Contract/Warranty</b>
	Check sample tubing Check instrument tubing	Daily Daily	
Hg CVAA	Check Nitrogen supply Check tubing for sample and reagents Check drying tube Check Mercury trap	Daily Daily When needed or monthly Monthly or as needed	Service Contract
Printers	Change toner Clean printer internal parts Change pick-up roller wheels	As needed As needed As needed	No
Copier	Change toner Routine maintenance	As needed As needed	Service Contract

## Appendix D: Calibration & Maintenance Schedule

Calibration And Maintenance Schedule			
Instrument	Activity	Frequency	Documentation
pH electrometers	Calibration: 1. pH buffer aliquot are used only once 2. Buffers used for calibration will bracket the pH of the media, reagent, or sample tested.	Before use	Worksheet/log book
pH probe	Maintenance: Use manufacturer's specifications	As needed	Worksheet/log book
Spectrophotometer.	1. Keep cells clean 2. Service contract. Check wavelength settings with color standards	Annually	Post service date on Unit
Refrigerators, Freezers, and BOD incubators	1. Thermometers are immersed in liquid to the appropriate immersion line 2. The thermometers are graduated in increments of 1°C or less	Temperatures are recorded each day in use	Worksheet/log book
DO electrometer	Calibrate as specified in SOP	Before use	Worksheet/log book
DO probe	Maintenance as specify by manufacturer	As needed	Worksheet/log book
CETAC Mercury Analyzer	Check tubing for wear Fill rinse tank with 10% HCl Insert clean drying tube filled with Magnesium Perchlorate Fill reductant bottle with 10% Stannous Chloride	Daily Daily Daily Daily	Worksheet/log book
UV-Vis Spectrophotometer	Clean cell Precision check/alignment Wavelength verification check	As required As required Annually	Worksheet/log book
ICP/MS	Check pump tubing Check liquid argon Check fluid level Check filters Clean or replace filters Check torch Check sample spray chamber for debris Clean and align nebulizer Check entrance slit for debris Replace pump tubing	Daily Daily Daily Weekly As required Daily Monthly Monthly Monthly As required As required	Worksheet/log book

<b>Calibration And Maintenance Schedule</b>			
<b>Instrument</b>	<b>Activity</b>	<b>Frequency</b>	<b>Documentation</b>
GC/MS Systems	Ion gauge tube degassing Pump oil-level check Pump oil changing Analyzer bake-out Analyzer cleaning Resolution adjustment Computer maintenance	As required Monthly Annually As required As required As required As required	Worksheet/log book
Electron Capture Detector (ECD)	Detector wipe test (Ni-63) Detector cleaning	Semi-annually As required	Worksheet/log book
Gas Chromatograph	Compare standard response to previous day or since last initial calibration Check carrier gas flow rate in column Detector, inlet, column oven temperature check Septum replacement Glass wool replacement Check system for gas leaks Check wiring integrity Bake injector/column Guard column maintenance Replace connectors/liners Change/replace column(s)	Daily  Daily via use of known RT Daily  As required As required W/cylinder change Monthly As required As required As required As required	Worksheet/log book
Flame Ionization Detector (FID)	Detector cleaning	As required	Worksheet/log book
HPLC	Change guard columns Change lamps Change pump seals Replace tubing Change fuses in power supply Filter all samples and solvents	As required As required As required As required As required  Daily	Worksheet/log book
TOC Analyzer	Check Sample Delivery Tubing Check Gas and Reagent supplies Replace Catalyst IR Detector cleaning	Daily Daily As required  As required As required	Worksheet/log book
Balances	Class "S" traceable weight check Clean pan and check if level Field service	Daily, when used  Daily Annually	
Conductivity Meter	0.01 M KCl calibration Conductivity cell cleaning	Daily, when used	

<b>Calibration And Maintenance Schedule</b>			
<b>Instrument</b>	<b>Activity</b>	<b>Frequency</b>	<b>Documentation</b>
		As required	
Turbidimeter	Check light bulb	Daily, when used	
Deionized/Water	Check resistance Check deionizer light Monitor for VOA's Replace mixed bed resins	Daily Daily Daily As required	
Drying Ovens	Temperature monitoring Temperature adjustments	Daily As required	
Refrigerators/ Freezers	Temperature monitoring Warning system checked Temperature adjustment Defrosting/cleaning	Daily Monthly As required As required	
pH/Specific Ion Meter	Calibration/check slope Clean electrode	Daily As required	
BOD Incubator	Temperature monitoring Coil and incubator cleaning	Daily Monthly	

## Appendix D: Standard Operating Procedures

SOP Number	Rev Number	SOP Title
		<b>General</b>
HN-GEN-001	6	Preparation of Standard Operating Procedures
HN-GEN-002	2	Laboratory Ethics, Accountability, & Responsibility
HN-GEN-003	2	Glassware Cleaning
HN-GEN-004	2	Client Confidentiality & Electronic Data Transfer
HN-GEN-005	3	Departures from Documented Procedures
HN-GEN-006	4	Resource Review
HN-GEN-007	2	Subcontract Sample Submittal
HN-GEN-008	3	QC Criteria Development
HN-GEN-009	2	Management/Control of Standard Operating Procedures
HN-GEN-010	2	Procurement of Services & Materials
		<b>Administrative</b>
HN-ADM-003	3	Work Order Reporting
HN-ADM-004	3	Complaint Resolution
HN-ADM-005	2	Report Formatting
		<b>Quality Assurance</b>
HN-QS-001	3	Chemical Purchase, Receipt, Preparation, Storage, & Tracking
HN-QS-002	3	Report Revisions
HN-QS-003	3	Non-Conformance & Corrective Action Reporting
HN-QS-004	2	Control Charting
HN-QS-005	2	Validation of New Instruments & Methods
HN-QS-006	2	Method Detection and Method Quantitation Limits
HN-QS-007	2	Reagent Water
HN-QS-008	3	Sub-Sampling & Composite Samples
HN-QS-009	2	Data Reduction, Review, & Validation
HN-QS-010	2	Laboratory Calculations & Significant Figures
HN-QS-011	3	Record Archival
HN-QS-012	4	Internal Audits
HN-QS-013	2	Employee Training
HN-QS-014	3	Laboratory Record Control Procedures
HN-QS-015	2	Data Integrity System
HN-QS-016	3	Manual Integration Policy
HN-QS-017	2	Quality Assurance Management Review
HN-QS-018	3	Sporadic Marginal Exceedance

HN-QS-019	2	Calibration Procedures for Chromatographic Methods
HN-QS-020	2	Batch QC Data Evaluation
HN-QS-021	2	Spectral & Photometric Calibration Procedures
HN-QS-022	2	Estimation of Measurement Uncertainty
		<b>Sample Management</b>
HN-SM1001	5	Sample Receipt Procedures
HN-SM-002	2	Bottle Order
HN-SM-003	2	Sample Log-In Procedures
		<b>Information Technology</b>
HN-IT-001	3	Data Integrity & Verification
HN-IT-002	2	Software Installation & Maintenance
HN-IT-003	3	IT Security
HN-IT-004	2	Test Code Management
HN-IT-005	1	Electronic Time Changes
		<b>Equipment</b>
HN-EQ-001	3	Balance Calibration & Use
HN-EQ-002	5	Thermometer Calibration & Temperature Monitoring
HN-EQ-003	2	Lab Volumetric Ware Calibration
HN-EQ-004	5	Preventative Maintenance
		<b>Safety</b>
HN-SAF-001	2	Waste Disposal Procedures
		<b>Microbiology</b>
HN-MB-001	4	Autoclave Maintenance
HN-MB-002	5	Sterilization Procedures
HN-MB-003	3	Buffered Dilution Water
HN-MB-021	1	Total & Fecal Coliform by ColiLert
HN-MB-022	1	E. Coli Membrane Filter
HN-MB-023	1	Heterotrophic Plate Count
HN-MB-024	1	General Coliform & E. Coli by Coliscan
		<b>Metals</b>
HN-MET-005	3	Mercury Analysis of Aqueous Samples
HN-MET-006	2	Mercury Analysis of Solid Samples
HN-MET-007	2	Soil Fractionation for Lead Analysis
HN-MET-008	4	Metals Analysis by ICP-MS
HN-MET-009	2	ICP-MS Solids Digestion

HN-MET-010	2	ICP-MS Aqueous Digestion
		<b>Wet Chemistry</b>
HN-WC-000	1	Anions by Ion Chromatography
HN-WC-001	4	Alkalinity
HN-WC-002	3	Total Organic Carbon
HN-WC-003	4	Phosphorus by FIA
HN-WC-004	6	Oil & Grease
HN-WC-005	7	BOD - CBOD
HN-WC-007	3	Chloride
HN-WC-008	6	Hexavalent Chromium
HN-WC-009	2	pH Measurement
HN-WC-010	6	Total Suspended, Volatile, and Dissolved Solids
HN-WC-011	3	Total and Fixed Solids
HN-WC-012	2	Nitrite (Colorimetric)
HN-WC-014	6	Cyanide
HN-WC-015	4	Reactive Cyanide
HN-WC-016	5	Total Kjeldahl Nitrogen
HN-WC-019	4	Specific Conductance
HN-WC-020	4	COD
HN-WC-021	3	Residual Chlorine
HN-WC-022	3	Flash Point P-M Closed Cup
HN-WC-023	2	Alkaline Digestion for Cr6
HN-WC-024	2	Karl Fischer Water Determination
HN-WC-025	2	Methyl Blue Anionic Surfactants
HN-WC-026	2	Sulfide, Rx Sulfide, & Acid Soluble Sulfides
HN-WC-027	2	Ammonia by FIA
HN-WC-028	2	TOX & AOX Determination
HN-WC-029	2	Phenols by FIA
HN-WC-030	1	Fluoride by ISE
HN-WC-031	1	Acidity
HN-WC-032	1	Nitrate/Nitrite by FIA
HN-WC-033	1	TOC by Walkley Black
		<b>Extraction</b>
HN-EXT-001	4	Liquid-Liquid Extraction (Separatory Funnel)
HN-EXT-002	2	Soxhlet Extraction of Solid Samples
HN-EXT-003	1	Automated Soxhlet Extraction of Solid Samples
HN-EXT-004	3	TCLP Extraction of Nonvolatiles
HN-EXT-005	1	TCLP Extraction for Volatiles
HN-EXT-006	Draft	SPLP Extraction for Nonvolatiles

HN-EXT-007	Draft	SPLP Extraction for Volatiles
		<b>GC/HPLC</b>
HN-GC-001	3	Pesticides
HN-GC-002	4	PCBs
		<b>GC/MS</b>
HN-SMS-001	4	Semi-Volatiles by GC/MS
HN-VMS-001	4	Volatiles by GC/MS
		<b>Field Procedures</b>
HN-FLD-001	2	Surface Water Sampling
HN-FLD-002	3	Ground Water Sampling
HN-FLD-003	3	Soil & Sediment Sampling
HN-FLD-004	3	Low Level Hg Sampling

## APPENDIX E – Containers, Preservation and Holding Times

Parameter	Containers <sup>1</sup>	Preservative	Holding Time <sup>2</sup>
Acidity / E305.1	P, G - 250 ml	4 ° C	14 days
Alkalinity / SM 2320B – E310.1	P, G - 250 mL	4 ° C	14 days
Ammonia as N	P, G – 500 mL	4 ° C; H <sub>2</sub> SO <sub>4</sub> to pH<2	28 days
Biological Oxygen Demand (BOD)	P, G – 1000 mL	4 ° C	48 hours
(Carbonaceous) Biological Oxygen Demand (CBOD)	P, G – 1000 mL	4 ° C	48 hours
Bromide	P, G – 500 mL	None required	28 days
(Total Organic) Carbon (TOC) / SW 9060	P, G – 250 mL	4 ° C; HNO <sub>3</sub> or H <sub>2</sub> SO <sub>4</sub> to pH<2	28 days
Chemical Oxygen Demand (COD)	P, G – 500 mL	4 ° C; H <sub>2</sub> SO <sub>4</sub> to pH<2	28 days
Chloride	P, G – 500 mL	None required	28 days
Color	P, G – 500 mL	4 ° C	48 hours
Conductivity (Spec. Conductance)	P, G – 250 mL	4 ° C	28 days
(Reactive) Cyanide	P, G – 4 oz wm	None required	14 days
Cyanide (Total and Amenable to Chlorination)	P, G - 1000 mL	4 ° C; NaOH to pH>12; 0.6g ascorbic acid	14 days
Cyanide (Total or Reactive) / Soil	P, G – 100 g in 250-ml wm bottle.	4 ° C	14 days
Fluoride	P – 250 mL	None required	28 days
Hardness	P, G – 250 mL	HNO <sub>3</sub> or H <sub>2</sub> SO <sub>4</sub> to pH<2	6 months
Nitrate as N	P, G – 250 mL	4 ° C	48 hours
Nitrate-Nitrite as N	P, G – 250 mL	4 ° C; H <sub>2</sub> SO <sub>4</sub> to pH<2	28 days
Nitrite as N	P, G – 250 mL	4 ° C	48 hours
(Total Kjeldahl) Nitrogen	P, G – 250 mL	4 ° C; H <sub>2</sub> SO <sub>4</sub> to pH<2	28 days
Oil and Grease	G – 1000 mL wm	4 ° C; H <sub>2</sub> SO <sub>4</sub> to pH<2	28 days
pH (hydrogen ion)	P, G – 250 mL	None required	analyze immediately
(Total) Phenols (wet method)	G / amber – 1000 mL	4 ° C; H <sub>2</sub> SO <sub>4</sub> to pH<2	28 days

Parameter	Containers <sup>1</sup>	Preservative	Holding Time <sup>2</sup>
( <i>ortho</i> -) Phosphate	P, G – 250 mL	Filter immediately; 4 ° C	48 hours
(Total) Phosphate	P, G – 250 mL	4 ° C; H <sub>2</sub> SO <sub>4</sub> to pH<2	28 days
Residue (Total Solids)	P, G – 500 mL	4 ° C	7 days
Residue (Dissolved Solids) (TDS)	P, G – 500 mL	4 ° C	7 days
Residue (Suspended Solids) (TSS)	P, G – 500 mL	4 ° C	7 days
Residue (Settleable)	P, G – 1000 mL	4 ° C	48 hours
Residue (Total Volatile) (TVS)	P, G – 500 mL	4 ° C	7 days
Residue (Volatile Suspended) (TVSS)	P, G – 500 mL	4 ° C	7 days
Silica	P – 500 mL	4 ° C	28 days
Chromium VI	P, G – 250 mL	4 ° C	24 hours
Chromium VI (soil)	P, G – 4 oz wide mouth	None	24 hours
Mercury	P, G – 500 mL	HNO <sub>3</sub> to pH<2	28 days
Mercury (soil)	P, G – 4 oz wm bottle	None	28 days
Metals (except Chromium IV and Hg)	P, G – 1000 mL	HNO <sub>3</sub> to pH<2	6 months
Metals (soil)	P, G – 50 g	None	6 months
TCLP Mercury	P, G – 1000 mL	4 ° C	28 days to extract; 28 days after extraction to analysis
TCLP Metals (except Mercury)	P, G – 1000 mL	4 ° C	180 days to extract; 180 days after extraction to analysis
Dioxins (TCDD)	G – 2 x 1L amber	4 ° C; 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> if Cl <sub>2</sub> is present	7 days to extract; 40 days after extraction to analysis
Pesticides in Soil (Organochlorine) 8081B	G, 4 oz wide mouth	4 ° C	7 days to extract; 40 days after extraction to analysis
Pesticides – water (Organochlorine)/8081B	Amber G, 2 x 1L	4 ° C; adjust pH to 4-5	7 days to extract; 40 days after extraction to analysis
PCBs in Soil SW 8082A	G, 4 oz wide mouth	4 ° C	7 days to extract; 40 days after extraction to analysis
PCBs in water SW 8082A / EPA 608	Amber G; 2 x 1L	4 ° C; adjust pH to 4-5	7 days to extract; 40 days after extraction to analysis

Parameter	Containers <sup>1</sup>	Preservative	Holding Time <sup>2</sup>
(Total) Petroleum Hydrocarbons (TPH) Water – by TX 1005	G – 2 x 40 mL with no headspace	4 °C; HCl to pH<2	14 days to extract; 14 days after extraction to analysis
Polynuclear Aromatic Hydrocarbons (PAHs) / (soil)	G, 4 oz wide mouth	4 ° C; store in the dark	14 days to extract; 40 days extraction to analysis
Polynuclear Aromatic Hydrocarbons (PAHs) by 8270 (water)	Amber G; 2 x 1L	4 ° C	7 days to extract; 40 days after extraction to analysis
Semi-Volatiles (BNAs) in soil	G, 4 oz wide mouth	4 ° C	7 days to extract; 40 days after extraction to analysis
Semi-Volatiles (BNAs)	Amber G, 2 x 1L	4 ° C	7 days to extract; 40 days after extraction to analysis
Semi-Volatiles (TCLP)	G, 4 oz wide mouth	4 ° C	14 days to TCLP extraction; 7 days from TCLP extraction to BNA extraction; 40 days after BNA extraction to analysis
Total Organic Halogens (TOX) / SW9020	Amber G, 250mL	4 ° C; H <sub>2</sub> SO <sub>4</sub> to pH<2	28 days
Volatiles (water) SW 8260B	G – 3 x 40 mL with no headspace	4 ° C; HCl to pH<2	14 days
Volatiles (TCLP)	G, 2 x 4 oz wide mouth	4 ° C	14 days to extract; 14 days after extraction to analysis
Volatiles (low level soil by 5035A, where soil likely contain VOCs < 200 ppb)	Collect sample using approved coring device (EnCore, etc) or field preserve 5 gram sample in pre-tared 40 ml VOA vial, containing 5ml of organic free water, 1g sodium bisulfate & stir bar	4 ° C; or freeze <sup>3</sup> samples to –12 to –20 ° C as an alternative to preservation with sodium bisulfate as a means to inhibit biodegradation.	48 hrs to transfer contents of core device to a 40 ml VOA vial , containing 5ml of organic free water, 1g sodium bisulfate & stir bar; analyze transferred sample 14 days from collection
Volatiles (high level soil by 5035A, where soil may contain VOCs >200 ppb)	Collect sample using approved coring device (EnCore, etc) or field preserve samples in pre-tared	4 ° C; or freeze <sup>3</sup> samples to –12 to 20 ° C as an alternative to preservation with methanol as a means	48 hrs to transfer contents of core device to a 40 ml VOA vial , containing 10 ml of purge and trap grade

<b>Parameter</b>	<b>Containers <sup>1</sup></b>	<b>Preservative</b>	<b>Holding Time <sup>2</sup></b>
	60 ml glass bottles with methanol	to inhibit biodegradation.	methanol; analyze methanol preserved sample 14 days from collection
Volatiles (Soil)	G, 2 oz wide mouth	4 ° C	14 days
Alpha, Beta, and Radium	P, G – 1000 mL	HNO <sub>3</sub> to pH<2	6 months

<sup>1</sup> (P) polyethylene/plastic; (G) Glass

<sup>2</sup> Recommended Holding Times from 40CFR136 and/or USEPA SW-846.

<sup>3</sup> Option to freeze core soil must be approved by regulatory agency or QA Project Plan.

## Appendix F: QC Summary

<b>Table F.1 Calibration Summary &amp; QC Procedures - Colorimetric Methods</b>			
<b>QC Check</b>	<b>Minimum Frequency</b>	<b>Acceptance Criteria</b>	<b>Corrective Action</b>
Initial multipoint calibration (minimum 5 standards and a blank).	initial calibration prior to sample analysis.	Correlation coefficient >0.995 for linear regression.	Correct problem then repeat initial calibration.
Second-source calibration check standard.	Once per initial calibration, prior to sample analysis.	Analyte within $\pm 10\%$ of expected value.	Correct problem then repeat initial calibration.
Calibration verification.	After every 15 samples and at the end of the analysis sequence.	The analyte within $\pm 10\%$ of expected value.	Correct problem then repeat ICAL or CCV and reanalyze all samples since last successful CCV.
Demonstrate ability to generate acceptable accuracy and precision using four replicate LCS.	Once per analyst.	QC acceptance criteria, Table G.1.1	Recalculate results; locate and fix system problem and rerun demonstration for analytes that did not meet criteria.
Method blank.	One per prep batch.	No analyte detected Above $\frac{1}{2}$ LOQ. or $> 5\%$ of regulatory limit or $> 5\%$ of target analyte detected in a sample.	Correct problem then reprep and analyze method blank and all samples in the affected batch.
LCS for the analyte.	One LCS per prep batch.	QC acceptance criteria, Table G.1.1	Correct problem then reprep and analyze the LCS and all samples in the affected prep batch.
MS/MSD.	One MS/MSD per every 20 field samples per matrix.	QC acceptance criteria, Table G.1.1; $RPD \leq 20\%$	Describe in Laboratory Review Checklist.
LOD study.	Once per 12 month period.	LODs established shall be $< 1/2$ the LOQs in Table F.1	None.

**Table F.2 Calibration Summary and QC Procedures for EPA Method 300.0 / SW9056A**

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Minimum five-point initial calibration for all analytes.	Initial calibration prior to sample analysis.	Calibration factor or Linear least squares regression - $r \geq 0.995$	Correct problem then repeat initial calibration.
Second-source (ICV) calibration verification, all analytes.	Once per five-point initial calibration.	All analytes within $\pm 10\%$ of expected value.	Correct problem then repeat initial calibration.
Retention time window verified for each analyte.	Each initial calibration	Verify RT $\pm 3$ times standard deviation for each analyte average retention time over 8 to 24 hr period after ICAL. CCVs must fall within the RT window	Correct problem then reanalyze all samples analyzed since the last retention time check.
Calibration verification (CCV and CCB)	CCV and CCB after every 10 injections and at the end of the analysis sequence.	All analytes within $\pm 10\%$ of expected value for CCV; no analytes in CCB above 2-3 times the LOD.	Correct problem, repeat calibration verification and reanalyze all samples since last successful calibration verification.
Demonstration of ability to generate acceptable accuracy and precision using four replicate LCS.	Annually, Once per analyst.	LCS recovery $\pm 10\%$ of expected value.	Recalculate results; locate and fix problem with system, then rerun demonstration for those analytes not meeting criteria.
Method blank.	One per analytical batch of 10 (E300.0) or 20 (SW9056A) or less.	No analytes detected above the LOQ or $> 5\%$ of regulatory limit or $>5\%$ of target analyte detected in a sample.	Correct problem, and then re-analyze method blank and all samples processed with the contaminated blank.
LCS for all analytes.	One LCS per analytical batch of 10 (E300) or 20 (SW9056A) field samples.	Recovery $\pm 10\%$ of expected value).	Correct problem, and then re-analyze the LCS and all samples in the affected analytical batch.

<b>Table F.2 Calibration Summary and QC Procedures for EPA Method 300.0 / SW9056A</b>			
<b>QC Check</b>	<b>Minimum Frequency</b>	<b>Acceptance Criteria</b>	<b>Corrective Action</b>
MS	One MS per every 10 (E300) or every 20 (SW9056A) field samples per matrix.	Advisory acceptance recovery $\pm 20\%$ of expected value	Describe in Laboratory Review Checklist.
Duplicate or MSD	One duplicate (or MSD) per every 10 (E300) or every 20 (SW9056A) field samples per matrix.	RPD $<20\%$	Describe in Laboratory Review Checklist.
LOD Study	Once per 12 month period	Detection limits established shall be $\leq \frac{1}{2}$ the LOQs	

<b>Table F.3 Calibration Summary &amp; QC Procedures - Ion Selective Electrode</b>			
<b>QC Check</b>	<b>Minimum Frequency</b>	<b>Acceptance Criteria</b>	<b>Corrective Action</b>
Minimum five-point initial calibration for the ISE analyte.	Upon initial instrument set-up, major maintenance (e.g. new ISE probe installation) or each time a CCV fails to meet criteria.	Slope in range of 55 to 59 mV	Correct problem then repeat initial calibration.
Second-source (ICV) calibration verification, all analytes.	Once per initial calibration curve	All analytes within $\pm 10\%$ of expected value.	Correct problem then repeat initial calibration.
Calibration verification (CCV and CCB)	CCV and CCB after every 10 injections and at the end of the analysis sequence.	All analytes within $\pm 10\%$ of expected value for CCV; no analytes in CCB above 2-3 times the LOD.	Correct problem, repeat CCV and reanalyze all affected samples since last successful CCV.

**Table F.3 Calibration Summary & QC Procedures - Ion Selective Electrode**

<b>QC Check</b>	<b>Minimum Frequency</b>	<b>Acceptance Criteria</b>	<b>Corrective Action</b>
Demonstration of ability to generate acceptable accuracy and precision using four replicate LCS.	Annually, Once per analyst.	LCS recovery $\pm 10\%$ of expected value.	Recalculate results; locate and fix problem with system, then rerun demonstration for those analytes not meeting criteria.
Method blank.	One per analytical batch of 10 (E300.0) or 20 (SW9056A) or less.	No analytes detected above the LOQ or $> 5\%$ of regulatory limit or $>5\%$ of target analyte detected in a sample.	Correct problem, and then re-analyze method blank and all samples processed with the contaminated blank.
LCS for all analytes.	One LCS per analytical batch of 10 (E300) or 20 (SW9056A) field samples.	Recovery $\pm 10\%$ of expected value).	Correct problem, and then re-analyze the LCS and all samples in the affected analytical batch.
MS	One MS per every 10 (E300) or every 20 (SW9056A) field samples per matrix.	Advisory acceptance recovery $\pm 20\%$ of expected value	Describe in Laboratory Review Checklist.
Duplicate or MSD	One duplicate (or MSD) per every 10 (E300) or every 20 (SW9056A) field samples per matrix.	RPD $<20\%$	Describe in Laboratory Review Checklist.
LOD Study	Once per 12 month period	Detection limits established shall be $\leq \frac{1}{2}$ the LOQs	

**Table F.4 - Summary of Calibration and QC Procedures for ICP/MS Methods SW6020A and 200.8**

<b>QC Check</b>	<b>Minimum Frequency</b>	<b>Acceptance Criteria</b>	<b>Corrective Action</b>
MS tuning sample.	Prior to initial calibration	SW6020A paragraph 11.4	Retune instrument then reanalyze tuning solution.

**Table F.4 - Summary of Calibration and QC Procedures for ICP/MS Methods SW6020A and 200.8**

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Initial calibration (minimum 3 standards and a blank).	Daily initial calibration prior to sample analysis.	$r > 0.995$ .	N/A.
Initial Calibration verification (second source).	Daily after initial calibration	All analytes within $\pm 10\%$ of expected value.	Correct problem and repeat initial calibration.
Calibration blank.	Before analyzing samples, after every 10 samples and at end of the analysis sequence.	No analytes detected $> 1/2$ LOQ.	Correct problem then analyze calibration blank and previous 10 samples.
Calibration verification (Instrument Check Standard).	Before beginning a sample run, after every 10 samples and at the end of the analysis sequence.	All analyte(s) within $\pm 10\%$ of expected value.	Correct problem then repeat ICAL or CCV and reanalyze all samples since last successful CCV.
Demonstrate ability to generate acceptable accuracy and precision using four replicate LCS.	Once per analyst.	6020A: QC acceptance criteria, Table G.2. 200.8: QC acceptance criteria, Recovery within 85-115% of expected results.	Recalculate results; locate and fix system problem and rerun demonstration for analytes that did not meet criteria.
Method blank.	One per preparation batch.	No analytes detected $> 1/2$ LOQ; for common lab contaminants (Ca, Na, Mg, Fe, Al, Zn) - $\geq$ LOQ ; or $> 5\%$ of regulatory limit or $> 5\%$ of target analyte detected in a sample.	Correct problem reprep and analyze method blank and all samples processed with the contaminated blank.
Interference check solutions (ICS-A and ICS-AB).	At the beginning and end of an analytical run or twice during a 12-hour period, whichever is more frequent.	ICS-A: All non-spiked analytes $< 1/2$ LOQ; within $\pm 20\%$ of true value. ICS-AB: Within $\pm 20\%$ of true value.	Terminate analysis; locate and correct problem; reanalyze ICS; reanalyze all affected samples.

**Table F.4 - Summary of Calibration and QC Procedures for ICP/MS Methods SW6020A and 200.8**

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
LCS for the analyte.	One LCS per prep batch.	<u>6020A</u> : QC acceptance criteria, Table G.2 <u>200.8</u> : QC acceptance criteria, Recovery within 85-115% of expected results.	Correct problem, reprep and analyze the LCS and all samples in affected prep batch.
Dilution test (6020A only).	Each preparatory batch.	1:4 dilution must agree within $\pm 10\%$ of the original determination for analytes present at concentrations $> 100x$ concentrations found in reagent blank.	Perform post digestion spike addition for failed analytes.
Post digestion spike addition (6020A only).	When dilution test fails.	Recovery within 75-125% of expected results.	Dilute the sample; reanalyze post digestion spike addition.
MS/MSD	<u>SW6020A</u> : One MS/MSD per every 20 field samples per matrix; <u>200.8</u> : One MS per every 10 field samples per matrix	<u>SW6020A</u> : QC advisory acceptance criteria, 85-115% of expected results ; <u>200.8</u> : QC advisory acceptance criteria, recovery within 70-130% of expected results	Describe in Laboratory Review Checklist.
Internal Standards (ISs).	Every sample.	<u>For 6020A</u> : See Table 21.3 – Sample IS intensity within 30-120% of intensity of IS in the ICAL blank. CCBs and CCVs must meet 80-120% criteria. <u>For 200.8</u> : Sample IS intensity within 60-125% of intensity of IS in the ICAL blank. CCBs and CCVs must meet 80-120%.	Perform corrective action as described in Method SW6020A, Section 8.3.
LOD study.	Perform Annually	LODs established shall be $\leq 1/2$ the LOQs in Table F.2.1	None.

**Table F.5 - Calibration & QC Procedures – Mercury SW7470A/EPA 245.1 & SW7471B - Houston Facility**

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Initial multipoint calibration (minimum 5 standards and a blank).	Daily initial calibration prior to sample analysis.	Correlation coefficient >0.995 for linear regression.	Correct problem then repeat initial calibration.
Instrument Performance Check (ICP = ICCV, for EPA 245.1 only)	Daily after initial calibration prior to sample analysis (same source as ICAL)	The analyte within $\pm 5\%$ of expected value (EPA 245.1 only).	Correct problem then repeat initial calibration.
Second-source Initial Calibration Verification standard.	Once per initial daily multipoint calibration.	Analyte within $\pm 10\%$ of expected value.	Correct problem then repeat initial calibration.
Calibration blank.	Once per initial daily multipoint calibration.	No analyte detected > $\frac{1}{2}$ LOQ.	Correct problem then reanalyze calibration blank and all samples associated with blank.
Continuing Calibration verification (CCV).	After every 10 samples and at the end of the analysis sequence.	The analyte within $\pm 10\%$ of expected value.	Correct problem then repeat calibration and reanalyze all samples since last successful calibration.
Demonstrate ability to generate acceptable accuracy and precision using four replicate LCS.	Once per analyst.	QC acceptance criteria, within $\pm 15\%$ of expected value.	Recalculate results; locate and fix system problem and rerun demonstration for those analytes not meeting criteria.
Method blank.	One per prep batch of 20 or less.	No analytes detected > $\frac{1}{2}$ LOQ or > 5% of regulatory limit or > 5% of target analyte detected in a sample.	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank.
LCS for the analyte.	One LCS per prep batch of 20 or less.	QC acceptance criteria, within $\pm 15\%$ of expected value.	Correct problem then reprep and analyze all samples

MS/MSD.	One MS/MSD per every 20 project samples per matrix.	QC acceptance criteria, within $\pm 15\%$ of expected (7470A & 7471B); , within $\pm 30\%$ of expected (for EPA 245.1)	Describe in Laboratory Review Checklist.
Demonstrate ability to generate acceptable accuracy and precision using four replicate LCS.	Initially once per analyst, then annually thereafter.	QC acceptance criteria, within $\pm 15\%$ of expected value.	Recalculate results; locate and fix system problem and rerun demonstration for analytes not meeting criteria.
LOD study.	Once per 12 month period.	LODs established shall be $\leq 1/2$ LOQs in Table F.2.2	None.

**Table F.6 - Calibration and QC Procedures for Method 8015D**

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Five-point initial calibration for all analytes.	Initial calibration prior to sample analysis.	Linear – RSD for all analytes $\leq 20\%$ or Linear – least squares regression $R > 0.995$ ; or	Correct problem then repeat initial calibration.
Second-source calibration verification (ICV).	Once per five-point initial calibration.	All analytes within $\leq 20\%$ of expected value.	Correct problem then repeat initial calibration.
Calibration verification (CCV).	Daily, before sample analysis, after every 20 samples and at the end of the analysis sequence.	All analytes within $\leq 20\%$ of expected value.	Correct problem, repeat CCV or ICAL and reanalyze all samples since last successful CCV.
Demonstrate ability to generate acceptable accuracy and precision using four replicate LCS.	Once per analyst.	QC acceptance criteria, Table G.4.	Recalculate results; locate and fix system problem and rerun demonstration for analytes not meeting criteria.

**Table F.6 - Calibration and QC Procedures for Method 8015D**

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Method blank.	One per prep batch.	No analytes detected $\geq$ LOQ for TPH or $\geq$ $\frac{1}{2}$ LOQ for Misc. Analytes or $>$ 5% of regulatory limit or $>$ 5% of target analyte detected in a sample.	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank.
LCS	One LCS per prep batch, LCS includes all analytes.	QC acceptance criteria, Table G.3.2	Correct problem, then re- prep and analyze the LCS and all samples in the affected prep batch.
Surrogate spike	Every sample, spiked sample, standard, and method blank.	QC acceptance criteria, Table G.3.2	Method 8000C, Section 9.6 Requirements. Describe in Laboratory Review Checklist.
MS/MSD	One MS/MSD per every 20 project samples per matrix.	QC acceptance criteria, Table G.3.2	Describe in Laboratory Review Checklist.
Demonstrate ability to generate acceptable accuracy and precision using four replicate LCS.	Initially once per analyst, then annually thereafter.	QC acceptance criteria, Table G.3.2	Recalculate results; locate and fix system problem and rerun demonstration for analytes not meeting criteria.
LOD study.	Once per 12 month period.	LODs established shall be $\leq$ $\frac{1}{2}$ LOQs in Table F.3.	None.

**Table F.7 Summary of Calibration and QC Procedures for Pesticides**

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
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**Table F.7 Summary of Calibration and QC Procedures for Pesticides**

<b>QC Check</b>	<b>Minimum Frequency</b>	<b>Acceptance Criteria</b>	<b>Corrective Action</b>
Five-point initial calibration for all analytes.	Initial calibration prior to sample analysis.	Linear – avg. RSD for all analytes <20% RSD or Linear – least squares regression; $r > 0.995$ ; or Non-linear – COD $>0.990$ (6 or more points must be used for second order). [Note: grand mean not allowed.]	Correct problem then repeat initial calibration.
Second-source (ICV) calibration verification For all analytes.	Once per five-point initial calibration.	All analytes within $\pm 15\%$ of expected value.	Correct problem then repeat initial calibration.
Retention time window verified for each analyte.	Each initial calibration	Verify $\pm 3$ times standard deviation for each analyte retention time from 72-hour study.	Correct problem then reanalyze all samples analyzed since the last retention time check.
Calibration verification (CCV).	Daily, before sample analysis, after every 20 samples and at the end of the analysis sequence.	All analytes within $\pm 15\%$ of expected value.	Correct problem then repeat CCV or ICAL and reanalyze all samples since last successful CCV.
Breakdown check (Endrin and DDT).	Daily prior to analysis of samples.	Degradation $<15\%$ .	Take corrective action prior to calibration. Repeat breakdown check.
Demonstrate ability to generate acceptable accuracy and precision using four replicate LCS.	Once per analyst.	QC acceptance criteria, Table G.6.	Recalculate results; locate and fix system problem and rerun demonstration for analytes not meeting criteria.
Method blank.	One per prep batch.	No analytes detected $>1/2$ LOQ or $>5\%$ of regulatory limit or $>5\%$ of target analyte detected in a sample.	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank.

**Table F.7 Summary of Calibration and QC Procedures for Pesticides**

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
LCS for all analytes.	One LCS per prep batch.	QC acceptance criteria, Tables G.6, G.18.	Correct problem then reprep and analyze the LCS and all samples in the affected prep batch.
Surrogate spike.	Every sample, spiked sample, standard, and method blank.	QC acceptance criteria, Table G.6.	Method 8000C, Section 9.6 Requirements. Describe in Laboratory Review Checklist.
MS/MSD.	One MS/MSD per every 20 project samples per matrix.	QC acceptance criteria, Tables G.6	Describe in Laboratory Review Checklist.
Second-column confirmation (excluding Toxaphene & chlordane).	100% for all positive results.	Same as for initial or primary column analysis.	Same as for initial or primary column analysis.
LOD study.	Once per 12 month period.	LODs established shall be $\leq 1/2$ LOQs in Table F.6.	None

**Table F.8 - Summary of Calibration and QC Procedures for PCBs**

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Minimum five-point initial calibration (ICAL) for Aroclor 1016/1260 mix. Single point calibration for other Aroclors, for pattern recognition and calibration factor.	Initial calibration prior to sample analysis.	Calibration Factor – RSD for all analytes (peaks) <20% or Linear – least squares regression $r > 0.995$ ; or Non-linear regression – (COD) $r^2 > 0.99$ (6 points must be used for 2 <sup>nd</sup> order). [Note: use of grand mean not allowed.]	Correct problem then repeat initial calibration.

**Table F.8 - Summary of Calibration and QC Procedures for PCBs**

<b>QC Check</b>	<b>Minimum Frequency</b>	<b>Acceptance Criteria</b>	<b>Corrective Action</b>
Second-source calibration verification (ICV) for PCB 1016/1260 mix.	Once per initial calibration .	Mix within $\pm 15\%$ of expected value.	Correct problem then repeat initial calibration.
Absolute RT position established for each analyte and surrogate	Set once with each ICAL and set at the beginning of each (12-hr) shift with CCV.	Position shall be set using the ICAL midpoint standard, or set with the value of CCV that is run at beginning of each (12-hr) shift.	N/A
RT window verification for each analyte and surrogate. RT window set $\pm 0.07$ minutes from the absolute RT for Aroclor 1016/1260 mix.	Each calibration verification (ICV and CCVs).	All analytes and surrogates in ICV & CCV must fall within the RT windows	Correct problem then reanalyze CCV and all samples analyzed since the last acceptable RT verification. If CCV fails RT verification again, redo ICAL & reset RT widow & position.
Calibration verification (CCV) for PCB 1016/1260 mix.	Daily, before sample analysis, after every 20 samples and at the end of the analysis sequence.	All analytes within $\pm 15\%$ of expected value.	Correct problem, repeat ICAL or CCV and reanalyze all affected samples since last successful CCV.
Demonstrate ability to generate acceptable accuracy and precision using four replicate LCS.	Once per analyst.	QC acceptance criteria, Table G.7.	Recalculate results; locate and fix system problem and rerun demonstration for analytes not meeting criteria.
Method blank.	One per prep batch.	No analytes detected $> 1/2$ LOQ or $> 5\%$ of regulatory limit or $> 5\%$ of target analyte detected in a sample.	Correct problem then re-prep and analyze method blank and all samples processed with the contaminated blank.
LCS (1016/1260 mix).	One LCS per prep batch.	QC acceptance criteria, Tables G.7	Correct problem then reprep and analyze the LCS and all samples in affected prep batch.
Surrogate spike.	Every sample, spiked sample, standard, and method blank.	QC acceptance criteria, Table G.7.	Method 8000C, Section 9.6 Requirements. Describe in Laboratory Review Checklist.

**Table F.8 - Summary of Calibration and QC Procedures for PCBs**

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
MS/MSD (1016/1260 mix).	One MS/MSD per every 20 samples per matrix.	QC acceptance criteria, Tables G.7	Describe in Laboratory Review Checklist.
LOD study.	Once per 12 month period.	Detection limits established shall be $\leq 1/2$ the LOQs in table F.7.	<i>NONE.</i>

**Table F.9 Calibration and QC Procedures for Method SW8260C /624**

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Minimally use five-point initial calibration for all analytes, use six points if second order curve fit to be used .	Initial calibration prior to sample analysis.	average RRF : see Table 11.7 in SOP; RSD for Target analytes <20%; or option below: Option 1 linear – least squares regression $r > 0.995$ . Option 2 non-linear – $r^2 > 0.99$ (must use 6 points at minimum). [Note: grand mean not allowed.]	Correct problem then repeat initial calibration.
Second-source (ICV) calibration verification.	Once per five-point initial calibration.	8260C- Analytes within $\pm 30\%$ of expected value, poor purging VOCs $\pm 40\%$ . 624 – Analytes within $\pm 20\%$ of expected value, poor purging VOCs $\pm 25\%$ (Acrolein, Acrylonitrile, ketones)	Correct problem then repeat initial calibration.
Relative Retention Time evaluated for each analyte in ICAL.	Each ICAL standard	Relative retention time (RRT) of the analyte within $\pm 0.06$ RRT units of the RRT of the ICAL midpoint.	Correct problem then re-run ICAL.

**Table F.9 Calibration and QC Procedures for Method SW8260C /624**

<b>QC Check</b>	<b>Minimum Frequency</b>	<b>Acceptance Criteria</b>	<b>Corrective Action</b>
Calibration verification (CCV).	Daily, before sample analysis and every 12 hours of analysis time for 80260C.	8260C – CCV min RRF- Table 11.7 in SOP; RSDs : < 20% Diff. (when using RFs) or drift (when using linear 1 <sup>st</sup> order or non-linear 2 <sup>nd</sup> order fit). 624 – All analytes within ±20 % D (or ±20 % Drift).	Correct problem then repeat ICAL
Calibration verification (CCV) Internal Standards.	With every calibration verification	Retention time ±30 seconds from retention time of the mid-point std. In the ICAL. EICP area within –50% to +100% of ICAL mid-point std.	Inspect mass spectrometer and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning.
Internal Standards – samples and QC samples.	All samples and QC samples except the CCV	Retention time ±30 seconds from retention time of the CCV. EICP area within – 50% to +100% of CCV.	Reanalyze sample to confirm IS failure due to matrix, and describe in lab review checklist.
Demonstrate ability to generate acceptable accuracy and precision using four LCS analyses.	Once per analyst.	QC acceptance criteria, Table G.9.	Recalculate results; locate and fix system problem and rerun demonstration for those analytes not meeting criteria.
Method blank.	One per preparation batch.	No analytes detected >½ LOQ; no common lab contaminants detected >LOQ or .> 5% of regulatory limit or >5% of target analyte detected in a sample.	Correct problem, then re-analyze method blank and all samples processed with contaminated blank.
LCS for all analytes.	One LCS per preparation batch.	QC acceptance criteria, Table G.9 and G.14	Correct problem, then re-analyze the LCS and all samples in the affected batch.
MS/MSD.	One MS/MSD per every 20 project samples per matrix.	QC acceptance criteria for % Recovery - Table G.9;	Describe in Laboratory Review Checklist. See section 16.7.

**Table F.9 Calibration and QC Procedures for Method SW8260C /624**

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
		20% RPD limit for waters; 30% PRD Limit for Soils	
Check of mass spectral ion intensities using BFB	Prior to initial calib. and each calibration verification.	Refer to criteria listed in the method description	Retune instrument and verify.
Surrogate spike.	Every sample, spiked sample, standard, and method blank.	QC acceptance criteria, Table G.9.	Method 8000C, Section 9.6 Requirements. Describe in Lab Review Checklist.
MDL study.	Once per 12 month period.	Detection limits established shall be < 1/3 the LOQs in Table 21.1	None.

**Table F.10 Summary of Calibration and QC Procedures for Method SW8270D/625**

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Check of mass spectral ion intensities using DFTPP.	Prior to Init. Calib. And 12hr Cont. Calibration verification (CCV).	Refer to criteria listed in the method description	Retune instrument and verify.
Minimum Five-point initial calibration for all analytes; use six points if second order curve fit is used.	Initial calibration prior to sample analysis.	Evaluate for best curve fit model, Avg Response Factors (avg RF) and each level RF should meet min RF requirements in SOP and %RSDs for each: $\leq 20\%$ or one option below: linear curve fit, $r > 0.995$ ; or when non-linear (quadratic) where $r^2 > 0.990$ and 6 points shall be used (2 <sup>nd</sup> order). [Note: use of grand mean not allowed.]	Correct problem then repeat initial calibration.

**Table F.10 Summary of Calibration and QC Procedures for Method SW8270D/625**

<b>QC Check</b>	<b>Minimum Frequency</b>	<b>Acceptance Criteria</b>	<b>Corrective Action</b>
Second-source (ICV) calibration verification.	Once per each initial calibration curve.	Analytes within $\pm 30\%$ of expected value.	Correct problem then rerun ICV. If ICV fails again, correct problem and repeat initial calibration.
Continuing Calibration Verification (CCV).	Daily, before sample analysis and every 12 hours of analysis time.	CCV RF should meet RF requirements in Table in SOP All compounds should meet $\leq 20\%$ difference (if using RFs) or $\leq 20\%$ drift (if using linear or non-linear calibration).	Correct problem then rerun CCV. If CCV fails again, repeat initial calibration.
CCV Internal Standards.	Immediately after or during data acquisition of calibration check standard (CCV).	Retention time $\pm 30$ seconds from RT of the mid-point standard in the ICAL. EICP area within $-50\%$ to $+100\%$ of ICAL mid-point standard.	Check mass spectrometer and GC for malfunctions; mandatory reanalysis of samples analyzed while system malfunctioned.
Internal Standards – samples and QC samples.	All samples and QC samples except the CCV	Retention time $\pm 30$ seconds from retention time of the daily CCV standard. EICP area within $-50\%$ to $+100\%$ of the daily CCV.	Reanalyze sample to confirm IS failure due to matrix, and describe in lab review checklist.
Method blank.	One per preparation batch.	No analytes detected $\geq \frac{1}{2}$ MQL; no common lab contaminants (e.g. phthalates) detected $\geq$ MQL or $> 5\%$ of regulatory limit or $> 5\%$ of target analyte detected in a sample.	Correct problem, then re-analyze method blank and all samples processed with the contaminated blank.
LCS for all analytes.	One LCS per preparation batch.	QC acceptance criteria, Table G.10 & G.14	Correct problem, then re-analyze the LCS and all samples in the affected preparation batch.

**Table F.10 Summary of Calibration and QC Procedures for Method SW8270D/625**

<b>QC Check</b>	<b>Minimum Frequency</b>	<b>Acceptance Criteria</b>	<b>Corrective Action</b>
MS/MSD.	One MS/MSD per every 20 project samples per matrix.	QC advisory criteria, Table G.10	Describe in Laboratory Review Checklist. For matrix evaluation. If MS results are outside LCS limits, evaluate if source of difference is due to matrix effect or lab error.
Surrogate spike.	All field samples and QC samples.	QC acceptance criteria, Table G.10	Method 8000C, Section 9.6 Requirements. Describe in Laboratory Review Checklist.
Demonstrate ability to generate acceptable accuracy and precision using four replicate LCS analyses.	Once per analyst.	QC acceptance criteria, Table G.10	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria.
MDL/LOD study.	MDL once annually.	Detection limits established should $\leq 1/3$ the LOQ in Table G.10	None.

**TABLE F.11 - NUMBER OF ALLOWABLE SPORADIC MARGINAL EXCEEDANCES**

<b>Number of analytes</b>	<b>Sporadic Marginal Exceedances Allowed</b>
0-11	0
11-30	1
31-50	2
51-70	3
71-90	4
>90	5

## **Appendix G: On-Site Documents (used by inclusion or reference)**

- (1) Department of Defense Quality System Manual for Environmental Laboratories, Version 3.0, May 2005
- (2) Standard Methods for the Examination of Water and Wastewater, APHA/AWWA/WEF, 19<sup>th</sup> Edition, 1995
- (3) Standard Methods for the Examination of Water and Wastewater, APHA/AWWA/WEF, 21<sup>st</sup> Edition, 2005
- (4) SW-846 Manual of Test Methods: On-line @ [www.epa.gov/sw-846](http://www.epa.gov/sw-846)
- (5) Clean Water Act Manual of Test Methods: On-line @ [www.epa.gov/waterscience](http://www.epa.gov/waterscience)
- (6) Superfund Contract Laboratory Program: On-line @ [www.epa.gov/superfund](http://www.epa.gov/superfund)
- (7) American Standard for Testing and Materials (ASTM) Test Methods: On-line @ [www.astm.org](http://www.astm.org)
- (8) Manual for the Certification of Laboratories Analyzing Drinking Water, EPA 815-R-05-004, January 2005

**Appendix H: Analytical Log Documents (Controlled)**

Lab Notebook Function	Master Location
Acidity Log	dserv1\GlobalDocs\Notebook Master
Ammonia Prep Log	dserv1\GlobalDocs\Notebook Master
AOX Prep Log	dserv1\GlobalDocs\Notebook Master
Autoclave Record Log	dserv1\GlobalDocs\Notebook Master
Balance Calibration Log	dserv1\GlobalDocs\Notebook Master
BOD-CBOD Log	dserv1\GlobalDocs\Notebook Master
Calorific/BTU Value Log	dserv1\GlobalDocs\Notebook Master
Chemical Inventory Log	dserv1\GlobalDocs\Notebook Master
Total Chloride Log	dserv1\GlobalDocs\Notebook Master
Reactive Cyanide Log	dserv1\GlobalDocs\Notebook Master
Cyanide Prep Log	dserv1\GlobalDocs\Notebook Master
COD Analysis Log	dserv1\GlobalDocs\Notebook Master
Fluoride Log	dserv1\GlobalDocs\Notebook Master
Free Liquid Log	dserv1\GlobalDocs\Notebook Master
Resistivity Monitoring Log	dserv1\GlobalDocs\Notebook Master
Temperature Monitoring Log	dserv1\GlobalDocs\Notebook Master
Visitor Log	dserv1\GlobalDocs\Notebook Master
GC Standard Prep Log	dserv1\GlobalDocs\Notebook Master
Hardness Log	dserv1\GlobalDocs\Notebook Master
Mercury Analysis Log	dserv1\GlobalDocs\Notebook Master
ICP-MS Maintenance Log	dserv1\GlobalDocs\Notebook Master
ICP-MS Calibration Log	dserv1\GlobalDocs\Notebook Master
ICP-MS Standard Prep Log	dserv1\GlobalDocs\Notebook Master
Ignitability Log	dserv1\GlobalDocs\Notebook Master
Karl Fischer Log	dserv1\GlobalDocs\Notebook Master
Hexavalent Chromium Log	dserv1\GlobalDocs\Notebook Master
Organic Extraction Log	dserv1\GlobalDocs\Notebook Master
Membrane Filter Log	dserv1\GlobalDocs\Notebook Master
Mercury Prep Log	dserv1\GlobalDocs\Notebook Master
Mercury Standard Prep Log	dserv1\GlobalDocs\Notebook Master
Metals Prep Log	dserv1\GlobalDocs\Notebook Master
Micro-HPC Log	dserv1\GlobalDocs\Notebook Master
Micro-Coliform (P/A) Log	dserv1\GlobalDocs\Notebook Master
Misc Analysis Log	dserv1\GlobalDocs\Notebook Master
Residual Chlorine Log	dserv1\GlobalDocs\Notebook Master

GCMS Volatile Run Log	dserv1\GlobalDocs\Notebook Master
MS Standard Prep Log	dserv1\GlobalDocs\Notebook Master
Oil & Grease Analysis Log	dserv1\GlobalDocs\Notebook Master
pH Analysis Log	dserv1\GlobalDocs\Notebook Master
Flash Point Analysis Log	dserv1\GlobalDocs\Notebook Master
Soil (Pb) Fractionation Log	dserv1\GlobalDocs\Notebook Master
Solids Log	dserv1\GlobalDocs\Notebook Master
Specific Conductance Analysis Log	dserv1\GlobalDocs\Notebook Master
Sulfide Analysis Log	dserv1\GlobalDocs\Notebook Master
TCLP Extraction Log	dserv1\GlobalDocs\Notebook Master
ZHE Extraction Log	dserv1\GlobalDocs\Notebook Master
TDS Analysis Log	dserv1\GlobalDocs\Notebook Master
TOC (Walkley Black) Analysis Log	dserv1\GlobalDocs\Notebook Master
Thermometer ID & Calibration Log	dserv1\GlobalDocs\Notebook Master
TSS Analysis Log	dserv1\GlobalDocs\Notebook Master
Turbidity Analysis Log	dserv1\GlobalDocs\Notebook Master
VSS Analysis Log	dserv1\GlobalDocs\Notebook Master
Wet Chem Standard & Reagent Log	dserv1\GlobalDocs\Notebook Master
Specific Gravity Log	dserv1\GlobalDocs\Notebook Master
Nitrate/Nitrite/Nitrogen Log	dserv1\GlobalDocs\Notebook Master
Total Phosphorus Log	dserv1\GlobalDocs\Notebook Master
KMNO4 Analysis Log	dserv1\GlobalDocs\Notebook Master
Total Alkalinity Log	dserv1\GlobalDocs\Notebook Master
TKN Prep Log	dserv1\GlobalDocs\Notebook Master
Phenol Prep Log	dserv1\GlobalDocs\Notebook Master

## Appendix I: Analytical Method Listing

<i>Hazardous &amp; Solid Waste</i>	<i>Analytical Methodology</i>	<i>Applicable Accreditation</i>
<b>Organic Chemistry</b>		
Non-Halogenated Organics	SW846 – 8015B	None
Pesticides	SW846 – 8081A	NELAC*
PCBs	SW846 – 8082	NELAC*
Organophosphorus Pesticides	SW846 – 8141A	None
Chlorinated Pesticides	SW846 – 8151A	None
Volatile Organics	SW846 – 8260C	NELAC*
SemiVolatile Organics	SW846 – 8270D	NELAC*
Polynuclear Aromatics	SW846-8270D	None
Carbonyl Compounds	SW846 – 8315	None
Volatile Organics by Isotopic Dilution	USEPA – 1666	None
SemiVolatile Organics by Isotopic Dilution	USEPA – 1665	None
<b>Inorganic Chemistry</b>		
Mercury	SW846 – 7470A / 7471	NELAC
Metals	SW846 – 6020	NELAC*
<b>General Chemistry</b>		
Cyanide	SW846 – 9014	NELAC
Sulfide	SW846 – 9030A	NELAC
Sulfate	SW846 – 9038	NELAC
pH	SW846 – 9040B / 9045C	NELAC
Conductance	SW846 – 9050A	NELAC
Anions	SW846 – 9056	NELAC*
Paint Filter	SW846 – 9095A	NELAC
Reactive Cyanide	SW846 – 9014	NELAC
Reactive Sulfide	SW846 – 9034	NELAC
Flashpoint	SW846 – 1010	None
Corrosivity	SW846 – 9040B	NELAC
<b>Extractions</b>		
TCLP	SW846 – 1311	NELAC
SPLP	SW846 – 1312	NELAC

<i>Wastewater</i>	<i>Analytical Methodology</i>	<i>Applicable Accreditation</i>
<b>Organic Chemistry</b>		
Pesticides	USEPA 608	NELAC*
PCBs	USEPA 608	NELAC
Volatile Organics	USEPA 624	NELAC*
SemiVolatile Organics	USEPA 625	NELAC*
<b>Inorganic Chemistry</b>		
Mercury	USEPA 245.1	NELAC
Metals	USEPA 200.8	NELAC
<b>General Chemistry</b>		
COD	SM 5220 D	NELAC
Hexavalent Chromium	SM 3500 Cr-D	NELAC
Total Kjeldahl Nitrogen	SM 4500NH3-G	NELAC
Conductance	USEPA 120.1	NELAC
pH	USEPA 150.1	NELAC
Total Dissolved Solids	USEPA 160.1	NELAC
Total Suspended Solids	USEPA 160.2	NELAC
Total Solids	USEPA 160.3	NELAC
Total Volatile Solids	USEPA 160.4	NELAC
Oil & Grease (gravimetric)	USEPA 1664A	NELAC
Anions	USEPA 300.0	NELAC*
Alkalinity	USEPA 310.1	NELAC
Chloride	USEPA 325.3	NELAC
Amenable Cyanide	USEPA 335.1	NELAC
Cyanide	USEPA 335.2	NELAC
Fluoride	USEPA 340.2	NELAC
Ammonia	USEPA 350.1	NELAC
Nitrate-Nitrite	USEPA 353.3	NELAC
Nitrite	USEPA 353.4	NELAC
Orthophosphate	USEPA 365.2	NELAC
Sulfate	USEPA 375.4	NELAC
Sulfide	USEPA 376.2	NELAC
BOD	USEPA 405.1	NELAC
Total Organic Carbon	USEPA 415.1	NELAC
Phenols	USEPA 420.1	NELAC
<b>Microbiology/Drinking Water</b>	<b>Analytical Methodology</b>	<b>Applicable Accreditation</b>
Coliform	SM 9223 (Colilert)	MI DEQ

Plate Count	SM 9215B	MI DEQ
Nitrate	USEPA 300.0	MI DEQ
Copper	USEPA 200.8	MI DEQ
Lead	USEPA 200.8	MI DEQ

\*: Specific analyte listing available upon request

***Appendix D***

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**Soil Vapor Extraction Pilot Test Equipment**

## Remedial Test Equipment

GeoCore Inc., P.O. Box 386, Salina, Kansas 67401 P(785)-826-1616 F(785)826-9508

<b>Soil Vapor Extraction System</b>			
<b>Item</b>	<b>Model</b>	<b>Range</b>	<b>Range</b>
Trailer Mounted Extraction Blower	GAST Model SDR6P	250 cfm	125 Inches Water @ 4,500 rpm
Flow meters (SVE well & dilution air)	Blue-White F-452	30-230 cfm	
Wellhead Vacuums & Pressure Measurement	Dwyer Series 477-3-FM Manometer	0-200 inches water	
	Dwyer Series 475-3 Mark 3	0-199.9 inches water	
Extraction Blower Air Sample Test Pump	GAST DOA--P104-AA		
Wellhead Air Sample Test Pump	Rietschle Thomas 107CDC20 D	12 Volt	
Wellhead Test Caps	Product Recovery Management Pneumatic Test Caps	Expanding Two and Four-Inch	
Air Sample Containers	SKC Tedlar	1 Liter Volume	
O2 Meter	MultiRAE IR Multi-gas Monitor PGM-54	0-30%	
CO2 Meter	MultiRAE IR Multi-gas Monitor PGM-54	0-20,000 ppm	
TPH Meter	MultiRAE IR Multi-gas Monitor PGM-54	0-2000 ppm	
LEL Meter	MultiRAE IR Multi-gas Monitor PGM-54	0-100%	