SITE INVESTIGATION WORK PLAN

BIGHOLE FEDERAL 13-01 FLOWLINE SPILL

CRAIG, COLORADO

October 26, 2012

Project #: 23X-001-001

SUBMITTED BY: Trihydro Corporation

1252 Commerce Drive, Laramie, WY 82070

PREPARED FOR: EMC Insurance Companies

Claim Number: 874451

Trihydro CORPORATION

ENGINEERING SOLUTIONS. ADVANCING BUSINESS.

Table of Contents

List of Tables

List of Figures

List of Appendices

A. PROJECT SCHEDULE

B. SOIL SCREENING SOP

C. SOIL SAMPLING SOP

D. FIELD DOCUMENTATION SOP

E. EXAMPLE FIELD FORM

F. EQUIPMENT DECONTAMINATION SOP

G. BORING LOG FORM

1.0 INTRODUCTION

This scope of work has been developed and is based on the understanding of the project requirements as outlined in the Notice of Alleged Violation (NOAV) dated August 6, 2012, which was amended on September 28, 2012 and the meeting conducted on August 30, 2012 with the Colorado Oil and Gas Conservation Commission (COGCC), J-W Energy (JWE), Trihydro Corporation (Trihydro) and ECC Horizons (ECC). On August 6, 2012, the COGCC issued a NOAV to JWE for a discharge at the Bighole Federal 13-01 (API# 05-081-06242) well site located in the Sand Wash Basin Oil Field, northwest of Craig, Colorado. On August 30, 2012, representatives of the COGCC met with representatives of JWE, ECC and Trihydro to discuss the following issues at the site:

- Discharge of produced water and condensate from an abandoned flow line
- Current and future disposition of the abandoned flow line

This work plan describes site investigation activities and evaluation of remediation alternatives in response to the discharge of produced water and condensate from an abandoned flow line at the site. The current and future disposition of the abandoned flow line will be addressed by JWE under separate cover.

2.0 SITE INFORMATION

The following information is provided to describe the site setting, discharge and initial response actions, and regulatory considerations.

2.1 SITE SETTING

The Bighole Federal 13-01 well site is located in Moffat County Colorado, approximately 35 miles northwest of the town of Craig near the intersection of County Road 7 and 42, as shown on Figure 1. The site is located within the Sand Wash Basin Oil Field. In addition to petroleum field operations, the area is used for grazing. The local climate is arid, and vegetation is dominated by sage brush and dry land grasses. The closest surface water feature is an ephemeral drainage identified as Bighole Gulch. An unnamed ephemeral tributary to Bighole Gulch is located adjacent to the site, and generally defined by larger trees and shrubs rather than a well-defined channel.

2.2 DISCHARGE AND INITIAL RESPONSE ACTIONS

In April 2012, the well field operator noticed standing water near an access road to the Raftopoulos 14-12 well site. Upon investigation it was determined that a valve was left open at the tank farm located at the Bighole Federal 13-01 well site located approximately 1 mile to the southeast. The valve that was left open was associated with a pumping station that pumped the produced water that was collected at the tank farm to an injection well located approximately 2 miles to the northwest. The produced water leaked out of the pumping station into the bermed area around the pumping station. The water then drained into a 3-inch metal pipe that was buried just under the surface of the ground. The 3-inch metal pipe had been abandoned in place after it was replaced with a new 3-inch HDPE pipe approximately 7 years ago. The produced water that drained into the abandoned pipe surfaced at a low spot between the pump house and the injection well. It was estimated that approximately 1,000 barrels of produced water was discharged at this location. The tank farm pumping station and associated site features are identified on Figure 2.

JWE mobilized an excavation contractor to pump standing water and remove visually impacted soils. The initial response to the discharge consisted of removal of produced water, and excavation of impacted soils from around the pipe. The excavation was estimated to be approximately 130 feet (ft) long, 20 ft wide, and 12 feet deep. Approximately 800 cubic yards (CY) of impacted soils were removed and stockpiled on the Raftopoulos 14-12 well pad, Figure 2.

A site walk was performed by JWE and Trihydro on August 28, 2012. The intent of the site walk was to observe the origin of the spill, work performed to date, and impacted soils stockpiled during initial response activities. Visual inspection of the area did not provide indications that the discharged produced water reached Bighole Gulch, an adjacent tributary.

2.3 REGULATORY CONSIDERATIONS

COGCC issued a NOAV, Document No. 20035833, on August 6, 2012, in response to the discharge of produced water. The NOAV referenced the following description of alleged violation:

> *Unauthorized discharge of produced water and condensate from an abandoned flow line. The subject release threatened Waters of the State, specifically an unnamed tributary to the Big Hole Gulch and associated wetlands. Failure to submit a site investigation & remediation work plan for prior approval. Failure to analyze samples for the contaminants listed in COGCC Table 910-1.*

On August 30, 2012, representatives of the COGCC, JWE, Trihydro, EMC, and ECC (consultant to EMC) met to discuss the NOAV. This work plan is proposed to comply with the COGCC requirements for a Site Investigation Work Plan, and is provided as an attachment to COGCC's Form 27, Site Investigation and Remediation Work Plan.

3.0 SITE INVESTIGATION

The scope of work for this project is summarized as follows:

- Characterize the soils adjacent to and below the excavation created by the initial response activities to determine if residual concentrations are below those defined by COGCC Rule 900, Table 910.1.
- Characterize the excavated soils stockpiled in conjunction with the initial response activities.
- Identify remediation alternatives for impacted soils, and identify a preferred alternative.

Field work will be scheduled with the driller and other interested parties once COGCC has approved the work plan. It is anticipated that the field work will be conducted before winter and should take one to two days to complete during one mobilization. A proposed project schedule is provided in Appendix A.

3.1 SAFETY

A Health and Safety Plan (HASP) will be prepared and will be available on-site while workers are present. The HASP will include an emergency action plan, job safety analysis forms, material safety data sheets, site control plan, spill containment plan, and decontamination procedures. For the work proposed, personnel are expected to use Modified Level D personnel protective equipment, including hard hats (as necessary), gloves, steel-toed boots, ear plugs (as necessary), and safety glasses. Site personnel, including subcontractors will be required to read and acknowledge the contents of the HASP prior to initiating field work. Job Safety Analysis forms for soil sample collection and vehicle operation will be reviewed in the field. Subcontractor field personnel will attend a daily safety briefing conducted by Trihydro personnel at the start of each day to review hazards and site-specific safety information.

3.2 ORIGINAL EXCAVATION

Soil sampling in the vicinity of the excavation created by initial response activities is proposed to evaluate the adequacy of soil excavation activities. Because the initial excavation was subsequently backfilled, the original excavation contractor will be contacted to identify the location and extent of the original excavation. Produced water pipeline locations near the excavation will be identified by private utility locates (if pipelines can be traceable) or potholing. Field and laboratory procedures are provided in the following sections.

3.3 SOIL BORINGS

The perimeter of the original excavation will be identified based on information provided by the original excavation contractor and existing surface indications. Based on the rectangular configuration of the original excavation, eleven boring locations will be identified using the following criteria:

- Three soil borings will be located in native soils adjacent to the two long sides of the original excavation, for a total of six borings (i.e., three on each side).
- One soil boring will be located in native soils adjacent to the two short sides of the original excavation, for a total of two borings (i.e., one on each end).
- Three soil borings will be located in the interior of the original excavation, along the long axis.

Soil borings will be installed with a geoprobe. Soil borings around the perimeter of the original excavation will be advanced to the reported depth of the original excavation, or approximately 12 ft below ground surface (bgs). Soil borings within the interior of the original excavation will be advanced to approximately 1 ft below the reported depth of the original excavation. Soil cores will be collected and inspected throughout the entire sample length. Soil cores will be obtained using a hollow tube sampling device equipped with acetate liners. Upon completion of each boring, the boring will be backfilled bentonite and investigative derived waste will be added to the stockpile.

3.3.1 FIELD SCREENING AND SAMPLE COLLECTION

Recovered soil cores will be visually observed, described, and recorded. A photo-ionization detector (PID) equipped with a 10.6 eV lamp and calibrated using a 100 parts per million (ppm) isobutylene gas standard will be used to field screen recovered soil cores. The PID will be placed inside the acetate liner at 2-ft intervals to identify the presence of volatile organic compounds (VOCs), and the associated measurements will be recorded.

The results of field screening activities will be used to select intervals for confirmation sampling and laboratory analysis. A soil sample from the interval with the highest PID reading in each boring will be collected. If the PID is unresponsive for soil borings around the perimeter of the excavation, a soil sample will be collected from between 4 and 8 ft below ground surface (bgs), which is the reported burial depth of the abandoned produced water line. If the PID is unresponsive for soil borings through the interior of the original excavation, a soil sample will be collected from the uppermost interval of native soil (if it is apparent), or the bottom of the boring. Standard operating procedures (SOPs) for soil screening and sampling are provided in Appendices B and C, respectively. Soil samples will be managed as described in Section 3.5.

3.3.2 LABORATORY ANALYSIS

As per COGCC Rules 910.b.(3)E and 910.b.(3)F, soil samples shall be submitted for laboratory analysis of pH, electrical conductivity (EC), sodium adsorption ratio (SAR), total petroleum hydrocarbons (TPH) as gasoline range organics (GRO) and diesel range organics (DRO). Samples will also be prepared for analysis of Benzene, Toluene, Ethylbenzene and Xylenes (BTEX) and the Polynuclear Aromatic Hydrocarbons (PAHs) – Table 910-1 listed compounds only. Decision criteria for BTEX and PAHs analysis of confirmation soil samples from the original excavation are provided in Figure 3.

Soil sample aliquots will be stored for up to 6 months should metals analysis be required. Decision criteria for metals analysis of confirmation soil samples from the original excavation are provided in Figure 4.

Soil samples will be stored by the laboratory at 4 (±2) ºC and analyzed using the methods within the noted in Table 1.

TABLE 1. CONFIRMATION SOIL SAMPLE ANALYTES LABORATORY METHODS AND HOLDING TIMES

Analyte	Analysis Method[1]	Sample Holding Time
pH	USDA Agricultural Handbook 60	Unknown
EC	USDA Agricultural Handbook 60	Unknown
SAR (Na, Ca, and Mg)	USDA Agricultural Handbook 60	Unknown
TPH (GRO and DRO)	USEPA SW-846 Method 8015	14 days
BTEX	USEPA SW-846 Method 8260B	14 days
PAHs (Table 910-1 only)	USEPA SW-846 Method 8270C	14 days for extraction; 40 days after extraction for analysis.
Total Metals	USEPA SW-846 Method 6010B	180 days

[1]Laboratory reporting limits will be below concentrations listed in COGCC Rule 900, Table 910-1.

3.4 STOCKPILED SOILS

3.4.1 SAMPLE COLLECTION

Soil samples will be collected from the soils stockpiled during the initial response activities, and analyzed to evaluate remediation alternatives, which may include on-site treatment and/or disposal at a landfill. A backhoe or hand auger will be used to collect three composite soil samples (i.e., a rate of one per 500 CY) from the stockpiled soils. The soils collected for BTEX analysis will be a grab sample to avoid volatilization during the compositing process. Samples will be collected based on areas with positive visual or olfactory indications of contamination, in an effort to be representative of the worst-case scenario. An SOP for soil sampling is provided in Appendix C. Soil samples will be managed as described in Section 3.5.

3.4.2 LABORATORY ANALYSIS

Samples of stockpiled soils will be analyzed as per the procedures described in Table 2. Analytes have been selected based on COGCC regulations, and waste screening criteria identified by the Milner Landfill in Steamboat Springs, Colorado. Additional analytes are also identified to evaluate the potential for on-site bioremediation.

TABLE 2. STOCKPILED SOIL SAMPLE ANALYTES LABORATORY METHODS, AND PURPOSE

Analyte	Laboratory Analysis Method[1]	Purpose
pH	USDA Agricultural Handbook 60	Landfill/COGCC
Total Metals[2]	USEPA SW-846 Method 6010B	Landfill/COGCC
TPH-DRO/TPH-GRO	USEPA SW-846 Method 8015	Landfill/COGCC
BTEX	USEPA SW-846 Method 8260B	Landfill/COGCC
Flashpoint	M1030	Landfill
TCLP (metals)	USEPA SW-846 Method 6010B	Landfill
Nitrogen	M351.2	Bioremediation/COGCC
Phosphorous	M365.1	Bioremediation/COGCC
EC	USDA Agricultural Handbook 60	Bioremediation/COGCC
SAR	USDA Agricultural Handbook 60	Bioremediation/COGCC

[1]Laboratory reporting limits will be below concentrations listed in Table 910-1 of COGCC Rule 900

[2] As listed on COGCC Rule 900, Table 910-1

3.5 BACKGROUND SOILS

Three discrete background soil samples will be collected from different locations on the lease site and analyzed for pH, EC, SAR, and arsenic to determine background concentrations. Background samples will be collected from areas that appear to be clean and undisturbed within the lease area. Background soil samples will be collected from approximately 4-8 ft bgs, to be consistent with the default sampling depth for confirmation samples from around the perimeter of the original excavation. An SOP for soil sampling is provided in Appendix C. Soil samples will be managed as described in Section 3.5. Background soil samples will be analyzed as per the relevant laboratory procedures described in Section 3.2.3.

3.6 SAMPLE MANAGEMENT

Soil samples will be placed in containers prepared and provided by the laboratory. The containers will be labeled with the client's name, sample location, date and time of sample collection, analytes for which the sample will be analyzed, and the sampler's initials. After each sample is collected, the lid will be immediately placed onto the container and tightened. Soil samples will be placed on ice in a cooler until they are transported to the laboratory under standard chain of custody procedures. One chain of custody form will be completed for each cooler. A custody seal will be placed on each cooler, and then the coolers will be shipped overnight to the analytical laboratory.

3.7 FIELD DOCUMENTATION

Field observations will be recorded in a field logbook. Field personnel will document the date, weather conditions, sampling site condition, time of sampling, health and safety measures implemented deviations from the work plan or clarifications of sampling procedures, and any other pertinent information. Photographs will be taken and annotated. Field forms will be filled out to record borehole depth, presence of odor or staining, soil description, and PID readings.

An SOP for field documentation and sample field forms are included in Appendices D and E, respectively.

3.8 EQUIPMENT DECONTAMINATION

To the extent possible disposable sampling equipment will be utilized to avoid decontamination of equipment. If equipment decontamination is required this will be performed using a non-phosphate detergent wash, rinsed with potable water, and a final deionized water rinse. An SOP for equipment decontamination is provided in Appendix F.

3.9 INVESTIGATION-DERIVED WASTE MANAGEMENT

Soils generated in conjunction with this work plan will not be used to backfill soil borings but will be placed with the stockpiled soils associated with the original excavation.

4.0 QUALITY ASSURANCE/QUALITY CONTROL

The quality assurance (QA) objectives provide quantitative and qualitative measures of the ability to produce high quality results through a properly designed sampling and analysis program. The objectives of the overall QA program are to:

1. Ensure that all procedures are documented, including any changes from the work plan protocol.
2. Ensure that all sampling and analytical procedures are conducted according to sound scientific principles.
3. Monitor the performance of the field sampling team and laboratory with a systematic audit program and provide for corrective action necessary to assure quality.
4. Evaluate the quality of the analytical data through a system of quantitative and qualitative criteria.
5. Ensure that all data and observations are properly recorded and archived.

4.1 FIELD OBJECTIVES

The procedures to evaluate field data for this investigation include checking for transcription errors and review of field logbooks, on the part of field team. The field data and field notes will be reviewed and signed after each day of sampling. The objectives of this review are to identify and correct errors in the field notes before the recollection of the field observations becomes dimmed by time.

The following quality control (QC) samples will be collected (or supplied) and analyzed for the following analytes:

Blind Duplicate Samples: One soil blind duplicate will be collected from the same core as the parent confirmation sample. The duplicate sample will be analyzed for the same analytes as the parent sample.

Equipment Rinseate Blanks: One equipment rinseate sample will be collected during soil confirmation sampling and analyzed for metals (only if confirmation samples are analyzed for metals).

Trip Blanks: One aqueous trip blank for each cooler will be analyzed for BTEX.

4.2 LABORATORY OBJECTIVES

The analytical laboratory will have a QC program in place to ensure the reliability and validity of the analysis performed at the laboratory. The internal QC checks include: Method blanks, instrument blanks, surrogate spikes, laboratory duplicates, laboratory control standards, internal standard areas for GC/MS analysis, and mass tuning for GC/MS analysis. All data obtained will be properly recorded. The data package will include a full deliverable package capable of allowing the recipient to reconstruct QC information and compare it to QC criteria.

4.3 DATA VALIDATION

A data validation review will be completed on all data received from the laboratory. The data validation will include Tier I and Tier II reviews. Qualifiers will be applied to the data based on the data validation review. The following criteria will be evaluated during the Tier I and II data validation process:

1. **Chain-of-Custody:** Is the chain-of-custody complete and were the analytical method(s) specified?

2. **Sample Check-in Conditions:** Did the samples arrive at the correct temperature and with the correct container count? Were the sample labels complete and was integrity of the samples and the container maintained?

3. **Holding Times:** Were the samples extracted within the method specified holding times? Were the extracted sample analyzed within the method specified holding time?

4. **Dilutions/Method Reporting Limits:** Were any samples diluted to an extent that the resulting reporting limits were raised to a degree which would render the associated data points unsuitable for the projects data quality objectives? Were the dilutions necessary and unavoidable? Is re-analysis of the sample extract possible or feasible?

5. **Were the following laboratory QC parameters within acceptable range?** Laboratory Control Samples, Matrix Spike/Matrix Spike Duplicate Recovery, Duplicate Sample Repeatability, Surrogate Recoveries, and Instrument Performance Checks.

5.0 DATA EVALUATION AND REPORTING

Following data quality evaluation activities, soil data will be compared to the standards in COGCC Rule 900, Table 910-1. COGCC Form 27 will be updated, and a summary report will be prepared and include:

- Summary of field, laboratory, and data validation activities
- Tabulation of current soil monitoring data
- Location map to identify the proximity of the site to relevant features
- Site map including soil sampling locations
- Summary of observations and conclusions
- Copies of field documentation and photos, laboratory report, and Tier II data validation report

6.0 REFERENCES

USEPA, 2005. SW-846 Online: Test Methods for Evaluating Solid Waste, Physical/Chemical Methods.

USEPA, 2007. Contract Laboratory Program (CLP) National Functional Guidelines for Superfund Organic Methods Data Review, U.S. Environmental Protection Agency, July 2007.

FIGURES

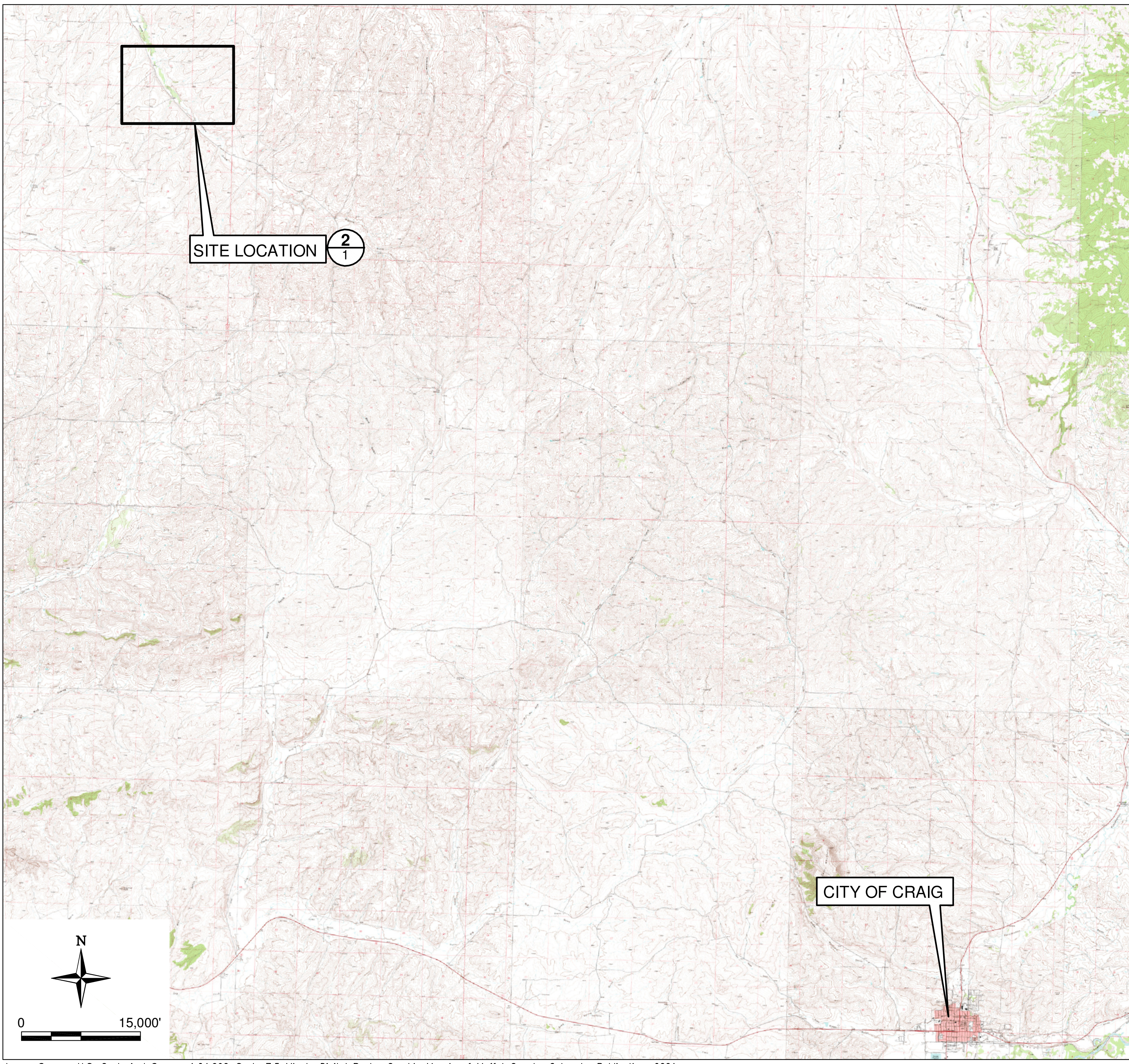


Image Source: U.S. Geological Survey, 1:24,000-Scale 7.5 Minute Digital Raster Graphic Mosaic of Moffat County, Colorado, Publication: 2001

1 USGS SITE LOCATION
SCALE: 1" = 15,000'

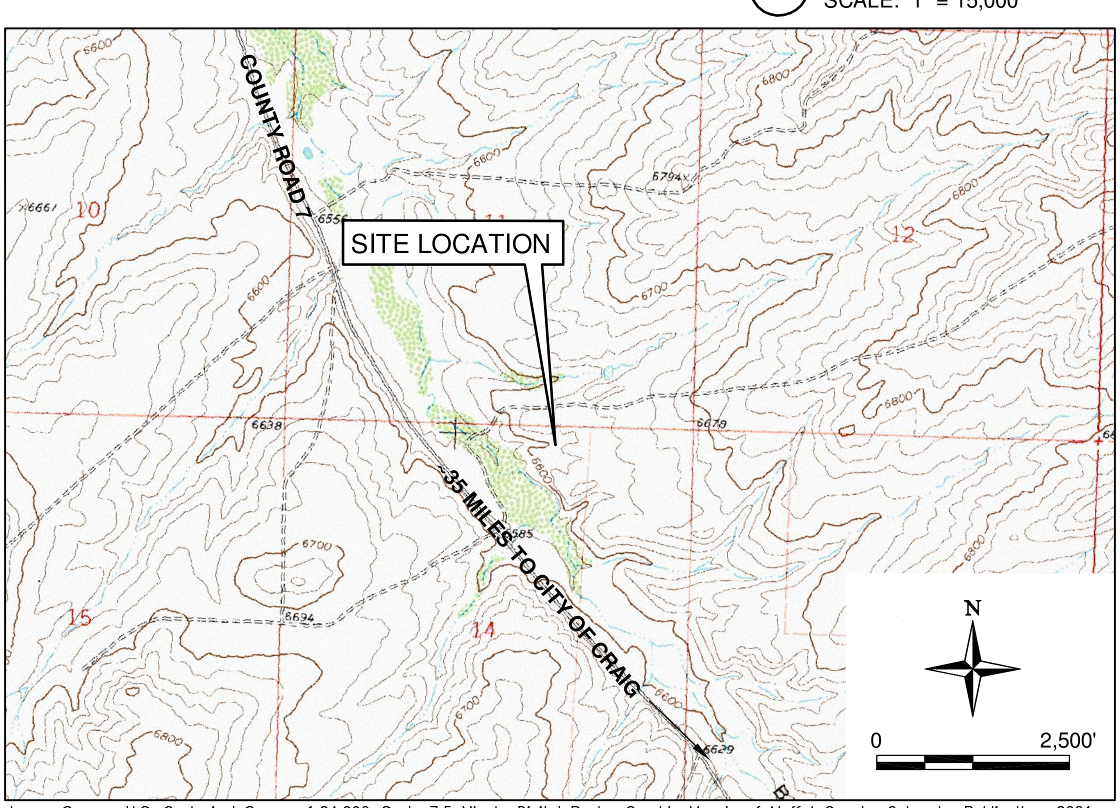
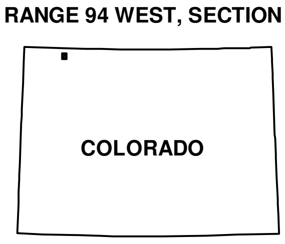


Image Source: U.S. Geological Survey, 1:24,000-Scale 7.5 Minute Digital Raster Graphic Mosaic of Moffat County, Colorado, Publication: 2001

2 ZOOMED USGS SITE LOCATION
SCALE: 1" = 2,500'

NOTE:

SITE LEGAL DESCRIPTION - TOWNSHIP 10 NORTH, RANGE 94 WEST, SECTION 11



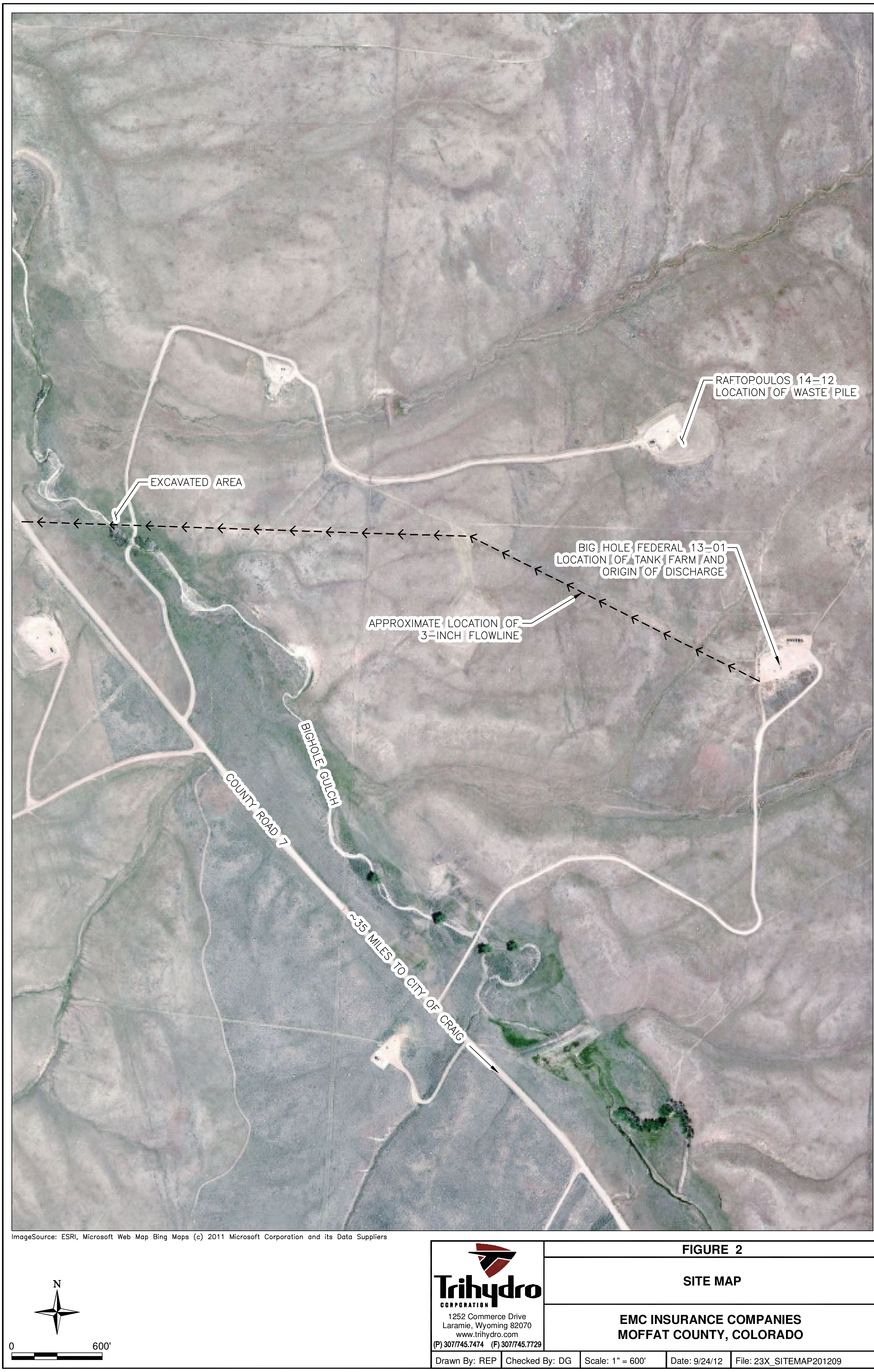
Trihydro CORPORATION
1252 Commerce Drive
Laramie, Wyoming 82070
www.trihydro.com
(P) 307/745.7474 (F) 307/745.7729

FIGURE 1

USGS LOCATION MAP

EMC INSURANCE COMPANIES
MOFFAT COUNTY, COLORADO

Drawn By: REP	Checked By: DG	Scale: AS SHOWN	Date: 10/1/12	File: 23X_USGS201209



ImageSource: ESRI, Microsoft Web Map Bing Maps (c) 2011 Microsoft Corporation and its Data Suppliers

Trihydro CORPORATION
1252 Commerce Drive
Laramie, Wyoming 82070
www.trihydro.com
(P) 307/745.7474 (F) 307/745.7729

FIGURE 2

SITE MAP

EMC INSURANCE COMPANIES
MOFFAT COUNTY, COLORADO

Drawn By: REP	Checked By: DG	Scale: 1" = 600'	Date: 9/24/12	File: 23X_SITEMAP201209

FIGURE 3. BTEX AND PAH ANALYSIS DECISION CRITERIA

Trihydro

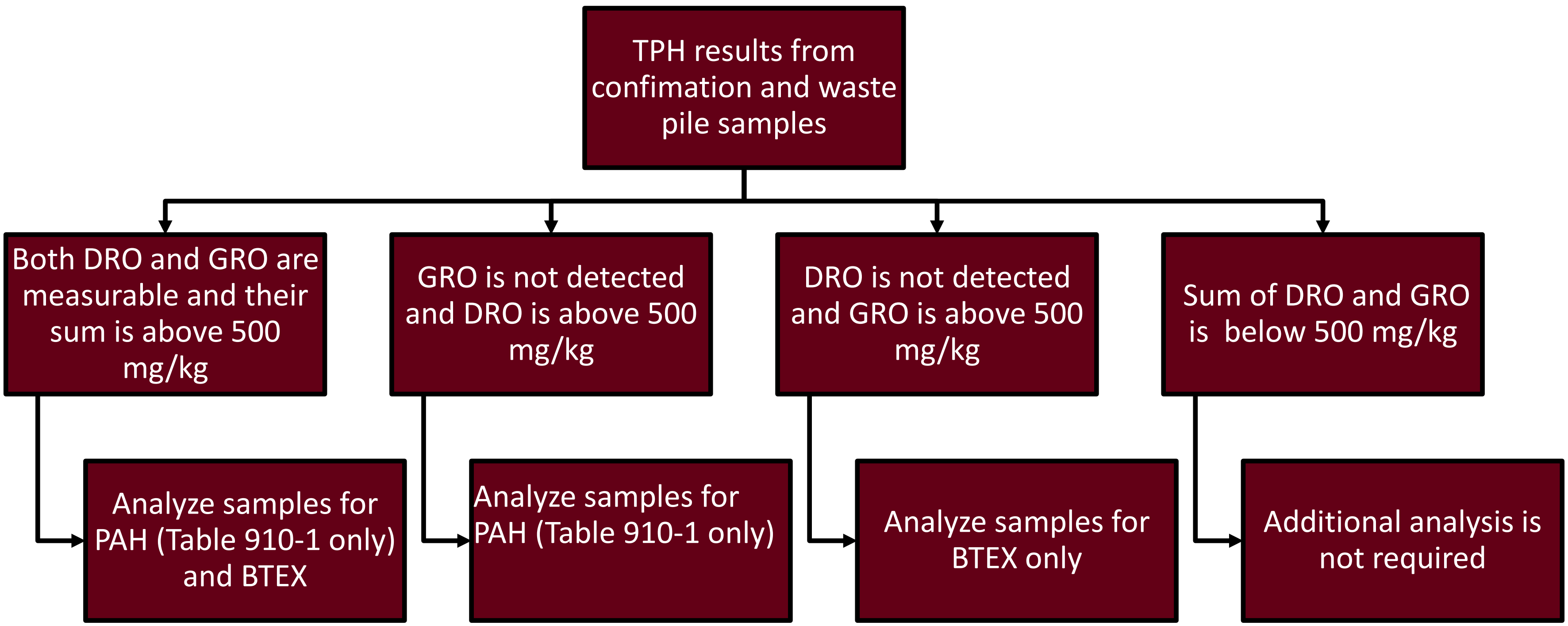
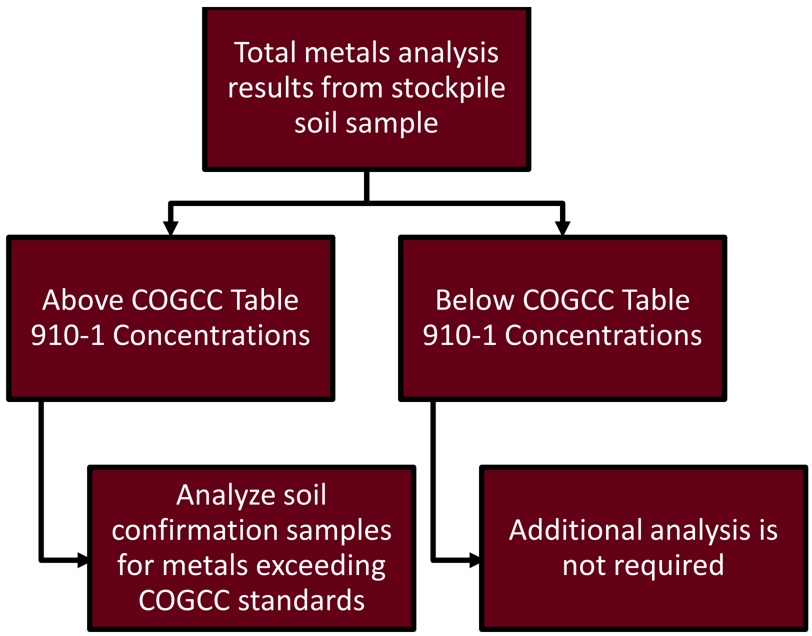
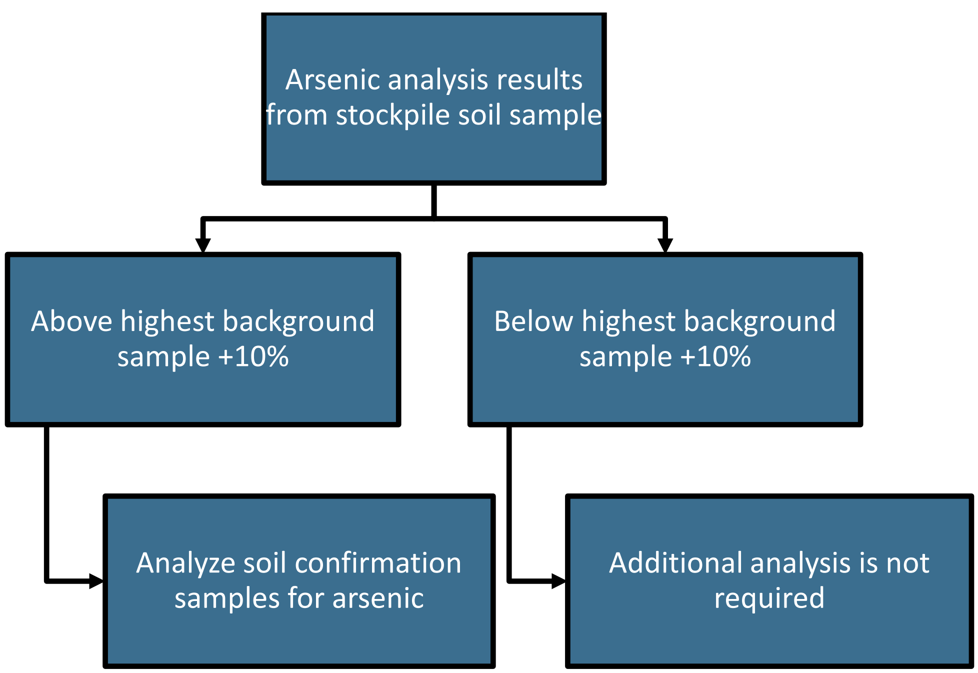


FIGURE 4. METALS ANALYSIS DECISION CRITERIA

Total Metals Analysis Decision Criteria



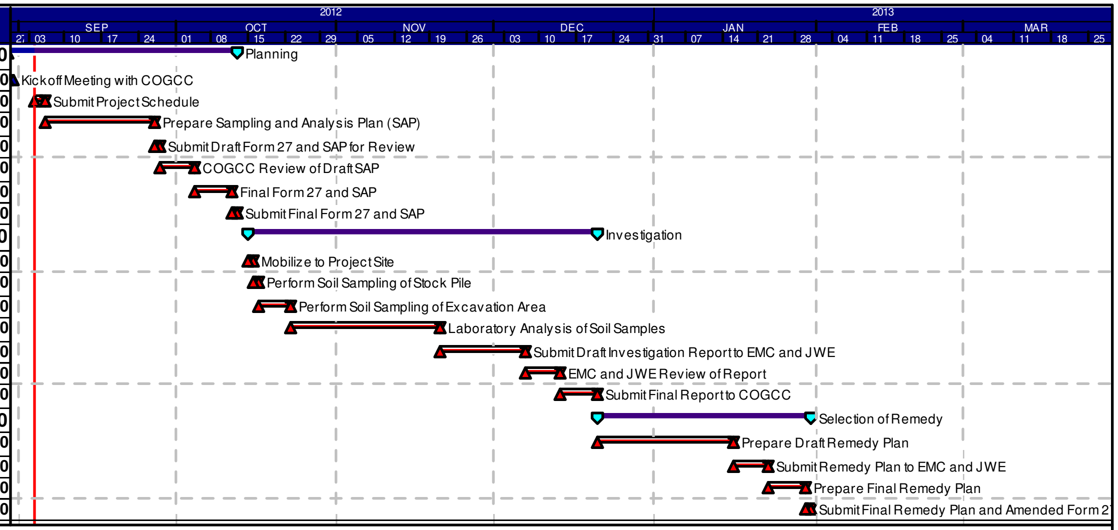
Arsenic Analysis Decision Criteria



APPENDIX A

PROJECT SCHEDULE

Outline Code	Activity Description	Rem Dur	Early Start	Early Finish	Total Float	%
1	**Planning**	29 *	08/30/12	10/12/12	0	0
1.1	Kickoff Meeting with COGCC	0	08/30/12	08/30/12		100
1.2	Submit Project Schedule	2	09/04/12	09/05/12	0	0
1.3	Prepare Sampling and Analysis Plan (SAP)	15	09/06/12	09/26/12	0	0
1.4	Submit Draft Form 27 and SAP for Review	1	09/27/12	09/27/12	0	0
1.5	COGCC Review of Draft SAP	5	09/28/12	10/04/12	0	0
1.6	Final Form 27 and SAP	5	10/05/12	10/11/12	0	0
1.7	Submit Final Form 27 and SAP	1	10/12/12	10/12/12	0	0
2	**Investigation**	47 *	10/15/12	12/20/12	0	0
2.1	Mobilize to Project Site	1	10/15/12	10/15/12	0	0
2.2	Perform Soil Sampling of Stock Pile	1	10/16/12	10/16/12	0	0
2.3	Perform Soil Sampling of Excavation Area	4	10/17/12	10/22/12	0	0
2.4	Laboratory Analysis of Soil Samples	21	10/23/12	11/20/12	0	0
2.5	Submit Draft Investigation Report to EMC and JWE	10	11/21/12	12/06/12	0	0
2.6	EMC and JWE Review of Report	5	12/07/12	12/13/12	0	0
2.7	Submit Final Report to COGCC	5	12/14/12	12/20/12	0	0
3	**Selection of Remedy**	26 *	12/21/12	01/30/13	0	0
3.1	Prepare Draft Remedy Plan	15	12/21/12	01/15/13	0	0
3.2	Submit Remedy Plan to EMC and JWE	5	01/16/13	01/22/13	0	0
3.3	Prepare Final Remedy Plan	5	01/23/13	01/29/13	0	0
3.4	Submit Final Remedy Plan and Amended Form 27	1	01/30/13	01/30/13	0	0



Start date	09/04/12 12:00AM
Finish date	01/30/13 4:59PM
Data date	09/04/12 12:00AM
Run date	09/04/12 7:00PM
Page number 1A	

JW-Energy, Great Divide, CO

- Early start point
- Early finish point
- Early bar
- Total float point
- Total float bar
- Progress bar
- Critical bar
- Summary bar
- Progress point
- Critical point
- Summary point
- Start milestone poin
- Finish milestone po

APPENDIX B

SOIL SCREENING STANDARD OPERATING PROCEDURE

TRIHYDRO CORPORATION

FIELD SCREENING

STANDARD OPERATING PROCEDURES

EMC INSURANCE COMPANIES

CRAIG, COLORADO SITE

The purpose of this Standard Operating Procedure (SOP) is to establish procedures for conducting field screening of soil samples. Field screening of soil samples involves the qualitative and quantitative field assessment of various indicators of potential contamination. Field screening procedures employed will include scanning the soil core and measurement of sample headspace for total organic vapors (TOV) using a photoionization detector (PID) and observation of visual/olfactory indicators.

Other soil field screening methods, such as the use of pH meters, chemical-specific detector tubes (Draeger tubes), soil-gas test kits, fiber optic chemical sensors, colormetric test kits, immunoassay test kits, portable infrared detectors (IR) and gas chromatography/mass spectrometry (GC/MS), are available. However, Trihydro Corporation does not routinely utilize these methods for field screening. If specific Work Plans require their use, procedures will be specified in the project Work Plans.

The PID uses an ultraviolet light source to ionize components of an incoming source. The ionization potential of the light source relative to the target compound governs the sensitivity of the instrument. Select a bulb having an ionization potential (commonly 8.4, 9.5, 10.2, and 11.7 electron volts [eV]) that is approximately equal to or greater than the target compounds. The PID will commonly detect compounds having ionization potentials up to 0.3 eV greater than the bulb value.

Use a PID when the presence of carbon-based volatile organic compounds is suspected to be present. Target compounds include hydrocarbons (benzene, toluene, etc.), halocarbons (carbon tetrachloride, vinyl chloride, Freon, etc.), solvents (tetrachloroethylene, trichloroethylene, etc.) and oxygenates (acetone, MTBE, etc.) which volatilize in air.

The steps used to conduct field screening of soil media are as listed below.

Step 1	Immediately after exposing the soil core, collected an approximate 100-gram aliquot of soil from each sampling interval using a clean, decontaminated stainless steel knife or spatula.
Step 2	Add the soil sample to a plastic zip top bag. Place the sealed container in a covered area (not in direct sunlight) for 15 minutes to allow organic constituents to volatilize to the headspace.

Step 3	Insert the PID probe tip into the baggie. Avoid contacting the soil or any fluids that may have collected in the sample container with the probe tip.
Step 4	Allow the instrument to stabilize, usually within 5 seconds of exposure to the headspace gas and note the highest measured instrument reading. Record the reading into field notes. If there are erratic readings (due to high TOV or moisture), obtain additional readings to obtain a representative headspace measurement.
Step 5	Allow the instrument to "zero-out" prior to taking a measurement for subsequent samples or re-measuring a sample.
Step 6	Note the presence of any visual indicators of contamination (staining or discoloration and/or sheen. Note the presence of any phase-separated liquids. Document your observations into field notes.
Step 7	Note and characterize the presence of any unusual odors in the working space over the sample. Describe odors in generic terms such as "gasoline-like", "musty", "sweet", "pungent", etc.

Note: PID readings are not recommended for saturated soils due to the potential for constituents in groundwater to potentially increase the TOV readings if groundwater is impacted, and the presence of liquid could affect the volatilization rate from the soil to the gaseous phase.

APPENDIX C

SOIL SAMPLING STANDARD OPERATING PROCEDURE

TRIHYDRO CORPORATION

SOIL SAMPLING

STANDARD OPERATING PROCEDURES

EMC INSURANCE COMPANIES, CRAIG COLORADO SITE

The purpose of this Standard Operating Procedure (SOP) is to establish procedures for collecting soil samples. Subsurface samples are most commonly collected using direct-push drill rigs. Coordination with the driller during pre-mobilization preparation is critical to assure that sampling objectives can be met.

The procedures for soil sampling with direct-push techniques are described below.

Step 1	Coordinate with the One Call for utility clearances prior to any. Prepare the drilling location by scraping away loose surficial material (gravel, sand, vegetation, etc.) that may fall into the boring as the borehole is advanced.
Step 2	If there is any potential for unknown subsurface utilities/structures, probe the soils with a shovel or rod to a minimum depth of five feet below ground surface (soils permitting), to assess for unmarked subsurface utilities or obstacles.
Step 3	Measure the interval from the tip of the drill bit to known points (joints or chalk marks on the drill rod) to establish the exact depth of the boring. Pre-mark the drill rod with a "total depth mark" to ensure arrival at the top of the intended sample interval.
Step 4	Remove the drill rod and install a clean, decontaminated sampling tool. Advance the tool to the bottom of the desired sample interval taking care to minimize slough (scrapings from the sidewall of the boring, partial collapse of the borehole, etc.). Use of a "closed-point" sampler can overcome the problem of slough partially loading the sample tool.
Step 5	Pre-mark the drill rod above the "total depth mark" with the length of the sampling tool to ensure that the sampling tool has been advanced through the desired sampling interval.
Step 6	If a direct push Macro or Large-bore sampler is used, employ an expendable acetate liner.
Step 7	Do not allow the driller to over-push the sampler. An over-pushed sampling tool results in displaced/missed sample interval and/or over- packing of the sample tool.

Step 8	Retrieve the sampling tool and transport it to the sample management location. Establish a convention with the driller to consistently identify and orient the "top of sample".
Step 9	Don a clean pair of nitrile gloves and open the sample tool. If the sample is removed from a re-usable sampling tool, place the core into a clean, decontaminated sample tray. If the sample was collected using an expendable liners, zip-cut the liner lengthwise to expose the soil core.
Step 10	Using a clean, decontaminated stainless steel knife or spatula, scrape the wall of the soil core to expose a clean surface. Identify and discard any obvious slough from the top of the soil core.
Step 11	Using a clean, decontaminated stainless steel knife or spatula, collect aliquots for headspace screening.
Step 12	Collect soil samples or place the remaining soil core into zip-lock polyethylene baggies pending the results of headspace screening to select samples to be sent to the laboratory.
Step 13	Collect the remaining soil samples for analysis in order of constituent volatility: ▪ VOCs (volatile organic compounds)/Benzene, Toluene, Ethylbenzene. Xylene (BTEX) ▪ TPH (total petroleum hydrocarbons) ▪ SVOCs (semi-volatile organic compounds)/Polynuclear Aromatic Hydrocarbons (PAHs) ▪ Other organic parameters (TOC [total organic carbon], PCBs, etc.) ▪ Metals ▪ Other inorganic parameters Note: Pack sample jars as full as possible and smear off the upper surface to minimize headspace in the sample jar.
Step 14	Identify and manage the collected samples.
Step 15	Decontaminate all equipment that comes into contact with sample material between sample intervals.
Step 16	Repeat the process, as required by the project work plan, to the total depth of the planned sampling interval. If soil intervals are identified that may warrant sampling in addition to intervals or conditions specified in the work plan, contact the Project Manager for guidance.
Step 17	Place soil cuttings into open-top, 55-gallon drums or other designated location.

Step 18	Log the soil core sample for soil type, soil color, odor, staining, moisture content, plasticity, and other geophysical parameters of interest.
Step 19	Document the sampling activity in the Boring Log Form including the sampling location and identity of samples collected and obtain any required photographs.

APPENDIX D

FIELD DOCUMENTATION STANDARD OPERATING PROCEDURE

STANDARD OPERATING PROCEDURE

FIELD DOCUMENTATION

ID#: GEN-0001

October 3, 2012

Project #: QAQ-CSO-P00

Trihydro Corporation

1252 Commerce Drive, Laramie, WY 82070

ACKNOWLEDGEMENTS

Author: Nella Dagnillo, Environmental Chemist, Special Facilities

Editor: Thyra Page, Technical Writer/Editor

Table of Contents

1.0 PURPOSE, SCOPE, AND RESPONSIBILITIES

This standard operating procedure (SOP) describes requirements associated with documenting field investigation and remediation activities. The procedures apply to field logbooks, sample labels, and chain-of custody documentation.

The Operational and Service Excellence (OSE) Business Unit is responsible for SOP maintenance, management, and revisions. Trihydro employees performing tasks within this SOP are responsible for meeting SOP requirements. For projects where activities within this SOP are necessary, the project manager (or designee) is responsible for ensuring that those activities are conducted in accordance with this and other SOPs. Project team members are responsible for documenting procedural information in sufficient detail (i.e., calculations, field notes, reports, etc.) and reporting these changes to OSE. Such documentation will be included as a component of project records.

2.0 PROCEDURES

Proper field documentation is a crucial part of the field investigation and remediation process. Documentation should be maintained to trace the possession and handling of samples from the time of collection through submittal to the laboratory, to allow sampling locations to be located in the future, to record sampling methods and equipment, and to identify field personnel responsibilities. Field documentation procedures are important from both the technical and legal perspective.

The following sections describe the procedures for field documentation. This SOP provides general guidance that can be adapted to site-specific procedures. Contact the Project Manager to tailor the procedure based on the specific project. Additional, site-specific documentation may be found in sampling and analysis plans, quality-assurance project plans, and work plans.

2.1 FIELD LOGBOOK

Field team members conducting sampling activities shall maintain a field logbook and/or field forms to document activities conducted by the field team each day. Any corrective actions or alterations of the prescribed preparation and/or sampling procedures will also be noted. Entries on all forms and logbooks should be made in indelible ink. A single stroke should be used to cross out incorrect information and initialed by the sampler. A single stroke with the field personnel’s initials shall be used to manage unused space left on a page. A new day’s entry shall start with a new page in the logbook. Field logbooks will be maintained in accordance with the procedures listed in Section 2.4.

Sections of the applicable field forms (**Appendix A**) should be filled out by members of the sampling team. Documentation will include the date of sampling, sample location, and sample identification. The sample-location coordinates obtained from the hand-held GPS will also be included on the field sampling forms. Any corrective actions or alterations of the prescribed preparation and/or sampling procedures will also be noted. Entries on all forms and logbooks should be made in indelible ink. A single stroke should be used to cross out incorrect information and initialed by the sampler.

Photographs will be used to substantiate and augment the field notes. Photographs will be numbered and recorded in the logbook or Photograph Log Form (**Appendix B**).

At a minimum, the following information shall be recorded in the field logbook:

- Name and location of the site
- Date(s) of sample collection events
- Name and affiliation of sampling personnel
- Name of field team members and responsibilities (if others)
- Daily time of arrival to the site
- Daily weather conditions
- Pertinent field observations
- Daily summary of field activities
- Daily summary of equipment-preparation procedures (notation of equipment calibration and maintenance), if appropriate
- Time of sample collection for each sample
- Sample locations and types of samples collected and sample-identification numbers
- Sample-collection depths, if applicable
- Sample description, if applicable
- Project quality-control samples (i.e., Field Duplicate Samples, Matrix Spike Samples, Field Blank Samples, Equipment Blank Samples, Trip Blank Samples) collected with each location or sampling event
- A description of sampling methodology by reference to the project-control documents (Field Sampling Plan, Project Plan, SOPs)

- Any corrective actions or alterations of the prescribed preparation and/or sampling procedures
- Specific sampling characteristics (e.g., depth, temperature, turbidity, total organic vapor) as outlined in specific work plan
- Physical description and sketch/photograph of the sample-collection location(s)
- A Global Position System (GPS) reference to the collected data, if applicable
- Record of daily phone calls and/or contact with individuals at the site
- Management or disposal of investigation-derived wastes

2.2 SAMPLE LABELS

Sample labels should include:

- The unique sample-identification number
- Sample location
- Parameter sampled
- Date and time sampled
- Sampler's initials
- Preservative used (if applicable)
- Site name or location
- Bottle types

Sample containers must be pre-labeled with as much of this information as possible before departing for the field. Any remaining information (such as sample time) should be filled out immediately prior to sample collection.

2.3 CHAIN-OF-CUSTODY DOCUMENTATION

The chain-of-custody (COC) form is intended to be a legal record of possession of samples for laboratory analysis. The COC form will be created during pre-job preparations. The COC form will be provided to the field-sampling personnel prior to sampling activities and should accompany the sample bottles through transport to the field site. The COC form should be completed by the field-sampling personnel at the time of sample collection and should bear the name of the person responsible for the secure and appropriate handling of the samples.

The Project Manager should maintain the COC form during sample-collection activities. Care should be taken during the COC process so that the samples listed on the COC form match what is provided in the cooler. Additionally, one individual COC form shall be completed per sample cooler submitted and all samples need to be accounted for during storage. The minimum information required for COC documentation includes:

- Name and location of the site
- Name and affiliation of the sampling personnel
- Sample-identification number
- Matrix and type of sample collected (grab or composite)
- Number of containers per sample
- Preservatives or fixatives used
- Date and time of samples collected
- Parameters to be analyzed
- Identification of couriers
- Identification of laboratory
- Custody seal numbers, if applicable

When completing COC forms, field personnel shall properly relinquish the samples to the chosen courier.

2.4 FIELD RECORDS MANAGEMENT

Field records must be managed according to the Quality Management System manual, SAP, and/or Work Plan**.** In addition to the original COC form that accompanies each sample shipment, a copy of each COC form must be provided to the master project files. A working copy of the COC form shall be retained in working files in the field-sampling work area for reference. The Project Manager will maintain a list of people requiring courtesy copies of the COC form. Courtesy copies may be distributed by either hard copy (mail) or electronic copy (e-mail) and shall be distributed the next working day after sample collection.

The receiving laboratory may provide a completed copy of the COC form as part of data deliverables or as part of routine sample-receipt notification (usually by e-mail). A copy released as part of data deliverables will become part of the project files. Any electronic copy may be printed and retained as a working copy in the field-sampling work area for reference.

Field logbooks shall have a unique identifier and shall have pre-numbered pages. Logbooks carried into the field shall have completed pages copied to project files on a weekly basis to minimize potential data loss caused by accidental loss or destruction. Copies shall be reviewed for legibility prior to storing electronically. Refer to Section 2.1, "Field Logbook," for additional logbook details.

2.5 PHOTOGRAPHS

Photographs will be used to substantiate and augment the field notes. For each photograph taken, the following items should be recorded in the field logbook:

- Photographer's name or initials
- Date and time of photograph
- General direction or orientation of the photograph (e.g., view toward the west or east)
- Brief description of the subject and fieldwork shown in the photograph
- For digital photographs, the sequential number of the photograph, file name, file location, and backup disc information (if applicable)
- For printed photographs, the sequential number of the photograph or specific file name

Follow these best practices when submitting photographs for the project notes:

- If you take photographs of sample characteristics and routine sampling activities, include a scale in the image and avoid using telephoto or wide-angle shots.
- If photographing a borehole location or a pole-mounted transformer, include a background object to show the location.
- Avoid photographing only a hole in the ground or a transformer showing only the sky.

Photographs will be numbered and a description of each will be recorded in the photograph log form (if applicable) (Appendix B). After completing field-sampling events, the Project Manager should submit all photographs for development and subsequent storage in the project files.

3.0 REFERENCES

Office of Environment and Research. 2009. *Tennessee Valley Authority (TVA) Standard Operating Procedure.*

U.S. EPA. *Guidance for Performing Preliminary Assessments Under CERCLA. Office of Solid Waste and Emergency Response.* Directive 9345.0-01A, 1991. http://www.epa.gov/superfund/sites/npl/hrsres/#PA%20Guidance.

U.S. EPA. *Region 4, Logbook Operating Procedure*. Document #SESDPROC-010-R3, November 2007.

4.0 APPENDICES

Appendix A   Field Forms

Daily Instrument Calibration/Maintenance Log

Field Record - Groundwater Sampling

Field Record – Sediment Sampling

Field Record – Surface-Water Sampling

Sediment Sample-Collection Log

Low-Flow Groundwater-Sampling Log

Appendix B   Photograph Log

Equipment-Calibration Report

This document can be used by Trihydro employees to report equipment-calibration information including reason and calibration outcome. **A copy of this report should be submitted to the Trihydro Quality Manager, care of tpage@trihydro.com.**

Equipment type:	**Manufacturer:**
Model:	**Serial/ID no.:**
Calibration standard:	
Purchase date:	**Responsible business unit:**
Location:	**Calibration frequency:**

	Daily	**Weekly**	**Monthly**	**Quarterly**	**Annually**	**Other**
Use frequency:						

Calibration Date	**Calibration Reason** (e.g., routine, broken, rough use, etc.)	**Inspector**	**Date Next Calibration Due**	**Calibration Comments** (e.g., accuracy, defects, lube, clean, etc.)

PHOTOGRAPH LOG

Project:

Location:

Number	Date	Direction	Description

APPENDIX E

FIELD DOCUMENTATION FORM

Soil Sampling Log

Project Name: ____________________
Sample ID: ____________________ Sample Date: ____________________
Sample Location: ____________________ Sample Time: ____________________
Samplers: ____________________ Photo Taken? (Y/N) ____________________
Weather: ____________________ Photo Description: ____________________

Sample Description

PID Readings

PID	Interval

Sampling Equipment: ____________________
Sample Depth: ____________________

Sample Description: (Color, grain size, odor, organic matter, etc.) ____________________

LOG-OF-BOREHOLE

PROJECT: JOB#:

LOC. OR COORDINATES: GROUND ELEV.:96.99’ TOTAL DEPTH DRILLED: TOTAL DEPTH CASED: BOREHOLE DIA.: 2” CASING DIA.: 1.0”	DATE: DRILLER: RIG: BIT(S): FLUID:	BOREHOLE: TIME COMPLETED: PAGE: 1 OF 1 LOGGED BY: DLM

DEPTH (ft)	MATERIAL	USCS Classification	TOV (ppmv)	DESCRIPTION AND COMMENTS

Notes:

APPENDIX F

EQUIPMENT DECONTAMINATION STANDARD OPERATING PROCEDURE

TRIHYDRO CORPORATION

EQUIPMENT DECONTAMINATION

STANDARD OPERATING PROCEDURES

EMC INSURANCE COMPANIES

CRAIG, COLORADO SITE

The purpose of this Standard Operating Procedure (SOP) is to establish procedures for decontamination of non-disposable equipment to prevent cross contamination.

Decontamination Procedures

Prior to use and between sampling locations, non-disposable sampling and water level measurement equipment will be decontaminated. Equipment will also be decontaminated if the equipment comes into contact with potentially contaminated surfaces. The decontamination method will vary depending on the type of equipment. Below are procedures for decontamination of an oil/water interface probe, a submersible pump, and tools, such as metal spoons, spatulas, bowls, split spoon samplers, brass sleeves, and other non-disposable sampling equipment.

Soil Sample Collection Tools

Step 1	Establish a decontamination area. If decontaminating drilling augers, rods, or other large equipment, a temporary decontamination pad will be established with appropriate drainage to provide collection of decontamination and rinse water without running off the decontamination pad. This will help to prevent the potential release of impacted materials. Decontamination of small tools (trowels, spatulas, bowels etc.) may be decontaminated using decontamination buckets or drums similar to that of submersible pump decontamination as in step 2. Water will be prevented from running off the decontamination pad.
Step 2	Fill an adequately sized, clean bucket/drum with tap water and non-phosphate detergent. Fill a second bucket/drum with clean, tap water. Fill a third bucket/drum with clean, distilled or deionized water.
Step 3	Submerge the tools into the series of buckets starting with the soapy wash. Using a scrub brush, scrub sediment off of the tools. Rinse by submerging the equipment into the tap and distilled water buckets.
Note	Large equipment such as augers, rods, or other large equipment may be decontaminated using steam or pressure washer on a decontamination pad.

Rinse water generated during the decontamination process will be containized in buckets, and then emptied into 55-gallon drums or disposed of through the remediation system or other designated location. Clients will manage the drummed disposal of the decontamination water through their waste management system, which may include sampling the rinse water or using a representative profile based on generator knowledge.