



Field Sampling Plan

Wendkirk Oil Field Engineering Design Field Activities Coke County, Texas



Prepared for:

**Railroad Commission of Texas
Oil and Gas Division
Site Remediation and Special Response**

William Miertschin, Project Manager



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1.0 INTRODUCTION

The purpose of this Field Sampling Plan is to detail for the field crew the activities to be performed during the engineering design data collection phase of the Wendkirk Oil Field project located in Coke County, Texas.

The TCEQ placed Segment 1426 of the Upper Colorado River on the State's 303(d) list because it does not meet water quality standards due to high salinity. Segment 1426 is located between E. V. Spence Reservoir and O. H. Ivie Reservoir in Coke and Runnels Counties. Previous analyses of the salinity of the Colorado River has indicated that concentrations increase downstream of the Wendkirk Oil Field. The Railroad Commission of Texas (RRC), Oil and Gas Division, has received a Section 319 Non-Point Source grant from the USEPA through the TCEQ to determine if oil and gas operations in the Wendkirk Oil Field are contributing to the high saline water. The overall objective of the project is to locate the nature and extent of the source(s) leading to the elevated salinity in the Colorado River and to evaluate best management practices to abate the source(s).

In an effort to define conditions at the site and identify potential source(s) contributing to high salinity concentrations in groundwater, TRC has installed 18 groundwater monitoring wells at the site. Groundwater samples have been collected from these monitoring wells along with existing water wells in the area and surface water from creeks, springs, and the Colorado River. Multiple geophysical surveys have also been conducted at the site and across the area to assist in identifying areas of potential concern. These data were used to prepare an approach to further define conditions at the site in preparation for implementing best management practices (BMPs) to reduce the amount of salinity impacted groundwater from reaching the Colorado River.

The approach for the engineering design data collection was presented in a Work Order provided to the RRC in May 2007. The approach involves performing aquifer step tests, pumping tests, and/or slug tests at existing groundwater monitoring wells. Activities will also include the installation of three additional groundwater monitoring wells and potentially four observation wells, if pumping tests are determined to be appropriate at the site. Groundwater sampling will be performed at the new monitoring wells. Information gathered from these activities will be used to properly design a remediation strategy to reduce the amount of salinity-impacted groundwater that is entering the Colorado River at the Wendkirk Oil Field.

Additional data will be collected from the Mays-01 water well, which is located on the south side of the river. The construction and history of this well is unknown; therefore, down-hole logging of the well will be performed to determine well construction and other properties of the well. These activities will be performed by a subcontractor and overseen by TRC personnel.

Depending on the construction of the well, up to five groundwater samples will be collected from discrete intervals to obtain a profile of the groundwater column.

The following section of this Field Sampling Plan provides the investigation approach and required guidance for field personnel to complete the planned field activities. The work will be divided into two mobilizations with the step tests and the investigation of Mays-01 water well occurring first, followed by monitoring/observation well installations, groundwater sampling, and the aquifer testing (pumping and/or slug testing). This Field Sampling Plan provides the locations and methods for performing these activities along with a rationale for the work and quality assurance/quality control (QA/QC) requirements. A Health and Safety Plan is presented in Appendix A. TRC field forms are included in Appendix B.

2.0 DATA COLLECTION PROTOCOL

As described in the Work Order, the engineering design field work consists of several field activities presented in detail below. These activities include: (1) aquifer step tests, (2) downhole logging of one water well and discrete water sample collection, (3) installation of monitor wells and observation wells, (4) aquifer pumping or slug testing, and (5) groundwater sampling. Activities 1 and 2 will occur during the first mobilization and activities 3 through 5 will occur during the second mobilization. This two mobilization approach is necessary so that data collected from the step tests may be evaluated for determining whether pumping tests or slug tests are more appropriate at the site.

The RRC will be responsible for arranging site access and obtaining permission to conduct the work scope prior to site mobilization. TRC will not conduct work on any property without verification from the RRC that access has been granted. The RRC will provide TRC with property access agreements (if applicable) or property owner requirements.

The field work will be completed in accordance with the most recent approved version of the Quality Assurance Project Plan (QAPP) for the Wendkirk Oil Field. Exceptions to these guidelines may be encountered during field activities. Exceptions will be recorded in field logbooks and will be addressed in Corrective Action Reports (CARs).

2.1 Objectives

The objectives of the engineering design field work are to obtain additional information regarding aquifer properties, construction details of the Mays-01 water well, and define groundwater concentrations and potential sources at the site. This information will be used to design a remediation strategy to reduce the amount of salinity-impacted groundwater that is entering the Colorado River at the Wendkirk Oil Field.

The required data will be collected during two separate field events. The first field event will consist of aquifer step tests (Section 2.2) and investigating the Mays-01 water well (Section 2.3). The second field event will include the installation of observation and/or groundwater monitoring wells (Section 2.4), aquifer pumping tests and/or slug tests (Section 2.5 and Section 2.6, respectively), and groundwater sampling of the newly installed monitoring wells (Section 2.7). The remaining sections of this Field Sampling Plan address work completion in accordance to the project goals and the approved Wendkirk Oil Field QAPP.

2.2 Aquifer Step Tests

A step-drawdown test will be performed on up to four existing monitoring wells. The step-drawdown test results will provide critical data for determining the feasibility of conducting a full-scale aquifer pumping test. Predetermining the discharge rate will ensure that the full-scale aquifer tests are maintained at a constant discharge rate and that the drawdown does not exceed the capacity of the well. If the drawdown induced during the aquifer pumping test reaches the pump intake, the usability of the test data will be diminished because the pump becomes damaged or the discharge rate becomes variable.

The data collected from the step-drawdown tests will be used to determine the specific capacity (discharge rate divided by drawdown) of the monitoring wells in the area targeted for potential engineering controls. Two graphs will be developed with the test data: (1) drawdown versus time and (2) drawdown versus discharge rate. These data will be analyzed to calculate the appropriate discharge rate for each pumping test.

2.2.1 Procedures and Operation

The basic procedure for a step-drawdown test involves conducting three or more steps of pumping where the discharge rate is incrementally increased during each step. The discharge rates should range across the entire spectrum of anticipated discharge rates during the full-scale aquifer test. Ideally, a constant discharge rate is maintained during each step.

The data from each step is graphed during the test with time on a logarithmic x-axis and drawdown on a linear y-axis. During each step, the drawdown should drop rapidly at the beginning of the test and stabilize as the test proceeds (reference Figure 1 from Suggested Operating Procedures for Aquifer Pumping Tests [USEPA, 1993]). When drawdown stabilizes, the discharge rate will be increased to initiate the next step. The final step should result in drawdown that is just above the pump intake (i.e. <1 foot). Each selected monitoring well will be pumped for a minimum of three successive and increasing discharge rate steps as allowed by drawdown. During each step, the discharge rate will remain constant. When drawdown stabilizes, the discharge rate will be increased to initiate the next step. The durations of each step and the total step test at each well will vary based on aquifer properties and the well construction. Field personnel will determine each step's duration and the overall step test length based on drawdown data collected at each well during the test. The step tests at each well will not exceed a total of three hours per well.

The groundwater elevation in the monitoring well will be monitored using data-loggers set at a linear data recording frequency of 10 seconds per reading. A logarithmic recording frequency is not required as the early time data is of no particular interests during a step-

drawdown test. The flow rate will be measured by recording the amount of time it takes to fill a container of a known volume (e.g., 5-gallon bucket, 55-gallon drum).

Groundwater produced during the step tests will be contained in a 100-500 gallon poly tank and the transferred to a site-centralized 4,000-6,500 gallon poly tank for storage pending disposal. All non-dedicated equipment placed within the well such as the transducers, water probe, pump, and discharge plumbing will be decontaminated according to the procedure in Section 2.9.

2.2.2 Test Analysis

The step-drawdown test data will be analyzed to determine the appropriate discharge rate for the full-scale aquifer tests and the resulting drawdown at that discharge rate. The analysis will be done manually as well as with software programs such as Aquifer Test for Windows, AQTESOLV, AquiferWin32, or equivalent. This analysis will be used to design each of the full-scale aquifer pumping tests.

2.3 Mays-01 Water Well Evaluation

Data collected during previous investigation activities at the site have indicated elevated salinity at the Mays-01 water well. No information concerning the installation and construction of this well has been found. To better understand how salinity concentrations measured in the well relate to the salinity concentrations observed across the site, TRC will use geophysical logging techniques (e.g., caliper test, resistivity, gamma, and down-hole camera) to determine the well construction. Based on the information obtained from this logging, up to five discrete groundwater samples will be collected from different depth intervals within the well, as described in Section 2.7.

2.4 Observation and Monitoring Well Installation

If the data collected from the step tests indicates that pumping tests are appropriate at the site, two existing monitoring wells will be selected for the pumping tests. In order to evaluate the aquifer pumping test at these two monitoring wells, two new observation wells will be installed near each selected monitor well for a total of four new observation wells. In addition, three new monitoring wells will be installed at the site to better define site conditions and assist in targeting the location of potential sources. Data from these new wells will assist in determining BMPs to address salinity-impacted groundwater at the site. The following subsections discuss the procedures and protocols for the installation of these wells.

2.4.1 Utility Clearance

The location of underground utilities will be identified in the areas where soil borings will be completed. As required by state law, the Texas One Call System, Texas Excavation Safety System, Inc., and/or the Lone Star Notification Center will be contacted. TRC personnel will meet with utility representatives as necessary prior to commencing subsurface work. Additional utility clearance will consist of reviewing available site maps, visual inspection, and probing the sample location with a hand auger or tile probe.

2.4.2 Locations and Nomenclature

The location of the proposed observation wells, if necessary, will be determined once the step test results have been reviewed and evaluated and the two existing monitoring wells have been selected for the pumping tests. Depending on the step test results, one observation well at each pumping test location will be installed approximately 15 feet away from the existing monitoring well. The second observation well at each pumping test location will be installed 30 feet away on the opposite side of the existing monitoring well from the first observation well. These observation wells will be labeled with “OB” for observation, the distance in feet from the existing monitor well being used for the pumping test (i.e., “15” or “30”), and with the monitor well identification. For example, if Monitoring Well MW-10 is selected for a pumping test, the observation wells installed around it would be labeled “MW10-OB15” and “MW10-OB30”.

During the mobilization to install the pumping test observation wells, TRC also will install three new delineation wells. One new monitoring well will be installed north of MW-16 to delineate elevated salinity observed at monitoring wells MW-01, MW-16, and MW-11, another monitoring well will be installed southeast of MW-18 at an area of former well field operations, and the remaining well will be installed southwest of MW-18 as access allows. The monitoring well north of MW-16 will help determine if salinity concentrations at MW-01 are isolated or connected to the elevated salinity concentrations observed at MW-11. Data collected from this new monitoring well will help direct how concentrations of elevated salinity in the vicinity of MW-01 are addressed and will also assist in refining the site conceptual model. The well southeast of MW-18 will assist in determining if there are former source areas upgradient of MW-18 contributing to concentrations measured in that well. The remaining monitoring well west-southwest of MW-18 will refine the western boundary of the area of impact and will assist in determining where controls should be installed. These new wells will be labeled MW-19, MW-20, and MW-21 based on the installation order.

2.4.3 Drilling and Well Installation

Soil borings will be completed for the installation of groundwater monitoring wells using a combination hollow-stem auger/air-rotary drilling rig. Sampling of unconsolidated sediments will be conducted using split soon or core barrel samplers during hollow-stem auger drilling. When consolidated sediments are encountered, the hollow-stem auger drilling rig will be converted to an air-rotary drilling rig. Rock core samples will not be collected during air-rotary drilling, thus boring lithology will be described based on soil cuttings ejected to the surface through the borehole. The soil will be described based on lithology, moisture content, and notable presence of impact. The lithologic description will be in accordance with ASTM Standard D 2488, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). The soil samples or cuttings will be field screened with a photo-ionization detector (PID) to identify volatile organic compound (VOC) vapors. The lithologic description and PID results will be recorded on the TRC Boring/Well Field Form presented in Appendix B. Soil samples will not be submitted for laboratory analysis since the sampled intervals will be within alluvial material above the ground water table that is not expected to serve as a migration pathway for the high salinity water impacting the Colorado River.

The soils borings will be converted into two-inch diameter monitoring wells upon completion of soil boring drilling activities. Based on the current knowledge of the site and estimated depths of the water-bearing units, it is assumed that the monitoring wells installed southwest and southeast of MW-18 will be installed to an estimated depth that is not to exceed 80 feet below ground surface (bgs). The monitoring well to be installed north of MW-16 will not exceed a depth of 50 feet bgs. The wells will be installed with a maximum of 20 feet of 0.010-inch machine slot Schedule 40 polyvinyl chloride (PVC) screen. The monitoring well screen will be installed across the air/groundwater interface and completed at a depth and length sufficient to compensate for seasonal fluctuations. The annular space around the screen will be filled with clean 20/40 silica sand to two feet above the well screen. A two-foot thick seal of hydrated bentonite chips will be placed above the sand pack, and the remaining annular space will be filled with a cement-bentonite grout. The PVC well casing will extend two to three feet above grade and will be protected with a steel protective casing and a two foot square concrete pad. The well completion information will be recorded on the TRC Boring/Well Field Form located in Appendix B. The newly installed monitoring wells will be developed upon completion using a disposable bailer. The well development method and volume of water removed during development will be recorded on the TRC Well Development Field Form presented in Appendix B.

The total depth and length of well screen for the new observation wells will be determined once the step drawdown test data has been reviewed and evaluated and the existing

wells selected for the pumping tests have been determined. These new observation wells will be constructed in the same manner as the existing monitoring wells selected for the pumping test and as described above.

2.5 Aquifer Pumping Tests

This section presents the procedures for conducting the aquifer tests including installing aquifer test equipment, recording static water levels, conducting the pumping tests, and record keeping. Each of these activities is detailed below.

2.5.1 Pumping Test Procedure

The aquifer extraction test will be a constant-discharge rate test. Each test is planned for a duration of 8 to 12 hours. The test may be concluded prior to that, however, if sufficient late-time data has been collected as indicated by stabilization of the drawdown data. Boundary or delayed drainage conditions are not anticipated; so only a limited amount of late-time data needs to be collected.

If possible, periods of significant climactic changes should be avoided. These include passage of a weather system that would significantly alter the barometric pressure, or a period of significant precipitation that would influence the Site recharge rate. Any such events occurring during the testing will be documented in the field notebook.

2.5.2 Equipment Installation and Testing

All equipment should be tested before the aquifer test, if feasible. Pumping equipment should not be tested by extracting formation groundwater that would impact static groundwater conditions. Electric, submersible pumps capable of the discharge rate determined from the step-drawdown tests will be installed in the extraction wells. The bottom of the pump will be placed at the bottom of the screened interval. The pump should not be placed within the well sump. The pump and motor should be sized to achieve the specified flow rate with consideration of vertical lift and friction losses. The pump will be secured with a cable that is attached to the well's steel protective cover. For flow rates less than 15 gallons per minute (gpm), a Grundfos Redi-Flo variable frequency drive pump or equivalent pump will be used. For flow rates greater than 15 gpm, a Grundfos Submersible Pump or equivalent pump will be used. An electric pump is preferred over a pneumatic pump, as electric pumps produce more consistent discharge and require only a power source rather than both a power source and an air compressor. Detailed pump specifications will be determined from the discharge rate established from the step-drawdown test data.

The discharge plumbing will consist of a flexible material. The discharge plumbing will be connected to the top of the pump. A check valve will be installed at the top of the pump to prevent backflow. The discharge plumbing will be placed on the ground from the wellhead to the holding tank. Unless disposable or dedicated plumbing is used, the discharge plumbing placed down the well will be decontaminated between aquifer tests. An approximately ten foot section of discharge plumbing near the well head will be hard piped. This section of plumbing will include a gate valve, in-line flow meter, and sample port.

2.5.3 Static Water Level Measurements

Static water levels will be recorded at the extraction well and all surrounding observation wells using a water probe. The static water levels should be recorded within 60 minutes of starting the aquifer test. Immediately prior to the test, the water level at each transducer should be set to 0.00 feet to facilitate observation of drawdown.

2.5.4 Starting the Aquifer Test

The aquifer test will be started following equipment installation and testing and the static water level has been measured. The discharge pump, data-loggers, and synchronized stopwatches will be activated simultaneously.

2.5.5 Aquifer Test Water Level Measurements

The groundwater level in the pumping wells will be recorded using downhole data-loggers installed at least two feet above the pump and safely below the maximum estimated drawdown. The downhole data-logger will be secured at the top of the well by at least two methods (e.g., steel leader, rope, etc.). The level of the transducer cannot be altered during the test. The water level can be downloaded to a computer during test operation for real-time data analysis. The data-loggers should be calibrated prior to installation in accordance with the manufacturer's specifications. The transducers will be capable of accurately detecting changes of less than 0.005 pounds per square inch (psi) or 0.001 feet of water. The data-logger specifications should be appropriate for the pressure changes and ranges anticipated during the aquifer test.

The water level measurements collected using data-loggers should be recorded using a logarithmic time interval. An example logarithmic frequency is provided in Table 2 (ASTM, 1996). The most frequent interval will be used at the beginning of the test and the frequency will decrease as the test proceeds until a maximum time interval of 10 minutes is reached. The increased data collection frequency at the beginning of the test is needed to properly record the early-time data.

The water level measurements should begin immediately with the activation of the extraction pump. The water level should be checked with a water probe every 30 to 60 minutes. The water level data should be downloaded from the data-logger as frequently as possible to confirm the system is operating properly and to evaluate the test results.

2.5.6 Monitoring Discharge Rate

The discharge rate for each test will be determined during the step-drawdown tests. The discharge rate will be monitored using in-line flow meters and by recording the time it takes to fill a container of a known volume (e.g., 5-gallon bucket, 55-gallon drum, etc.).

At the beginning of the test, the discharge rate should be brought up to the planned rate as quickly as possible, and the discharge rate should be monitored and recorded as frequently as practical. Adjustments should be made to achieve a constant-discharge rate at or near the planned discharge rate. Adjustments should be made throughout the test to maintain the constant-discharge rate. Electric motors are nearly constant-load devices, so that as the pumping lift increases due to water level declines (i.e., drawdown), the pumping discharge rate decreases. The flow rate can be increased by opening the gate valve and decreased by closing the gate valve. The flow rate of the Grundfos Redi-Flo or equivalent pump can also be adjusted using the pump controller.

Once the discharge rate has stabilized, it should be monitored and recorded every 30 minutes. This involves recording the in-line flow meter totalizer reading and checking the flow rate at the discharge point by measuring the time required to fill a container of known volume (e.g., 5-gallon bucket or 55-gallon drum).

2.5.7 Test Analysis

The pumping test data will be analyzed to determine the appropriate discharge rate of a extraction well system at the site. The data will be analyzed manually, as well as with software programs such as Aquifer Test for Windows, AQTESOLV, AquiferWin32, or equivalent. This analysis will be used to design potential BMPs, such as engineering controls, in order to reduce the amount salinity-impacted groundwater reaching the Colorado River.

2.6 Aquifer Slug Tests

Slug tests will be performed on multiple wells if the step test data indicates that the aquifer will not support pumping tests. Aquifer slug tests will be performed to estimate the hydraulic conductivity and flow rate at monitoring wells across the area targeted for BMPs. The slug test data will be used in the selection and design of BMPs to address the salinity impacted

groundwater affecting the Colorado River. The slug tests will be performed in general accordance with ASTM D4044-02 Standard Test Method (Field Procedure) for Instantaneous Change in Head (Slug) Tests for Determining Hydraulic Properties of Aquifers. The number and location of the wells for slug testing will be determined following the analysis of the step test data.

In general, conditions within the Wendkirk Oil Field are unconfined; therefore, rising-head slug tests will be performed. Falling-head slug tests will not be conducted. The slug tests will be performed in accordance with the following sequential steps:

- Measure the static depth to water to an accuracy of 0.01 feet and total well depth.
- Using construction data from the well installation, install a pressure transducer approximately 0.5 to 1.0 feet above the bottom of the well. The transducer must not be placed in silt at the bottom of the well.
- Secure the transducer cable at the top of the well and place any transducer cable away from areas of walking or vehicle traffic. Any disturbance of the transducer will render the test useless.
- Program the pressure transducer to record data in feet at the most frequent sampling rate, which must be no greater than 1 second per reading. The pressure transducer will record the date, actual time, elapsed time, barometric pressure, and water pressure. The pressure transducer will be programmed using a hand-held device or laptop computer.
- The test will be activated by instantaneous removal of a slug of water using one or more 3-foot long, 1.6-inch diameter polyvinyl chloride (PVC) bailers. A sufficient number of bailers should be used to remove as much water from the well as possible.
- The bailers will be carefully placed in the well so that they do not contact the pressure transducer or stress the pressure transducer cable.
- The water level will be monitored using the water level probe until it returns to the static level.
- Once the water level has returned to static level, the pressure transducer will be activated and then the bailers will be removed from the well as quickly as possible to induce drawdown. The recovered water will be transferred to a 55-gallon drum.

- The water level recovery recorded by the pressure transducer will be monitored using, in preferred order, a hand-held device, laptop computer, or water level probe.
- The test will be run until the water level recovers to 95 percent of the static level. If 95 percent recovery is not achieved after an elapsed time of 180 minutes, then a field decision will be made regarding the necessary length of test to obtain sufficient data. The recovery percentage is measured using the following equation, where DTW = depth to water:

$$[\text{Current DTW} - \text{Static DTW}] / [\text{Maximum DTW} - \text{Static DTW}]$$

- Once the criteria to end the test are met, then data recording will cease. The pressure transducer will be removed from the well and decontaminated.

2.6.1 Test Analysis

As with the step tests and pumping test data, data collected from the slug tests will be analyzed manually as well as with software programs such as Aquifer Test for Windows, AQTESOLV, AquiferWin32, or equivalent. This analysis will be used to design potential BMPs, such as engineering controls, in place of or to complement the pumping test data.

2.7 Groundwater Sampling

Groundwater sampling will be conducted at the three new monitoring wells and the Mays-01 water well. Prior to sampling, the depth to groundwater will be gauged at the monitoring wells. This gauging will be conducted when the monitoring wells are most likely at equilibrium (i.e., after recovery from well development). The fluid level measurements will be collected using a water level meter with an accuracy of 0.01 feet. The data will be recorded in the field logbook. The water level meter will be decontaminated between wells.

The monitoring wells will be purged and sampled using disposable PVC bailers, a decontaminated submersible pump, or an existing water well pump. The monitoring wells will be purged until the field water quality parameters stabilize over three consecutive readings. If the water quality parameters have not stabilized after removal of three well volumes, then a maximum of five well volumes should be removed prior to sampling. If the well goes dry, a sample will be collected as soon after the water level sufficiently recovers to a level that a sample can be collected. Parameters are considered to have stabilized if, over three consecutive readings, all the following criteria are met:

- pH ± 0.1 unit
- Temperature within 3%
- Conductivity within 3%
- Oxidation-reduction potential (ORP) within 10 millivolts (mv)

The water quality meter used to record field parameters will be calibrated according to the manufacturer's specifications. The make, model, calibration fluids, and calibration results for the water quality meter will be recorded in the field logbook. The meter will be triple rinsed with groundwater from the next sample aliquot. The water quality parameters will be recorded on TRC's Groundwater Sampling Form located in Appendix B. A description of the water quality (e.g., clarity, sheen, odor, etc.) will be recorded during the purging process.

The number and depths of the groundwater samples from the Mays-01 water well will be determined in the field based on the downhole logging results. Up to five (5) discrete groundwater samples will be collected from the well in order to develop a qualitative vertical profile of conditions within the well. These samples will be grab samples collected through use of a submersible pump. The pump will be lowered to the deepest target depth and at least one pump/tubing volume will be purged prior to sampling that depth. The pumping rate will be set at low-flow levels (i.e., less than one gallon per minute) so as not to cause drawdown in the well or to stress the aquifer. Field parameters will be collected along with the groundwater samples for analysis, as described below. Once the deepest target interval has been sampled, the pump will be carefully raised up to next target interval and a sample and field parameters will again be collected following the purging of at least one pump/tubing volume. This process will be repeated until samples have been collected from all target intervals identified in the well.

The groundwater samples collected from the new monitoring wells and the Mays-01 water well will be submitted for laboratory analysis of chloride, sulfate, sodium, calcium, and total dissolved solids (TDS). Samples will be collected in the following order:

- Anions (chloride and sulfate)
- Cations (sodium, calcium)
- TDS

Field QA/QC samples will be collected as follows: duplicate, matrix spike, and matrix spike duplicate each at a frequency of five percent. The laboratory sample analysis and frequency is presented in Table 2-1, the laboratory sample specifications are presented in Table 2-2, and the sample nomenclature is presented in Table 2-3.

Table 2-1. Summary of Sample Type, Sample Location, Analysis, and Frequency

Sample Type	Sample Location	Analysis	Frequency
Groundwater	Monitoring Wells	TDS, Cations, Anions,	1 sample per well
	Mays-01 Water Well	TDS, Cations, Anions,	Up to 5 discrete samples
Duplicate Liquid	Monitoring Wells,	Same as original sample	5 percent
Matrix Spike / Matrix Spike Duplicate	Field Determination	Same as original sample	5 percent

Anions are chloride and sulfate

Cations are calcium and sodium,

Table 2-2. Laboratory Sample Specifications

Media	Laboratory Analysis	Method	Sample Container	Preservative & Handling	Laboratory
Water	TDS	EPA 160.1	250-mL polyethylene	Cool to 4°C	DHL Analytical
	Anions	EPA 300.0	500-mL polyethylene		
	Cations	EPA 6020	250-mL polyethylene	Cool to 4°C; HNO ₃ to pH < 2	

Anions are chloride and sulfate

Cations are calcium and sodium,

Table 2-3. Sample Nomenclature

Sample Type	Identification	Notes
Groundwater	W-MW-yy	W = identifies Wendkirk investigation area MW = monitoring well yy = designated monitoring well identification number
Duplicate	W-MW-yy-D	W = identifies Wendkirk investigation area MW = monitoring well yy = designated monitoring well identification number D = identifies duplicate (QA/QC) sample
Equipment Blank	W-EB-mm-dd-yy-z	W = identifies Wendkirk investigation area EB = identifies equipment blank (QA/QC) sample mm = month (e.g., 07) dd = day (e.g., 01) yy = year (e.g., 06) z = sequential EB sample collected per day (start with 1 each day)
Matrix Spike/Matrix Spike Duplicate	Same as the original sample	On the Chain of Custody, the sample will be listed on the same line as the original sample
Trip Blank	W-TB-mm-dd-yy-z	W = identifies Wendkirk investigation area TB = identifies trip blank (QA/QC) sample mm = month (e.g., 07) dd = day (e.g., 01) yy = year (e.g., 06) z = sequential TB sample collected per day (start with 1 each day)

2.8 Investigation-Derived Waste

The soil investigation-derived waste (IDW) will be spread along the ground surface, which is consistent with previous investigations at the site. If soil impacts are observed, then the soil will be placed in 55-gallon steel drums for disposal upon receiving the results of the laboratory analysis.

The liquid IDW (purge and decontamination water) will be placed in either 55-gallon steel drums that will be sealed, labeled, and staged at the site or will be contained in the

centralized 4,000-6,500 gallon poly tank for future off-site disposal. Determination as to whether the water IDW must be taken to an offsite disposal facility will be made based on the analytical data and communications with RRC representatives.

2.9 Decontamination

If the equipment used for sample collection is not dedicated or disposable, then it must be decontaminated. The objective of equipment decontamination is to remove potential contaminants from a sampling device or field equipment prior to and between collection of samples for laboratory analysis and to limit personnel exposure to residual contamination that may be present on used field equipment. Most sampling equipment can be decontaminated by using the following procedure:

1. Lay out sufficient polyethylene sheeting on the ground or floor to allow placement of the equipment being decontaminated.
2. Remove non-aqueous phase liquids (NAPL), if present, with an absorbent pad or other suitable device.
3. Remove any solid material (to the degree possible) with a brush and potable tap or distilled water.
4. Wash the equipment with a brush, laboratory grade non-phosphate detergent (e.g., Liquinox, Alconox), and potable or distilled tap water.
5. Rinse the equipment with potable or distilled tap water.
6. Rinse the equipment with 70 percent isopropyl alcohol.
7. Rinse the equipment with distilled water.
8. Reassemble equipment, if necessary, and wrap completely in clean, unused aluminum foil, shiny side out for transport and/or storage. Re-use of equipment on the same day without wrapping in foil is acceptable.

The drilling equipment will be decontaminated by washing with high-pressure water or a steam cleaner. If the drilling equipment has significant impacts, then additional decontamination will be performed as follows: (1) wash with a brush, laboratory-grade non-phosphate detergent (e.g., Liquinox, Alconox), and tap or distilled water, (2) rinse with tap water, and (3) rinse with distilled water. All decontamination fluids will be collected and containerized for disposal.

2.10 Handling of Samples for Laboratory Analysis

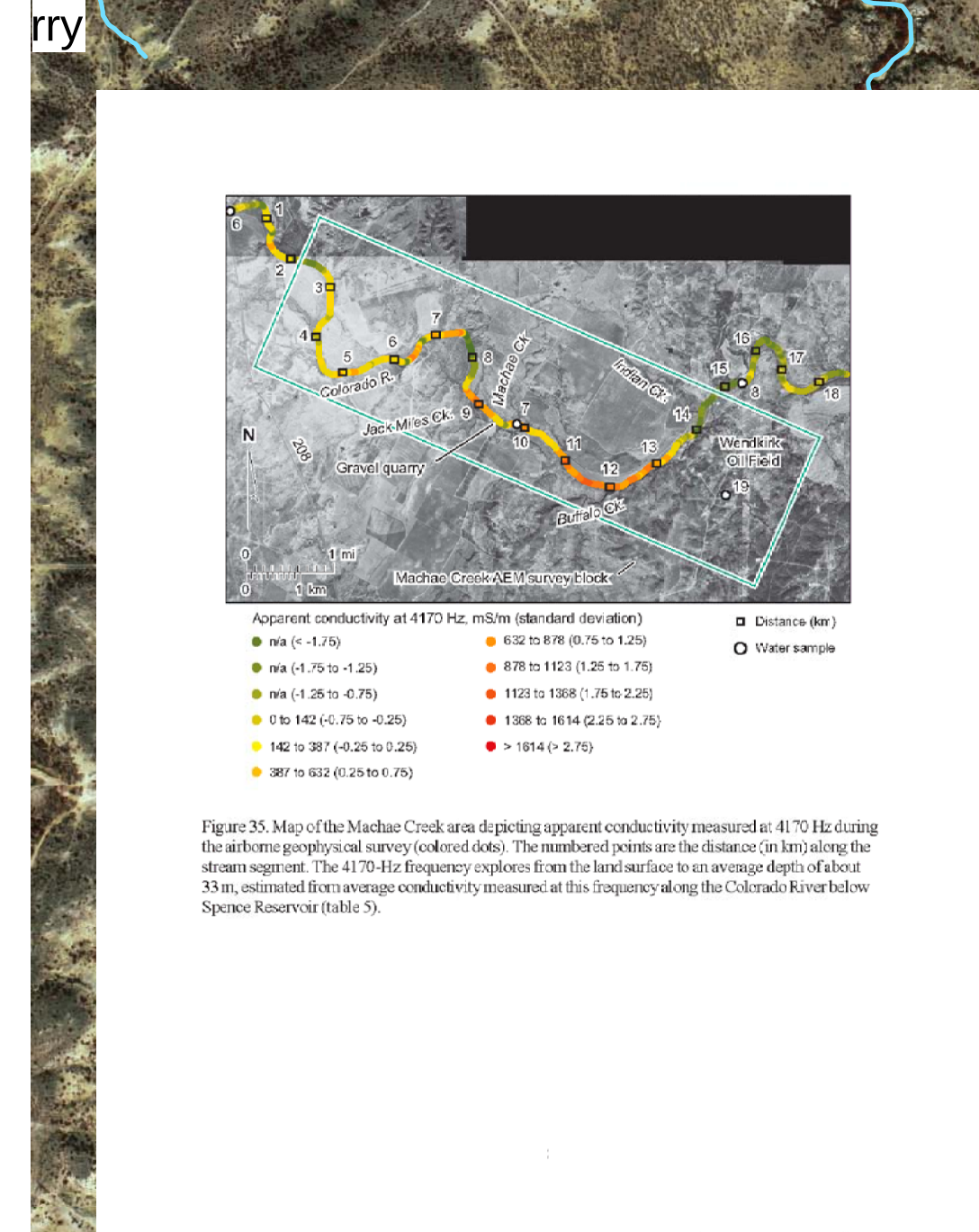
The water sample containers will be labeled, secured with bubble wrap (if glass), placed in a resealable plastic bag, and immediately placed in a cooler with ice at 4°C. The sample labels will include the client name (RRC), site name (Wendkirk), unique sample identification as presented in Table 2-3, sample collection time and date, sample analysis, preservatives, sample matrix, analytical laboratory, and initials of the sampler(s). The samples will be secured with packing material and kept at 4°C with double-bagged, wet ice. The cooler will be secured with packing tape and signed and dated custody seals will be placed over adjacent sides of the cooler lid and secured with tape.

The groundwater samples, along with a chain of custody, will either be delivered using a courier service or hand delivered by TRC field personnel to DHL Analytical in Round Rock, Texas. If samples are shipped on Friday for Saturday delivery, the receiving laboratory will be contacted so provisions can be made for the laboratory to receive the samples. The chain of custody form will note that laboratory analysis is to be in accordance with the most recent approved version of the QAPP. All of the requested analytes will be reported to the limits specified in the QAPP.

2.11 Surveying

A preliminary coordinate survey of the new monitoring wells and observation wells, if installed, will be completed using a global positioning system (GPS) unit. The survey instrument will be capable of locating coordinates within an accuracy of one meter. The survey will be conducted using the North American Datum (NAD) 83 Texas State Plane, Central Zone coordinate system. The top of the well casing for the new monitoring and observation wells will be tied into the existing site survey by a licensed surveying firm.

FIGURES



- SOURCE:**
1. BEG Airborne Geophysical Survey Report (ground conductivity, hydrochemical analysis, and surface water measurements)
 2. Texas Water Development Board (water and gas well locations)
 3. Texas Department of Licensing Regulation (water wells)
 4. U.S.G.S.Digital Ortho Quarter Quads (DQQs) for Bronte SE (1996), Bronte SW (1996), Cement Mountain NE (1996), Cement Mountain NW (1996), Robert Lee SE (1996), Robert Lee SW (1996), Shawville NE (1996), and Shawville NW (1996), Texas DQQs
 5. National Hydrography Dataset (surface drainage).
 6. Approximate location of pits determined from historical aerial photographs (1939, 1957, 1964, and 1971)

PROPOSED WELL LOCATIONS

RAILROAD COMMISSION OF TEXAS WENDKIRK OIL FIELD		
PROJECT NO.: 151478	DATE: 6/14/2007	
	505 EAST HUNTLAND DRIVE SUITE 250 AUSTIN, TEXAS 78752 512-329-6080	FIGURE 2-1

ATTACHMENT A

HEALTH AND SAFETY PLAN

**Health and Safety Plan
Wendkirk Oil Field Investigation
Coke County, Texas**

Prepared for:



**Railroad Commission of Texas
Oil and Gas Division
Site Remediation and Special Response**

William B. Miertschin, Project Manager

Prepared by:



**505 East Huntland Drive, Suite 250
Austin, Texas 78752**

Mark A. Robbins, Project Manager

June 2006

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1.0 INTRODUCTION

This Health and Safety Plan (HSP) addresses field activities to be conducted during the Wendkirk Phase II investigation located in Coke County, Texas. The Railroad Commission of Texas (RRC), Oil and Gas Division, has received a Section 319 Non-Point Source grant from the USEPA through the TCEQ to determine if oil and gas operations in the Wendkirk Oil Field are contributing to the high saline water. The objective of the investigation is to determine the nature and extent of oil and gas (O&G) exploration and production (E&P) source(s), if found, that lead to the high salinity in the Wendkirk Oil Field portion of the Machae Creek Area of the Colorado River.

This HSP has been developed in conformance with the directives and requirements of the TRC *Health and Safety Policy and Procedure Manual*, June 2001, and 29 Code of Federal Regulations (CFR) 1910.120(i)(2). This HSP and any subsequent addenda will apply to all TRC personnel who are involved with on-site activities at the Wendkirk oil field. By implementing this plan, TRC does not assume any liability for the health and safety of non-TRC personnel involved in the activities performed during this project.

TRC field personnel and TRC subcontracted field personnel must participate in medical monitoring, respirator fit testing, and hazardous waste training programs as specified by Occupational Safety and Health Administration (OSHA) regulations (per 29 CFR 1910.120, Hazardous Waste Operations and Emergency Response [HAZWPER]).

All work must be conducted in compliance with applicable OSHA regulations, including 29 CFR 1910 (General Industry Standards) and 29 CFR 1926 (Construction Industry Standards).

2.0 ADMINISTRATIVE INFORMATION

Site Name: Wendkirk Oil Field

Site Location: Coke County, Texas

Project Title: Wendkirk Phase II Investigation

Client: Railroad Commission of Texas

Project Manager: Mark Robbins

TRC Task Leader(s):

Corporate Health & Safety Officer (CHSO): Gary Ritter

Assistant Project Manager: Arsin Sahba

Field/Site Health & Safety Officer (SHSO): Matt Webre

Analytical: Steve Miller

Peer Reviewer: Arsin Sahba

2.1 Health and Safety Plan Requirement Rationale

This HSP is required due to past and present conditions, which have been reported to exist at the Wendkirk oil field. The chemicals of concern (COCs) include the potential presence of volatile organic compounds (VOCs), total petroleum hydrocarbons (TPH), and hydrogen sulfide (H₂S).

2.2 Health and Safety Plan Approval

Health & Safety Officer: Matt Webre

Signature: _____ Date: _____

3.0 PROJECT DESCRIPTION

The following sections describe the history of the Wendkirk oil field and the proposed field activities at the project area.

3.1 Site Description and History

The TCEQ placed Segment 1426 of the Upper Colorado River on the State's 303(d) list because it does not meet water quality standards due to high salinity. Segment 1426 is located between E. V. Spence Reservoir and O. H. Ivie Reservoir in Coke and Runnels Counties. Previous analyses of the salinity of the Colorado River has indicated that concentrations increase downstream of the Wendkirk Oil Field.

As part of this TCEQ total maximum daily load (TMDL) project, an airborne geophysical survey of Segment 1426 was conducted by the University of Texas Bureau of Economic Geology (BEG) for the TCEQ. This survey indicated four areas of elevated conductivity along the Upper Colorado River. The most upstream area, referred to as the Machae Creek Area, was the focus of this preliminary investigation. Within the Machae Creek Area, the Colorado River is 17 kilometers long and has several intermittent tributaries. The Wendkirk Oil Field is located at the downstream extent of the Machae Creek Area.

The RRC has asked TRC to conduct an investigation with the objective of determining the nature and extent of O&G E&P source(s), if found, that lead to the high salinity in the Wendkirk Oil Field portion of the Machae Creek Area of the Colorado River.

3.2 TRC Field Activities

The field investigation is scheduled to be completed between July and September 2006. For the purpose of this HSP, the field investigation scope has been divided into the following tasks:

- Seasonal Water Monitoring - surface water sampling of the Colorado River and its tributaries, water sampling seeps and springs, and collecting groundwater samples from water wells.
- Groundwater Investigation – utility locates, marking well locations, drilling soil borings, monitoring well installation, well gauging, groundwater sampling, surveying, and managing investigation-derived waste (IDW).

4.0 SITE HAZARDS

The following site hazards are present or could be encountered at the Wendkirk oil field project area.

4.1 Chemical Hazards

COCs include VOCs, TPH, and H₂S. Site personnel should avoid touching, breathing or ingesting any media encountered on the site. Nitrile gloves must be worn at all times when in contact with the soil, water, and/or hydrocarbons. Section 8 describes in detail procedures that will be followed to ensure a safe breathing zone and protection from vapors of these potential COCs. Appendix A summarizes the various constituents of concern, the Permissible Exposure Levels (PELs), and the major potential health effects of each. Material Safety Data Sheets (MSDSs) for the COCs are located in Appendix B of this HSP.

4.2 Physical Hazards

4.2.1 Heat Stress

Heat stress results when the body is unable to get rid of excess heat. Stages of heat stress are heat cramps, heat exhaustion, and heat stroke. The latter can be fatal. Heat stress is of particular concern when workers must wear chemical protective clothing and ambient air temperatures are high, because protective clothing reduces evaporative body cooling. If ambient air temperatures at the site reach 70°F, heat stress symptoms should be watched for and control measures applied, if they appear.

These symptoms include:

- Heat rash, which may result from continuous exposure to heat or humid air.
- Heat cramps which are caused by heavy sweating and inadequate electrolyte replacement. Signs and symptoms include:
 - + Muscle spasms, and
 - + Pain in the hands, feet, and abdomen.
- Heat exhaustion, which may occur 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, and
 - + Fainting.
- Heat stroke is the most serious form of heat stress in which temperature regulation fails and the body temperature rises to critical levels. Immediate action must be taken to cool the body before serious injury or death occurs. Competent medical help must be obtained. Signs and symptoms include:
 - + Red, hot, unusually dry skin,
 - + Lack of or reduced perspiration,
 - + Nausea,
 - + Dizziness and confusion,
 - + Strong, rapid pulse, and
 - + Coma.

A worker who exhibits any of these symptoms will be immediately relieved of responsibilities and told to consume electrolyte fluid or cool water while resting in a shaded area. The individual should not return to work until symptoms are no longer recognizable. If symptoms appear critical, persist, or get worse, the SHSO will seek immediate medical attention for the employee. If the individual does resume work, he/she will be monitored for any increase in heart rate or body temperature for the remainder of their shift. In addition, the worker will be requested to consume electrolyte fluid or cool water every hour.

The SHSO will monitor workers hourly when:

- Symptoms of heat stress are reported or observed;
- Ambient temperatures exceed 70°F and workers are dressed in impervious clothing; or
- Ambient temperatures exceed 90°F and workers are dressed in normal clothing.

Workers will be monitored for heat stress conditions by measuring the heart rate (HR) by radial (wrist) pulse for 30 seconds after one minute of rest. The HR after one minute of rest should not exceed 110 beats per minute. If HR is higher, the next work period shall be shortened by 33%, while the rest period length remains the same. If the pulse rate is still 110 beats per minute after one minute of rest in the next rest period, the following work cycle will be shortened by another 33 percent. This shortening of the work period must continue until the worker's HR is no greater than 110 beats per minute.

4.2.2 Cold Stress

Types of cold stress include general body coldness, hypothermia, and frostbite. The latter two require medical attention. Hypothermia can be fatal while frostbite can result in the amputation of limbs. If ambient air temperatures at the site reach below 39°F, cold stress symptoms should be watched for and control measures applied, if they appear. These symptoms include:

- General body coldness, which is caused by a drop in skin temperature. Signs and symptoms include shivering, numbness in extremities, and loss in manual dexterity and strength.
- Hypothermia is a decrease in deep body temperature (normally 98.6°F). Signs and symptoms include uncontrollable shivering, slurred speech and memory lapses, irregular breathing, and drowsiness.
- Frostbite occurs when there is inadequate circulation and/or insulation of a body part. Signs and symptoms include skin color change (white or grayish yellow to reddish violet to black), and pain initially, followed by cold and numbness in the affected part.

Preventative measures will help avert serious illness due to cold stress. Appropriate clothing will be worn on the basis of the exterior temperature, wind chill factor, and the level of work. Precautions will be taken to minimize exposed flesh and clothing should be layered as appropriate. A worker who exhibits any symptoms of cold stress will be immediately relieved of responsibilities. If symptoms appear critical, persist, or get worse, the SHSO will seek immediate medical attention for the employee. If the individual does resume work, he/she will be monitored. In addition, the following guidelines will be followed.

Work Below 39°F (4°C)

- The employees shall wear cold protective clothing appropriate for the level of cold and physical activity.
- If the air temperature at the site is decreased by wind or artificial ventilation, the cooling effect of the wind will be reduced by shielding the work area or by wearing a removable outer windbreak garment.
- If the clothing on the employee may become wet on the job site, the outer layer of the clothing will be water repellent.
- Workers who become immersed in water or whose clothing becomes wet will immediately be provided with a change of clothing and treated for hypothermia.
- 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.

4.2.3 Sunburn

Prolonged exposure of the skin to the sun, even on overcast days, can result in sunburn, which can be severe enough to be incapacitating, especially with fair-skinned individuals. Repeated sun burning can eventually cause premature aging of the skin and skin cancer in individuals. Always wear clothing to reduce the amount of exposed skin and frequently use sun block creams or lotions.

4.2.4 Exposure to Excessive Noise

Overexposure to noise can result in hearing loss. If it is difficult to hear normal speech when the speaker is 3 feet from the listener, for more than 4 hours a day, the noise level must be measured. If it exceeds 85 decibels (dBA) as an 8-hour, time-weighted average, hearing protection will be worn in accordance with 29 CFR 1910.95. If a sound level meter is not available, then the noise level will be assumed to be 85 dBA if one cannot communicate at normal voice level within 3 feet from another person. If this is the case, then appropriate hearing protection will be donned.

4.2.5 Heavy Equipment and Motor Vehicle Operation

Only qualified personnel will operate heavy equipment and motor vehicles. Equipment will not be operated in a manner that will endanger persons or property. All heavy equipment and motor vehicles will be operated in accordance with the manufacturer's instructions and 29 CFR 1926 Subpart O.

The following inspection and repair controls will also be implemented during this project:

- Equipment and vehicles will be inspected by the operator on a daily basis, prior to starting work.
- All heavy equipment exhaust systems will be checked daily and confirmed to have no embers or sparking.
- Any unsafe equipment or vehicles will be removed from service until safety defects can be corrected.
- Equipment will be shut down and locked out before maintenance or repairs are made.

Operators will follow these rules:

- Motor vehicles and heavy equipment will be shut down during re-fueling operations.
- Operators will not leave their equipment unattended while it is running.
- Whenever equipment is parked, the parking brake will be set. If the equipment is parked on an incline, in addition to setting the parking brake, the wheels will also be chocked.
- Operators will be trained and experienced in the use of their equipment.
- Vehicles or equipment will not be operated in a careless or unsafe manner.
- Personnel will wear appropriate personal protective equipment (PPE) when working with heavy equipment. Dermal protection must fit properly and be taped to prevent "caught on" or "caught between" hazards.

Required equipment features include:

- All equipment and vehicles will have an audible backup alarm and an audible warning device (i.e., a horn).
- Each vehicle and piece of equipment will have a portable fire extinguisher rated not less than 10-B:C.

When working with moving equipment:

- One designated person will give signals to the operators of both equipment and vehicles in any work area.
- Personnel will stay clear of the operational area of the equipment. Workers are not permitted to stand directly underneath any load or piece of equipment, i.e., man-lift, backhoe bucket, crane load, etc.
- Work areas will be adequately illuminated.

4.2.6 Excavations and Trenches

Compliance with excavation and trenching standards established by OSHA regulation 29 CFR 1926 Subpart P is a requirement of this HSP, as well as the compliance with the requirements presented below.

- Trenches and other large holes must be marked with yellow caution tape at any time the excavation is left unattended. The caution tape must be placed no less than 2 feet from the edge of the excavation
- Personnel will not be allowed to enter an excavation greater than 4 feet deep unless the excavation is properly sloped.
- Excavation spoil shall be placed a minimum of 3 feet from the edge of the excavation.

4.2.7 Slips, Trips, and Falls

Slipping and tripping hazards may be encountered at the site. Footwear appropriate for walking over mud and rocks should be worn. In addition, proper site housekeeping and removal of trash and debris will reduce slipping and tripping hazards. Proper site housekeeping will be the responsibility of all site personnel, and the SHSO will make regular inspections to evaluate if the work area is adequately clean.

4.2.8 Thorny or Abrasive Vegetation

Thorny and abrasive vegetation may be encountered during some work activities. Appropriate clothing (i.e., gloves, long sleeve shirt, heavy pants, steel-toe boots) should be worn when working around thorny vegetation.

4.2.9 Manual Lifting

Back injuries are among the leading occupational injuries reported by industrial workers. Using proper manual lifting techniques can reduce back injuries such as pulls and disc impairments. Leg muscles are stronger than back muscles, so workers should lift with their legs and not with their back.

If the load is too heavy, do not lift it alone. Individual heavy lifting must be avoided. Lifting is always easier when performed with another person. Assistance should always be used when necessary.

4.2.10 Hand and Power Tools

Dangerous hand tools (such as saws, hammers, axes, knives, shovels) and power tools (such as chain saws, power augers, drill motors, chippers, water pumps, and weed trimmers) may be used during some investigation activities.

All hand and power tools will be maintained in a safe condition and in good repair. Hand and power tools will be used in accordance with 29 CFR 1926, Subpart I (1926.300 through 1926.307). Workers are not permitted to bring unsafe tools on-site. All tools will be used, inspected, and maintained in accordance with the manufacturer's instructions. Throwing tools or dropping tools to lower levels is prohibited. Hand and power tools will be inspected, tested, and determined to be in safe operating condition prior to each use. Periodic safety inspections of all tools will be conducted by the tool operator, the Site Manager or the SHSO to evaluate if the tools are in good condition and are being properly maintained. Any tool that fails an inspection will be immediately removed from service and tagged with a "Do Not Use" sign.

Workers using hand and power tools who are exposed to falling, flying, abrasive, or splashing hazards will be required to wear PPE. Eye protection must always be worn when working on-site. Additional eye and face protection, such as safety goggles or face shields, may also be required when working with specific hand and power tools. Workers using tools in areas where there is a head injury hazard will wear hard hats. Hearing protection will always be worn when working with power tools, and additional hearing protection may be required when working with certain power tools if noise levels

are excessively high. Workers using tools that may subject their hands to an injury, such as cuts, abrasions, punctures, or burns, will wear protective gloves. Loose or frayed clothing, dangling jewelry, or loose long hair will not be worn when working with power tools.

Electric power-operated tools require ground fault circuit interceptors (GFCI). Electric power-operated tools will be double insulated or grounded, and equipped with an on/off switch. Guards must be provided to protect the operator and other nearby workers from hazards such as in-going nip points, rotating parts, flying chips, and sparks. All reciprocating, rotating, and moving parts of tools will be guarded if contact is possible. Removing machine guards is prohibited.

Circular saws must be equipped with guards that completely enclose the cutting edges and have anti-kickback devices. All planer and joiner blades must be fully guarded. The use of cracked, bent, or otherwise defective parts is prohibited. Chain saws must have an automatic chain brake or kickback device. The worker operating the chain saw will hold it with both hands during cutting operations. A chain saw must never be used to cut above the operator's shoulder height. Chain saws will not be re-fueled while running or hot. Power saws will not be left unattended.

Operators of these tools will be instructed on the proper operation and safety precautions prior to operating such equipment. Only qualified workers will operate pneumatic tools, powder-actuated tools, and abrasive blasting tools. No one shall operate equipment that is in ill repair.

4.2.11 Weather-Related Hazards

Weather-related hazards include the potential for heat, electrical storms, treacherous weather-related working conditions, or limited visibility. These hazards correlate with the season in which site activities occur. Outside work will be suspended during electrical storms. In the event of other adverse weather conditions, the Field Team Leader will determine if work can continue without endangering the health and safety of site personnel.

4.3 Biological Hazards

Although large wild animals (such as deer, wild hogs) may be present in the area, it is unlikely that they will be encountered due to the noise produced by the fieldwork. However, poisonous snakes, mosquitoes, spiders, and bees may be encountered. The former requires that precautionary measures be taken when disturbing rocks and other

ground features. To greatly reduce insect bites, site personnel should use insect repellent, keep shirts buttoned, sleeves rolled down, and avoid areas with high grass and dense vegetation whenever possible. Snake guards should be used in areas (i.e., rock features, tall grass, etc.) where there is a potential to encounter snakes. Personnel that have allergic reactions to insect stings should inform the SHSO of the condition, carry the appropriate medications with them in the field, and take extra precautions to avoid being stung.

4.4 Drowning Hazards

According to OSHA 29 CFR 1917.126, personnel will be required to wear a personal floatation device (PFD) when conducting work in areas where there is a potential to slip or fall into a body of water, specifically on river banks with steep slopes. The PFD will be inspected each day prior to use for defects and/or wear and tear. PFD's will be sized appropriately for personnel and used in accordance with the manufacturer's recommendations.

4.5 Additional Hazards

Due to long periods of heat/sun exposure, above ground steel pipes or any other piping present at the site could be brittle. Avoid driving heavy machinery over these pipes whenever possible. If a pipe breaks, inform the Field Team Leader and the RRC representative immediately.

Potential fire and explosion hazards from petroleum and hydrogen sulfide (H₂S) gas. No smoking will be allowed at the site. Flames and sparking equipment should be kept away from wells. All workers or work crews will wear a personal H₂S monitor. If the H₂S exceeds the National Institute for Occupational Safety and Health (NIOSH) Recommended Exposure Limit (REL) of 10 parts per million (ppm) at any time, all work will cease and the area will be evacuated. Work will not resume until conditions improve. H₂S gas is also heavier than air and is more likely to accumulate in low-lying areas. To avoid this hazard personnel should not enter any excavations or trenches found on site. H₂S can cause eye irritation and is soluble in water, therefore personnel should not wear contact lenses when it is possible to encounter H₂S. Prior to working in an area where H₂S exposure could be a problem, the wind direction should be noted and an upwind escape route should be planned.

5.0 ACTIVITY-SPECIFIC REQUIREMENTS

5.1 Site Communication

Internal and external communications will be maintained to facilitate quick and smooth response to emergency situations. The following sections describe communication methods.

5.1.1 External Communication

External communication will be accomplished by telephone. The Field Task Leader will keep a cellular phone on-site at all times during the investigation.

All personnel must be familiar with the protocol (phone number of emergency organizations, contact person) for contacting public emergency aid teams such as fire departments, ambulance units, and hospitals. These numbers must be posted in the field logbook.

5.1.2 Internal Communication

Internal communication will be used among personnel to alert team members to emergencies, pass along safety information, and maintain site control. Verbal and visual signals will be necessary for internal communication. For effective communication, visual signals/commands must be pre-arranged. Both a primary and backup system are necessary.

5.2 Standard Work Uniform

TRC requires the following work clothing be worn by all contractors while on-site:

- Steel-toed boots which have a defined heel, are of the lace-up variety, and are ankle height or taller;
- Safety glasses with permanently attached side shields that meet or exceed American National Standards Institute (ANSI) Z 87.1-1989; and
- Ear plugs when noise levels exceed 85 dBA (i.e., unable to communicate in a normal voice level at arm's length distance from another individual);

5.3 Personal Protective Equipment

In addition to the standard work uniform, the following PPE will be worn within the Exclusion Zone, i.e., area within 25 feet of the work area.

Level D Protective Uniform

- Steel toed boots;
- Hard hat;
- Hearing protection when noise levels exceed 85 dBA as an 8-hour, time-weighted average;
- Tyvek coveralls when collecting samples from pits and tanks;
- Nitrile gloves when handling soil, water, and/or hydrocarbons.

Level C Protective Uniform

- Half-face (only for airborne levels of 1 to 10 parts per million [ppm]) with organic vapor/dust cartridges (refer to Section 8.2 for respirator use action levels);
- Full-face (only for airborne levels of 10 to 50 ppm) with organic vapor/dust cartridges (refer to Section 8.2 for respirator use action levels);
- Tyvek coveralls;
- Nitrile gloves when handling soil, water, and/or hydrocarbons.

Field Monitoring and Other Equipment

- Photoionization detector (PID) (calibrated with 100 ppm Isobutylene);
- Personal floatation devices;
- Personal H₂S Monitors;
- Snake guards;
- Wind indicator;
- First aid kit; and

- Fire extinguisher.

Conditions Warranting Upgrade from Level D to C (Notify SHSO)

- PID readings greater than 1 ppm above background in breathing zone for more than 1 minute; and
- Unusual odors (i.e., organic or aromatic) are noted.

Conditions Warranting Cessation of Work and Leaving Area Immediately (Notify SHSO)

- PID readings exceed 50 ppm above background in breathing zone for greater than 1 minute;
- The PID malfunctions (work may resume when meter is repaired);
- Odors (organic, aromatic, almond, mothball, sweet tarry, sweet pungent, or mint-like) are experienced while wearing respirators (indicating cartridge breakthrough);
- Any member of field team experiences symptoms possibly related to chemical exposure such as dizziness or nausea; and
- Any member of the field team experiences symptoms related to heat or cold stress.

5.4 Work Zones

Zones marked by barriers in which specific tasks are to be completed. These zones include the exclusion zone, contamination reduction zone, and support zone.

5.4.1 Exclusion Zones (to be marked by flagging, tape, etc., where feasible)

At a minimum, the Exclusion Zones will include at least a 25-foot radius around the work area.

5.4.2 Contamination Reduction Zones (CRZ)

Personnel performing equipment decontamination will wear PPE and follow the procedures for decontamination of equipment and personnel outlined in Section 5.5. All personnel and equipment must pass through one of the CRZ before leaving the site at the

end of each workday. A CRZ will be located at the edge of the Exclusion Zone for personnel and small sampling equipment decontamination. All other equipment will be decontaminated at the site decontamination area.

5.4.3 Support Zones

The Support Zone is intended as an area that remains free of contamination and is used for staging activities, breaks, and eating. It is extremely important to keep this area clean, and free of contamination. Never bring contaminated equipment, articles, or yourself into this area without going through the decontamination procedures first.

5.5 Decontamination Procedures

5.5.1 Equipment Decontamination

Drilling equipment and soil/water sampling equipment shall be fully decontaminated at the contamination reduction zones between and before they are removed from the site. Decontamination for drilling equipment will consist of soap and water wash and potable water rinse or using a high-pressure hot water or steam cleaning unit. Additional scrubbing may be required to remove all encrusted materials. Soil/water sampling equipment shall be cleaned between each use by the following procedures (1) removing any solids to the degree possible with a brush and tap water; (2) washing with a brush using laboratory-grade, non-phosphate detergent and tap water, (3) rinsing with tap water, (4) rinsing with 70-percent-grade isopropyl alcohol, and (5) rinsing with distilled water. All decontamination water will be contained and disposed of properly.

5.5.2 Personnel Decontamination

A personnel decontamination area will be designated as the CRZ. This CRZ will be located at the edge of each Exclusion Zone. Personnel will become thoroughly familiar with the following decontamination procedure before work begins in Exclusion Zones:

- Place equipment and/or samples in designated area, move to the next area (marked with signs), if necessary;
- Wash boots (overboots, if used) and outer gloves using soap (Alconox or equivalent) in water solution, and potable water rinse;
- Remove overboots (if used) and outer gloves, and place in plastic bags (in 30-gallon drum);

- Remove disposable coveralls and place in plastic bag in drum;
- Remove respirator (if used), thoroughly wash and store in a sealed bag outside the CRZ;
- Remove boots and store in appropriate location;
- Remove disposable inner gloves (if used) and place in plastic bag (in 30-gallon drum); and
- Wash hands and face with water and hand soap (especially before eating or drinking).

All decontamination water will be contained and disposed of properly.

It is recommended that after leaving the site at the end of the workday that personnel shower immediately at their place of lodging.

5.5.3 Storage Procedures for Expendable Clothing/Equipment

Used, expendable clothing and equipment shall be placed in drums labeled as “Waste PPE Material.” Proper disposal will be coordinated with the RRC.

6.0 GENERAL HEALTH AND SAFETY REQUIREMENTS

6.1 Responsibilities of the SHSO

The TRC SHSO is responsible for project safety, decontamination, environmental monitoring, and field medical monitoring activities. The SHSO will ensure that all field personnel comply with the provisions of this HSP. The SHSO has the authority to stop site work in the event of safety violations or if he/she makes the judgment that an upgraded level of personal protection may be required. Anyone may stop any operation that threatens the health and safety of personnel. The SHSO is responsible for designating and marking work zones and for restricting access to Exclusion Zones to properly attired personnel.

The SHSO reports directly to the CHSO. All safety-related questions should be referred to the CHSO. The SHSO will keep the CHSO and Project Manager informed of the status of safety-related site activities and assessments. The SHSO will notify the CHSO and Project Manager immediately of any exposure incidents, injuries, accidents, or emergency situations.

6.2 Health and Safety Clearances

TRC personnel authorized to go on-site must meet the following requirements:

- Successfully complete a basic 40-hour health and safety training course and 8 hours of refresher training each year following completion of the basic course;
- Successfully complete H₂S training for hydrogen sulfide exposure;
- At least one TRC field employee must have completed and be current for cardiopulmonary resuscitation (CPR)/First Aid Training;
- Receive clearances from a TRC-approved physician to wear respiratory protective devices and to work with hazardous materials; and
- Pass a respirator fit test.

6.3 Distribution of the HSP

A copy of this plan must be provided to each member of the site team covered by the plan and to an authorized representative of each TRC field subcontractor covered by its provisions. Each site team member receiving a copy of the plan must acknowledge

receipt of, and express willingness to comply with, the provisions of the plan by signing the attached compliance agreement form. The signed forms must be submitted to the Project Manager or Assistant Project Manager for filing.

6.4 Safety Briefings

All TRC and TRC subcontracted personnel scheduled for fieldwork at the Wendkirk oil field project area will receive an initial health and safety briefing by the SHSO prior to starting work activities. The briefing will include a thorough review of this HSP with particular attention to site-specific health and safety requirements and emergency response procedures. Daily briefings will be conducted by the SHSO on-site to reinforce health and safety awareness and to allow personnel the opportunity for comments or questions. All daily briefings will be documented.

6.5 On-Site Presence of Plan

A copy of this HSP must be present at the site each day that work is in progress.

6.6 Respirators

6.6.1 Usage

The following procedures shall be followed to ensure that air-purifying respirators provide the full protection for which they are rated:

- All employees who are required to wear respirators shall be included in the TRC Medical Monitoring Program and will be medically approved for respirator use before donning a respirator;
- Employees shall wear only respirators for which they have been fit-tested by a competent individual;
- Respirators are to be donned outside the potential hazard zone in which they are planned to be used;
- Prior to donning, the wearer shall inspect the respirator for any physical defects or breakage including, but not limited to:
 - + Broken or frayed straps,
 - + Improperly seated valves,

- + Dirt,
 - + Holes,
 - + Distorted face seal, and
 - + Opaque face piece on full-facepiece respirators.
- After donning the respirator, the employee shall conduct a negative-pressure fit check to assure that the inlet and exhaust valves, and the respirator cartridges, are properly seated. The employee shall then conduct a positive-pressure fit check to ensure that a proper face piece seal against the face has been obtained. The zone of potentially hazardous exposure is not to be entered until the employee has successfully executed both positive- and negative-pressure fit checks.
 - Employees shall immediately evacuate the work area if they experience difficulty breathing, dizziness, or other symptoms of potentially harmful chemical exposure.
 - Cartridges are to be replaced every morning at the beginning of the workday or when breakthrough is detected (whichever comes first).

Note: If at any time during use of the respirator, the contaminant of concern, or any other contaminant, is detected by smell, taste, or irritation, the employee is to leave the work area immediately and inform the SHSO.

6.6.2 Cleaning

Respirators assigned to an individual employee shall be cleaned by that employee at the end of each day's work involving more than four hours of respirator use and at the end of every week in which the respirator is used for at least two hours. Respirators are to be washed and rinsed in warm water (120 to 140°F) using a disinfecting solution intended for cleaning respirators, and blot or air-dried. Cleaning solutions, available from respirator manufacturers, will be provided on-site.

6.6.3 Storage

Respirators shall be stored in a manner that protects them from exposure to sunlight, dust, chemicals, and extremes of heat and cold. Respirators shall not be stored in tool kits. The preferred storage procedure for respirators is in individual plastic bags placed in rigid containers to prevent deformation of the facepiece.

7.0 SITE-SPECIFIC HEALTH AND SAFETY REQUIREMENTS

7.1 General Work Rules

- Fieldwork will be conducted only during daylight hours unless adequate lighting is provided.
- No smoking will be permitted at the site.
- In the event of direct skin contact by chemicals of concern, the affected area will be washed immediately with soap and water.
- In the event the PPE is ripped or torn, work shall stop and the PPE shall be removed and replaced as soon as possible.
- Personnel should never climb over or under refuse or obstacles so as to endanger themselves or others.
- Practice contamination avoidance. Never sit down or kneel, never lay equipment on the ground, avoid obvious sources of contamination such as puddles, and avoid unnecessary contact with on-site objects.
- Water samples to be analyzed for various contaminants may need to be, or already are, preserved with nitric acid, hydrochloric acid, or sulfuric acid before shipment to the analytical laboratory. Nitrile or polyvinyl chloride (PVC) gloves should be worn when handling these corrosive chemicals or samples preserved with them. Sample preservation should be performed in a well-ventilated area to avoid potential accumulation of toxic vapors. In circumstances where bad weather or poor lighting does not allow preservation at the site, preservation should be performed at a later time, or not at all. Samples should not be preserved in hotel rooms or other public areas.
- No eating, drinking, smoking, or any practice that increases the probability of hand-to-mouth transfer and ingestion of material will be allowed in the Exclusion or Contamination Reduction Zones.
- Hard contact lenses should not be worn in the Exclusion or Contamination Reduction Zones. No jewelry, which interferes with protective clothing fit, will be worn.

- No beards, sideburns, or mustaches will be allowed which interfere with respirator mask seals, if respirators are used. The SHSO will determine if facial hair presents such an interference.
- Field personnel should remain aware of wind direction throughout the day. Wind socks or flagging will be used for this purpose. Equipment setup and sampling efforts should be directed to the greatest extent possible so that workers remain upwind of potential sources of exposure.
- No drilling or earth moving activities will be permitted during periods of thunderstorms and lightning.
- Machinery, tools, material, electrical installation, and other equipment and work practices that are judged unsafe, or not in compliance with this HSP, OSHA, or other applicable standards, shall be removed or replaced or the work practice corrected. Only employees qualified by training and/or experience will operate equipment and machinery.
- Before excavating or sampling, an Exclusion Zone must be established around the equipment after it has been positioned. The boundary of the Exclusion Zone shall extend at least 25 feet from the work area, and, if practical, marked with stakes spaced no more than 20 feet apart and connected with fluorescent orange tape. Only authorized personnel will be allowed to enter Exclusion Zones.
- Representatives of federal, state, and local agencies; newspaper and other news media; the public; and all other individuals who are not a part of the TRC site team are classified as visitors and will not be permitted to enter Exclusion Zones under control by TRC, unless they can prove that they have met OSHA medical and training requirements for hazardous waste operation, have available to them PPE equivalent to that specified in this plan, and obtain permission from the TRC site or project manager.

7.2 Documentation

The following must be kept on file by the SHSO:

- Copies of the TRC Employee Health and Safety Compliance Agreement (attached) documenting health and safety briefings and personnel signatures;

- Records of usage and calibration of environmental monitoring equipment;
- Documentation of employee injury/exposure incidents;
- Records of safety violation and remedial actions taken;
- Documentation of subcontractors' compliance with TRC for health and safety training and medical monitoring.

A health and safety field logbook will be maintained on-site and should contain such information as weather conditions, employees and visitors on-site, level of personal protection, monitoring instrument readings (average, peak, and background), and subjects discussed during site health and safety briefings, and names of attendees. All field personnel, including subcontractors, must sign the TRC Employee Health and Safety Compliance Agreement indicating that they have attended a briefing by the SHSO, and that they understand and agree to abide by the provisions of this HSP, in addition to the provisions of their own health and safety plan prior to working at the Wendkirk oil field project area.

7.3 Site Specific Requirements

7.3.1 Housekeeping

Good housekeeping is of the utmost importance in the prevention of accidents, injuries, and fires. Clean-up will be conducted on a daily basis.

7.3.2 Spills

No contaminants are to be discharged on the Wendkirk oil field project area. Should it occur, it must be reported by the quickest means possible to the RRC representative with jurisdictional authority (this includes oils, diesel fuel, gasoline, etc.). Decontamination water is considered to be contaminated and should not be released onto the ground. All decontamination water spills should be reported to the TRC Field Team Leader for determination of appropriate action.

7.3.3 Operation of Vehicles and Equipment

Equipment and vehicles must operate at a safe speed being aware of operating conditions as well as other equipment and men working in close proximity. Extreme caution must be exercised at all grade crossings.

8.0 VAPOR/GAS MONITORING

Since a risk of inhalation exposure could be present, air monitoring will be conducted for organic vapors and hydrogen sulfide.

8.1 Monitoring Instruments

A PID with a 10.6 electron volt lamp, calibrated with 100 ppm isobutylene will be used to monitor organic vapors. The PID will be read in ppm. The action level was calculated, taking into account, the various constituents present at the site and their respective PELs.

The concentrations of hydrogen sulfide will be continuously monitored for each group of field employees using personal H₂S gas monitors. These monitors will be personal monitors to be worn in the vicinity of the employee's breathing zone. Each TRC employee will be provided a personal H₂S gas monitor. The monitors will be calibrated according to the manufacturer's recommendations.

8.2 Action Levels

Respirators must be donned by all persons working in any Exclusion Zone in which the average PID reading is 1 ppm above background in the breathing zone (for greater than 1 minute). Half-face respirators will be worn from 1 to 10 ppm and full-face respirators will be worn from 10 to 50 ppm. The Exclusion Zone must be evacuated whenever the average meter reading equals or exceeds 50 ppm above background in the breathing zone for greater than 1 minute.

H₂S is a colorless gas with a strong sulfurous odor similar to that of rotten eggs. Initially, the presence of the gas is easily detected by smell, but the sense of smell becomes rapidly fatigued and cannot be relied upon to indicate the continued presence of hydrogen sulfide gas. Furthermore, the sense of smell cannot recognize increasing concentrations of the gas. The personal gas monitors will be worn by each TRC employee. The alarms will sound if the H₂S gas concentration reaches the OSHA ceiling limit for eight-hour exposure of 10 ppm. If the concentration at any point exceeds the ceiling determined by OSHA, the area will be immediately be evacuated, using a predetermined upwind escape route, until the hydrogen sulfide concentrations have returned to safe levels.

If evacuation becomes necessary, the SHSO shall take charge and direct personnel to move from the Exclusion Zone to a predetermined area and to stay there. The SHSO

shall first determine that all personnel have left the Exclusion Zone and are safe, then consult the CHSO on how to proceed.

9.0 EMERGENCY PROCEDURES

Emergency procedures listed in this HSP are designed to give the field team instructions in handling medical emergencies, fire, and explosions.

9.1 Medical Injuries

Medical problems that can occur on-site need to be handled competently and quickly. Each field team member should be aware of the instructions and information given below:

- Seek professional medical attention for personnel that are bleeding severely, experiencing intense pain, unconscious, or not breathing. Each member of the site team should know how to call for an ambulance.
- If you get anything in your eyes (chemical or dust), flood them with water for 15 minutes. Be sure to tell the SHSO. The SHSO will make sure that the victim washes the eyes for the full 15 minutes.
- Do not remove objects that are impaled (stuck) in the eye.
- Always seek medical attention for eye injuries.
- Stop bleeding with direct pressure. Place bandage over the wound and press down with your hand. If possible, raise the bleeding extremity above the level of the heart. Use a tourniquet **ONLY** in extreme cases when you are not able to stop severe bleeding.
- If you contact the waste, wash the affected area with soap and water immediately.

9.2 Fire and Explosion Response Procedures

Fires can be caused by the drilling rig activity. The TRC field team should verify that the drilling rig has a fire extinguisher on hand at all times. The procedures for using a fire extinguisher is to **pull** the safety pin, **aim** the extinguisher at the base of the flames and discharge the extinguisher by **squeezing** and **sweeping** the flames from a distance of 6 feet (PASS-pull, aim, squeeze, sweep). Move in closer as the flames are put out.

- Never use water on an electrical fire or a solvent fire. All extinguishers should be dry chemical labeled “Class A, B, or C”; and

- Keep decontamination solvents well away from the steam cleaner.

9.3 Emergency Medical Information

TRC Safety Contact (site): _____

TRC Safety Contact (Austin): Arsin Sahba (512) 684-3137
(512) 789-9147

Project Manager Mark Robbins (512) 684-3107
(512) 917-9687

RRC District 7C: Brian Floyd (325) 657-7450

9.3.1 First Aid

First aid on the site will consist of a first aid kit. The kit will be brought to the site daily by the SHSO and be kept at the edge of the Exclusion Zone during site activities.

9.3.2 Hospitals

Personnel with any injuries shall be taken to the San Angelo Community Medical Center, which is located at a distance of approximately thirty (30) miles south from the Wendkirk oil field project area. Twenty-four hour emergency services have been confirmed for this hospital. Driving directions from the Wendkirk oil field project area to this San Angelo Community Medical Center (hospital) are provided in Appendix C of this HSP.

9.3.3 Emergency Numbers

Service	Address	Phone
Fire Department:	N Chadbourne San Angelo, Texas 76903	911 (325) 653-1960
Police Department:	13 E 7 th Street Robert Lee, Texas 76945	911 (325) 453-2717
Hospital:	San Angelo Community Medical Center 3501 Knickerbocker Road San Angelo, Texas 76904	911 (325) 949-9511
Ambulance Services:	Robert Lee Ambulance Service 307 W 8 th Street Robert Lee, Texas 76945	911 (325) 453-2511
Nearest phone: Cellular phone	Field Task Leader	(____) _____

Emergency Services are accessed through 911

10.0 SITE PERSONNEL ACKNOWLEDGE OF HSP

The following TRC site personnel have read, understand, and agree to comply with all of the health and safety directives for the Wendkirk oil field project area investigation.

Crew	Date

In addition, the following contractor personnel have been briefed on the site hazards, have reviewed their own HSP (per 29 CFR 1910.120(i)(2)), have completed the required 40-hour OSHA Training (per 29 CFR 1926.21 and 1910.120(e)), have been properly respirator fit tested, and are involved in their company's Medical Surveillance Program (per 29 CFR 1910.120(f)). They hereby acknowledge having met all the above stated requirements for working at the Wendkirk oil field project area.

Contractor Personnel	Company	Date
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

APPENDIX A

Potential Chemical Hazards

Table 5-2 Summary of Exposure Levels

CHEMICAL HAZARD DATA								
Chemical Name	Carcinogen (Y/N)	Skin Absorption Hazard (Y/N)	TWA					
			OSHA PEL	NIOSH REL	ACGIH TLV	OSHA STEL	IDLH	Routes of Exposure
Benzene	Y	Y	1.0 ppm	0.1 ppm	0.5 ppm	5 ppm	500 ppm	I,S,G,C
Toluene	N	Y	200 ppm	100 ppm	50 ppm	300 ppm	500 ppm	I,S,G,C
Xylene(s)	N	Y	100 ppm	150 ppm	100 ppm	N/A	900 ppm	I,S,G,C
Ethylbenzene	N	N	100 ppm	100 ppm	100 ppm	N/A	800 ppm	I,G,C
Hydrogen Sulfide (H ₂ S)	N	N	20 ppm	10 ppm	10 ppm	N/A	100 ppm	I,C
Hydrochloric Acid (HCl)	N	N	N/A	5 ppm	5 ppm	5 ppm	50 ppm	I,C
Sulfuric Acid (H ₂ SO ₄)	N	N	1 mg/m ³	1 mg/m ³	1 mg/m ³	N/A	15 mg/m ³	I,G,C
Nitric Acid (HNO ₃)	N	N	2 ppm	2 ppm	2 ppm	N/A	25 ppm	I,G,C
Isopropyl Alcohol	N	N	400 ppm	400 ppm	400 ppm	N/A	2000 ppm	I,G,C
Portland Cement	N	N	10 mg/m ³	10 mg/m ³	10 mg/m ³	N/A	5000 mg/m ³	I,G,C
Gasoline	Y	N	N/A	N/A	300 ppm	N/A	NA	I,S,G,C
Diesel Fuel	N	Y	N/A	N/A	100 ppm	N/A	NA	I,G,C
Diesel Exhaust	Y	N	N/A	N/A	0.15 mg/m ³	N/A	NA	I,C

TWA = Time-Weighted Average

PEL = Permissible Exposure Limit

REL = Recommended Exposure Limit identifying NIOSH

TLV = Threshold Limit Value identifying ACGIH

STEL = Short Term Exposure Limit

IDLH = Immediate Dangerous to Life or Health

Routes of Exposure: I = inhalation, S = skin absorption, G = ingestion, C = skin contact

ppm = parts per million

mg/m³ = milligrams per cubic meter (of air)

APPENDIX B

Material Safety Data Sheets

APPENDIX C

Map/Route to the Nearest Hospitals

Driving Directions from Wendkirk Oil Field (Mays Ranch) to San Angelo Community Medical Center at 3501 Knickerbocker Road, San Angelo, Texas 76904, Phone: (325) 949-9511

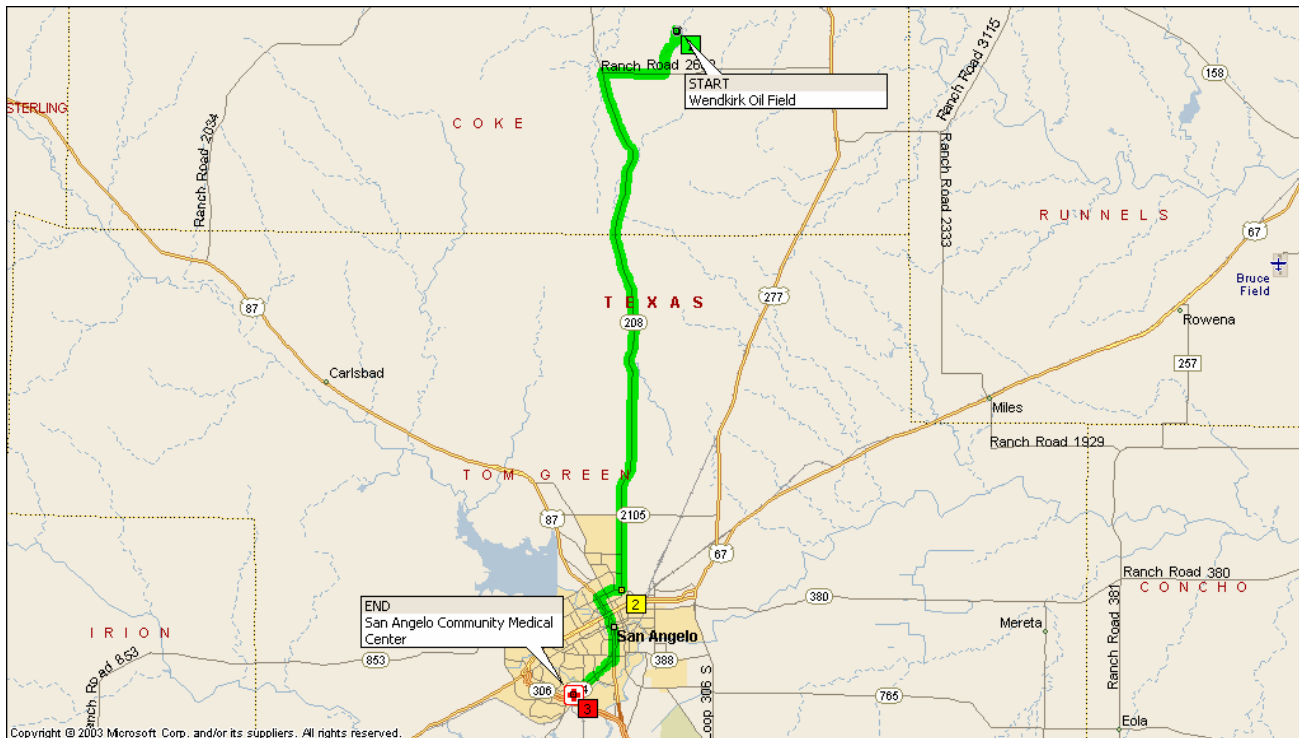
Driving Directions

For

Depart Wendkirk Oil Field on Mays Ranch Road (South)	1.5 mi
Turn RIGHT (West) onto Ranch Road 2662	2.6 mi
Turn LEFT onto SR-208	21.9 mi
Turn RIGHT onto SR-208 [E 19 th St.]	1.1 mi
Turn LEFT onto US-87 [N. Bryant Blvd.]	2.7 mi
Turn RIGHT onto Knickerbocker Rd. {FM 584}	2.2 mi
Arrive at San Angelo Community Medical Center	

Driving distance: 32 miles

Estimated time: 40 minutes



ATTACHMENT B

FIELD FORMS

		BORING #		Client			Date & Time	Start	
				Site				Finish	
Soil Sampling Method				Boring	Drill Method				
Water Level	Depth (ft bgs)				Diameter (in)		Depth (ft)		
	Date		Time			Grout			

Sample Interval (feet bgs)	Sample Recovery (inches or feet)	Sample Time & ID	Lithologic Interval (inches or feet)	Field Screening Data	Lithology (Particle Size in Percentage; Any Other Descriptions)	Color	Odor	Moisture	Toughness	Plasticity	Consistency	Cementation
									Clay & Silt Only			

		WELL #		Client				Date & Time	Start	
				Site					Finish	
Permit Number						Boring	Drill Method			
Soil Sampling Method							Diameter (in)		Depth (ft bgs)	
Well Depth		ft bgs		ft toc		Grout	Type			
Casing	Length (ft)		Diameter (in)				Interval (feet bgs)			
	Material		Length +/- Grade (ft bgs)			Seal	Type			
Screen	Length (ft)		Diameter (in)				Interval (feet bgs)			
	Material		Slot Size			Sand Pack	Type			
Bottom Cap	Length (ft)		Diameter (in)				Interval (feet bgs)			
	Material					Well Development				
Water Level	Depth (ft toc)					Surface Completion				
	Date			Time						

Sample Interval (feet bgs)	Sample Recovery (inches or feet)	Sample Time & ID	Lithologic Interval (inches or feet)	Field Screening Data	Lithology (Particle Size in Percentage; Any Other Descriptions)	Color	Odor	Moisture	Toughness	Plasticity	Consistency	Cementation	Well Diagram

