AP - 051

STAGE 1 WORKPLAN

11/11/2005

ADVENTURE'S FIRST STOP
MAVERIK

MAVERIK COUNTRY STORES, INC.
880 West Center Street
North Salt Lake, UT 84054-2913
Phone: (801) 936-5557
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November 11, 2005

Roger C. Anderson
Glenn von Gonten
New Mexico Energy, Minerals and Natural Resources Department
Oil Conservation Division
1220 South St. Francis Drive
Santa Fe, New Mexico 87505

Subject: Stage 1 Abatement Plan, Former Maverik (Caribou) Refinery, Kirtland, New Mexico

Gentlemen:

Enclosed please find a Stage 1 Abatement Plan for the above-referenced site that was prepared for Maverik by our consultant RETEC. We will implement the plan upon receiving your approval to proceed. As we agreed with you during our meeting on November 2nd, preparation of a Stage 2 Abatement Plan will await the outcome of Stage 1. Please contact me if you have any questions or concerns.

Sincerely,

Maverik Country Stores, Inc.

Dennis Riding, PE & PG
Environmental Director

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Oil Conservation Division
Environmental Bureau

Stage I Abatement Plan

Maverik (Caribou) Former Refinery
Kirtland, New Mexico

Prepared by:

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1726 Cole Boulevard
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RETEC Project Number: MCS01-19100-200

Prepared for:

Maverik Country Stores, Inc.
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Julia Griffin, Environmental Scientist

Reviewed by:

Jenny Phillips JG

Jenny Phillips, Project Manager

November 11, 2005

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1 Introduction

Maverik Country Stores, Inc. (Maverik), previously known as Caribou Four Corners Inc., operated a small crude topping refinery near Kirtland, New Mexico from 1963 until April 1982 at which time it was shut down. Maverik contracted with the RETEC Group, Inc. (RETEC) to develop this Stage 1 Abatement Plan. The scope of work proposed in this work plan will be completed in accordance with the requirements included in the letter dated September 12, 2005, from Roger C. Anderson of the New Mexico Energy, Minerals and Natural Resources, Oil Conservation Division (NMOCD). This letter was submitted to Maverik following receipt of laboratory analysis of a water sample collected by NMOCD from the private well of Mr. Roland Jackson, located downgradient from the site.

Maverik completed a significant amount of investigation and corrective measures implementation during the 1980's and 1990's. Investigation results are documented in the 1988 Dames and Moore Phase I Hydrogeologic Evaluation, the 1988 Dames and Moore Phase II Subsurface Soil and Solid Waste Containment Evaluation, and groundwater investigation and monitoring programs. The Phase I and Phase II site evaluations were completed to characterize the nature and distribution of impacts at the former refinery. An assessment of off-site property contamination was completed in 1989. Groundwater investigation and monitoring efforts have been completed since 1989 to monitor site groundwater impacts at the former refinery following installation of a slurry wall in June of 1990.

This document presents the objectives, background, proposed scope of work, and procedures for the Stage 1 Abatement.

1.1 Objectives

The objectives of this Stage 1 Abatement Plan are to:

- Design a site investigation that will adequately define groundwater conditions on and off site
- Provide the data to select and design an effective abatement option, if necessary, based on groundwater data collection

2 Facility Description and Background

2.1 Former Refinery Location

The former refinery is located one-half to three-quarters of a mile north of the San Juan River (Figure 1) in Kirtland, New Mexico. The site is bounded by two unlined irrigation ditches (except approximately 300 feet in which Maverik installed a concrete pipe); the Farmer's Mutual Irrigation Ditch which runs along the terrace between the refinery area and the tank farm area and a branch of this irrigation ditch which borders the west side of the site.

The site is approximately 0.4 miles north-northeast from the existing banks of the San Juan River (Figure 1). The tank farm is located within the floodplain of the San Juan River, with the northern boundary of the tank farm paralleling the edge of the floodplain. This is demonstrated by the obvious topographic rise from 5190 to greater than 5210 feet mean sea level (msl) along the northern boundary, and the finer silty-clayey sands encountered at the northernmost monitoring wells MW-1 and MW-2 located along the edge of the floodplain. The former refinery site is located immediately to the north, out of the floodplain above the 5210 contour. The tank farm elevation ranges from about 5187 feet msl in the southern part, to 5206 feet msl along the northern boundary.

2.2 Former Refinery Background

Maverik (formerly Caribou) operated the refinery from 1963 until 1982. During operation, crude oil was refined into regular and leaded gasoline, diesel fuel and No. 5 fuel oil. Process units included a crude distillation unit, naphtha hydrotreating unit and naphtha reformer unit. Because of the plant design, there was no wastewater process stream. Consequently, there is no API separator or dissolved air flotation unit. Within a few months of facility shut down, all remaining product, feedstocks, and intermediate products were removed from storage tanks and sold.

2.3 Previous Investigations and Historical Data

Site geology and hydrogeology have been characterized during multiple investigations that have been conducted at the site. Historical groundwater, soil, free product, and surface water data collected at the site are detailed in the following reports:

- *Phase I Hydrogeologic Evaluation* (Dames and Moore, February 1988)
- *Addendum to Phase I Hydrogeologic Evaluation* (Dames and Moore, June, 1988)
- *Phase II Subsurface Soil and Solid Waste Containment Evaluation* (Dames and Moore, June 1988)
- *Water Quality Data Summary for the Completion of the Hydrogeologic Evaluation* (Dames and Moore, January 1989)
- *Preliminary Assessment of the Off-Site Property Contamination* (Dames and Moore, June 1989)
- *Status Report Remediation Work and Round 1 Long-Term Groundwater Quality Monitoring Data Results* (Dames and Moore, July 1989)
- *Status Report Remediation Work and Round 2 Long-Term Groundwater Quality Monitoring Data Results* (Dames and Moore, November 1989)
- *Status Report Remediation Work and Round 3 Long-Term Groundwater Quality Monitoring Data Results* (Dames and Moore, February 1990)
- *On-Site Ground, Surface Water and Sludge Laboratory Analytical Data and Modified Groundwater Remediation Plan* (Dames and Moore, March 1990)
- *Status Report Remediation Work and Round 4 Long-Term Groundwater Quality Monitoring Data Results* (Dames and Moore, August 1990)
- *Status Report Remediation Work and Round 5 Long-Term Groundwater Quality Monitoring Data Results* (Dames and Moore, December 1990)
- *Limited Asbestos Survey* (Envirotech, Inc., June 1993)
- Quarterly and Annual Groundwater Monitoring Reports (Various, 1991-2004)

3 Stage 1 Abatement Scope of Work

The scope of work in this abatement plan includes sampling and analysis of groundwater from existing monitoring wells, an irrigation ditch field survey, a private well ownership and construction survey, a slurry wall integrity demonstration if groundwater results warrant, reporting of activities conducted, and public notice and participation.

3.1 Groundwater Investigation

Semiannual groundwater monitoring was conducted at the site from 1990 to 1998. Annual groundwater monitoring began in 1999 and has continued to the present. Groundwater target analytes established for the current groundwater monitoring program are benzene, toluene, ethylbenzene, total xylenes (BTEX) and 1,2-dichloroethane (1,2-DCA). Currently, 9 of the on-site and off-site monitoring wells and piezometers are sampled.

All wells will need to be located and assessed for the ability to collect fluid level and groundwater sample data. Fluid level data will be collected from monitoring wells MW-1 through MW-22 and piezometers P-1 through P-4 (Figure 2) as able, to provide groundwater elevation and potential free product thickness data. Monitoring wells MW-11and MW-12 were abandoned, and MW-13 was destroyed. Therefore, these wells will not be gauged or sampled. Fluid-level gauging will be conducted in accordance with the RETEC Standard Operating Procedure (SOP) 231, included in Appendix A, using an electric oil/water interface probe (i.e., Solinst Model 122 Oil/Water Interface Meter, or Heron Sm.OIL Oil/Water Interface Meter). All fluid level data collected will be documented on a Fluid Level Monitoring Log provided in SOP 231.

Review of well construction data indicates the existing monitoring wells and piezometers are screened appropriately for the collection of representative groundwater samples (Table 1). Although some screened intervals have historically been below water table elevations, potential dissolved concentrations of analytes of concern will be detected in groundwater samples based on the purging and sampling procedures to be used. Groundwater samples will be collected in accordance with the SOP 230 (Appendix A). Bottom-loading, disposable, high-density polyethylene (HDPE) bailers will be used for groundwater sample collection. Groundwater quality parameters including pH, temperature, and conductivity will be collected during well purging prior to sample collection. Groundwater will be purged from the monitoring well until the groundwater quality parameters have stabilized or three well-casing volumes have been evacuated. Field parameter data collected during groundwater sampling will be recorded on a Groundwater Sample Data Sheet provided in SOP 230.

Although the monitoring wells have been sampled for halogenated and aromatic volatile organics during historical monitoring, monitoring wells

currently sampled as part of the annual program are analyzed for BTEX and 1,2-DCA only. The historical analysis of volatiles does not include all volatile compounds detected in Mr. Jackson's well. While not detected in previous monitoring well sampling, it is proposed to analyze the samples collected during the Stage 1 Abatement for a complete list of volatile organic compounds, using EPA Method 8260, to complement the sampling conducted by NMOCD for Mr. Jackson, as well as to provide a comprehensive evaluation of site conditions and confirm their absence. This analysis will provide more accurate data for current groundwater conditions.

Quality assurance samples including field blanks, blind duplicates, and trip blanks, will be collected and analyzed in accordance with the Quality Assurance Project Plan (QAPP) (Appendix B).

For groundwater, one field blank and blind duplicate will be collected for every 20 groundwater samples collected. In addition, one trip blank will be placed in each cooler to accompany the groundwater samples during shipment to the receiving laboratory.

The quality assurance samples will be analyzed as follows:

- Groundwater equipment blanks, field blanks, blind duplicate, and trip blanks: EPA Method 8260

For each sample or set of samples shipped for laboratory analyses, a chain-of-custody form will be completed to accompany the samples.

Water generated during monitoring well purging/sampling activities will be disposed of at a permitted disposal facility in accordance with the NMOCD Sampling and Disposal Guidelines.

3.2 Irrigation Ditch Field Survey

A general reconnaissance of the irrigation ditches in the vicinity of the site (Farmer's Mutual Irrigation Ditch and Westside Irrigation Ditch, Figure 2) will be conducted. This will include the determination of all lateral ditches, notation of nearby private wells, and identification of potential alternative sources of contamination. The integrity of the ditches will also be surveyed and recorded, and any visual staining of soils or surface water sheen will be noted. If stained soil or surface water sheens are encountered, Maverik will follow up with a plan for potential sampling of the soil and/or surface water from the associated location(s).

3.3 Private Well Ownership and Construction Survey

As historically reported, private water wells in the area, if used at all, are used for irrigation and stock watering. A private water well survey was completed in 1987 in conjunction with the Phase I Hydrogeologic Evaluation. Well

locations are shown on Figure 2. Due to potentially outdated well ownership information, a private well survey will be conducted as part of the Stage 1 Abatement. Field personnel will confirm the locations shown on Figure 2 by a door to door survey and a state and city record search for well construction and property owner details. Any well information that is not available or is refused to be provided by the property owner will be noted. Any wells located hydraulically downgradient of the site or downgradient of the irrigation ditches and that remain in use by the owners will be sampled with the associated property owner's permission. Samples will be analyzed for EPA Method 8260.

3.4 Slurry Wall Integrity Demonstration

Following the collection of groundwater samples and review of the groundwater results, a slurry wall evaluation may be conducted to demonstrate its integrity. If the groundwater investigation determines that impacts from within the slurry wall are a potential source of downgradient impacts, the slurry wall evaluation will include:

- Installation of soil borings into the soil-bentonite backfill of the slurry wall to: 1) collect samples for laboratory permeability testing, and 2) evaluate rooting effects along the south end where trees were observed in close proximity to the wall. If sufficient records are not available to locate the wall, a backhoe will be required to cut trenches in order to locate the slurry wall prior to drilling. The backhoe could also be used to evaluate the effects of tree rooting on the wall.

- After the soil-bentonite backfill samples are collected, laboratory permeability testing will be conducted on 6 samples of the soil-bentonite backfill material. Four of the samples would be collected from below the water table and 2 samples would be collected above the water table. This will provide appropriate distribution along the wall to verify effectiveness along the entire length. Results from samples above and below the water table will be compared to identify potential compatibility problems which may have increased the permeability of the backfill material.

- Upon completion of the permeability testing, a compatibility test will be conducted on one of the samples collected to assure that long term compatibility of the slurry wall will be maintained. This is accomplished be changing the permeant used during the permeability test from water to impacted water from the site or product, if present. This test is conducted until 3 pore volumes have passed through the sample. At completion of the testing, permeabilities from the start to finish of the test are compared to check for a significant increase in permeability, indicating an incompatibility.

4 Health and Safety

The field activities associated with this investigation will be conducted in accordance with the guidelines outlined in the most recent *Site-Specific Health and Safety Plan* (HASP) (Appendix C) for the site, which will be available on site during all fieldwork. All personnel involved in the investigation will be required to review and comply with the HASP.

To perform field activities on site, all field personnel must wear a hard hat, safety glasses, and steel-toed boots, and must provide the site operations manager with a copy of their current Occupational Safety and Health Administration (OSHA) 40-hour training certificate and/or OSHA 8-hour refresher-training certificate. The potential health and safety hazards associated with the field activities proposed in this work plan, and the respective precautionary health and safety guidelines, are addressed in the HASP.

5 Investigation Schedule

Maverik proposes to initiate the groundwater sampling, irrigation ditch field survey, and private well survey within 2 weeks of approval of the Stage 1 Abatement, pending holidays and weather. The slurry wall integrity evaluation will be conducted upon review of the groundwater sample results.

5.1 Report Preparation

A final site investigation report will be prepared upon completion of proposed Stage 1 Abatement activities. The report will address the methods and procedures, analytical and field survey results, and other information related to the Stage 1 Abatement activities. Copies of the report will be submitted to NMOCD.

6 Public Notice

Within 30 days of filing the Stage 1 Abatement Plan proposal, a news release in a format approved by the NMOCD will be issued by the secretary of the New Mexico Department of the Environment. The information contained will be in accordance with Section 20.6.2.4108 A. NMAC.

Table 1
Monitoring Well Construction Summary

Well ID	Completion Date	Total Depth (ft. BGS)	Well Diameter (in.)	Top of Steel Casing Elevation (ft. AMSL)	Top of PVC Casing Elevation (ft. AMSL)	Ground Surface Elevation (ft. AMSL)	Top of Screen (ft. BGS)	Bottom of Screen (ft. BGS)	Screen Length (ft.)	Top of Screen Elevation (ft. AMSL)	Bottom of Screen Elevation (ft. AMSL)	Groundwater Elevation (ft. AMSL)	Last Measured	Comments
MW-1	1987	21.5	2	5207.79	5207.24	5205.75	11.5	21.5	10	5194.3	5184.3	5196.6	1999	
MW-2	1987	15	2	5197.10	5196.93	5195.25	5	15	10	5190.3	5180.3	5190.4	1999	
MW-3	1987	14.5	2	5183.00	5181.46	5181.06	4.5	14.5	10	5176.6	5166.6	5179.6	1987	
MW-4	1987	15	2	5178.41	5177.1	5176.14	5	15	10	5171.1	5161.1	5171.7	1987	
MW-5	1987	15	2	5175.62	5175.09	5173.67	5	15	10	5168.7	5158.7	5169.4	1987	
MW-6	1987	15.5	2	5176.40	5176.01	5174.23	5.5	15.5	10	5168.7	5158.7	5171.6	1987	
MW-7	1987	15	2	5183.71	5182.84	5181.73	5	15	10	5176.7	5166.7	5178.6	1987	
MW-8	1987	15	2	5186.00	5185.87	5184.02	5	15	10	5179.0	5169.0	5181.8	1987	
MW-9	1987	15	2	5191.39	5191.22	5189.33	5	15	10	5184.3	5174.3	5187.5	2005	
MW-10	1987	12.5	2	5189.80	5189.30	5187.47	2.5	12.5	10	5185.0	5175.0	5186.0	2005	
MW-11	1987	33	2	5197.26	5197.15	5194.97	23	33	10	5172.0	5162.0	na	1987	abandoned 1990
MW-12	1987	12	2	5196.66	5196.19	5194.80	2	12	10	5192.8	5182.8	na	1987	abandoned 1990
MW-13	1987	5	2	5187.76	na	5187.56	0	5	5	5187.6	5182.6	na	1998	destroyed
MW-14	1989	6	2	na	5194.47	5190.70	1	6	5	5189.7	5184.7	5186.9	2005	
MW-15	1989	6	2	na	5188.80	5185.40	1	6	5	5184.4	5179.4	5182.9	1999	
MW-16	1990	13	2	na	5194.98	5193.74	3	13	10	5190.7	5180.7	5189.5	2005	
MW-17	1993	15	2	5196.49	5195.91	5193.43	5	15	10	5188.4	5178.4	5188.2	1990	
MW-18	1993	15	2	5202.27	5201.75	5199.14	5	15	10	5194.1	5184.1	5190.1	2005	
MW-19	1990	12.5	2	na	5189.54	5188.28	2.5	12.5	10	5185.8	5175.8	5187.2	2005	
MW-20	1990	12	2	na	5191.05	5190.10	2	12	10	5188.1	5178.1	5187.2	2005	
MW-21	1990	13	2	na	5194.81	5193.62	3	13	10	5190.6	5180.6	5189.3	2005	
MW-22	1990	13	2	na	5195.86	5194.58	3	13	10	5191.6	5181.6	5189.0	1990	
P-1	1993	8	2	na	5197.66	5195.74	3	8	5	5192.7	5187.7	5187.8	1998	
P-2	1993	8	2	na	5192.32	5190.50	3	8	5	5187.5	5182.5	5182.4	1998	
P-3	1993	8	2	na	5193.21	5191.44	3	8	5	5188.4	5183.4	5186.3	1998	
P-4	1993	8	2	na	5198.82	5197.06	3	8	5	5194.1	5189.1	5192.4	1998	

Notes:

AMSL = Above mean sea level
BGS = Below ground surface
na = not applicable

RETEC

Stage 1 Abatement Plan

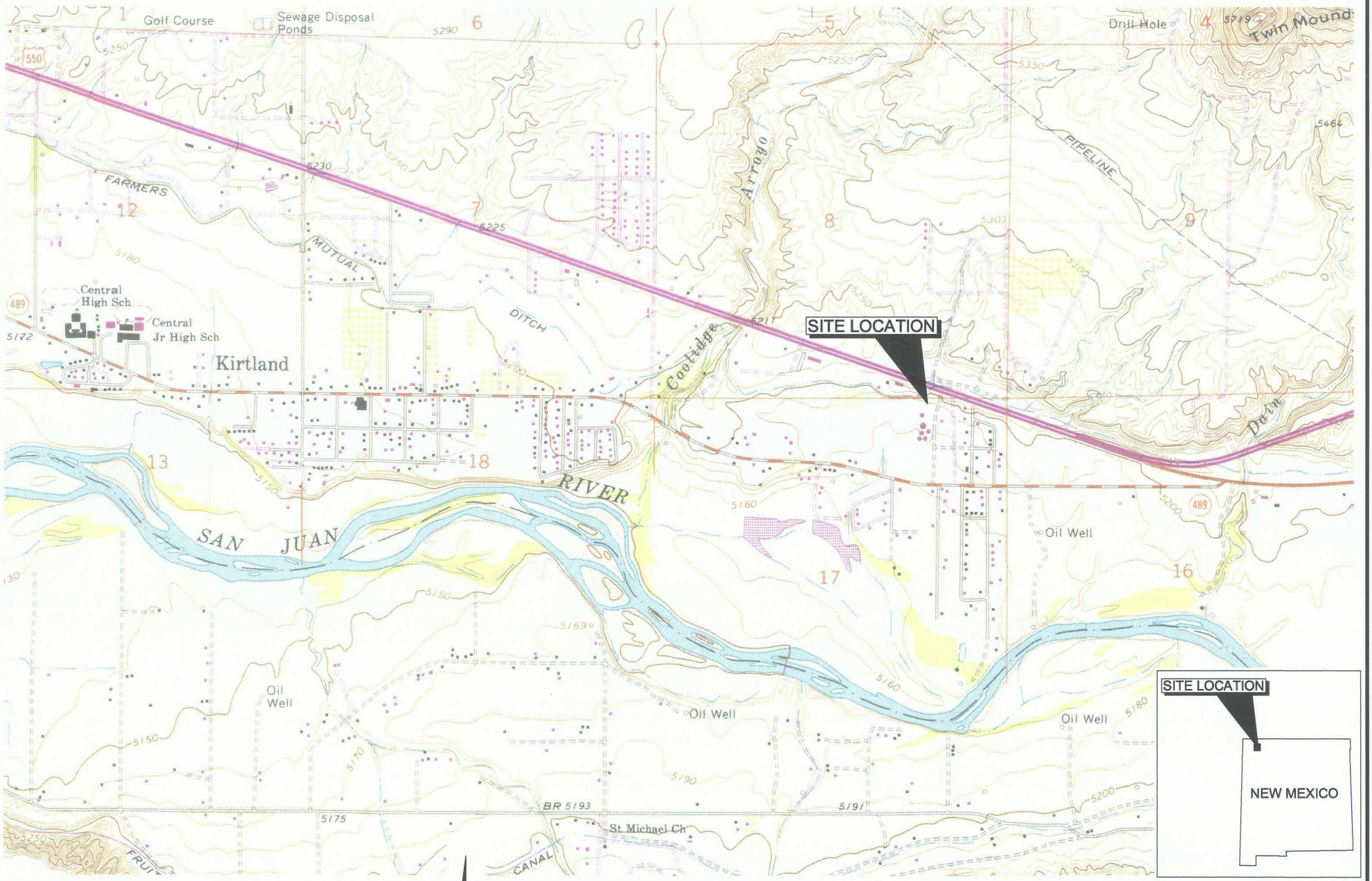
Maverik (Caribou) Former Refinery, Kirtland, New Mexico

DATE: 11/10/05 | DRWN: E.S.S./DEN

SITE LOCATION MAP

FIGURE 2

File: M:\TEMP\mav-kirtland\Mav-Kirt-SWP_2.dwg Layout: FIGURE 2 User: eschwartz Plotted: Nov 11, 2005 - 1:51pm Xref's:



RETEC

1000 0 2000

1"=2000'

N

Stage 1 Abatement Plan

Maverik (Caribou) Former Refinery, Kirtland, New Mexico

DATE: 11/10/05 | DRWN: E.S.S./DEN

VICINITY MAP

FIGURE 1

Appendix A

Standard Operating Procedures (SOPs)

RETEC Standard Operating Procedure (SOP) 230
Groundwater Sampling

1.0 Purpose and Applicability

This SOP describes the collection of valid and representative samples from groundwater monitoring wells. Specific project requirements as described in an approved Work Plan, Sampling Plan, Quality Assurance Project Plan, or Health & Safety Plan will take precedence over the procedures described in this document.

2.0 Responsibilities

The field sampling coordinator will have the responsibility to oversee and ensure that all groundwater sampling is performed in accordance with the project specific sampling program and this SOP. In addition, the field sampling coordinator must ensure that all field workers are fully apprised of this SOP.

3.0 Supporting Materials

The list below identifies the types of equipment which may be used for a range of groundwater sampling applications. From this list, project specific equipment will be selected based upon project objectives and site conditions (e.g., the depth to groundwater, purge volumes, analytical parameters, well construction, and physical/chemical properties of the analytes). The types of sampling equipment are as follows:

- Purging/Sample Collection
  - Bailers and bailer cord
  - Centrifugal pump
  - Bladder pump or Peristaltic pump

The most widely applicable equipment that will contact the water must be made of inert materials, preferably stainless steel or fluorocarbon resin.

- Sample Preparation/Field Measurement
  - pH meter
  - Specific conductance meter
  - Thermometer
  - Filtration apparatus
  - Water-level measurement equipment

All equipment will be calibrated before use following the manufacturer's specifications.

- General
  - Distilled water dispenser bottle
  - Methanol or isopropyl dispenser bottle
  - Decontamination equipment
  - Personal protection equipment as specified in the Project Health and Safety Plan
  - Field data sheets and field book
  - Sample containers, labels, and preservation solutions
  - Buckets and drums
  - Coolers and ice
  - Paper towels or chemical-free cloths

4.0 Methods and Procedures

The following sections describe the methods and procedures required to collect representative groundwater samples.

4.1 Water-Level Measurement

After unlocking and/or opening a monitoring well, the first task will be to obtain a water-level measurement. A static-water level will be measured in the well prior to the purging and collection of any samples. The water level is needed for estimating the purge volume and may also be used for mapping the potentiometric surface of the groundwater. Water-level measurements will be made using an electronic or mechanical device following the methods described in SOP 231.

Measurement of point location for the well should be clearly marked on the outermost casing or identified in previous sample collection records. This point is usually established on the well casing itself, but may be marked on the protective steel casing in some cases. In either case, it is important that the marked point coincide with the same point of measurement used by the surveyor. If not marked from previous investigations, the water level measuring point should be marked on the north side of the well casing and noted in the groundwater sampling form (Figure 1). Whatever measuring point is used, the location should be described on the groundwater sampling form.

To obtain a water level measurement lower a decontaminated mechanical or an electronic sounding unit into the monitoring well until the audible sound of the unit is detected or indicates water contact. At this time the precise measurement should be determined by repeatedly raising and lowering the tape or cable to converge on the exact measurement. The water-level measurement should be entered on the groundwater sampling form. The

water-level measurement device shall be decontaminated immediately after use following the procedures outlined in SOP 120.

4.2 Purging and Sample Collection Procedures

Well purging is the activity of removing some volume of water from a monitoring well in order to induce "fresh" groundwater to flow into the well prior to sampling. Under most well construction and hydrogeologic conditions, this provides water that is more representative of the groundwater in saturated materials adjoining the well.

The volume of water to be removed, referred to as the purge volume, is a function of the water- yielding capacity of the well, the well diameter and depth, and the depth to water made just prior to purging. The well depth should be sounded with the water-level cable or tape just before or after measuring the static depth to water. A well volume is defined as the product of the length of water column and the volume per unit length of well casing, a function of casing inside diameter. The following data can be used in this field calculation:

Inside Diameter, inches	Gallons/foot
1 1/4	0.077
1 1/2	0.10
2	0.16
3	0.37
4	0.65
6	1.64

According to the TEGD (USEPA, 1986), the purge volume should equal at least three well volumes when the earth materials will yield relatively large quantities of water, and between one and two well volumes when the earth materials will only yield small quantities to the well. From a field operations viewpoint, large quantities (high yield) means that the well can not be pumped or bailed "dry" by removing three well volumes. Small quantities (low yield) are identified when the well can be pumped or bailed "dry".

Based on experience and recent scientific literature, it will be The RETEC Group, Inc. (RETEC) policy to minimize the generation of water turbidity when purging. Turbidity is especially of concern when testing the samples for metals or for selected organics that may be sorbed to the sediment. Turbidity will be minimized by:

- Using a low-pumping rate submersible pump such as a compressed- gas driven bladder pump
- Slowly moving the bailer in and out of the water column; avoid dropping the bailer and removing it quickly

Purging will be performed for all groundwater monitoring wells prior to sample collection.

Three general methods are used for well purging. Well purging may be achieved using bailers, surface pumps, or down-well submersible pumps. In all cases pH and specific conductance will be monitored during purging. Field parameter values will be entered on the groundwater sampling form along with the corresponding purge volume. The following sections explain the procedures to be used to purge and collect samples from monitoring wells.

4.2.1 Bailing

Obtain a clean decontaminated bailer and a spool of polypropylene rope or equivalent bailer cord. Using the rope at the end of the spool, tie a bowline knot, or equivalent, through the bailer loop. Test the knot for adequacy by creating tension between the line and the bailer. Tie again if needed.

Lower the bailer to the bottom of the monitoring well and remove an additional five feet of cord from the spool. Cut the cord at the spool and secure the rope to the well head or the wrist of the person who shall perform the bailing.

Raise the bailer by grasping a section of cord using each hand alternately. This bailer lift method is used so that the bailer cord will not come into contact with the ground or other potentially contaminated surfaces.

Samples collected by bailing will be poured directly into sample containers from bailers which are full of fresh groundwater. Samples will be collected in the following order:

- Volatile organic compounds
- Semivolatile organic compounds
- Pesticides/Herbicides/PCBs/Dioxins
- Organic indicator compounds
- Metals (total and/or dissolved)
- Miscellaneous inorganic compounds
- Radiometric compounds
- Microbial analyses

During sample collection, bailers will not be allowed to contact the sample containers.

4.2.2 Pumping

Groundwater withdrawal using pumps is commonly performed with centrifugal, peristaltic, submersible, or bladder pumps. Peristaltic and centrifugal pumps are limited to conditions where groundwater need only be raised through approximately 20 to 25 feet of vertical distance. Submersible or bladder pumps can be used when groundwater is greater than 25 feet below grade. Specific methods for pumps will be discussed in the project specific sampling plan. Pumping for collection of samples to be analyzed for volatile organics will only be with bladder pumps.

Samples collected by pumping will be transferred directly from the pump discharge tubing into the sample containers. Samples will be collected in the following order:

- Volatile organic compounds
- Semivolatile organic compounds
- Pesticides/Herbicides/PCBs/Dioxins
- Organic indicator compounds
- Metals (total and/or dissolved)
- Miscellaneous inorganic compounds
- Radiometric compounds
- Microbial analyses

During sample collection, the discharge tubing will not be allowed to contact the sample containers.

4.3 Sample Preparation and Filtration

Specific procedures pertaining to the handling and shipment of samples shall be in accordance with SOP 110. A clean pair of gloves and decontaminated sampling tools will be used when handling the samples during collection to prevent cross contamination.

Prior to transport or shipment, groundwater samples may require preparation and/or preservation. Field preparation may entail filtration, preservation in the form of chemical additives, or temperature control. Specific preservation requirements will be described in the project specific sampling plans.

Groundwater samples collected for dissolved metals analyses will be filtered prior to being placed in sample containers. Groundwater filtration is performed using a peristaltic pump and a 0.45 micron water filter unless otherwise specified in the project specific sampling plan. For most dissolved metal analyses, pH adjustment of the sample is also required and shall be performed after filtration.

5.0 Quality Assurance/Quality Control

Quality Assurance/Quality Control (QA/QC) requirements include, but are not limited to, blind field duplicates, blind rinsate blanks, and blind field blanks. These samples will be collected on a frequency of one QA/QC sample per 10 field samples or a minimum of one QA/QC sample per day unless otherwise specified in the project specific sampling plan.

6.0 Documentation

Various documents will be completed and maintained as a part of Groundwater Sample collection. These documents will provide a summary of the sample collection procedures

and conditions, shipment method, analyses requested, and the custody history. These documents may include:

- Field book
- Groundwater sampling forms
- Sample labels
- Chain-of-custody
- Shipping receipts

All documentation will be stored in the project files.

7.0 References

Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells, EPA 600/4-89/034, published by National Water Well Association, 1989.

RCRA Ground Water Monitoring Technical Enforcement Guidance Document, published by National Water Well Association, 1986.

A Compendium of Superfund Field Operations, EPA 540/P-87/001, published by the Office of Emergency and Remedial Response, Office of Waste Programs Enforcement, US EPA, 1987.

The RETEC Group, Inc.
Groundwater Sampling Form

PROJECT _____ WELL NO._____
PROJECT NO. _____ SAMPLERS_____

1. **WELL CONDITION CHECKLIST:**
   a. Bump posts_____ Prot. casing/lock_____ Surface pad_____
   b. Well visibility (paint)_____
   c. Well label_____

2. **WATER LEVEL MEASUREMENT:**
   DATE_____ TIME_____
   WEATHER CONDITIONS_____
   a. Location of measuring point _____
   b. Depth of water table from measuring point _____
   c. Height of measuring point above ground surface _____
   d. Total depth of well below measuring point _____
   e. Length of water column (line 2d-2b) _____

3. **WELL PURGING:**
   DATE_____ TIME_____
   WEATHER CONDITIONS_____
   a. Purge method _____
   b. Required purge volume at 3 well volumes _____

Pumping Duration	Volume Rmvd.	PH	Cond.	T(C)	Color	Turbidity

4. **SAMPLE COLLECTION:**
   DATE_____ TIME_____
   WEATHER CONDITIONS_____
   a. Collection method_____
   b. Meter calibration Date Model
      pH meter _____
      Conductivity meter _____
   c. Sample information pH_____ Cond._____ T(C)_____ Turbidity_____

Analysis	Containers	Sample Prep./Preservation

   d. Chain of custody form_____ COC tape_____
   e. Shipping container_____

5. **COMMENTS:**_____
_____
_____

RETEC Standard Operating Procedure (SOP) 231
Water-Level Measurements

1.0 Purpose and Applicability

The RETEC Group, Inc. (RETEC) SOP 231 describes the measurement of water levels in groundwater monitoring wells or piezometers. Water-level measurements are fundamental to groundwater and solute transport studies. Water-level data are used to indicate the directions of groundwater flow and areas of recharge and discharge, to evaluate the effects of manmade and natural stresses on the groundwater system, to define the hydraulic characteristics of aquifers, and to evaluate stream-aquifer relations. Measurements of the static-water level are also needed to estimate the amount of water to be purged from a well prior to sample collection.

Specific project requirements as described in an approved Work Plan, Sampling Plan, Quality Assurance Project Plan, Job Hazard Analysis (JHA), Safety Task Analysis Review (STAR), or Site-Specific Health and Safety Plan (HASP) will take precedence over the procedures described in this document.

2.0 Responsibilities

The field sampling coordinator will have the responsibility to oversee and ensure that all procedures are performed in accordance with the project-specific sampling program and this SOP.

3.0 Health and Safety

This section presents the generic hazards associated with the collection of water-level measurements. The site-specific HASP, JHAs, and STARs will address additional requirements and will take precedence over this document. Appropriate personal protective equipment (PPE) must be worn as determined in the Site-Specific HASP, which typically consists of Level D protection. Under circumstances where potential airborne exposure is possible respiratory protective equipment may be required based on personal air monitoring results. Upgrades to Level C will be coordinated with your Site Safety and Health Officer (SSHO) or Environment, Health, and Safety (EHS) Coordinator.

Health and safety hazards during groundwater level measurements may involve:

- Slip, trips, and falls in tall grasses over obstacles and berms near well locations. Review terrain hazards prior to conducting these operations. Ensure that you have safe means of access/egress to the wellhead.

- Exposure to site contaminants. If there is product in the well (especially

gasoline) take all precautions necessary to prevent fire/explosion and/or exposure to airborne vapors.

- Ergonomics. Use appropriate ergonomic techniques when inserting or retrieving equipment for the wells to preclude injury to the arms, shoulders or back.

If the well is suspected of being contaminated, or has a history of contamination, the static water-level measurements should be made while wearing appropriate personal protective equipment (PPE). The air in the wellhead should be sampled for organic vapors using a Photo Ionization Detector (PID). The results shall be recorded in the Fluid-Level Monitoring Log (Figure 1) or the project field book. This is the first indication of the presence of a non-aqueous phase liquid (NAPL). If the potential for fire or explosion exists, use of the probe ground wire is required.

4.0 Supporting Materials

This section identifies the types of equipment that may be used for measurement of groundwater levels. Based on project objectives, observed or probable well contamination, and well construction, a project-specific equipment list will be determined from the following equipment:

- Water-level and/or product-level measuring device
- Distilled water dispenser bottle
- Methanol or isopropyl in properly labeled dispenser bottles
- Plastic sheeting
- PPE as specified in the Site-Specific HASP
- Fluid-level monitoring logs and field book
- Paper towels or chemical-free cloths
- Material Safety Data Sheets (MSDSs) for any chemicals or site-specific contaminants
- A copy of the Site-Specific HASP

5.0 Methods and Procedures

When taking a series of fluid-level measurements at a number of monitoring wells, it is generally good practice to go in order from the least- to the most contaminated well. Additionally, the measurement of all site wells should be done consecutively and before any sampling activities begin. This will ensure the data are representative of aquifer

conditions. All pertinent data should be entered in the Fluid-Level Monitoring Log (Figure 1) or the project field book.

5.1 Well Evaluation

Upon arrival at a monitoring well, the surface seal and well protective casing should be examined for any evidence of frost heaving, cracking, or vandalism. All observations should be recorded in the fluid-level monitoring log or the project field book.

The area around the well should be cleared of weeds and other materials prior to measuring the static-water level (avoid contact with poison ivy or other allergenic plants). A drop cloth or other material (e.g., plastic garbage bag) should be placed on the ground around the well, especially if the ground is disturbed or potentially contaminated. This will save time and work for cleaning equipment or tubing if it falls on the ground during preparation or operation. The well protective casing should then be unlocked and the cap removed.

5.2 Measuring Point Location

The measuring point location for the well should be clearly marked on the outermost casing or identified in previous sample collection records. This point is usually established on the well casing itself, but may be marked on the protective steel casing in some cases. In either case, it is important that the marked point coincide with the same point of measurement used by the surveyor. If not marked from previous investigations, the water-level measuring point should be marked on the north side of the well casing and noted in the Fluid-Level Monitoring Log (Figure 1) or the project field book. Monitoring well measurements for total depth and water level should be consistently measured from one reference point so that these data can be used for assessing trends in the groundwater.

5.3 Water-Level Measurement

Water-level measurements shall be made using an electronic or mechanical device. Several methods for water-level measurement are described below. The specific method to be used will be defined in the project-specific sampling plan.

5.3.1 Graduated Steel Tape

The graduated steel-tape method is considered an accurate method for measuring the water level in nonflowing wells. Steel surveying tapes in lengths of 100, 200, 300, 500, and 1,000 feet are commonly used; a black tape is better than a chromium-plated tape. The tapes are mounted on hand-cranked reels up to 500-foot lengths; for greater depth, a motor-driven tape drive is usually required. A slender weight is attached to the ring at the end of the tape to ensure plumbness and to permit some feel for obstructions.

The lower few feet of tape is chalked by pulling the tape across a piece of blue carpenter's chalk. The wet chalk mark identifies the portion of the tape that was submerged. Lower the graduated steel-tape from the measuring point at the top of the well until a short length of the tape is submerged. The weight and tape should be lowered into the water

slowly to prevent splashing. Submergence of the weight and tape may temporarily cause the water level to rise in wells or piezometers having very small diameters. This effect can be significant if the well is in materials of very low hydraulic conductivity.

Under dry surface conditions, it may be desirable to pull the tape from the well by hand, being careful not to allow it to become kinked, and reading the water mark before rewinding the tape onto the reel. In this way, the watermark on the chalked part of the tape is rapidly brought to the surface before the wetted part of the tape dries. In cold regions, rapid withdrawal of the tape from the well is necessary before the wet part freezes and becomes difficult to read. Read the tape at the measuring point, and then read the watermark on the tape. The difference between these two readings is the depth to water below the measuring point. Errors resulting from the effects of thermal expansion of tapes and of stretch due to the suspended weight of the tape and plumb weight can become significant at high temperatures and for measured depths in excess of 1,000 feet.

The observer should make two measurements. If two measurements of static-water level made within a few minutes do not agree within 0.01 or 0.02 foot in observation wells having a depth to water of less than a couple hundred feet, continue to measure until the reason for the lack of agreement is determined or until the results are shown to be reliable. Where water is dripping into the well or covering the well casing wall, it may be impossible to get a good watermark on the chalked tape.

Water-level measurement should be entered in the fluid-level monitoring log or the project field book. The water-level measurement device shall be decontaminated immediately after use.

5.3.2 Electrical Methods

Many types of electrical instruments are available for water-level measurement; most operate on the principle that a circuit is completed when two electrodes are immersed in water. Electrodes are generally contained in a weighted probe that keeps the tape taut while providing some shielding of the electrodes against false indications as the probe is being lowered into the well. Before lowering the probe into the well, the circuitry can be checked by dipping the probe in water and observing the indicator (a light, sound, and/or meter).

To obtain a water-level measurement, slowly lower the decontaminated probe into the monitoring well until the indicator (light, sound, and/or meter) shows water contact. At this time, the precise measurement should be determined by repeatedly raising and lowering the tape or cable to converge on the exact measurement.

In wells having a layer of NAPL floating on the water, the electric tape will not respond to the oil surface and, thus, the fluid level determined will be different than would be determined by a steel tape. The difference depends on how much NAPL is floating on the water. Dual media tapes are recommended in that instance to measure both NAPL and water levels using the same measuring device. The procedure is discussed in Section 5.4.

Water-level measurement should be entered in the fluid-level monitoring log or the project field book. The water-level measurement device shall be decontaminated immediately after use.

5.3.3 Airline

The airline method is especially useful in pumped wells where water turbulence may preclude using more precise methods. A small diameter air-type tube of known length is installed from the surface to a depth below the lowest water level expected. Compressed air is used to purge the water from the tube. The pressure, in pounds per square inch (psi), needed to purge the water from the airline multiplied by 2.31 (feet of water for one psi) equals the length in feet of submerged airline. The depth to water below the center of the pressure gage can be easily calculated by subtracting the length of airline below the water surface from the total length of airline (assuming the air line is essentially straight).

Accuracy depends on the precision to which the pressure can be read. The accuracy of an airline or pressure gage measurement depends primarily on the accuracy and condition of the gage. It is normally within 1 foot of the true level as determined by means of a steel-tape measurement. The airlines themselves, however, have been known to become clogged with mineral deposits or bacterial growth, or to develop leaks and consequently yield false information. A series of airline measurements should be checked periodically by the use of a steel tape or an electric water-level indicator.

The airline and any connections to it must be airtight throughout the entire length. A long-term increase in airline pressure may indicate gradual clogging of the airline. A relatively sudden decrease in airline pressure may indicate a leak or break in the airline. Airline pressures that never go above a constant low value may indicate that the water level has dropped below the outlet orifice of the airline. To minimize the effect of turbulence, the lower end of the airline should be at least 5 feet above or below the pump intake. Corrections should be made for fluid temperatures much different from 20° C and for vertical differences in air density in the well column for cases where the depth to water is very large.

5.4 Procedures for Immiscible Fluids

At those facilities where monitoring to determine the presence or extent of immiscible fluids is required, the sampler will need to use special procedures for the measurement of fluid levels. The procedures required will depend on whether light NAPL (LNAPL) that form lenses floating on top of the water table or dense NAPL (DNAPL) that sink through the aquifer and form lenses over lower permeability layers are present.

In the case of LNAPL, measurements of immiscible fluid and water level usually cannot be accomplished by using normal techniques. For example, a chalked steel-tape measurement will only indicate the depth to the immiscible fluid (not the depth to water) and a conventional electric water-level probe will not generally respond to nonconducting immiscible fluids.

To circumvent these problems, the use of special techniques and equipment can be specified. These techniques have been specially developed to measure fluid levels in wells containing LNAPL or DNAPL, particularly petroleum products. One method is similar to the chalked steel-tape method. The difference is the use of a special paste or gel rather than ordinary carpenters chalk. Such indicator pastes, when applied to the end of the steel tape and submerged in the well, will show the top of the oil as a wet line and the top of the water as a distinct color change. Another method, similar to the electric-tape method, uses a dual purpose probe and indicator system. The probe can detect the presence of any fluid (through the wetting effect) and can also detect fluids that conduct electricity. Thus, if a well is contaminated with low density, nonconducting LNAPL such as gasoline, the probe will first detect the surface of the gasoline, but it will not register electrical conduction. However, when the probe is lowered deeper to contact water, electrical conduction will be detected. The detection of a DNAPL would be similar.

5.5 Measurement of Total Depth

During water-level measurement, the total depth of the well may also be measured. This measurement gives an indication of possible sediment buildup within the well that may significantly reduce the screened depth. The same methods used for measuring water levels (e.g., steel tape or electrical probes) may be used to measure the total well depth. The most convenient time to measure the total well depth is immediately following measurement of the water level and prior to removing the measurement device completely from the well. The measurement device (steel tape or electrical probe) is lowered down the well until the measurement tape becomes slack indicating the weighted end of the tape or probe has reached the bottom of the well. While the probe remains touching the bottom and the tape pulled taut, the total well depth shall be recorded into the field book.

6.0 Quality Assurance/Quality Control

To ensure that accurate data are collected, repeated measurements of the fluid depths should be made. The readings should be within 0.01 to 0.02 feet of each other. A secondary check, if data are available, is to compare previous readings collected under similar conditions (e.g., summer months, wells pumping, etc.).

7.0 Documentation

Data will be recorded into the fluid-level monitoring log form, the project field book, or, if groundwater sampling, the groundwater sample collection record. Additional comments, observations, or details will also be noted. These documents will provide a summary of the water-level measurement procedures and conditions and will be kept the in project files.

Fluid-Level Monitoring Log

Site Location:	Project Name:
Personnel:	Project No.:
Gauging Instrument:	Date(s):

Well Number	Date	Time	Depth to LNAPL (ft)	Depth to Water (ft)	Total Depth (ft)	LNAPL Thickness (ft)	Remarks

Figure 1

Appendix B

Quality Assurance Project Plan (QAPP)

Appendix B
Quality Assurance Project Plan

Maverik (Caribou) Former Refinery
Kirtland, New Mexico

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November 11, 2005

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List of Acronyms

ASTM	American Society for Testing and Materials
CLP	Contract Laboratory Program
DQO	Data Quality Objective
EDD	Electronic Data Deliverable
Eh	Redox Potential
EQuIS	Environmental Quality Information System
GC/MS	Gas Chromatograph/Mass Spectrometer
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NAPL	Non Aqueous Phase Liquid
NMOCD	New Mexico Energy, Minerals, and Natural Resources, Oil Conservation Division
OSHA	Occupational Safety and Health Administration
PARCC	Precision, Accuracy (bias), Representativeness, Comparability, and Completeness
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RPD	Relative Percent Difference
SAP	Sampling and Analysis Plan
SOP	Standard Operating Procedure
U.S. EPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound

1 Introduction

This Quality Assurance Project Plan (QAPP) presents the project organization, objectives, activities, and quality assurance (QA) procedures that will be implemented at the Former Maverik Refinery in Kirtland, New Mexico. This QAPP was prepared following the United States Environmental Protection Agency (U.S. EPA) Guidance for Quality Assurance Project Plans (U.S. EPA, 1998) and the EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations (U.S. EPA, 1997a).

This QAPP describes procedures to ensure that project sampling and analysis activities are consistent with project quality goals, and is presented as an appendix to the *Stage 1 Abatement Plan*. The QAPP is considered an integral portion of the project work plans. Therefore this QAPP will be applicable to subsequent work plans for the Former Refinery; which will be prepared, reviewed and approved separately as the scope of work will be defined between Maverik and New Mexico Energy, Minerals, and Natural Resources, Oil Conservation Division (NMOCD).

Upon approval, this QAPP will be applicable to any subsequent investigations at the Former Refinery. The QAPP will be used as a reference for general items to be addressed in each work plan. Additional information, such as special personnel or equipment requirements or a schedule for the work to be performed, will also be included in the individual work plans. A summary of all items necessary to complete activities at the site will be included in a checklist that will be submitted with the work plan. A copy of the checklist is included in Attachment A.

This QAPP Is organized as follows:

- **Section 1** - pertains to project organization, and the roles and responsibilities of project participants. This section also references data quality objectives (DQOs) necessary to effectively address project objectives.

- **Section 2** - references the data collection design and sampling methods. Analytical methods and Quality Control (QC) (field and laboratory) requirements are also presented in this section. Field and laboratory instrument calibration requirements, data acquisition, and data management requirements for field investigations are provided.

- **Section 3** - details the systematic procedures needed for situations outside of control criteria are identified and described.

- **Section 4** - presents processes and criteria for the data reduction and validation and for data management.

1.1 Project/Task Organization

The project team for the Former Refinery includes representatives of the NMOCD, Maverik, and Maverik's contractors and consultants. Figure 1 presents a project organization diagram identifying team members and showing established lines of communication. The designated contacts for the NMOCD and Maverik will serve as the official channels for communication.

The responsibilities of the key individuals making up the project team are briefly highlighted below:

- **NMOCD Project Manager** – Performs technical oversight and approves technical documents.

- **Maverik Project Manager** - Interacts with the contractor on regulatory, technical, and financial issues; interacts with agency representatives on regulatory and technical issues; and implements each work plan through oversight of the contractor.

- **Project Manager** - Interacts with Maverik on regulatory, technical, and financial matters; oversees project schedules; and overall implementation of the work plans. The Project Manager serves as the primary point of contact between Maverik representatives and the remainder of the project team.

- **Task Manager** - Supports the Project Manager on regulatory, technical and/or financial issues; day-to-day implementation of project plans; technical performance and staffing of the project; development, maintenance, and safekeeping of project documentation; progress and technical reports; issues of nonconformancy with project plans; project schedules; and coordination with subcontractors.

- **Field Team Leader/Manager** - Coordinates the activities of field personnel and subcontractors; assures adherence of the fieldwork to the project plans; and documents fieldwork. The Field Team Leader/Manager may also be a Sampling Team Leader, Site Safety Officer, and Records Custodian/Sample Coordinator.

- **Sampling Team Leader** - Coordinates the activities of the Sampling Team Members with respect to installing and calibrating the field instrumentation, conducting the sampling program, assuring the availability and maintenance of all sampling equipment, materials and decontamination. Supervises the accurate completion of all sampling documentation that includes chain-of-

custody records, sample labels, and field logbooks. The Sampling Team Leader may also assume the responsibilities of the Site Health and Safety Officer and/or Field Record Custodian/Sample Coordinator.

- **Sampling Team Member** - Performs field operations and various field tests (documentation, decontamination, air monitoring, etc.) and collects appropriate environmental samples from the various media under the supervision of the Sampling Team Leader. The Sampling Team is responsible for performing all fieldwork in accordance with the requirements and procedures stipulated in the project plans. A Sample Team Member may also serve as the Field Record Custodian/Sample Coordinator.

- **Field Record Custodian/Sample Coordinator** - Accurately completes pre-sampling and sampling records, chain-of-custody records, shipping and handling of samples, and manages records from field activities. Schedules and tracks all samples and sample data to the laboratory including the initial request for analytical services, coordination of shipments of sample and materials, communication of sampling information, resolution of problems in scheduling laboratory services and supplies, and reception of all sample data packages for document control.

- **Site Health and Safety Officer** - Implements the site-specific health and safety directives in the Health and Safety Plan and documents all health and safety related activities.

- **Project QA Officer** – Responsible for laboratory coordination for scheduled site work and assuring that the specified analytical and data management procedures are followed and documented. Responsible for assessing the precision, accuracy, and completeness of the data in the review of field and laboratory data for compliance with QA objectives (precision, accuracy, and completeness). Responsible for finalizing electronic laboratory data files for import into project database; reviewing database generated tables for accuracy.

1.2 Project Description

Individual project and task descriptions and a schedule for task completion will be included in individual work plans. General procedures and requirements for the collection and reporting of data collected at the Former Refinery are provided below.

Field documentation required for this project includes:

- Pertinent Health and Safety Documentation
- Field Activity Summary Forms
- Sample Collection Forms
- Chain-of-custody Forms
- Boring Logs, Well Construction Records
- Field Instrument Calibration Records

Analytical work for field investigations will include fully documented Update III SW-846 (U.S. EPA, 1997b) sample collection, preservation, and handling procedures; Update III SW-846 or approved American Society for Testing and Materials (ASTM) analytical methods. Data validation will comply with Update III SW-846 method criteria and will follow the U.S. EPA Contract Laboratory Program (CLP): National Functional Guidelines (U.S. EPA, 1994 and 1999), as they apply to the analytical methods employed.

1.3 Data Quality Objectives

In accordance with guidance provided by the U.S. EPA in the Advanced Notice of Proposed Rulemaking (U.S. EPA, 1996), data gathering strategies should be tailored to reflect the DQOs. DQOs reflect the overall degree of data quality or uncertainty that the decision maker is willing to accept during decision-making. DQOs are used to specify the quality of the data, usually in terms of precision, bias, representativeness, comparability, and completeness. DQOs apply to the entire measurement system (e.g., sampling locations, methods of collection and handling, field analysis, and laboratory analysis). DQOs are used to ensure that environmental data are scientifically valid, defensible, and of an appropriate level of quality given the intended use for the data (U.S. EPA, 1996).

The U.S. EPA's goal in using DQOs is to "...minimize expenditures related to data collection by eliminating unnecessary duplicative, or overly precise data. At the same time, the data collected should have sufficient quality and quantity to support defensible decision making" (U.S. EPA, 1994). DQOs are intended to (U.S. EPA, 1994 and 1999):

- Clarify the study objectives
- Define the most appropriate type of data to collect
- Determine the most appropriate conditions from which to collect data
- Specify tolerable limits on decision errors to establish quantity and quality of data

1.3.1 Measurement Performance Criteria

QA objectives data include the qualitative guidelines listed above, as well as quantitative determinations of the data quality indicators or precision, accuracy (bias), representativeness, comparability, and completeness (PARCC) parameters. The objectives for PARCC parameters will vary with the anticipated use of the data. A discussion of how each of these five parameters will be integrated into this project is provided below.

Precision

Precision measures the reproducibility of measurements under a given set of conditions. Precision is measured by the relative percent difference (RPD), which is a quantitative measure of the variability of a group of measurements compared to their average value. The overall precision of measurement data is a mixture of sampling and analytical factors. Precision is evaluated through field and laboratory duplicate samples.

Sampling precision will be evaluated by analysis of field duplicate samples from a given location. When determining field precision, the acceptable level of variability in results will be no greater than 20 percent RPD for water samples. Field duplicate samples will be collected for analysis at a rate of one sample in 10 (10 percent). Field duplicates will not be collected for soil due to the non-homogeneous nature of the matrix.

Laboratory precision will be evaluated through analysis of laboratory duplicates, laboratory control sample duplicates (LCSDs), and matrix spike duplicates (MSDs). RPDs are calculated for duplicates and compared to laboratory established control limits. Control limits will vary with analysis and sample type (i.e., duplicate, LCSD, MSD). Laboratory precision will be determined by matrix for one sample in 20 (5 percent).

Accuracy

Accuracy measures the closeness of an individual measurement or the average of a number of measurements to the true value. Accuracy includes a combination of random and systematic error components that result from sampling and analytical operations. Sources of error include the sampling process, field contamination, sample preservation, sample handling, sample matrix, laboratory preparation, and analysis techniques.

Sampling accuracy will be assessed by evaluating the results of field-generated blanks and trip blanks. Field-generated blanks will be collected at a frequency ratio of 1:10. One trip blank per cooler containing samples for Volatile Organic Compounds (VOCs) analysis will be submitted for analysis.

Laboratory accuracy for analytical methods will be assessed by spiking samples with known standards and measuring the percent recovery of the

spiked analyte. Known standards include matrix spikes (MSs), surrogate spikes, and laboratory control samples (LCSs). Surrogate spikes are required for all environmental and QC samples analyzed for organics. MSs and/or laboratory control spikes will be submitted for no less than one sample in 20 (5 percent).

Recovery of surrogate, matrix, and laboratory control spikes will be evaluated after each analytical run by the laboratory analyst to verify that the values are within published SW-846, CLP, or laboratory control-charted limits (U.S. EPA, 1997b, 1994, and 1999). If recovery values are outside control limits, the system will be evaluated to confirm that all instrumentation is operating properly. The data will be reviewed to determine whether the unacceptable spike results are due to matrix interference. If matrix interferences are affecting surrogate and/or matrix spike recovery and re-extraction is not deemed useful, the data will be annotated to document the situation. However, if a surrogate recovery is less than 10 percent the sample will be re-extracted and reanalyzed once, unless there is objective evidence of matrix interference.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is a qualitative parameter used to ensure proper design of the sampling program. Representativeness criteria are best satisfied by making certain that sampling locations are selected properly, a sufficient number of samples are collected, proper sampling techniques are used, proper analytical procedures are followed, and sample holding times are not exceeded. Representativeness will be assessed by analyzing field duplicate samples.

Completeness

Completeness is defined as the percentage of measurements made that are judged to be valid measurements. Completeness will be calculated following completion of the analytical testing. Completeness is defined by the equation below:

$$C\% = \frac{S}{R}(100\%)$$

Where: C = completeness
S = number of valid analyses
R = number of samples collected for each parameter analyzed

The completeness goal is essentially the same for all data uses: that a sufficient amount of valid data be generated. It is important that critical

samples are identified and plans made to achieve valid data from critical samples. It is expected that field measurements and laboratory analyses will provide data meeting QC completeness acceptance criteria of 90 percent or more for all samples tested.

Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared to another. Sample data should be comparable with other measurement data for similar samples and sample conditions. This goal is achieved through the use of standard techniques to collect and analyze representative samples and the consistent reporting of analytical results in appropriate units. Comparability is limited by the other PARCC parameters because the data sets can only be compared with confidence when precision and accuracy are known.

1.3.2 Special Training Requirements/Certification

Specific training requirements for performing fieldwork at the site are as follow:

- All field personnel assigned to the site must have successfully completed 40 hours of training for hazardous site work in accordance with Occupational Safety and Health Administration (OSHA) 29 Code of Federal Regulations (CFR) 1910.120(e)(3) and be current with their 8-hour refresher training in accordance with OSHA 29 CFR 1910.120(e)(8). Documentation of OSHA training is required prior to personnel being permitted to work on site.

- Personnel managing or supervising work on site will also have successfully completed 8 hours of Manager/Supervisor Training meeting the requirements of OSHA 29 CFR1910.120(e)(4).

- Personnel assigned to the site must be enrolled in a medical surveillance program meeting the requirements of OSHA 29 CFR 1910.120(f). Personnel must have successfully passed an occupational physical during the past 12 months and be medically cleared to work on a hazardous waste site and capable of wearing appropriate personal protective equipment and respiratory protection as may be required.

- Personnel assigned to the site who must wear a respirator must be familiar with the requirements in the OSHA respiratory standard (29 CFR 1910.134). Personnel who are required to wear respirator protection must have successfully passed a respirator fit test within the last 12 months.

It is the responsibility of the employing organization to provide their employees with the required training, medical monitoring, and fit testing prior to assigning them to work at this site. Each employing organization will be responsible for providing documentation of training, monitoring, and fit testing (with make/model of respirator) to the Project Manager and Site Health and Safety Officer prior to sending their employees to the site to work.

1.4 Documentation and Records

This section of the QAPP identifies the protocols for reporting and documentation of field records, laboratory analytical data reports, and Electronic Data Deliverable (EDD) reports generated in this program.

1.4.1 Field Records

Field records will include all sample collection forms, borehole logs, well completion forms, chain-of-custody forms, field instrument calibration records, and daily field activity logs. Direct read data and/or measurements during fieldwork will be written on customized and numbered field forms, immediately after measurements have been taken. If entries must be changed, the reason for the change should be noted and the change should not obscure the original entry (e.g., a single line drawn through text or an "X" through figures, tables, or maps). The change will be initialed and dated by the responsible person. Any lost, damaged, or voided field forms will be reported to the Field Team Leader immediately.

1.4.2 Laboratory Data Report Format

Analytical data reports for samples will include items such as a narrative outlining any problems, corrections, anomalies, and conclusions, reports for method blanks, LCS samples, MS/MSD samples, and the chain of custody. The following data items may be requested by the contractor:

- Instrument chromatograms (or legible copies)
- Raw data system printouts (or legible photocopies) identifying date of analysis, analyst, in-house data reviewer comments, parameters analyzed, calibration curve, calibration verifications, method blanks, samples, and any dilutions, sample duplicates, spikes, and control samples
- Photocopies of laboratory notebooks relevant to the analytical data

Additionally, the laboratory will provide one copy of the associated EDD as appropriate for the requested analyses. The laboratory report will be submitted in hardcopy format, on CD-ROM, or electronically.

1.4.3 Analytical Data Validation

To provide an independent validation of the data reports generated during sampling activities, Maverik's consultant will review and validate the data presented in the final reports submitted by the analytical laboratories. Data validation will be performed using the Functional Guidelines (U.S. EPA, 1999 and 1994) as they apply to the Update III SW-846 (U.S. EPA, 1997b) and ASTM methodologies. Validation checklists and summary tables will be completed, and will include discussions of any data outliers and validation action taken.

Data validation checklists will include assessments of data precision, accuracy, completeness, and method compliance. Sample results, case narratives, and analytical QC summary forms will be reviewed at a frequency of 100 percent. All sample and QC results will be compared to the EDDs at a minimum frequency of 10 percent. Analytical data documentation will be submitted to the Quality Assurance Manager in hardcopy format and on CD-ROM or electronically and will also be retained by the laboratory.

1.4.4 Archiving and Retrieval

During all active stages of the project, one copy of field documents, laboratory summary reports, work plans, and other reports will be filed in a central location to allow easy and frequent access. Raw laboratory data and calculations will be maintained by the analytical laboratory for 5 years prior to disposal without notification.

2 Measurement / Data Acquisition

Project analytical methods will be selected on the basis of the level of analytical quality control needed to meet project DQOs and data user needs. Standard or Modified U.S. EPA methods will be selected when available.

2.1 Sample Methods Requirements

Field sampling protocols and the supporting Standard Operating Procedures are included in associated work plans. These protocols include detailed procedures for sample collection, equipment preparation, decontamination procedures, and documentation.

The initial responsibility for monitoring the quality of field measurements lies with the field personnel. Each technical staff member is responsible for verifying that all QC procedures are followed. The technical staff member assesses the correctness of the field methods and the ability to meet QA objectives. If a problem occurs that might jeopardize the integrity of the project or cause a QA objective not to be met, the Project Manager will be notified. Corrective action measures will then be selected and implemented. The technical staff member will document the problem, the selected corrective action, and the corrective action results as a permanent record.

If corrective action requires a departure from procedures in the sampling and analysis plan (SAP), these changes will be documented on the field activities summary form. In circumstances where unanticipated conditions are encountered, appropriate sampling actions consistent with project objectives will be conducted after the Field Team Leader confers with the Project Manager. This change will be noted in the field activities summary.

2.2 Sample Handling and Chain of Custody Requirements

Sample custody will be maintained and documented in the field from collection through delivery to the laboratory. Sample custody is documented through the use of field forms and consultant or laboratory provided chain-of-custody forms documenting the name of the sampler, the time of sample collection, and the relinquishment of samples (under custody seal) to the analytical laboratory. The sampler is responsible for the care and custody of samples from the time they are collected until they are properly transferred.

Within the laboratory, chain-of-custody procedures will be followed to document the integrity and security of the samples, as well as the sample paths and locations within the laboratory. Upon receipt of the samples, the sample custodian will follow these procedures:

- Check for custody seals and ensure that they were placed on the outside of each shipping container.

- Date and sign chain-of-custody forms and any other documents using full signature.

- Open each cooler, place a thermometer inside the temperature blank until the temperature stabilizes, and record the cooler's temperature on the sample analysis form.

- Remove all sample containers from coolers and check for breakage.

- Compare sample identifications and number of bottles to the chain of custody form. All discrepancies in chain-of-custody procedures (e.g., analysis requested, number of bottles, etc.) will be recorded. If required, the QA Officer will be notified to resolve problematic sample receipt issues.

- Log samples into the laboratory database. Record date and time of sample collection, date received, turn-around time, client code, client project number and name, laboratory job number, number of jars, sample matrix, requested analyses, method of sample delivery, and the air bill number (if applicable). Samples will then be stored appropriately.

For the laboratory to satisfy custody provisions, the following minimum procedures will be followed. When not in use, samples will be stored within the secured laboratory facility or in a locking storage facility where access is limited to the sample custodian and other key laboratory personnel. Analysts will maintain possession of samples and return samples to secured storage before the end of each working day.

Once all analytical work has been completed and the data report submitted by the lab, samples and extracts will be transferred from cold storage to a sample archiving area where they will be stored. Custody will be maintained in the long-term storage area until ultimate disposition. Disposal will be in accordance with local, state, and federal landfill and wastewater regulations.

2.3 Analytical Method Requirements

The contracted laboratory, and any subcontractors, will implement project-required Standard Operating Procedures (SOPs) for sample preparation, cleanup, and analysis. These SOPs will be based on SW-846, Update III (U.S. EPA, 1997b).

Documentation of appropriate method performance for the project target compounds will be available from the selected laboratory and will include the

criteria for acceptance, rejection, or qualification of data. The laboratory is also required to periodically update method performance data such as control limits and method detection limits. Minor changes such as these may be communicated to Maverik but will not be subject to approval provided that method criteria continue to be met.

Corrective action in the analytical laboratory may be required due to equipment malfunction, failure of internal QA/QC checks, method blank contamination, noncompliance with QA requirements, or failure of performance or system audits. When measurement equipment or analytical methods fail QA/QC checks, the problem will be handled, in accordance with the laboratory's QA Manual and SOPs.

The laboratory may screen samples for VOC analysis by gas chromatography/mass spectrometry (GC/MS) to avoid excessive sample dilution and to minimize the effects of sample matrix. Screening results help to determine whether samples will be analyzed as low- or medium-level concentration samples. The screening procedure also indicates an appropriate sample dilution level, if necessary. The laboratory should make every attempt to report analytical results for all methods as close to the stated reporting limits as possible. Samples reported at diluted levels must report positive results for at least one target analyte within the analytical method, or be reanalyzed at a more appropriate level of dilution at no cost to the client. The laboratory will need to take extra care to avoid holding time conflicts for samples requiring reanalysis due to excessive sample dilution.

2.4 Quality Control Requirements

This section details the measurement checks required to meet the DQOs for the Former Refinery.

2.4.1 Field QC Requirements

Laboratory analysis of field duplicates and field blanks will assess the precision and accuracy of field sampling techniques. The ratio of duplicate samples to field samples is one duplicate sample to every 20 field samples collected of water samples. MS/MSD samples will be collected 1 per 20 water samples. Field and equipment blanks will be collected at a minimum frequency of one per 20 samples of each matrix. Trip blanks will accompany all shipments containing samples for analysis of VOCs. QC samples will be collected in accordance with the applicable sampling procedures presented in the work plan. A summary of QC sample requirements is included in Table 1.

The QC procedures for measuring pH, redox potential (Eh), conductance, and temperature in groundwater samples will include calibrating the instruments, measuring duplicate samples, and checking the reproducibility of the measurements by taking multiple readings on a single sample or reference standard.

2.4.2 Laboratory QC Requirements

All analytical procedures will be documented in writing as SOPs, with each SOP including a QA section that addresses the minimum QC requirements for the procedure.

An analytical batch is defined as 20 samples or less of the same type of matrix, prepared and analyzed as a group. The following analytical QC samples will be associated with each batch if the control procedure is applicable to the analysis.

Method Blank

A reagent or media blank will be analyzed as a check on laboratory contamination (glassware, reagents, analytical hardware, etc.) that might affect analytical results. A sample consisting of laboratory reagent-grade water (distilled and deionized water) or a solid matrix will be analyzed to monitor the analytical instrument for contamination. The method blank is processed through the entire analytical procedure, including sample preparation. The results are used in conjunction with other control data to validate overall system performance and identify bias that may impact data quality.

Laboratory Control Samples

Independently prepared check samples will be processed through the entire analytical procedure. The purpose of these samples is to monitor and assure the accuracy of the procedure in the absence of matrix interference. Results of the LCS are charted and must meet acceptance criteria. Laboratory control samples must be analyzed per SW-846 for applicable analyses, at least once with each analytical batch. LCS duplicates are also analyzed with each analytical batch.

Matrix Spikes

An aliquot of a sample will be spiked with a known amount of selected analyte(s). Percent recoveries of the selected spiked analytes are tabulated by subtracting the non-spiked concentration from the spiked sample results. Results are used to assess accuracy in specific matrices. Matrix spikes must be analyzed per SW-846 for applicable analyses, at least once with each matrix-specific analytical batch, with a one in 20 sample minimum. Matrix spike duplicates are also analyzed with each matrix-specific batch.

Percent recovery is calculated as follows:

$$\%R = \frac{(C_1 - C_0)}{C_2} \times 100$$

Where: %R = Percent recovery
C_1 = Measured concentration in spiked sample aliquot

C_0 = Measured concentration in unspiked sample aliquot
C_2 = Actual concentration of spike added

MSDs will be analyzed to monitor the method precision. Results in RPD are tabulated and charted. The RPD calculation (for two samples, C1 and C2) is shown below. For analytical methods in which spiking is not applicable, sample duplicates are used to assess precision.

Percent recovery is calculated as follows:

$$RPD = \frac{C_1 - C_2}{\left(\frac{C_1 + C_2}{2}\right)} \times 100$$

Where: RPD = Relative percent difference
C1 = Larger of the two observed values
C2 = Smaller of the two observed values

2.4.3 Instrument/Equipment Calibration Requirements

All equipment and instruments used to generate data will be calibrated, adjusted, and maintained to operate within manufacturer's specifications and SOPs. Methods and intervals of calibration and maintenance will be based on the type of equipment and stability characteristics: required accuracy, intended use, and environmental factors (e.g., temperature and humidity). Such an effort will be conducted by trained technicians using service manuals or through service agreements with a qualified maintenance contractor. In addition, procedures will ensure that trained personnel use the equipment properly.

Field Instrument Calibration

Field instruments will be calibrated according to manufacturer specifications. Instruments that may be used during fieldwork include a pH meter, potentiometer for Eh measurement, photoionization detector, conductivity meter, organic vapor analyzer or organic vapor photoionization detector. For specific instructions on the calibration frequency, the acceptance criteria and the conditions that will require more frequent recalibration, refer to equipment manuals.

All the calibration procedures performed will be documented on specified field forms, and will include the date/time of calibration, name of person performing the calibration, reference standard used, temperature at which readings were taken, and the readings. Multiple readings on one sample or standard, as well as readings on replicate samples, will likewise be documented.

Laboratory Instrument Calibration

Calibration procedures for a specific laboratory instrument are detailed in laboratory SOPs. The SOP for each analysis performed in the laboratory will describe the calibration procedures, frequency, acceptance criteria, and the conditions that will require recalibration.

2.4.4 Inspection/Acceptance Requirements for Supplies and Consumables

This section describes the requirements for the procurement of supplies and consumables to assure that the supplies purchased for this project meet the required quality criteria of this plan.

Field supplies include the following items:

- Gloves
- Tyvek Coveralls
- Deionized or Distilled Water
- Solvents/Detergent
- Soil Sampling Supplies (trowels, etc.)
- Pumps and Tubing for Low-Flow Samplings
- Bailers
- Decontamination Reagents and Supplies
- Field Equipment Calibration Standards

The Field Team Leader will be responsible for material procurement and control. He/she will verify upon receipt that materials meet the required specifications. The Field Team Leader will also verify that material storage is properly maintained and contamination of materials is not allowed.

Laboratories contracted for this project must have procedures that are documented and followed that cover the following:

- Checking purity standards, reagent grade water, and other chemicals, as appropriate, versus intended use
- Preparation and storage of chemicals
- Requirements for disposable glassware (grade and handling)

The laboratory project manager or designee will be responsible for procuring and shipping the appropriate sample containers and preservatives to the sampling site. The containers will be precleaned and certified by lot. Reagents provided will be of the appropriate grade for the analysis. Records of these certifications and grades of material will be maintained on file at the laboratory.

2.5 Data Acquisition Requirements (Non-Direct Measurements)

This section requires the identification of any types of data needed for the project implementation that are obtained from non-measurement sources, such as computer databases, programs, literature files, and historical databases. At this time, the use of non-direct measurement data is not anticipated for project implementation. If such data should be considered necessary for an investigation, the relevance and intended use of the data will be indicated and referenced in the associated work plan or report.

3 Project Quality Assessment/Oversight Program

When errors, deficiencies, or outside of control criteria situations exist, the program provides systematic procedures, called corrective actions, to resolve problems and restore proper functioning to the sampling and/or analytical system.

Field QA objectives are obtained by assuring that field systems audits are routinely checked and instruments are properly calibrated and are part of a preventive maintenance program.

3.1 Field Corrective Action

The Field Team Leader/Manager reviews the procedures being implemented in the field for consistency with established protocols. Sample collection, preservation, and labeling, etc., are checked for accuracy and completeness. Where procedures are not strictly in compliance with the established protocol, deviations are documented and reported to the Project Manager. Corrective actions will be defined by the Field Team Leader/Manager and Project Manager and documented as appropriate. Upon implementation of the corrective action, the Field Team Leader/Manager provides the Project Manager with appropriate field notes documenting field implementation.

3.2 Laboratory Corrective Action

The Laboratory QA Officer will review the data generated to ensure that all quality control samples have been run as specified in the protocol. This review will include calibration procedures, frequency, and results. Instrument maintenance logs may also be checked. Recoveries of matrix spike samples will be checked for consistency with method accuracy and matrix spike duplicate samples will be checked with method precision. Deficiencies that require corrective action will be defined and documented as appropriate.

Once resolved, documentation of the corrective action procedure is filed with the laboratory QA department. A corrective action memo shall also be provided to the contractor's Project QA Officer for inclusion in the project file.

4 Data Reduction, Validation and Usability

All sample results, QC summaries, raw data, and EDDs will be reviewed for precision, accuracy, and QAPP and method compliance by the laboratory prior to release of the data to the QA Officer. The QA Officer (or his/her appointee) will also check these data for precision, accuracy, completeness, method compliance, and QAPP compliance as an independent validator. These reviews, along with a review of data representativeness and comparability, performed by an active and knowledgeable project participant will be used to make a determination regarding the usability of the data collected during this project.

4.1 Data Reduction

This section summarizes the procedures for ensuring the accuracy of the data reduction process. Both field and laboratory data reduction procedures are summarized. Responsibilities for the data reduction process are delegated as follows:

- Technical personnel will document and review their own work and are responsible for the accuracy of the work.
- Calculations will receive a method and calculation check by a secondary reviewer prior to reporting (peer review).
- The laboratory QA Officer or Project Manager will be responsible for ensuring that data reduction is performed according to protocols discussed in this QAPP.

4.1.1 Field Data Reduction

Field data records will, wherever possible, be organized into standard formats. Data from the field forms will be retained in permanent files and/or input to summary tables and databases to reduce data. The Field Team Leader will review and proof all forms to determine whether errors were made during field documentation.

Tables and databases will be stored on an internal fixed disk, with daily backups at the consultants' offices. Field data will be reported through preparation and transmission of report sheets containing tabulated results of measurements made in the field, and documentation of all field activities. Pertinent results will be summarized in tables included within annual monitoring reports.

4.1.2 Laboratory Data Reduction

The laboratories will follow the data reduction and calculation procedures set forth in U.S. EPA-approved methods and 40 CFR Part 136.

The following procedures may be used for laboratory data reduction:

- Data from simple analytical procedures, such as titration procedures, are converted into final form by means of a spreadsheet program.

- All gas GCs must be equipped with programmable data systems that generate results in units ready for review by a laboratory supervisor.

Hardcopy data reports, data reports on CD-ROM, and EDDs generated by the laboratory will undergo internal data verification by the Project Manager or designee before being released. The laboratory's Project Manager will approve submittal of the final data report and EDD after internal review.

4.2 Data Validation

A laboratory supervisor or the laboratory's QA Manager will verify completeness and method compliance, as well as raw data entry and calculations by analysts. The QA Manager or designee will be responsible for checking each group or test data package for precision, accuracy, method compliance, compliance to special client requirements, such as target analyte lists, methodology, and completeness. The laboratory Project Manager will conduct the final checks in the data process for both final data reports submitted in hardcopy or on CD-ROM and EDDs.

After laboratory release of the verified data report and EDD, data validation will be performed on laboratory analytical data by the QA Officer or his/her designee. Precision, accuracy, completeness, and method compliance validation will be conducted by a person skilled in laboratory data validation. Data validation results will be reported to the Project Manager in the format shown on the RETEC Analytical Data Validation Checklist provided in Attachment C, or in a similar format. Representativeness and comparability validation will also be completed.

4.2.1 Laboratory Data Validation

Technical verification requires comparison of QC and instrument performance standard results to required control limits. Technical verification is conducted throughout the analytical process, first by analysts, and finally by the laboratory's QA Manager and Project Manager. No data will be released to the QA Officer prior to the completion of these data verification procedures. The following QC elements will be reviewed (as appropriate) for a full verification effort:

- EDD comparison of both hand entered and direct instrument download of data to final hardcopy data reports or final data report on CD-ROM
- Analytical holding times
- Blank contamination
- Initial instrument calibration
- Continuing instrument calibration
- Internal standards
- System performance standards (tunes)
- Interference checks
- Serial dilutions
- Chain-of-custody review
- Analytical accuracy (MS/MSD recoveries, LCS/LCSD recoveries, and surrogate recoveries)
- Analytical precision (comparison of duplicate, LCSD, and MSD results, expressed as RPD)
- Compound identification
- Compound quantitation and reported detection limits
- Target analyte list

4.2.2 Independent Data Validation

Final hardcopy or CD-ROM data reports must be complete and have sufficient quality to undergo the appropriate level of data review by an independent validator. Incomplete data reports will not be accepted and will be returned to the laboratory for correction. EDDs are compared 100 percent to the sample data and QC summaries submitted in hardcopy or on CD-ROM by the laboratory. The QA Officer compares EDDs to the data submitted and corrects any minor errors directly in hardcopy data reports or EDD files after verifying with the laboratory which entry is correct. If major errors are found, the QA Officer will reject the reports or EDDs, and the laboratory will be obligated to correct and resubmit them. If errors are found in the CD-ROM data, the laboratory will provide a corrected data report on CD-ROM. The combined data records will be sufficiently detailed to provide complete and

accurate history of data gathering and results for future legal or administrative actions, if necessary.

The data validation process assures technical data quality and method compliance; provides precision, accuracy, and completeness assessments; verifies that adequate analytical documentation was performed and reported; determines whether the analytical data are usable; and helps the data user to determine whether project DQOs were met. Laboratory data will be evaluated by the Project Manager or QA Officer using the checklist provided in SOP 410 in Attachment C, or a similar form. Independent data validation will be conducted by the QA Officer or his/her designee. Procedural requirements and data validation requirements, as described in this QAPP, will conform to the guidelines presented in the Contract Laboratory Program (U.S. EPA. 1999 and 1994).

4.3 Data Validation Methods for Precision, Accuracy, Completeness, and Method Compliance

Data will be checked against the PARCC parameters described in Section 1.4.1. The data validation for precision, accuracy, completeness, and method compliance will be conducted by the QA Manager or his/her designee in accordance with the Contract Laboratory Program (U.S. EPA, 1994 and 1999) as they apply to selected methods. Data validation will include 100 percent QC summary review, 100 percent EDD review, assessments of data precision, accuracy, completeness, compliance to special client requirements, and method compliance.

Data validation will include 100 percent review of the following QC measurements as they apply to the analytical methods followed:

- Detection limits and dilution factors
- Holding times
- Surrogates
- Instrument, preparation, and method blanks
- MS samples
- Duplicates
- Laboratory control samples

Other validation and assessment techniques include:

- Chain-of-Custody review
- 100 percent review of EDD to final data reports

Data validation qualifiers, as defined in the Contract Laboratory Program (U.S. EPA. 1994 and 1999) will be assigned and entered into the laboratory

EDD by the QA Officer prior to the EDD being incorporated into the project database.

4.4 Data Validation for Representativeness and Comparability

Independent data validation for representativeness and comparability will also be conducted and include the following components:

4.4.1 Basic Checklist

A standard check for simple errors in data handling will inspect data for:

- Typographical (data entry) errors
- Misplaced decimal points
- Incorrect units of measurement
- Detection limits parallel to dilution ratios
- Confusion of zero values, no detectable contaminant, and "no sample taken" notations
- Transposed "total," "dissolved," or "extractable" concentrations
- Verification that all data are traceable to a location, date, and analytical technique

4.4.2 Supportive Information

Supportive information, such as the following, must be complete to properly interpret the data:

- Documentation of sampling techniques
- Placement/distribution of samples
- Well construction, including location of screened interval and sealing to prevent cross-contamination

Professional judgment should be used to review data that appear inconsistent with existing regional data for possible errors. While this may appear to be a qualitative approach, it is in reality based upon the application of recognized data characteristics. Examples of the application of this approach will include:

- Comparison of data from samples to data from blanks
- Comparison of pH and dissolved metals values
- Comparison with previous data from same unit/area
- Review relative to sample media and location
- Check of dissolved parameters for those that seem high relative to normal solubility characteristics (similar to metals and pH comparisons)

4.4.3 Data Handling Concepts

The data will be checked for the implementation of "standard procedures" that are frequently omitted or misused, such as:

- Handling outliers (Do they represent real values or errors?)
- Interpretation of blanks (Do "hits" on specific parameters in field, trip, or lab blanks represent problems with the raw data or other influences on data interpretation?)
- Level of detection (For samples having "less than detectable" values, has the detection level, ½ the detection level, or zero been used in statistical analyses or has the sample been dropped from the analysis?)

Flags will be used to highlight data that, as a result of the data quality review, appear to be useful for only limited purposes or should be qualified in some way. Flags for specific conditions will be created, incorporated, and defined in the computerized database.

4.5 Reconciliation with Data Quality Objectives

Data collected will be evaluated and the quality for their intended uses will be determined on an individual basis. Data will also be compared to the DQOs established in the work plans and the completeness of the performed work will be assessed. Upon completion and/or approval of the data validation report by the QA Officer, a copy will be submitted to the Project Manager.

4.6 Data Management

The two major types of data to be managed are laboratory results and field monitoring data, such as fluid levels, lithology, and well construction information. Procedures for managing these data sets are described below.

The information compiled for the chemical analysis results will include:

- Sampling date and time
- Sample identification
- Duplicate sample cross-reference identification
- Sample matrix
- Analytical laboratory/ analytical method date of analysis
- Constituents, results, units, date validation qualifiers, detection limits, and dilutions

The field monitoring information may include:

- Location identification
- Monitoring well reference point elevations
- Depth to non-aqueous phase liquid (NAPL)
- Depth to water
- Ph, conductivity, temperature, Eh, and dissolved oxygen
- Lithology and hydrocarbon log from drilling activities
- Date and time of measurement
- Computed NAPL elevation
- Computed NAPL thickness
- Computed groundwater elevation
- Other field data, as necessary

4.6.1 Database Maintenance

Database maintenance involves a set of specific procedures by which each item of data is processed from the time it is logged in the field or laboratory to when it is issued as a report.

Database Entry and Validation

Field monitoring information from each sampling event or monitoring round will be entered into the database following completion of field activities. Chemical data from each sampling event will be entered into the database after independent data validation by the QA officer.

Field data, results received from the laboratory, and data validation qualifiers will be entered into the database. Prior to database entry of chemical data, at least 10 percent of the laboratory EDD will be checked against the hardcopy or CD-ROM data report by the QA Officer or his/her designee.

Retrieval and Transfer of Information

Data tables of laboratory analytical results will be produced using the capabilities of Excel or Access 2000. All data tables will be checked 100 percent for accuracy against final laboratory reports.

4.7 Reports to Management

Data validation and any required data quality assessment reports will be prepared by the QA Officer or designee and will be provided to all data users when the data sets are approved.

5 References

U.S. EPA, 1994. *Contract Laboratory Program: National Functional Guidelines for Inorganic Data Review.* Washington, D.C.: United States Environmental Protection Agency. EPA 540/R-94/013 February 1994.

U.S. EPA, 1996. *Advanced Notice of Proposed Rulemaking: Corrective Action for Releases from Solid Waste Management Units at Hazardous Waste Management Facilities.* Washington, D.C.: United States Environmental Protection Agency. EPA/OSW-FR-96.

U.S. EPA, 1997a. *EPA Requirements for Quality Assurance Projects Plans for Environmental Data Operations, Draft Final.* Washington, D.C.: United States Environmental Protection Agency. EPA QA/R-5.

U.S. EPA, 1997b. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, Final Update III.* Washington, D.C.

U.S. EPA, 1998. *Guidance for Quality Assurance Project Plans.* Washington, D.C.: United States Environmental Protection Agency. February 1998. EPA QA/G-5.

U.S. EPA, 1999. *Contract Laboratory Program: National Functional Guidelines for Organic Data Review.* Washington, D.C.: United States Environmental Protection Agency. EPA 540/R-99/010 October 1999.

Table

Table 2-1
Summary of QC Sample Requirements

Sample Matrix	Frequency	Analytes	Exceptions	Example
Soils, Sediment	1 Equipment (Rinseate) Blank[1] per 20 soils collected (1 EB/20 soils, or 5%).	EB - same analytes (VOCs, SVOCs, and/or metals only) as required for samples being collected.	Do NOT collect duplicate samples of soil or sediment. Do NOT collect equipment blanks if soil sampling equipment is dedicated, i.e. not re-used at different locations	You're tasked with collecting 31 soil samples using shovel, spatula, and mixing bowl that will be decontaminated between sampling locations and re-used at next location. Immediately after decon'ing shovel, spatula, and mixing bowl, prepare 1 EB by pouring distilled water over each of these implements just cleaned. Immediately following another decon. event, prepare a 2nd EB (total of 2 EBs).
Groundwater (GW)	1 Blind Duplicate[2], 1 Equipment Blank per 20 groundwater samples collected. 1 Matrix Spike / Matrix Spike Duplicate (MS/MSD)[3] per 20 groundwater samples collected. (1 DUP/20 GW, 1 EB/20 GW or 5%; 1 MS-MSD/20 GW or 5%)	DUP - same analytes as req'd for original identified sample. EB - same analytes (VOCs, SVOCs, and/or metals only) as req'd for samples. MS/MSD - organics only (no metals).	Do NOT collect equipment blanks if groundwater sampling equipment is dedicated	You're tasked with collecting 21 groundwater samples using disposable bailers. Plan to collect 1 blind duplicate and 1 MS/MSD sample. No need to prepare EB of disposable bailer that is not decon'd.
Surface Water (SW)	1 Blind Duplicate, 1 Equipment Blank per 20 surface water samples collected (1 DUP/20 SW, 1 EB/20 SW or 5%)	DUP - same analytes as req'd for original identified sample. EB - same analytes (VOCs, SVOCs, and/or metals only) as req'd for samples.	Do NOT collect equipment blanks if surface water sampling equipment is dedicated	You're tasked with collecting 2 surface water samples from 2 different ponds using the extendable grab sampler, which you will decontaminate after collecting the 1st sample and re-use. Collect 1 duplicate from one of the locations. Immediately after decon'ing the grab sampler, prepare 1 EB by pouring distilled water into and out of it.
Trip Blanks (TB)	1 Trip Blank[4] per (bulk) sample delivery group (SDG, e.g. cooler) sent to analytical laboratory *if* VOCs analysis requested for any samples contained therein.	Volatile organics only (VOCs)	Do NOT submit trip blanks if VOCs analysis is not required.	(a) You're about to ship a cooler full of soil samples that are to be analyzed for VOCs, SVOCs, and metals. Include 1 TB in this cooler. (b) You're about to ship a set of soil samples to be analyzed for SVOCs and metals only, and a set of groundwater samples to be analyzed for BTEX. However you decide to pack the samples, you need to include 1 TB in the cooler that contains the GW samples. A TB does NOT need to accompany the soils.
Field Blanks (FB)	1 Field Blank[5] per 20 samples of any matrix, or 1 Field Blank per sample batch if less than 20 samples are collected (1 FB/20 samples or 5%)	Same analytes as req'd for actual samples.		You're tasked with collecting a grand total of 47 soil, groundwater, and surface water samples (excluding the duplicates). Prepare 2 FBs, preferably in different areas from which you've just collected these samples and of which you've kept records.

Table 2-1
Summary of QC Sample Requirements

Sample Matrix	Frequency	Analytes	Exceptions	Example
Temperature Blanks	Not required. Good QA practice to include 1 per bulk sample container (cooler), particularly during hot weather.	Only useful for shipments of biodegradable organics samples (not necessary for metals)		

Notes:

1 - Equipment (Rinseate) Blank Preparation: decontaminate all sampling equipment according to specified procedure (SOP 120, QAPP App.A), pour clean distilled water over / through each implement. just cleaned, and collect the rinseate into the appropriate laboratory containers. An EB is meant to demonstrate that your equipment decon removed any constituents that could possibly cross-contaminate your next sample collected with that equipment. If you're using dedicated equipment (e.g. disposable bailers) and don't need to decon, you don't need an EB.

2 - Blind Duplicate Preparation: fill 2 sets of sample bottles in the same order (fill original and DUP VOCs vials 1st, then original and DUP SVOCs bottles, etc.), but do not identify to the laboratory the real location of the duplicate, e.g. "DUP 1" = blind duplicate of well MW-115 groundwater. Blind dup's are part of the QA check of the laboratory.

3 - MS/MSD - fill 3 sets of sample bottles, in the same order, and DO identify the real location of the triplicates, e.g. MW-115 MS = well MW-115 matrix spike sample. MS/MSD samples are used by the laboratory for their QA check.

4 - Trip Blank - container with liquid (no or only small bubbles) should originate from the analytical laboratory with lab's custody seal and other identifying criteria attached; do *not* prepare your own TB (that would be an FB). Date the TB when you first begin using it, and pack TB with the samples you collect and keep in your custody until shipping them (the SDG). TB should accompany and be handled and cooled in the same manner as samples collected throughout the day and temporarily stored in a field cooler, transferred at night back into refrigerator storage with the samples, etc. until that group of samples is shipped. This TB is then shipped with its SDG, and a new TB labeled with the new date is started to accompany the next batch of samples collected. Ship only Lab A's TBs to Lab A. Do not ship Lab X's TB to Lab A--that is not where it originated. A TB is meant to check whether your samples were cross-contaminated by any volatile contaminants introduced from the environments with which they came in contact, e.g. the inside of the cooler next to real samples, the inside of a refrigerator, the inside of your or a courier's truck.

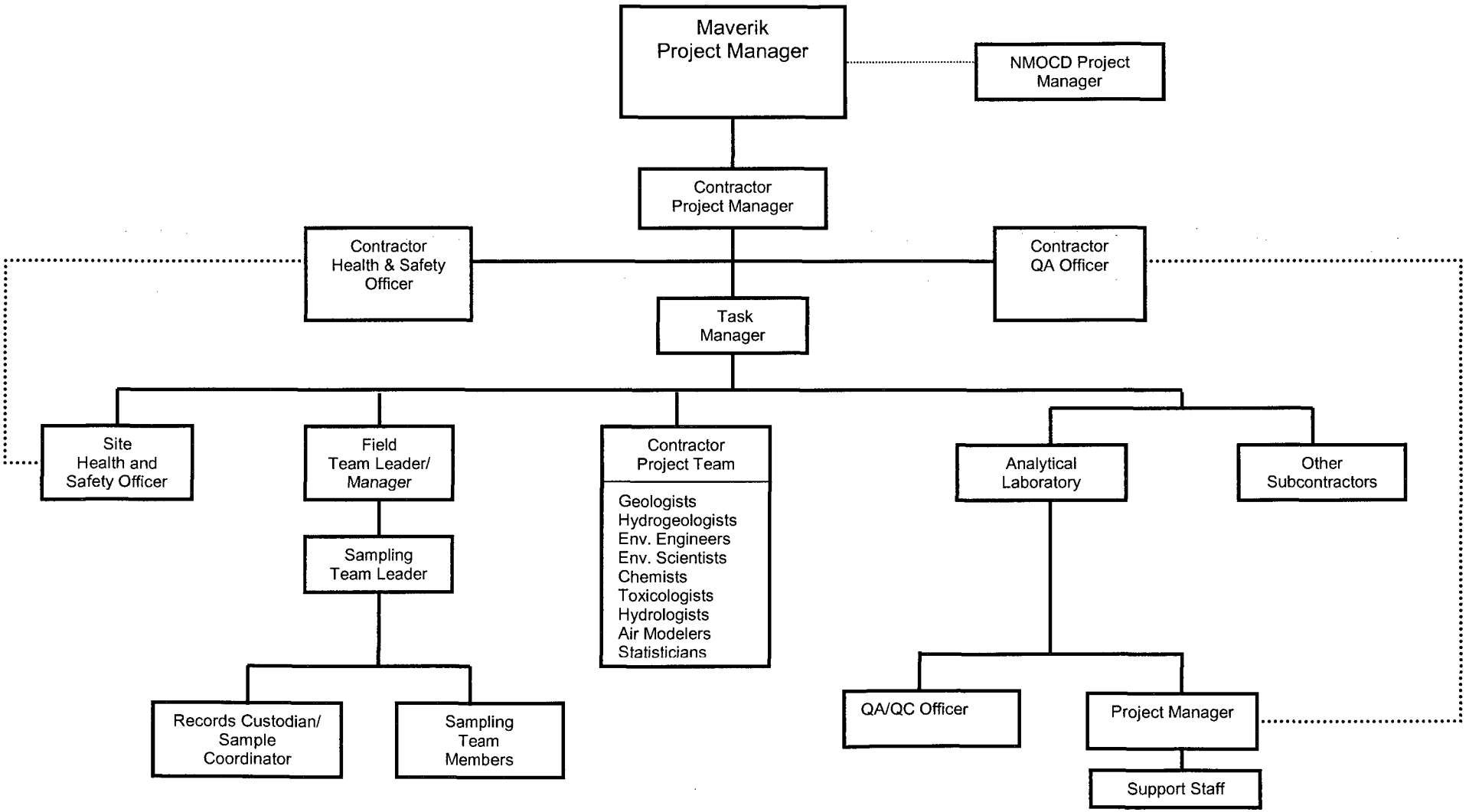
5 - Field Blank - while at the sampling site (not in the lab or hotel room), pour clean distilled water into laboratory containers. Pack the FB with the other samples and keep it together with that SDG until shipped, much like a trip blank. An FB is meant to check whether your samples were cross-contaminated by any airborne contaminants introduced from the environment where you were sampling, e.g. near a drill rig and its exhaust, next to a busy road with vehicle exhaust, near an active factory and its air emissions, during a very windy day when windblown particulates could enter an uncapped jar. Because an FB's purpose is partly redundant to that of a TB, the FB is often omitted.

References:

Garrett, P, 1988. *How to Sample Ground Water and Soils.* National Water Well Association, Ohio.
USEPA, Sep. 1986. *RCRA Ground-Water Monitoring Technical Enforcement Guidance Document* [TEGD]. OSWER-9950.1.
USEPA, 1987. *A Compendium of Superfund Field Operations,* EPA540/P-87/001. OSWER Office of Waste Programs Enforcement.
USEPA Region III. RCRA Enforcement Guidance Document: Blank Guidelines.

Figure

Figure 1
Project QA/QC Organization



Attachment A

Investigation Work Plan Check List

ATTACHMENT A
INVESTIGATION WORK PLAN CHECK LIST
Cross References to QAPP Requirements

REQUIREMENT IN QAPP	CONTAINED IN WORK PLAN?	COMMENTS
Notes special personnel or equipment requirements		
Provides work schedule		
States and characterizes measurement quality objectives as to applicable action levels or criteria		
Lists samples required as to type and number		
States sampling network design and rationale		
Gives sampling locations and sampling frequency		
Identifies sample matrices		
Lists classification of each measurement parameter as either critical or needed for information only		
Gives appropriate validation study information for non-standard situations		
Lists equipment needed		
Identifies support facilities		
Identifies analytical methods to be followed (with all options) and required equipment		
Specifies needed laboratory turnaround time if important to project schedule		

Attachment B

Data Validation SOP 410

RETEC Standard Operating Procedure 410
Data Assessment

1.0 Purpose and Applicability

The purpose of the RETEC Standard Operating Procedure (SOP) 410 is to assess the quality and legal defensibility of analytical data.

The RETEC Group, Inc. (RETEC) SOP 410 describes the procedure used for the assessment of laboratory data in support of risk assessment, field remediation, site characterizations, monitoring programs, and preliminary site investigations. Data assessment is especially important if the data is to be used in critical decision making or will undergo close legal scrutiny.

Generally, data verification and validation will follow review criteria presented in the *USEPA Contract Laboratory Program National Functional Guidelines for Organic/Inorganic Data Review* (Functional Guidelines), document numbers EPA540/R-99/008 and EPA540/R-01/008 of October 1999 (Organic) and July 2002 (Inorganic), as they apply USEPA SW-846 or ASTM (Standard Methods) methodology. Specific project requirements as described in an approved Work Plan, Sampling and Analysis Plan (SAP), Quality Assurance Project Plan (QAPP), Job Hazard Analysis (JHA), Safety Task Analysis Review (STAR), or Site-Specific Health and Safety Plan (HASP) will take precedence over the procedures described in this document. If required, regional government regulations will take precedence over the procedures described in this document.

2.0 Responsibilities

- The Project Manager has the responsibility to communicate project requirements and data quality objectives to support personnel, and to provide applicable work documents such as the Work Plan, SAP, QAPP, JHA, STAR, or Site-Specific HASP to the QA Manager. The Project Manager establishes the level of data assessment that is required (see Section 5.2), alerts the QA Manager that data assessment will be required, and arranges for the data to be delivered to the Data Validators.

- The Quality Assurance (QA) Manager has the responsibility to schedule data validation work. The QA Manager provides final review of laboratory audits, data usability reports, and QAPPs. The QA Manager also provides peer review as needed for data assessment reports. In addition, the QA Manager reviews the data assessment SOP annually, maintains the currency of guidance documents, and keeps abreast of new analytical standards and regulatory requirements.

- The Project Chemist serves as the resource and primary contact for all laboratory activities. The project chemist has the responsibility to conduct and report on-site inspections (laboratory audits) of proposed subcontracting laboratories against contract and regulatory requirements, and follows-up and reports on the status of corrective measures implemented in response to deficiencies identified during systems audit(s). The Project Chemist also provides laboratory coordination for projects, assessment of project data and reports on the usability and completeness of the analytical work, and provides peer review of draft data assessment reports.

- The Data Validator has the responsibility to assess data and report on the precision, accuracy, method compliance, and completeness of the analytical work. The Data Validator also provides peer review of draft data assessment reports, and works with the Project Chemist and Project Manager to establish sampling and analysis requirements. The Data Validator will use his/her technical degree, environmental laboratory experience, and training in data validation along with knowledge of project requirements to assess the analytical data according to guidance documents that are detailed in this SOP.

3.0 Health and Safety

Section 3.0 is not applicable.

4.0 Supporting Materials

Section 4.0 is not applicable.

5.0 Methods and Procedures

5.1 Definitions

- **Data assessment** is a systematic process for reviewing a body of data against a set of criteria to provide assurance that the data are adequate for their intended use. Data assessment consists of data editing, screening, checking, auditing, verification or validation, certification, and review. The level of effort devoted to data assessment will depend on the data quality objective level (DQO Level) to be met and the RETEC data validation level (RETEC DV Level) conducted. Refer to Section 5.2 for a description of these levels.

- **Precision** is a measure of the closeness with which multiple analyses of a given sample agree with each other. Precision is evaluated by replicate analyses, by repeated analyses of a known, stable standard, or by analysis of known additions to samples. It is a measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. Precision is best expressed in terms of relative percent difference (RPD) or percent difference (%D). Various measures of precision exist depending upon the "prescribed

similar conditions." Field precision is measured by evaluating field duplicate results. Laboratory precision is measured by evaluating laboratory duplicate RPDs, laboratory control sample/laboratory control sample duplicate (LCS/LCSD) RPDs, matrix spike/matrix spike duplicate (MS/MSD) RPDs, or serial dilution %Ds.

- **Accuracy** is the degree of agreement of a measurement (or average of measurements of the same thing), with an accepted reference or true value, usually expressed as the difference between two values, or the difference as a percentage of the reference or true value. Field accuracy, a measure of the sampling bias, is measured by evaluating blank samples that originate in the field or that track sample transport. Laboratory accuracy, a measure of the system bias, is measured by evaluating LCS/LCSD percent recoveries (%Rs), MS/MSD %Rs, and organic system monitoring compounds (surrogate) %Rs.

- **Completeness** is a ration of the amount of valid data obtained from a measurement system compared to the amount projected to be obtained under ideal conditions. Completeness is the overall ratio of the number of samples planned versus the number of samples with valid analyses. Completeness goals are set at 90-100%. Determination of completeness may include, but is not limited to review of chain of custody records, laboratory analytical methods and detection limits, laboratory case narratives, electronic data deliverables (EDDs), and specific project requirements.

- **Method Compliance** is a data quality indicator that describes the degree with which a laboratory has followed the specifications of the EPA or nationally-recognized, validated, and published analytical method. Method compliance ensures comparability of the analytical data. Method compliance is assessed by evaluating sample integrity, holding times, laboratory blanks, system performance checks, initial and continuing instrument calibrations, internal standards, target analyte identification, and analyte quantitation against method specified requirements, while applying EPA data validation guidelines as applicable.

- **Bias** is a measure of systematic error. It has three components, one due to the method, another to a laboratory's use of the method, and the third due to sample matrix.

- **Qualifiers** are alphabetic "flags" assigned to results in the data review and validation process to indicate the limitations of the results based on specific quality control criteria. The specific reasons for assigning qualifiers are provided in the associated data validation report. Examples of data qualifiers are the EPA-defined data qualifiers assigned under the EPA Contract Laboratory Program (CLP). See Table 1 for a list of EPA qualifiers for organics and inorganics and their meanings.

5.2 Levels of Data Assessment

Data quality objectives (DQOs) are qualitative and quantitative statements, which specify the quality of the data required to support decisions made during various site activities. DQOs are based on the end uses of the data to be collected. Different data uses require different levels of data quality. Five data quality objective levels (DQO Levels) are defined in the USEPA guidance document *Model Quality Assurance Project Plan,* Office of Superfund, Region V, 1991 (USEPA, 1991). Four different RETEC data validation levels (RETEC DV Levels) have been developed to identify the varying levels of methodology, documentation, and data assessment effort required to meet the requested EPA DQO Levels. The EPA DQO Levels and the corresponding RETEC data validation levels are defined as follows:

5.2.1 DQO Level 1 – RETEC DV Level not applicable

DQO Level 1 (Screening) - No RETEC DV Level: This provides the lowest level data quality assurance but the most rapid results. It is often used for health and safety monitoring at the site, preliminary comparison to previous results, initial site characterization to locate areas for subsequent and more accurate analyses, and for engineering screening of alternatives (bench-scale tests).

DQO Level 1 does not generate any quality control results, so data validation is not applicable.

5.2.2 DQO Level 2 – RETEC DV Level I

DQO Level 2 (Field Analyses) - RETEC DV Level I: This provides rapid results but better quality assurance than DQO Level 1. This level may include mobile laboratory generated data depending on the level of quality control exercised.

RETEC DV Level I data verification applies to these limited field tests only.

5.2.3 DQO Level 3 – RETEC DV Level II

DQO Level 3 (Engineering) – RETEC DV Level II: This provides an intermediate level of data quality assurance and is used for preliminary site characterization. Engineering analyses may include mobile laboratory generated data and some analytical laboratory methods (e.g., laboratory data with quick turnaround used for screening but without full quality control documentation.

RETEC DV Level II data assessment protocol is generally followed for preliminary site investigations or on-going long-term monitoring events that have already passed stricter scrutiny and do not continue to require full CLP or CLP-type data validation. With Level II data verification, the laboratory is entrusted to have met all internal quality control requirements (i.e., calibrations, performance checks) as directed in the analytical methods followed. A RETEC Level II Data Assessment provides a definitive assessment of analytical precision, accuracy, method compliance, and completeness but does not

examine other internal quality control checks (i.e., calibrations, performance checks). The minimum analytical documentation provided by the laboratory for a RETEC Level II data package should include: case narratives, detection limits, percent moisture calculations, dilution factors, method blanks, surrogates, matrix spikes, laboratory control samples, laboratory duplicates, extraction and analysis dates, and Chain-of-Custody forms. Sample summary forms must include the sample ID, the laboratory sample ID, date sampled, matrix, method reference, units of measurement, and initial and final sample volumes. QC summary forms must include a means to cross reference laboratory QC with the associated samples. This level of data assessment is also referred to as a data verification.

5.2.4 DQO Level 4 – RETEC DV Levels III and IV

DQO Level 4 (Confirmational) – RETEC DV Levels III and IV: This provides the highest level of data quality assurance and is used for purposes of risk assessment, evaluation of remedial alternatives, and litigation support. These analyses require full QA/QC support and documentation in accordance with EPA recognized protocols. Analytical laboratory data deliverables associated with DQO Level 4 allow for thorough data validation procedures to be followed.

RETEC DV Level III data validation is followed for site investigations of a more conclusive nature, sites undergoing risk assessment, and/or for sample data that must pass litigation scrutiny. All aspects provided in a Level II data package are contained in a Level III package, so precision, accuracy, method compliance, and completeness can be assessed. Additionally, analytical system performance, and overall qualitative and quantitative measurements are evaluated. In addition to the Level II documentation stated above, a Level III data package should include at a minimum: system performance (tuning) reports, instrument calibrations, internal standards, interference checks, serial dilutions, preparation/extraction benchsheets, analysis run logs, and chromatograms and quantitation reports for all samples and standards. CLP Forms I-VIII or equivalent for organics and CLP Forms I-XIV or equivalent for inorganics.

RETEC DV Level IV data validation follows RETEC DV Level III procedures, and additionally contains back-calculation of 10% of the reported sample and QC results. With increased laboratory implementation of direct download capabilities from instrumentation to laboratory information management system (LIMS) reporting systems, this level of review is not as widely required.

5.2.5 DQO Level 5 – RETEC DV Levels III and IV

DQO Level 5 (Non-Standard Methods) - RETEC DV Levels III and IV: This refers to analyses by non-standard protocols, for example, when exacting detection limits or analysis of an unusual chemical compound is required. The analyses often require method development or adaptation. The level of laboratory QA/QC documentation provided is similar to that of DQO Level 4.

RETEC DV Levels III and IV are applicable to this DQO Level.

5.2.6 Focused Review

A focused review investigation answers specific data quality issues such as nonconformances that would cause data rejection. A focused review is initiated in response to specific questions from data users regarding data (quality) usability or technical issues.

5.3 Basic Approaches for Data Assessment

The Functional Guidelines, regional modifications, and specific project requirements provide the basis for data assessment.

The Functional Guidelines address gas chromatography/mass spectrometric (GC/MS) analyses of volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs), organochlorine pesticides, polychlorinated biphenyls (PCBs), dioxins and furans, inductively coupled plasma spectroscopy (ICP) metals, graphite furnace atomic absorption (GFAA) metals, cold vapor atomic adsorption (CVAA) metals, and total cyanide. The Functional Guidelines were written for the USEPA Contract Laboratory Program (CLP Superfund) program. This approach will be used in areas where the Functional Guidelines can be applied to related technology. For technologies that are not addressed in the Functional Guidelines, the RETEC standard approach for validating data is detailed in the following sections. Appendix 1 details the standard RETEC approach to areas of data assessment that are not fully covered in the Functional Guidelines.

5.3.1 GC Purgables

Volatile organic data by gas chromatography (GC) methods such as 8021B and gasoline range organics (GRO) are assessed using the Functional Guidelines (Organic), unless otherwise requested by the client. The Functional Guidelines address volatiles determinations by GC/MS technology (8260B), but the qualification guidance for holding time, surrogates, blanks, laboratory control standards and matrix spikes may be applied to GC analyses. For a higher level of review, USEPA SW-846 method-specific QC requirements will be applied to measurements like instrument calibration. EPA-defined data qualifiers are applied to validated GC data. The validator must use professional judgment, regulatory agency (e.g., EPA, AFCEE) guidance, and method specifications to assess the usability of GC data.

The following information is essential when validating GC VOA data.

5.3.1.1 Method Specification Limits

Parametric limits that are specifically noted in the analytical method and must be met to assure that the process is in-control. The limits may regard initial and continuing calibrations and laboratory control standard recoveries.

5.3.1.2 Laboratory Quality Control Limits

The laboratory may use "pre-control" limits prior to establishing statistical control limits based on historical data. The validator may determine whether the lab's "pre-control" or statistical limits are reasonable by comparing them to any precision and accuracy data provided in the method (e.g., Standard Methods, "Precision and Bias" sections).

5.3.1.3 Regulatory Agency Guidance Documents

Regulatory agencies publish data validation guidance documents to standardize the process. One example is the Functional Guidelines (Organic) which addresses GCMS volatile analysis, but the qualification guidance may be applied to GC analyses.

5.3.2 GC/HPLC Extractable Hydrocarbons, Herbicides, OP Pesticides

Semivolatile (extractables) organic data by gas chromatographic methods such as SW8310, diesel range organics (DRO), organophosphorus pesticides (SW8141), and herbicides (8151A) are validated using the Functional Guidelines (Organic), unless otherwise requested by the client. The Functional Guidelines address organochlorine pesticide determinations by GC technology. However, the qualification guidance for holding time, surrogates, blanks, laboratory control standards, and matrix spikes may be applied to other GC analyses. For a higher level of review, USEPA SW-846 method-specific QC requirements will be applied to measurements like instrument calibration. EPA-defined data qualifiers are applied to validated GC data. The validator must use professional judgment, regulatory agency (e.g., EPA, AFCEE) guidance, and method specifications to assess the usability of GC data.

The following information is essential when validating GC and HPLC extractables data data.

5.3.2.1 Method Specification Limits

Parametric limits that are specifically noted in the analytical method and must be met to assure that the process is in-control. The limits may regard initial and continuing calibrations and laboratory control standard recoveries.

5.3.2.2 Laboratory Quality Control Limits

The laboratory may use "pre-control" limits prior to establishing statistical control limits based on historical data. The validator may determine whether the lab's "pre-control" or statistical limits are reasonable by comparing them to any precision and accuracy data provided in the method (e.g., Standard Methods, "Precision and Bias" sections).

5.3.2.3 Regulatory Agency Guidance Documents

Regulatory agencies publish data validation guidance documents to standardize the process. One example is the Functional Guidelines (Organic) which addresses GCMS volatile analysis, but the qualification guidance may be applied to GC analyses.

5.3.3 General Chemistry

General chemistry analyses encompass gravimetric, colorimetric, spectrophotometric, and potentiometric technologies. This type of analyses may also be referred to as Wet Chemistry or Classic Chemistry. This category of analyses includes such diverse tests as Biochemical Oxygen Demand (BOD), Total Organic Carbon (TOC) and Hexavalent Chromium. Precision and accuracy control limits for these analyses will follow the control limits given in the Functional Guidelines (Inorganic), unless the laboratory provides control-charted QC limits. EPA-defined data qualifiers are applied to validated wet chemistry data unless otherwise requested by the client. The validator must use professional judgment, regulator agency (e.g., EPA, AFCEE) guidance, and method information to assess the usability of wet chemistry data.

The following information is essential when validating general chemistry data.

5.3.3.1 Method Specification Limits

Method Specification Limits: Parametric limits that are specifically noted in the analytical method must be met to assure that the process is in control. The limits may regard analytical conditions, quality control checks or sample holding times prior to analysis.

Example: BOD Specification Limit from SM 17 5210B

Dissolved oxygen uptake of seed control: 6.0 – 1.0 mg/L

Should the seed control uptake be outside the limits, seed viability is in question.

5.3.3.2 Laboratory Quality Control Limits

The laboratory may use "pre-control" limits prior to establishing statistical limits using historical data. The validator may determine whether the lab's "pre-control" or statistical limits are reasonable by comparing them to any precision and accuracy data provided in the method (e.g., Standard Methods "Precision and Bias" sections.)

5.3.3.3 Regulatory Agency Guidance Documents

Regulatory agencies publish data validation guidance documents to standardize the process. One example is the Functional Guidelines (Inorganic) which

addresses only total cyanide and trace metals analyses, but the qualification guidance may be applied to other inorganic analyses.

5.4 Assessment of Data Quality Indicators

Analytical data will be reviewed for precision, accuracy, method compliance, and completeness. The following sections provide a discussion of the steps necessary to evaluate these data quality indicators. The following criteria are recommended and should be evaluated on a project-specific basis. Evaluation of the analytical data will include:

- A review of the Work Plan or QAPP;
- A review of the laboratory project narrative;
- A review of holding times, detection limits, dilutions, methods of analysis;
- A check of data flags, reporting units, and sample matrices;
- Precision assessment by reviewing field duplicates, laboratory duplicates, LCS/LCSD sets; MS/MSD sets, and serial dilutions;
- Accuracy assessment by reviewing field blanks, equipment rinse blanks, trip blanks, LCS/LCSD recoveries, MS/MSD recoveries, and surrogate recoveries;
- Method compliance assessment by reviewing sample integrity and specific analytical method QC measurements such as system performance checks or tunes, instrument calibrations, laboratory blanks, internal standards, interference checks, and target analyte identification and quantitation as necessary;
- Completeness assessment by reviewing chain of custody records as well as overall precision, accuracy, and method compliance results for data rejected due to extreme quality control non-compliance.

Any deviations from the requirements of the QAPP will be identified in the data assessment report. Additionally, the laboratory will be contacted, if necessary and appropriate corrective actions will be requested.

5.4.1 Evaluation of Precision

Precision is the measure of variability of individual sample measurements. Field precision is determined by comparison of field duplicate sample results. Laboratory precision is evaluated by examination of laboratory duplicates, LCS/LCSD RPDs, MS/MSD RPDs, and metals serial dilutions. Field duplicates are generally collected at a frequency of 1 in 20 samples, with at least one field duplicate per matrix collected. Laboratory duplicate frequency is generally one in 20 samples for organics, and one in 10 samples for inorganics, with at least one duplicate analysis per sample matrix.

Evaluation of field and laboratory duplicates for precision is done using the Relative Percent Difference (RPD) or Percent Difference (%D). The RPD is defined as the difference between two duplicate samples divided by the mean and expressed as a percent. The %D for serial dilutions during metals analysis indicates how close a diluted value corresponds with the original result. Field duplicate RPD (advisory) limits are set at 0-30% for water samples and 0-50% for soil samples. These field duplicate RPD limits have been taken from EPA Region I guidance on data review. Laboratory RPD and %D limits reference published US EPA limits or laboratory control charted limits, and vary with the analysis and sample type (i.e., duplicate, LCSD, MSD, serial dilution). When RPDs or %Ds exceed limits, consideration will be given to the possibility of sample heterogeneity

5.4.2 Evaluation of Accuracy

Field accuracy is a measure of the sampling bias, and is determined by evaluating field blank, equipment (rinsate) blank, and trip blank results. Field blanks and equipment rinse blanks document sample contamination occurring during field activities. Trip blanks document volatile organic contamination occurring during sample transport. Field blanks are generally collected at a one in 20 sample frequency or one per sampling event whichever is more frequent. Equipment rinse blanks are generally collected at a one in 20 sample frequency, unless dedicated sampling equipment is used. One trip blank is required for each cooler containing samples for volatiles analysis.

Laboratory accuracy is a measure of the system bias. Laboratory QC samples, used to measure accuracy, follow type and frequency criteria set forth in the analytical methods employed (usually one in 20 for organics, and one in ten for inorganics). Laboratory accuracy is evaluated by reviewing LCS/LCSD, MS/MSD, and surrogate percent recoveries (%Rs). Percent recoveries are compared to published limits or statistical laboratory limits depending on the analysis. LCS/LCSD recoveries demonstrate the overall performance of the analysis. MS/MSD recoveries provide information on sample matrix interferences that may affect analytical performance. Surrogate recoveries measure system performance and efficiency, and also provide insight into matrix interference possibilities.

5.4.3 Evaluation of Method Compliance

The degree to which the laboratory has complied with the specifications of a published, validated (e.g., EPA) method is evaluated in order to assess the comparability of the analytical data. The parameters assessed include sample integrity, holding times, laboratory blanks, system performance checks, initial and continuing instrument calibrations, internal standards, GFAA metals duplicate injections, post digestion spikes, target analyte identification, and analyte quantitation. Laboratory blanks are analyzed to identify any contaminants introduced during the preparation, extraction, or analysis phase of the method. Tunes are performed to ensure mass resolution and proper identification of target analytes during GC/MS analysis. Instrument calibrations measure system performance throughout the analytical procedure and establish the quantitation criteria for the analytes. ICP interference checks verify the laboratory's interelement and

background correction factors. GFAA duplicate injections and post digestion spikes aid in sample analyte quantitation.

Method compliance parameters are evaluated according to the appropriate methodology followed. In instances where QC criteria are not met for these parameters, data validation qualifiers are assigned in accordance with the appropriate guidance documents.

5.4.4 Evaluation of Completeness

Completeness is the overall measure of the ratio of samples planned versus the number of samples with verified analyses. Determination of completeness includes a review of project objectives, chain-of-custody records, laboratory analytical methods and detection limits, and a review of project narratives. Completeness also includes 100% review of the laboratory QC summary reports. The data quality objective is to achieve 90-100% completeness of data collected, unless otherwise stated in the QAPP.

5.5 Electronic Disk Deliverable (EDD)

When requested by the client or project manager, the EDD will be compared to hard copy data and data validation qualifiers will be added to the EDD. The EDD may also be checked for compliance with specified project formats.

5.6 Improper Laboratory Practices

The Data Validator will be alert to improper laboratory practices and will report any to the Project Manager.

6.0 Quality Assurance/Quality Control

Elements and appendices of the SOP will be reviewed by the QA Manager annually for currency. The QA Manager or his/her designee will ensure that the governmental validation guidance documents on the RETEC Analytical Data Quality Interest Group Site are current. Reports will be peer reviewed before delivery to the internal or external client.

7.0 Documentation

Problems with analytical procedures, analytical results outside QC limits, or other unusual conditions will be documented during the data verification or validation process. This information will be summarized in a data assessment report accompanying the analytical data. The report will include a list of samples reviewed, the completed data verification/validation checklist, and a table of qualified analytical data. An example of the RETEC Analytical Data Validation Checklist is presented as Appendix 2. Modifications to the checklist may be made to best frame for clarity the information for the client. Any modifications will undergo peer review before being presented to the client.

8.0 References

USEPA Contract Laboratory Program, *National Functional Guidelines for Inorganic Data Review*, EPA 540/R-01/008, July 2002.

USEPA Contract Laboratory Program, *National Functional Guidelines for Low Concentration Organic Data Review*, Final, EPA 540-R-00-006, June 2001.

USEPA, *Guidance on Environmental Data Verification and Data Validation*, Peer Review Draft, EPA QA/G-8, June 2001.

USEPA Contract Laboratory Program, *National Functional Guidelines for Organic Data Review*, EPA 540/R-99/008, October 1999.

USEPA, Contract Laboratory Program (CLP), *Statement of Work for Organic Analysis, Multi-Media, Multi-Concentration,* Document OLM3.2, 1996.

USEPA Contract Laboratory Program, *National Functional Guidelines for Dioxin/Furan Data Validation, Multi-Media, Multi-Concentration,* Document DFLM01.1), Draft, January 1996.

USEPA, Contract Laboratory Program (CLP), *Statement of Work for Inorganic Analysis, Multi-Media, Multi-Concentration,* Document ILM4.0, 1995.

USEPA, *Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater*, 40 CFR, Part 136, Revised as of July 1, 1995, Appendix A to Part 136.

USEPA, *Methods for the Determination of Metals in Environmental Samples*, EPA/600/4-91-010, June 1991 and Supplement I, EPA/600-R-94-111, May 1994.

USEPA, *Methods for the Determination of Inorganic Substances in Environmental Samples,* EPA/600-R-93-100, August 1993.

USEPA, *Model Quality Assurance Project Plan*, Region V, Office of Superfund, May 1991.

USEPA, *Test Methods for Evaluating Solid Waste Physical/Chemical Methods*, SW-846, Third Edition, September 1986 and its updates.

USEPA, *Methods for Chemical Analysis of Water and Wastes*, EPA600/4-79-020, Revised March 1983.

American Public Health Association, American Water Works Association, Water Pollution Control Federation, *Standard Methods for the Examination of Water and Wastewater*, 19th Edition, 1995.

Table 1 Data Validation Qualifier Flags

Organic and Inorganic Data Validation Qualifiers	
J	The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample (estimated concentration).
N	The analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification".
NJ	The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents its approximate concentration (tentative identification/estimated concentration).
R	The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified. Data identified as rejected cannot be used in decision-making.
U	The reported concentration is determined to be a false positive due to the presence of laboratory or field contamination. This qualifier is only assigned to positive results during data validation, and is not identical to the U laboratory flag that indicates undetected results. Often, project directives will dictate that the U data validation qualifier be entered as "UB" into the project database to avoid confusion.
UJ	The analyte was not detected above the reported concentration. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

Appendix 1
"Grey Areas" and Guidance for their Evaluation

General:

Grossly Exceeded Holding Time: Two times the holding time (from the day sampled), unless otherwise defined. For example, if a holding time is defined as 7 days, it would be grossly exceeded at 15 days.

Soil Holding Times: The default will be the method recommended holding time period. For example, the holding times for soil total organic carbon will be 28 days; SVOCs (8270) and polynuclear aromatic hydrocarbons by GC (8310) will be 14 days from the day sampled to extraction, if thermal preservation has been maintained, and 40 days from extraction to analysis; and dioxins and furans (methods 1613B, 8290, 8280A) will be one year from the day sampled to extraction, if thermal preservation has been maintained, and 40 days from extraction to analysis.

GC and GC/MS Organics:

Laboratory control samples (LCSs) will be required for all organic analyses. If no laboratory control limits are specified, or if the data validator believes that the laboratory control limits are too broad, the limits of 70-130% will be employed. LCSs outside 70-130% will be qualified as J or UJ, if the recovery is below 30%, the analytes will be rejected in all associated data.

Organic LCS/LCSD and MS/MSD and RPDs: If two of the three are out, (i.e., a LCS % R and an RPD), J or UJ according to direction of bias.

Extremely low GC/MS internal standard areas: If not otherwise defined, analytes associated with internal standards that are recovered at 10% or less will be rejected.

Organic MS %R below 10%: reject analyte in this sample.

GC or HPLC 2nd column confirmation greater than 40% difference - qualify as NJ and suggest GC/MS confirmation. N portion is left up to professional judgment.

PAH Method 8310 calibration: ICAL - $r^2 > 0.990$, $r > 0.995$ or RSD $\leq 20\%$; CCAL - %D $\leq 15\%$, but any ND analyte may be –15% to +30% for 1 detector

Metals:

Metals CRDL standards (all metals): use 50-150 %R as standard. If < 50% then J and UJ anything below twice the low standard. If > 150% then J hits below twice the low standard

Negative CCBs: If CCB is a negative value that is greater than twice the reporting limit, J hits up to 5 times the RL and UJ for NDs.

Metals Serial Dilution: If concentration of initial analysis is > diluted analysis, J flag all hits in associated samples as positive interference. If initial concentration is < diluted concentration, J and UJ all results in associated samples as negative interference.

Dissolved metals greater than total metals: If the dissolved concentration is > RL, J and UJ as appropriate in that sample.

General Chemistry:

Control limits for LCS, MS, RPD: default to Functional Guidelines metals control limits unless laboratory control-charted limits are provided.

Continuing instrument calibration: use ± 50 %D as acceptance limit, unless otherwise specified in the analytical method.

Appendix 2

RETEC ANALYTICAL DATA VALIDATION CHECKLIST

Project Name:		Laboratory:					
Project Reference:		Sample Matrix:					
RETEC Project Task Number:		Sample Start Date:					
Date Validated/By Whom:		Sample End Date:					
Validation Report Reviewed By:		Review Date:					
Samples Analyzed:							
Parameters Analyzed:							
Laboratory Project IDs:							
PRECISION, ACCURACY, METHOD COMPLIANCE, AND COMPLETENESS ASSESSMENT							
Precision:		Acceptable		Unacceptable		Initials	
Comments:							
Accuracy:		Acceptable		Unacceptable		Initials	
Comments:							
Method Compliance:		Acceptable		Unacceptable		Initials	
Comments:							
Completeness:		Acceptable		Unacceptable		Initials	
Comments:							
VALIDATION CRITERIA CHECK							
Data validation flags used in this review:							
1. Did the laboratory identify any non-conformances related to the analytical results?		Yes		No		Initials	
Explanation:							
2. Were sample Chain-of-Custody forms complete?		Yes		No		Initials	
Comments:							
3. Were all the analyses requested for the samples on the COCs completed by the laboratory?		Yes		No		Initials	
Comments:							

RETEC ANALYTICAL DATA VALIDATION CHECKLIST (cont.)

4. Were samples received in good condition and at the appropriate temperature?		Yes		No		Initials
Comments:						
5. Were the requested analytical methods in compliance with WP/QAPP, permit, or COC?		Yes		No		Initials
Comments:						
6. Were detection limits in accordance with WP/QAPP, permit, or method?		Yes		No		Initials
Comments:						
7. Do the laboratory reports include only those constituents requested to be reported for a specific analytical method?		Yes		No		Initials
Comments:						
8. Were sample holding times met?		Yes		No		Initials
Comments:						
9. Were correct concentration units reported?		Yes		No		Initials
Comments:						
10. Were the reporting requirements for flagged data met?		Yes		No		Initials
Comments:						
11. Were laboratory blank samples free of target analyte contamination?		Yes		No		Initials
Comments:						
12. Were trip blank, field blank, and/or equipment rinse blank samples free of target analyte contamination?		Yes		No		Initials
Comments:						
13. Were instrument calibrations within method control limits?		Yes		No		Initials
Comments:						
14. Were surrogate recoveries within control limits?		Yes		No		Initials
Comments:						
15. Were laboratory control sample recoveries within control limits?		Yes		No		Initials
Comments:						

RETEC ANALYTICAL DATA VALIDATION CHECKLIST (cont.)

16. Were matrix spike recoveries within control limits?		Yes		No		Initials
Comments:						
17. Were duplicate RPDs and/or serial dilution %Ds within control limits?		Yes		No		Initials
Comments:						
18. Were organic system performance criteria met?		Yes		No		Initials
Comments:						
19. Were internal standards within method criteria for GC/MS sample analyses?		Yes		No		Initials
Comments:						
20. Were inorganic system performance criteria met?		Yes		No		Initials
Comments:						
21. Were blind field duplicates collected? If so, discuss the precision (RPD) of the results.		Yes		No		Initials
Duplicate Sample No.			Primary Sample No.			
Comments:						
22. Were qualitative criteria for organic target analyte identification met?		Yes		No		Initials
Comments:						
23. Were 100% of the EDD concentrations and reporting limits compared to the hardcopy data reports?		Yes		No		Initials
Comments:						
24. General Comments:						

Attachment C

RETEC Analytical Data Validation Checklist

Attachment C
RETEC Analytical Data Validation Checklist

Project Name:	Laboratory:
Project Reference:	Sample Matrix:
ThermoRetec Project:	Sample Start Date:
Date Validated:	Sample End Date:
Samples Analyzed:	
Parameters Analyzed:	
Laboratory Project ID:	

PRECISION, ACCURACY, METHOD COMPLIANCE, AND COMPLETENESS ASSESSMENT

Precision:	Acceptable	Unacceptable	Initials
Comments:			
Accuracy:	Acceptable	Unacceptable	Initials
Comments:			
Method Compliance:	Acceptable	Unacceptable	Initials
Comments:			
Completeness:	Acceptable	Unacceptable	Initials
Comments:			

VALIDATION CRITERIA CHECK

Data validation flags used in this review:

Attachment C
RETEC Analytical Data Validation Checklist

1. Did the laboratory identify any nonconformances related to the analytical results?	Yes	No	Initials
Explanation:			
2. Were sample COC forms complete?	Yes	No	Initials
Comments:			
3. Were detection limits in accordance with QAPP, permit, or method?	Yes	No	Initials
Comments:			
4. Were the requested analytical methods in compliance with QAPP, permit, or COC?	Yes	No	Initials
Comments:			
5. Were samples received in good condition?	Yes	No	Initials
Comments:			
6. Were sample holding times met?	Yes	No	Initials
Comments:			
7. Were correct concentration units reported?	Yes	No	Initials
Comments:			
8. Do the laboratory reports include only those constituents requested to be reported for a specific analytical method?	Yes	No	Initials
Comments:			
9. Were the reporting requirements for flagged data met?	Yes	No	Initials
Comments:			
10. Were GC/MS system performance checks (BFB and DFTPP tunes) within method criteria?	Yes	No	Initials
Comments:			

Attachment C
Retec Analytical Data Validation Checklist

11. Were ICP metals system performance checks (ICP Interference Check) within method criteria?	Yes	No	Initials
Comments:			
12. Were instrument calibrations within method control limits?	Yes	No	Initials
Comments:			
13. Were laboratory blank samples free of target analyte contamination?	Yes	No	Initials
Comments:			
14. Were surrogate recoveries within control limits for organic analyses?	Yes	No	Initials
Comments:			
15. Were laboratory duplicate RPDs or %Ds within control limits?	Yes	No	Initials
Comments:			
16. Were matrix spike recoveries within control limits?	Yes	No	Initials
Comments:			
17. Were laboratory control sample recoveries within control limits?	Yes	No	Initials
Comments:			
18. Were internal standards within method criteria for GC/MS sample analyses?	Yes	No	Initials
Comments:			
19. Were detections found in trip blank, field blank, or rinse blank samples?	Yes	No	Initials
Comments:			

Attachment C
RETEC Analytical Data Validation Checklist

20. RPD Evaluation of Field Duplicates:	Yes	No	Initials
Duplicate Sample No.	Primary Sample No.		
Comments:			
21. Were 100% of the EDD concentrations and reporting limits compared to the final laboratory data reports?	Yes	No	Initials
Comments:			
22. General Comments: Data were evaluated based on validation criteria set forth in the U.S. EPA. 1994o			

Notes:
COC = Chain of Custody
QAPP = Quality Assurance Project Plan
GC/MS = Gas Chromatography / Mass Spectrometer
BFB = Bromofluorobenzene
DFTPP = Decafluorotriphenylphosphine

Appendix C

Health and Safety Plan (HASP)

Appendix C
Site-Specific Health & Safety Plan

Maverik (Caribou) Former Refinery
Kirtland, New Mexico

Prepared by:

The RETEC Group
1726 Cole Bvld., Bldg., 22, Suite 150
Golden, CO 80401

RETEC Project Number: MCS01-19100-200

Prepared for:

Maverik Country Stores, Inc.
880 West Center St.
North Salt Lake, UT 84054

On Site Emergency Phone Numbers	
Fire:	911
Police:	911
Ambulance:	911
For more emergency numbers and directions to the hospital, turn to page 5-6.	

November 11, 2005

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HEALTH AND SAFETY PLAN CHECKLIST
(For Verification Purposes Only)

Project Number: MCS01-19100-200	**Date:**
Client: Maverik Country Stores, Inc.	**Verified by:**
Site: Former Maverik Refinery	

Please make sure that you Verify Compliance with the Following Items:

- Necessary Signatures (Health and Safety Officer, Project Manager, HASP Preparer) ☐
- Training Requirements (Section 1.3) ☐
- Medical Monitoring Requirements (Section 1.4) ☐
- Fit-Testing (Section 1.5) ☐
- Attachment E Notice Posted (Section 1.8) ☐
- Hazard Communication Program Material Posted (Section 1.9) ☐
- Appropriate PPE Available (Section 3) ☐
- Work Zones Established (Section 4.1) Appropriate Signage in Place (Section 4.1) ☐
- Emergency Telephone Numbers Verified & Posted (Section 5) ☐
- Hospital Route Verified & Posted (Section 5) ☐
- Evacuation Routes Established (Section 5.6) ☐
- Amendments, if applicable, are properly documented (Page vii and Attachment A) ☐
- Site Safety Acknowledgment Form Completed (Attachment B) ☐
- Kick-Off Meeting Convened and Documented (Attachment D) ☐

Signature _____
Site Health and Safety Officer

Note: ( ) Location in HASP

HEALTH AND SAFETY PLAN AMENDMENT RECORD

Client: Maverik Country Stores, Inc.		
Project No.: MCS01-19100-200		
Project Manager: Jenny Phillips		
Site Engineer: Bjorn Selvig		
Amendment No.	**Date**	**Description**

NOTE: See Safety Plan Amendments (Attachment A) for Complete Description.

1 Introduction

This document describes the health and safety protocols developed for the Former Maverik Refinery site, located in Kirtland, New Mexico. This plan was developed to protect on-site personnel, visitors, and the public from known or suspected health and safety hazards. General site information is summarized in Table 1-1. Background information pertaining to site history and general hazards is listed in Table 1-2.

The procedures and guidelines contained herein are based on generally recognized health and safety practices. This is an "evergreen" document so specific sections of this plan should be changed or revised when additional information is received or when conditions at the site change. Any changes or revisions to this plan will be made by a written amendment which will become a permanent part of this plan and placed in Attachment A.

1.1 Site Safety Plan Acknowledgment and Acceptance

The project manager, site engineer, site safety and health officer (SSHO), or other designated representative shall be responsible for informing all individuals assigned to work on the site, or visit the site beyond the clean/support zone, of the contents of this plan and ensuring that each person signs the Site Safety Plan Acknowledgment Form in Attachment B. By signing the Safety Plan Acknowledgment Form, individuals recognize the site health and safety hazards, known or suspected, and will adhere to the protocols required to minimize exposure to such hazards.

Additionally, all personnel visiting the site must sign the visitor's log in Attachment C indicating the date and time of their visit.

1.2 Site Health and Safety Meetings

A pre-construction meeting addressing site-specific safety issues shall be held on the first day of mobilization to the site and prior to the commencement of any work activities. Mandatory attendance is required for all personnel assigned to the site. At the conclusion of the meeting, personnel are to sign the Safety Plan Acknowledgment Form in Attachment B, indicating their attendance and understanding of the health and safety protocols. As additional personnel are assigned to the site, it is the responsibility of the project manager/site engineer, and/or SSHO to ensure that new personnel are briefed on health and safety protocols and that they also have reviewed and signed the Safety Plan Acknowledgment Form.

Additional health and safety meetings will be held on a regularly scheduled basis throughout the duration of the project. Weekly meetings are strongly

recommended. These meetings shall be conducted to inform all personnel of changing site conditions, to review Safety Task Analysis Review and Job Safety Analysis (STAR/JSA) forms (see Attachments L and M), to understand any near misses and "lessons learned," to present pertinent site safety topics, and to address any worker health and safety concerns. The site engineer or SSHO will complete the Site Safety Meeting form in Attachment D indicating the date, time, topics discussed, and personnel in attendance of all health and safety meetings.

1.3 Training Requirements

All personnel assigned to work on this site beyond the support zone must have successfully completed 40 hours of Training for Hazardous Waste Site Work in accordance with OSHA 29 CFR 1910.120(e)(3), and be current with their 8-Hour Refresher Training in accordance with OSHA 29 CFR 1910.120(e)(8).

Personnel managing or supervising work on site must also have successfully completed 8 Hours of Manager/Supervisor Training, meeting the requirements of 29 CFR 1910.120(e)(4). Documentation of OSHA training is required prior to personnel being permitted to work on site.

Any exceptions to the training requirements will be explicitly specified either in this Health and Safety Plan (HASP) or through a HASP amendment.

1.4 Medical Monitoring Requirements

All personnel assigned to work on this site beyond the support zone must be enrolled in a medical surveillance program meeting the requirements of OSHA 29 CFR 1910.120(f). Personnel must have successfully passed an occupational physical during the past 12 months (24 months if approved by RETEC's Environmental Health and Safety Department), be medically cleared to work on hazardous waste sites, and be capable of wearing appropriate person protective equipment (PPE) including any respiratory protection.

Any exceptions to the medical monitoring requirements will be explicitly specified either in this HASP or through a HASP amendment.

1.5 Fit Testing Requirements

All personnel assigned to work on this site beyond the support zone and who must wear a respirator must be familiar with the requirements in RETEC's respiratory protection program and the OSHA respiratory standard (29 CFR 1910.134). All personnel who are required to wear respiratory protection must have successfully passed a respirator fit test within the past 12 months. Documentation of a successful respirator fit test for the appropriate type of respirator needed for work on this specific site (half-face or full-face air-purifying respiratory (APR) or supplied air) will be required. The project

manager, project site engineer, or SSHO is to ensure that the respirator being worn by personnel is the same size, make, and model as that specified on any respirator fit test records from the past 12-month period.

1.6 Stop Work Policy

Of particular importance are the expectations that (1) each person is responsible for protecting themselves at all times and (2) each person will look for hazardous behaviors in others and commit to stop unsafe acts before they occur.

In keeping with these principles, the "STOP WORK" policy is designed to empower all personnel to take action to prevent unsafe acts or conditions, regardless of company affiliation or role within the project. "STOP WORK" is defined as either stopping or not beginning a specific activity that poses a danger to human health or to the environment. Work will not resume until efforts are completed to remedy the unsafe conditions. With the "STOP WORK" responsibility comes the reassurance of no reprisals against the employee based on his decision to stop work in lieu of unsafe conditions.

1.7 Responsibilities

The project manager, site engineer, and SSHO are responsible for overall project administration and for coordinating health and safety protocols and procedures for all personnel on site at all times. All applicable U.S. EPA, OSHA, state, and local health and safety requirements shall be maintained throughout the course of the project. This HASP covers all personnel on site; however, each subcontractor is also responsible for the health and safety of its employees. If there is a dispute with regards to health and safety, the following procedures shall be followed:

1) The project manager or site engineer shall attempt to resolve the issue independently with a complete written follow-up to RETEC's Environmental Health and Safety Director, or

2) If the issue cannot be resolved, the project manager shall consult the Environmental Health and Safety Director immediately, and the specific task or operation in dispute shall be discontinued until the issue is resolved.

Any person who observes health and safety problems or infractions should immediately stop work and report the problem or infraction to appropriate personnel.

1.8 Access to Employee Exposure and Medical Records

OSHA provides employees and their designated representatives a right-of-access to relevant exposure and medical records (29 CFR 1910.20). The "Notification of Access to Employee Exposure and Medical Records" (Attachment E) is to be posted in a prominent location at all RETEC field operations.

1.9 Hazard Communication

RETEC will advise everyone assigned to this site of the hazards associated with working on site and the methodology to be utilized to mitigate those hazards and prevent exposures. This information will be presented to personnel prior to initiation of any field activities.

The following information regarding hazardous materials will be presented to site personnel per RETEC's Hazard Communication Program:

- Material Safety Data Sheets (MSDS)
- Chemical/physical hazards
- Appropriate PPE for protection from exposure
- Labeling

1.10 Behavior Safety

RETEC utilizes a behavioral safety process rooted in periodic observation and feedback. This approach seeks to encourage safe behavior through (1) monitoring work activities to confirm safe practices, (2) providing immediate feedback to motivate safe behavior, and (3) taking preemptive actions to correct observed shortcomings before they might result in an accident or injury. These corrective actions focus on uncovering and addressing the root causes of unsafe behavior.

The observation and feedback process consists of the following:

- Certain activities deemed most critical to safe performance are targeted for periodic observation
- The project manager, site manager, site safety supervisor, etc., determine the appropriate intervals for periodic observations
- Assigned observers record whether the targeted activities are being performed "100% Safe" or note specific incidents of unsafe behavior (without identifying individuals)
- Observers provide immediate feedback, either commending safe performance or correcting unsafe behaviors

- Results of observations are tracked over time, and persistent problems are targeted for preemptive corrective actions

More detail on RETEC's safety observation and feedback process can be found in the document entitled *BEST: Employees' Guide to Optimizing Environmental, Health and Safety Performance.*

Table 1-1 General Information

Client: Maverik Country Stores, Inc.	**Proj. No.:** MCS01-19100-200
Site Name: Former Maverik Refinery	
Site Location: Kirtland, NM	
Description of Field Activities: Stage I Abatement Plan activities	
Dates of Field Activities: to be determined	
Project Manager: Jenny Phillips	**Project Manager Telephone No.:** (970) 493-3700
Site Engineer/Manager: Bjorn Selvig	**Office:** Ft. Collins
Note: All RETEC personnel assigned to the site are current in their OSHA training, medical surveillance examination, respirator fit test, and first aid/CPR (where applicable). Documentation may be obtained from the RETEC Monroeville office from Tina McHugh, EH&S Program Administrator at (412) 380-0140.	

Table 1-2 Background

Overall Hazard Is:			
High: ☐	**Low:** ☒	**Moderate:** ☐	**Unknown:** ☐
Facility Description: The former refinery is located ½ to ¾ mile north of the San Juan River in Kirtland, NM. The site is bounded by 2 unlined irrigation ditches. The site is approximately 0.4 miles north-northeast from the existing banks of the San Juan River. The tank farm is located within the floodplain of the San Juan River.			
Status: Former crude topping refinery shut down in 1982			
Unusual Features (containers, dikes, buildings, power lines, terrain, etc.): The included site map, Figure 4-1, shows the site layout and features.			
Site History (worker injury, complaints, regulatory agency action): Maverik operated the refinery from 1963 until 1982. During operation, crude oil was refined into regular and leaded gasoline, diesel fuel, and No. 5 fuel oil. After facility shut down, all remaining product, feedstocks, and intermediate products were removed from storage tanks and sold.			
Waste Types:			
Liquid: ☒	**Solid:** ☒	**Sludge:** ☐	**Gas:** ☐
Characteristics:			
Corrosive: ☐	**Ignitable:** ☐	**Volatile:** ☒	**Toxic:** ☐
Reactive: ☐	**Unknown:** ☐	**Radioactive:** ☐	
Other (Name): ☐			

2 Health & Safety Risk Analysis

This section identifies the specific hazards associated with site operations and presents an analysis of documented or potential chemical hazards that exist at the site. Every effort must be made to reduce or eliminate these hazards. Those which cannot be eliminated must be abated by use of engineering controls and/or PPE.

2.1 Precautions When Working Around Heavy Equipment

The following precautions will be taken to minimize heavy equipment hazards:

- All equipment must pass inspection to ensure that it is in safe working order prior to use. An inspection form is included as Attachment K.
- All equipment must have back-up alarms.
- Personnel must make eye contact with the operator before approaching the equipment.
- Operators must be aware of personnel in the area and use proper hand signals before maneuvering.
- Operators must wear hard hats when operating machines unless equipment has an enclosed cab or cage cover.
- Operators must wear hard hats when going to and from their equipment.
- Operators must be cautious when maneuvering equipment near over-head power lines.

2.2 General Site Hazards

2.2.1 Lighting

Work areas must have adequate lighting for employees to see to work and identify hazards (5-foot candles minimum, comparable to a single 75- to 100-watt bulb). Applicable OSHA standards for lighting (29 CFR 1910.120(m)) shall apply.

2.2.2 Electrical Power

All electrical power must have a ground fault circuit interrupter as part of the circuit. All equipment must be suitable and approved for the class of hazardous atmosphere in which it is being used. Applicable OSHA standards for electric power (29 CFR 1910 Subpart S) shall apply.

2.2.3 Lockout/Tagout

Operations where the unexpected energization, or start-up of equipment, or release of stored energy could cause injury to personnel will be protected by the implementation of a lockout/tagout program meeting the requirements of 29 CFR 1910.147. See Section 6 of this HASP for more details.

Sites which have structural barriers preventing the equipment from being moved on to the tracks, are not required to have these lockable disconnect switches. Fencing, ditches and walls would be considered adequate structural barriers to equipment movement on the tracks.

2.2.4 Fall Protection

Work site slip, trip, and fall accidents can result in serious injuries or fatalities. Procedures to help prevent these types of incidents will be implemented. Elevated work (above 4 feet) where a fall potential exists will be performed using appropriate ladders and/or fall protection (i.e., body harness, lifeline, etc.) Applicable OSHA standards for fall protection (29 CFR 1910.21 through 29 CFR 1910.32) shall apply.

2.2.5 Drum Handling

The movement, opening, and sampling of drums will be conducted in accordance with 29 CFR 1910.120(j).

2.2.6 Cold Stress

When the temperature falls below 40°F, cold stress protocols shall be followed. Employees must be supplied with adequate clothing to maintain core temperature. Cold stress is discussed in detail in Attachment F.

2.2.7 Heat Stress

When the temperature exceeds 70°F and personnel are wearing personal protective clothing, a heat stress monitoring program shall be implemented. Employees shall have break periods and access to drinking water. Heat stress is discussed in detail in Attachment G.

2.2.8 Eye Wash Protection

All operations involving the potential for eye injury, splash, etc., must have approved eye wash units locally available as per 29 CFR 1910.151(c).

2.2.9 Hearing Protection

When the noise level of any operation exceeds the 8-hour Time Weight Average (TWA) of 85 decibels, a hearing protection program meeting the requirements of 29 CFR 1910.95 will be implemented.

2.2.10 Fire Protection/Fire Prevention

Operations involving the potential for fire hazards shall be conducted in a manner which minimizes the risk. When fire hazards exist, non-sparking tools and fire extinguishers shall be used or available as required. Sources of ignition shall be removed. When necessary, explosion-proof instruments and/or bonding and grounding will be used to prevent explosion and/or fire.

2.2.11 Utilities

Overhead and underground utility hazards shall be identified and/or inspected prior to conducting operations involving potential contact. These operations include any ground disturbance activities (i.e., drilling, trenching, and excavation) or overhead work (see Section 2.2.14).

2.2.12 Confined Space Entry

If any operation is conducted in an area classified as a permit-required confined space by OSHA, a "Confined Space Entry Permit" will be completed and all applicable procedures meeting the requirements of 29 CFR 1910.146 will be implemented.

It is unlikely that confined space entry will be conducted as part of this project. However, if it is necessary, RETEC corporate EH&S will be notified prior to conducting these activities.

2.2.13 Excavation/Trenching

Any excavation/trench greater than units of 4 feet deep in which personnel must enter will be designed and constructed per all applicable requirements of 29 CFR 1926, Subpart P.

2.2.14 Overhead Power Lines

Any time work is performed in the vicinity of high-tension wires, a person who is a good judge of distance will be assigned to help operators maneuver equipment in and around the wires.

The following distances will always be maintained around high-tension wires:

- For lines rated 50 kV or below, minimum clearance between the lines and any part of the crane or load shall be 10 feet.

- For lines rated over 50 kV, minimum clearance between the lines and any part of the crane or load shall be 10 feet plus 0.4 inch for each 1 kV, over 50 kV, or twice the length of the line insulator, but never less than 10 feet.

- In transit with no load and boom lowered, the equipment clearance shall be a minimum of 4 feet for voltages less than 50 kV, 10 feet for voltages over 50 kV, up to and including 345 kV, and 16 feet for voltages up to and including 750 kV.

2.2.15 Buried Utilities and Ground Disturbance

Contact with underground facilities, electrical, and communication cables may results in ruptures, fire, explosion, and/or the release of toxic substances, resulting in the injury or loss of life, property damage, and loss of production. All underground utility hazards shall be identified and/or inspected prior to conducting operations involving potential contact.

Additional efforts will be taken to locate and identify buried utilities above and beyond relying on utility locate or one-call services, because not all entities with buried lines have agreements with these services. These additional efforts may include review of historical drawings and photographs; a site inspection to identify potential utility corridors; or hand digging, auguring or vacuum excavation of test holes (pot-holing) to verify the presence or absence of buried lines.

A ground disturbance permit, provided in Appendix I, will be completed prior to initiating any type of ground disturbance (e.g., drilling, excavation, trenching, etc) greater than 1 foot below ground surface.

3 Personal Protective Equipment

The following is a brief description of the PPE which may be required during various phases of the project. The U.S. EPA (Levels A, B, C, and D) terminology for protective equipment will be used.

Respiratory protective equipment shall be NIOSH approved and use shall conform to OSHA 29 CFR 1910.134.

3.1 Level C

Level C protection shall be used when:

- Substance(s) require the same level of skin protection as Level D, but a greater level of respiratory protection
- The types of air contaminants have been identified, concentrations measured, and respirator decision logic indicates that APRs are sufficient to remove the contaminants
- The substance has adequate warning properties and all criteria for the selection of APR has been met

Table 3-1 Level C PPE to be Utilized

(Check Appropriate PPE)

☐	Half-face APR (MSHA/NIOSH approved) or
☐	Full-face APR (MSHA/NIOSH approved)
☐	**Type of Cartridges to be Used:**
☐	Chemical-resistant clothing check appropriate garments (one-piece coverall; hooded one-or two-piece; chemical splash suit; chemical-resistant hood and apron; disposable chemical coveralls (i.e., Tyvek) ☐ One-Piece Coverall ☐ Hooded one-or-two piece chemical splash suit ☐ Chemical-resistant hood and apron ☐ Disposable Chemical-resistant Coveralls **Fabric Type:**
☒	Disposable inner gloves (surgical)
☐	Disposable chemical-resistant outer gloves **Material Type:**
☐	Chemical-resistant boots with steel toe and shank or disposable boot covers; booties **Material Type:**
☐	Sleeves to be duct-taped over gloves and pants to be duct-taped over boots
☐	Safety goggles or
☒	Safety glasses

☒	Hard hat
☐	Hard hat with face shield
☐	Hearing Protectors (**REQUIRED** if site noise levels are greater than 85 dB based on an 8-hour TWA)
☐	Two-way radio communication (intrinsically safe)
☐	Long cotton underwear
☐	**Modifications:**

3.2 Level D

Level D protection will be used when:

- The atmosphere contains no known hazard
- Work functions preclude splashes, immersions, or the potential for unexpected inhalation of or contact with hazardous concentrations of chemicals
- Atmospheric concentrations of contaminants are less than the TLV

Table 3-2 Level D PPE (Minimum Work Uniform Permitted)
(Check Appropriate PPE)

☐	Standard work uniform/coveralls
☒	Work boots with steel toe and shank
☒	Work gloves
☐	Safety goggles
☒	Safety glasses
☐	Hearing Protectors (**REQUIRED** if site noise levels are greater than 85 dB based on an 8-hour TWA)
☒	Hard hat
☐	Hard hat with face shield
☐	Two-way radio communication (intrinsically safe)
☐	Long cotton underwear
☐	**Modifications:**

Table 3-3 Activity vs. Level of Protection

Activity	Level of PPE	Special Requirements
Groundwater sampling	D	Be aware of pinch point, repetitive motion, and trip/fall hazards.
Private well and ditch survey	D	Be aware of insects and trip/fall hazards.

4 Site Control

4.1 Work Zones

The primary purpose for site controls is to establish the hazardous area perimeter, to reduce migration of contaminants into clean areas, and to prevent access or exposure to hazardous materials by personnel. At the end of each workday, the site should be secured and/or guarded to prevent unauthorized entry. Site work zones will include:

- **Clean Zone/Support Zone.** This uncontaminated zone will be the area outside the exclusion and decontamination zone and within the geographic perimeters of the site (typically the job trailer). This area is used for staging of materials, parking of vehicles, office and laboratory facilities, sanitation facilities, and receipt of deliveries. Personnel entering this zone may include delivery personnel, visitors, security guards, etc. These personnel will not necessarily be permitted in the exclusion zone. All personnel arriving in the support zone will report to the job trailer or other check in point and sign the visitor sign-in log in Attachment C of this HASP. There will be only one controlled entry/exit point from the clean zone to the decontamination zone.

- **Decontamination Reduction Zone (DRZ).** The decontamination reduction zone will provide a location for removal of contaminated PPE and final decontamination of PPE. A separate decontamination area will be established for heavy equipment. All personnel and equipment must exit via the decon area.

- **Exclusion Zone/Hot Zone.** The exclusion zone will be the "hot zone" or contaminated area inside the site or work area perimeter. Entry to and exit from this zone will be made through a designated point. Appropriate warning signs to identify the exclusion zone should be posted (i.e., "DANGER," "AUTHORIZED PERSONNEL ONLY," "PROTECTIVE EQUIPMENT BEYOND THIS POINT," etc.). Personnel and equipment decontamination must accompany exit from the exclusion zone.

RETEC

Stage 1 Abatement Plan

Maverik (Caribou) Former Refinery, Kirtland, New Mexico

DATE: 11/10/05 | DRWN: E.S.S./DEN

SITE LOCATION MAP

FIGURE 2

File: M:\TEMP\mav-kirtland\Mav-Kirt-SIWP_2.dwg Layout: FIGURE 2 User: eschwartz Plotted: Nov 11, 2005 - 1:51pm Xref's:

4.2 General Field Safety and Standard Operating Procedures

- The "Buddy System" will be used at all times by all field personnel in the exclusion zone, especially if personnel are required to wear Level C or higher PPE. No one is to perform fieldwork alone unless approved by the project manager or office Health and Safety Coordinator and/or Director of EH&S. Maintain visual, voice, and/or radio communication at all times.

- Whenever possible, avoid contact with contaminated (or potentially contaminated) surfaces. Walk around (not through) puddles and discolored surfaces. Do not kneel or set equipment on the ground. Stay away from waste drums unless it is necessary to sample or handle the drums. Protect equipment from contamination by bagging.

- Eating, drinking, and/or smoking are only permitted in designated areas in the support zone.

- Hands and face must be thoroughly washed upon leaving the decon area.

- Beards and/or other facial hair that interferes with respirator fit will preclude admission to the exclusion zone when level C PPE is required.

- All equipment must be decontaminated or properly discarded upon exit from the exclusion zone.

- All personnel exiting the exclusion zone must go through the decontamination procedures as described in this HASP.

- PPE as described in this HASP will be required for all field personnel working on site.

- Contact lenses may be worn on the site provided safety glasses or goggles are also worn. Any exceptions to wearing of contact lenses will be specified in this HASP or through a HASP amendment.

5 Emergency Response/Contingency Plan

It is essential that site personnel be prepared in the event of an emergency. Emergencies can take many forms: illnesses/injuries, chemical exposure, fires, explosions, spills, leaks, releases of harmful contaminants, or sudden changes in weather. Table 5-1 outlines the contact information for emergencies.

5.1 Emergency Contacts/Telephone Numbers

Table 5-1 Emergency Contacts/Telephone Numbers

Fire:	911
Police:	911
Ambulance:	911
Capable of Transporting Contaminated Personnel?	**Yes:** ☐ **No:** ☐
Hospital:	San Juan Regional Medical Center 801 West Maple Farmington, NM 87401 (505) 325-5011
Chemical Trauma Capabilities?	**Yes:** ☐ **No:** ☐
Decontamination Capabilities?	**Yes:** ☐ **No:** ☐
Directions from Site to Hospital:	**1:** East on US-64 from NM-489 for 6.3 miles. **2:** Turn Right on NM 371/S. Lake St. for 0.2 miles **3:** Turn Left on W. Maple St. for <0.1 miles **4:** End at 801 W. Maple St.
Note: See map for route to hospital at the end of this section. ***The route to the hospital was verified by:*** Distance from the Site to the hospital is: approximately 7 miles. The approximate driving time is: approximately 10 minutes.	
Poison Control Center	(800) 222-1222
Airport:	Farmington Municipal Airport
National Response Center	(800) 424-8802
Center for Disease Control	(770) 488-7100
ATF (explosion information)	(202) 927-8330
Chemtrec	(800) 424-9300
State Environmental Agency	(505) 476-3440
RETEC Corporate Office	Mr. Mike Knupp (978) 371-1422
RETEC Personnel Office (local)	(970) 493-3700
RETEC Corporate EH&S Director	Mr. Jim Colbert (970) 493-3700
RETEC Personnel Medical Consultant (Corporate)	Health Resources (800) 350-4511 600 West Cumming Park, Suite 3400 Woburn, MA 018101-6350
RETEC Project Manager	Jenny Phillips (970) 493-3700
Client Contact	Dennis Riding (801) 335-3860

Table 5-2 Emergency Equipment Available On Site

Communication Equipment:	
☐	Public Telephones
☐	Private Telephones ( ) - ( ) -
☐	Cellular Telephones [Name of person with phone.]( ) - [Name of person with phone.]( ) -
☐	Two-Way Radio (walkie-talkie)
☐	Emergency Alarms/Horns
Medical Equipment:	
☐	First Aid Kits
☐	Stretcher
☐	Eye Wash Station and/or Bottle
☐	Safety Shower
☐	Blankets
☐	Other (please specify):
Fire Fighting Equipment:	
☐	Fire Extinguisher Type:
☐	Other:
Spill/Leak Equipment	
☐	Absorbent Boom Pads
☐	Dry Absorbent
Additional Safety Equipment:	

5.2 Personal Responsibilities during Emergencies

The SSHO or designee has primary responsibility for responding to and correcting emergency situations. The on-site SSHO will:

- Take appropriate measures to protect personnel including withdrawal from the exclusion zone, total evacuation and securing of the site, or upgrading/downgrading the level of protective clothing and respiratory protection
- Notify the Project Manager.
- Take appropriate measures to protect the public and the environment including isolating and securing the site, preventing run-off to surface waters, and ending and/or controlling the emergency to the extent possible
- Ensure that the appropriate federal, state, and local agencies are informed, and emergency response plans are coordinated. In the event of a fire or explosion, the local fire department should be

summoned immediately. In the event of an air release of toxic materials, the local authorities should be informed in order to assess the need for evacuation. In the event of a spill, sanitary districts and drinking water systems may need to be alerted.

- Ensure that appropriate decon treatment for exposed or injured personnel is obtained.
- Determine the cause of the incident and make recommendations to prevent recurrence.
- Ensure that all required reports have been prepared.
- If an injury has occurred, depending on the type and severity, notify RETEC's Medical Consultant and/or Occupational Physician.
- Notify RETEC's Environmental Health & Safety Department and Human Resources Department.
- Notify the injured person's regional office.
- Prepare an Incident Report (Attachment H) and submit the report to RETEC's Environmental Health & Safety Department, Human Resource Department, Regional Manager, Operations Manager, and Health & Safety Coordinator within 24 hours.
- If the incident results in one or more fatalities or hospitalization of three or more personnel, notify the local OSHA office within 8 hours.

5.3 Medical Emergencies

Any person who becomes ill or injured in the exclusion zone must be decontaminated to the maximum extent possible. If the injury and/or illness is minor, full decontamination should be completed and, if possible, first aid administered prior to transport. If the patient's condition is serious, partial decontamination should be completed to the extent practicable (i.e., disrobing of the victim and redressing in clean coveralls or wrapping in a blanket). First aid should be administered while awaiting an ambulance or paramedics. ***All*** *injuries and illnesses must be reported to the Project Manager, SSHO, Health and Safety Department, Human Resources Department, Regional Manager, Operations Manager, and Health and Safety Coordinator.*

Any person transporting an injured/exposed person to a hospital for treatment should take directions to the hospital with them, and information on the chemicals involved. Any vehicle used to transport contaminated personnel will be cleaned or decontaminated as necessary.

5.4 Fire or Explosion

In the event of a fire or explosion, the local fire department must be summoned immediately. Upon their arrival, the project manager/site engineer and/or SSHO will advise the fire commander of the location and nature of the fire and identification of all hazardous materials on site.

If it is safe to do so and personnel have been properly trained, site personnel may use fire-fighting equipment available on site, or remove or isolate flammable or other hazardous materials, which may contribute to the fire (i.e., incipient stage fire-fighting only).

5.5 Spill or Leaks

In the event of a spill or leak, appropriately trained site personnel will locate the source of the spill and stop the flow, if it can be done safely. Personnel will also begin containment and recovery of the spilled material, if it can be done safely.

5.6 Evacuation Routes and Resources

Evacuation routes will be established by work area locations for the site. Evacuation should be conducted immediately, without regard for equipment, under conditions of extreme emergency. See site map (Figure 4-1) for evacuation routes.

- Evacuation notification will be a continuous blast on an air horn, vehicle horn, or by verbal communication.
- Keep upwind of smoke, vapors, or spill location.
- Exit through the decontamination corridor, if possible.
- If evacuation is not via the decontamination corridor, site personnel should remove contaminated clothing once they are in a location of safety and leave the clothing near the exclusion zone or in a safe place.
- The project manager/site engineer or SSHO will conduct a head count to ensure all personnel have been evacuated safely.

- In the event that a site evacuation is necessary, all personnel are to:
  - Escape the emergency situation
  - Decontaminate to the maximum extent practical
  - Meet at RETEC's site trailer, vehicle, command post, or some other pre-arranged location

5.7 Near Miss

If anyone on site witnesses a near-miss, they must complete the Near-Miss Report (Attachment J) and submit it to the Environmental Health and Safety Department and Local Health and Safety Coordinator **within 72 hours.** Near accidents are incidents that, depending on the circumstances, could have resulted in death, personal injury, and/or property/equipment damage.

6 Lockout/Tagout

Does this project involve the operation of machines and/or equipment in which the unexpected energization or start up of the machinery or equipment, or release of stored energy, could cause injury to personnel?

No: ☒	**Yes:** ☐

If the answer is **NO**, proceed to the next section. If the answer is **YES**, OSHA regulations for Lockout/Tagout (29 CFR 1910.147) must be implemented and personnel must comply with all Lockout/Tagout procedures.

To assure personnel are protected from equipment accidentally operating during maintenance and servicing, OSHA requires the utilization of lockout/tagout procedures. These procedures apply to maintenance and/or servicing of equipment and not to normal operations.

These procedures apply to operations when guards are removed or bypassed, other safety devices are bypassed, or any part of the body is in a danger zone for the servicing and/or maintenance of the equipment. The procedures do not apply to cord-plug-connected equipment, which is under the control of the operator.

Some of the common energy sources which require lockout/tagout procedures include, but are not limited to:

- Electrical
- Hydraulic
- Pneumatic
- Chemical
- Thermal

6.1 Tags

Tags are only warning devices and do not provide physical restraint. Tags **MUST NOT** be removed without authorization of the person responsible for its attachment and must never be bypassed or ignored. Tags must be legible, understandable, and used as part of the overall lockout/tagout program. Tagout devices shall warn against hazardous conditions and shall include verbiage such as:

- DO NOT START
- DO NOT OPEN
- DO NOT CLOSE
- DO NOT ENERGIZE
- DO NOT OPERATE

6.2 Locks

Locks are used as a positive means to hold energy isolating devices in the "safe" or "off" position. Locks prevent removal without excessive force or unusual techniques such as the use of bolt cutters, etc.

The lockout/tagout procedure requires the utilization of a lockout device on all energy isolating devices, which can be locked out, unless it can be demonstrated that a tagout device provides the equivalent amount of protection. If tagouts are authorized, they must be placed in the same location where the lock would be placed. All lockout/tagout devices shall be singularly identified, used only for controlling energy, durable, standardized, and identifiable.

6.3 Procedures

- **Prepare.** Notify affected personnel that work requiring lockout/tagout will be performed.

- **Shutdown.** Turn off or shut down the equipment by following an orderly shutdown procedure.

- **Isolation.** Locate and isolate the equipment energy isolating devices. Isolate equipment from both primary and secondary power sources.

- **Lockout/Tagout.** Lockout/tagout each energy isolating device in a "safe" or "off" position. If the tagout device is utilized, affix it at the same point where the lock would be used or as close as possible to that location.

- **Stored Energy.** Assure all potentially hazardous or residual energy is relieved or otherwise made safe. Make sure the stored energy will not reaccumulate by locking a vent valve in the open position.

- **Verify.** Verify proper isolation and/or de-energization by testing the start button to ensure that the equipment will not operate. Make sure you push the STOP button after activating the start button.

- **Perform Work.** After lockout/tagout procedures have been implemented, execute the maintenance and/or servicing work.

- **Release.** Ensure that all non-essential items (tools, etc.) have been removed and the equipment is operationally intact. Ensure that personnel are safely positioned and affected personnel have been notified.

- **Removal.** Only the authorized employee who applied the devices may remove lockout/tagout devices.

- **Notification.** Notify affected personnel that the maintenance and/or servicing is complete, the lockout/tagout devices have been removed, and the equipment is released for operation.

Testing or positioning may be required for some equipment. Before removing lockout/tagout devices, clear the machine, remove personnel, remove devices, energize, and proceed with testing. After testing, de-energize and reapply the lockout/tagout procedures.

Outside personnel, such as contractors, and RETEC personnel shall inform each other of their lockout/tagout procedures to assure all lockout/tagout procedures are complied with.

Some jobs may require lockout/tagout of numerous energy isolation devices. A group lockout/tagout is then used which provides equal protection. Group lockout/tagout must be under the primary responsibility of an authorized employee. Each group member must apply his/her own personal lockout/tagout device.

During shift changes, special procedures must be utilized to assure the continuity of lockout/tagout protection. There must be an orderly transfer between off-going and on-coming personnel.

7 Drilling Safety

Will this project require the use of a drill or direct push equipment rig for well installation and/or subsurface sampling?

No: ☒	Yes: ☐

If the answer to this question is **NO**, proceed to the next section. If the answer is **YES**, read this section and follow all procedures for safe work practices around a drill rig.

Note: Site Engineer or SSHO must complete the Drill Rig Inspection Log in Attachment K prior to the initiation of any drilling operations.

Accidents may occur during drilling activities. Hazards include: subsurface and overhead utilities, heavy machinery, heavy falling objects, slip/trip/fall, and potential flying debris. It is the Site Engineer/SSHO responsibility to ensure drilling activities are conducted safely. During the site safety meeting, the Site Engineer/SSHO should check that **all** of the following requirements are in place:

- Personnel are 40-Hour OSHA trained
- Personnel are current with 8-Hour Annual Refresher Training
- Personnel are enrolled in a medical monitoring program
- Personnel have been successfully fit-tested within the last 12 months
- Personnel are trained in drill rig safe operating practices
- Personnel are trained in First Aid/CPR
- Personnel are trained in emergency procedures
- Emergency telephone numbers are posted
- Personnel have received site orientation
- Personnel have reviewed the HASP

Every drill crew should have a designated safety supervisor who has authority to enforce safety on the drilling site.

Prior to the commencement of any drilling activities, the Site Engineer/SSHO must ensure the following:

PPE

- All drilling crewmembers are wearing appropriate PPE including, at a minimum: hard hat, safety shoes/boots, appropriate gloves, safety glasses, and any other PPE that may be required on a particular site.

- Clothing of drilling crew is close fitting without loose ends, straps, draw strings, belts, or other unfastened parts.
- Drilling crew is not wearing jewelry.

Housekeeping

- Suitable storage is used for tools, materials, and supplies.
- Pipes, drill rods, casings, augers, and other drilling tools are properly placed in racks or sills to prevent rolling and/or sliding.
- Penetration or other driving hammers are placed at a safe location on the ground and secure from moving.
- Work area, platforms, walkways, scaffolding, and other access ways are free of materials, debris, obstructions, and substances.
- All controls and control linkages, warning and operation lights, and lenses are free of oil and grease and/or ice.
- Gasoline is stored only in non-sparking red containers with a flame arrester in the fill spout and the word "gasoline" easily visible.

Maintenance

- The drill rig engine is shut down to make repairs and/or adjustments. Follow lockout/tagout procedures in Section 6.
- Wheels are blocked, leveling jacks are lowered, and hand breaks set before working under a drill rig.
- All pressure on hydraulics, fluid, and air systems, as appropriate, are released prior to performing maintenance.
- Personnel do not touch engine or exhaust systems immediately after a drilling operation.
- Personnel never climb the mast for maintenance or repairs.
- Personnel never weld or cut near fuel tank.
- Drill rig is kept well maintained with appropriate quantities and qualities of lubricants, hydraulic oils, etc.
- Filter plugs, guards, high-pressure hose clamps, chains, and cables that have been removed for maintenance are replaced.

Hand Tools

- All hand tools are kept in good condition.
- All damaged tools are either repaired or replaced immediately.
- Personnel must use the right tool for the right job.

Clear Work Area

- The site is adequately cleared and leveled prior to drilling to accommodate drill rig and supplies.
- Drainage is established to channel away drilling fluids or precipitation

Drilling Operations

- Drill rigs are not to be driven from hole to hole with derrick in raised position.
- Personnel must check for overhead obstruction before raising the derrick.
- The raised mast should be a minimum of one mast length from overhead power lines.
- Drill rig is leveled and stabilized with leveling jacks and/or sold cribbing before derrick is raised.
- Derrick is locked before initiating operations.
- Personnel only operate drill rig from position of controls.
- Exhaust fumes are vented out of area if drilling in a confined or enclosed area.
- Personnel should clean mud and grease from their boots before stepping onto the drill rig platform and use handholds and railings.
- Personnel do not touch any metal parts with exposed flesh during freezing weather.
- All unattended boreholes are adequately covered and marked.
- All operations are terminated during electrical storms.
- Personnel working on an elevated derrick platform must wear appropriate fall protection and attach the lifeline to the derrick just above the derrick platform to a solid structural derrick.

- When drilling in areas of high-level soil and groundwater impact using air rotary methods, ensure the following precautions are taken to avoid splashing workers and equipment with free-phase product or highly impacted groundwater which may "air lift" rapidly from the borehole:

  - Attempt to complete the boring to total depth without work stoppages which may allow liquids to accumulate in the boring (unless unsafe conditions arise).

  - Upgrade to modified Level D including polycoated Tyvek if impacted soil is expected or encountered.

  - Ensure the work zone is properly ventilated by positioning personnel and potential ignition sources upwind of the boring or utilizing engineering controls such as fans or blowers.

  - Use the minimum amount of air pressure necessary to evacuate cuttings from the boring once impacted soil is encountered.

- All tools are attached to derrick with safety lines.

- While working on a derrick platform, never guide drill rods or pipe into racks or other supports by taking hold of a moving hoist line or traveling block.

- Loose tools are never left on derrick platform.

- Personnel must use appropriate lifting techniques to prevent bodily injury.

Overhead and Buried Utilities

- All overhead and buried utilities are identified and located and noted on all boring location plans and boring assignment sheets.

Supplying Power to Job Site

- All wiring and fixtures used to provide electricity for drilling operations are installed by a qualified person in accordance with the National Electric Code (NFPA 70-1984) with consideration with the American Petroleum Institutes recommended practices for electrical installation for production facilities (API-RP-500 B).

- Ground fault protection should be used for all separators and remote power sources.

Contact with Electricity

- If a drilling rig or a drill rig carrier makes contact with overhead or underground electrical wiring, that the operator and the person in the seat of the vehicle remain seated and not leave the vehicle and not touch any part of the vehicle or drill rig.

- If personnel must evacuate the drill rig, they must jump clear, as far as possible, and land with both feet together, and then hop from the scene.

Safety Operating Practices

- There exists a system of responsibility between the operator and the tool handler when connecting and disconnecting auger sections.

- Handler stands away from rotating auger when connecting and disconnecting auger sections.

- A pin is inserted and tapped in place, using a hammer or similar device, when securing the augur to a power coupling.

- A tool hoist is used when lowering second section of auger into place.

- Both operators stand clear of auger as it is being lifted into place.

- Long-handled shovels are used to move dirt away from auger.

- No attempt shall be made to exceed manufacturers' ratings of speed, force, torque, pressure, flow, etc. The drill rig and tools are to be used only for the purposes for which they are intended and designed.

- Soil and mud are cleaned from rotating augers using appropriate tools and not by hand.

Attachment A

Site Safety Plan Amendments

PLEASE USE THIS DOCUMENT TO MAKE ANY CHANGES TO THE HEALTH AND SAFETY PLAN

Site Safety Plan Amendments

Amendment No.:_____

Client:	**Project Number:**
Location:	**Date:**
Project Manger:	**Site Engineer:**
Site H&S Officer:	
Amendment:	
Reason for Amendment:	
Alternative Safeguard Procedures:	
Required Changes in PPE:	

_____ _____

Site Health and Safety Officer **Date**

_____ _____

EH&S Director **Effective Date**

Attachment B

Site Safety Plan Acknowledgment Form

Site Safety Plan
Acknowledgment Form

I have been informed, understand, and will abide by all the procedures and protocols set forth in this Site Health and Safety Plan for the _____ site.

Project Number:_____

Name(Print)	Signature	Affiliation	Date

Attachment C

Visitor Sign-In Log

Visitor Sign-In Log

Client:_____ **Project Number:**_____

Location:_____ **Site Engr.:**_____

Project Mgr.:_____ **Site H&S Officer:**_____

Date	Name	Affiliation	Purpose of Visit	Site H&S Training		Do you have Level D PPE?		Time In	Time Out
				Yes	No	Yes	No		

Attachment D
Site Safety Meeting Form

Our behavior-based safety process is the key to our success!

Site Safety Meeting

Project Name:_____ **Location:**_____
Date:_____ **Time:**_____
Project Number:_____ **Instructor:**_____

Safety Topics Presented

Planned Activities:_____

Special Permits Required
_____UST Removal
_____Confined Entry
_____Other:

Status
_____

Personal Protective Equipment:_____

Chemical Hazards:_____

Other:_____

Name	Attendee's Signatures

Attachment E

Notification of Access to Employee Exposure and Medical Records

Notice

To All Employees: This Notice Is to Provide Information for Compliance with 29 CFR Part 1910 Subpart C - General Safety and Health Provisions - Paragraph 1910.1020, Access to Employee Exposure and Medical Records.

(i) The existence, location, and availability of any records covered by this section is as follows:

RETEC Consulting Corporation
3040 William Pitt Way
Pittsburgh, Pennsylvania 15238
Attn: Tina McHugh
Environmental Health and Safety Program Administrator

(ii) The Person responsible for maintaining and providing access to these records is RETEC's Corporate Health and Safety Program Administrator.

(iii) Each employee has the right to access these records.

(iv) A copy of this standard and its appendices are available to all affected employees at each RETEC office location.

For More Information or Questions Contact:

Ms. Tina L. McHugh
Corporate Health and Safety Program Administrator
(412) 380-0140

Attachment F

Cold Stress

Cold Stress

These Threshold Limit Values (TLVs) are intended to protect workers from the severe effects of cold stress (hypothermia) and cold injury and to describe exposures to cold working conditions under which it is believed that nearly all workers can be repeatedly exposed without adverse health effects. The TLV objective is to prevent the deep body core temperature from falling below 36°C and to prevent cold injury to body extremities. Deep body temperature is the core temperature of the body as determined by rectal temperature measurements. For a single, occasional exposure to a cold environment, a drop in core temperature to no lower than 35°C should be permitted. In addition to provisions for total body protection, TLV objective is to protect all parts of the body with emphasis on hands, feet, and head from cold injury.

Introduction

Fatal exposures to cold among workers have almost always resulted from accidental exposures involving failure to escape from low environmental air temperatures or from immersion in low temperature water. The single most important aspect of life-threatening hypothermia is the fall in the deep core temperature of the body. The clinical presentations of victims of hypothermia are shown in Table 1 (taken from Dembert in AFP, January 1982). Workmen should be protected from exposure to cold so that the deep core temperature does not fall below 36°C (96.8°F); lower body temperatures will very likely result in reduced mental alertness, reduction in rational decision-making, or loss of consciousness with the threat of fatal consequences.

Pain in the extremities may be the first early warning of danger to cold stress. During exposure to cold, maximum severe shivering develops when the body temperature has fallen to 35°C (95°F). This must be taken as a sign of danger to the workers and exposure to cold should be immediately terminated for any workers when severe shivering becomes evident. Useful physical or mental work is limited when severe shivering occurs.

Since prolonged exposure to cold air or to immersion in cold water in temperatures well above freezing can lead to dangerous hypothermia, whole body protection must be provided.

1. Adequate insulating clothing to maintain core temperatures above 36°C must be provided to workers if work is performed in air temperatures below 4°C (40°F). Wind chill factor[1] or the cooling power of the air is a critical factor. An equivalent chill temperature chart relating the actual dry bulb air temperature and the wind velocity is presented in Table 2. The equivalent chill temperatures on exposed skin are determined by estimating the combined cooling effect of wind and low air temperatures.

[1]Wind chill factor is a unit of heat loss from a body defined in watts per meter squared per hour being a function of the air temperature and wind velocity upon the exposed body.

2. Unless there are unusual or extenuating circumstances, cold injury to other than hands, feet, and head is not likely to occur without the development of the initial signs of hypothermia. Older workers or workers with circulatory problems require special precautionary protection against cold injury. The use of extra insulating clothing and/or a reduction in the duration of the exposure period are among the special precautions which should be considered. The precautionary action to be taken will depend upon the physical condition of the worker and should be determined with the advice of a physician with knowledge of the cold stress factors and the medical condition of the worker.

Evaluation and Control

For exposed skin, continuous exposure should not be permitted when the air speed and temperature result in an equivalent chill temperature of -32°C (-25°F). Superficial or deep local tissue freezing will occur only at temperatures below -1°C regardless of wind speed.

At air temperatures of 2°C (35.6°F) or less, it is imperative that workers who become immersed in water or whose clothing becomes wet be immediately provided a change of clothing and be treated for hypothermia.

Table 1 Progress Clinical Presentations of Hypothermia[2]

Core Temperature		Clinical Signs
°C	°F	
37.6	99.6	"Normal" rectal temperature
37.0	98.6	"Normal" oral temperature
36.0	96.8	Metabolic rate increases in an attempt to compensate for heat loss
35.0	95.0	Maximum shivering
34.0	93.2	Victim conscious and responsive, with normal blood
33.0	91.4	Severe hypothermia below this temperature
32.0 31.0	89.6 87.8	Consciousness clouded; blood pressure becomes difficult to obtain; pupils dilated but react to light; shivering ceases
30.0 29.0	86.0 84.2	Progressive loss of consciousness; muscular rigidity increases; pulse and blood pressure difficult to obtain; respiratory rate decreases
28.0	82.4	Ventricular fibrillation possible with myocardial irritability
27.0	80.6	Voluntary motion ceases; pupils non-reactive to light; deep tendon and superficial reflexes absent
26.0	78.8	Victim seldom conscious
25.0	77.0	Ventricular fibrillation may occur spontaneously
24.0	75.2	Pulmonary edema
22.0 21.0	71.6 69.8	Maximum risk of ventricular fibrillation
20.0	68.0	Cardiac standstill
18.0	64.4	Lowest accidental hypothermia victim to recover
17.0	62.6	Isoelectric electroencephalogram
9.0	48.2	Lowest artificially cooled hypothermia patient to recover

[2]Presentations approximately related to core temperature. Reprinted from the January 1982 issue of American Family Physician published by the American Academy of Fandly Physicians.

Table 2 Cooling Power of Wind on Exposed Flesh Expressed as Equivalent Temperature (under calm conditions)

Est. Wind Speed (mph)	Actual Temperature Reading (°F)											
	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
	Equivalent Chill Temperature (°F)											
Calm	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-68
10	40	28	16	4	-9	-24	-33	-46	-58	-70	-83	-95
15	36	22	9	-5	-18	-32	-45	-58	-72	-85	-99	-112
20	32	18	4	-10	-25	-39	-53	-67	-82	-96	-110	-131
25	30	16	0	-15	-29	-44	-59	-74	-88	-104	-118	-133
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109	-125	-140
35	27	11	-4	-20	-35	-51	-67	-82	-98	-113	-129	-145
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-148
(Wind speeds greater than 40 mph have little additional effect).	**Little Danger** In < 1 hr. with dry skin. Maximum danger of false sense of security.				**Increasing Danger** Danger from freezing of exposed flesh within one minute.			**Greater Danger** Flesh may freeze within 30 seconds.				
	Trench foot and immersion foot may occur at any point on this chart.											

Note:
Developed by U.S. Army Research Institute of Environmental Medicine, Natick, MA.

Recommended limits for properly clothed workers for periods of work at temperatures below freezing are shown in Table 3. Special protection of the hands is required to maintain manual dexterity for the prevention of accidents:

1. If fine work is to be performed with bare hands for more than 10-20 minutes in an environment below 16°C (60°F), special provisions should be established for keeping the workers' hands warm. For this purpose, warm air jets, radiant heaters (fuel burner or electric radiator), or contact warm plates may be utilized. Metal handles of tools and control bars shall be covered by thermal insulating material at temperatures below -1°C (30°F).

To prevent contact frostbite, the workers should wear anti-contact gloves.

1. When cold surfaces below -7°C (20°F) are within reach, a warning should be given to each worker by his supervisor to prevent inadvertent contact by skin.

2. If the air temperature is -17.5°C (9°F) or less, the hands should be protected by mittens. Machine controls and tools for use in cold conditions should be designed so that they can be handled without removing the mittens.

Provisions for additional total body protection are required if work is performed in an environment at or below 4°C (40°F). The workers shall wear cold protective clothing appropriate for the level of cold and physical activity:

1. If the air velocity at the job site is increased by wind, draft, or artificial ventilating equipment, the cooling effect of the wind shall be reduced by shielding the work area, or by wearing an easily removable outer windbreak layer garment. Wind chill cooling rates are illustrated in Table 4.

2. If only light work is involved and if the clothing on the worker may become wet on the job site, the outer layer of the clothing used may be of a type impermeable to water. With more severe work under such conditions, the outer layer should be water repellent and the outerwear should be changed as it becomes wet. The outer garments must include provisions for easy ventilation in order to prevent wetting of inner layers by sweat. If work is done at normal temperatures or in a hot environment before entering the cold area, and the clothing is wet, the employee shall change into dry clothes before entering the cold area. The workers shall change socks and any removable felt insoles at regular daily intervals or use vapor barrier boots. The optimal frequency of change shall be determined empirically and will vary individually and according to the type shoe worn and how much the individual's feet sweat.

3. If extremities, ears, toes, and nose cannot be protected sufficiently to prevent sensation of excessive cold or frostbite by handwear, footwear, and facemasks, these protective items shall be supplied in auxiliary heated versions.

4. If the available clothing does not give adequate protection to prevent hypothermia or frostbite, work shall be modified or suspended until adequate clothing is made available or until weather conditions improve.

5. Workers handling evaporative liquid (gasoline, alcohol, or cleaning fluids) at air temperature below 4°C (40°F) shall take special precautions to avoid soaking of clothing or gloves with the liquids because of the added danger of cold injury due to evaporative cooling. Special note should be taken of the particularly acute effects of splashes of "cryogenic fluids" or those liquids with a boiling point only just above ambient temperatures.

Table 3 Threshold Limit Values Work/Warm-up Schedule for Four-Hour Shift

Air Temp – Sunny Sky		Non-Noticeable Wind		5 mph Wind		10 mph Wind		15 mph Wind		20 mph Wind	
°C	°F	Max. Work Period (min.)	No. of Breaks	Max. Work Period (min.)	No. of Breaks	Max. Work Period (min.)	No. of Breaks	Max. Work Period (min.)	No. of Breaks	Max. Work Period (min.)	No. of Breaks
-26° to -28°	-15° to -1°	Normal Breaks		Normal Breaks		75	2	55	3	40	4
-29° to -31°	-20° to -24°	Normal Breaks		75	2	55	3	40	4	30	5
-32° to -34°	-25° to -29°	75	2	55	3	40	4	30	5	Non-emergency work should cease	
-35° to -37°	-30° to -34°	55	3	40	4	30	5	Non-emergency work should cease			
-38° to -39°	-35° to -39°	40	4	30	5	Non-emergency work should cease					
-40° to -42°	-40° to -44°	30	5	Non-emergency work should cease							
-43° & below	-45° & below	Non-emergency work should cease									

Notes:

1. Schedule applies to moderate-to-heavy work activity with warm-up breaks of ten (10) minutes in a warm location. For light-to-moderate work (limited physical movement): apply the schedule one step lower. For example, at 30°F with no noticeable wind (Step 4), a worker at a job with little physical movement should have a maximum work period of 40 minutes with 4 breaks in a 4-hour period (5).

2. The following is suggested as a guide for estimating wind velocity if accurate information is not available: 5 mph - light flag moves; 10 mph - light flag fully extended; 15 mph - raises newspaper sheet; 20 mph - blowing and drifting snow.

3. If only the wind chill cooling rate is available, a rough rule of thumb for applying it rather than the temperature and wind velocity factors given above would be:
   (1) special warm-up breaks should be initiated at a wind chill of about 1720 Wm/2
   (2) all non-emergency work should have ceased at or before a wind chill of 2250 W/m2.

   In general, the warm-up schedule provided above slightly under-compensates for the wind at the warmer temperatures, assuming acclimatization and clothing appropriate for winter work. On the other hand, the chart slightly over-compensates for the actual temperatures in the colder ranges, since windy conditions rarely prevail at extremely low temperatures.

   Adapted from Occupational Health & Safety Division, Saskatchewan Department of Labor.

Table 4 Wind Chill Cooling Rate Effects*

Wind Chill Rates (Watts/m^3)	Comments/Effects
700	Conditions considered comfortable when dressed skiing.
1200	Conditions no longer pleasant for outdoor activities on overcast days.
1400	Conditions no longer pleasant for outdoor activities on sunny days.
1600	Freezing of exposed skin begins for most people depending on the degree of activity and the amount of sunshine.
2300	Conditions for outdoor travel such as walking become dangerous. Exposed areas of the face freeze in less than 1 minute for the average person.
2700	Exposed flesh will freeze within half a minute for the average person.

**Adapted from Canadian Department of the Environment, Atmospheric Environment Service.*

Work-Warming Regimen

If work is performed continuously in the cold at an equivalent chill temperature (ECT) or below -7°C (20°F), heated warming shelters (tents, cabins, rest rooms, etc.) shall be made available nearby and the workers should be encouraged to use these shelters at regular intervals, the frequency depending on the severity of the environmental exposure. The onset of heavy shivering, frostbite, the feeling of excessive fatigue, drowsiness, irritability, or euphoria are indications for the immediate return to the shelter. When entering the heated shelter, the outer layer of clothing shall be removed and the remainder of the clothing loosened to permit sweat evaporation. Also, a change of dry work clothing may be provided. A change of dry work clothing shall be provided as necessary to prevent workers from returning to their work with wet clothing. Dehydration, or the loss of body fluids, occurs insidiously in the cold environment and may increase the susceptibility of the worker to cold injury due to a significant change in blood flow to the extremities. Warm sweet drinks and soups should be provided at the work site to provide caloric intake and fluid volume. The intake of coffee should be limited because of the diuretic and circulatory effects.

For work practices at or below -12°C (10°F) ECT, the following shall apply:

1. The worker shall be under constant protective observation (buddy system or supervision).

2. The work rate should not be so high as to cause heavy sweating that will result in wet clothing; if heavy work must be done, rest periods must be taken in heated shelters and opportunity for changing into dry clothing shall be provided.

3. New employees shall not be required to work full time in cold in the first days until they become accustomed to the working conditions and required protective clothing.

4. The weight and bulkiness of clothing shall be included in estimating the required work performance and weights to be lifted by the worker.

5. The work shall be arranged in such a way that sitting still or standing still for long periods is minimized. Unprotected metal chair seats shall not be used. The worker should be protected from drafts to the greatest extent possible.

6. The workers shall be instructed in safety and health procedures. The training program shall include, as a minimum, instruction in:

   a) Proper re-warming procedures and appropriate first aid treatment.

   b) Proper clothing practices.

   c) Proper eating and drinking habits.

   d) Recognition of impending frostbite.

   e) Recognition of signs and symptoms of impending hypothermia or excessive cooling of body even when shivering does not occur.

   f) Safe work practices.

Special Workplace Recommendations

Special design requirements for refrigerator rooms include the following:

1. In refrigerator rooms, the air velocity should be minimized as much as possible and should not exceed 1 meter/sec. (200 fpm) at the job site. This can be achieved by properly designed air distribution systems.

2. Special wind-protective clothing shall be provided based upon existing air velocities to which workers are exposed.

Special caution shall be exercised when working with toxic substances and when workers are exposed to vibration. Cold exposure may require reduced exposure limits.

Eye protection for workers employed outdoors in a snow and/or ice-covered terrain shall be supplied. Special safety goggles to protect against ultraviolet light and glare (which can produce temporary conjunctivitis and/or temporary loss of vision) and blowing ice crystals are required when there is an expanse of snow coverage causing a potential eye exposure hazard.

Workplace monitoring is required as follows:

1. Suitable thermometry should be arranged at any workplace where the environmental temperature is below 16°C (60°F) to enable overall compliance with the requirements of the TLV to be maintained.

2. Whenever the air temperature at a workplace falls below -1°C (30°F), the dry bulb temperature should be measured and recorded at least every 4 hours.

3. In an indoor workplace, the wind speed should also be recorded at least every 2 hours whenever the rate of air movement exceeds 2 meters per second (5 mph).

4. In an outdoor work situation, the wind speed should be measured and recorded together with the air temperature whenever the air temperature is below -1°C (30°F).

5. The equivalent chill temperature shall be recorded with the other data whenever the equivalent chill temperature is below -7°C (20°F).

Employees shall be excluded from work in cold at -1°C (30°F) or below if they are suffering from diseases or taking medication which interferes with normal body temperature regulation or reduces tolerance to work in cold environments. Workers who are routinely exposed to temperatures below -24°C (-10°F) with wind speeds less than five miles per hour should be medically certified as suitable for such exposures.

Trauma sustained in freezing or subzero conditions requires special attention because an injured worker is predisposed to secondary cold injury. Special provisions must be made to prevent hypothermia and secondary freezing of damaged tissues, in addition to providing first aid treatment.

Attachment G

Heat Stress and Other Physiological Factors

Heat Stress

Wearing PPE puts a hazardous waste worker at considerable risk of developing heat stress. This can result in health effects ranging from transient heat and fatigue to serious illness or death. Heat stress is caused by a number of interacting factors, including environmental conditions, clothing, workload, and the individual characteristics of the worker. Because heat stress is probably one of most common (and potentially serious) illnesses at hazardous wastes sites, regular monitoring and other preventative precautions are vital.

Individuals vary in their susceptibility to heat stress. Factors that may predispose someone to heat stress include:

- Lack of physical fitness
- Lack of acclimatization
- Age
- Dehydration
- Obesity
- Alcohol and drug use
- Infection
- Sunburn
- Diarrhea
- Chronic disease

Reduced work tolerance and the increased risk of excessive heat stress is directly influenced by the amount and type of PPE worn. PPE adds weight and bulk, severely reduces the body's access to normal heat exchange mechanisms (evaporation, convection, and radiation), and increases energy expenditure. Therefore, when selecting PPE, each item's benefit should be carefully evaluated in relation to its potential for increasing the risk of heat stress. Once PPE is selected, the safe duration of work/rest periods should be determined based on the following:

- Anticipated work rate
- Ambient temperature and other environmental factors
- Type of protective ensemble
- Individual worker characteristics and fitness

Monitoring

Because the incidence of heat stress depends on a variety of factors, all workers, even those not wearing protective equipment, should be monitored.

- For workers wearing permeable clothing (e.g., standard cotton or synthetic work clothes), follow recommendations for monitoring requirements and suggested work/rest schedules in the current American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values for Heat Stress. If the actual work clothing differs from the ACGIH standard ensemble in insulation value and/or wind and vapor permeability, change the monitoring requirements and work/rest schedules accordingly.

- For workers wearing semi-permeable or impermeable[1] encapsulating ensembles, the ACGIH standard cannot be used. For these situations, workers should be monitored when the temperature in the work area is above 70°F (21°C).

To monitor the worker, measure the following:

- **Heart Rate.** Count the radial pulse during a 30-second period as early as possible in the rest period.

  If the heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle by one-third and keep the rest period the same.

  If the heart rate still exceeds 110 beats per minute at the next rest period, shorten the following work cycle by one-third.

- **Oral Temperature.** Use a clinical thermometer (3 minutes under the tongue) or similar device to measure the oral temperature at the end of the work period (before drinking).

  If the oral temperature exceeds 99.6°F (37.7°C) at the beginning of the next rest period, shorten the following work cycle by one-third.

  Do not permit a worker to wear a semi-permeable or impermeable garment when his/her oral temperature exceeds 100.6°F (38.1°C).

- **Body Water Loss, If Possible.** Measure weight on a scale accurate to +0.25 lb at the beginning and end of each work day to see if enough fluids are being taken to prevent dehydration. Weights should be taken while the employee wears similar clothing. The body water loss should not exceed 1.5 percent total body weight loss in a workday.

Initially, the frequency of physiological monitoring depends on the air temperature adjusted for solar radiation and the level of physical work (see Table 1). The length of the work cycle will be governed by the frequency of the required physiological monitoring.

[1]Although no protective ensemble is "completely" impermeable, for practical purposes an outfit may be considered impermeable when calculating heat stress risk.

Table 1 Suggested Frequency of Physiological Monitoring for Fit and Acclimatized Workers[2]

Adjusted Temperature[3]		Normal Ensemble[4]	Impermeable Ensemble
°F	°C		
90 or above	32.2 or above	After each 45 minutes of work	After each 15 minutes of work
87.5 – 90	30.8 – 32.2	After each 60 minutes of work	After each 30 minutes of work
87.5 – 85.5	28.1 – 30.8	After each 90 minutes of work	After each 60 minutes of work
77.5 – 82.5	25.3 – 28.1	After each 120 minutes of work	After each 90 minutes of work
72.5 – 77.5	22.5 – 25.3	After each 150 minutes of work	After each 120 minutes of work

[2]For work levels of 250 Kilocalories/hour.

[3]Calculate the adjusted air temperature (ta adj) using this equation: ta adj = ta ° = (13 + % sunshine). Measure air temp. (ta) with a standard thermometer, with the bulb shielded from radiant heat. Estimate percent sunshine by judging what percent time the sun is not covered by clouds that are thick enough to produce a shadow. (100 percent sunshine = no cloud cover and a sharp, distant shadow, 0 percent sunshine = no shadows).

[4]*A normal work ensemble consists of cotton coveralls or other cotton clothing with long sleeves and pants.*

Prevention

Proper training and preventive measures will help avert serious illness and decrease in productivity. Preventing heat stress is particularly important because once someone suffers from heat stroke or heat exhaustion, the person may be predisposed to additional heat injuries. To avoid heat stress, management should take the following steps.

- Adjust work schedules:
  - Modify work/rest schedules according to monitoring requirements.
  - Mandate work slowdowns as needed.
  - Rotate personnel: alternate job functions to minimize overstress or overexertion at one task.
  - Add additional personnel to work teams.
  - Perform work during cooler hours of the day, if possible, or at night, if adequate lighting can be provided.
  - Provide shelter (air-conditioned, if possible) or shaded areas to protect personnel during rest periods.

- Maintain workers' body fluids at normal levels. This is necessary to ensure that the cardiovascular system functions adequately. Daily fluid intake must approximately equal the amount of water lost in sweat. The normal thirst mechanism is not sensitive enough to ensure that enough water will be drunk to replace lost water. When heavy sweating occurs, encourage the worker to drink more. The following strategies may be useful:
  - Maintain water temperature at 50° to 60°F (10° to 15.6°C).
  - Provide small disposable cups that hold about 4 ounces (0.1 liter).
  - Have workers drink 16 ounces (0.5 liters) of fluid (preferably water or diluted drinks) before beginning work.
  - Urge workers to drink a cup or two every 15 to 20 minutes, or at each monitoring break. A total of 1 to 1.6 gallons (4 to 6 liters) of fluid per day are recommended, but more may be necessary to maintain body weight.
  - Weigh workers before and after work to determine if fluid replacement is adequate.
- Provide cooling devices to aid natural body heat exchange during prolonged work or severe heat exposure. Cooling devices include:
  - Field showers or hose-down areas to reduce body temperature and/or to cool off protective clothing.
  - Cooling jackets, vests, or suits.
- Train workers to recognize and treat heat stress. As part of training, identify the signs and symptoms of heat stress.

Other Factors

PPE decreases worker performance as compared to an unequipped individual. The magnitude of this effect varies considerably, depending on both the individual and the PPE ensemble used. This section discusses the demonstrated physiological responses to PPE, the individual human traits that play a factor in these responses, and some of the precautionary and training measures that need to be taken to avoid PPE-induced injury.

The physiological factors which may affect worker ability to function using PPE include:

- Physical condition
- Level of acclimatization
- Age
- Gender
- Weight

Physical Condition. Physical fitness is a major factor influencing a person's ability to perform work under heat stress. The more fit someone is, the more work they can safely perform. At a given level of work a fit person, relative to an unfit person, will have:

- Less physiological strain
- A lower heart rate
- A lower body temperature, which indicates less retained body heat (a rise in internal temperature precipitates heat injury)
- A more efficient sweating mechanism
- Slightly lower oxygen consumption
- Slightly lower carbon dioxide production

Level of Acclimatization. The degree to which a worker's body has physiologically adjusted or acclimatized to working under hot conditions affects his or her ability to do work. Acclimatized individuals generally have lower heart rates and body temperatures than non-acclimatized individuals and sweat sooner and more profusely. This enables them to maintain lower skin and body temperatures at a given level of environmental heat and work loads than non-acclimatized workers. Sweat composition also becomes more dilute with acclimatization, which reduces salt loss.

Acclimatization can occur after just a few days of exposure to a hot environment. NIOSH recommends a progressive 6-day acclimatization period for the non-acclimatized worker before allowing him/her to do full work on a hot job. Under this regimen, the first day of work on site is begun using only 50 percent of the anticipated workload and exposure time, and is increased slowly over the next several days. If the workers can acclimatize quickly, this period may be shortened by two or three days. If this period includes time off, however, workers can lose acclimatization in a matter of days, and work regimens should be adjusted taking this into account.

When enclosed in an impermeable suit, fit-acclimatized individuals sweat more profusely than un-fit or non-acclimatized individuals and may, therefore, actually face a greater danger of heat exhaustion due to rapid dehydration. Consuming adequate quantities of water can prevent this. See previous section on prevention for additional information.

Age. Generally, maximum work capacity declines with increasing age, but this is not always the case. Active, well-conditioned seniors often have performance capabilities equal to or greater than young sedentary individuals. However, there is some evidence, indicated by lower sweat rate and higher body core temperatures, that older individuals are less effective in compensating for a given level of environmental heat and work load. At moderate thermal loads, however, the physiological responses of "young" and "old" are similar and performance is not affected.

Age should not be the sole criterion for judging whether or not an individual should be subjected to moderate heat stress. Fitness level is a more important factor.

Gender. The literature indicates that women tolerate heat stress at least as well as their male counterparts. Generally, a woman's work capacity averages 10 to 30 percent less than that of a man. The primary reasons for this are the greater oxygen-carrying capacity and the stronger heart in the male. However, a similar situation exists as with aging: not all men have greater work capacities than all women.

Weight. The ability of a body to dissipate heat depends on the ratio of its surface area to its mass (surface area/weight). Heat loss (dissipation) is a function of surface area and heat production is dependent on mass. Therefore, heat balance is described by the ratio of the two.

Since overweight individuals (those with a low ratio) produce more heat per units of surface area than thin individuals (those with a high ratio), overweight individuals should be given special consideration in heat stress situations. However, when wearing impermeable clothing, the weight of an individual is not a critical factor in determining the ability to dissipate excess heat.

Signs and Symptoms of Heat Stress

- Heat rash may result from continuous exposure to heat or humid air.
- Heavy sweating with inadequate electrolyte replacement causes heat cramps. Signs and symptoms include:
  - Muscle spasms
  - Pain in the hands, feet, and abdomen
- Heat exhaustion occurs from increased stress on various body organs including inadequate blood circulation due to cardiovascular insufficiency or dehydration. Signs and symptoms include:
  - Pale, cool, moist skin
  - Heavy sweating
  - Dizziness
  - Nausea
  - Fainting
- Heat stroke is the most serious form of heat stress. Temperature regulation fails and the body temperature rises to critical levels. immediate action must be taken to cool the body before serious injury and death occurs. Competent medical help must be obtained. Signs and symptoms are:
  - Red, hot, usually dry skin
  - Lack of or reduced perspiration
  - Nausea
  - Dizziness and confusion
  - Strong, rapid pulse
  - Coma

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Attachment H

EHS Incident Report

RETEC

EHS Incident Report

Section One: Background Information

Your Name	_____	Today's Date	_____
Project Name	_____	Site Name	_____
Project Manager	_____	Project Number	_____

Were there any witnesses to the incident? ☐Yes ☐No

If yes, list name(s)/office locations (including subcontractors):

_____

_____

Was weather a factor? (Check one) ☐Yes ☐No

If yes, please describe weather conditions:

_____

_____

_____

Section Two: Injury, Illness and Exposure

Was there an injury, illness or exposure associated with this incident?

☐ Yes ☐ No

If yes, please complete this section.
If no, please proceed to Section Three.

Name of Injured:	_____	Job Title:	_____
Male/Female:	_____	Date of Hire:	_____
Date of Birth:	_____	SSN:	_____
Date/Time of Injury/Exposure:	_____	Time Employee Began Work:	_____
Supervisor:	_____	H&S Coordinator:	_____
Log Number:	_____	SSN:	_____

Employee's Home Address: _____

_____

_____

NOTE: the Occupational Safety and Health Administration requires the above information for regulatory reporting.

Where did the incident occur (place name, address)?

_____

_____

_____

_____

Please describe the incident:

_____

_____

_____

_____

_____

_____

Was injured person/persons using required PPE? (Circle one) ☐Yes ☐No

Were there any unsafe conditions at the time of the incident? (Check one) ☐Yes ☐No

If yes, please describe:

_____

_____

_____

_____

Please describe what the employee was doing just before the incident (was there an unsafe act involved?):

_____

_____

_____

_____

_____

What was the severity of the injury / exposure (please check):

☐First Aid Only ☐Medical Treatment- Only ☐Fatality ☐Non-Occupational

What was the nature of the injury / exposure (please check):

☐Fractures	☐Blisters	☐Heat Exhaustion	☐Dislocations
☐Respiratory Allergy	☐Toxic Respiratory	☐ Exposure	☐Concussion
☐Heat Burns	☐Toxic Ingestion	☐Faint/Dizziness	☐Abrasions
☐Chemical Burns	☐Cold Exposure	☐Toxic Respiratory	☐Lacerations
☐Radiation Burns	☐Frostbite	☐Dermal Allergy	☐Punctures
☐Bruises	☐Heatstroke	☐Ergonomic	☐Sprains
☐Bites	☐Other:		

Parts of Body Affected (Specify Right/Left): _____

Date medical care was received: _____

Was employee taken to the emergency room? ☐Yes ☐ No

Was employee hospitalized overnight as an in-patient? ☐Yes ☐ No

Facility Where Medical Care Was Received:

Clinic/Hospital Name: _____

Name of Attending Physician: _____

Clinic/Hospital Address: _____

Clinic/Hospital Telephone Number: _____

Section Three: Environmental Incident

Did one of the following occur: a spill to land over one quart, any spills to surface water, a significant release to the air, a violation of permit conditions, receipt of a Notice of Violation, or an event that causes potentially significant damage to the environment?

☐ Yes ☐ No

Did a RETEC employee directly contribute to the incident?

☐ Yes ☐ No

If yes to both, please complete this section.
If no to either, the incident is not required to be reported to the RETEC EHS Department. Continue to Section Four.

What type of environmental incident occurred?

☐Spill to Land ☐Spill to Water ☐Release to Air ☐Permit Violation ☐Notice of Violation ☐Other

If other, specify:

Please describe the incident in detail:

If the incident was a spill or release, what material was involved and what amount?

Was there a violation of permit limits associated with the incident? ☐Yes ☐No

If yes, list permits and issuing agencies

_____

_____

_____

_____

Were the required regulatory agencies notified? ☐Yes ☐No

If yes, which agencies were notified?

_____

_____

_____

Section Four: Property Damage / Loss

Did the damage exceed $500.00

☐ Yes ☐ No

If yes, please complete this section.
If no to either, the incident is not required to be reported to the RETEC EHS Department. Continue to Section Five.

What type of loss and/or property damage occurred?

☐Equipment Failure ☐Collision ☐Contamination ☐Weather ☐Fire ☐Vandalism/Theft ☐Other

If other, specify:

Describe the incident of loss or damaged property in detail (RETEC):

Describe the incident of loss or damage of property in detail (3rd Party):

sWas a RETEC insurance representative contacted? ☐Yes ☐No

If yes, list name of agent and time

What was the approximate cost of the loss / property damage?

Please proceed to Section Five.

Section Five: Analysis and Corrective Action

Were there any behavioral factors that contributed to the incident? (Check one) ☐Yes ☐No

If yes, please describe (describe any unsafe acts or conditions):

_____

_____

_____

_____

What can be done to prevent a recurrence of this type of incident?

_____

_____

_____

_____

List corrective actions that were taken to prevent this type of incident in the future:

_____

_____

_____

Person Responsible for taking corrective action: _____

Forward this form within 24 hours to the following:

☐Health and Safety Department - Monroeville
☐Regional Manager - Local
☐Operations Manager – Local
☐Health and Safety Coordinator – Local

_____ _____
Employee's Signature Date

_____ _____
Employee's Supervisor Signature Date

PROJECT MANAGERS ARE REQUIRED TO SUBMIT A ROOT CAUSE ANALYSIS FOR ALL INCIDENTS.

Attachment I

Ground Disturbance Permit

GROUND DISTURBANCE PERMIT

Location: _____
(legal description)

Permit Duration: Date: _____ Time Initiated: _____ AM ☐ PM ☐
Time Expired: _____ AM ☐ PM ☐

Company Representative: _____ Phone # _____
Emergency Phone Number: _____ Additional Number _____
Receive "One-Call" Notification: Date: _____ Time: _____ AM ☐ PM ☐
Location Request Number: _____
Company Requesting Line Location: _____ Phone # _____
Contractor Performing Work: _____
Description of Work to be Performed: _____

PLEASE INDICATE STATUS OF ITEMS 1 THROUGH 10

1.	One-Call has been notified and contacts have been made to determine the existence and location of underground facilities and utilities in the vicinity of work area.	YES ☐	NO ☐	
2.	Available records have been referenced and a plot plan or drawing indicating the location of all underground facilities and utilities have been provided and is available for reference at the worksite.	YES ☐	NO ☐	
3.	All pipeline regulations and Site-Specific Health and Safety Plan guidance applicable to area are followed.	YES ☐	NO ☐	
4.	A pre-job safety meeting, including a Safety Task Analysis Review (STAR), has been conducted by the Qualified Person (including noting nearest pipeline isolation valves nearest the ground disturbance area).	YES ☐	NO ☐	
5.	All proposed ground disturbance areas have been identified and marked.	FLAGS ☐	PAINT ☐	Other ☐
6.	Ground Disturbance Procedures have been followed to identify all known facilities and utilities as noted on the plot plan, pipeline maps or drawing that pass within the controlled area of the ground disturbance (within 2 ft of both sides). All utilities or facilities have been exposed as needed.	YES ☐	NO ☐	
7.	Other Safe Work Permits, as applicable, have been issued. (Ref.: Confined Space, Lockout, Hot Work, etc.)	YES ☐	NO ☐	NA ☐
8	Precautions have been taken to prevent contact with overhead power lines and "**guy-wires**".	YES ☐	NO ☐	NA ☐
9	All environmental concerns have been discussed and applicable permits and plans have been obtained.	YES ☐	NO ☐	NA ☐
10	Has appropriate internal communication (e.g., Project Manager) taken place?	YES ☐	NO ☐	

This permit shall be regarded as "void" and must be re-issued if the permit expires.

For any permit question that is not answered as "Yes" or "NA", justification for proceeding with ground disturbance activities must be documented

Additional comments, instructions or requirements:

The provisions of this permit have been discussed with Contract Company's Representative responsible for ground disturbance.

(Printed Name)

(Signature) (Date)
Designated Qualified Person
responsible for ground disturbance

The requirements of this permit have been discussed with me and I agree to abide by its requirements.

(Printed Name)

(Signature) (Date)
Contract Company Representative
responsible for ground disturbance

Attachment J

Near-Miss Incident Report

Near-Miss Incident Report

Name:_____ **Date of Near Miss:**_____

Client:_____ **Project Number:**_____

Did this incident involve an Environmental Near-Miss? ☐ Yes ☐ No

I witnessed a near-accident this day at:_____

Was appropriate PPE being worn?: ☐ Yes ☐ No

The following is an account of what happened:_____

I believe this could have resulted in injury and/or damage to: (check all that pertain)

☐ Personnel ☐ Property ☐ Equipment

If these circumstances occurred:_____

I recommend the following actions to prevent this from occurring in the future:_____

Note: Use additional paper if required

Attachment K
Drill Rig Inspection Log

Drilling Safety Audit

Project Name:_____ **Project Number:**_____

Date:_____ **Subcontractor Audited:**_____

Auditor:_____

General Safety		
Safety Officer Designated for Job:	☐ Yes	☐ No
Name:		
Safety Meeting Performed (Daily)	☐ Yes	☐ No
Personal Protective Equipment (PPE)		
Hard Hats	☐ Yes	☐ No
Safety Glasses	☐ Yes	☐ No
Steel Toed Boots	☐ Yes	☐ No
Hearing Protection	☐ Yes	☐ No
Work Gloves	☐ Yes	☐ No
Orange Work Vests	☐ Yes	☐ No
Traffic Cones and Signs	☐ Yes	☐ No
Other	☐ Yes	☐ No
Disposal of PPE in Proper Waste Containers (if applicable)	☐ Yes	☐ No
Comments:		
Daily Inspections of Drill Rig:		
Structural Damage, Loose Bolts	☐ Yes	☐ No
Proper Tension in Chain Drives	☐ Yes	☐ No
Loose or Missing Guards, Fluid Leaks	☐ Yes	☐ No
Damaged Hoses and/or Damaged Pressure	☐ Yes	☐ No
Gages and Pressure Relief Valves	☐ Yes	☐ No
Comments:		

Check and test all safety devices such as:		
Emergency shutdown switches, at least daily	☐ Yes	☐ No
Check all gages and warning lights and ensure control levers are functioning properly	☐ Yes	☐ No
First Aid and fire extinguishers on drill rig	☐ Yes	☐ No
Back up alarm functioning properly	☐ Yes	☐ No
Comments:		

Drill Crew Training Requirements:		
40-hour OSHA Training	☐ Yes	☐ No
8-hour Annual Refresher Training	☐ Yes	☐ No
Drill Rig Training/Safe Operating Practices	☐ Yes	☐ No
First Aid/CPR	☐ Yes	☐ No
Emergency Procedures	☐ Yes	☐ No
Emergency Phone Numbers Posted	☐ Yes	☐ No
Site Orientation	☐ Yes	☐ No
Health and Safety Plan Review	☐ Yes	☐ No
Comments:		

Housekeeping:		
Suitable storage for tools, materials, and supplies	☐ Yes	☐ No
Pipes, drill rods, casing, and augers stacked on racks to prevent rolling and sliding	☐ Yes	☐ No
Platforms and other work areas free of debris materials and obstructions	☐ Yes	☐ No
Comments:		

Hand Tools:		
Tools in good condition	☐ Yes	☐ No
Broken tools discarded and replaced	☐ Yes	☐ No
Right tool used for the right job	☐ Yes	☐ No
Comments:		

Drilling Operations:		
Mast or derrick down when moving rig	☐ Yes	☐ No
Overhead obstructions identified before mast is raised	☐ Yes	☐ No
Drill rig stabilized using leveling jacks or solid cribbing	☐ Yes	☐ No
Secure and lock derrick	☐ Yes	☐ No
Comments:		

Overhead and Buried Utilities:		
Buried utilities identified and marked	☐ Yes	☐ No
Safe distance of drill rig from overhead power lines	☐ Yes	☐ No
Comments:		

Wire Line Hoists Wire Rope and Hardware:		
Inspection for broken wires where reduction in rope diameter, wire diameter, fatigue, corrosion, damage from gear jamming, crushing, bird caging, kinking	☐ Yes	☐ No
Inspect and lubricate parts daily	☐ Yes	☐ No
Comments:		

Auger Operations: What to look for:

- A system of responsibility between the operator and the tool handler when connecting and disconnecting auger sections and inserting and removing auger fork.
- During connecting and disconnecting auger sections and inserting auger for the tool, handler should position himself away from the auger column while it is rotating.
- When securing the auger to the power coupling, pin should be inserted and tapped into place using a hammer or other similar device.
- Tool hoist should be used to lower second section of auger into place.
- Both operators should be clear of auger as it is being lifted into place.
- Long-handled shovel should be used to move dirt away from auger.

Overall Summary:

Attachment L

Safety Task Analysis Review (STAR)

Identify Potential Hazards

- ☐ Abrasions
- ☐ Cave-in
- ☐ Chemical/Thermal Burn
- ☐ Confined Space
- ☐ Cuts
- ☐ Dermatitis
- ☐ Dropping Materials/Tools to lower level
- ☐ Drowning/Flowing water
- ☐ Dust
- ☐ Electrical Shock
- ☐ Elevated Work
- ☐ Energized Equipment
- ☐ Fire
- ☐ Flammability
- ☐ Foreign body in eye
- ☐ Hazardous materials
- ☐ Hazardous Exposure
  - ☐ -Absorption
  - ☐ -Inhalation
  - ☐ -Ingestion
- ☐ Heat or Cold Stress
- ☐ Heavy Equipment Operation
- ☐ Heavy Lifting
- ☐ High Noise Levels
- ☐ Impact Noise
- ☐ Inability to maintain communication
- ☐ Inclement weather
- ☐ Overhead work
- ☐ Overhead utilities
- ☐ Pinch points
- ☐ Pressurized lines
- ☐ Slips, Trips, Falls
- ☐ Sprains/Strains
- ☐ Traffic
- ☐ Underground Utilities

Identify Controls

- ☐ Air Monitoring
- ☐ Barricades/Fencing
- ☐ Buddy System
- ☐ Clothing appropriate for weather
- ☐ Confined Space Procedures
- ☐ Decontamination
- ☐ Drinking Water
- ☐ Dust abatement
- ☐ Equipment inspection
- ☐ Exclusion zones
- ☐ Exhaust ventilation
- ☐ Fall Protection
- ☐ Fire extinguisher/Fire watch
- ☐ Flotation Devices/Lifelines
- ☐ Grounds on Equipment/Tanks
- ☐ Ground Fault Interrupter
- ☐ Ground Hydraulic Attachments
- ☐ Hand signal communication
- ☐ Hazardous/Flammable material storage
- ☐ Hearing Protection (Specify)
- ☐ Hoses, Access to water
- ☐ Hot Work Procedures
- ☐ Isolation of Machinery or Process
- ☐ Lockout/Tagout
- ☐ Machine Guarding
- ☐ Manual Lifting Equipment (Chain Falls)
- ☐ Protective Equipment
  - ☐ -Hard Hat
  - ☐ -Steel-Toed Boots
  - ☐ -Work Coveralls
- ☐ Tyvek or Saranac
  - ☐ -Gloves
  - ☐ -Shoe/Boot Coverings
  - ☐ -Safety Glasses
  - ☐ -Safety Glasses with side shields
  - ☐ -Face Shield
  - ☐ -Other (specify)
- ☐ Proper lifting techniques
- ☐ Proper tools
- ☐ Radio Communication
- ☐ Respirator, (specify type)
- ☐ Safety Harness/Lanyard/Scaffold
- ☐ Sloping, Benching, Shoring
- ☐ Trench Box
- ☐ Vehicle Inspection
- ☐ Other:

Pre-Task Review

1. Has Job Hazard Analysis been completed and reviewed?
   ☐ Yes ☐ No ☐ N/A
2. Permit Issued?
   ☐ Yes ☐ No ☐ N/A
   What type? ☐ Hot Work
   ☐ Confined Space ☐ Excavation
   ☐ Other:_____
3. Proper Safety Equipment on Job Site?
   ☐ Yes ☐ No ☐ N/A
4. Proper tools for job?
   ☐ Yes ☐ No ☐ N/A
5. Oxygen/Flammability checked?
   ☐ Yes ☐ No ☐ N/A
6. Reviewed MSDSs for any hazardous substance that might be present?
   ☐ Yes ☐ No ☐ N/A
7. Proper training for all personnel?
   ☐ Yes ☐ No ☐ N/A

Post-Task Review

1. Work area cleaned up?
   ☐ Yes ☐ No ☐ N/A
2. All locks and tags removed and signed off by individuals?
   ☐ Yes ☐ No ☐ N/A
3. Permits turned in?
   ☐ Yes ☐ No ☐ N/A
4. STAR submitted to SSHO?
   ☐ Yes ☐ No ☐ N/A

Lessons Learned/Feedback:_____

_____

_____

RETEC Corporation

Safety Task Analysis Review (STAR)

Job Description:_____

List Tasks:

Job Location:_____

Client Rep.:_____

Phone #:_____

List Hazards:

Person(s) working on this task:

List Controls:

Completed By

Company

Date

Attachment M

Job Safety Analysis (JSA) Form

Job Safety and Hazard Analysis

Job/Operation	JSHA No.	JSHA Status	Page_____of__	☐ New Revision No.:____
Analysis by:	Reviewed & Approved by:		Process/Machine Equipment:	
Employee Position Title:	Approval Date:		Recommended/Required PPE:	
Department/Division:	Annual Review Date:		Special Hazards:	

Sequence of Basic Job Steps		Potential Hazards/Accidents		Recommended Safe Job Procedures	
Step #		Step #		Step #	