



**ROXY'S CLEANERS AND ALTERATIONS  
INTERIM REMEDIAL ACTION  
HAVRE, MONTANA**

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**May 30, 2017**

**Project #: 776-023-002**

**SUBMITTED BY:** Trihydro Corporation

1252 Commerce Drive, Laramie, WY 82070

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# 1.0 BACKGROUND

Montana Department of Environmental Quality (MDEQ) contracted with Trihydro Corporation (Trihydro) under Task Order No. 22, MDEQ Contract No. 414031, to perform interim remedial actions at a former dry cleaning establishment Roxy's Cleaners and Alterations (Roxy's) in Havre, MT, to reduce chlorinated solvent contamination in the groundwater, vadose zone, and indoor air. The interim remedial actions prescribed by MDEQ in Task Order 22 included in-situ enhanced bioremediation and soil vapor extraction (SVE). Various portions of this work were performed by subcontractors, who were selected through a limited solicitation. This report discusses the installation of the SVE system, the in-situ bioremediation enhanced injection activities and all applicable monitoring. The report also provides recommendations for future operation of the SVE system and the applicability of future in-situ enhanced bioremediation injections.

## 1.1 REPORT ORGANIZATION

This Report is organized into sections that describe the background, the means and methods used to obtain the information necessary to meet the report objectives, the quality, and usability of data, the results of the investigation, and the nature and extent of contamination at Roxy's Cleaners and Alterations (Roxy's).

Accordingly, the summary report is comprised of the following sections:

- Section 2 – Soil Vapor Extraction
- Section 3 – SVE System Startup
- Section 4 – In Situ Enhanced Bioremediation
- Section 5 – Indoor Air Sampling
- Section 6 – SVE Operation
- Section 7 – Groundwater Sampling
- Section 8 – SVE System Performance
- Section 9 – Investigation Derived Waste
- Section 10 – Summary and Recommendations
- Section 11 – References

Trihydro's field notes for the activities described in this report are provided in Appendix A. Photographs documenting field work are provided in Appendix B. A field communication log is provided in Appendix C. All work was



conducted in accordance with a site-specific health and safety plan (Safety Plan) that is provided in Appendix D. The Safety Plan was kept onsite during all field work activities.

## 1.2 PURPOSE AND OBJECTIVES

The primary objective of this report is to summarize interim remedial actions performed by Trihydro at Roxy's between November 2015 and June 2017. These actions included SVE system design, construction and operation of the SVE system, in-situ bioremediation injections, and sampling for chlorinated solvents in groundwater, indoor air, and air extracted by the SVE system.

## 1.3 ROXY'S SITE DESCRIPTION

The MDEQ Hazardous Waste Program's records indicate that Roxy's address was 425 1<sup>st</sup> Street in Havre, Montana. However, the current address for the property is 417 1<sup>st</sup> Street, MT. (MSL 2017). The general location and site plan for Roxy's are shown in Figures 1 and 2, respectively. The building at this location was constructed in 1905 (MSL 2017) and has historically housed a variety of businesses. The former business known as Roxy's occupied this building between 2000 and 2007. Prior to 2000, Roxy's was known as Classic Cleaners. According to MDEQ's records, Classic Cleaners registered as a Halogenated Solvent User (MT0000906925) in 1989, and used tetrachloroethene (PCE) as part of its dry cleaning operation. Classic Cleaners/Roxy's was inspected by the MDEQ Hazardous Waste Program in 1994 and 2000 (MDEQ 1994 and MDEQ 2000). No violations were reported in either inspection report. In September 2008, a MDEQ Hazardous Waste Inspector visited the Roxy's location and reported that the business space (the northern portion of the building) was occupied by "The Dollar Store" with no sign of an operating dry cleaners (MDEQ 2008). The current owner of the building did not own the building at the time that Classic Cleaners or Roxy's operated.

In September 2015, when the Task Order 22 work commenced, the building was only partially occupied; a business (Bearly Square Quilting) was leasing the upper level of the southern portion of the building, and the building owner was occupying an apartment in the southern portion of the basement. The upper level of the northern portion was vacant. The northern portion of the basement was used as storage for a variety of items, including vehicles and remaining stock from the owner's former business (Creative Leisure). Creative Leisure formerly operated in the southern portion of the upper level where Bearly Square Quilting is located. The physical address for Bearly Square Quilting and Creative Leisure was 417 1<sup>st</sup> Street, which is consistent with the property record (MSL 2017).

As shown on Figure 2, the Roxy's building is located between two parallel east-west streets, US Route 2 (1<sup>st</sup> Street) on the south and Main Street on the north. The Roxy's building is bounded on the east side by two buildings (Northern Land and Realty and the former Griggs Printing) separated from the Roxy's building by a distance of two to three feet.



Northern Land and Realty occupies the southern building. The northern building, which is now vacant, was most recently occupied by Grigg's Printing. A paved parking lot is located west of the Roxy's building. Access to the building is achieved via an elevated sidewalk that runs along the west side. A ramped driveway near the northwest corner of the Roxy's building allows vehicles to access the northern portion of the basement from the parking lot.

A former tunnel connecting the building to the Havre underground tunnel system is located in the basement just south of the ramped driveway. During the interim actions described in this report, the tunnel entrance was blocked to disallow access. The condition of the tunnel is unknown.

The Burlington Northern Santa Fe (BNSF) active railyard is located across Main Street directly north of the Roxy's building. The Milk River is located on the north side of BNSF. The BNSF railyard is part of the BN Havre Facility, a Comprehensive Environmental Cleanup Responsibility Act (CECRA)/state superfund facility. MDEQ provided reports for the BN Havre CECRA Facility, which indicate that groundwater flow is generally to the north. The depth to groundwater varies from approximately 10 to 12 feet below ground surface (ft-bgs), depending on the season of the year (K/J 2009).

#### 1.4 PREVIOUS SAMPLING

Sampling of subslab soil vapor and indoor air in the Roxy's building was performed by BNSF's contractor on January 20, 2011, as part of the BN Havre Facility remedial investigations (K/J 2012). The indoor air basement PCE concentrations in January 2011 was 59 micro-grams per cubic meter ( $\mu\text{g}/\text{m}^3$ ) and the PCE concentration in a subslab soil vapor sample was 9000  $\mu\text{g}/\text{m}^3$ . The January 2011 indoor air PCE concentrations exceed the 2011 EPA Regional Screening Level (RSL) and the May 2016 RSL of 11  $\mu\text{g}/\text{m}^3$ . The presence of PCE beneath the building presents a potential risk for vapors to migrate from the underground source into the overlying structure.

#### 1.5 SITE-SPECIFIC SCREENING LEVELS FOR INDOOR AIR

In August 2015, MDEQ calculated the indoor air site-specific screening levels (SSSLs) for Roxy's using EPA's RSL Calculator ([https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl\\_search](https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search)) (MDEQ 2015b). The SSSLs calculation spreadsheets for the Roxy's building are provided in Appendix E and are summarized below:

	<b>Residential Indoor Air Screening Level (<math>\mu\text{g}/\text{m}^3</math>)</b>	<b>Commercial Indoor Air Screening Level (<math>\mu\text{g}/\text{m}^3</math>)</b>
Tetrachloroethylene (PCE)	39.7	173
Trichloroethylene (TCE)	1.76	8.76
Vinyl Chloride (VC)	0.568	10.2



SSSLs were calculated for PCE, TCE and VC. PCE is the main contaminant of potential concern (COPC) and TCE and VC are breakdown products of PCE. Cis-1,2-DCE is also a breakdown product of PCE, but an SSSL was not calculated for it because toxicity information is not available.

## 2.0 SOIL VAPOR EXTRACTION

MDEQ chose SVE as an interim remedial action for Roxy's because SVE is a widely-recognized means of remediating subsurface soil contaminants that volatilize naturally (or can be induced to do so).

### 2.1 CONCEPT

The main COPC at the Roxy's building is PCE which was identified by the results of previous investigations (K/J 2012). PCE and its daughter products (e.g., TCE, cis-1,2-DCE, VC) are volatile organic compounds that are liquid at room temperature, but readily evaporate into the air and easily dissolve in groundwater. SVE is a process that removes contaminated soil vapor (e.g. air) from the unsaturated zone under vacuum, treats the soil vapor to remove the contamination, and discharges filtered air to the atmosphere. SVE can effectively reduce contaminant concentrations in the vadose zone, contaminant migration to groundwater, and direct contact (e.g., dermal or inhalation) risks to humans. In close proximity to a building, an SVE system can apply a vacuum that may also reduce or reverse pressure beneath the building and mitigate the potential vapor intrusion.

### 2.2 DESIGN

The intent of the SVE system at the Roxy's building is reduce the contaminant concentrations in the vadose zone which in turn will reduce migration of chlorinated solvent vapor from the soil into the building and to reduce contaminant migration to the groundwater. Effectiveness of vapor extraction from subsurface soil is largely dependent upon the lithology, as air (and contaminant vapors) will move much more easily through coarse-grained, loosely packed soil than through fine-grained, compressed soil. Lithology at the BN Havre Facility consists of silts and silty clays interspersed with layers of silty fine to medium sand. In some locations well-graded sand with fine to coarse gravel was encountered (K/J 2009 and K/J 2013). This lithology suggested that SVE would be effective at extracting the vapors from Roxy's building.

The SVE design at the Roxy's building includes six vertical wells slotted over the bottom five feet. The six wells are connected to a blower that exerts a vacuum on the well, creating a pressure gradient in the subsurface; thus, vapors in the subsurface are drawn up through the well and forced through a filtering system designed to capture the contaminants before the air is exhausted into the ambient environment. Commonly, granulated activated carbon (GAC) is the medium used to filter and capture volatile organic compounds (VOCs), including chlorinated solvents, before discharged to the atmosphere.

## 2.3 WELL SITING

The SVE wells were located along the west side of the building, as close to the building as practical. The location of the SVE wells was selected based on the potential location of residual PCE contamination beneath the building, the expected radius of influence (ROI) of the SVE wells, contractor safety, traffic concerns, and accessibility to install and perform maintenance on the wells. The SVE well locations are shown on Figure 3.

## 2.4 INSTALLATION PHASE 1

Boland Drilling Company (Boland), out of Great Falls, MT, performed the well installation phase of the work. Utility locates were requested by Boland and performed by Northwestern Energy and the City of Havre on November 9, 2015. Drilling commenced on the same day using a Central Mine Equipment (CME) hollow stem auger rig at the most southern selected well location (SVE06). This boring was advanced to approximately 12.5 feet below ground surface (ft-bgs) and the well was installed. Similarly, wells SVE05 and SVE04 were installed in-line to the north of SVE06. However, when drilling SVE03 to the north of SVE04, the drilling rig encountered refusal at approximately 7 ft-bgs where a concrete structure was encountered. Multiple drilling attempts, first stepping out to the west from SVE03, then attempts to drill SVE02 and SVE01, all encountered the same refusal at approximately the same depth. With MDEQ approval, the decision was made to discontinue drilling at this location with the current equipment and return to the site with an air rotary drill rig to attempt penetration of the subsurface concrete (MDEQ 2015c).

Boland returned to the Roxy's parking lot on November 30, 2015, and deployed a 6-inch air rotary drill rig at the proposed location for SVE01. The air rotary drill penetrated approximately 4 inches of concrete and the well installation was completed to a depth of approximately 13 ft-bgs. Similarly, wells SVE02 and SVE03 were successfully installed after penetrating approximately 6 and 10 inches of concrete at 7 ft-bgs, respectively. Screened intervals on wells SVE04, SVE05, and SVE06 are located at approximately 7 to 12 ft-bgs and for wells SVE01, SVE02, and SVE03 at approximately 7.5 to 12.5 ft-bgs. Field boring logs and well installation diagrams are provided in Appendix F and a finished SVE well drawing is shown on Figure 4. Disposal of the soil cuttings is discussed in Section 9.

## 2.5 INSTALLATION PHASE 2

Remington Technologies LLC, (Remington), out of Loveland, CO, was contracted to excavate and install the collection manifolds between the six SVE wells. The scope of work included excavation between the SVE wells, installation of a network of piping connecting the wells; connection of the SVE vacuum system to the well network; pouring a 9' x 15' concrete pad to site the SVE system shed; and reclamation of the excavation site.

Remington began work on December 3, 2015. Remington used a backhoe to remove asphalt between the wells and from the slab construction site for the SVE system shed. Remington removed and stockpiled the asphalt with a skidsteer, and once the asphalt was removed and stockpiled, the backhoe was used to excavate a trench along the west side of the wells. Disposition of the removed asphalt and excavated soil is discussed in Section 9. Six runs of 1.5 inch schedule 40 polyvinyl chloride (PVC) pipe were laid in the trench, each connected to a well, and terminated at the location for the SVE system shed. Each well/pipe combination was pressure tested at 25 pounds per square inch (psi), prior to filling the trench with Flowfill, a combination of cement, fly ash, aggregate, and water. A concrete slab for the SVE system shed was poured with piping from wells stubbed up through the slab. Work in preparation for the arrival of the SVE system was completed on December 9, 2015. A schematic of the manifold piping installation is shown on Figure 5.

On December 3, 2015, during the removal of asphalt, Trihydro noticed that the corner of the brick wall retaining the elevated sidewalk had been chipped. An investigation revealed that the backhoe being used to remove asphalt had contacted the brick, breaking off a corner. Trihydro contacted the property owner, who after viewing the damage, said that he was not “concerned”; however, Remington volunteered to repair the damage at no charge to the project. Repairs were completed to the property owner’s satisfaction on December 7, 2015. The incident, notification of the property owner, subsequent repairs, and the property owner’s verbal acceptance of the repairs are documented in the Field Notes for December 3 through December 7, 2015, which are contained in Field Notes 2016, in Appendix A.

### **2.5.1 SOIL VAPOR PROBE**

On December 14, 2015 (Trihydro 2015), MDEQ requested the installation of a soil vapor probe in the basement of the Roxy’s building to further quantify the SVE system ROI and to evaluate subslab contaminant concentrations. On January 13, 2016, Trihydro met with the property owner to determine an acceptable location for installation of a soil vapor probe through the basement floor. The property owner agreed to allow installation of the probe at a location near the east wall of the basement, approximately due east of SVE02, and Trihydro installed the probe. The property owner’s verbal agreement is documented in the field notes (Field Notes 2016 in Appendix A) for January 13, 2016. The location of the probe is shown on Figure 3 and a diagram of the installation is shown in Figure 6.

Utility clearances were conducted prior to probe installation activities. The Montana 811 UDIG call center was contacted and utility markings were made by utility locators. Additional scrutiny was made to the proximity of a natural gas, floor drain, and water lines in the liquor store utility closet. The UDIG utility ticket is included in Appendix H2.

On January 13, 2016, Trihydro installed a subslab soil gas sample probe in the basement of the building, near the east wall as shown on Figure 3. A rotary hammer with a 7/8-inch drill bit was used to core through the basement floor which was approximately 5 inches thick at that location. The drill bit was advanced to a final depth of 12-inches below the top of the slab. The soil vapor probe was constructed by inserting a 6-inch long stainless steel vapor screen into the borehole and attaching 1/4-inch Teflon tubing to connect to a stainless steel sample port. The borehole was backfilled with 10/20 silica sand, and the top three- to four-inches of the borehole were sealed with Quickcrete. Construction detail of the soil vapor sample probe is shown on Figure 6.

## 2.6 INSTALLATION PHASE 3

Process Technologies Support (PTS) out of Loveland, CO was contracted to construct a stand-alone system, consisting of a shed containing a vacuum system; moisture collection system; heat exchanger; filter system and the necessary control infrastructure to allow the system to operate without frequent operator intervention. The system provided by PTS is housed in an 8' x14' shed, uses a 15 horse-power (hp) Teco-Westinghouse blower motor, a 70 gallon tank for moisture collection, an American Industrial Heat Transfer heat exchanger with a 1 hp Baldor motor, and filters the effluent through series-connected canisters containing activated charcoal or other filter media. The system also employs a Sensaphone™ Telemetry module to automatically notify remote operators of system faults, via email and a Sensaphone™ website. A complete operator's manual containing as-built drawings, wiring diagrams, operating procedures and component specifications is provided in Appendix G.

The SVE system was delivered to the site on December 21, 2015, and was unloaded directly onto the concrete slab and bolted down. Power was subsequently provided by Northwestern Energy, and the system was connected by a licensed electrician from Schine Electric, a local electrical contractor.

## 3.0 SVE SYSTEM STARTUP

Once the SVE system was installed and connected to the network of SVE wells, a pre-start checklist was used to verify that electrical connections were correct and that system controls were properly set. The system check was completed January 13, 2016, and a copy of the completed checklist is located in Appendix G.

### 3.1 RADIUS OF INFLUENCE (ROI)

Once the SVE system was installed and connected to the network of six SVE wells, the system was evaluated to determine if the ROI (the distance at which the wells would exert a sufficient pressure gradient to withdraw contaminants from the soil) was sufficient to reach the area under the basement of the building. Pilot testing was not conducted prior to the installation of the system so the ROI was verified by measuring induced vacuum between wells following the step-test procedure contained in Appendix H. In addition to verifying influence between the six SVE wells, vacuum readings were also taken at the soil probe location in the basement. A generally-accepted value in the range of 0.01 to 1.0 (in H<sub>2</sub>O) induced vacuum indicates influence from the well being tested (USACE, 2002).

The procedure began by establishing a maximum system vacuum, measured at the SVE blower, and then the induced vacuum was measured at each well head. The procedure then required that the vacuum be reduced to one-third of the maximum value with only one well open (SVE03), and vacuum was measured at the well(s) furthest from the open well. The vacuum was then increased to two-thirds of the maximum value and measurements were repeated. Finally, the vacuum was increased to the maximum vacuum value, and the measurements were repeated. The entire procedure was then repeated (Stage 2) with SVE04 open, rather than SVE03. Wells SVE03 and SVE04 were used as open wells during this process as they are central to the line of extraction wells and therefore the vacuum influence could be measured bi-directionally. Alternatively, the test could have been performed with each of the wells, or with any subset; however, wells SVE03 and SVE04 provided evidence of induced vacuum at a radius sufficient to affect the soil below of the building.

#### 3.1.1 RESULTS

ROI testing was conducted January 14 and 15, 2016. Maximum applied vacuum was 83 (inches H<sub>2</sub>O); however, at that vacuum, water was observed being pulled into the SVE collection manifold, so the maximum applied vacuum used for the remainder of the step-tests was reduced to 53 (inches H<sub>2</sub>O). At this value, induced vacuums on wells SVE01 - SVE06 was respectively 48, 45, 49, 44, 46, and 48 (inches H<sub>2</sub>O). Induced vacuum measured at the soil vapor probe was 0.05 (inches H<sub>2</sub>O) when the maximum vacuum (83 inches H<sub>2</sub>O) was applied and 0.02 (in H<sub>2</sub>O) when the reduced vacuum (53 inches H<sub>2</sub>O) was applied.

The results from the step-tests are shown in Table H1 in Appendix H. During Stage 1 of testing, using SVE03 as the open (influencing) well, vacuum was measured at SVE01 and at the soil probe at two-thirds and full system vacuum. There was no measureable vacuum at SVE06. During Stage 2 of the test, in which SVE04 was the designated open (influencing) well, difficulty was experienced achieving and maintaining vacuum at SVE04, even when blower vacuum was increased. As a result, no induced vacuum was measured at SVE01 or SVE06. Induced vacuum was measured at SVE03 and SVE05, the wells nearest SVE04, when a vacuum of 53 (in H<sub>2</sub>O) was applied to well SVE04. Induced vacuum at the soil vapor probe was also undetectable in Stage 2 of the testing.

As stated above, the generally accepted value in the range of 0.01 to 1.0 (in H<sub>2</sub>O) induced vacuum indicates influence from the well being tested, though it does not necessarily guarantee that extraction of contaminants will occur. Induced vacuums measured at the extraction wells generally met or exceeded this criteria when applied vacuum was two-thirds or greater of the applied vacuum of 53 (in H<sub>2</sub>O). Vacuums measured at the soil probe have run at the lower end of this range, but the capping effect of the basement floor may increase the effect of applied vacuum. Therefore, the lower induced vacuums indicated are anticipated to still be sufficient to promote contaminant travel to the extraction wells.

## 4.0 IN-SITU ENHANCED BIOREMEDIATION

In a favorable subsurface environment, i.e. one in which a sufficient number of anaerobic microbes are present, the natural degradation of PCE is optimized, producing TCE, which degrades to DCE, which degrades to VC. The end product of this process is ethane or methane. The degradation of PCE to these daughter products is a process known as reductive dechlorination in which hydrogen atoms are substituted for chlorine atoms in the chlorinated solvent molecule, to release an electron during the microbes' respiration process. In order to ensure that a sufficient number of microbes are present in the subsurface to accomplish and sustain this process, it is often necessary to supplement the supply of nutrients available to the microbes. This can be accomplished by injecting solutions containing high levels of carbon nutrients into the subsurface. Many of the fluids used for injections of this sort are some form of emulsified vegetable oil (EVO) which pose no threat to the environment and contain high levels of carbon nutrients.

Injections of EVO are usually done at multiple locations at the groundwater table, depending on depth to groundwater and contaminant source location, in areas at or up-gradient from, the contaminant source. Depending on the subsurface lithology, it may require a sizable number of injection locations to achieve adequate coverage.

### 4.1 INJECTION EVENT

MDEQ selected EVO as the enhanced bioremediation substrate to reduce residual PCE contamination at the Roxy's property. Based on historic PCE subslab vapor concentrations, a residual contaminant source area is believed to underlie the basement floor of the Roxy's building. Therefore, the injection was designed to target that area. This was accomplished by drilling through the basement floor in various locations, advancing probes through the floor and through the vadose zone at all locations, and injecting the EVO into the shallow groundwater at all locations. Injection depths were about 14.5 ft-bgs, or 4.5 ft below the basement floor. Inputs to the injection design calculations which are contained in Appendix I, were based on the lithology of the surrounding area (K/J 2009 and K/J 2013) and Trihydro's experience at similar sites, and resulted in an estimated injection ROI of 6.7 feet using a 3.1% solution of EVO in water. Given the estimated injection ROI, a pattern of injection points was established to attempt to achieve coverage throughout the subsurface soil below the unoccupied (garage portion) of the basement. The final location of the injection points, which are shown on Figure 3, was also based on accessibility. Due to limited accessibility, no injection points were planned to penetrate the floor of the apartment.

Remington Technologies, LLC (Remington), out of Loveland, CO was contracted to perform the injections. Utility locates were requested by Remington and performed by Last Call Locating out of Billings, Mt. The call ticket can be found in Appendix I. Injection activities began January 20, 2016. Borings were accomplished using a Geoprobe for most injection sites, but five locations required hand-augering due to the potential proximity of utilities. As each

boring was completed, a 3.1% solution of EVO in water was injected into the shallow groundwater. Municipal water was obtained for the solution via a fire hydrant located at the southwest corner of the Site parking lot, as previously arranged with the City of Havre. Most locations received approximately 425 gallons of solution. One location accepted only 100 gallons (A5) before solution began to return to the surface and overflow the borehole, and three received over 700 gallons (J7, J9, and K10). When injection was complete at each location, the boring was filled with bentonite chips, sealed with Quikcrete and finished to match the level of the surrounding basement floor surface. A total of 23 injection locations received a total 10,625 gallons of the EVO solution. Appendix I contains injection locations, volumes of solution injected at each location, and daily injection field logs. Injection locations are shown on Figure 3. Subsurface injections were completed on January 26, 2016 and a report by Remington documenting the injection event is also included in Appendix I.

## 5.0 INDOOR AIR SAMPLING

Indoor air sampling was initially performed at the site in January 2011 as part of the BN Havre Facility supplemental remedial investigation. At that time, concentrations of PCE exceeded the May 2016 EPA residential RSL ( $11 \mu\text{g}/\text{m}^3$ ) for indoor air at all locations sampled: building main floor ( $56 \mu\text{g}/\text{m}^3$ ); two samples taken in the building basement ( $51$  and  $59 \mu\text{g}/\text{m}^3$ ; K/J 2012). TCE was also detected in each of the indoor air samples at levels below the May 2016 EPA residential RSL. VC was not detected in any samples at that time.

On March 16, 2016, Trihydro performed indoor air sampling at the Roxy's building after bringing the SVE system online and following the subsurface EVO injections. Certified-clean 6-liter Summa canisters with 24-hour controllers were used to collect indoor air samples from the garage area of the basement, the apartment area of the basement, and from outside ambient air. A field duplicate sample was also collected from the garage area of the basement. The samples were analyzed by ALS Environmental Laboratories in Simi Valley, CA and the analytical results were validated by Trihydro. Laboratory analytical reports and validation reports are provided in Appendix J. PCE was detected in the samples collected in the apartment, the garage, and the field duplicate (garage) at concentrations of 6.8, 26, and  $27 \mu\text{g}/\text{m}^3$  respectively. TCE was detected in the same samples at concentrations of 0.35, 1.2, and  $1.2 \mu\text{g}/\text{m}^3$ , respectively. Cis-1,2-DCE was also detected in the garage and field duplicate samples at concentrations of 0.43 and  $0.41 \mu\text{g}/\text{m}^3$  respectively. PCE and TCE detections were below the Roxy's residential SSSLs for indoor air (i.e.,  $39.7 \mu\text{g}/\text{m}^3$  and  $1.76 \mu\text{g}/\text{m}^3$ , respectively). Cis-1,2-DCE is a breakdown product of PCE and TCE, but a SSSL has not been calculated for cis-1,2-DCE. Section 1.5 provides more detail about the SSSLs. There were no detections of VC. In addition, there were no detections of target constituents in the ambient (outdoor) air samples.

Indoor air sampling was repeated on March 1, 2017. Samples were taken from the same locations as the March 2016 sampling event, with the field duplicate collected in the apartment. As before, the samples were analyzed and the analytical results were validated. Laboratory analytical reports and validation reports are provided in Appendix J. PCE was detected in the samples collected in the garage, the apartment, and the field duplicate (apartment) at 8.4, 3.2, and  $3.3 \mu\text{g}/\text{m}^3$  respectively. TCE was detected in the same samples at 0.45, 0.16, and  $0.17 \mu\text{g}/\text{m}^3$ , respectively. Cis-1,2-DCE was detected only in the garage at a concentration of  $0.17 \mu\text{g}/\text{m}^3$  and there were no detections of VC. All concentrations were less than the SSSLs. The analytical results for both indoor air sampling events are shown in Table 1.

## 6.0 SVE OPERATION

Following the step-tests discussed in Section 3.0, the SVE system was programmed to run 24 hours per day, 7 days per week. Trihydro initially visited the site approximately twice per month to perform operations and maintenance (O&M) tasks, monitor system performance, and make adjustments as necessary. Beginning in May 2016, the frequency of routine visits was decreased to once per month. During each visit, in addition to performing routine maintenance, photoionization detector (PID) readings were taken at the following locations: inline sample ports for each well; pre-dilution air input sample port; inlet and outlet sample ports for the first filter canister; and at the outlet sample port for the second filter canister. Occasionally, PID readings and vacuum measurements were collected from the subsurface vapor probe. The readings obtained during each of these visits are shown in Table 2 which also contains system run time, flow and vacuum readings for each visit.

### 6.1 FILTER MEDIA

Subsurface vapor is drawn into the six horizontal SVE wells located on the western side of the building then passes through a manifold, inline air filter, knockout tank, regenerative blower, and filtration media before discharging into the atmosphere. A schematic of the SVE system is shown in Figure 8, and additional system diagrams and technical information can be found in the O&M Manual contained in Appendix G. Two canisters containing GAC which effectively captures PCE, TCE, and DCE are used to treat the vapor before discharge. GAC is less effective at capturing VC. VC concentrations have been detected in down-gradient groundwater and VC is a product of reductive dechlorination. Therefore, a third canister containing Zeolite was added to SVE filter system because Zeolite is effective at capturing VC. The Zeolite canister is located between the two canisters containing GAC and should capture any VC that the system may begin to draw from the subsurface. VC was not been detected in the February 2016 or May 2016 influent or effluent samples submitted for laboratory analysis. VC was detected in the April 2017 influent sample submitted for laboratory analysis, but not in the effluent sample. See Section 6.2.

During routine visits, the influent and effluent of the system is measured using a PID. If the PID reading from the outlet of the first filter canister indicates that VOCs are present in the vapor, the filter canister is removed and replaced by the canister next in line and a fresh canister is rotated into the secondary position. The filter medium from the removed canister is sampled for laboratory analysis of TCLP Extractable VOCs (TCLP – Toxicity Characteristic Leaching Procedure) to verify disposal options.

## 6.2 LABORATORY ANALYTICAL VERIFICATION

Samples of the influent and effluent of the system, i.e. the vapor entering and leaving the first of the filter canisters, were also submitted for VOCs laboratory analytical analysis. Samples for laboratory analysis have been taken from these locations three times: February 2016, May 2016, and April 2017. The samples taken in February 2016 were qualified as R (rejected) during the data validation process due to exceeding the hold time. The February 2016 samples were collected in tedlar bags for headspace gas analysis (Method 8260) which have are short holding time. The February 2016 sample results are not discussed further as the data were rejected.

The May 2016 samples were collected in Summa canisters and analyzed for TO-15 analysis (PCE, TCE, cis-1,2-DCE, and VC) and TO-13 (methane) and the results were acceptable. The results for this event showed 1,500  $\mu\text{g}/\text{m}^3$  PCE in the sample before the filter canisters and 150  $\mu\text{g}/\text{m}^3$  PCE after the filter canisters. TCE was detected at 19  $\mu\text{g}/\text{m}^3$  before the filter canisters and 1.9  $\mu\text{g}/\text{m}^3$  after the filter canisters. Vinyl chloride was not detected in either of the May 2016 samples. Results of the laboratory analyses are listed in Table 3.

The April 2017 samples were also collected in Summa canisters for TO-15 and TO-13 analysis. The results for this event were similar to those obtained in the previous sampling event: 1300  $\mu\text{g}/\text{m}^3$  PCE, 20  $\mu\text{g}/\text{m}^3$  TCE, and 6.4  $\mu\text{g}/\text{m}^3$  vinyl chloride measured in the sample taken from before the filter canisters. The sample taken after the filter canister contained no measurable concentrations of VOCs.

At the same time samples were collected from before and after the SVE filter system for laboratory analysis, samples were also collected from the subslab soil vapor probe located in the basement. In May 2016 this sample exhibited a PCE concentration of 15,000  $\mu\text{g}/\text{m}^3$ , and a TCE concentration of 210  $\mu\text{g}/\text{m}^3$ . No other VOCs were detected. Samples taken from subslab in April 2017 exhibited much lower concentrations of PCE (320  $\mu\text{g}/\text{m}^3$ ) and TCE (3.3  $\mu\text{g}/\text{m}^3$ ). Cis-1,2-DCE was also detected in April 2017 at a concentration of 0.2  $\mu\text{g}/\text{m}^3$ . VC was not detected in the April 2017 subslab sample.

## 6.3 CYCLE TIME

As noted above, the system was initially set for continuous operation. However, the constant operation inflicts a higher level of wear on the mechanical components of the system which required more frequent O&M visits to the site. Accordingly, Trihydro, with MDEQ's concurrence, reduced the hours of system operation to avoid unnecessary O&M, which provided no measurable benefit (MDEQ 2016). The system was then programmed to run 12 hours during the day and shut down for 12 hours overnight beginning March 4, 2016.

## 6.4 WATER IN SYSTEM

Since start up in January 2016, the system has been plagued with water being drawn into some of the wells. This was first noticed during the step testing when the maximum test vacuum had to be reduced to 53 (in H<sub>2</sub>O) to prevent water being drawn into the system. Wells SVE01, SVE02, and SVE03, in particular, continued to exhibit a tendency to draw water into the system. On March 23, 2016, slightly smaller sheaves were installed on the blower motor to reduce the blower RPMs, and thereby reduce the induced vacuum. The sheaves were provided by PTS and reduced the RPM by nearly one-half, i.e. from approximately 2400 RPM to approximately 1300 RPM. However, the system continued to draw water into the wells previously mentioned.

On July 22, 2016, well SVE03 was fitted with a “screen reducer” consisting of piping and O-rings assembled and fit down inside the well casing to reduce the five-foot screened interval to approximately the upper 18 inches. This was done in an attempt to restrict infiltration by groundwater at the well casing, and if successful, wells SVE01 and SVE02 would be similarly modified. The modification to well SVE03 did not fully correct the problem and water continues to be evident in SVE03 as well as in SVE02 and SVE01. However, despite the groundwater issues, the system appears to be operating effectively because PID readings of the vapor stream from each well indicates that contaminant mass is being removed.

## 7.0 GROUNDWATER SAMPLING

Groundwater flow is generally to the north-under the site. Three wells installed as part of the investigation work for the BN Havre Facility were selected for groundwater sampling as part of the Roxy's interim remedial action. The wells are identified as HV-41, HV-43, and HV-62, and their locations are shown on Figure 2. HV-41 and HV-43 are cross-gradient of Roxy's, located to the west-northwest and east-northeast of Roxy's. HV-62 is located north and down-gradient of Roxy's. All three wells were accessed and sampled with BNSF's permission. Sampling events were coordinated with routine monitoring events at the BN Havre Facility.

Groundwater was sampled in April 2016, June 2016, and March 2017 using low-flow methods. In each case, a BNSF representative provided access to the three wells which were sampled. June corresponds to high groundwater conditions and March corresponds to low groundwater conditions. Samples were analyzed by Energy Laboratories in Helena, MT, and analytical results were validated by Trihydro (Appendix J).

Historic groundwater sampling by BNSF was used for baseline (prior to EVO injections) comparisons. HV-41 and HV-43 were last sampled by BNSF in June 2013; HV-62 was last sampled by BNSF in March 2014. During these sampling events, PCE was detected in HV-41 at 0.031 micrograms per liter ( $\mu\text{g/L}$ ); in HV-43 at 0.030/0.043  $\mu\text{g/L}$ ; and in HV-62 at 0.069  $\mu\text{g/L}$ . Following the EVO injections in January 2016, PCE was not detected ( $<1$  to  $<1.2$   $\mu\text{g/L}$ ) in the three wells April 2016, June 2016, or March 2017.

In June 2013, TCE was detected in HV-41 at 0.08  $\mu\text{g/L}$  and in HV-43 at 1.4/1.5  $\mu\text{g/L}$ . In March 2014, TCE was detected in HV-62 at 1.4  $\mu\text{g/L}$ . TCE concentrations ranged from 0.53  $\mu\text{g/L}$  to 1.4  $\mu\text{g/L}$  in the three wells between April 2016 and March 2017 following the January 2016 EVO injections.

Cis-1,2-DCE was  $<0.5$   $\mu\text{g/L}$  in HV-41 and 150/140  $\mu\text{g/L}$  in HV-43 in June 2013; and was 770  $\mu\text{g/L}$  in HV-62 in March 2014. After the EVO injection in January 2016, cis-1,2-DCE increased from  $<1$   $\mu\text{g/L}$  (April 2016) to 197  $\mu\text{g/L}$  / 98  $\mu\text{g/L}$  (June 2016) in HV-41. In HV-43, cis-1,2-DCE was 152  $\mu\text{g/L}$  in April 2016; increased to 189  $\mu\text{g/L}$  / 181  $\mu\text{g/L}$  in June 2016; then decreased to  $<1$   $\mu\text{g/L}$  in March 2017. In HV-62, cis-1,2-DCE was 17  $\mu\text{g/L}$  in April 2016, increased to 1670  $\mu\text{g/L}$  in June 2016; then decreased to 72  $\mu\text{g/L}$  in March 2017.

VC was  $<0.5$   $\mu\text{g/L}$  in HV-41, and 0.14/0.10  $\mu\text{g/L}$  in HV-43 in June 2013; and was 270  $\mu\text{g/L}$  in HV-62 in March 2014.

VC concentrations in HV-41 and HV-43 were <1 µg/L and 0.19 µg/L, respectively, in April 2016; <1 µg/L in both wells in June 2016 and March 2017. In HV-62, VC was detected at 60 µg/L in April 2016; 392 µg/L in June 2016; and 234 µg/L in March 2017.

Table 4a shows the analytical results from June 2013 to March 2017. Analytical results for the entire analytical suite for groundwater are shown in Table 4b which also contains historical (1993 through 2013) sample results for those wells. Plots of chlorinated solvent concentrations in wells HV-41, HV-43, and HV-62 are shown on Figures 11, 12, and 13, respectively.

## 8.0 SVE SYSTEM PERFORMANCE

Laboratory analytical data shown in Table 3, indicate that PCE has been the primary constituent of the soil vapor extracted from the subsurface, detected at two to three orders of magnitude greater concentrations than TCE.

Therefore, the molecular mass of PCE (165.82 gram/mol) was used to calculate mass removed by the system, using the formula below:

$$\frac{mg}{m^3} = (ppm * MW)/24.46$$

Where: 24.46 = molar volume at 25 deg C and 760 mmHg

MW = molecular weight

mmHG = millimeters of mercury

ppm = parts per million

The cumulative mass removed by the system is plotted in Figure 9 which shows that an estimated 12 lbs. of chlorinated solvents have been removed from the subsurface in a little over one year of operation. Plots of individual wells' extraction rates (pounds removed per hour of run time) are shown in Figure 10. The plots of extraction rates in Figure 10 suggest that:

- The injection of the EVO solution in January 2016 may have had at least a temporary impact on the extraction rate in some wells, increasing the availability of vapor for extraction. The maximum duration of effect from EVO injection is generally estimated to be two years.
- In general, SVE01, SVE02, and SVE03 appear to under-perform in comparison to the other wells; i.e. the extraction rates for these three generally trend lower than those of the other three (SVE04, SVE05, and SVE06). As noted above, SVE01, SVE02, and SVE03 have a tendency to draw water into the system. The lower extraction rates may be due in part to the decreased flow used to try to alleviate that problem. In addition, SVE01, SVE02, and SVE03 were installed through a concrete slab encountered at approximately 7 ft-bgs for each well. Although the lateral extent of the concrete is unknown, its presence may create a "capping" effect in the vicinity of the three wells. This in combination with SVE01, SVE02, and SVE03 being installed deeper than SVE04, SVE05, and SVE06 increases their tendency to draw groundwater; thus limiting the effectiveness of SVE01, SVE02, and SVE03. In spite of the potential limitations of SVE01, SVE02, and SVE03, all six wells are currently extracting chlorinated solvents from the subsurface.

To verify the ROI of the SVE system, induced vacuum readings have been measured occasionally from the soil vapor probe in the basement of the building. During these measurements, PID readings were also collected. The initial PID reading in February 2016 was 3.3 parts per million (ppm). In April and May 2016, the soil vapor probe PID readings were 6.22 and 41.2 ppm, respectively. Laboratory analytical results from the soil vapor probe (i.e. subslab sample) showed that PCE and TCE were detected at 15,000  $\mu\text{g}/\text{m}^3$  and 210  $\mu\text{g}/\text{m}^3$ , respectively, in May 2016. The most recent PID reading was 1.17 ppm (April 2017). The increase in VOC concentrations, as measured by the PID, in the soil vapor probe in April/May 2016 may be the result of increased concentrations of PCE breakdown products (e.g., TCE, cis-1,2-DCE, VC) following the January 2016 bioremediation injections. Tables 5.a through 5.g contain PID readings for individual wells, converted into mass removed based on those readings.

Indoor air samples were collected from both the garage portion and apartment portion of the Roxy's building basement in March 2016 and March 2017. PCE concentrations decreased from 27  $\mu\text{g}/\text{m}^3$  to 8.6  $\mu\text{g}/\text{m}^3$  in the garage, and from 6.8  $\mu\text{g}/\text{m}^3$  to 3.3  $\mu\text{g}/\text{m}^3$  in the apartment. TCE concentrations decreased from 1.2  $\mu\text{g}/\text{m}^3$  to 0.45  $\mu\text{g}/\text{m}^3$  in the garage, and from 0.35  $\mu\text{g}/\text{m}^3$  to 0.17  $\mu\text{g}/\text{m}^3$  in the apartment. Cis-1,2-DCE concentrations in the garage decreased from 0.43  $\mu\text{g}/\text{m}^3$  to 0.17  $\mu\text{g}/\text{m}^3$  in the garage. Cis-1,2-DCE was not detected in the apartment. VC was not detected in any of the indoor air samples. All indoor concentrations were below the site-specific residential screening levels calculated by MDEQ (MDEQ 2015b and Section 1.5).

As discussed in Section 6.2, samples were collected from the subslab soil vapor probe in May 2016 and April 2017. PCE concentrations decreased from 15,000  $\mu\text{g}/\text{m}^3$  in May 2016 to 320  $\mu\text{g}/\text{m}^3$  in April 2017. TCE concentrations decreased of 210  $\mu\text{g}/\text{m}^3$  to 3.3  $\mu\text{g}/\text{m}^3$  in April 2017. Cis-1,2-DCE was not detected in May 2016, but was detected at 0.2  $\mu\text{g}/\text{m}^3$  in April 2017. VC was not detected in the May 2016 or April 2017 subslab samples. The decrease in PCE and TCE concentrations indicate that the SVE system and enhanced bioremediation injections are reducing concentrations.

Groundwater sample results were combined with historical results for wells HV-41, HV-43, and HV-62 in Table 4 and used to produce plots of PCE, TCE, DCE, and VC concentrations over time for each well, as shown in Figures 10 through 12. The information in Table 4 and the temporal plots provide the following information:

- Well HV-41
  - PCE was detected once (June 2013 at 0.031  $\mu\text{g}/\text{L}$ ) in 16 samples collected since 2004.
  - TCE was detected at 0.08  $\mu\text{g}/\text{L}$  in June 2013, and at 1.2  $\mu\text{g}/\text{L}$  in March 2017. The previous maximum was 0.11  $\mu\text{g}/\text{L}$  in 2004.

- DCE was detected once (198 µg/L) in March 2017 and was previously not detected.
- VC was last detected in 2004.
- Well HV-43
  - PCE was last detected in June 2013 at 0.043 µg/L.
  - TCE was not detected in March 2017 after being consistently detected since 2004 with a maximum concentration of 29 µg/L in March 2006.
  - Cis-1,2-DCE was not detected in March 2017 after detections in April and June 2016 of 152 and 189 µg/L, respectively. Historically, cis-1,2-DCE has been detected since 1993 with a maximum concentration of 410 µg/L in June 2010.
  - VC was not detected in June 2016 and March 2017 after being consistently detected since 2004 with a maximum concentration of 5.61 µg/L in March 2004.
- Well HV-62
  - PCE concentrations have been trending downward since April 2004 (117 µg/L), with non-detects (<1.2 µg/L) in 2016 and 2017.
  - TCE concentrations have decreased overall from a maximum of 541 µg/L (June 2006) to <1 µg/L (March 2017).
  - DCE was detected at a historic high (1670 µg/L) in June 2016 and near a historic low (72 µg/L) in March 2017. Historically DCE has been detected since April 2004.
  - VC concentrations in June 2016 and March 2017 were 392 and 234 µg/L, respectively, compared to 270 µg/L in March 2014.

## 9.0 INVESTIGATION DERIVED WASTE

Investigation derived waste (IDW) included soil cuttings generated by drilling wells, excavated soils from trenching activities, asphalt removed for trenching, purged groundwater during sampling events, and used filter media from the SVE system.

Soil cuttings generated during the drilling of the SVE wells were collected and stored in five 55-gallon drums pending the results of laboratory analysis for PCE and TCE which was performed on December 8, 2015. The results of the analysis showed that PCE was measured at a concentration of 0.46 mg/kg (EPA Residential Soil RSL for PCE is 8.1 mg/kg) and that TCE was non-detect. The cuttings were subsequently disposed of at the Hill County Landfill by Boland Drilling.

Removed asphalt and soils excavated during trenching activities were stored on-site until trenching was completed. Remington arranged for transport and disposal of the asphalt and soils. The asphalt was removed for recycling by Bill Baltrusch Construction and the excavated soil was trucked to Hill County Landfill by Patrick Construction Trucking on December 8, 2015 as documented in Appendix K.

Ground water sampling required that the wells be purged until field parameters were stable, using low-flow techniques. Purge water generated during this process was discharged to the ground surface which is consistent with MDEQ's purge water disposal policy (MDEQ 2015a).

Used filter material (GAC) from the SVE system was sampled and sent for laboratory TCLP Extractable analysis (Appendix J). Trihydro forwarded the results of the analysis to the Hill County Sanitarian, and requested permission to dispose of the GAC at the Hill County Landfill (Trihydro 2016b, 2016c, 2016d, and 2017). Three drums of used GAC material, at approximately 200 pounds per drum, were disposed at the Hill County Landfill on July 21, 2016, October 25, 2016, and April 7, 2017. Each time the Hill County Sanitarian reviewed the laboratory analysis and approved disposal of the material to the Hill County Landfill (Vincent 2016a, 2016b, and 2017). In each case, the TCLP Extractable VOCs were not detected. Laboratory reports containing the results of the analyses are included in Appendix J. Waste disposal document is provided in Appendix K.

### 9.1 WASTE DETERMINATION

As stated in Section 1.3, the DEQ Hazardous Waste Program conducted Compliance Evaluation Inspections at Classic Cleaners/Roxy's in 1994 and 2000. The only information available to DEQ on the dry cleaning operations at Classics

Cleaners/Roxy's is provided in the Compliance Evaluation Inspection Reports (MDEQ 1994 and 2000). These reports briefly describe the type of dry-cleaning machines used and how the machine filters were changed. Neither report indicates if or where releases of PCE may have occurred or if releases would have involved new PCE, unused PCE, or spent/used PCE. Both inspection reports noted that the handling of spent solvent material was in compliance with applicable State hazardous waste laws and no violations were reported during either inspection (DEQ 1994 and DEQ 2000).

Other than the interviews documented in MDEQ 1994 and 2000, DEQ has not interviewed the previous owners of Classic Cleaners/Roxy's, and has been unable to obtain additional information on the Classic Cleaners/Roxy's dry cleaning process. The current owner of the building did not own the building at the time of the drying cleaning operations and is unfamiliar with the dry cleaning operations.

Because DEQ Compliance Evaluation Inspections did not identify any disposal violations at the former Classic Cleaners/Roxy's and because of limited information regarding the dry cleaning operations, DEQ was unable to determine with any level of certainty that the solvent is spent. Accordingly, DEQ determined that waste generated during the Roxy's interim remedial action was not a listed hazardous waste. However, as described above (Section 9), the GAC material is analyzed to determine if it is a characteristic hazardous waste and disposed of accordingly.

## 10.0 SUMMARY AND RECOMMENDATIONS

The SVE system continues to extract chlorinated solvents from the subsurface. It currently operates on a 12-hour on, 12-hour off basis, and is serviced approximately once per month. The system has removed roughly 12 pounds of chlorinated solvents from the subsurface since its installation in January 2016. Indoor air concentrations of chlorinated solvents have decreased and are below site-specific screening levels while concentrations of chlorinated solvents in soil gas beneath the building have been reduced by orders of magnitude. Groundwater sample data suggest that cis-1,2-DCE and VC concentrations in down-gradient well HV-62 appear to be fluctuating with historic highs in June 2016. PCE and TCE were not detected in the most recent round of sampling.

Based on the SVE system successfully extracting PCE from the subsurface soil, Trihydro recommends the following:

- Continue operation of the SVE system at the current duty rate; i.e. 12-hour on and 12-hour off.
  - Monthly O&M schedule with semi-annual laboratory analysis to verify continued extraction
- Conduct at least two more groundwater sampling events during high and low water table periods.
- Consider a second injection event as the higher concentrations of DCE and VC in groundwater from MW-62 suggest that the EVO injection has optimized the natural degradation of PCE, and typically, EVO injections are expected to sustain an effect for a maximum of two years.
- Continue annual subslab (soil vapor) sampling to verify that concentrations beneath the building are decreasing.

## 11.0 REFERENCES

- Kennedy/Jenks Consultants (K/J) 2009. Final Remedial Investigation Report. Burlington Northern Fueling Facility, Havre, Montana. May.
- K/J 2012. Revised Addendum to Remedial Investigation Report Supplement, Revision No. 2 (Indoor Air/Soil Gas Investigation Report). Burlington Northern Fueling Facility, Havre, Montana. November 2.
- K/J 2013. Remedial Investigation Report Supplement, Revision No. 3. Burlington Northern Fueling Facility, Havre, Montana. June.
- Montana Department of Environmental Quality (MDEQ) 1994. Field Investigation Report for Classic Cleaners (MT0000906925). Prepared by Pierre Amicucci. Waste Management Division. Hazardous Waste Program. October 7.
- MDEQ 2000. Field Investigation Report for Roxy's Cleaners and Alterations (MT0000906925). Prepared by Ann Kron. Permitting and Compliance Division. Air & Waste Management Bureau. June 20.
- MDEQ 2008. Field Investigation Report for Roxy's Cleaners and Alterations (MT0000906925). Prepared by Robert Reinke. Permitting and Compliance Division. Waste & Underground Tank Management Bureau. September 30.
- MDEQ 2015a. Disposal of Untreated Purge Water from Monitoring Wells. Retrieved from MDEQ's website: [http://deq.mt.gov/Portals/112/Land/StateSuperfund/Documents/PurgeWater7\\_27\\_15.pdf](http://deq.mt.gov/Portals/112/Land/StateSuperfund/Documents/PurgeWater7_27_15.pdf). July 27, 2015.
- MDEQ 2015b. Email from Kate Fry to James Gleason (Trihydro). Re: TO MOD Roxy's Additional Drilling. November 18.
- MDEQ 2015c. Email from Kate Fry ([kfry@mt.gov](mailto:kfry@mt.gov)) to James Gleason ([jgleason@trihydro.com](mailto:jgleason@trihydro.com)). Roxy's Site Specific Screening Levels for Indoor Air. August 31.
- Montana State Library (MSL) 2017. Montana Cadastral Mapping Project. Property Record Card. 417 1<sup>st</sup> St., Havre, MT 59501. Available at <http://svc.mt.gov/msl/mtcadastral/>. Printed April 26.
- Trihydro Corporation (Trihydro) 2015. Summary of Status Call. December 14.



Trihydro 2016a. Summary of Status Call. March 8.

Trihydro 2016b. Email from James Gleason ([jgleason@trihydro.com](mailto:jgleason@trihydro.com)) to Clay Vincent ([vincentc@co.hill.mt.us](mailto:vincentc@co.hill.mt.us)). Disposal of Granulated Carbon. September 6.

Trihydro 2016c. Email from James Gleason ([jgleason@trihydro.com](mailto:jgleason@trihydro.com)) to Clay Vincent ([vincentc@co.hill.mt.us](mailto:vincentc@co.hill.mt.us)). Filter Material Disposal. December 10.

Trihydro 2016d. Email from Joel Riebli ([jriebli@trihydro.com](mailto:jriebli@trihydro.com)) to Clay Vincent ([vincentc@co.hill.mt.us](mailto:vincentc@co.hill.mt.us)). Filter Material Disposal. December 16.

Trihydro 2017. Email from James Gleason ([jgleason@trihydro.com](mailto:jgleason@trihydro.com)) to Clay Vincent ([vincentc@co.hill.mt.us](mailto:vincentc@co.hill.mt.us)). Filter Material Disposal. May 8.

United States Environmental Protection Agency (USEPA) 2011. Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites. May 2011.

USACE, 2002. Soil Vapor Extraction and Bioventing, United States Army Corps of Engineers, June 3, 2002.

USEPA 2016. RSLs for Chemical Contaminants at Superfund Sites. May 2016.

Vincent, Clay ([vincentc@co.hill.mt.us](mailto:vincentc@co.hill.mt.us)) 2016a. Email to James Gleason ([jgleason@trihydro.com](mailto:jgleason@trihydro.com)). Response to Disposal of Granulated Carbon. September 6.

Vincent, Clay ([vincentc@co.hill.mt.us](mailto:vincentc@co.hill.mt.us)) 2016b. Email to Joel Riebli ([jriebli@trihydro.com](mailto:jriebli@trihydro.com)). Response to Filter Material Disposal. December 16.

Vincent, Clay ([vincentc@co.hill.mt.us](mailto:vincentc@co.hill.mt.us)) 2017. Email to James Gleason ([jgleason@trihydro.com](mailto:jgleason@trihydro.com)). Response to Filter Material Disposal. May 8.



## TABLES

**TABLE 1. INDOOR AIR ANALYTICAL RESULTS  
ROXY'S INTERIM REMEDIAL ACTION  
HAVRE, MT**

Location	Sample Type <sup>1</sup>	Date Sampled	Analyte	Lab Result	Lab Limit	Lab MDL	Lab Units	Reviewer Qualifier <sup>2</sup>	Matrix	Residential SSSL (ug/m <sup>3</sup> ) <sup>1</sup>
Ambient Air	N	3/16/2016	cis-1,2-Dichloroethene	ND	0.19	0.18	ug/m3	--	Air	
Ambient Air	N	3/1/2017	cis-1,2-Dichloroethene	ND	0.14	0.13	ug/m3	--	Air	
Ambient Air	N	3/16/2016	Methane	ND	0.19	0	%v/v	--	Air	
Ambient Air	N	3/1/2017	Methane	2.8	0.72	0.16	ppmV	--	Air	
Ambient Air	N	3/16/2016	Tetrachloroethene	ND	0.19	0.14	ug/m3	--	Air	39.7
Ambient Air	N	3/1/2017	Tetrachloroethene	ND	0.14	0.1	ug/m3	--	Air	39.7
Ambient Air	N	3/16/2016	Trichloroethene	ND	0.19	0.17	ug/m3	--	Air	1.76
Ambient Air	N	3/1/2017	Trichloroethene	ND	0.14	0.13	ug/m3	--	Air	1.76
Ambient Air	N	3/16/2016	Vinyl Chloride	ND	0.19	0.18	ug/m3	--	Air	0.568
Ambient Air	N	3/1/2017	Vinyl Chloride	ND	0.14	0.14	ug/m3	--	Air	0.568
Apartment	N	3/16/2016	cis-1,2-Dichloroethene	ND	0.16	0.15	ug/m3	--	Air	
Apartment	N	3/1/2017	cis-1,2-Dichloroethene	ND	0.15	0.14	ug/m3	--	Air	
Apartment	FD	3/1/2017	cis-1,2-Dichloroethene	ND	0.16	0.14	ug/m3	--	Air	
Apartment	N	3/16/2016	Methane	ND	0.16	0	%v/v	--	Air	
Apartment	N	3/1/2017	Methane	3.3	0.74	0.16	ppmV	--	Air	
Apartment	FD	3/1/2017	Methane	3.4	0.78	0.17	ppmV	--	Air	
Apartment	N	3/16/2016	Tetrachloroethene	6.8	0.16	0.12	ug/m3	--	Air	39.7
Apartment	N	3/1/2017	Tetrachloroethene	3.2	0.15	0.11	ug/m3	--	Air	39.7
Apartment	FD	3/1/2017	Tetrachloroethene	3.3	0.16	0.11	ug/m3	--	Air	39.7
Apartment	N	3/16/2016	Trichloroethene	0.35	0.16	0.15	ug/m3	--	Air	1.76
Apartment	N	3/1/2017	Trichloroethene	0.16	0.15	0.13	ug/m3	--	Air	1.76
Apartment	FD	3/1/2017	Trichloroethene	0.17	0.16	0.14	ug/m3	--	Air	1.76
Apartment	N	3/16/2016	Vinyl Chloride	ND	0.16	0.16	ug/m3	--	Air	0.568
Apartment	N	3/1/2017	Vinyl Chloride	ND	0.15	0.14	ug/m3	--	Air	0.568
Apartment	FD	3/1/2017	Vinyl Chloride	ND	0.16	0.15	ug/m3	--	Air	0.568
Garage	N	3/16/2016	cis-1,2-Dichloroethene	0.43	0.17	0.15	ug/m3	--	Air	
Garage	FD	3/16/2016	cis-1,2-Dichloroethene	0.41	0.19	0.17	ug/m3	--	Air	
Garage	N	3/1/2017	cis-1,2-Dichloroethene	0.17	0.13	0.12	ug/m3	--	Air	
Garage	N	3/16/2016	Methane	ND	0.17	0	%v/v	--	Air	
Garage	FD	3/16/2016	Methane	ND	0.19	0	%v/v	--	Air	
Garage	N	3/1/2017	Methane	4.2	0.63	0.14	ppmV	--	Air	
Garage	N	3/16/2016	Tetrachloroethene	27	0.17	0.12	ug/m3	--	Air	39.7
Garage	FD	3/16/2016	Tetrachloroethene	26	0.19	0.13	ug/m3	--	Air	39.7
Garage	N	3/1/2017	Tetrachloroethene	8.4	0.13	0.091	ug/m3	--	Air	39.7
Garage	N	3/16/2016	Trichloroethene	1.2	0.17	0.15	ug/m3	--	Air	1.76
Garage	FD	3/16/2016	Trichloroethene	1.2	0.19	0.17	ug/m3	--	Air	1.76
Garage	N	3/1/2017	Trichloroethene	0.45	0.13	0.11	ug/m3	--	Air	1.76
Garage	N	3/16/2016	Vinyl Chloride	ND	0.17	0.16	ug/m3	--	Air	0.568
Garage	FD	3/16/2016	Vinyl Chloride	ND	0.19	0.18	ug/m3	--	Air	0.568
Garage	N	3/1/2017	Vinyl Chloride	ND	0.13	0.12	ug/m3	--	Air	0.568

1) N=> Normal Sample, FD=> Field Duplicate

2) Based on data validation conducted by Trihydro (Appendix J), "--" indicates no qualification required

3) The residential site-specific screening level (SSSL) for Roxy's is based on residential use using EPA's Regional Screening Level Calculator. See Appendix E  
ug/m<sup>3</sup> => microgram/cubic meter

TABLE 2. O&M DATA, SYSTEM FLOW, VACUUM, PID READINGS  
ROXY'S INTERIM REMEDIAL ACTION  
HAVRE, MT

Date	SVE System (hours)	Heat Exchanger System (hours)	SVE Total Flow (cfm)	SVE Inlet Vacuum (in H2O)	Pre-Air Dilution PID (ppm)	SVE01 Flow (cfm)	SVE01 Vacuum (in H2O)	SVE01 PID (ppm)	SVE02 Flow (cfm)	SVE02 Vacuum (in H2O)	SVE02 PID (ppm)	SVE03 Flow (cfm)	SVE03 Vacuum (in H2O)	SVE03 PID (ppm)	SVE04 Flow (cfm)	SVE04 Vacuum (in H2O)	SVE04 PID (ppm)	SVE05 Flow (cfm)	SVE05 Vacuum (in H2O)	SVE05 PID (ppm)	SVE06 Flow (cfm)	SVE06 Vacuum (in H2O)	SVE06 PID (ppm)	Knock Out Tank Vacuum (in H2O)	Knock Out Tank Slight Tube	SVE Discharge Pressure (in H2O)	SVE Discharge PID (ppm)	Carbon Drum Inlet #1 Pressure (in H2O)	Carbon Drum #1 Outlet PID (ppm)	Carbon Drum Inlet #2 Pressure (in H2O)	Carbon Drum Outlet#2 PID (ppm)	Soil Probe Vacuum (in H2O)	Soil Probe PID (ppm)		
1/20/2016																																			
1/22/2016	53.8	54.2	>200	-56	--	<10	-50	--	<10	-38	--	<10	-50	--	27	-47	--	15	-50	--	22	-50	--	-48	Empty	60	0.0	28	--	12	--	--	--	--	
1/23/2016	79.5	80.0	>200	-57	--	18	-42	--	22	-49	--	34	-53	--	25	-50	--	20	-42	--	52	-32	--	-49	Empty	58	0.0	28	--	12	--	--	--	--	
1/24/2016	93.6	94.1	>200	-58	--	19	-42	--	21	-49	--	34	-53	--	23	-50	--	21	-42	--	52	-32	--	-50	Empty	57.5	0.0	27	--	12	--	--	--	--	
1/25/2016	115.9	116.3	>200	-58	--	<10	-52	--	37	-44	--	15	-48	--	15	-48	--	25	-52	--	24	-52	--	-50	Empty	59	0.0	27.5	--	12	--	--	--	--	
1/25/2016	125.4	125.8	>200	-60	--	<10	-56	--	<10	-50	--	<10	-32	--	18	-50	--	15	-53	--	25	-54	--	-51	Empty	57.5	0.0	27	--	11.5	--	--	--	--	
1/26/2016	140.0	140.4	>200	-60	--	<10	-54	--	<10	-47	--	15	-50	--	15	-50	--	20	-53	--	22	-53	--	-51	Empty	57.5	0.0	27	--	11.5	--	--	--	--	
1/26/2016	149.1	149.6	>200	-61	--	<10	-55	--	<10	-50	--	12	-55	--	14	-51	--	21	-55	--	20	-55	--	-53	Empty	56	0.0	26.5	--	11	--	--	--	--	
1/27/2016																																			
1/28/2016	173.0	173.5	>200	-62	--	15	-56	--	<10	-53	--	11	-56	--	14	-53	--	24	-56	--	15	-56	--	-54	Empty	55	0.0	26.5	--	10.5	--	--	--	--	
2/10/2016	489.0	489.5	>200	-61	0.0	19	-44	0.0	36	-43	0.0	12	-50	0.0	<10	-50	0.0	24	-50	0.0	33	-50	0.0	-50	Empty	55	0.0	27	0.0	11	0.0	-0.02	3.3	--	--
2/11/2016	506.9	507.4	>200	-59	3.0	<10	-43	5.8	45	-43	4.5	<10	-49	2.7	<10	-49	10.0	46	-49	6.4	16	-49	0.9	-50	Empty	56	0.0	26.5	0.0	11	0.0	--	--	--	--
3/4/2016	1,040.5	1,041.0	>200	-53	--	<10	-35.5	--	16	-42	--	16	-42	--	28	-42	--	<10	-47	--	18	-44	--	-45	Empty	56	--	26.5	--	10.6	--	-0.03	--	--	--
3/16/2016	1,180.4	1,180.9	>200	-58	--	<10	-44	--	<10	-47	--	<10	-53	--	21	-46	--	14	-52	--	26	-51	--	-50	Empty	54	--	26.2	--	10.6	--	--	--	--	--
3/23/2016	1,267.5	1,268.0	>200	-61	0.2	<10	-44	0.3	14	-49	0.1	<10	-57	0.2	13	-46	0.1	12	-53	0.9	14	-53	1.1	-42	Empty	52.4	0.0	25.8	0.0	10.4	0.0	--	--	--	--
3/24/2016	1,270.6	1,271.1	130	-49	--	<10	-45	--	<10	-43	--	<10	-50	--	23	-46	--	>50	-43	--	24	-46	--	-44	Empty	20	--	10.5	--	3.1	--	--	--	--	--
4/7/2016	1,311.3	1,311.8	135	-33	0.8	16	-31	0.8	15	-29	0.8	<10	-36	0.3	21	-37	0.4	30	-31	0.3	25	-32	0.1	-30	Empty	23	1.4	12.2	0.0	3.8	0.0	--	--	--	--
4/20/2016	1,469.3	1,469.8	127	-51	5.7	21	-45	6.0	<10	-42	4.6	<10	-50	6.0	18	-46	5.9	22	-49	1.9	12	-50	1.1	-47	Empty	19	5.0	10.6	3.1	3	2.8	-0.02	6.22	--	--
5/18/2016	1,764.9	1,765.3	>200	-49	2.8	<10	-48	0.1	<10	-52	0.9	14	-53	3.0	14	-51	3.6	22	-50	2.0	14	-50	3.2	-45	Empty	18	0.8	10.5	0.6	3	0.6	-0.03	41.2	--	--
6/24/2016	2,207.5	2,208.0	>200	-47	0.8	19	-43	0.0	<10	-50	0.0	<10	-50	0.0	<10	-48	1.1	14	-47	0.4	18	-48	0.7	-42	Empty	18	0.3	10.7	0.7	3.3	0.0	--	--	--	--
7/21/2016	2,528.1	2,528.6	>200	-49	1.3	18	-48	4.7	<10	-50	1.4	<10	-51	2.4	<10	-50	0.3	<10	-49	0.0	<10	-49	0.0	-42	Empty	18	0.1	11	0.0	3	0.0	--	--	--	--
7/22/2016	2,538.8	2,539.3	>200	-68	1.3	26	-65	3.1	13	-63	0.0	24	-55	1.3	<10	-63	2.1	25	-65	0.5	<10	-63	1.9	-65	Empty	9.5	0.2	3	0.0	--	--	--	--	--	--
8/17/2016	2,852.2	2,852.7	116	-58	2.0	21	-55	0.2	<10	-54	0.0	15	-61	0.0	<10	-56	0.3	20	-57	0.1	<10	-59	0.3	-54	Empty	19	0.0	11.5	0.0	9.8	0.0	-0.03	0.8	--	--
8/18/2016	2,876.1	2,876.6	131	-52	--	<10	-51	--	<10	-54	--	27	-56	--	<10	-53	--	17	-52	--	14	-52	--	-48	Empty	19.7	--	12.4	--	10.2	--	--	--	--	--
8/26/2016	3,067.7	3,068.2	117	-40	--	16	-39	--	<10	-43	--	<10	-42	--	<10	-42	--	19	-41	--	<10	-43	--	-36	Empty	20.8	--	14.1	--	11.7	--	--	--	--	--
9/8/2016	3,087.9	3,088.4	106	-46	--	19	-46	--	<10	-49	--	<10	-51	--	14	-48	--	21	-47	--	11	-47	--	42	Empty	21.1	--	13	--	11	--	--	--	--	--
10/4/2016	3,394.2	3,394.7	105	-49	1.4	21	-48	1.1	<10	-49	0.3	<10	-53	0.4	<10	-50	1.2	17	-49	0.3	15	-49	1.2	-45	Empty	20.5	0.6	13.4	0.0	10.5	0.0	--	--	--	--
10/5/2016	3,403.1	3,403.6	113	-48	1.8	19	-47	1.1	<10	-50	0.3	<10	-52	0.7	<10	-49	1.6	27	-48	1.4	14	-49	1.8	-44	Empty	21	0.5	14	0.0	11	0.0	--	--	--	--
10/25/2016	3,639.0	3,639.5	94	-49.5	1.4	18	-45	0.4	<10	-51	0.5	<10	-53	0.4	14	-46	1.8	27	-47	0.5	14	-50	1.1	-45	Empty	21.8	0.2	14.2	0.2	11	0.0	--	--	--	--
11/22/2016	3,971.6	3,972.1	105	-45	0.6	21	-43	1.2	<10	-47	0.7	<10	-49	0.1	12	-47	0.3	24	-46	0.5	13	-45	0.3	-40	1/2 Full	27.7	0.1	11.6	0.0	11	0.0	--	--	--	--
12/15/2016	4,233.7	4,234.2	135	-45	0.2	<10	-46	0.2	<10	-45	0.1	<10	-46	0.1	<10	-47	0.1	<10	-47	0.1	<10	-46	0.5	-42	Empty	28	0.0	11.5	0.0	10.5	0.0	0	1.4	--	--
12/29/2016	4,569.2	4,569.7	135	-46	2.1	<10	-49	0.6	<10	-49	1.9	<10	-50	1.5	<10	-47	9.5	18	-47	1.1	14	-47	1.8	-42	Empty	27.5	0.3	11.5	0.0	12.5	0.0	--	--	--	--
1/27/2017	4,918.3	4,918.8	135	-46	2.4	<10	-47	0.1	<10	-49	1.1	<10	-49	0.3	<10	-48	2.1	17	-48	0.6	14	-47	1.0	-42	Empty	27	0.4	11.5	0.0	12.5	0.0	--	--	--	--
2/16/2017	5,156.7	5,157.2	138	-45	3.3	<10	-46	0.2	<10	-48	2.6	<10	-48	1.0	18	-46	8.9	18	-46	2.1	14	-45	5.5	-41	Empty	27.5	0.3	11.5	0.0	12.4	0.0	--	--	--	--
3/16/2017	5,514.6	5,515.1	133	-46	1.134	26	-43	0.766	<10	-46	1.428	<10	-48	0.683	20	-45	6.450	26	-45	1.506	24	-45	1.631	-42	Empty	27.5	0.492	12.5	0.021	11.5	0.003	--	--	--	--
3/20/2017	5,668.3	5,668.8	141	-49.9	0.871	24	-47	0.188	<10	-48	1.143	<10	-51	0.230	12	-50	1.710	22	-49.8	1.040	18	-50	0.644	-45	Empty	27.5	0.237	13	0.007	11.5	0.000	--	--	--	--
4/6/2017	5,764.7	5,765.2	140	-52	1.421	23	-50	1.328	19	-53	1.674	<10	-56	0.654	14	-53	1.991	27	-53	0.941	25	-53	1.646	-50	Empty	28	0.406	13	0.031	11.4	0.004	-0.06	1.171	--	--
5/17/2017	6,255.5	6,256	142	-43	0.284	23	-30	0.112	<10	-39	0.003	<10	-46	0.144	16	-37	0.995	14	-34	0.898	24	-39	0.377	-38	Empty	38	0.114	15.4	0	9.2	0	-0.04	0.77	--	--

cfm => cubic feet per minute  
ppm => parts per million  
in H2O => inches of water  
"--" => not measured

**TABLE 3. INFLUENT, EFFLUENT, AND SOIL GAS ANALYTICAL RESULTS  
ROXY'S INTERIM REMEDIAL ACTION  
HAVRE, MT**

Location	Sample Type <sup>1</sup>	Date Sampled	Analyte	Lab Result <sup>2</sup>	Lab Limit	Lab Units <sup>3</sup>	Reviewer Qualifier <sup>4</sup>	Matrix	Residential SSSL (ug/m <sup>3</sup> ) <sup>5</sup>
Post-Filter	N	2/10/2016	cis-1,2-Dichloroethene	ND	1	mg/m3	R	Air	
Pre-Filter	N	2/10/2016	cis-1,2-Dichloroethene	ND	1	mg/m3	R	Air	
Post-Filter	N	2/10/2016	Methane	3.7	2	ppm	R	Air	
Pre-Filter	N	2/10/2016	Methane	3.3	2	ppm	R	Air	
Post-Filter	N	2/10/2016	Tetrachloroethene	ND	1	mg/m3	R	Air	39.7
Pre-Filter	N	2/10/2016	Tetrachloroethene	ND	1	mg/m3	R	Air	39.7
Post-Filter	N	2/10/2016	Trichloroethene	ND	1	mg/m3	R	Air	1.76
Pre-Filter	N	2/10/2016	Trichloroethene	ND	1	mg/m3	R	Air	1.76
Post-Filter	N	2/10/2016	Vinyl Chloride	ND	1	mg/m3	R	Air	0.568
Pre-Filter	N	2/10/2016	Vinyl Chloride	ND	1	mg/m3	R	Air	0.568
Soil Probe	N	2/10/2016	cis-1,2-Dichloroethene	ND	1	mg/m3	R	Air	
Soil Probe	N	2/10/2016	Methane	4.1	2	ppm	R	Air	
Soil Probe	N	2/10/2016	Tetrachloroethene	15	1	mg/m3	R	Air	39.7
Soil Probe	N	2/10/2016	Trichloroethene	ND	1	mg/m3	R	Air	1.76
Soil Probe	N	2/10/2016	Vinyl Chloride	ND	1	mg/m3	R	Air	0.568
Soil Probe	N	5/18/2016	cis-1,2-Dichloroethene	ND	16	ug/m3		Air	
Soil Probe	N	5/18/2016	Methane	83	0.73	ppmv		Air	
Soil Probe	N	5/18/2016	Tetrachloroethene	15000	150	ug/m3		Air	39.7
Soil Probe	N	5/18/2016	Trichloroethene	210	16	ug/m3		Air	1.76
Soil Probe	N	5/18/2016	Vinyl Chloride	ND	16	ug/m3		Air	0.568
Post-Filter	N	5/18/2016	cis-1,2-Dichloroethene	ND	0.36	ug/m3		Air	
Post-Filter	N	5/18/2016	Methane	3.4	0.73	ppmv		Air	
Post-Filter	N	5/18/2016	Tetrachloroethene	150	0.36	ug/m3		Air	39.7
Post-Filter	N	5/18/2016	Trichloroethene	1.9	0.36	ug/m3		Air	1.76
Post-Filter	N	5/18/2016	Vinyl Chloride	ND	0.36	ug/m3		Air	0.568
Pre-Filter	N	5/18/2016	cis-1,2-Dichloroethene	ND	1.5	ug/m3		Air	
Pre-Filter	N	5/18/2016	Methane	3.4	0.77	ppmv		Air	
Pre-Filter	N	5/18/2016	Tetrachloroethene	1500	3.1	ug/m3		Air	39.7
Pre-Filter	N	5/18/2016	Trichloroethene	19	1.5	ug/m3		Air	1.76
Pre-Filter	N	5/18/2016	Vinyl Chloride	ND	1.5	ug/m3		Air	0.568
Post-Filter	N	4/6/2017	Methane	4.2	0.73	ppmV		Air	
Pre-Filter	N	4/6/2017	Methane	4	0.73	ppmV		Air	
Field Dup	FD	4/6/2017	Methane	3.97	4	ppmV		Air	
Post-Filter	N	4/6/2017	Vinyl Chloride	ND	0.15	ug/m3		Air	0.568
Post-Filter	N	4/6/2017	cis-1,2-Dichloroethene	ND	0.15	ug/m3		Air	
Post-Filter	N	4/6/2017	Trichloroethene	ND	0.15	ug/m3		Air	1.76

**TABLE 3. INFLUENT, EFFLUENT, AND SOIL GAS ANALYTICAL RESULTS  
ROXY'S INTERIM REMEDIAL ACTION  
HAVRE, MT**

Location	Sample Type <sup>1</sup>	Date Sampled	Analyte	Lab Result <sup>2</sup>	Lab Limit	Lab Units <sup>3</sup>	Reviewer Qualifier <sup>4</sup>	Matrix	Residential SSSL (ug/m <sup>3</sup> ) <sup>5</sup>
Post-Filter	N	4/6/2017	Tetrachloroethene	ND	0.15	ug/m3		Air	39.7
Pre-Filter	N	4/6/2017	Vinyl Chloride	6.4	1.5	ug/m3		Air	0.568
Pre-Filter	N	4/6/2017	cis-1,2-Dichloroethene	ND	1.5	ug/m3		Air	
Pre-Filter	N	4/6/2017	Trichloroethene	20	1.5	ug/m3		Air	1.76
Pre-Filter	N	4/6/2017	Tetrachloroethene	1300	1.5	ug/m3		Air	39.7
Field Dup	FD	4/6/2017	Vinyl Chloride	ND	1.5	ug/m3		Air	0.568
Field Dup	FD	4/6/2017	cis-1,2-Dichloroethene	ND	1.5	ug/m3		Air	
Field Dup	FD	4/6/2017	Trichloroethene	18.7	1.5	ug/m3		Air	1.76
Field Dup	FD	4/6/2017	Tetrachloroethene	1290	1.5	ug/m3		Air	39.7
Soil Probe	N	4/6/2017	Methane	5	0.66	ppmV		Air	
Soil Probe	N	4/6/2017	Vinyl Chloride	ND	0.13	ug/m3		Air	0.568
Soil Probe	N	4/6/2017	cis-1,2-Dichloroethene	0.2	0.13	ug/m3		Air	
Soil Probe	N	4/6/2017	Trichloroethene	3.3	0.13	ug/m3		Air	1.76
Soil Probe	N	4/6/2017	Tetrachloroethene	320	0.38	ug/m3		Air	39.7

1) "N" => Normal sample; "FD" => Field Duplicate

2) "ND" => Not detected above the laboratory reporting limit

3) ppm => parts per million (weight basis); ppmv => parts per million (volume basis); mg/m3 => milligrams/cubic meter; ug/m<sup>3</sup> => microgram/cubic meter

4) Based on data validation conducted by Trihydro (Appendix J); R=> Data rejected as not useable

5) The residential site-specific screening level (SSSL) for Roxy's is based on residential use using EPA's Regional Screening Level Calculator. See Appendix E

**TABLE 4a. GROUNDWATER ANALYTICAL RESULTS: 2013 - 2017  
ROXY'S INTERIM REMEDIAL ACTION  
HAVRE, MT**

<b>Well</b>	<b>Date</b>	<b>PCE µg/L</b>	<b>TCE µg/L</b>	<b>cis-1,2-DCE µg/L</b>	<b>Vinyl Chloride µg/L</b>	<b>Comments</b>
<b>HV-41</b>	June 2013	0.031	0.08	<0.5	<0.5	BNSF Sample
	April 2016	<1 / <1	<1 / <1	<1 / <1	<1 / <1	Trihydro Sample
	June 2016	<1	<1	<1	<1	Trihydro Sample
	March 2017	<1 / <1	1.2 / 1.2	197 / 198	<1 / <1	Trihydro Sample
<b>HV-43</b>	June 2013	0.030 / 0.043	1.4 / 1.5	150 / 140	0.14 / 0.10	BNSF Sample
	April 2016	<1	0.9	152	0.19	Trihydro Sample
	June 2016	<1 / <1	1.1 / 1.1	189 / 181	<1 / <1	Trihydro Sample
	March 2017	<1	<1	<1	<1	Trihydro Sample
<b>HV-62</b>	March 2014	0.069	1.4	770	270	BNSF Sample
	April 2016	<1	0.53	17	60	Trihydro Sample
	June 2016	<1.2	1.4	1670	392	Trihydro Sample
	March 2017	<1	<1	72	234	Trihydro Sample

µg/L - micrograms per Liter

**TABLE 4b. HISTORIC GROUNDWATER ANALYTICAL RESULTS  
ROXY'S INTERIM REMEDIAL ACTION  
HAVRE, MT**

Location	Sample Type <sup>1</sup>	Date Time Sampled <sup>2</sup>	Analyte	Lab Result <sup>3</sup>	Lab Limit	Lab Units <sup>4</sup>	Reviewer Qualifier <sup>5</sup>	Matrix
HV-41	N	4/6/2016	1,1,1,2-Tetrachloroethane	ND	1	ug/L	--	Water
HV-41	FD	4/6/2016	1,1,1,2-Tetrachloroethane	ND	1	ug/L	--	Water
HV-41	N	6/24/2016	1,1,1,2-Tetrachloroethane	ND	1	ug/L	--	Water
HV-41	N	3/21/2017	1,1,1,2-Tetrachloroethane	ND	1	ug/L	--	Water
HV-41	FD	3/21/2017	1,1,1,2-Tetrachloroethane	ND	1	ug/L	--	Water
HV-41	N	4/6/2016	1,1,1-Trichloroethane	ND	1	ug/L	--	Water
HV-41	FD	4/6/2016	1,1,1-Trichloroethane	ND	1	ug/L	--	Water
HV-41	N	6/24/2016	1,1,1-Trichloroethane	ND	1	ug/L	--	Water
HV-41	N	3/21/2017	1,1,1-Trichloroethane	ND	1	ug/L	--	Water
HV-41	FD	3/21/2017	1,1,1-Trichloroethane	ND	1	ug/L	--	Water
HV-41	N	4/6/2016	1,1,2,2-Tetrachloroethane	ND	1	ug/L	--	Water
HV-41	FD	4/6/2016	1,1,2,2-Tetrachloroethane	ND	1	ug/L	--	Water
HV-41	N	6/24/2016	1,1,2,2-Tetrachloroethane	ND	1	ug/L	--	Water
HV-41	N	3/21/2017	1,1,2,2-Tetrachloroethane	ND	1	ug/L	--	Water
HV-41	FD	3/21/2017	1,1,2,2-Tetrachloroethane	ND	1	ug/L	--	Water
HV-41	N	4/6/2016	1,1,2-Trichloroethane	ND	1	ug/L	--	Water
HV-41	FD	4/6/2016	1,1,2-Trichloroethane	ND	1	ug/L	--	Water
HV-41	N	6/24/2016	1,1,2-Trichloroethane	ND	1	ug/L	--	Water
HV-41	N	3/21/2017	1,1,2-Trichloroethane	ND	1	ug/L	--	Water
HV-41	FD	3/21/2017	1,1,2-Trichloroethane	ND	1	ug/L	--	Water
HV-41	N	4/6/2016	1,1-Dichloroethane	ND	1	ug/L	--	Water
HV-41	FD	4/6/2016	1,1-Dichloroethane	ND	1	ug/L	--	Water
HV-41	N	6/24/2016	1,1-Dichloroethane	ND	1	ug/L	--	Water
HV-41	N	3/21/2017	1,1-Dichloroethane	ND	1	ug/L	--	Water
HV-41	FD	3/21/2017	1,1-Dichloroethane	ND	1	ug/L	--	Water
HV-41	N	4/6/2016	1,1-Dichloroethene	ND	1	ug/L	--	Water
HV-41	FD	4/6/2016	1,1-Dichloroethene	ND	1	ug/L	--	Water
HV-41	N	6/24/2016	1,1-Dichloroethene	ND	1	ug/L	--	Water
HV-41	N	3/21/2017	1,1-Dichloroethene	ND	1	ug/L	--	Water
HV-41	FD	3/21/2017	1,1-Dichloroethene	ND	1	ug/L	--	Water
HV-41	N	4/6/2016	1,1-Dichloropropene	ND	1	ug/L	--	Water
HV-41	FD	4/6/2016	1,1-Dichloropropene	ND	1	ug/L	--	Water
HV-41	N	6/24/2016	1,1-Dichloropropene	ND	1	ug/L	--	Water
HV-41	N	3/21/2017	1,1-Dichloropropene	ND	1	ug/L	--	Water
HV-41	FD	3/21/2017	1,1-Dichloropropene	ND	1	ug/L	--	Water
HV-41	N	4/6/2016	1,2,3-Trichloropropane	ND	1	ug/L	--	Water
HV-41	FD	4/6/2016	1,2,3-Trichloropropane	ND	1	ug/L	--	Water
HV-41	N	6/24/2016	1,2,3-Trichloropropane	ND	1	ug/L	--	Water
HV-41	N	3/21/2017	1,2,3-Trichloropropane	ND	1	ug/L	--	Water

**TABLE 4b. HISTORIC GROUNDWATER ANALYTICAL RESULTS  
ROXY'S INTERIM REMEDIAL ACTION  
HAVRE, MT**

Location	Sample Type <sup>1</sup>	Date Time Sampled <sup>2</sup>	Analyte	Lab Result <sup>3</sup>	Lab Limit	Lab Units <sup>4</sup>	Reviewer Qualifier <sup>5</sup>	Matrix
HV-41	FD	3/21/2017	1,2,3-Trichloropropane	ND	1	ug/L	--	Water
HV-41	N	4/6/2016	1,2-Dibromoethane	ND	1	ug/L	--	Water
HV-41	FD	4/6/2016	1,2-Dibromoethane	ND	1	ug/L	--	Water
HV-41	N	6/24/2016	1,2-Dibromoethane	ND	1	ug/L	--	Water
HV-41	N	3/21/2017	1,2-Dibromoethane	ND	1	ug/L	--	Water
HV-41	FD	3/21/2017	1,2-Dibromoethane	ND	1	ug/L	--	Water
HV-41	N	4/6/2016	1,2-Dichlorobenzene	ND	1	ug/L	--	Water
HV-41	FD	4/6/2016	1,2-Dichlorobenzene	ND	1	ug/L	--	Water
HV-41	N	6/24/2016	1,2-Dichlorobenzene	ND	1	ug/L	--	Water
HV-41	N	3/21/2017	1,2-Dichlorobenzene	ND	1	ug/L	--	Water
HV-41	FD	3/21/2017	1,2-Dichlorobenzene	ND	1	ug/L	--	Water
HV-41	N	4/6/2016	1,2-Dichloroethane	ND	1	ug/L	--	Water
HV-41	FD	4/6/2016	1,2-Dichloroethane	ND	1	ug/L	--	Water
HV-41	N	6/24/2016	1,2-Dichloroethane	ND	1	ug/L	--	Water
HV-41	N	3/21/2017	1,2-Dichloroethane	ND	1	ug/L	--	Water
HV-41	FD	3/21/2017	1,2-Dichloroethane	ND	1	ug/L	--	Water
HV-41	N	4/6/2016	1,2-Dichloropropane	ND	1	ug/L	--	Water
HV-41	FD	4/6/2016	1,2-Dichloropropane	ND	1	ug/L	--	Water
HV-41	N	6/24/2016	1,2-Dichloropropane	ND	1	ug/L	--	Water
HV-41	N	3/21/2017	1,2-Dichloropropane	ND	1	ug/L	--	Water
HV-41	FD	3/21/2017	1,2-Dichloropropane	ND	1	ug/L	--	Water
HV-41	N	4/6/2016	1,3-Dichlorobenzene	ND	1	ug/L	--	Water
HV-41	FD	4/6/2016	1,3-Dichlorobenzene	ND	1	ug/L	--	Water
HV-41	N	6/24/2016	1,3-Dichlorobenzene	ND	1	ug/L	--	Water
HV-41	N	3/21/2017	1,3-Dichlorobenzene	ND	1	ug/L	--	Water
HV-41	FD	3/21/2017	1,3-Dichlorobenzene	ND	1	ug/L	--	Water
HV-41	N	4/6/2016	1,3-Dichloropropane	ND	1	ug/L	--	Water
HV-41	FD	4/6/2016	1,3-Dichloropropane	ND	1	ug/L	--	Water
HV-41	N	6/24/2016	1,3-Dichloropropane	ND	1	ug/L	--	Water
HV-41	N	3/21/2017	1,3-Dichloropropane	ND	1	ug/L	--	Water
HV-41	FD	3/21/2017	1,3-Dichloropropane	ND	1	ug/L	--	Water
HV-41	N	4/6/2016	1,4-Dichlorobenzene	ND	1	ug/L	--	Water
HV-41	FD	4/6/2016	1,4-Dichlorobenzene	ND	1	ug/L	--	Water
HV-41	N	6/24/2016	1,4-Dichlorobenzene	ND	1	ug/L	--	Water
HV-41	N	3/21/2017	1,4-Dichlorobenzene	ND	1	ug/L	--	Water
HV-41	FD	3/21/2017	1,4-Dichlorobenzene	ND	1	ug/L	--	Water
HV-41	N	4/6/2016	2,2-Dichloropropane	ND	1	ug/L	--	Water
HV-41	FD	4/6/2016	2,2-Dichloropropane	ND	1	ug/L	--	Water
HV-41	N	6/24/2016	2,2-Dichloropropane	ND	1	ug/L	--	Water

**TABLE 4b. HISTORIC GROUNDWATER ANALYTICAL RESULTS  
ROXY'S INTERIM REMEDIAL ACTION  
HAVRE, MT**

Location	Sample Type <sup>1</sup>	Date Time Sampled <sup>2</sup>	Analyte	Lab Result <sup>3</sup>	Lab Limit	Lab Units <sup>4</sup>	Reviewer Qualifier <sup>5</sup>	Matrix
HV-41	N	3/21/2017	2,2-Dichloropropane	ND	1	ug/L	--	Water
HV-41	FD	3/21/2017	2,2-Dichloropropane	ND	1	ug/L	--	Water
HV-41	N	4/6/2016	2-Butanone	ND	20	ug/L	--	Water
HV-41	FD	4/6/2016	2-Butanone	ND	20	ug/L	--	Water
HV-41	N	6/24/2016	2-Butanone	ND	20	ug/L	--	Water
HV-41	N	4/6/2016	2-Chlorotoluene	ND	1	ug/L	--	Water
HV-41	FD	4/6/2016	2-Chlorotoluene	ND	1	ug/L	--	Water
HV-41	N	6/24/2016	2-Chlorotoluene	ND	1	ug/L	--	Water
HV-41	N	3/21/2017	2-Chlorotoluene	ND	1	ug/L	--	Water
HV-41	FD	3/21/2017	2-Chlorotoluene	ND	1	ug/L	--	Water
HV-41	N	4/6/2016	4-Chlorotoluene	ND	1	ug/L	--	Water
HV-41	FD	4/6/2016	4-Chlorotoluene	ND	1	ug/L	--	Water
HV-41	N	6/24/2016	4-Chlorotoluene	ND	1	ug/L	--	Water
HV-41	N	3/21/2017	4-Chlorotoluene	ND	1	ug/L	--	Water
HV-41	FD	3/21/2017	4-Chlorotoluene	ND	1	ug/L	--	Water
HV-41	N	3/21/2017	Arsenic	0.004	0.001	mg/L	--	Water
HV-41	N	3/21/2017	Arsenic	0.003	0.001	mg/L	--	Water
HV-41	FD	3/21/2017	Arsenic	0.004	0.001	mg/L	--	Water
HV-41	FD	3/21/2017	Arsenic	0.004	0.001	mg/L	--	Water
HV-41	N	4/6/2016	Arsenic, Dissolved	0.004	0.001	mg/L	J+	Water
HV-41	FD	4/6/2016	Arsenic, Dissolved	0.002	0.001	mg/L	J+	Water
HV-41	N	6/24/2016	Arsenic, Dissolved	ND	0.001	mg/L	--	Water
HV-41	N	4/6/2016	Benzene	ND	1	ug/L	--	Water
HV-41	FD	4/6/2016	Benzene	ND	1	ug/L	--	Water
HV-41	N	6/24/2016	Benzene	ND	1	ug/L	--	Water
HV-41	N	3/21/2017	Benzene	ND	1	ug/L	--	Water
HV-41	FD	3/21/2017	Benzene	ND	1	ug/L	--	Water
HV-41	N	4/6/2016	Bromobenzene	ND	1	ug/L	--	Water
HV-41	FD	4/6/2016	Bromobenzene	ND	1	ug/L	--	Water
HV-41	N	6/24/2016	Bromobenzene	ND	1	ug/L	--	Water
HV-41	N	3/21/2017	Bromobenzene	ND	1	ug/L	--	Water
HV-41	FD	3/21/2017	Bromobenzene	ND	1	ug/L	--	Water
HV-41	N	4/6/2016	Bromochloromethane	ND	1	ug/L	--	Water
HV-41	FD	4/6/2016	Bromochloromethane	ND	1	ug/L	--	Water
HV-41	N	6/24/2016	Bromochloromethane	ND	1	ug/L	--	Water
HV-41	N	3/21/2017	Bromochloromethane	ND	1	ug/L	--	Water
HV-41	FD	3/21/2017	Bromochloromethane	ND	1	ug/L	--	Water
HV-41	N	4/6/2016	Bromodichloromethane	ND	1	ug/L	--	Water
HV-41	FD	4/6/2016	Bromodichloromethane	ND	1	ug/L	--	Water

**TABLE 4b. HISTORIC GROUNDWATER ANALYTICAL RESULTS  
ROXY'S INTERIM REMEDIAL ACTION  
HAVRE, MT**

Location	Sample Type <sup>1</sup>	Date Time Sampled <sup>2</sup>	Analyte	Lab Result <sup>3</sup>	Lab Limit	Lab Units <sup>4</sup>	Reviewer Qualifier <sup>5</sup>	Matrix
HV-41	N	6/24/2016	Bromodichloromethane	ND	1	ug/L	--	Water
HV-41	N	3/21/2017	Bromodichloromethane	ND	1	ug/L	--	Water
HV-41	FD	3/21/2017	Bromodichloromethane	ND	1	ug/L	--	Water
HV-41	N	4/6/2016	Bromoform	ND	1	ug/L	--	Water
HV-41	FD	4/6/2016	Bromoform	ND	1	ug/L	--	Water
HV-41	N	6/24/2016	Bromoform	ND	1	ug/L	--	Water
HV-41	N	3/21/2017	Bromoform	ND	1	ug/L	--	Water
HV-41	FD	3/21/2017	Bromoform	ND	1	ug/L	--	Water
HV-41	N	4/6/2016	Bromomethane	ND	1	ug/L	--	Water
HV-41	FD	4/6/2016	Bromomethane	ND	1	ug/L	--	Water
HV-41	N	6/24/2016	Bromomethane	ND	1	ug/L	--	Water
HV-41	N	3/21/2017	Bromomethane	ND	1	ug/L	--	Water
HV-41	FD	3/21/2017	Bromomethane	ND	1	ug/L	--	Water
HV-41	N	4/6/2016	Carbon tetrachloride	ND	1	ug/L	--	Water
HV-41	FD	4/6/2016	Carbon tetrachloride	ND	1	ug/L	--	Water
HV-41	N	6/24/2016	Carbon tetrachloride	ND	1	ug/L	--	Water
HV-41	N	3/21/2017	Carbon tetrachloride	ND	1	ug/L	--	Water
HV-41	FD	3/21/2017	Carbon tetrachloride	ND	1	ug/L	--	Water
HV-41	N	4/6/2016	Chlorobenzene	ND	1	ug/L	--	Water
HV-41	FD	4/6/2016	Chlorobenzene	ND	1	ug/L	--	Water
HV-41	N	6/24/2016	Chlorobenzene	ND	1	ug/L	--	Water
HV-41	N	3/21/2017	Chlorobenzene	ND	1	ug/L	--	Water
HV-41	FD	3/21/2017	Chlorobenzene	ND	1	ug/L	--	Water
HV-41	N	3/21/2017	Chlorodibromomethane	ND	1	ug/L	--	Water
HV-41	FD	3/21/2017	Chlorodibromomethane	ND	1	ug/L	--	Water
HV-41	N	4/6/2016	Chloroethane	ND	1	ug/L	--	Water
HV-41	FD	4/6/2016	Chloroethane	ND	1	ug/L	--	Water
HV-41	N	6/24/2016	Chloroethane	ND	1	ug/L	--	Water
HV-41	N	3/21/2017	Chloroethane	ND	1	ug/L	--	Water
HV-41	FD	3/21/2017	Chloroethane	ND	1	ug/L	--	Water
HV-41	N	4/6/2016	Chloroform	ND	1	ug/L	--	Water
HV-41	FD	4/6/2016	Chloroform	ND	1	ug/L	--	Water
HV-41	N	6/24/2016	Chloroform	ND	1	ug/L	--	Water
HV-41	N	3/21/2017	Chloroform	ND	1	ug/L	--	Water
HV-41	FD	3/21/2017	Chloroform	ND	1	ug/L	--	Water
HV-41	N	4/6/2016	Chloromethane	ND	1	ug/L	--	Water
HV-41	FD	4/6/2016	Chloromethane	ND	1	ug/L	--	Water
HV-41	N	6/24/2016	Chloromethane	ND	1	ug/L	--	Water
HV-41	N	3/21/2017	Chloromethane	ND	1	ug/L	--	Water

**TABLE 4b. HISTORIC GROUNDWATER ANALYTICAL RESULTS  
ROXY'S INTERIM REMEDIAL ACTION  
HAVRE, MT**

Location	Sample Type <sup>1</sup>	Date Time Sampled <sup>2</sup>	Analyte	Lab Result <sup>3</sup>	Lab Limit	Lab Units <sup>4</sup>	Reviewer Qualifier <sup>5</sup>	Matrix
HV-41	FD	3/21/2017	Chloromethane	ND	1	ug/L	--	Water
HV-41	N	3/1/2004	cis-1,2-Dichloroethene	ND	1	ug/L	--	Water
HV-41	N	6/1/2004	cis-1,2-Dichloroethene	ND	1	ug/L	--	Water
HV-41	N	3/1/2006	cis-1,2-Dichloroethene	ND	0.5	ug/L	--	Water
HV-41	N	6/1/2006	cis-1,2-Dichloroethene	ND	0.5	ug/L	--	Water
HV-41	N	6/7/2007	cis-1,2-Dichloroethene	ND	0.5	ug/L	--	Water
HV-41	N	6/7/2008	cis-1,2-Dichloroethene	ND	0.5	ug/L	--	Water
HV-41	N	6/7/2009	cis-1,2-Dichloroethene	ND	0.5	ug/L	--	Water
HV-41	N	6/1/2010	cis-1,2-Dichloroethene	ND	0.5	ug/L	--	Water
HV-41	N	6/11/2011	cis-1,2-Dichloroethene	ND	0.5	ug/L	--	Water
HV-41	N	6/12/2012	cis-1,2-Dichloroethene	ND	0.5	ug/L	--	Water
HV-41	N	6/21/2013	cis-1,2-Dichloroethene	ND	0.5	ug/L	--	Water
HV-41	N	4/6/2016	cis-1,2-Dichloroethene	ND	1	ug/L	--	Water
HV-41	FD	4/6/2016	cis-1,2-Dichloroethene	ND	1	ug/L	--	Water
HV-41	N	6/24/2016	cis-1,2-Dichloroethene	ND	1	ug/L	--	Water
HV-41	N	3/21/2017	cis-1,2-Dichloroethene	197	25	ug/L	--	Water
HV-41	FD	3/21/2017	cis-1,2-Dichloroethene	198	25	ug/L	--	Water
HV-41	N	4/6/2016	cis-1,3-Dichloropropene	ND	1	ug/L	--	Water
HV-41	FD	4/6/2016	cis-1,3-Dichloropropene	ND	1	ug/L	--	Water
HV-41	N	6/24/2016	cis-1,3-Dichloropropene	ND	1	ug/L	--	Water
HV-41	N	3/21/2017	cis-1,3-Dichloropropene	ND	1	ug/L	--	Water
HV-41	FD	3/21/2017	cis-1,3-Dichloropropene	ND	1	ug/L	--	Water
HV-41	Field	4/6/2016	Conductance	1.79	N/A	mS/cm	--	Water
HV-41	Field	4/6/2016	Conductance	1.82	N/A	mS/cm	--	Water
HV-41	Field	4/6/2016	Conductance	1.82	N/A	mS/cm	--	Water
HV-41	Field	4/6/2016	Conductance	1.83	N/A	mS/cm	--	Water
HV-41	Field	6/24/2016	Conductance	1.91	N/A	mS/cm	--	Water
HV-41	Field	6/24/2016	Conductance	1.94	N/A	mS/cm	--	Water
HV-41	Field	6/24/2016	Conductance	1.93	N/A	mS/cm	--	Water
HV-41	Field	6/24/2016	Conductance	1.94	N/A	mS/cm	--	Water
HV-41	Field	3/31/2017	Conductance	2.91	N/A	mS/cm	--	Water
HV-41	Field	3/31/2017	Conductance	2.92	N/A	mS/cm	--	Water
HV-41	Field	3/31/2017	Conductance	2.92	N/A	mS/cm	--	Water
HV-41	Field	3/31/2017	Conductance	2.92	N/A	mS/cm	--	Water
HV-41	N	4/6/2016	Dibromochloromethane	ND	1	ug/L	--	Water
HV-41	FD	4/6/2016	Dibromochloromethane	ND	1	ug/L	--	Water
HV-41	N	6/24/2016	Dibromochloromethane	ND	1	ug/L	--	Water
HV-41	N	4/6/2016	Dibromomethane	ND	1	ug/L	--	Water
HV-41	FD	4/6/2016	Dibromomethane	ND	1	ug/L	--	Water

**TABLE 4b. HISTORIC GROUNDWATER ANALYTICAL RESULTS  
ROXY'S INTERIM REMEDIAL ACTION  
HAVRE, MT**

Location	Sample Type <sup>1</sup>	Date Time Sampled <sup>2</sup>	Analyte	Lab Result <sup>3</sup>	Lab Limit	Lab Units <sup>4</sup>	Reviewer Qualifier <sup>5</sup>	Matrix
HV-41	N	6/24/2016	Dibromomethane	ND	1	ug/L	--	Water
HV-41	N	3/21/2017	Dibromomethane	ND	1	ug/L	--	Water
HV-41	FD	3/21/2017	Dibromomethane	ND	1	ug/L	--	Water
HV-41	N	4/6/2016	Dichlorodifluoromethane	ND	1	ug/L	--	Water
HV-41	FD	4/6/2016	Dichlorodifluoromethane	ND	1	ug/L	--	Water
HV-41	N	6/24/2016	Dichlorodifluoromethane	ND	1	ug/L	--	Water
HV-41	N	3/21/2017	Dichlorodifluoromethane	ND	1	ug/L	--	Water
HV-41	FD	3/21/2017	Dichlorodifluoromethane	ND	1	ug/L	--	Water
HV-41	Field	4/6/2016	Dissolved Oxygen	0.1	N/A	%	--	Water
HV-41	Field	4/6/2016	Dissolved Oxygen	0.3	N/A	%	--	Water
HV-41	Field	4/6/2016	Dissolved Oxygen	3.91	N/A	%	--	Water
HV-41	Field	4/6/2016	Dissolved Oxygen	7.01	N/A	%	--	Water
HV-41	Field	4/6/2016	Dissolved Oxygen	0.01	N/A	mg/L	--	Water
HV-41	Field	4/6/2016	Dissolved Oxygen	0.03	N/A	mg/L	--	Water
HV-41	Field	4/6/2016	Dissolved Oxygen	0.39	N/A	mg/L	--	Water
HV-41	Field	4/6/2016	Dissolved Oxygen	0.7	N/A	mg/L	--	Water
HV-41	Field	6/24/2016	Dissolved Oxygen	0.4	N/A	mg/L	--	Water
HV-41	Field	6/24/2016	Dissolved Oxygen	0.11	N/A	mg/L	--	Water
HV-41	Field	6/24/2016	Dissolved Oxygen	0	N/A	mg/L	--	Water
HV-41	Field	6/24/2016	Dissolved Oxygen	0	N/A	mg/L	--	Water
HV-41	Field	3/31/2017	Dissolved Oxygen	9.67	N/A	mg/L	--	Water
HV-41	Field	3/31/2017	Dissolved Oxygen	9.34	N/A	mg/L	--	Water
HV-41	Field	3/31/2017	Dissolved Oxygen	9.01	N/A	mg/L	--	Water
HV-41	Field	3/31/2017	Dissolved Oxygen	8.88	N/A	mg/L	--	Water
HV-41	Field	4/6/2016	Depth to Water	11.58	N/A	ft-bmp	--	Water
HV-41	Field	4/6/2016	Depth to Water	11.58	N/A	ft-bmp	--	Water
HV-41	Field	4/6/2016	Depth to Water	11.59	N/A	ft-bmp	--	Water
HV-41	Field	4/6/2016	Depth to Water	11.59	N/A	ft-bmp	--	Water
HV-41	Field	6/24/2016	Depth to Water	10.52	N/A	ft-bmp	--	Water
HV-41	Field	6/24/2016	Depth to Water	10.53	N/A	ft-bmp	--	Water
HV-41	Field	6/24/2016	Depth to Water	10.53	N/A	ft-bmp	--	Water
HV-41	Field	6/24/2016	Depth to Water	10.53	N/A	ft-bmp	--	Water
HV-41	Field	3/31/2017	Depth to Water	11.19	N/A	ft-bmp	--	Water
HV-41	Field	3/31/2017	Depth to Water	11.19	N/A	ft-bmp	--	Water
HV-41	Field	3/31/2017	Depth to Water	11.2	N/A	ft-bmp	--	Water
HV-41	Field	3/31/2017	Depth to Water	11.2	N/A	ft-bmp	--	Water
HV-41	N	4/6/2016	Ethylbenzene	ND	1	ug/L	--	Water
HV-41	FD	4/6/2016	Ethylbenzene	ND	1	ug/L	--	Water
HV-41	N	6/24/2016	Ethylbenzene	ND	1	ug/L	--	Water

**TABLE 4b. HISTORIC GROUNDWATER ANALYTICAL RESULTS  
ROXY'S INTERIM REMEDIAL ACTION  
HAVRE, MT**

Location	Sample Type <sup>1</sup>	Date Time Sampled <sup>2</sup>	Analyte	Lab Result <sup>3</sup>	Lab Limit	Lab Units <sup>4</sup>	Reviewer Qualifier <sup>5</sup>	Matrix
HV-41	N	3/21/2017	Ethylbenzene	ND	1	ug/L	--	Water
HV-41	FD	3/21/2017	Ethylbenzene	ND	1	ug/L	--	Water
HV-41	N	4/6/2016	m,p-Xylene	ND	1	ug/L	--	Water
HV-41	FD	4/6/2016	m,p-Xylene	ND	1	ug/L	--	Water
HV-41	N	6/24/2016	m,p-Xylene	ND	1	ug/L	--	Water
HV-41	N	3/21/2017	m+p-Xylenes	ND	1	ug/L	--	Water
HV-41	FD	3/21/2017	m+p-Xylenes	ND	1	ug/L	--	Water
HV-41	N	3/21/2017	Methyl ethyl ketone	ND	20	ug/L	--	Water
HV-41	FD	3/21/2017	Methyl ethyl ketone	ND	20	ug/L	--	Water
HV-41	N	3/21/2017	Methyl tert-butyl ether (MTBE)	ND	1	ug/L	--	Water
HV-41	FD	3/21/2017	Methyl tert-butyl ether (MTBE)	ND	1	ug/L	--	Water
HV-41	N	4/6/2016	Methylene Chloride	ND	1	ug/L	--	Water
HV-41	FD	4/6/2016	Methylene Chloride	ND	1	ug/L	--	Water
HV-41	N	6/24/2016	Methylene Chloride	ND	1	ug/L	--	Water
HV-41	N	3/21/2017	Methylene chloride	ND	1	ug/L	--	Water
HV-41	FD	3/21/2017	Methylene chloride	ND	1	ug/L	--	Water
HV-41	N	4/6/2016	Methyl tert-butyl ether (MTBE)	ND	1	ug/L	--	Water
HV-41	FD	4/6/2016	Methyl tert-butyl ether (MTBE)	ND	1	ug/L	--	Water
HV-41	N	6/24/2016	Methyl tert-butyl ether (MTBE)	ND	1	ug/L	--	Water
HV-41	Field	4/6/2016	Oxygen Reduction Potential	-160	N/A	mV	--	Water
HV-41	Field	4/6/2016	Oxygen Reduction Potential	-169	N/A	mV	--	Water
HV-41	Field	4/6/2016	Oxygen Reduction Potential	-173	N/A	mV	--	Water
HV-41	Field	4/6/2016	Oxygen Reduction Potential	-172	N/A	mV	--	Water
HV-41	Field	6/24/2016	Oxygen Reduction Potential	-213	N/A	mV	--	Water
HV-41	Field	6/24/2016	Oxygen Reduction Potential	-211	N/A	mV	--	Water
HV-41	Field	6/24/2016	Oxygen Reduction Potential	-217	N/A	mV	--	Water
HV-41	Field	6/24/2016	Oxygen Reduction Potential	-217	N/A	mV	--	Water
HV-41	Field	3/31/2017	Oxygen Reduction Potential	<b>133</b>	N/A	mV	--	Water
HV-41	Field	3/31/2017	Oxygen Reduction Potential	<b>84</b>	N/A	mV	--	Water
HV-41	Field	3/31/2017	Oxygen Reduction Potential	22	N/A	mV	--	Water
HV-41	Field	3/31/2017	Oxygen Reduction Potential	-31	N/A	mV	--	Water
HV-41	N	4/6/2016	o-Xylene	0.18	1	ug/L	J	Water
HV-41	FD	4/6/2016	o-Xylene	0.18	1	ug/L	J	Water
HV-41	N	6/24/2016	o-Xylene	ND	1	ug/L	--	Water
HV-41	N	3/21/2017	o-Xylene	ND	1	ug/L	--	Water
HV-41	FD	3/21/2017	o-Xylene	ND	1	ug/L	--	Water
HV-41	Field	4/6/2016	pH	7.43	N/A	Std Units	--	Water
HV-41	Field	4/6/2016	pH	7.45	N/A	Std Units	--	Water
HV-41	Field	4/6/2016	pH	7.46	N/A	Std Units	--	Water

**TABLE 4b. HISTORIC GROUNDWATER ANALYTICAL RESULTS  
ROXY'S INTERIM REMEDIAL ACTION  
HAVRE, MT**

Location	Sample Type <sup>1</sup>	Date Time Sampled <sup>2</sup>	Analyte	Lab Result <sup>3</sup>	Lab Limit	Lab Units <sup>4</sup>	Reviewer Qualifier <sup>5</sup>	Matrix
HV-41	Field	4/6/2016	pH	7.43	N/A	Std Units	--	Water
HV-41	Field	6/24/2016	pH	7.16	N/A	Std Units	--	Water
HV-41	Field	6/24/2016	pH	7.13	N/A	Std Units	--	Water
HV-41	Field	6/24/2016	pH	7.1	N/A	Std Units	--	Water
HV-41	Field	6/24/2016	pH	7.09	N/A	Std Units	--	Water
HV-41	Field	3/31/2017	pH	6.27	N/A	Std Units	--	Water
HV-41	Field	3/31/2017	pH	6.37	N/A	Std Units	--	Water
HV-41	Field	3/31/2017	pH	6.37	N/A	Std Units	--	Water
HV-41	Field	3/31/2017	pH	6.38	N/A	Std Units	--	Water
HV-41	N	4/6/2016	Styrene	ND	1	ug/L	--	Water
HV-41	FD	4/6/2016	Styrene	ND	1	ug/L	--	Water
HV-41	N	6/24/2016	Styrene	ND	1	ug/L	--	Water
HV-41	N	3/21/2017	Styrene	ND	1	ug/L	--	Water
HV-41	FD	3/21/2017	Styrene	ND	1	ug/L	--	Water
HV-41	N	4/6/2016	Sulfide, Total	1	1	mg/L	U	Water
HV-41	FD	4/6/2016	Sulfide, Total	1	1	mg/L	U	Water
HV-41	N	3/1/2004	Tetrachloroethene	ND	1	ug/L	--	Water
HV-41	N	6/1/2004	Tetrachloroethene	ND	1	ug/L	--	Water
HV-41	N	3/1/2006	Tetrachloroethene	ND	0.5	ug/L	--	Water
HV-41	N	6/1/2006	Tetrachloroethene	ND	0.5	ug/L	--	Water
HV-41	N	6/7/2007	Tetrachloroethene	ND	0.5	ug/L	--	Water
HV-41	N	6/7/2008	Tetrachloroethene	ND	0.5	ug/L	--	Water
HV-41	N	6/7/2009	Tetrachloroethene	ND	0.5	ug/L	--	Water
HV-41	N	6/1/2010	Tetrachloroethene	ND	0.5	ug/L	--	Water
HV-41	N	6/11/2011	Tetrachloroethene	ND	0.5	ug/L	--	Water
HV-41	N	6/12/2012	Tetrachloroethene	ND	0.5	ug/L	--	Water
HV-41	N	6/21/2013	Tetrachloroethene	0.031	0.5	ug/L	J	Water
HV-41	N	4/6/2016	Tetrachloroethene	ND	1	ug/L	--	Water
HV-41	FD	4/6/2016	Tetrachloroethene	ND	1	ug/L	--	Water
HV-41	N	6/24/2016	Tetrachloroethene	ND	1	ug/L	--	Water
HV-41	N	3/21/2017	Tetrachloroethene	ND	1	ug/L	--	Water
HV-41	FD	3/21/2017	Tetrachloroethene	ND	1	ug/L	--	Water
HV-41	N	4/6/2016	Toluene	0.16	1	ug/L	U	Water
HV-41	FD	4/6/2016	Toluene	0.16	1	ug/L	U	Water
HV-41	N	6/24/2016	Toluene	ND	1	ug/L	--	Water
HV-41	N	3/21/2017	Toluene	ND	1	ug/L	--	Water
HV-41	FD	3/21/2017	Toluene	ND	1	ug/L	--	Water
HV-41	N	4/6/2016	Total Organic Carbon	5.3	0.5	mg/L	--	Water
HV-41	FD	4/6/2016	Total Organic Carbon	5.3	0.5	mg/L	--	Water

**TABLE 4b. HISTORIC GROUNDWATER ANALYTICAL RESULTS  
ROXY'S INTERIM REMEDIAL ACTION  
HAVRE, MT**

Location	Sample Type <sup>1</sup>	Date Time Sampled <sup>2</sup>	Analyte	Lab Result <sup>3</sup>	Lab Limit	Lab Units <sup>4</sup>	Reviewer Qualifier <sup>5</sup>	Matrix
HV-41	N	4/6/2016	trans-1,2-Dichloroethene	ND	1	ug/L	--	Water
HV-41	FD	4/6/2016	trans-1,2-Dichloroethene	ND	1	ug/L	--	Water
HV-41	N	6/24/2016	trans-1,2-Dichloroethene	ND	1	ug/L	--	Water
HV-41	N	3/21/2017	trans-1,2-Dichloroethene	59	25	ug/L	--	Water
HV-41	FD	3/21/2017	trans-1,2-Dichloroethene	59	25	ug/L	--	Water
HV-41	N	4/6/2016	trans-1,3-Dichloropropene	ND	1	ug/L	--	Water
HV-41	FD	4/6/2016	trans-1,3-Dichloropropene	ND	1	ug/L	--	Water
HV-41	N	6/24/2016	trans-1,3-Dichloropropene	ND	1	ug/L	--	Water
HV-41	N	3/21/2017	trans-1,3-Dichloropropene	ND	1	ug/L	--	Water
HV-41	FD	3/21/2017	trans-1,3-Dichloropropene	ND	1	ug/L	--	Water
HV-41	N	3/1/2004	Trichloroethene	ND	1	ug/L	--	Water
HV-41	N	6/1/2004	Trichloroethene	ND	1	ug/L	--	Water
HV-41	N	3/1/2006	Trichloroethene	ND	0.5	ug/L	--	Water
HV-41	N/FD	6/1/2006	Trichloroethene	<0.5/0.09	0.5	ug/L	J	Water
HV-41	N	6/7/2007	Trichloroethene	ND	0.5	ug/L	--	Water
HV-41	N	6/7/2008	Trichloroethene	0.11	0.5	ug/L	J	Water
HV-41	N	6/7/2009	Trichloroethene	ND	0.5	ug/L	--	Water
HV-41	N	6/1/2010	Trichloroethene	ND	0.5	ug/L	--	Water
HV-41	N	6/11/2011	Trichloroethene	ND	0.5	ug/L	--	Water
HV-41	N	6/12/2012	Trichloroethene	ND	0.5	ug/L	--	Water
HV-41	N	6/21/2013	Trichloroethene	0.08	0.5	ug/L	J	Water
HV-41	N	4/6/2016	Trichloroethene	ND	1	ug/L	--	Water
HV-41	FD	4/6/2016	Trichloroethene	ND	1	ug/L	--	Water
HV-41	N	6/24/2016	Trichloroethene	ND	1	ug/L	--	Water
HV-41	N	3/21/2017	Trichloroethene	1.2	1	ug/L	--	Water
HV-41	FD	3/21/2017	Trichloroethene	1.2	1	ug/L	--	Water
HV-41	N	4/6/2016	Trichlorofluoromethane	ND	1	ug/L	--	Water
HV-41	FD	4/6/2016	Trichlorofluoromethane	ND	1	ug/L	--	Water
HV-41	N	6/24/2016	Trichlorofluoromethane	ND	1	ug/L	--	Water
HV-41	N	3/21/2017	Trichlorofluoromethane	ND	1	ug/L	--	Water
HV-41	FD	3/21/2017	Trichlorofluoromethane	ND	1	ug/L	--	Water
HV-41	Field	6/24/2016	Turbidity	0.4	N/A	NTUs	--	Water
HV-41	Field	6/24/2016	Turbidity	1.8	N/A	NTUs	--	Water
HV-41	Field	6/24/2016	Turbidity	0.9	N/A	NTUs	--	Water
HV-41	Field	6/24/2016	Turbidity	5.8	N/A	NTUs	--	Water
HV-41	Field	3/31/2017	Turbidity	2.6	N/A	NTUs	--	Water
HV-41	Field	3/31/2017	Turbidity	2	N/A	NTUs	--	Water
HV-41	Field	3/31/2017	Turbidity	1.4	N/A	NTUs	--	Water
HV-41	Field	3/31/2017	Turbidity	0.4	N/A	NTUs	--	Water

**TABLE 4b. HISTORIC GROUNDWATER ANALYTICAL RESULTS  
ROXY'S INTERIM REMEDIAL ACTION  
HAVRE, MT**

Location	Sample Type <sup>1</sup>	Date Time Sampled <sup>2</sup>	Analyte	Lab Result <sup>3</sup>	Lab Limit	Lab Units <sup>4</sup>	Reviewer Qualifier <sup>5</sup>	Matrix
HV-41	N	3/1/2004	Vinyl Chloride	ND	1	ug/L	--	Water
HV-41	N	6/1/2004	Vinyl Chloride	ND	1	ug/L	--	Water
HV-41	N	3/1/2006	Vinyl Chloride	ND	0.5	ug/L	--	Water
HV-41	N	6/1/2006	Vinyl Chloride	ND	0.5	ug/L	--	Water
HV-41	N	6/7/2007	Vinyl Chloride	ND	0.5	ug/L	--	Water
HV-41	N	6/7/2008	Vinyl Chloride	ND	0.5	ug/L	--	Water
HV-41	N	6/7/2009	Vinyl Chloride	ND	0.5	ug/L	--	Water
HV-41	N	6/1/2010	Vinyl Chloride	ND	0.5	ug/L	--	Water
HV-41	N	6/11/2011	Vinyl Chloride	ND	0.5	ug/L	--	Water
HV-41	N	6/12/2012	Vinyl Chloride	ND	0.5	ug/L	--	Water
HV-41	N	6/21/2013	Vinyl Chloride	ND	0.5	ug/L	--	Water
HV-41	N	4/6/2016	Vinyl Chloride	ND	1	ug/L	--	Water
HV-41	FD	4/6/2016	Vinyl Chloride	ND	1	ug/L	--	Water
HV-41	N	6/24/2016	Vinyl Chloride	ND	1	ug/L	--	Water
HV-41	N	3/21/2017	Vinyl chloride	ND	1	ug/L	--	Water
HV-41	FD	3/21/2017	Vinyl chloride	ND	1	ug/L	--	Water
HV-41	N	4/6/2016	Xylenes, Total	0.18	1	ug/L	J	Water
HV-41	FD	4/6/2016	Xylenes, Total	0.18	1	ug/L	J	Water
HV-41	N	6/24/2016	Xylenes, Total	ND	1	ug/L	--	Water
HV-41	N	3/21/2017	Xylenes, Total	ND	1	ug/L	--	Water
HV-41	FD	3/21/2017	Xylenes, Total	ND	1	ug/L	--	Water
HV-43	N	4/6/2016	1,1,1,2-Tetrachloroethane	ND	1	ug/L	--	Water
HV-43	N	6/24/2016	1,1,1,2-Tetrachloroethane	ND	1	ug/L	--	Water
HV-43	FD	6/24/2016	1,1,1,2-Tetrachloroethane	ND	1	ug/L	--	Water
HV-43	N	3/21/2017	1,1,1,2-Tetrachloroethane	ND	1	ug/L	--	Water
HV-43	N	4/6/2016	1,1,1-Trichloroethane	ND	1	ug/L	--	Water
HV-43	N	6/24/2016	1,1,1-Trichloroethane	ND	1	ug/L	--	Water
HV-43	FD	6/24/2016	1,1,1-Trichloroethane	ND	1	ug/L	--	Water
HV-43	N	3/21/2017	1,1,1-Trichloroethane	ND	1	ug/L	--	Water
HV-43	N	4/6/2016	1,1,2,2-Tetrachloroethane	ND	1	ug/L	--	Water
HV-43	N	6/24/2016	1,1,2,2-Tetrachloroethane	ND	1	ug/L	--	Water
HV-43	FD	6/24/2016	1,1,2,2-Tetrachloroethane	ND	1	ug/L	--	Water
HV-43	N	3/21/2017	1,1,2,2-Tetrachloroethane	ND	1	ug/L	--	Water
HV-43	N	4/6/2016	1,1,2-Trichloroethane	ND	1	ug/L	--	Water
HV-43	N	6/24/2016	1,1,2-Trichloroethane	ND	1	ug/L	--	Water
HV-43	FD	6/24/2016	1,1,2-Trichloroethane	ND	1	ug/L	--	Water
HV-43	N	3/21/2017	1,1,2-Trichloroethane	ND	1	ug/L	--	Water
HV-43	N	4/6/2016	1,1-Dichloroethane	ND	1	ug/L	--	Water
HV-43	N	6/24/2016	1,1-Dichloroethane	ND	1	ug/L	--	Water

**TABLE 4b. HISTORIC GROUNDWATER ANALYTICAL RESULTS  
ROXY'S INTERIM REMEDIAL ACTION  
HAVRE, MT**

Location	Sample Type <sup>1</sup>	Date Time Sampled <sup>2</sup>	Analyte	Lab Result <sup>3</sup>	Lab Limit	Lab Units <sup>4</sup>	Reviewer Qualifier <sup>5</sup>	Matrix
HV-43	FD	6/24/2016	1,1-Dichloroethane	ND	1	ug/L	--	Water
HV-43	N	3/21/2017	1,1-Dichloroethane	ND	1	ug/L	--	Water
HV-43	N	4/6/2016	1,1-Dichloroethene	ND	1	ug/L	--	Water
HV-43	N	6/24/2016	1,1-Dichloroethene	ND	1	ug/L	--	Water
HV-43	FD	6/24/2016	1,1-Dichloroethene	ND	1	ug/L	--	Water
HV-43	N	3/21/2017	1,1-Dichloroethene	ND	1	ug/L	--	Water
HV-43	N	4/6/2016	1,1-Dichloropropene	ND	1	ug/L	--	Water
HV-43	N	6/24/2016	1,1-Dichloropropene	ND	1	ug/L	--	Water
HV-43	FD	6/24/2016	1,1-Dichloropropene	ND	1	ug/L	--	Water
HV-43	N	3/21/2017	1,1-Dichloropropene	ND	1	ug/L	--	Water
HV-43	N	4/6/2016	1,2,3-Trichloropropane	ND	1	ug/L	--	Water
HV-43	N	6/24/2016	1,2,3-Trichloropropane	ND	1	ug/L	--	Water
HV-43	FD	6/24/2016	1,2,3-Trichloropropane	ND	1	ug/L	--	Water
HV-43	N	3/21/2017	1,2,3-Trichloropropane	ND	1	ug/L	--	Water
HV-43	N	4/6/2016	1,2-Dibromoethane	ND	1	ug/L	--	Water
HV-43	N	6/24/2016	1,2-Dibromoethane	ND	1	ug/L	--	Water
HV-43	FD	6/24/2016	1,2-Dibromoethane	ND	1	ug/L	--	Water
HV-43	N	3/21/2017	1,2-Dibromoethane	ND	1	ug/L	--	Water
HV-43	N	4/6/2016	1,2-Dichlorobenzene	ND	1	ug/L	--	Water
HV-43	N	6/24/2016	1,2-Dichlorobenzene	ND	1	ug/L	--	Water
HV-43	FD	6/24/2016	1,2-Dichlorobenzene	ND	1	ug/L	--	Water
HV-43	N	3/21/2017	1,2-Dichlorobenzene	ND	1	ug/L	--	Water
HV-43	N	4/6/2016	1,2-Dichloroethane	ND	1	ug/L	--	Water
HV-43	N	6/24/2016	1,2-Dichloroethane	ND	1	ug/L	--	Water
HV-43	FD	6/24/2016	1,2-Dichloroethane	ND	1	ug/L	--	Water
HV-43	N	3/21/2017	1,2-Dichloroethane	ND	1	ug/L	--	Water
HV-43	N	4/6/2016	1,2-Dichloropropane	ND	1	ug/L	--	Water
HV-43	N	6/24/2016	1,2-Dichloropropane	ND	1	ug/L	--	Water
HV-43	FD	6/24/2016	1,2-Dichloropropane	ND	1	ug/L	--	Water
HV-43	N	3/21/2017	1,2-Dichloropropane	ND	1	ug/L	--	Water
HV-43	N	4/6/2016	1,3-Dichlorobenzene	ND	1	ug/L	--	Water
HV-43	N	6/24/2016	1,3-Dichlorobenzene	ND	1	ug/L	--	Water
HV-43	FD	6/24/2016	1,3-Dichlorobenzene	ND	1	ug/L	--	Water
HV-43	N	3/21/2017	1,3-Dichlorobenzene	ND	1	ug/L	--	Water
HV-43	N	4/6/2016	1,3-Dichloropropane	ND	1	ug/L	--	Water
HV-43	N	6/24/2016	1,3-Dichloropropane	ND	1	ug/L	--	Water
HV-43	FD	6/24/2016	1,3-Dichloropropane	ND	1	ug/L	--	Water
HV-43	N	3/21/2017	1,3-Dichloropropane	ND	1	ug/L	--	Water
HV-43	N	4/6/2016	1,4-Dichlorobenzene	ND	1	ug/L	--	Water

**TABLE 4b. HISTORIC GROUNDWATER ANALYTICAL RESULTS  
ROXY'S INTERIM REMEDIAL ACTION  
HAVRE, MT**

Location	Sample Type <sup>1</sup>	Date Time Sampled <sup>2</sup>	Analyte	Lab Result <sup>3</sup>	Lab Limit	Lab Units <sup>4</sup>	Reviewer Qualifier <sup>5</sup>	Matrix
HV-43	N	6/24/2016	1,4-Dichlorobenzene	ND	1	ug/L	--	Water
HV-43	FD	6/24/2016	1,4-Dichlorobenzene	ND	1	ug/L	--	Water
HV-43	N	3/21/2017	1,4-Dichlorobenzene	ND	1	ug/L	--	Water
HV-43	N	4/6/2016	2,2-Dichloropropane	ND	1	ug/L	--	Water
HV-43	N	6/24/2016	2,2-Dichloropropane	ND	1	ug/L	--	Water
HV-43	FD	6/24/2016	2,2-Dichloropropane	ND	1	ug/L	--	Water
HV-43	N	3/21/2017	2,2-Dichloropropane	ND	1	ug/L	--	Water
HV-43	N	4/6/2016	2-Butanone	ND	20	ug/L	--	Water
HV-43	N	6/24/2016	2-Butanone	ND	20	ug/L	--	Water
HV-43	FD	6/24/2016	2-Butanone	ND	20	ug/L	--	Water
HV-43	N	4/6/2016	2-Chlorotoluene	ND	1	ug/L	--	Water
HV-43	N	6/24/2016	2-Chlorotoluene	ND	1	ug/L	--	Water
HV-43	FD	6/24/2016	2-Chlorotoluene	ND	1	ug/L	--	Water
HV-43	N	3/21/2017	2-Chlorotoluene	ND	1	ug/L	--	Water
HV-43	N	4/6/2016	4-Chlorotoluene	ND	1	ug/L	--	Water
HV-43	N	6/24/2016	4-Chlorotoluene	ND	1	ug/L	--	Water
HV-43	FD	6/24/2016	4-Chlorotoluene	ND	1	ug/L	--	Water
HV-43	N	3/21/2017	4-Chlorotoluene	ND	1	ug/L	--	Water
HV-43	N	3/21/2017	Arsenic	0.002	0.001	mg/L	--	Water
HV-43	N	3/21/2017	Arsenic	0.002	0.001	mg/L	--	Water
HV-43	N	4/6/2016	Arsenic, Dissolved	0.005	0.001	mg/L	J+	Water
HV-43	N	6/24/2016	Arsenic, Dissolved	0.004	0.001	mg/L	--	Water
HV-43	FD	6/24/2016	Arsenic, Dissolved	0.004	0.001	mg/L	--	Water
HV-43	N	4/6/2016	Benzene	ND	1	ug/L	--	Water
HV-43	N	6/24/2016	Benzene	ND	1	ug/L	--	Water
HV-43	FD	6/24/2016	Benzene	ND	1	ug/L	--	Water
HV-43	N	3/21/2017	Benzene	ND	1	ug/L	--	Water
HV-43	N	4/6/2016	Bromobenzene	ND	1	ug/L	--	Water
HV-43	N	6/24/2016	Bromobenzene	ND	1	ug/L	--	Water
HV-43	FD	6/24/2016	Bromobenzene	ND	1	ug/L	--	Water
HV-43	N	3/21/2017	Bromobenzene	ND	1	ug/L	--	Water
HV-43	N	4/6/2016	Bromochloromethane	ND	1	ug/L	--	Water
HV-43	N	6/24/2016	Bromochloromethane	ND	1	ug/L	--	Water
HV-43	FD	6/24/2016	Bromochloromethane	ND	1	ug/L	--	Water
HV-43	N	3/21/2017	Bromochloromethane	ND	1	ug/L	--	Water
HV-43	N	4/6/2016	Bromodichloromethane	ND	1	ug/L	--	Water
HV-43	N	6/24/2016	Bromodichloromethane	ND	1	ug/L	--	Water
HV-43	FD	6/24/2016	Bromodichloromethane	ND	1	ug/L	--	Water
HV-43	N	3/21/2017	Bromodichloromethane	ND	1	ug/L	--	Water

**TABLE 4b. HISTORIC GROUNDWATER ANALYTICAL RESULTS  
ROXY'S INTERIM REMEDIAL ACTION  
HAVRE, MT**

Location	Sample Type <sup>1</sup>	Date Time Sampled <sup>2</sup>	Analyte	Lab Result <sup>3</sup>	Lab Limit	Lab Units <sup>4</sup>	Reviewer Qualifier <sup>5</sup>	Matrix
HV-43	N	4/6/2016	Bromoform	ND	1	ug/L	--	Water
HV-43	N	6/24/2016	Bromoform	ND	1	ug/L	--	Water
HV-43	FD	6/24/2016	Bromoform	ND	1	ug/L	--	Water
HV-43	N	3/21/2017	Bromoform	ND	1	ug/L	--	Water
HV-43	N	4/6/2016	Bromomethane	ND	1	ug/L	--	Water
HV-43	N	6/24/2016	Bromomethane	ND	1	ug/L	--	Water
HV-43	FD	6/24/2016	Bromomethane	ND	1	ug/L	--	Water
HV-43	N	3/21/2017	Bromomethane	ND	1	ug/L	--	Water
HV-43	N	4/6/2016	Carbon tetrachloride	ND	1	ug/L	--	Water
HV-43	N	6/24/2016	Carbon tetrachloride	ND	1	ug/L	--	Water
HV-43	FD	6/24/2016	Carbon tetrachloride	ND	1	ug/L	--	Water
HV-43	N	3/21/2017	Carbon tetrachloride	ND	1	ug/L	--	Water
HV-43	N	4/6/2016	Chlorobenzene	ND	1	ug/L	--	Water
HV-43	N	6/24/2016	Chlorobenzene	ND	1	ug/L	--	Water
HV-43	FD	6/24/2016	Chlorobenzene	ND	1	ug/L	--	Water
HV-43	N	3/21/2017	Chlorobenzene	ND	1	ug/L	--	Water
HV-43	N	3/21/2017	Chlorodibromomethane	ND	1	ug/L	--	Water
HV-43	N	4/6/2016	Chloroethane	ND	1	ug/L	--	Water
HV-43	N	6/24/2016	Chloroethane	ND	1	ug/L	--	Water
HV-43	FD	6/24/2016	Chloroethane	ND	1	ug/L	--	Water
HV-43	N	3/21/2017	Chloroethane	ND	1	ug/L	--	Water
HV-43	N	4/6/2016	Chloroform	ND	1	ug/L	--	Water
HV-43	N	6/24/2016	Chloroform	ND	1	ug/L	--	Water
HV-43	FD	6/24/2016	Chloroform	ND	1	ug/L	--	Water
HV-43	N	3/21/2017	Chloroform	ND	1	ug/L	--	Water
HV-43	N	4/6/2016	Chloromethane	ND	1	ug/L	--	Water
HV-43	N	6/24/2016	Chloromethane	ND	1	ug/L	--	Water
HV-43	FD	6/24/2016	Chloromethane	ND	1	ug/L	--	Water
HV-43	N	3/21/2017	Chloromethane	ND	1	ug/L	--	Water
HV-43	N	8/1/1993	cis-1,2-Dichloroethene	170	Unknown	ug/L	--	Water
HV-43	N	3/1/2004	cis-1,2-Dichloroethene	33.0	Unknown	ug/L	--	Water
HV-43	N/FD	3/1/2006	cis-1,2-Dichloroethene	266/245	Unknown	ug/L	--	Water
HV-43	N/FD	6/1/2006	cis-1,2-Dichloroethene	194/184	Unknown	ug/L	--	Water
HV-43	N	6/7/2007	cis-1,2-Dichloroethene	396	Unknown	ug/L	--	Water
HV-43	N	6/7/2008	cis-1,2-Dichloroethene	87.4	Unknown	ug/L	J	Water
HV-43	N/FD	6/1/2009	cis-1,2-Dichloroethene	269/270	Unknown	ug/L	--	Water
HV-43	N	6/1/2010	cis-1,2-Dichloroethene	410	Unknown	ug/L	J	Water
HV-43	N	6/1/2011	cis-1,2-Dichloroethene	250	Unknown	ug/L	--	Water
HV-43	N	6/10/2012	cis-1,2-Dichloroethene	82	Unknown	ug/L	--	Water

**TABLE 4b. HISTORIC GROUNDWATER ANALYTICAL RESULTS  
ROXY'S INTERIM REMEDIAL ACTION  
HAVRE, MT**

Location	Sample Type <sup>1</sup>	Date Time Sampled <sup>2</sup>	Analyte	Lab Result <sup>3</sup>	Lab Limit	Lab Units <sup>4</sup>	Reviewer Qualifier <sup>5</sup>	Matrix
HV-43	N/FD	6/21/2013	cis-1,2-Dichloroethene	150/140	Unknown	ug/L	--	Water
HV-43	N	4/6/2016	cis-1,2-Dichloroethene	152	3.8	ug/L	--	Water
HV-43	N	6/24/2016	cis-1,2-Dichloroethene	189	2.5	ug/L	--	Water
HV-43	FD	6/24/2016	cis-1,2-Dichloroethene	181	2.5	ug/L	--	Water
HV-43	N	3/21/2017	cis-1,2-Dichloroethene	ND	1	ug/L	--	Water
HV-43	N	4/6/2016	cis-1,3-Dichloropropene	ND	1	ug/L	--	Water
HV-43	N	6/24/2016	cis-1,3-Dichloropropene	ND	1	ug/L	--	Water
HV-43	FD	6/24/2016	cis-1,3-Dichloropropene	ND	1	ug/L	--	Water
HV-43	N	3/21/2017	cis-1,3-Dichloropropene	ND	1	ug/L	--	Water
HV-43	Field	4/6/2016	Conductance	2.1	N/A	mS/cm	--	Water
HV-43	Field	4/6/2016	Conductance	2.11	N/A	mS/cm	--	Water
HV-43	Field	4/6/2016	Conductance	2.11	N/A	mS/cm	--	Water
HV-43	Field	4/6/2016	Conductance	2.12	N/A	mS/cm	--	Water
HV-43	Field	4/6/2016	Conductance	2.12	N/A	mS/cm	--	Water
HV-43	Field	4/6/2016	Conductance	2.12	N/A	mS/cm	--	Water
HV-43	Field	6/24/2016	Conductance	2.49	N/A	mS/cm	--	Water
HV-43	Field	6/24/2016	Conductance	2.49	N/A	mS/cm	--	Water
HV-43	Field	6/24/2016	Conductance	2.49	N/A	mS/cm	--	Water
HV-43	Field	6/24/2016	Conductance	2.49	N/A	mS/cm	--	Water
HV-43	Field	6/24/2016	Conductance	2.49	N/A	mS/cm	--	Water
HV-43	Field	3/31/2017	Conductance	2.37	N/A	mS/cm	--	Water
HV-43	Field	3/31/2017	Conductance	2.35	N/A	mS/cm	--	Water
HV-43	Field	3/31/2017	Conductance	2.34	N/A	mS/cm	--	Water
HV-43	Field	3/31/2017	Conductance	2.33	N/A	mS/cm	--	Water
HV-43	N	4/6/2016	Dibromochloromethane	ND	1	ug/L	--	Water
HV-43	N	6/24/2016	Dibromochloromethane	ND	1	ug/L	--	Water
HV-43	FD	6/24/2016	Dibromochloromethane	ND	1	ug/L	--	Water
HV-43	N	4/6/2016	Dibromomethane	ND	1	ug/L	--	Water
HV-43	N	6/24/2016	Dibromomethane	ND	1	ug/L	--	Water
HV-43	FD	6/24/2016	Dibromomethane	ND	1	ug/L	--	Water
HV-43	N	3/21/2017	Dibromomethane	ND	1	ug/L	--	Water
HV-43	N	4/6/2016	Dichlorodifluoromethane	ND	1	ug/L	--	Water
HV-43	N	6/24/2016	Dichlorodifluoromethane	ND	1	ug/L	--	Water
HV-43	FD	6/24/2016	Dichlorodifluoromethane	ND	1	ug/L	--	Water
HV-43	N	3/21/2017	Dichlorodifluoromethane	ND	1	ug/L	--	Water
HV-43	Field	4/6/2016	Dissolved Oxygen	19.95	N/A	%	--	Water
HV-43	Field	4/6/2016	Dissolved Oxygen	16.71	N/A	%	--	Water
HV-43	Field	4/6/2016	Dissolved Oxygen	14.28	N/A	%	--	Water
HV-43	Field	4/6/2016	Dissolved Oxygen	12.63	N/A	%	--	Water
HV-43	Field	4/6/2016	Dissolved Oxygen	10.3	N/A	%	--	Water

**TABLE 4b. HISTORIC GROUNDWATER ANALYTICAL RESULTS  
ROXY'S INTERIM REMEDIAL ACTION  
HAVRE, MT**

Location	Sample Type <sup>1</sup>	Date Time Sampled <sup>2</sup>	Analyte	Lab Result <sup>3</sup>	Lab Limit	Lab Units <sup>4</sup>	Reviewer Qualifier <sup>5</sup>	Matrix
HV-43	Field	4/6/2016	Dissolved Oxygen	9.15	N/A	%	--	Water
HV-43	Field	4/6/2016	Dissolved Oxygen	1.87	N/A	mg/L	--	Water
HV-43	Field	4/6/2016	Dissolved Oxygen	1.59	N/A	mg/L	--	Water
HV-43	Field	4/6/2016	Dissolved Oxygen	1.37	N/A	mg/L	--	Water
HV-43	Field	4/6/2016	Dissolved Oxygen	1.22	N/A	mg/L	--	Water
HV-43	Field	4/6/2016	Dissolved Oxygen	1	N/A	mg/L	--	Water
HV-43	Field	4/6/2016	Dissolved Oxygen	0.89	N/A	mg/L	--	Water
HV-43	Field	6/24/2016	Dissolved Oxygen	0.81	N/A	mg/L	--	Water
HV-43	Field	6/24/2016	Dissolved Oxygen	0.44	N/A	mg/L	--	Water
HV-43	Field	6/24/2016	Dissolved Oxygen	0.08	N/A	mg/L	--	Water
HV-43	Field	6/24/2016	Dissolved Oxygen	0	N/A	mg/L	--	Water
HV-43	Field	3/31/2017	Dissolved Oxygen	2.02	N/A	mg/L	--	Water
HV-43	Field	3/31/2017	Dissolved Oxygen	1.74	N/A	mg/L	--	Water
HV-43	Field	3/31/2017	Dissolved Oxygen	1.31	N/A	mg/L	--	Water
HV-43	Field	3/31/2017	Dissolved Oxygen	1.13	N/A	mg/L	--	Water
HV-43	Field	4/6/2016	Depth to Water	11.5	N/A	ft-bmp	--	Water
HV-43	Field	4/6/2016	Depth to Water	11.5	N/A	ft-bmp	--	Water
HV-43	Field	4/6/2016	Depth to Water	11.5	N/A	ft-bmp	--	Water
HV-43	Field	4/6/2016	Depth to Water	11.5	N/A	ft-bmp	--	Water
HV-43	Field	4/6/2016	Depth to Water	11.5	N/A	ft-bmp	--	Water
HV-43	Field	4/6/2016	Depth to Water	11.51	N/A	ft-bmp	--	Water
HV-43	Field	6/24/2016	Depth to Water	10.56	N/A	ft-bmp	--	Water
HV-43	Field	6/24/2016	Depth to Water	10.57	N/A	ft-bmp	--	Water
HV-43	Field	6/24/2016	Depth to Water	10.58	N/A	ft-bmp	--	Water
HV-43	Field	6/24/2016	Depth to Water	10.58	N/A	ft-bmp	--	Water
HV-43	Field	3/31/2017	Depth to Water	11.22	N/A	ft-bmp	--	Water
HV-43	Field	3/31/2017	Depth to Water	11.24	N/A	ft-bmp	--	Water
HV-43	Field	3/31/2017	Depth to Water	11.26	N/A	ft-bmp	--	Water
HV-43	Field	3/31/2017	Depth to Water	11.26	N/A	ft-bmp	--	Water
HV-43	N	4/6/2016	Ethylbenzene	ND	1	ug/L	--	Water
HV-43	N	6/24/2016	Ethylbenzene	ND	1	ug/L	--	Water
HV-43	FD	6/24/2016	Ethylbenzene	ND	1	ug/L	--	Water
HV-43	N	3/21/2017	Ethylbenzene	ND	1	ug/L	--	Water
HV-43	N	4/6/2016	m,p-Xylene	ND	1	ug/L	--	Water
HV-43	N	6/24/2016	m,p-Xylene	ND	1	ug/L	--	Water
HV-43	FD	6/24/2016	m,p-Xylene	ND	1	ug/L	--	Water
HV-43	N	3/21/2017	m+p-Xylenes	ND	1	ug/L	--	Water
HV-43	N	3/21/2017	Methyl ethyl ketone	ND	20	ug/L	--	Water
HV-43	N	3/21/2017	Methyl tert-butyl ether (MTBE)	ND	1	ug/L	--	Water

**TABLE 4b. HISTORIC GROUNDWATER ANALYTICAL RESULTS  
ROXY'S INTERIM REMEDIAL ACTION  
HAVRE, MT**

Location	Sample Type <sup>1</sup>	Date Time Sampled <sup>2</sup>	Analyte	Lab Result <sup>3</sup>	Lab Limit	Lab Units <sup>4</sup>	Reviewer Qualifier <sup>5</sup>	Matrix
HV-43	N	4/6/2016	Methylene Chloride	ND	1	ug/L	--	Water
HV-43	N	6/24/2016	Methylene Chloride	ND	1	ug/L	--	Water
HV-43	FD	6/24/2016	Methylene Chloride	ND	1	ug/L	--	Water
HV-43	N	3/21/2017	Methylene chloride	ND	1	ug/L	--	Water
HV-43	N	4/6/2016	Methyl tert-butyl ether (MTBE)	ND	1	ug/L	--	Water
HV-43	N	6/24/2016	Methyl tert-butyl ether (MTBE)	ND	1	ug/L	--	Water
HV-43	FD	6/24/2016	Methyl tert-butyl ether (MTBE)	ND	1	ug/L	--	Water
HV-43	Field	4/6/2016	Oxygen Reduction Potential	182	N/A	mV	--	Water
HV-43	Field	4/6/2016	Oxygen Reduction Potential	177	N/A	mV	--	Water
HV-43	Field	4/6/2016	Oxygen Reduction Potential	171	N/A	mV	--	Water
HV-43	Field	4/6/2016	Oxygen Reduction Potential	154	N/A	mV	--	Water
HV-43	Field	4/6/2016	Oxygen Reduction Potential	90	N/A	mV	--	Water
HV-43	Field	4/6/2016	Oxygen Reduction Potential	9	N/A	mV	--	Water
HV-43	Field	6/24/2016	Oxygen Reduction Potential	15	N/A	mV	--	Water
HV-43	Field	6/24/2016	Oxygen Reduction Potential	2	N/A	mV	--	Water
HV-43	Field	6/24/2016	Oxygen Reduction Potential	-7	N/A	mV	--	Water
HV-43	Field	6/24/2016	Oxygen Reduction Potential	-15	N/A	mV	--	Water
HV-43	Field	3/31/2017	Oxygen Reduction Potential	-154	N/A	mV	--	Water
HV-43	Field	3/31/2017	Oxygen Reduction Potential	-171	N/A	mV	--	Water
HV-43	Field	3/31/2017	Oxygen Reduction Potential	-175	N/A	mV	--	Water
HV-43	Field	3/31/2017	Oxygen Reduction Potential	-177	N/A	mV	--	Water
HV-43	N	4/6/2016	o-Xylene	ND	1	ug/L	--	Water
HV-43	N	6/24/2016	o-Xylene	ND	1	ug/L	--	Water
HV-43	FD	6/24/2016	o-Xylene	ND	1	ug/L	--	Water
HV-43	N	3/21/2017	o-Xylene	ND	1	ug/L	--	Water
HV-43	Field	4/6/2016	pH	7.32	N/A	Std Units	--	Water
HV-43	Field	4/6/2016	pH	7.4	N/A	Std Units	--	Water
HV-43	Field	4/6/2016	pH	7.44	N/A	Std Units	--	Water
HV-43	Field	4/6/2016	pH	7.46	N/A	Std Units	--	Water
HV-43	Field	4/6/2016	pH	7.48	N/A	Std Units	--	Water
HV-43	Field	4/6/2016	pH	7.47	N/A	Std Units	--	Water
HV-43	Field	6/24/2016	pH	6.99	N/A	Std Units	--	Water
HV-43	Field	6/24/2016	pH	6.97	N/A	Std Units	--	Water
HV-43	Field	6/24/2016	pH	6.96	N/A	Std Units	--	Water
HV-43	Field	6/24/2016	pH	6.95	N/A	Std Units	--	Water
HV-43	Field	3/31/2017	pH	6.42	N/A	Std Units	--	Water
HV-43	Field	3/31/2017	pH	6.57	N/A	Std Units	--	Water
HV-43	Field	3/31/2017	pH	6.62	N/A	Std Units	--	Water
HV-43	Field	3/31/2017	pH	6.66	N/A	Std Units	--	Water

**TABLE 4b. HISTORIC GROUNDWATER ANALYTICAL RESULTS  
ROXY'S INTERIM REMEDIAL ACTION  
HAVRE, MT**

Location	Sample Type <sup>1</sup>	Date Time Sampled <sup>2</sup>	Analyte	Lab Result <sup>3</sup>	Lab Limit	Lab Units <sup>4</sup>	Reviewer Qualifier <sup>5</sup>	Matrix
HV-43	N	4/6/2016	Styrene	ND	1	ug/L	--	Water
HV-43	N	6/24/2016	Styrene	ND	1	ug/L	--	Water
HV-43	FD	6/24/2016	Styrene	ND	1	ug/L	--	Water
HV-43	N	3/21/2017	Styrene	ND	1	ug/L	--	Water
HV-43	N	4/6/2016	Sulfide, Total	1	1	mg/L	U	Water
HV-43	N	8/1/1993	Tetrachloroethene	4.9	Unknown	ug/L	--	Water
HV-43	N	3/1/2004	Tetrachloroethene	ND	1	ug/L	--	Water
HV-43	N	3/1/2006	Tetrachloroethene	ND	0.5	ug/L	--	Water
HV-43	N	6/1/2006	Tetrachloroethene	ND	1	ug/L	--	Water
HV-43	N	6/7/2007	Tetrachloroethene	ND	0.5	ug/L	--	Water
HV-43	N	6/7/2008	Tetrachloroethene	ND	0.5	ug/L	--	Water
HV-43	N/FD	6/1/2009	Tetrachloroethene	0.13/0.12	Unknown	ug/L	J	Water
HV-43	N	6/1/2010	Tetrachloroethene	0.053	Unknown	ug/L	--	Water
HV-43	N	6/1/2011	Tetrachloroethene	0.075	Unknown	ug/L	J	Water
HV-43	N	6/10/2012	Tetrachloroethene	ND	0.5	ug/L	--	Water
HV-43	N/FD	6/21/2013	Tetrachloroethene	0.030/0.043	Unknown	ug/L	J	Water
HV-43	N	4/6/2016	Tetrachloroethene	ND	1	ug/L	--	Water
HV-43	N	6/24/2016	Tetrachloroethene	ND	1	ug/L	--	Water
HV-43	FD	6/24/2016	Tetrachloroethene	ND	1	ug/L	--	Water
HV-43	N	3/21/2017	Tetrachloroethene	ND	1	ug/L	--	Water
HV-43	N	4/6/2016	Toluene	0.18	1	ug/L	U	Water
HV-43	N	6/24/2016	Toluene	ND	1	ug/L	--	Water
HV-43	FD	6/24/2016	Toluene	ND	1	ug/L	--	Water
HV-43	N	3/21/2017	Toluene	ND	1	ug/L	--	Water
HV-43	N	4/6/2016	Total Organic Carbon	4.5	0.5	mg/L	--	Water
HV-43	N	4/6/2016	trans-1,2-Dichloroethene	39	3.8	ug/L	--	Water
HV-43	N	6/24/2016	trans-1,2-Dichloroethene	51	2.5	ug/L	--	Water
HV-43	FD	6/24/2016	trans-1,2-Dichloroethene	50	2.5	ug/L	--	Water
HV-43	N	3/21/2017	trans-1,2-Dichloroethene	ND	1	ug/L	--	Water
HV-43	N	4/6/2016	trans-1,3-Dichloropropene	ND	1	ug/L	--	Water
HV-43	N	6/24/2016	trans-1,3-Dichloropropene	ND	1	ug/L	--	Water
HV-43	FD	6/24/2016	trans-1,3-Dichloropropene	ND	1	ug/L	--	Water
HV-43	N	3/21/2017	trans-1,3-Dichloropropene	ND	1	ug/L	--	Water
HV-43	N	8/1/1993	Trichloroethene	11	Unknown	ug/L	--	Water
HV-43	N	3/1/2004	Trichloroethene	1.72	Unknown	ug/L	--	Water
HV-43	N/FD	3/1/2006	Trichloroethene	29.0/26.0	Unknown	ug/L	--	Water
HV-43	N/FD	6/1/2006	Trichloroethene	20.9/19.8	Unknown	ug/L	--	Water
HV-43	N	6/7/2007	Trichloroethene	30.7	Unknown	ug/L	--	Water
HV-43	N	6/7/2008	Trichloroethene	12.9	Unknown	ug/L	--	Water

**TABLE 4b. HISTORIC GROUNDWATER ANALYTICAL RESULTS  
ROXY'S INTERIM REMEDIAL ACTION  
HAVRE, MT**

Location	Sample Type <sup>1</sup>	Date Time Sampled <sup>2</sup>	Analyte	Lab Result <sup>3</sup>	Lab Limit	Lab Units <sup>4</sup>	Reviewer Qualifier <sup>5</sup>	Matrix
HV-43	N/FD	6/1/2009	Trichloroethene	7.20/7.21	Unknown	ug/L	--	Water
HV-43	N	6/1/2010	Trichloroethene	4.1	Unknown	ug/L	--	Water
HV-43	N	6/1/2011	Trichloroethene	2.3	Unknown	ug/L	--	Water
HV-43	N	6/10/2012	Trichloroethene	1.2	Unknown	ug/L	--	Water
HV-43	N/FD	6/21/2013	Trichloroethene	1.4/1.5	Unknown	ug/L	--	Water
HV-43	N	4/6/2016	Trichloroethene	0.9	1	ug/L	J	Water
HV-43	N	6/24/2016	Trichloroethene	1.1	1	ug/L	--	Water
HV-43	FD	6/24/2016	Trichloroethene	1.1	1	ug/L	--	Water
HV-43	N	3/21/2017	Trichloroethene	ND	1	ug/L	--	Water
HV-43	N	4/6/2016	Trichlorofluoromethane	ND	1	ug/L	--	Water
HV-43	N	6/24/2016	Trichlorofluoromethane	ND	1	ug/L	--	Water
HV-43	FD	6/24/2016	Trichlorofluoromethane	ND	1	ug/L	--	Water
HV-43	N	3/21/2017	Trichlorofluoromethane	ND	1	ug/L	--	Water
HV-43	Field	6/24/2016	Turbidity	121	N/A	NTUs	--	Water
HV-43	Field	6/24/2016	Turbidity	115	N/A	NTUs	--	Water
HV-43	Field	6/24/2016	Turbidity	115	N/A	NTUs	--	Water
HV-43	Field	6/24/2016	Turbidity	120	N/A	NTUs	--	Water
HV-43	Field	3/31/2017	Turbidity	9.2	N/A	NTUs	--	Water
HV-43	Field	3/31/2017	Turbidity	8.5	N/A	NTUs	--	Water
HV-43	Field	3/31/2017	Turbidity	4.5	N/A	NTUs	--	Water
HV-43	Field	3/31/2017	Turbidity	2	N/A	NTUs	--	Water
HV-43	N	8/1/1993	Vinyl Chloride	ND	2	ug/L	--	Water
HV-43	N	3/1/2004	Vinyl Chloride	5.61	Unknown	ug/L	--	Water
HV-43	N/FD	3/1/2006	Vinyl Chloride	0.66/<2.0	2	ug/L	--	Water
HV-43	N/FD	6/1/2006	Vinyl Chloride	1.84/1.64	Unknown	ug/L	--	Water
HV-43	N	6/7/2007	Vinyl Chloride	1.40	Unknown	ug/L	--	Water
HV-43	N	6/7/2008	Vinyl Chloride	1.01	Unknown	ug/L	--	Water
HV-43	N/FD	6/1/2009	Vinyl Chloride	0.39/0.37	Unknown	ug/L	J	Water
HV-43	N	6/1/2010	Vinyl Chloride	0.35	Unknown	ug/L	--	Water
HV-43	N	6/1/2011	Vinyl Chloride	0.60	Unknown	ug/L	--	Water
HV-43	N	6/10/2012	Vinyl Chloride	0.31	Unknown	ug/L	J	Water
HV-43	N/FD	6/21/2013	Vinyl Chloride	0.14/0.10	Unknown	ug/L	J	Water
HV-43	N	4/6/2016	Vinyl Chloride	0.19	1	ug/L	J	Water
HV-43	N	6/24/2016	Vinyl Chloride	ND	1	ug/L	--	Water
HV-43	FD	6/24/2016	Vinyl Chloride	ND	1	ug/L	--	Water
HV-43	N	3/21/2017	Vinyl chloride	ND	1	ug/L	--	Water
HV-43	N	4/6/2016	Xylenes, Total	ND	1	ug/L	--	Water
HV-43	N	6/24/2016	Xylenes, Total	ND	1	ug/L	--	Water
HV-43	FD	6/24/2016	Xylenes, Total	ND	1	ug/L	--	Water

**TABLE 4b. HISTORIC GROUNDWATER ANALYTICAL RESULTS  
ROXY'S INTERIM REMEDIAL ACTION  
HAVRE, MT**

Location	Sample Type <sup>1</sup>	Date Time Sampled <sup>2</sup>	Analyte	Lab Result <sup>3</sup>	Lab Limit	Lab Units <sup>4</sup>	Reviewer Qualifier <sup>5</sup>	Matrix
HV-43	N	3/21/2017	Xylenes, Total	ND	1	ug/L	--	Water
HV-62	N	4/6/2016	1,1,1,2-Tetrachloroethane	ND	1	ug/L	--	Water
HV-62	N	6/24/2016	1,1,1,2-Tetrachloroethane	ND	1.2	ug/L	--	Water
HV-62	N	3/21/2017	1,1,1,2-Tetrachloroethane	ND	1	ug/L	--	Water
HV-62	N	4/6/2016	1,1,1-Trichloroethane	ND	1	ug/L	--	Water
HV-62	N	6/24/2016	1,1,1-Trichloroethane	ND	1.2	ug/L	--	Water
HV-62	N	3/21/2017	1,1,1-Trichloroethane	ND	1	ug/L	--	Water
HV-62	N	4/6/2016	1,1,2,2-Tetrachloroethane	ND	1	ug/L	--	Water
HV-62	N	6/24/2016	1,1,2,2-Tetrachloroethane	ND	1.2	ug/L	--	Water
HV-62	N	3/21/2017	1,1,2,2-Tetrachloroethane	ND	1	ug/L	--	Water
HV-62	N	4/6/2016	1,1,2-Trichloroethane	ND	1	ug/L	--	Water
HV-62	N	6/24/2016	1,1,2-Trichloroethane	ND	1.2	ug/L	--	Water
HV-62	N	3/21/2017	1,1,2-Trichloroethane	ND	1	ug/L	--	Water
HV-62	N	4/6/2016	1,1-Dichloroethane	ND	1	ug/L	--	Water
HV-62	N	6/24/2016	1,1-Dichloroethane	ND	1.2	ug/L	--	Water
HV-62	N	3/21/2017	1,1-Dichloroethane	ND	1	ug/L	--	Water
HV-62	N	4/6/2016	1,1-Dichloroethene	ND	1	ug/L	--	Water
HV-62	N	6/24/2016	1,1-Dichloroethene	ND	1.2	ug/L	--	Water
HV-62	N	3/21/2017	1,1-Dichloroethene	ND	1	ug/L	--	Water
HV-62	N	4/6/2016	1,1-Dichloropropene	ND	1	ug/L	--	Water
HV-62	N	6/24/2016	1,1-Dichloropropene	ND	1.2	ug/L	--	Water
HV-62	N	3/21/2017	1,1-Dichloropropene	ND	1	ug/L	--	Water
HV-62	N	4/6/2016	1,2,3-Trichloropropane	ND	1	ug/L	--	Water
HV-62	N	6/24/2016	1,2,3-Trichloropropane	ND	1.2	ug/L	--	Water
HV-62	N	3/21/2017	1,2,3-Trichloropropane	ND	1	ug/L	--	Water
HV-62	N	4/6/2016	1,2-Dibromoethane	ND	1	ug/L	--	Water
HV-62	N	6/24/2016	1,2-Dibromoethane	ND	1.2	ug/L	--	Water
HV-62	N	3/21/2017	1,2-Dibromoethane	ND	1	ug/L	--	Water
HV-62	N	4/6/2016	1,2-Dichlorobenzene	ND	1	ug/L	--	Water
HV-62	N	6/24/2016	1,2-Dichlorobenzene	ND	1.2	ug/L	--	Water
HV-62	N	3/21/2017	1,2-Dichlorobenzene	ND	1	ug/L	--	Water
HV-62	N	4/6/2016	1,2-Dichloroethane	ND	1	ug/L	--	Water
HV-62	N	6/24/2016	1,2-Dichloroethane	ND	1.2	ug/L	--	Water
HV-62	N	3/21/2017	1,2-Dichloroethane	ND	1	ug/L	--	Water
HV-62	N	4/6/2016	1,2-Dichloropropane	ND	1	ug/L	--	Water
HV-62	N	6/24/2016	1,2-Dichloropropane	ND	1.2	ug/L	--	Water
HV-62	N	3/21/2017	1,2-Dichloropropane	ND	1	ug/L	--	Water
HV-62	N	4/6/2016	1,3-Dichlorobenzene	ND	1	ug/L	--	Water
HV-62	N	6/24/2016	1,3-Dichlorobenzene	ND	1.2	ug/L	--	Water

**TABLE 4b. HISTORIC GROUNDWATER ANALYTICAL RESULTS  
ROXY'S INTERIM REMEDIAL ACTION  
HAVRE, MT**

Location	Sample Type <sup>1</sup>	Date Time Sampled <sup>2</sup>	Analyte	Lab Result <sup>3</sup>	Lab Limit	Lab Units <sup>4</sup>	Reviewer Qualifier <sup>5</sup>	Matrix
HV-62	N	3/21/2017	1,3-Dichlorobenzene	ND	1	ug/L	--	Water
HV-62	N	4/6/2016	1,3-Dichloropropane	ND	1	ug/L	--	Water
HV-62	N	6/24/2016	1,3-Dichloropropane	ND	1.2	ug/L	--	Water
HV-62	N	3/21/2017	1,3-Dichloropropane	ND	1	ug/L	--	Water
HV-62	N	4/6/2016	1,4-Dichlorobenzene	ND	1	ug/L	--	Water
HV-62	N	6/24/2016	1,4-Dichlorobenzene	ND	1.2	ug/L	--	Water
HV-62	N	3/21/2017	1,4-Dichlorobenzene	ND	1	ug/L	--	Water
HV-62	N	4/6/2016	2,2-Dichloropropane	ND	1	ug/L	--	Water
HV-62	N	6/24/2016	2,2-Dichloropropane	ND	1.2	ug/L	--	Water
HV-62	N	3/21/2017	2,2-Dichloropropane	ND	1	ug/L	--	Water
HV-62	N	4/6/2016	2-Butanone	ND	20	ug/L	--	Water
HV-62	N	6/24/2016	2-Butanone	ND	20	ug/L	--	Water
HV-62	N	4/6/2016	2-Chlorotoluene	ND	1	ug/L	--	Water
HV-62	N	6/24/2016	2-Chlorotoluene	ND	1.2	ug/L	--	Water
HV-62	N	3/21/2017	2-Chlorotoluene	ND	1	ug/L	--	Water
HV-62	N	4/6/2016	4-Chlorotoluene	ND	1	ug/L	--	Water
HV-62	N	6/24/2016	4-Chlorotoluene	ND	1.2	ug/L	--	Water
HV-62	N	3/21/2017	4-Chlorotoluene	ND	1	ug/L	--	Water
HV-62	N	3/21/2017	Arsenic	0.004	0.001	mg/L	--	Water
HV-62	N	3/21/2017	Arsenic	0.005	0.001	mg/L	--	Water
HV-62	N	4/6/2016	Arsenic, Dissolved	0.024	0.001	mg/L	J+	Water
HV-62	N	6/24/2016	Arsenic, Dissolved	0.003	0.001	mg/L	--	Water
HV-62	N	4/6/2016	Benzene	1.8	1	ug/L	--	Water
HV-62	N	6/24/2016	Benzene	ND	1.2	ug/L	--	Water
HV-62	N	3/21/2017	Benzene	1.1	1	ug/L	--	Water
HV-62	N	4/6/2016	Bromobenzene	ND	1	ug/L	--	Water
HV-62	N	6/24/2016	Bromobenzene	ND	1.2	ug/L	--	Water
HV-62	N	3/21/2017	Bromobenzene	ND	1	ug/L	--	Water
HV-62	N	4/6/2016	Bromochloromethane	ND	1	ug/L	--	Water
HV-62	N	6/24/2016	Bromochloromethane	ND	1.2	ug/L	--	Water
HV-62	N	3/21/2017	Bromochloromethane	ND	1	ug/L	--	Water
HV-62	N	4/6/2016	Bromodichloromethane	ND	1	ug/L	--	Water
HV-62	N	6/24/2016	Bromodichloromethane	ND	1.2	ug/L	--	Water
HV-62	N	3/21/2017	Bromodichloromethane	ND	1	ug/L	--	Water
HV-62	N	4/6/2016	Bromoform	ND	1	ug/L	--	Water
HV-62	N	6/24/2016	Bromoform	ND	1.2	ug/L	--	Water
HV-62	N	3/21/2017	Bromoform	ND	1	ug/L	--	Water
HV-62	N	4/6/2016	Bromomethane	ND	1	ug/L	--	Water
HV-62	N	6/24/2016	Bromomethane	ND	1.2	ug/L	--	Water

**TABLE 4b. HISTORIC GROUNDWATER ANALYTICAL RESULTS  
ROXY'S INTERIM REMEDIAL ACTION  
HAVRE, MT**

Location	Sample Type <sup>1</sup>	Date Time Sampled <sup>2</sup>	Analyte	Lab Result <sup>3</sup>	Lab Limit	Lab Units <sup>4</sup>	Reviewer Qualifier <sup>5</sup>	Matrix
HV-62	N	3/21/2017	Bromomethane	ND	1	ug/L	--	Water
HV-62	N	4/6/2016	Carbon tetrachloride	ND	1	ug/L	--	Water
HV-62	N	6/24/2016	Carbon tetrachloride	ND	1.2	ug/L	--	Water
HV-62	N	3/21/2017	Carbon tetrachloride	ND	1	ug/L	--	Water
HV-62	N	4/6/2016	Chlorobenzene	ND	1	ug/L	--	Water
HV-62	N	6/24/2016	Chlorobenzene	ND	1.2	ug/L	--	Water
HV-62	N	3/21/2017	Chlorobenzene	ND	1	ug/L	--	Water
HV-62	N	3/21/2017	Chlorodibromomethane	ND	1	ug/L	--	Water
HV-62	N	4/6/2016	Chloroethane	ND	1	ug/L	--	Water
HV-62	N	6/24/2016	Chloroethane	ND	1.2	ug/L	--	Water
HV-62	N	3/21/2017	Chloroethane	ND	1	ug/L	--	Water
HV-62	N	4/6/2016	Chloroform	ND	1	ug/L	--	Water
HV-62	N	6/24/2016	Chloroform	ND	1.2	ug/L	--	Water
HV-62	N	3/21/2017	Chloroform	ND	1	ug/L	--	Water
HV-62	N	4/6/2016	Chloromethane	ND	1	ug/L	--	Water
HV-62	N	6/24/2016	Chloromethane	ND	1.2	ug/L	--	Water
HV-62	N	3/21/2017	Chloromethane	ND	1	ug/L	--	Water
HV-62	N	4/12/2004	cis-1,2-Dichloroethene	910	Unknown	ug/L	--	Water
HV-62	N	3/1/2006	cis-1,2-Dichloroethene	1,280	Unknown	ug/L	--	Water
HV-62	N	6/1/2006	cis-1,2-Dichloroethene	544	Unknown	ug/L	--	Water
HV-62	N	3/29/2014	cis-1,2-Dichloroethene	770	Unknown	ug/L	--	Water
HV-62	N	4/6/2016	cis-1,2-Dichloroethene	17	1	ug/L	--	Water
HV-62	N	6/24/2016	cis-1,2-Dichloroethene	1670	25	ug/L	--	Water
HV-62	N	3/21/2017	cis-1,2-Dichloroethene	72	50	ug/L	--	Water
HV-62	N	4/6/2016	cis-1,3-Dichloropropene	ND	1	ug/L	--	Water
HV-62	N	6/24/2016	cis-1,3-Dichloropropene	ND	1.2	ug/L	--	Water
HV-62	N	3/21/2017	cis-1,3-Dichloropropene	ND	1	ug/L	--	Water
HV-62	Field	4/6/2016	Conductance	1.73	N/A	mS/cm	--	Water
HV-62	Field	4/6/2016	Conductance	1.76	N/A	mS/cm	--	Water
HV-62	Field	4/6/2016	Conductance	1.77	N/A	mS/cm	--	Water
HV-62	Field	4/6/2016	Conductance	1.78	N/A	mS/cm	--	Water
HV-62	Field	6/24/2016	Conductance	2.18	N/A	mS/cm	--	Water
HV-62	Field	6/24/2016	Conductance	2.17	N/A	mS/cm	--	Water
HV-62	Field	6/24/2016	Conductance	2.18	N/A	mS/cm	--	Water
HV-62	Field	6/24/2016	Conductance	2.18	N/A	mS/cm	--	Water
HV-62	Field	3/31/2017	Conductance	2.34	N/A	mS/cm	--	Water
HV-62	Field	3/31/2017	Conductance	2.35	N/A	mS/cm	--	Water
HV-62	Field	3/31/2017	Conductance	2.34	N/A	mS/cm	--	Water
HV-62	Field	3/31/2017	Conductance	2.34	N/A	mS/cm	--	Water

**TABLE 4b. HISTORIC GROUNDWATER ANALYTICAL RESULTS  
ROXY'S INTERIM REMEDIAL ACTION  
HAVRE, MT**

Location	Sample Type <sup>1</sup>	Date Time Sampled <sup>2</sup>	Analyte	Lab Result <sup>3</sup>	Lab Limit	Lab Units <sup>4</sup>	Reviewer Qualifier <sup>5</sup>	Matrix
HV-62	N	4/6/2016	Dibromochloromethane	ND	1	ug/L	--	Water
HV-62	N	6/24/2016	Dibromochloromethane	ND	1.2	ug/L	--	Water
HV-62	N	4/6/2016	Dibromomethane	ND	1	ug/L	--	Water
HV-62	N	6/24/2016	Dibromomethane	ND	1.2	ug/L	--	Water
HV-62	N	3/21/2017	Dibromomethane	ND	1	ug/L	--	Water
HV-62	N	4/6/2016	Dichlorodifluoromethane	ND	1	ug/L	--	Water
HV-62	N	6/24/2016	Dichlorodifluoromethane	ND	1.2	ug/L	--	Water
HV-62	N	3/21/2017	Dichlorodifluoromethane	ND	1	ug/L	--	Water
HV-62	Field	4/6/2016	Dissolved Oxygen	7.86	N/A	%	--	Water
HV-62	Field	4/6/2016	Dissolved Oxygen	0	N/A	%	--	Water
HV-62	Field	4/6/2016	Dissolved Oxygen	0	N/A	%	--	Water
HV-62	Field	4/6/2016	Dissolved Oxygen	0	N/A	%	--	Water
HV-62	Field	4/6/2016	Dissolved Oxygen	0.76	N/A	mg/L	--	Water
HV-62	Field	4/6/2016	Dissolved Oxygen	0	N/A	mg/L	--	Water
HV-62	Field	4/6/2016	Dissolved Oxygen	0	N/A	mg/L	--	Water
HV-62	Field	4/6/2016	Dissolved Oxygen	0	N/A	mg/L	--	Water
HV-62	Field	6/24/2016	Dissolved Oxygen	0	N/A	mg/L	--	Water
HV-62	Field	6/24/2016	Dissolved Oxygen	0	N/A	mg/L	--	Water
HV-62	Field	6/24/2016	Dissolved Oxygen	0.11	N/A	mg/L	--	Water
HV-62	Field	6/24/2016	Dissolved Oxygen	0	N/A	mg/L	--	Water
HV-62	Field	3/31/2017	Dissolved Oxygen	1.64	N/A	mg/L	--	Water
HV-62	Field	3/31/2017	Dissolved Oxygen	1.16	N/A	mg/L	--	Water
HV-62	Field	3/31/2017	Dissolved Oxygen	0.95	N/A	mg/L	--	Water
HV-62	Field	3/31/2017	Dissolved Oxygen	0.84	N/A	mg/L	--	Water
HV-62	Field	4/6/2016	Depth to Water	12.42	N/A	ft-bmp	--	Water
HV-62	Field	4/6/2016	Depth to Water	12.42	N/A	ft-bmp	--	Water
HV-62	Field	4/6/2016	Depth to Water	12.43	N/A	ft-bmp	--	Water
HV-62	Field	4/6/2016	Depth to Water	12.43	N/A	ft-bmp	--	Water
HV-62	Field	6/24/2016	Depth to Water	11.42	N/A	ft-bmp	--	Water
HV-62	Field	6/24/2016	Depth to Water	11.42	N/A	ft-bmp	--	Water
HV-62	Field	6/24/2016	Depth to Water	11.42	N/A	ft-bmp	--	Water
HV-62	Field	6/24/2016	Depth to Water	11.42	N/A	ft-bmp	--	Water
HV-62	Field	3/31/2017	Depth to Water	12.14	N/A	ft-bmp	--	Water
HV-62	Field	3/31/2017	Depth to Water	12.14	N/A	ft-bmp	--	Water
HV-62	Field	3/31/2017	Depth to Water	12.13	N/A	ft-bmp	--	Water
HV-62	Field	3/31/2017	Depth to Water	12.13	N/A	ft-bmp	--	Water
HV-62	N	4/6/2016	Ethylbenzene	2.5	1	ug/L	--	Water
HV-62	N	6/24/2016	Ethylbenzene	3.1	1.2	ug/L	--	Water
HV-62	N	3/21/2017	Ethylbenzene	6.1	1	ug/L	--	Water

**TABLE 4b. HISTORIC GROUNDWATER ANALYTICAL RESULTS  
ROXY'S INTERIM REMEDIAL ACTION  
HAVRE, MT**

Location	Sample Type <sup>1</sup>	Date Time Sampled <sup>2</sup>	Analyte	Lab Result <sup>3</sup>	Lab Limit	Lab Units <sup>4</sup>	Reviewer Qualifier <sup>5</sup>	Matrix
HV-62	N	4/6/2016	m,p-Xylene	0.28	1	ug/L	J	Water
HV-62	N	6/24/2016	m,p-Xylene	ND	2.5	ug/L	--	Water
HV-62	N	3/21/2017	m+p-Xylenes	1.1	1	ug/L	--	Water
HV-62	N	3/21/2017	Methyl ethyl ketone	ND	20	ug/L	--	Water
HV-62	N	3/21/2017	Methyl tert-butyl ether (MTBE)	ND	1	ug/L	--	Water
HV-62	N	4/6/2016	Methylene Chloride	ND	1	ug/L	--	Water
HV-62	N	6/24/2016	Methylene Chloride	ND	1.2	ug/L	--	Water
HV-62	N	3/21/2017	Methylene chloride	ND	1	ug/L	--	Water
HV-62	N	4/6/2016	Methyl tert-butyl ether (MTBE)	ND	1	ug/L	--	Water
HV-62	N	6/24/2016	Methyl tert-butyl ether (MTBE)	ND	1.2	ug/L	--	Water
HV-62	Field	4/6/2016	Oxygen Reduction Potential	-168	N/A	mV	--	Water
HV-62	Field	4/6/2016	Oxygen Reduction Potential	-186	N/A	mV	--	Water
HV-62	Field	4/6/2016	Oxygen Reduction Potential	-199	N/A	mV	--	Water
HV-62	Field	4/6/2016	Oxygen Reduction Potential	-204	N/A	mV	--	Water
HV-62	Field	6/24/2016	Oxygen Reduction Potential	-156	N/A	mV	--	Water
HV-62	Field	6/24/2016	Oxygen Reduction Potential	-159	N/A	mV	--	Water
HV-62	Field	6/24/2016	Oxygen Reduction Potential	-157	N/A	mV	--	Water
HV-62	Field	6/24/2016	Oxygen Reduction Potential	-159	N/A	mV	--	Water
HV-62	Field	3/31/2017	Oxygen Reduction Potential	-209	N/A	mV	--	Water
HV-62	Field	3/31/2017	Oxygen Reduction Potential	-226	N/A	mV	--	Water
HV-62	Field	3/31/2017	Oxygen Reduction Potential	-234	N/A	mV	--	Water
HV-62	Field	3/31/2017	Oxygen Reduction Potential	-240	N/A	mV	--	Water
HV-62	N	4/6/2016	o-Xylene	1.2	1	ug/L	--	Water
HV-62	N	6/24/2016	o-Xylene	2.4	1.2	ug/L	--	Water
HV-62	N	3/21/2017	o-Xylene	3.4	1	ug/L	--	Water
HV-62	Field	4/6/2016	pH	7.45	N/A	Std Units	--	Water
HV-62	Field	4/6/2016	pH	7.52	N/A	Std Units	--	Water
HV-62	Field	4/6/2016	pH	7.53	N/A	Std Units	--	Water
HV-62	Field	4/6/2016	pH	7.56	N/A	Std Units	--	Water
HV-62	Field	6/24/2016	pH	7.16	N/A	Std Units	--	Water
HV-62	Field	6/24/2016	pH	7.15	N/A	Std Units	--	Water
HV-62	Field	6/24/2016	pH	7.15	N/A	Std Units	--	Water
HV-62	Field	6/24/2016	pH	7.15	N/A	Std Units	--	Water
HV-62	Field	3/31/2017	pH	6.6	N/A	Std Units	--	Water
HV-62	Field	3/31/2017	pH	6.69	N/A	Std Units	--	Water
HV-62	Field	3/31/2017	pH	6.74	N/A	Std Units	--	Water
HV-62	Field	3/31/2017	pH	6.77	N/A	Std Units	--	Water
HV-62	N	4/6/2016	Styrene	ND	1	ug/L	--	Water
HV-62	N	6/24/2016	Styrene	ND	1.2	ug/L	--	Water

**TABLE 4b. HISTORIC GROUNDWATER ANALYTICAL RESULTS  
ROXY'S INTERIM REMEDIAL ACTION  
HAVRE, MT**

Location	Sample Type <sup>1</sup>	Date Time Sampled <sup>2</sup>	Analyte	Lab Result <sup>3</sup>	Lab Limit	Lab Units <sup>4</sup>	Reviewer Qualifier <sup>5</sup>	Matrix
HV-62	N	3/21/2017	Styrene	ND	1	ug/L	--	Water
HV-62	N	4/6/2016	Sulfide, Total	2	1	mg/L	JB	Water
HV-62	N	4/12/2004	Tetrachloroethene	117	Unknown	ug/L	--	Water
HV-62	N	3/1/2006	Tetrachloroethene	25.1	Unknown	ug/L	--	Water
HV-62	N	6/1/2006	Tetrachloroethene	14	Unknown	ug/L	J	Water
HV-62	N	3/29/2014	Tetrachloroethene	0.069	Unknown	ug/L	J	Water
HV-62	N	4/6/2016	Tetrachloroethene	ND	1	ug/L	--	Water
HV-62	N	6/24/2016	Tetrachloroethene	ND	1.2	ug/L	--	Water
HV-62	N	3/21/2017	Tetrachloroethene	ND	1	ug/L	--	Water
HV-62	N	4/6/2016	Toluene	0.26	1	ug/L	U	Water
HV-62	N	6/24/2016	Toluene	ND	1.2	ug/L	--	Water
HV-62	N	3/21/2017	Toluene	ND	1	ug/L	--	Water
HV-62	N	4/6/2016	Total Organic Carbon	17.2	4	mg/L	--	Water
HV-62	N	4/6/2016	trans-1,2-Dichloroethene	17	1	ug/L	--	Water
HV-62	N	6/24/2016	trans-1,2-Dichloroethene	128	2.5	ug/L	--	Water
HV-62	N	3/21/2017	trans-1,2-Dichloroethene	79	50	ug/L	--	Water
HV-62	N	4/6/2016	trans-1,3-Dichloropropene	ND	1	ug/L	--	Water
HV-62	N	6/24/2016	trans-1,3-Dichloropropene	ND	1.2	ug/L	--	Water
HV-62	N	3/21/2017	trans-1,3-Dichloropropene	ND	1	ug/L	--	Water
HV-62	N	4/12/2004	Trichloroethene	168	Unknown	ug/L	--	Water
HV-62	N	3/1/2006	Trichloroethene	288	Unknown	ug/L	--	Water
HV-62	N	6/1/2006	Trichloroethene	541	Unknown	ug/L	--	Water
HV-62	N	3/29/2014	Trichloroethene	1.4	Unknown	ug/L	--	Water
HV-62	N	4/6/2016	Trichloroethene	0.53	1	ug/L	J	Water
HV-62	N	6/24/2016	Trichloroethene	1.4	1.2	ug/L	--	Water
HV-62	N	3/21/2017	Trichloroethene	ND	1	ug/L	--	Water
HV-62	N	4/6/2016	Trichlorofluoromethane	ND	1	ug/L	--	Water
HV-62	N	6/24/2016	Trichlorofluoromethane	ND	1.2	ug/L	--	Water
HV-62	N	3/21/2017	Trichlorofluoromethane	ND	1	ug/L	--	Water
HV-62	Field	6/24/2016	Turbidity	0.1	N/A	NTUs	--	Water
HV-62	Field	6/24/2016	Turbidity	0.6	N/A	NTUs	--	Water
HV-62	Field	6/24/2016	Turbidity	5	N/A	NTUs	--	Water
HV-62	Field	6/24/2016	Turbidity	7.3	N/A	NTUs	--	Water
HV-62	Field	3/31/2017	Turbidity	0.1	N/A	NTUs	--	Water
HV-62	Field	3/31/2017	Turbidity	0.3	N/A	NTUs	--	Water
HV-62	Field	3/31/2017	Turbidity	0.8	N/A	NTUs	--	Water
HV-62	Field	3/31/2017	Turbidity	0.2	N/A	NTUs	--	Water
HV-62	N	4/12/2004	Vinyl Chloride	188	Unknown	ug/L	--	Water
HV-62	N	3/1/2006	Vinyl Chloride	217	Unknown	ug/L	--	Water

**TABLE 4b. HISTORIC GROUNDWATER ANALYTICAL RESULTS  
ROXY'S INTERIM REMEDIAL ACTION  
HAVRE, MT**

Location	Sample Type <sup>1</sup>	Date Time Sampled <sup>2</sup>	Analyte	Lab Result <sup>3</sup>	Lab Limit	Lab Units <sup>4</sup>	Reviewer Qualifier <sup>5</sup>	Matrix
HV-62	N	6/1/2006	Vinyl Chloride	87.0	Unknown	ug/L	--	Water
HV-62	N	3/29/2014	Vinyl Chloride	270	Unknown	ug/L	--	Water
HV-62	N	4/6/2016	Vinyl Chloride	60	12	ug/L	--	Water
HV-62	N	6/24/2016	Vinyl Chloride	392	25	ug/L	J+	Water
HV-62	N	3/21/2017	Vinyl chloride	234	50	ug/L	--	Water
HV-62	N	4/6/2016	Xylenes, Total	1.5	1	ug/L	--	Water
HV-62	N	6/24/2016	Xylenes, Total	4	1.2	ug/L	--	Water
HV-62	N	3/21/2017	Xylenes, Total	4.6	1	ug/L	--	Water

- 1) "N" => Normal sample; "FD" => Field duplicate; "Field" => Parameter measured in the field
- 2) Data collected prior to April 2016 were sampled by BNSF
- 3) "ND" => Not detected above laboratory reporting limit (Lab Limit)
- 4) % => Percent; ft-bmp => feet below measuring point; mg/L => milligrams/ liter; mS/cm => milliSiemens/ centimeter; mV => millivolt; NTUs => Nephelometric Turbidity Units; ug/L => microgram/Liter
- 5) Based on data validation conducted by Trihydro (Appendix J). BNSF data was not validated by Trihydro.
  - J Estimated concentration
  - J+ The result is an estimated concentration, but may be biased high
  - JB Estimated concentration due to blank contamination
  - U Evaluated to be undetected at the reporting limit

**TABLE 5a. CONTAMINANT MASS REMOVED SVE01  
ROXY'S INTERIM REMEDIAL ACTION  
HAVRE, MT**

Date	SVE System (hours)	Run Time (hours)	Heat Exchanger System (hours)	SVE01 Flow		SVE01 Vacuum (in H2O)	SVE01 PID		PCE Molecular Weight Used (g/mol)	Mass Removed			
				(cfm)	(m3/hr)		(ppm)	(mg/m3)		(mg/hour)	(mg/period)	lbs/period	(lbs cum)
1/20/2016													
1/22/2016	53.8	53.8	54.2	5	8.50	-50		0	165.82	0	0	0	0
1/23/2016	79.5	25.7	80.0	18	30.58	-42		0	165.82	0	0	0	0
1/24/2016	93.6	14.1	94.1	19	32.28	-42		0	165.82	0	0	0	0
1/25/2016	115.9	22.3	116.3	5	8.50	-52		0	165.82	0	0	0	0
1/25/2016	125.4	9.5	125.8	5	8.50	-56		0	165.82	0	0	0	0
1/26/2016	140.0	14.6	140.4	5	8.50	-54		0	165.82	0	0	0	0
1/26/2016	149.1	9.1	149.6	5	8.50	-55		0	165.82	0	0	0	0
1/28/2016	173.0	23.9	173.5	15	25.49	-56		0	165.82	0	0	0	0
2/10/2016	489.0	316.0	489.5	19	32.28	-44	0.0	0	165.82	0	0	0	0
2/11/2016	506.9	17.9	507.4	5	8.50	-43	5.8	39.33562	165.82	334.160057	5981.46502	0.01318688	0.01318688
3/4/2016	1,040.5	533.6	1,041.0	5	8.50	-35.5		0	165.82	0	0	0	0.01318688
3/16/2016	1,180.4	139.9	1,180.9	5	8.50	-44		0	165.82	0	0	0	0.01318688
3/23/2016	1,267.5	87.1	1,268.0	5	8.50	-44	0.3	2.034601	165.82	17.2841409	1505.44867	0.00331895	0.01650583
3/24/2016	1,270.6	3.1	1,271.1	5	8.50	-45		0	165.82	0	0	0	0.01650583
4/7/2016	1,311.3	40.7	1,311.8	16	27.18	-31	0.8	5.425603	165.82	147.491336	6002.89736	0.01323413	0.02973997
4/20/2016	1,469.3	158.0	1,469.8	21	35.68	-45	6.0	40.42074	165.82	1442.18872	227865.817	0.50235854	0.53209851
5/18/2016	1,764.9	295.6	1,765.3	5	8.50	-48	0.1	0.6782	165.82	5.76138029	1703.06402	0.00375462	0.53585313
6/24/2016	2,207.5	442.6	2,208.0	19	32.28	-43	0.0	0	165.82	0	0	0	0.53585313
7/21/2016	2,528.1	320.6	2,528.6	18	30.58	-48	4.7	31.87542	165.82	974.825546	312529.07	0.68900922	1.22486235
7/22/2016	2,538.8	10.7	2,539.3	26	44.17	-65	3.1	21.02421	165.82	928.734503	9937.45919	0.02190837	1.24677071
8/17/2016	2,852.2	313.4	2,852.7	21	35.68	-55	0.2	1.356401	165.82	48.3955945	15167.1793	0.03343793	1.28020865
8/18/2016	2,876.1	23.9	2,876.6	5	8.50	-51		0	165.82	0	0	0	1.28020865
8/26/2016	3,067.7	191.6	3,068.2	16	27.18	-39		0	165.82	0	0	0	1.28020865
9/8/2016	3,087.9	20.2	3,088.4	19	32.28	-46		0	165.82	0	0	0	1.28020865
10/4/2016	3,394.2	306.3	3,394.7	21	35.68	-48	1.1	7.460204	165.82	266.17577	81529.6382	0.17974223	1.45995088
10/5/2016	3,403.1	8.9	3,403.6	19	32.28	-47	1.1	7.460204	165.82	240.825696	2143.3487	0.00472528	1.46467616
10/25/2016	3,639.0	235.9	3,639.5	18	30.58	-45	0.4	2.712802	165.82	82.9638762	19571.1784	0.0431471	1.50782326
11/22/2016	3,971.6	332.6	3,972.1	21	35.68	-43	1.2	8.138405	165.82	290.373567	96578.2483	0.21291876	1.72074202
12/15/2016	4,233.7	262.1	4,234.2	5	8.50	-46	0.2	1.356401	165.82	11.5227606	3020.11555	0.00665822	1.72740024
12/29/2016	4,569.2	335.5	4,569.7	5	8.50	-49	0.6	4.069202	165.82	34.5682818	11597.6585	0.02556848	1.75296872
1/27/2017	4,918.3	349.1	4,918.8	5	8.50	-47	0.1	0.6782	165.82	5.76138029	2011.29786	0.00443416	1.75740288
2/16/2017	5,156.7	238.4	5,157.2	5	8.50	-46	0.2	1.356401	165.82	11.5227606	2747.02612	0.00605616	1.76345904
3/16/2017	5,514.6	357.9	5,515.1	26	44.17	-43	0.8	5.195015	165.82	229.4873	82133.5046	0.18107353	1.94453257
3/20/2017	5,568.3	53.7	5,568.8	24	40.78	-47	0.2	1.275017	165.82	51.9906958	2791.90036	0.00615509	1.95068766
4/6/2017	5,764.7	196.4	5,765.2	23	39.08	-50	1.3	9.006501	165.82	351.951199	69123.2156	0.15239073	2.10307839

lbs => pounds removed per time interval

lbs cum => cumulative pounds removed

PCE => Tetrachloroethene

Not Measured

**TABLE 5b. CONTAMINANT MASS REMOVED SVE02  
ROXY'S INTERIM REMEDIAL ACTION  
HAVRE, MT**

Date	SVE System (hours)	Run Time (hours)	Heat Exchange System (hours)	SVE02 Flow		SVE02 Vacuum (in H2O)	SVE02 PID		PCE Molecular Weight Used (g/mol)	Mass Removed			
				(cfm)	(m3/hr)		(ppm)	(mg/m3)		(mg/hour)	(mg/period)	(lbs/period)	(lbs cum)
1/20/2016													
1/22/2016	53.8	53.8	54.2	5	8.50	-38		0	165.82	0	0	0	
1/23/2016	79.5	25.7	80.0	22	37.38	-49		0	165.82	0	0	0	0
1/24/2016	93.6	14.1	94.1	21	35.68	-49		0	165.82	0	0	0	0
1/25/2016	115.9	22.3	116.3	37	62.86	-44		0	165.82	0	0	0	0
1/25/2016	125.4	9.5	125.8	5	8.50	-50		0	165.82	0	0	0	0
1/26/2016	140.0	14.6	140.4	5	8.50	-47		0	165.82	0	0	0	0
1/26/2016	149.1	9.1	149.6	5	8.50	-50		0	165.82	0	0	0	0
1/28/2016	173.0	23.9	173.5	5	8.50	-53		0	165.82	0	0	0	0
2/10/2016	489.0	316.0	489.5	36	61.16	-43	0.0	0	165.82	0	0	0	0
2/11/2016	506.9	17.9	507.4	45	76.46	-43	4.5	30.51902	165.82	2333.359	41767.13	0.092081	0.092081
3/4/2016	1,040.5	533.6	1,041.0	16	27.18	-42		0	165.82	0	0	0	0.092081
3/16/2016	1,180.4	139.9	1,180.9	5	8.50	-47		0	165.82	0	0	0	0.092081
3/23/2016	1,267.5	87.1	1,268.0	14	23.79	-49	0.1	0.6782	165.82	16.13186	1405.085	0.003098	0.095179
3/24/2016	1,270.6	3.1	1,271.1	5	8.50	-43		0	165.82	0	0	0	0.095179
4/7/2016	1,311.3	40.7	1,311.8	15	25.49	-29	0.8	5.425603	165.82	138.2731	5627.716	0.012407	0.107586
4/20/2016	1,469.3	158.0	1,469.8	5	8.50	-42	4.6	31.26504	165.82	265.5996	41964.74	0.092516	0.200102
5/18/2016	1,764.9	295.6	1,765.3	5	8.50	-52	0.9	6.103804	165.82	51.85242	15327.58	0.033792	0.233894
6/24/2016	2,207.5	442.6	2,208.0	5	8.50	-50	0.0	0	165.82	0	0	0	0.233894
7/21/2016	2528.1	320.6	2528.6	5	8.50	-50	1.4	9.494806	165.82	80.65932	25859.38	0.05701	0.290904
7/22/2016	2538.8	10.7	2539.3	13	22.09	-63	0	0	165.82	0	0	0	0.290904
8/17/2016	2852.2	313.4	2852.7	5	8.50	-54	0	0	165.82	0	0	0	0.290904
8/18/2016	2876.1	23.9	2876.6	5	8.50	-54		0	165.82	0	0	0	0.290904
8/26/2016	3067.7	191.6	3068.2	5	8.50	-43		0	165.82	0	0	0	0.290904
9/8/2016	3087.9	20.2	3088.4	5	8.50	-49		0	165.82	0	0	0	0.290904
10/4/2016	3394.2	306.3	3394.7	5	8.50	-49	0.3	2.034601	165.82	17.28414	5294.132	0.011672	0.302575
10/5/2016	3403.1	8.9	3403.6	5	8.50	-50	0.3	2.034601	165.82	17.28414	153.8289	0.000339	0.302914
10/25/2016	3639	235.9	3639.5	5	8.50	-51	0.5	3.391002	165.82	28.8069	6795.548	0.014982	0.317896
11/22/2016	3971.6	332.6	3972.1	5	8.50	-47	0.7	4.747403	165.82	40.32966	13413.65	0.029572	0.347468
12/15/2016	4233.7	262.1	4234.2	5	8.50	-45	0.1	0.6782	165.82	5.76138	1510.058	0.003329	0.350797
12/29/2016	4569.2	597.6	4569.7	5	8.50	-49	1.9	12.88581	165.82	109.4662	65417.02	0.14422	0.495017
1/27/2017	4918.3	349.1	4918.8	5	8.50	-49	1.1	7.460204	165.82	63.37518	22124.28	0.048776	0.543793
2/16/2017	5156.7	238.4	5157.2	5	8.50	-48	2.6	17.63321	165.82	149.7959	35711.34	0.07873	0.622523
3/16/2017	5514.6	357.9	5515.1	5	8.50	-46	1.428	9.684702	165.82	82.27251	29445.33	0.064916	0.687439
3/20/2017	5568.3	53.7	5568.8	5	8.50	-48	1.143	7.751831	165.82	65.85258	3536.283	0.007796	0.695235
4/6/2017	5764.7	196.4	5765.2	19	32.28	-53	1.674	11.35307	165.82	366.4929	71979.21	0.158687	0.853922

lbs => pounds removed per time interval

lbs cum => cumulative pounds removed

PCE => Tetrachloroethene

Not Measured

**TABLE 5c. CONTAMINANT MASS REMOVED SVE03  
ROXY'S INTERIM REMEDIAL ACTION  
HAVRE, MT**

Date	SVE System	Run Time	Heat Exchange r System	SVE03 Flow		SVE03 Vacuum	SVE03 PID		PCE Molecular Weight Used	Mass Removed			
				(cfm)	(m3/hr)		(in H2O)	(ppm)		(mg/m3)	(g/mol)	(mg/hour)	mg/period
1/20/2016													
1/22/2016	53.8	53.8	54.2	5	8.50	-50		0	165.82	0	0	0	
1/23/2016	79.5	25.7	80.0	34	57.77	-53		0	165.82	0	0	0	0
1/24/2016	93.6	14.1	94.1	34	57.77	-53		0	165.82	0	0	0	0
1/25/2016	115.9	22.3	116.3	5	8.50	-52		0	165.82	0	0	0	0
1/25/2016	125.4	9.5	125.8	5	8.50	-32		0	165.82	0	0	0	0
1/26/2016	140.0	14.6	140.4	5	8.50	-41		0	165.82	0	0	0	0
1/26/2016	149.1	9.1	149.6	12	20.39	-55		0	165.82	0	0	0	0
1/28/2016	173.0	23.9	173.5	11	18.69	-56		0	165.82	0	0	0	0
2/10/2016	489.0	316.0	489.5	12	20.39	-50	0.0	0	165.82	0	0	0	0
2/11/2016	506.9	17.9	507.4	5	8.50	-49	2.7	18.31141	165.82	155.5573	2784.475	0.006139	0.006139
3/4/2016	1,040.5	533.6	1,041.0	5	8.50	-37		0	165.82	0	0	0	0.006139
3/16/2016	1,180.4	139.9	1,180.9	5	8.50	-53		0	165.82	0	0	0	0.006139
3/23/2016	1,267.5	87.1	1,268.0	5	8.50	-57	0.2	1.356401	165.82	11.52276	1003.632	0.002213	0.008351
3/24/2016	1,270.6	3.1	1,271.1	5	8.50	-50		0	165.82	0	0	0	0.008351
4/7/2016	1,311.3	40.7	1,311.8	5	8.50	-36	0.3	2.034601	165.82	17.28414	703.4645	0.001551	0.009902
4/20/2016	1,469.3	158.0	1,469.8	5	8.50	-50	6.0	40.69202	165.82	345.6828	54617.89	0.120412	0.130314
5/18/2016	1,764.9	295.6	1,765.3	14	23.79	-53	3.0	20.34601	165.82	483.9559	143057.4	0.315388	0.445702
6/24/2016	2,207.5	442.6	2,208.0	5	8.50	-50	0.0	0	165.82	0	0	0	0.445702
7/21/2016	2,528.1	320.6	2,528.6	5	8.50	-51	2.4	16.27681	165.82	138.2731	44330.36	0.097732	0.543434
7/22/2016	2,538.8	10.7	2,539.3	24	40.78	-55	1.3	8.816605	165.82	359.5101	3846.758	0.008481	0.551914
8/17/2016	2,852.2	313.4	2,852.7	15	25.49	-61	0.0	0	165.82	0	0	0	0.551914
8/18/2016	2,876.1	23.9	2,876.6	27	45.87	-56		0	165.82	0	0	0	0.551914
8/26/2016	3,067.7	191.6	3,068.2	5	8.50	-42		0	165.82	0	0	0	0.551914
9/8/2016	3,087.9	20.2	3,088.4	5	8.50	-51		0	165.82	0	0	0	0.551914
10/4/2016	3,394.2	306.3	3,394.7	5	8.50	-53	0.4	2.712802	165.82	23.04552	7058.843	0.015562	0.567477
10/5/2016	3,403.1	8.9	3,403.6	5	8.50	-52	0.7	4.747403	165.82	40.32966	358.934	0.000791	0.568268
10/25/2016	3,639.0	235.9	3,639.5	5	8.50	-53	0.4	2.712802	165.82	23.04552	5436.438	0.011985	0.580253
11/22/2016	3,971.6	568.5	3,972.1	5	8.50	-49	0.1	0.6782	165.82	5.76138	3275.345	0.007221	0.587474
12/15/2016	4,233.7	262.1	4,234.2	5	8.50	-46	0.1	0.6782	165.82	5.76138	1510.058	0.003329	0.590803
12/29/2016	4,569.2	335.5	4,569.7	5	8.50	-50	1.5	10.17301	165.82	86.4207	28994.15	0.063921	0.654724
1/27/2017	4,918.3	349.1	4,918.8	5	8.50	-49	0.3	2.034601	165.82	17.28414	6033.894	0.013302	0.668027
2/16/2017	5,156.7	238.4	5,157.2	5	8.50	-48	1.0	6.782004	165.82	57.6138	13735.13	0.030281	0.698308
3/16/2017	5,514.6	357.9	5,515.1	5	8.50	-48	0.7	4.632109	165.82	39.35023	14083.45	0.031049	0.729356
3/20/2017	5,568.3	53.7	5,568.8	5	8.50	-51	0.2	1.559861	165.82	13.25117	711.5881	0.001569	0.730925
4/6/2017	5,764.7	196.4	5,765.2	5	8.50	-56	0.7	4.435431	165.82	37.67943	7400.239	0.016315	0.74724

lbs => pounds removed per time interval

lbs cum => cumulative pounds removed

PCE => Tetrachloroethene

Not Measured

**TABLE 5d. CONTAMINANT MASS REMOVED SVE04  
ROXY'S INTERIM REMEDIAL ACTION  
HAVRE, MT**

Date	SVE System (hours)	Run Time (hours)	Heat Exchange r System (hours)	SVE04 Flow		SVE04 Vacuum (in H2O)	SVE04 PID		PCE Molecular Weight Used (g/mol)	Mass Removed			
				(cfm)	(m3/hr)		(ppm)	(mg/m3)		(mg/hour)	(mg/period)	lbs/period	(lbs cum)
1/20/2016													
1/22/2016	53.8	53.8	54.2	27	45.87	-47		0	165.82	0	0	0	
1/23/2016	79.5	25.7	80.0	25	42.48	-50		0	165.82	0	0	0	0
1/24/2016	93.6	14.1	94.1	23	39.08	-50		0	165.82	0	0	0	0
1/25/2016	115.9	22.3	116.3	15	25.49	-48		0	165.82	0	0	0	0
1/25/2016	125.4	9.5	125.8	18	30.58	-50		0	165.82	0	0	0	0
1/26/2016	140.0	14.6	140.4	15	25.49	-50		0	165.82	0	0	0	0
1/26/2016	149.1	9.1	149.6	14	23.79	-51		0	165.82	0	0	0	0
1/28/2016	173.0	23.9	173.5	14	23.79	-53		0	165.82	0	0	0	0
2/10/2016	489.0	316.0	489.5	5	8.50	-50	0.0	0	165.82	0	0	0	0
2/11/2016	506.9	17.9	507.4	5	8.50	-49	10.0	67.82004	165.82	576.1380294	10312.87073	0.022736007	0.022736007
3/4/2016	1,040.5	533.6	1,041.0	28	47.57	-42		0	165.82	0	0	0	0.022736007
3/16/2016	1,180.4	139.9	1,180.9	21	35.68	-46		0	165.82	0	0	0	0.022736007
3/23/2016	1,267.5	87.1	1,268.0	13	22.09	-48	0.1	0.6782	165.82	14.97958877	1304.722181	0.002876422	0.025612429
3/24/2016	1,270.6	3.1	1,271.1	23	39.08	-46		0	165.82	0	0	0	0.025612429
4/7/2016	1,311.3	40.7	1,311.8	21	35.68	-37	0.4	2.712802	165.82	96.79118895	3939.40139	0.008684901	0.03429733
4/20/2016	1,469.3	158.0	1,469.8	18	30.58	-46	5.9	40.08164	165.82	1225.791271	193675.0209	0.426980681	0.46127801
5/18/2016	1,764.9	295.6	1,765.3	14	23.79	-51	3.6	24.41521	165.82	580.7471337	171668.8527	0.378465345	0.839743355
6/24/2016	2,207.5	442.6	2,208.0	5	8.50	-48	1.1	7.460204	165.82	63.37518324	28049.8561	0.061839398	0.901582753
7/21/2016	2,528.1	320.6	2,528.6	5	8.50	-50	0.3	2.034601	165.82	17.28414088	5541.295567	0.012216476	0.913799228
7/22/2016	2,538.8	10.7	2,539.3	0	0.00	-63	2.1	14.24221	165.82	0	0	0	0.913799228
8/17/2016	2,852.2	313.4	2,852.7	5	8.50	-56	0.3	2.034601	165.82	17.28414088	5416.849753	0.011942119	0.925741348
8/18/2016	2,876.1	23.9	2,876.6	5	8.50	-53		0	165.82	0	0	0	0.925741348
8/26/2016	3,067.7	191.6	3,068.2	5	8.50	-42		0	165.82	0	0	0	0.925741348
9/8/2016	3,087.9	20.2	3,088.4	14	23.79	-48		0	165.82	0	0	0	0.925741348
10/4/2016	3,394.2	306.3	3,394.7	5	8.50	-50	1.2	8.138405	165.82	69.13656353	21176.52941	0.046686294	0.972427641
10/5/2016	3,403.1	8.9	3,403.6	5	8.50	-49	1.6	10.85121	165.82	92.18208471	820.4205539	0.001808719	0.974236361
10/25/2016	3,639.0	235.9	3,639.5	14	23.79	-46	1.8	12.20761	165.82	290.3735668	68499.12442	0.151014842	1.125251203
11/22/2016	3,971.6	332.6	3,972.1	12	20.39	-47	0.3	2.034601	165.82	41.48193812	13796.89262	0.030416966	1.155668169
12/15/2016	4,233.7	262.1	4,234.2	5	8.50	-47	0.1	0.6782	165.82	5.761380294	1510.057775	0.00332911	1.15899728
12/29/2016	4,569.2	335.5	4,569.7	5	8.50	-47	9.5	64.42904	165.82	547.331128	183629.5934	0.404834286	1.563831566
1/27/2017	4,918.3	349.1	4,918.8	5	8.50	-48	2.1	14.24221	165.82	120.9889862	42237.25508	0.093117284	1.65694885
2/16/2017	5,156.7	238.4	5,157.2	18	30.58	-46	8.9	60.35984	165.82	1845.946246	440073.5851	0.970196972	2.627145822
3/16/2017	5,514.6	357.9	5,515.1	20	33.98	-45	6.5	43.74393	165.82	1486.436116	531995.4859	1.17285024	3.799996062
3/20/2017	5,568.3	53.7	5,568.8	21	35.68	-50	1.7	11.59723	165.82	413.7823327	22220.11127	0.048987	3.848983062
4/6/2017	5,764.7	196.4	5,765.2	22	37.38	-53	2.0	13.50297	165.82	504.7199593	99127.00001	0.218537805	4.067520867

lbs => pounds removed per time interval

lbs cum => cumulative pounds removed

PCE => Tetrachloroethene

Not Measured

**TABLE 5e. CONTAMINANT MASS REMOVED SVE05  
ROXY'S INTERIM REMEDIAL ACTION  
HAVRE, MT**

Date	SVE System (hours)	Run Time (hours)	Heat Exchanger System (hours)	SVE05 Flow		SVE05 Vacuum (in H2O)	SVE05 PID		PCE Molecular Weight Used (g/mol)	Mass Removed			
				(cfm)	(m3/hr)		(ppm)	(mg/m3)		(mg/hour)	(mg/period)	lbs/period	(lbs cum)
1/20/2016													
1/22/2016	53.8	53.8	54.2	15	25.49	-50		0	165.82	0	0	0	
1/23/2016	79.5	25.7	80.0	20	33.98	-42		0	165.82	0	0	0	0
1/24/2016	93.6	14.1	94.1	21	35.68	-42		0	165.82	0	0	0	0
1/25/2016	115.9	22.3	116.3	25	42.48	-52		0	165.82	0	0	0	0
1/25/2016	125.4	9.5	125.8	15	25.49	-53		0	165.82	0	0	0	0
1/26/2016	140.0	14.6	140.4	20	33.98	-53		0	165.82	0	0	0	0
1/26/2016	149.1	9.1	149.6	21	35.68	-55		0	165.82	0	0	0	0
1/28/2016	173.0	23.9	173.5	24	40.78	-56		0	165.82	0	0	0	0
2/10/2016	489.0	316.0	489.5	24	40.78	-50	0.0	0	165.82	0	0	0	0
2/11/2016	506.9	17.9	507.4	46	78.15	-49	6.4	43.40483	165.82	3392.300717	60722.18284	0.13387	0.13387
3/4/2016	1,040.5	533.6	1,041.0	5	8.50	-47		0	165.82	0	0	0	0.13387
3/16/2016	1,180.4	139.9	1,180.9	14	23.79	-52		0	165.82	0	0	0	0.13387
3/23/2016	1,267.5	87.1	1,268.0	12	20.39	-53	0.9	6.103804	165.82	124.4458144	10839.23043	0.023896	0.157766
3/24/2016	1,270.6	3.1	1,271.1	60	101.94	-43		0	165.82	0	0	0	0.157766
4/7/2016	1,311.3	40.7	1,311.8	30	50.97	-31	0.3	2.034601	165.82	103.7048453	4220.787204	0.009305	0.167071
4/20/2016	1,469.3	158.0	1,469.8	22	37.38	-49	1.9	12.75017	165.82	476.581378	75299.85772	0.166008	0.333079
5/18/2016	1,764.9	295.6	1,765.3	22	37.38	-50	2.0	13.56401	165.82	507.0014659	149869.6333	0.330406	0.663485
6/24/2016	2,207.5	442.6	2,208.0	14	23.79	-47	0.4	2.712802	165.82	64.5274593	28559.85349	0.062964	0.726449
7/21/2016	2,528.1	320.6	2,528.6	5	8.50	-49	0.0	0	165.82	0	0	0	0.726449
7/22/2016	2,538.8	10.7	2,539.3	25	42.48	-65	0.5	3.391002	165.82	144.0345074	1541.169229	0.003398	0.729847
8/17/2016	2,852.2	313.4	2,852.7	20	33.98	-57	0.1	0.6782	165.82	23.04552118	7222.466337	0.015923	0.74577
8/18/2016	2,876.1	23.9	2,876.6	17	28.88	-52		0	165.82	0	0	0	0.74577
8/26/2016	3,067.7	191.6	3,068.2	19	32.28	-41		0	165.82	0	0	0	0.74577
9/8/2016	3,087.9	20.2	3,088.4	21	35.68	-47		0	165.82	0	0	0	0.74577
10/4/2016	3,394.2	306.3	3,394.7	17	28.88	-49	0.3	2.034601	165.82	58.766079	18000.05	0.039683	0.785453
10/5/2016	3,403.1	8.9	3,403.6	27	45.87	-48	1.4	9.494806	165.82	435.5603503	3876.487117	0.008546	0.793999
10/25/2016	3,639.0	235.9	3,639.5	22	37.38	-47	0.5	3.391002	165.82	126.7503665	29900.41145	0.065919	0.859918
11/22/2016	3,971.6	332.6	3,972.1	24	40.78	-46	0.5	3.391002	165.82	138.2731271	45989.64206	0.10139	0.961308
12/15/2016	4,233.7	262.1	4,234.2	5	8.50	-47	0.1	0.6782	165.82	5.761380294	1510.057775	0.003329	0.964637
12/29/2016	4,569.2	335.5	4,569.7	18	30.58	-47	1.1	7.460204	165.82	228.1506597	76544.54632	0.168752	1.133389
1/27/2017	4,918.3	349.1	4,918.8	17	28.88	-48	0.6	4.069202	165.82	117.532158	41030.47636	0.090457	1.223846
2/16/2017	5,156.7	238.4	5,157.2	18	30.58	-46	2.1	14.24221	165.82	435.5603503	103837.5875	0.228923	1.452769
3/16/2017	5,514.6	357.9	5,515.1	26	44.17	-45	1.5	10.2137	165.82	451.1852136	161479.188	0.356001	1.80877
3/20/2017	5,568.3	53.7	5,568.8	22	37.38	-49.8	1.0	7.053284	165.82	263.6407623	14157.50893	0.031212	1.839982
4/6/2017	5,764.7	196.4	5,765.2	27	45.87	-53	0.9	6.381866	165.82	292.7587783	57497.82405	0.126761	1.966743

lbs => pounds removed per time interval

lbs cum => cumulative pounds removed

PCE => Tetrachloroethene

Not Measured

**TABLE 5f. CONTAMINANT MASS REMOVED SVE06  
ROXY'S INTERIM REMEDIAL ACTION  
HAVRE, MT**

Date	SVE System	Run Time	Heat Exchanger System	SVE06 Flow		SVE06 Vacuum	SVE06 PID		PCE Molecular Weight Used	Mass Removed				
				(cfm)	(m3/hr)		(in H2O)	(ppm)		(mg/m3)	(g/mol)	(mg/hour)	(mg/period)	lb/period
1/20/2016														
1/22/2016	53.8	53.8	54.2	22	37.38	-50		0	165.82	0	0	0		
1/23/2016	79.5	25.7	80.0	52	88.35	-32		0	165.82	0	0	0	0	0
1/24/2016	93.6	14.1	94.1	52	88.35	-32		0	165.82	0	0	0	0	0
1/25/2016	115.9	22.3	116.3	24	40.78	-52		0	165.82	0	0	0	0	0
1/25/2016	125.4	9.5	125.8	25	42.48	-54		0	165.82	0	0	0	0	0
1/26/2016	140.0	14.6	140.4	22	37.38	-53		0	165.82	0	0	0	0	0
1/26/2016	149.1	9.1	149.6	20	33.98	-55		0	165.82	0	0	0	0	0
1/28/2016	173.0	23.9	173.5	15	25.49	-56		0	165.82	0	0	0	0	0
2/10/2016	489.0	316.0	489.5	33	56.07	-50	0.0	0	165.82	0	0	0	0	0
2/11/2016	506.9	17.9	507.4	16	27.18	-49	0.9	6.103804	165.82	165.927752	2970.10677	0.00654797	0.00654797	
3/4/2016	1,040.5	533.6	1,041.0	18	30.58	-44		0	165.82	0	0	0	0.00654797	
3/16/2016	1,180.4	139.9	1,180.9	26	44.17	-51		0	165.82	0	0	0	0.00654797	
3/23/2016	1,267.5	87.1	1,268.0	14	23.79	-53	1.1	7.460204	165.82	177.450513	15455.9397	0.03407454	0.04062251	
3/24/2016	1,270.6	3.1	1,271.1	24	40.78	-46	0.0	0	165.82	0	0	0	0.04062251	
4/7/2016	1,311.3	40.7	1,311.8	25	42.48	-32	0.1	0.6782	165.82	28.8069015	1172.44089	0.00258479	0.0432073	
4/20/2016	1,469.3	158.0	1,469.8	12	20.39	-50	1.1	7.460204	165.82	152.10044	24031.8695	0.05298125	0.09618855	
5/18/2016	1,764.9	295.6	1,765.3	14	23.79	-50	3.2	21.70241	165.82	516.219674	152594.536	0.33641364	0.43260219	
6/24/2016	2,207.5	442.6	2,208.0	18	30.58	-48	0.7	4.747403	165.82	145.186783	64259.6703	0.14166844	0.57427063	
7/21/2016	2,528.1	320.6	2,528.6	5	8.50	-49	0.0	0	165.82	0	0	0	0.57427063	
7/22/2016	2,538.8	10.7	2,539.3	5	8.50	-63	1.9	12.88581	165.82	109.466226	1171.28861	0.00258225	0.57685288	
8/17/2016	2,852.2	313.4	2,852.7	5	8.50	-59	0.3	2.034601	165.82	17.2841409	5416.84975	0.01194212	0.588795	
8/18/2016	2,876.1	23.9	2,876.6	14	23.79	-52		0	165.82	0	0	0	0.588795	
8/26/2016	3,067.7	191.6	3,068.2	5	8.50	-43		0	165.82	0	0	0	0.588795	
9/8/2016	3,087.9	20.2	3,088.4	11	18.69	-47		0	165.82	0	0	0	0.588795	
10/4/2016	3,394.2	306.3	3,394.7	15	25.49	-49	1.2	8.138405	165.82	207.409691	63529.5882	0.14005888	0.72885388	
10/5/2016	3,403.1	8.9	3,403.6	14	23.79	-49	1.8	12.20761	165.82	290.373567	2584.32474	0.00569747	0.73455135	
10/25/2016	3,639.0	235.9	3,639.5	14	23.79	-50	1.1	7.460204	165.82	177.450513	41860.576	0.09228685	0.82683819	
11/22/2016	3,971.6	332.6	3,972.1	13	22.09	-45	0.3	2.034601	165.82	44.9387663	14946.6337	0.03295171	0.85978991	
12/15/2016	4,233.7	262.1	4,234.2	5	8.50	-46	0.5	3.391002	165.82	28.8069015	7550.28888	0.01664555	0.87643546	
12/29/2016	4,569.2	335.5	4,569.7	14	23.79	-47	1.8	12.20761	165.82	290.373567	97420.3317	0.21477524	1.0912107	
1/27/2017	4,918.3	349.1	4,918.8	14	23.79	-47	1.0	6.782004	165.82	161.318648	56316.3401	0.12415638	1.21536708	
2/16/2017	5,156.7	238.4	5,157.2	14	23.79	-45	5.5	37.30102	165.82	887.252565	211521.012	0.46632439	1.68169147	
3/16/2017	5,514.6	357.9	5,515.1	24	40.78	-45	1.6	11.06145	165.82	451.04694	161429.7	0.35589186	2.03758333	
3/20/2017	5,568.3	53.7	5,568.8	18	30.58	-50	0.6	4.367611	165.82	133.571841	7172.80785	0.01581335	2.05339667	
4/6/2017	5,764.7	196.4	5,765.2	25	42.48	-53	1.6	11.16318	165.82	474.161598	93125.3379	0.20530639	2.25870307	

lbs => pounds removed per time interval

lbs cum => cumulative pounds removed

PCE => Tetrachloroethene

Not Measured

**TABLE 5g. CONTAMINANT MASS REMOVED - ALL WELLS COMBINED  
ROXY'S INTERIM REMEDIAL ACTION  
HAVRE, MT**

Date	SVE System (hours)	Heat Exchanger System (hours)	SVE01		SVE02		SVE03		SVE04		SVE05		SVE06		SUM (lbs cum)
			lbs	(lbs cum)											
1/20/2016															
1/22/2016	53.8	54.2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00
1/23/2016	79.5	80.0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00
1/24/2016	93.6	94.1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00
1/25/2016	115.9	116.3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00
1/25/2016	125.4	125.8	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00
1/26/2016	140.0	140.4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00
1/26/2016	149.1	149.6	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00
1/28/2016	173.0	173.5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00
2/10/2016	489.0	489.5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00
2/11/2016	506.9	507.4	0.0007	0.0132	0.0051	0.0921	0.0003	0.0061	0.0013	0.0227	0.0075	0.1339	0.0004	0.0065	0.27
3/4/2016	1,040.5	1,041.0	0.0000	0.0132	0.0000	0.0921	0.0000	0.0061	0.0000	0.0227	0.0000	0.1339	0.0000	0.0065	0.27
3/16/2016	1,180.4	1,180.9	0.0000	0.0132	0.0000	0.0921	0.0000	0.0061	0.0000	0.0227	0.0000	0.1339	0.0000	0.0065	0.27
3/23/2016	1,267.5	1,268.0	0.0000	0.0165	0.0000	0.0952	0.0000	0.0084	0.0000	0.0256	0.0003	0.1578	0.0004	0.0406	0.34
3/24/2016	1,270.6	1,271.1	0.0000	0.0165	0.0000	0.0952	0.0000	0.0084	0.0000	0.0256	0.0000	0.1578	0.0000	0.0406	0.34
4/7/2016	1,311.3	1,311.8	0.0003	0.0297	0.0003	0.1076	0.0000	0.0099	0.0002	0.0343	0.0002	0.1671	0.0001	0.0432	0.39
4/20/2016	1,469.3	1,469.8	0.0032	0.5321	0.0006	0.2001	0.0008	0.1303	0.0027	0.4613	0.0011	0.3331	0.0003	0.0962	1.75
5/18/2016	1,764.9	1,765.3	0.0000	0.5359	0.0001	0.2339	0.0011	0.4457	0.0013	0.8397	0.0011	0.6635	0.0011	0.4326	3.15
6/24/2016	2,207.5	2,208.0	0.0000	0.5359	0.0000	0.2339	0.0000	0.4457	0.0001	0.9016	0.0001	0.7264	0.0003	0.5743	3.42
7/21/2016	2,528.1	2,528.6	0.0021	1.2249	0.0002	0.2909	0.0003	0.5434	0.0000	0.9138	0.0000	0.7264	0.0000	0.5743	4.27
7/22/2016	2,538.8	2,539.3	0.0020	1.2468	0.0000	0.2909	0.0008	0.5519	0.0000	0.9138	0.0003	0.7298	0.0002	0.5769	4.31
8/17/2016	2,852.2	2,852.7	0.0001	1.2802	0.0000	0.2909	0.0000	0.5519	0.0000	0.9257	0.0001	0.7458	0.0000	0.5888	4.38
8/18/2016	2,876.1	2,876.6	0.0000	1.2802	0.0000	0.2909	0.0000	0.5519	0.0000	0.9257	0.0000	0.7458	0.0000	0.5888	4.38
8/26/2016	3,067.7	3,068.2	0.0000	1.2802	0.0000	0.2909	0.0000	0.5519	0.0000	0.9257	0.0000	0.7458	0.0000	0.5888	4.38
9/8/2016	3,087.9	3,088.4	0.0000	1.2802	0.0000	0.2909	0.0000	0.5519	0.0000	0.9257	0.0000	0.7458	0.0000	0.5888	4.38
10/4/2016	3,394.2	3,394.7	0.0006	1.4600	0.0000	0.3026	0.0001	0.5675	0.0002	0.9724	0.0001	0.7855	0.0005	0.7289	4.82
10/5/2016	3,403.1	3,403.6	0.0005	1.4647	0.0000	0.3029	0.0001	0.5683	0.0002	0.9742	0.0010	0.7940	0.0006	0.7346	4.84
10/25/2016	3,639.0	3,639.5	0.0002	1.5078	0.0001	0.3179	0.0001	0.5803	0.0006	1.1253	0.0003	0.8599	0.0004	0.8268	5.22
11/22/2016	3,971.6	3,972.1	0.0006	1.7207	0.0001	0.3475	0.0000	0.5875	0.0001	1.1557	0.0003	0.9613	0.0001	0.8598	5.63
12/15/2016	4,233.7	4,234.2	0.0000	1.7274	0.0000	0.3508	0.0000	0.5908	0.0000	1.1590	0.0000	0.9646	0.0001	0.8764	5.67
12/29/2016	4,569.2	4,569.7	0.0001	1.7530	0.0002	0.4950	0.0002	0.6547	0.0012	1.5638	0.0005	1.1334	0.0006	1.0912	6.69
1/27/2017	4,918.3	4,918.8	0.0000	1.7574	0.0001	0.5438	0.0000	0.6680	0.0003	1.6569	0.0003	1.2238	0.0004	1.2154	7.07
2/16/2017	5,156.7	5,157.2	0.0000	1.7635	0.0003	0.6225	0.0001	0.6983	0.0041	2.6271	0.0010	1.4528	0.0020	1.6817	8.85
3/16/2017	5,514.6	5,515.1	0.0005	1.9445	0.0002	0.6874	0.0001	0.7294	0.0033	3.8000	0.0010	1.8088	0.0010	2.0376	11.01
3/20/2017	5,568.3	5,568.8	0.0001	1.9507	0.0001	0.6952	0.0000	0.7309	0.0009	3.8490	0.0006	1.8400	0.0003	2.0534	11.12
4/6/2017	5,764.7	5,765.2	0.0008	2.1031	0.0008	0.8539	0.0001	0.7472	0.0011	4.0675	0.0006	1.9667	0.0010	2.2587	12.00

lbs => pounds removed per time interval

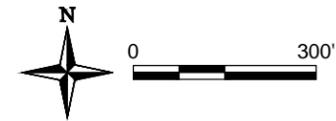
lbs cum => cumulative pounds removed

## FIGURES



Image Citation: Google Earth pro Clip, Publication: July 2015

**1 PROJECT LOCATION MAP**  
SCALE 1" = 300'



**EXPLANATION**

----- BNSF FACILITY BOUNDARY

**NOTES:**

1. ALL SITE FEATURES ARE APPROXIMATE.
2. SITE LEGAL DESCRIPTION: TOWNSHIP 32 NORTH, RANGE 16 EAST, SECTION 5

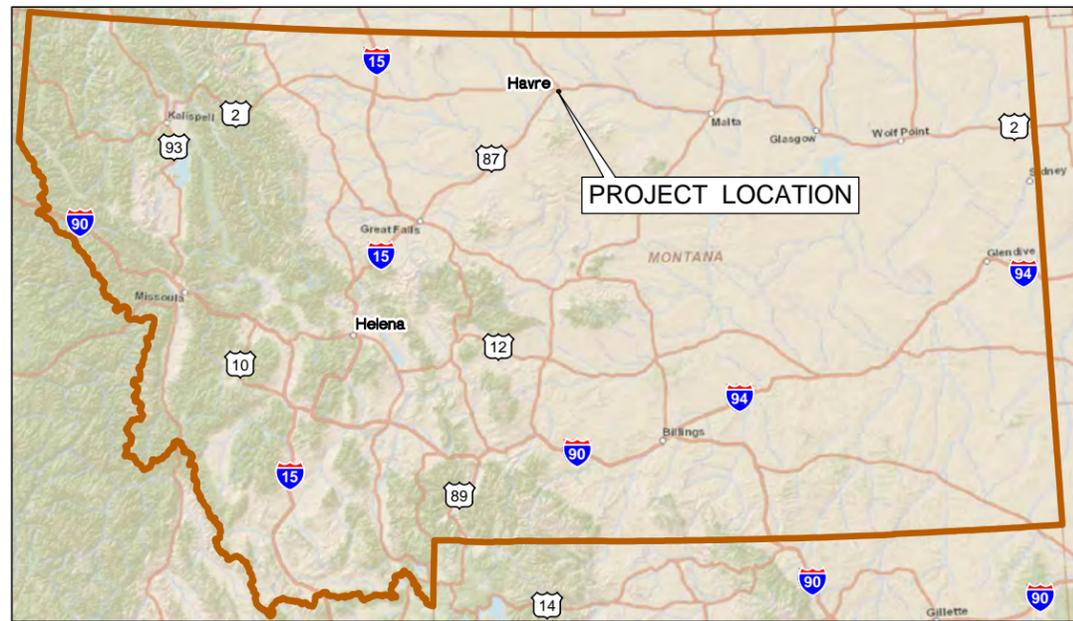
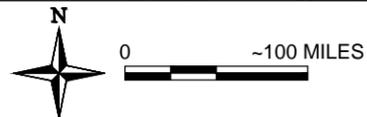


Image Citation: ESRI, Street Map USA

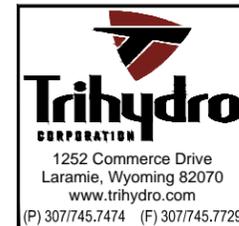
**2 MONTANA STATE MAP**  
SCALE 1" = ~100 MILES



**FIGURE 1**

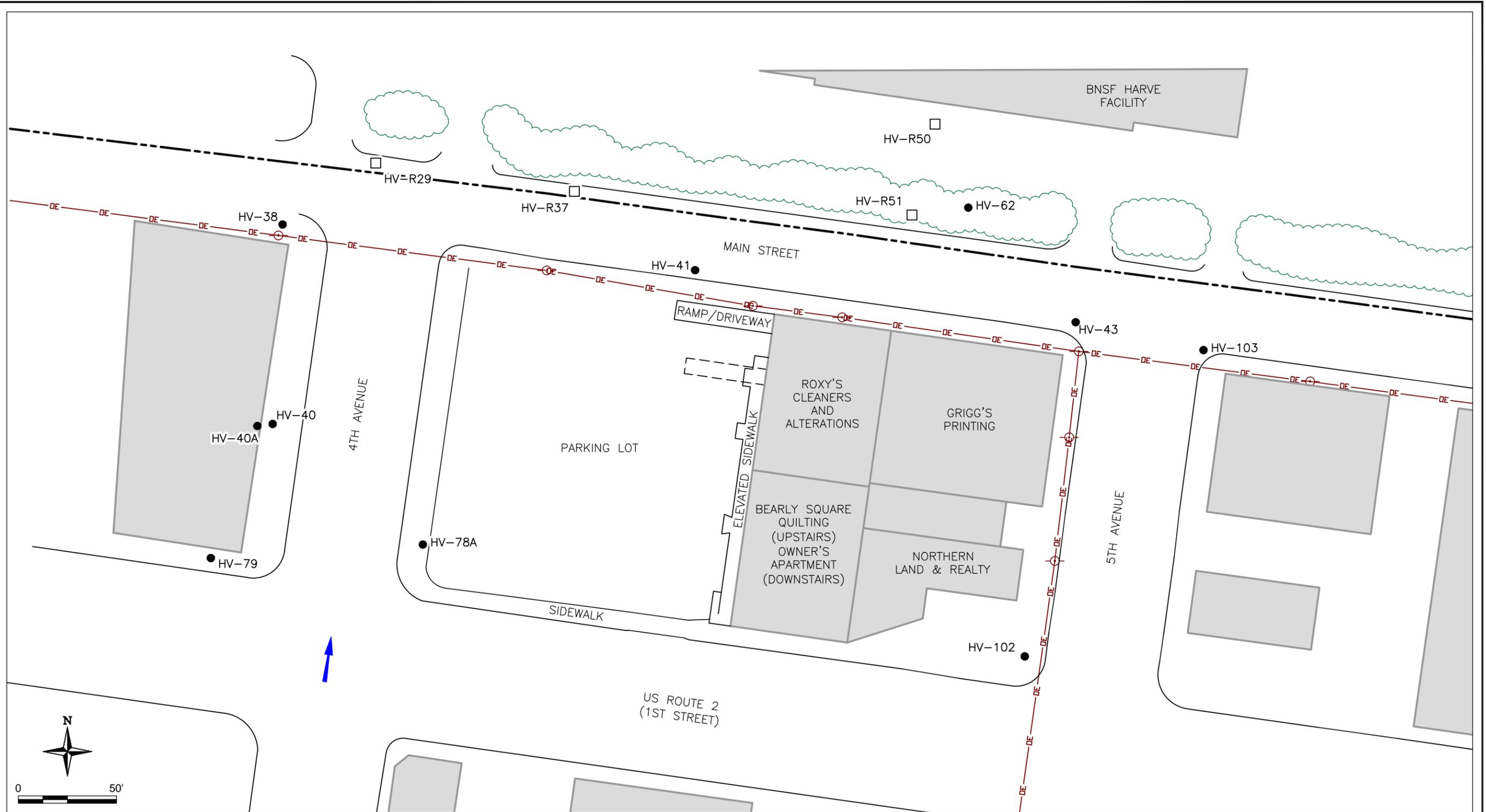
**PROJECT LOCATION**

**ROXY'S CLEANERS AND ALTERATIONS**  
417 1ST STREET  
HAVRE, MONTANA



Drawn By: REP | Checked By: JG | Scale: AS SHOWN | Date: 5/24/17 | File: 776-SITELOC201704

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**EXPLANATION**

- |          |                                 |   |                            |
|----------|---------------------------------|---|----------------------------|
| ● HV-79  | MONITORING WELL AND DESIGNATION | ← | GROUNDWATER FLOW DIRECTION |
| □ HV-R29 | RECOVERY WELL AND DESIGNATION   | ⊙ | UTILITY POLE               |
| ---      | BNSF FACILITY BOUNDARY          | ▭ | BUILDING                   |
| —DE—     | OVERHEAD ELECTRICAL LINE        | ⬭ | TREE OR LANDSCAPING AREA   |
| - - -    | FORMER TUNNEL                   |   |                            |

**NOTES:**

1. ALL UTILITIES AND SITE FEATURES ARE APPROXIMATE.
2. APPROXIMATE GROUNDWATER FLOW DIRECTION DERIVED FROM FIGURE 73B CONCEPTUAL DEPICTION OF PREFERENTIAL GROUNDWATER FLOW/SOLVENT TRANSPARENT PATHWAYS IN UPPER SATURATED ZONE (USZ), CDM SMITH, JUNE 2009.

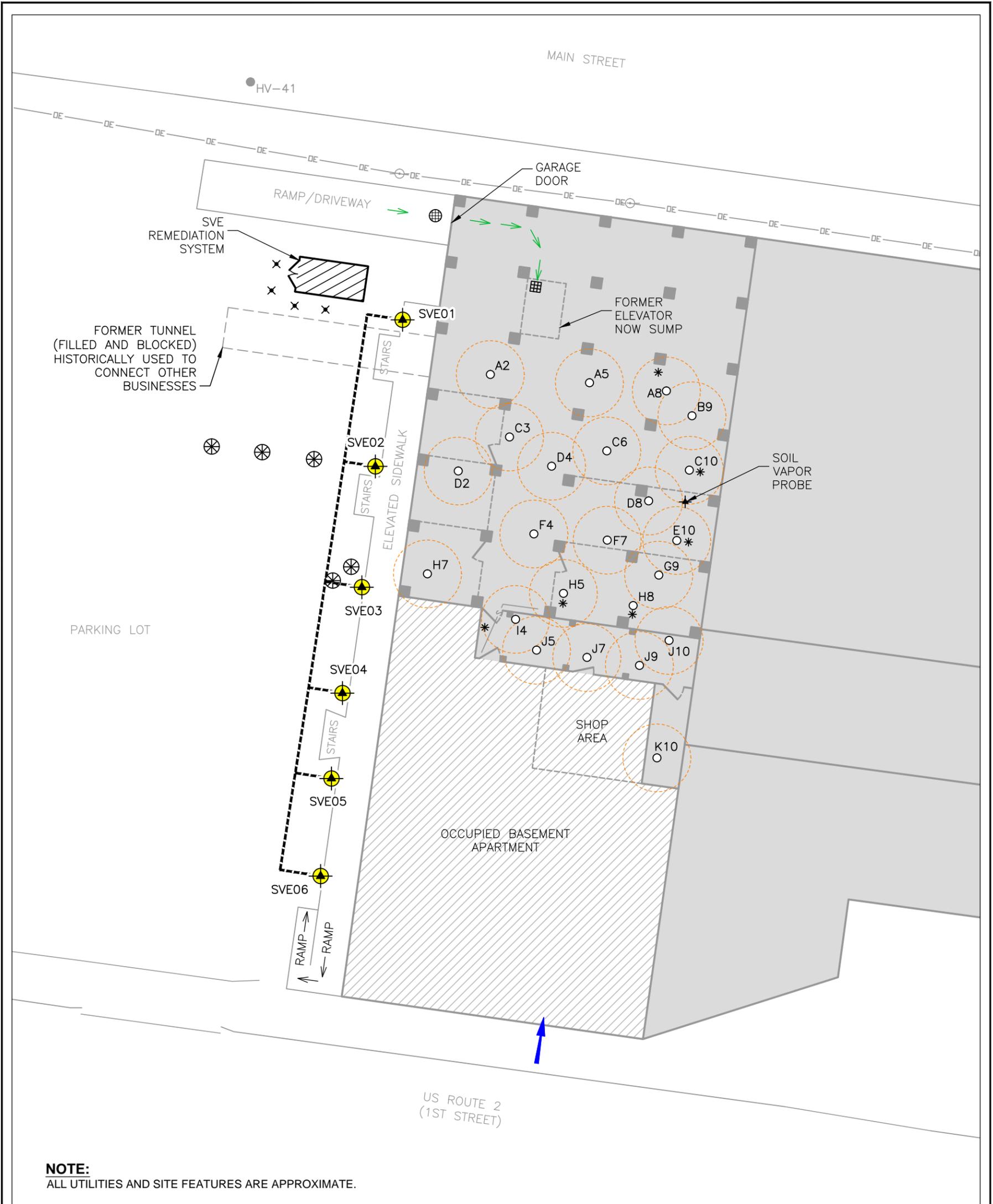
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CORPORATION  
1252 Commerce Drive  
Laramie, Wyoming 82070  
www.trihydro.com  
(P) 307/745.7474 (F) 307/745.7729

**FIGURE 2**

**SITE PLAN**

**ROXY'S CLEANERS AND ALTERATIONS**  
417 1ST STREET  
HAVRE, MONTANA

Drawn By: REP | Checked By: JG | Scale: 1" = 50' | Date: 5/24/17 | File: 776-SITEPLAN201704

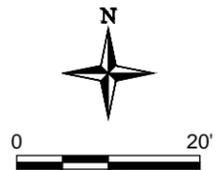


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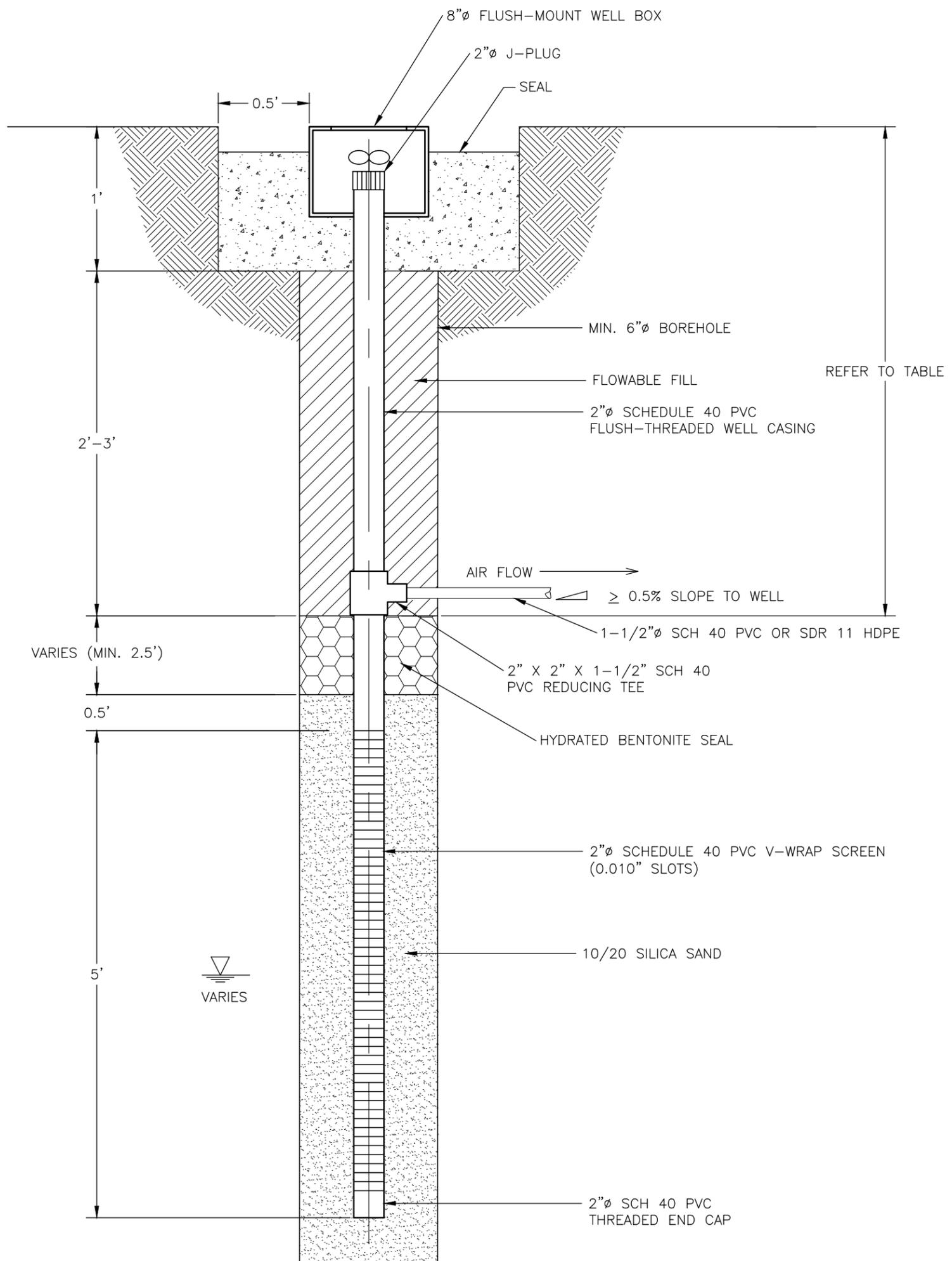
**NOTE:**  
ALL UTILITIES AND SITE FEATURES ARE APPROXIMATE.

**EXPLANATION**

- |  |          |                                  |  |                                      |
|--|----------|----------------------------------|--|--------------------------------------|
|  | RXYSVE06 | SOIL VAPOR EXTRACTION (SVE) WELL |  | UTILITY POLE (ESTIMATED)             |
|  | HV-43    | MONITORING WELL AND DESIGNATION  |  | OVERHEAD ELECTRICAL LINE (ESTIMATED) |
|  |          | REJECTED SVE WELL                |  | SEWER                                |
|  |          | SOIL VAPOR PROBE                 |  | FORMER TUNNEL                        |
|  | A2       | EVO INJECTION POINT DESIGNATION  |  | BUILDING                             |
|  |          | REJECTED EVO INJECTION           |  | SUPPORT COLUMN                       |
|  |          | FLOOR DRAIN                      |  |                                      |
|  |          | SUMP PUMP                        |  |                                      |
|  |          | BOLLARD                          |  |                                      |
|  |          | ESTIMATED RADIUS OF INFLUENCE    |  |                                      |
|  |          | GROUNDWATER FLOW DIRECTION       |  |                                      |
|  |          | STORMWATER FLOW TO SUMP          |  |                                      |
|  |          | REMEDIATION TRENCH               |  |                                      |
|  |          | SYSTEM BUILDING                  |  |                                      |



<p><b>Trihydro</b> CORPORATION 1252 Commerce Drive Laramie, Wyoming 82070 www.trihydro.com (P) 307.745.7474 (F) 307.745.7729</p>	<b>FIGURE 3</b>			
	<b>SVE WELL LOCATIONS AND BASEMENT EVO INJECTION LOCATIONS</b>			
	<b>ROXY'S CLEANERS AND ALTERATIONS 417 1ST STREET HAVRE, MONTANA</b>			
Drawn By: REP	Checked By: JG	Scale: 1" = 20'	Date: 6/7/17	File: 776-INJLOC201704



AS INSTALLED DIMENSIONS	
SVE01	25"
SVE02	30"
SVE03	31"
SVE04	33"
SVE05	36"
SVE06	41.5"

**NOTES:**

1. FINAL WELL DESIGN INCLUDING TOTAL DEPTH, SCREEN AND CASING LENGTHS WERE DETERMINED IN THE FIELD BY THE ENGINEER (ALL WELLS).
2. SURROUNDING ASPHALT AND PAVEMENT WAS SAW CUT TO RECEIVE WELLHEAD COMPLETIONS.
3. IN AREAS DIRECTED BY THE ENGINEER, THE WELL BOX WAS INSTALLED 1/2" ABOVE EXISTING SURFACE; CONCRETE SLOPES DOWN TO EXISTING SURFACE.

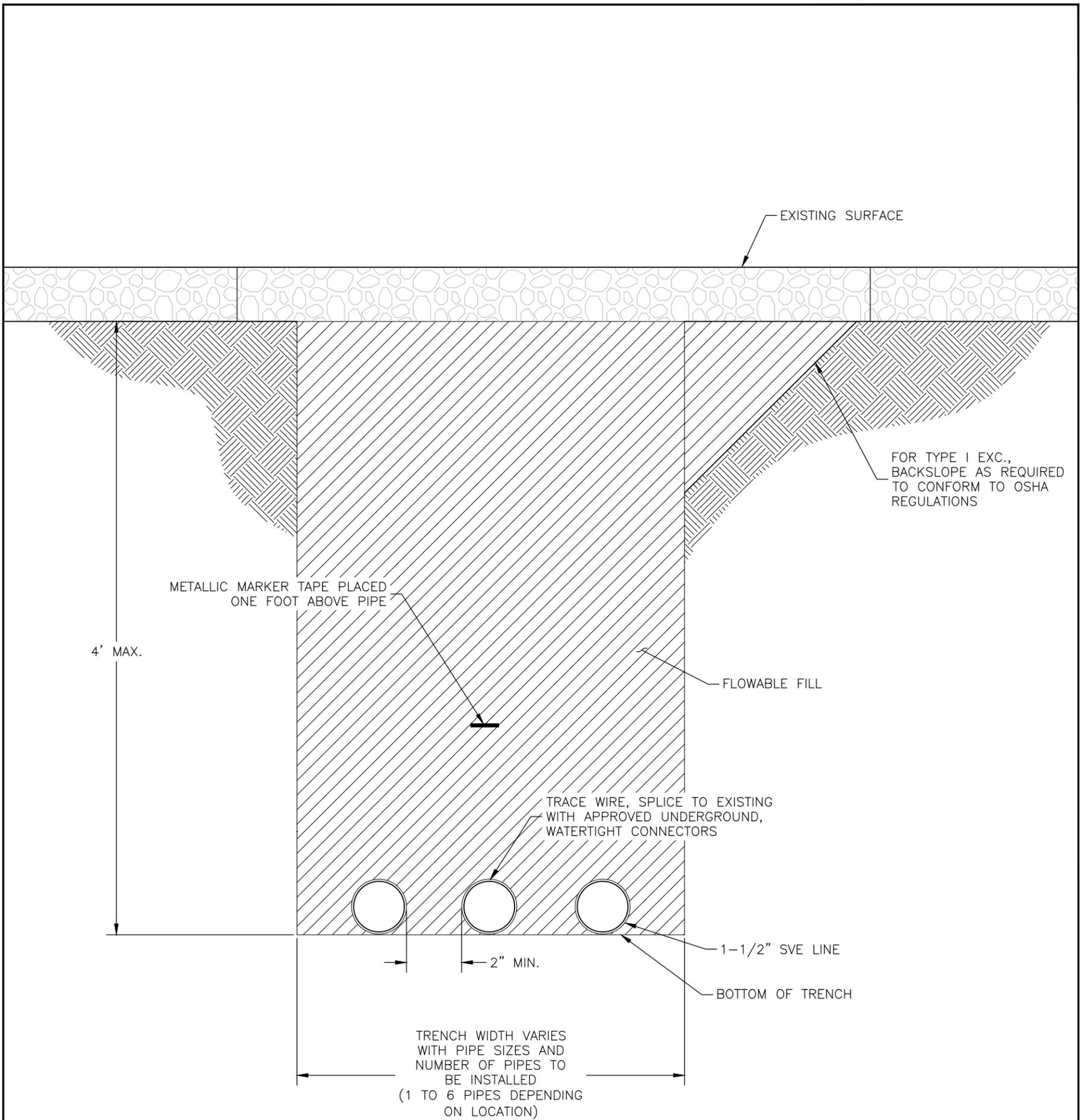
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**FIGURE 4**

**TYPICAL SOIL VAPOR EXTRACTION WELL**

**ROXY'S CLEANERS AND ALTERATIONS  
417 1ST STREET  
HAVRE, MONTANA**

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FOR TYPE I EXC.,  
BACKSLOPE AS REQUIRED  
TO CONFORM TO OSHA  
REGULATIONS

METALLIC MARKER TAPE PLACED  
ONE FOOT ABOVE PIPE

4' MAX.

FLOWABLE FILL

TRACE WIRE, SPLICE TO EXISTING  
WITH APPROVED UNDERGROUND,  
WATERTIGHT CONNECTORS

1-1/2" SVE LINE

BOTTOM OF TRENCH

TRENCH WIDTH VARIES  
WITH PIPE SIZES AND  
NUMBER OF PIPES TO  
BE INSTALLED  
(1 TO 6 PIPES DEPENDING  
ON LOCATION)

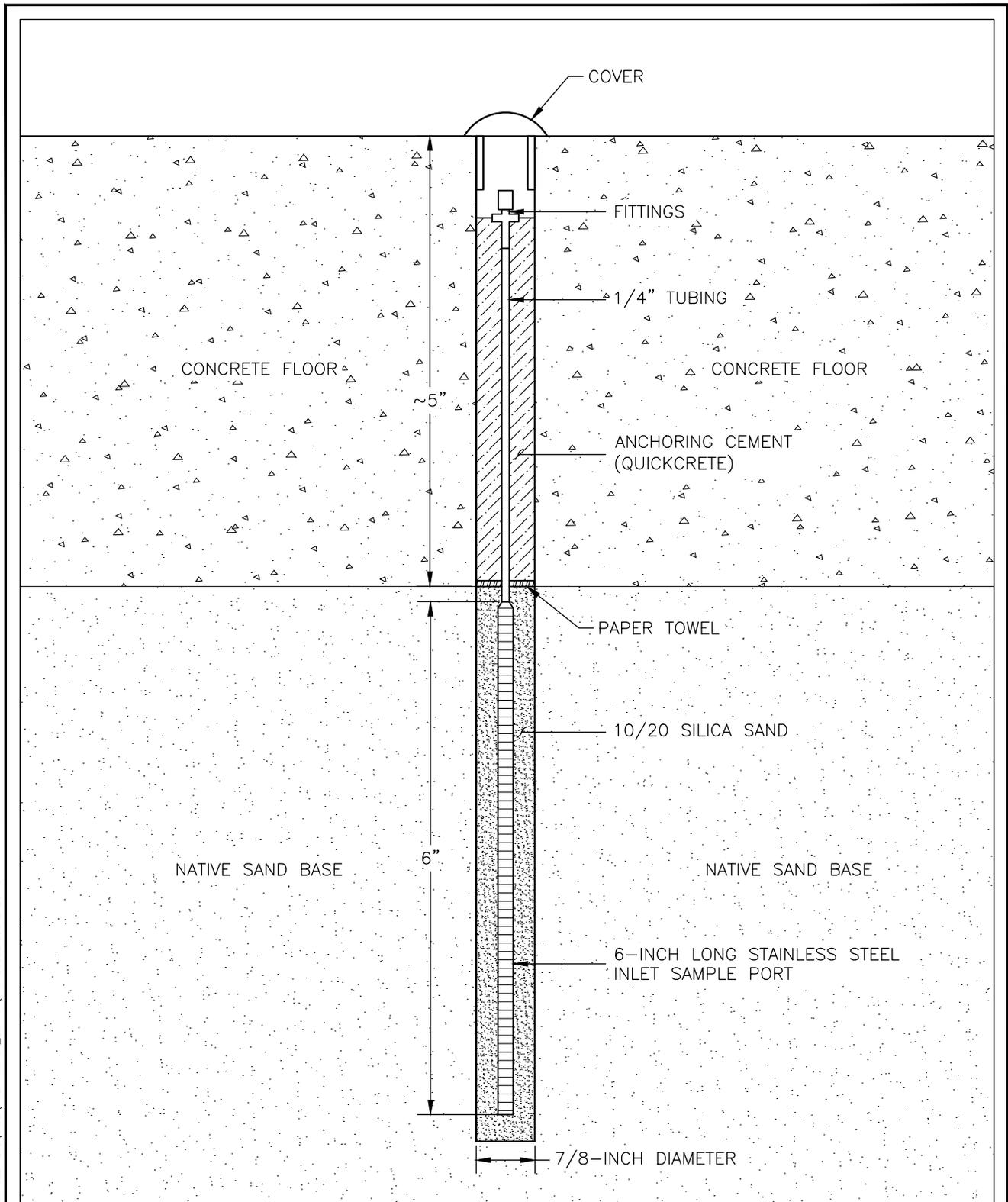
2" MIN.

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**NOTES:**

1. TRENCH WAS BACKFILLED WITH FLOWABLE FILL (NO PIPE BEDDING) WITHIN 10 FEET OF EACH SVE WELL.
2. SVE PIPING WAS SLOPED CONTINUOUSLY AT LEAST 1/2% TOWARD SVE WELLS

 <b>Trihydro</b> CORPORATION 1252 Commerce Drive Laramie, Wyoming 82070 www.trihydro.com (P) 307.745.7474 (F) 307.745.7729	<b>FIGURE 5</b>			
	<b>TYPICAL REMEDIATION TRENCH</b>			
	<b>ROXY'S CLEANERS AND ALTERATIONS</b> <b>417 1ST STREET</b> <b>HAVRE, MONTANA</b>			
Drawn By: REP	Checked By: JG	Scale: NONE	Date: 5/24/17	File: 776-DETRMDTRENCH201704



**FIGURE 6**

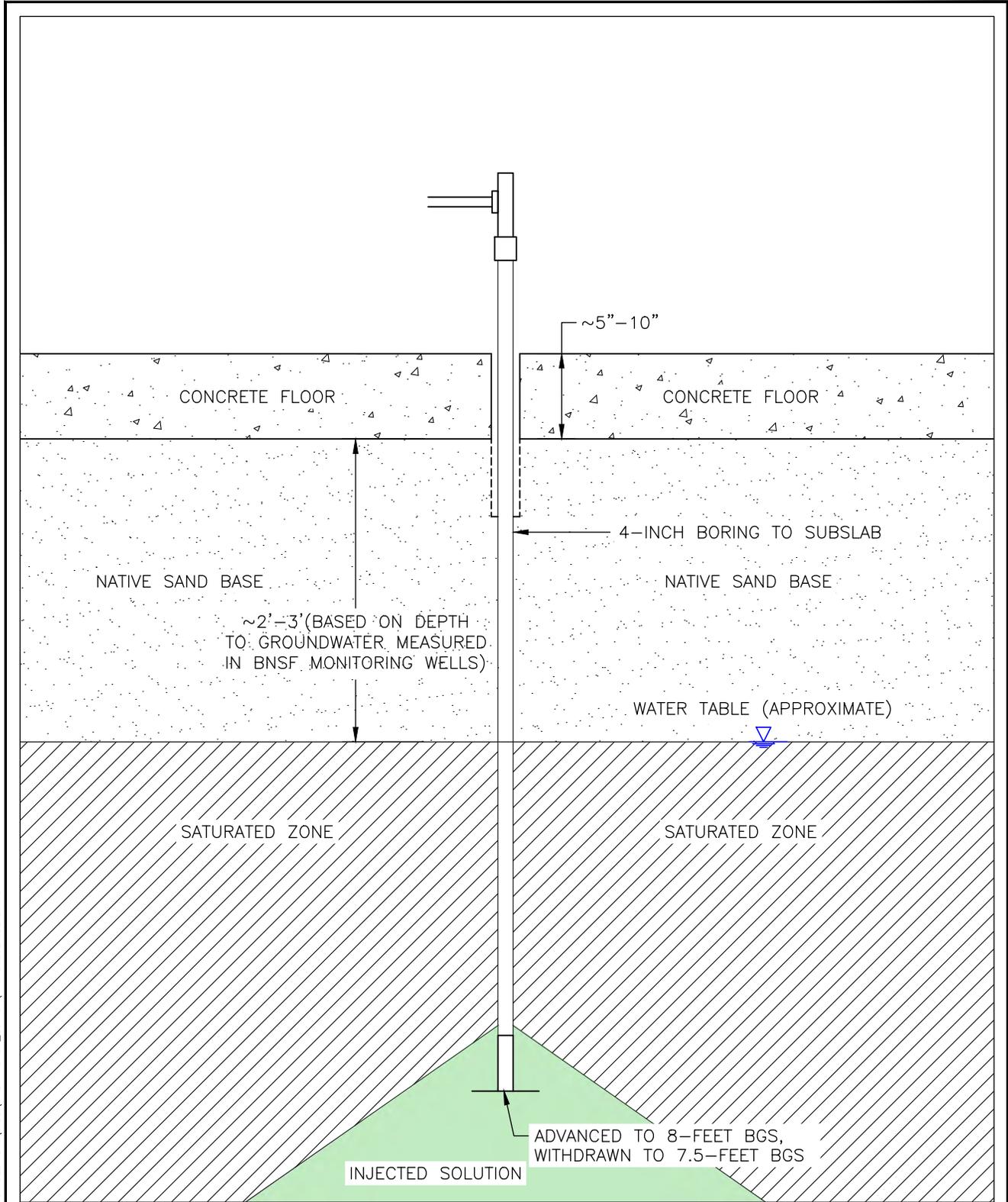
**SUBSLAB PROBE DETAIL**

**ROXY'S CLEANERS AND ALTERATIONS  
417 1ST STREET  
HAVRE, MONTANA**



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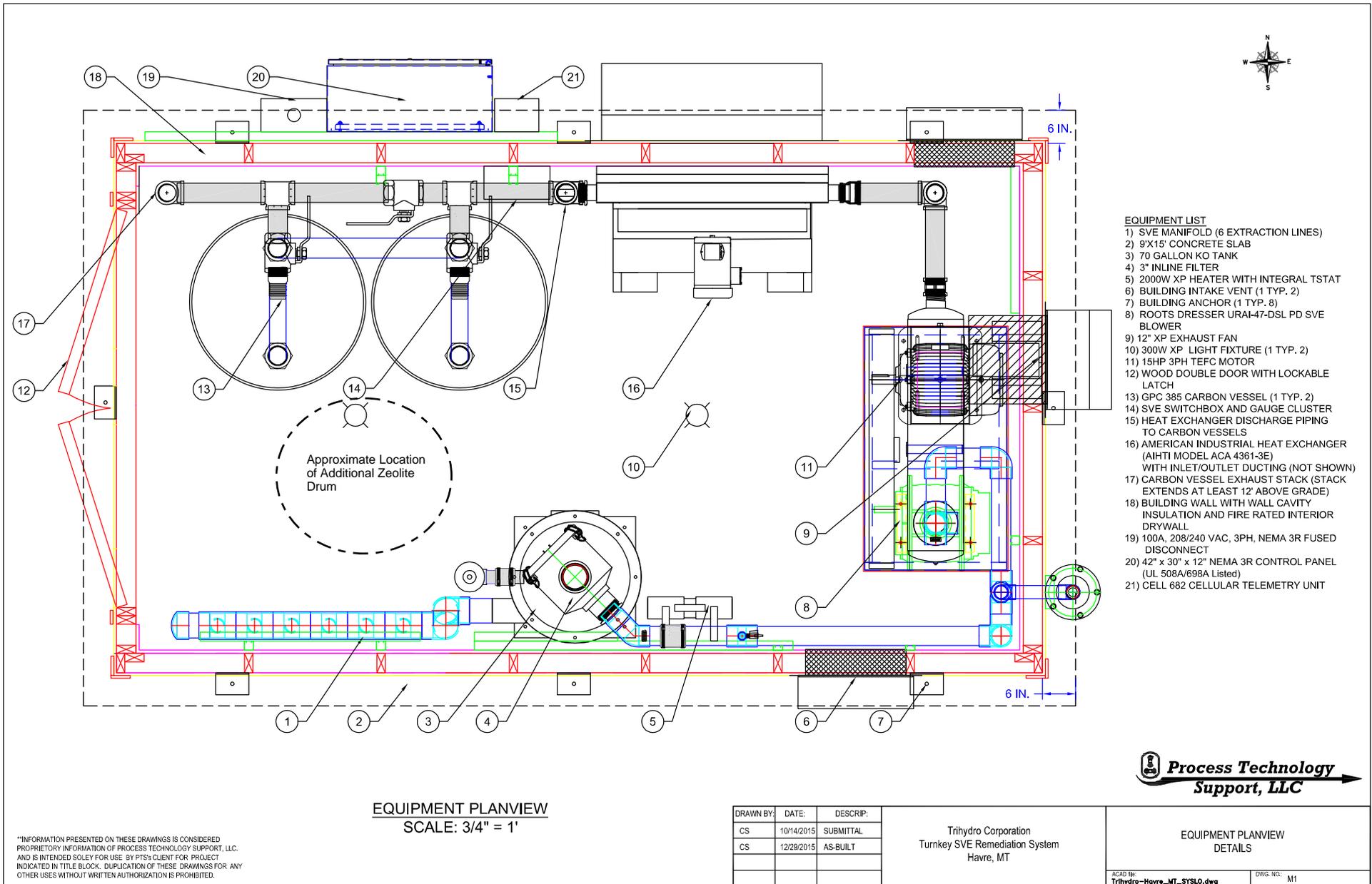
**FIGURE 7**

**TYPICAL SUBSLAB INJECTION DETAIL**

**ROXY'S CLEANERS AND ALTERATIONS**  
**417 1ST STREET**  
**HAVRE, MONTANA**

Drawn By: REP	Checked By: JG	Scale: NONE	Date: 5/24/17	File: 776-SUBSLABDET201704
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FIG. 8 SVE SYSTEM SCHEMATIC



- EQUIPMENT LIST**
- 1) SVE MANIFOLD (6 EXTRACTION LINES)
  - 2) 9'X15' CONCRETE SLAB
  - 3) 70 GALLON KO TANK
  - 4) 3" INLINE FILTER
  - 5) 2000W XP HEATER WITH INTEGRAL TSTAT
  - 6) BUILDING INTAKE VENT (1 TYP. 2)
  - 7) BUILDING ANCHOR (1 TYP. 8)
  - 8) ROOTS DRESSER URAI-47-DSL PD SVE BLOWER
  - 9) 12" XP EXHAUST FAN
  - 10) 300W XP LIGHT FIXTURE (1 TYP. 2)
  - 11) 15HP 3PH TEFC MOTOR
  - 12) WOOD DOUBLE DOOR WITH LOCKABLE LATCH
  - 13) GPC 385 CARBON VESSEL (1 TYP. 2)
  - 14) SVE SWITCHBOX AND GAUGE CLUSTER
  - 15) HEAT EXCHANGER DISCHARGE PIPING TO CARBON VESSELS
  - 16) AMERICAN INDUSTRIAL HEAT EXCHANGER (AIHTI MODEL ACA 4361-3E) WITH INLET/OUTLET DUCTING (NOT SHOWN)
  - 17) CARBON VESSEL EXHAUST STACK (STACK EXTENDS AT LEAST 12' ABOVE GRADE)
  - 18) BUILDING WALL WITH WALL CAVITY INSULATION AND FIRE RATED INTERIOR DRYWALL
  - 19) 100A, 208/240 VAC, 3PH, NEMA 3R FUSED DISCONNECT
  - 20) 42" x 30" x 12" NEMA 3R CONTROL PANEL (UL 508A/698A Listed)
  - 21) CELL 682 CELLULAR TELEMETRY UNIT

**EQUIPMENT PLANVIEW**  
SCALE: 3/4" = 1'

\*INFORMATION PRESENTED ON THESE DRAWINGS IS CONSIDERED PROPRIETARY INFORMATION OF PROCESS TECHNOLOGY SUPPORT, LLC. AND IS INTENDED SOLELY FOR USE BY PT'S CLIENT FOR PROJECT INDICATED IN TITLE BLOCK. DUPLICATION OF THESE DRAWINGS FOR ANY OTHER USES WITHOUT WRITTEN AUTHORIZATION IS PROHIBITED.

DRAWN BY:	DATE:	DESCRIP:
CS	10/14/2015	SUBMITTAL
CS	12/29/2015	AS-BUILT

Trihydro Corporation  
Turnkey SVE Remediation System  
Havre, MT



EQUIPMENT PLANVIEW  
DETAILS

ACAD FILE: Trihydro-Havre\_MT\_SYSL0.dwg DWG NO: M1

FIGURE 9. CUMULATIVE POUNDS CHLORINATED SOLVENTS REMOVED  
ROXY'S CLEANERS and ALTERATIONS  
(Based on PCE)

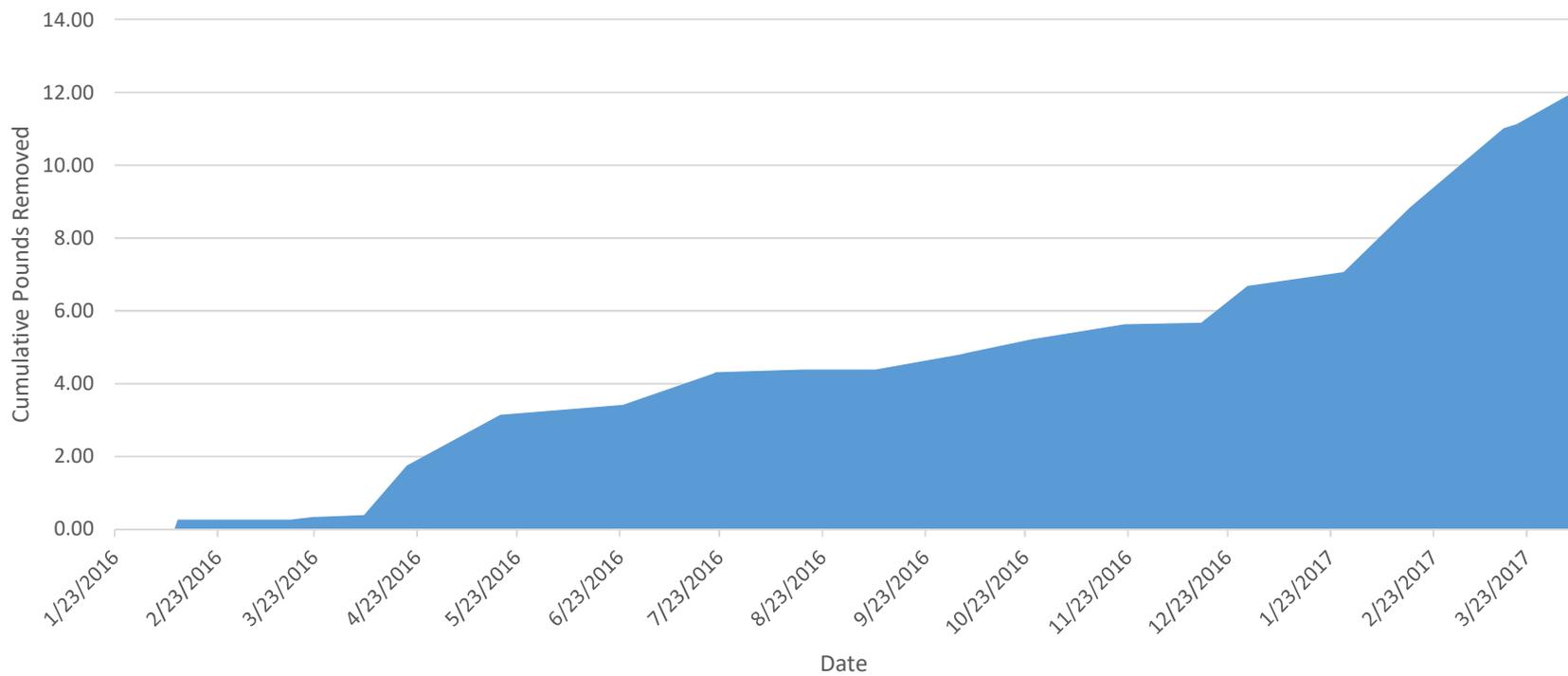


FIGURE 10. INDIVIDUAL WELL PERFORMANCE  
 CHLORINATED POUNDS REMOVED PER HOUR RUN TIME  
 ROXY'S CLEANERS and ALTERATIONS  
 (BASED on PCE)

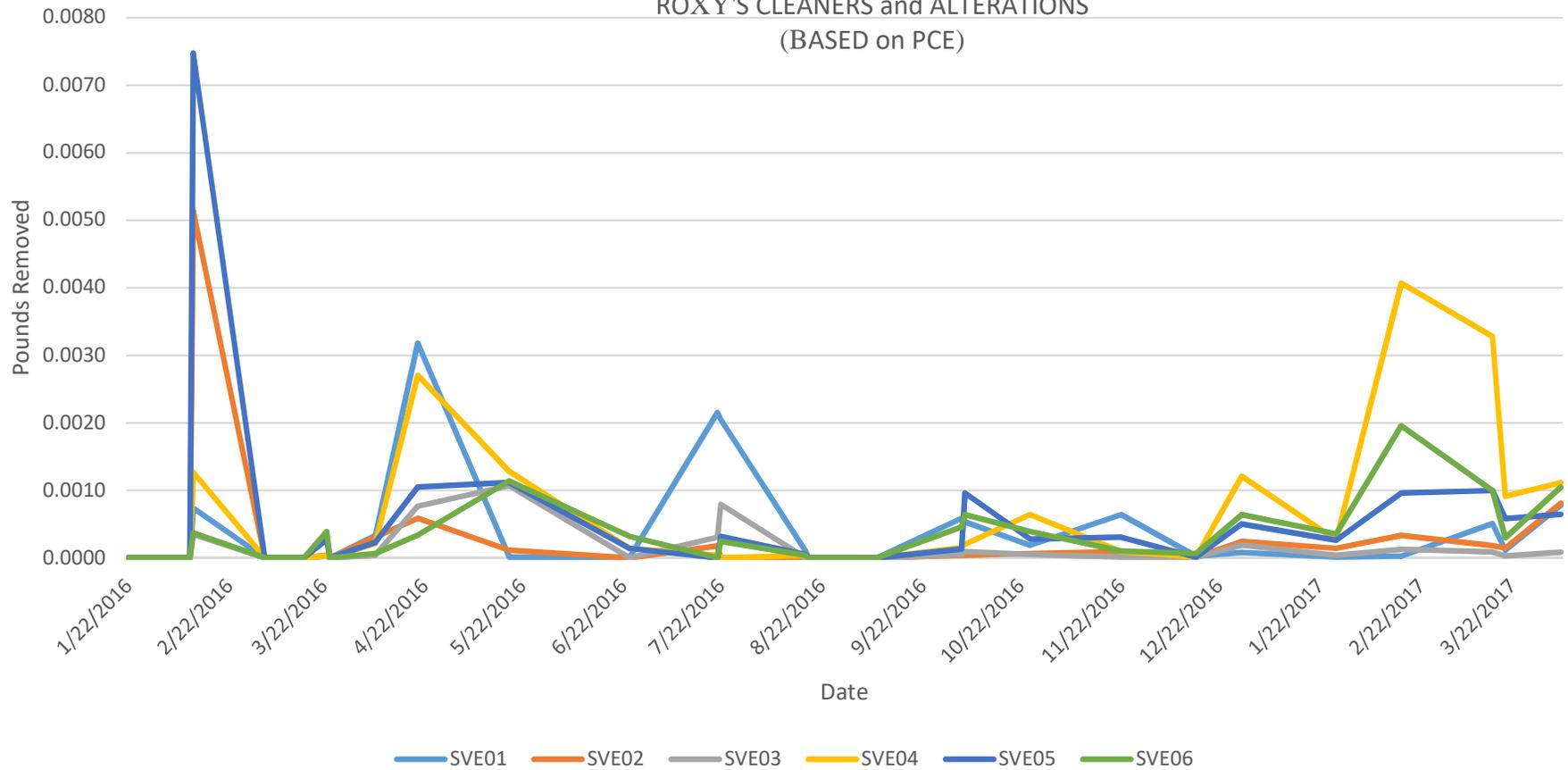


FIGURE 11. CONCENTRATIONS IN WELL HV-41  
ROXY'S CLEANERS and ALTERATIONS

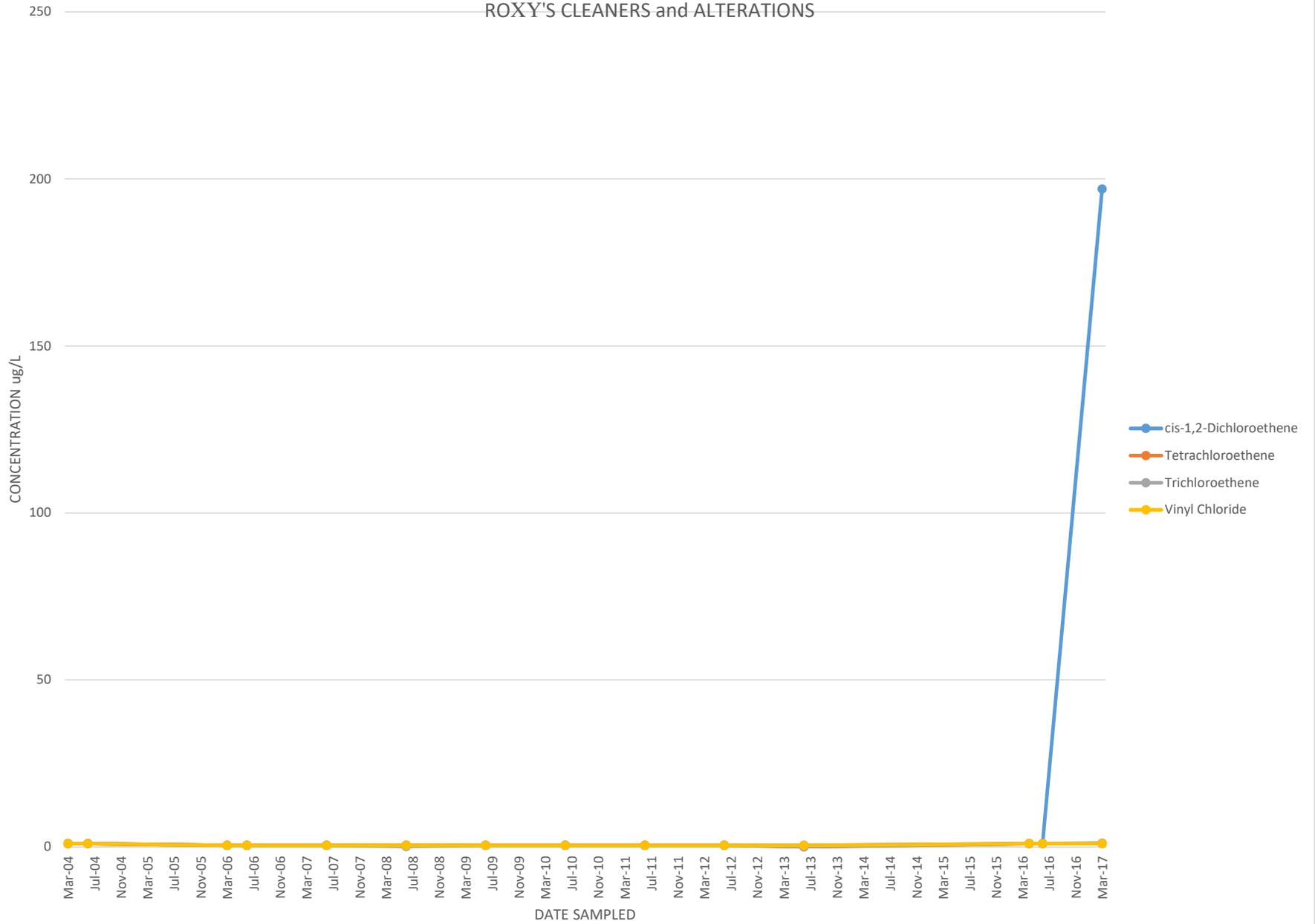


FIGURE 12. CONCENTRATIONS IN WELL HV-43  
ROXY'S CLEANERS and ALTERATIONS

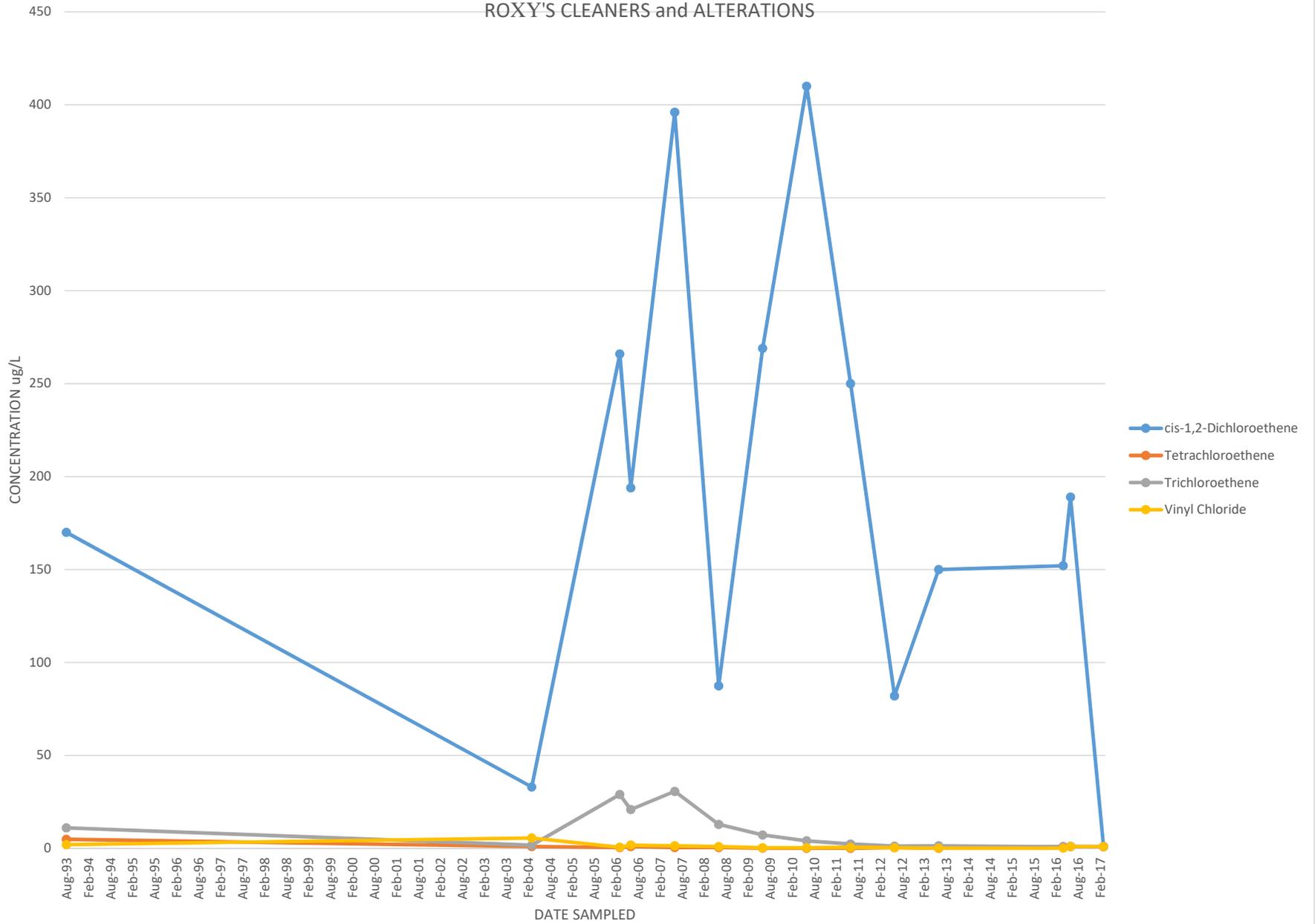
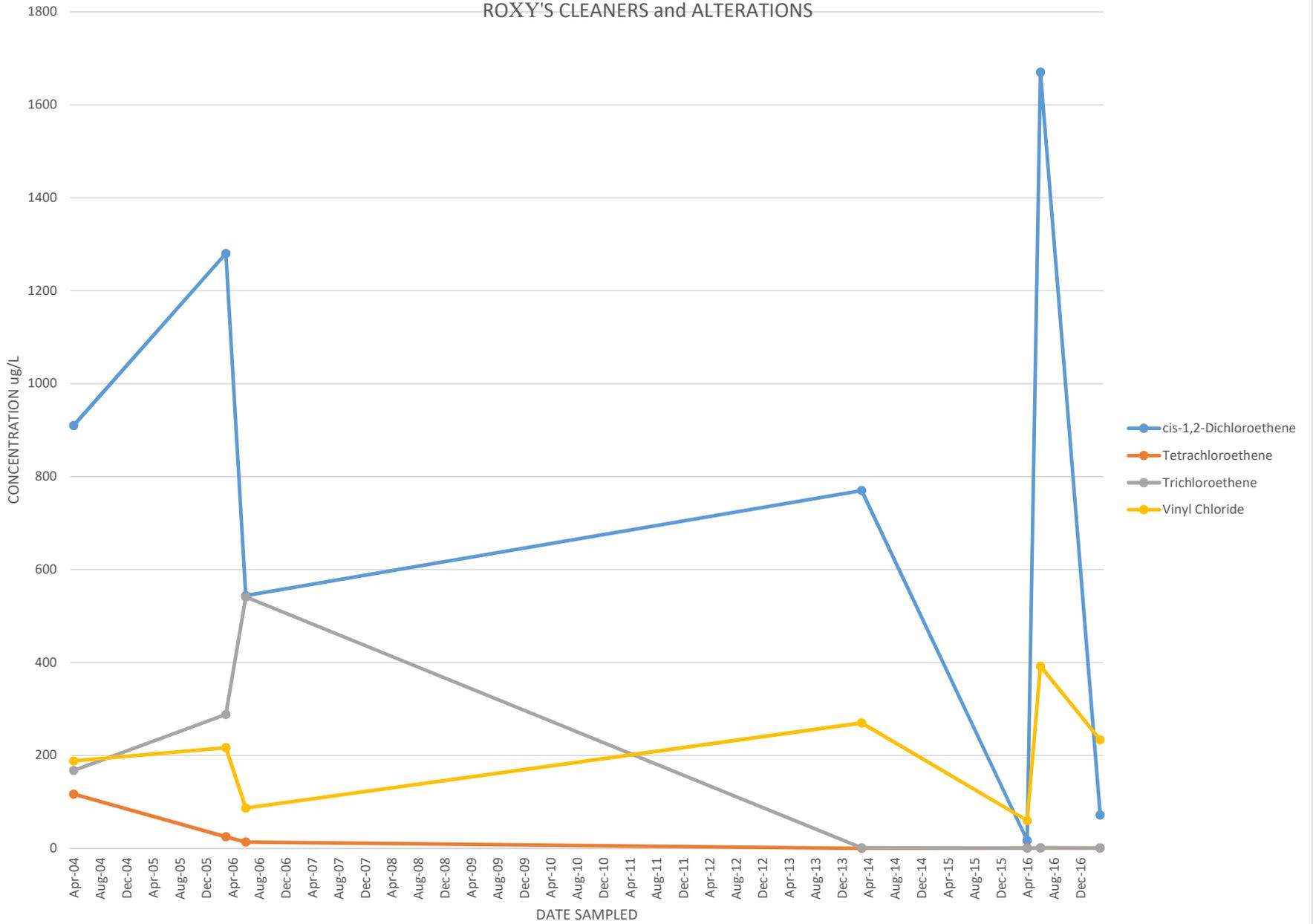


FIGURE 13. CONCENTRATIONS IN WELL HV-62  
ROXY'S CLEANERS and ALTERATIONS



## FIGURES

**APPENDIX A**

**FIELD LOGS AND NOTES**



4 Location Haure, MT Date 11/09/2015

Project / Client MDEQ SRS Roxy Cleaners

Pg 1/6 776-023-002

0730 Joel Riebli (JR) purchases distilled water at grocery store. Total \$ 1.79

0740 JR arrives at the former Roxy Cleaners property.

\* Boland Drilling called in re 811 utility locate. Ticket # 15100804.

\* Charter marked no utilities in parking lot

\* Northwestern Energy marked no utilities in parking lot but marked gas line on the south edge of main street. Overhead power lines on the western side of the parking lot.

\* City of Haure - sewer line under main street - water line under US Route 2. Water line marked about 20' west of the Bearly Square Quilting building off of US Route 2. Do not know where the line goes on the parking lot.

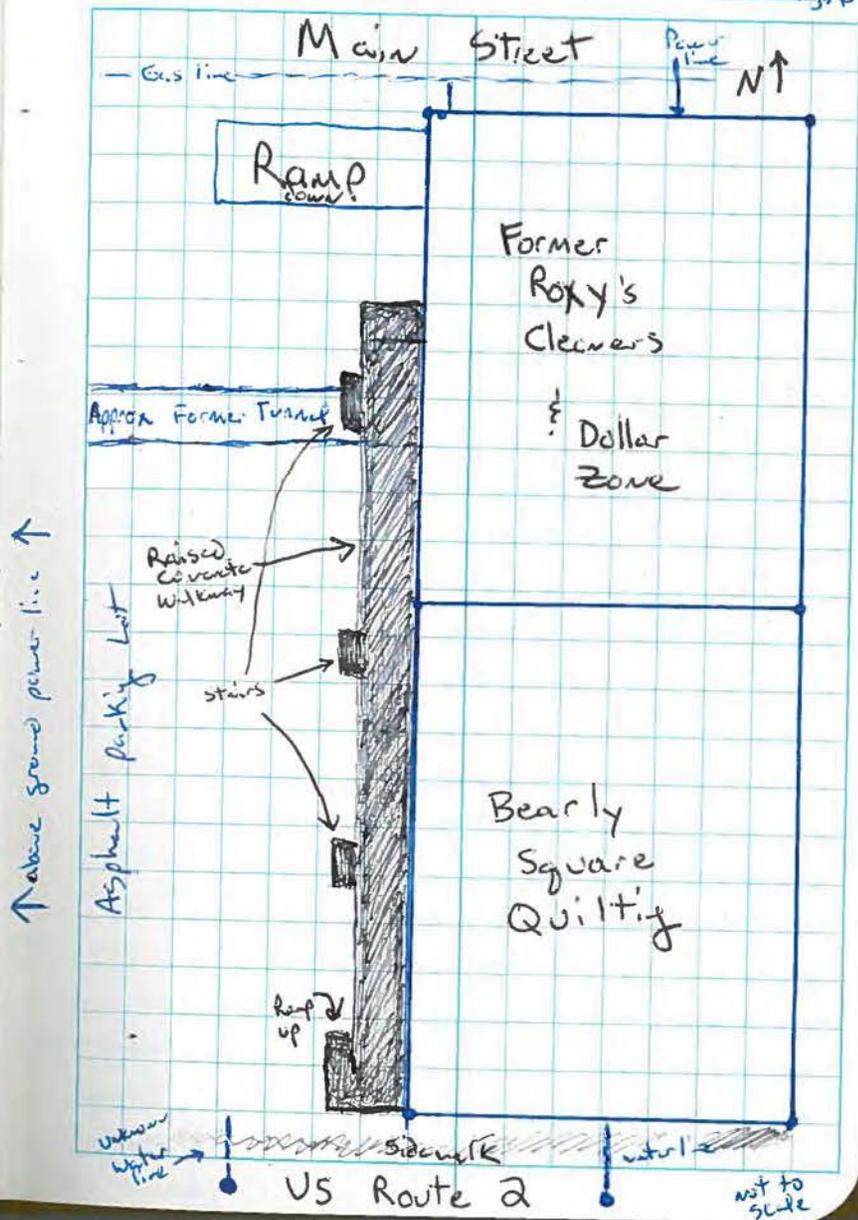
0815 Called Jim Gleason about the unknown water line that Boland will need to find out where it goes before drilling can start.

0845 Boland Drilling arrives on site. Chris Boland (Driller) & Chuck Belter (driller-helper)

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Location Havre, MT Date 11/09/2015Project / Client MDEQ SRS Roxy Cleaners

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0900 Tailgate safety meeting with Boland, discuss utility locations, the unknown water line, stop work authority, some dry cleaners contain, noise hazards, pedestrian hazards, inspecting the drill rig, slip/trip/fall, pinch points.

0915 City of Havre utility department arrives on site. said the unknown water line is shown as no longer being tied in with the water line, that the city hall building was in the parking lot and that three water lines were not connected to the water line when the water line was upgraded a few years ago. They checked to see if the valve was closed but unable to since it wouldn't budge. They did say that the water line under the Beauty Square / Dollar Zone is just south of the Beauty Square building.

\* Inspect drill rig (CME 55 hollow stem auger).

\* Calibrate the TNA 1000B FID/PID (Serial # 68692) using 100ppm methane (LOT # FAO-150A-100-3) cal gas (SP)

7

Location \_\_\_\_\_ Date 11/09/2015

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\* SVE location RXYSVE06 is Sully next to the ramp. The location was moved to the North.

1000 Boland Drilling starts drilling RXYSVE06 using a 6" diameter hollow stem auger and split spoon sampler. SEE field notes.

1150 End drilling RXYSVE06. Drilled to 125' bgs. well screen is between 7'-12' bgs. 10/20 silica sand around the slotted screen on Bentonite above the sand and screens the top 4' of the well, 10/20 sand around the pipe. Drill pipe cleaned.

1200 Start drilling RXY SVE 05 (next to one of the concrete stairs near the entrance to Beauty Square Quilting)

1350 End drilling RXY SVE 05. Drilled to 125' bgs. well screen is between 7-12' bgs with 10/20 silica sand as the filter pack. Drill pipe was cleaned.

1355 Start drilling RXY SVE 04 (next to one of the concrete stairs).

1520 End drilling RXY SVE 04. Drilled to 125' bgs with the well screen between 7-12'. 10/20 silica sand filter pack. Drill pipe cleaned. (SP)

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776-023-002.

1530 Start drilling <sup>SP</sup>~~SVE~~ RXYSVE03.

1610 AT ~7' bgs drill into concrete structure - unable to proceed; location filled with bentonite chips (hydrated).

1630 Start drilling RXYSVE03 attempt #2 (moved location about 10' to the north).

1700 AT 7' bgs drill encountered the concrete structure once again; location plugged and pipe cleaned.

1730 Boland / Trihydro OSS site - plan a meeting at 0730 tomorrow.  
-Joel Riabli

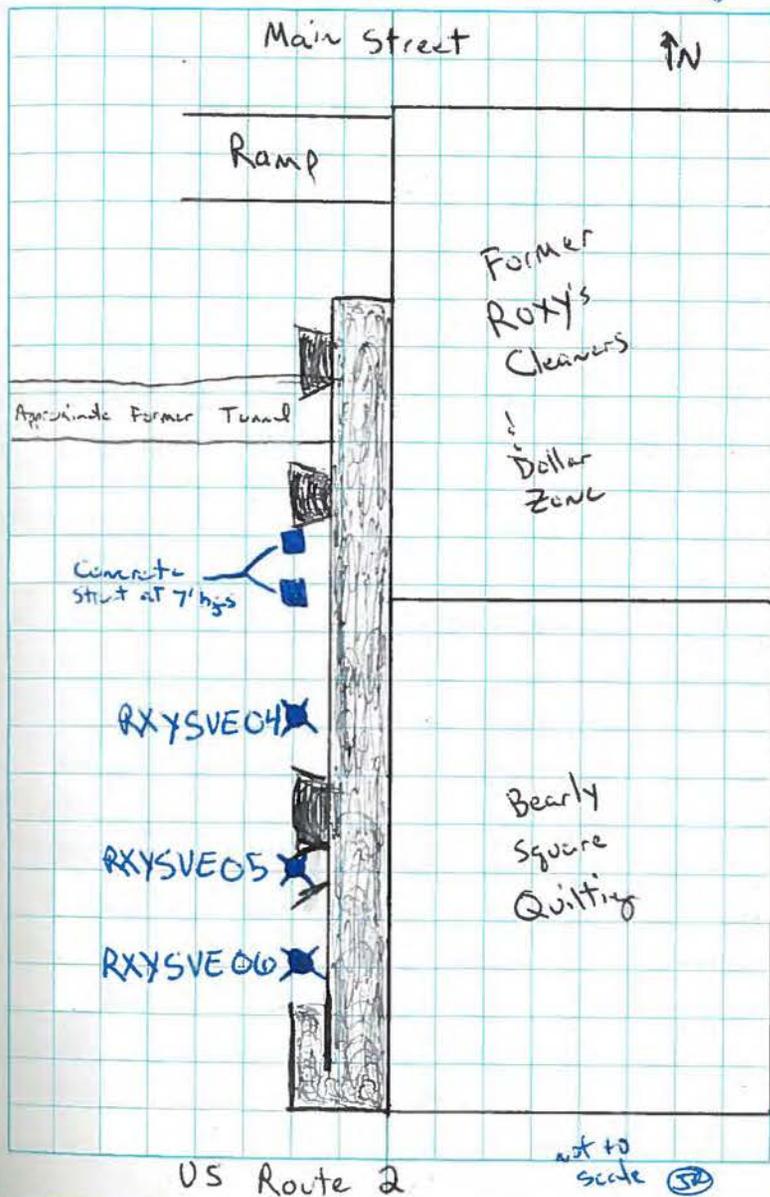

Location \_\_\_\_\_

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- 0710 Joel Riebli (JR) arrives at the former Roxy's Cleaners. Light snow, ~31°F, etc.
- 0715 Boland Drilling (Chris Boland) & (Chuck Beltr) arrive on site.
- 0720 Tailgate safety meeting. Good job commingling and spotting vehicles. Discussed the three remark locations, the former tunnel, the large ramp, weather conditions, stop work authority, emergency info.
- \* Boland inspects drill rig.
  - \* JR calibrates the TVA 100CB FID/PID with the 100 ppm methane calibrati gas.
- 0745 start drilling RXY SVE03 (attempt #3) ~~but~~ stepped out between the previous two attempts.
- 0800 Encountered concrete at 7' bgs. Back fill hole with bentonite (hydrated) cleaned drilling pipe.
- 0805 JR called Jim Gleason. Discussed drilling closer to SVE02 location.
- 0815 start drilling near the RXY SVE02 locati. Just south of the former tunnel.
- 0830 Encountered concrete at 7' bgs. Back filled hole with bentonite.

- 0833 JR called Jim; discussed stepping out 10' away towards the west.
- 0850 Start drilling; found concrete at 7' bgs.
- 0920 stepped out 10' additional south. Began drilling. Encountering concrete at 7' bgs.
- 0930 Called Jim; discussed stepping out to 40' from the former Roxy Cleaners building.
- 0945 Start drilling ~40' from building; Encountered concrete at 7' bgs. Back filled hole with hydrated bentonite and cleaned drill pipe.
- 1015 start drilling at RXY SVE01. Encountered concrete at 7' bgs. Back filled with hydrated bentonite.
- \* stopped drilling need different option due to the concrete at ~7' bgs.
- 1040 Spoked with Jim. Discussed getting cost estimates using a air rotary drill rig to get through the concrete at 3' bgs.
- \* Boland using cold patch asphalt to patch the three SVE completed locations and the 8 boreholes where concrete was encountered.

Location Haure → Helena Date 11/10/2015

Project / Client MDEQ SRS Roxxy Cleaners

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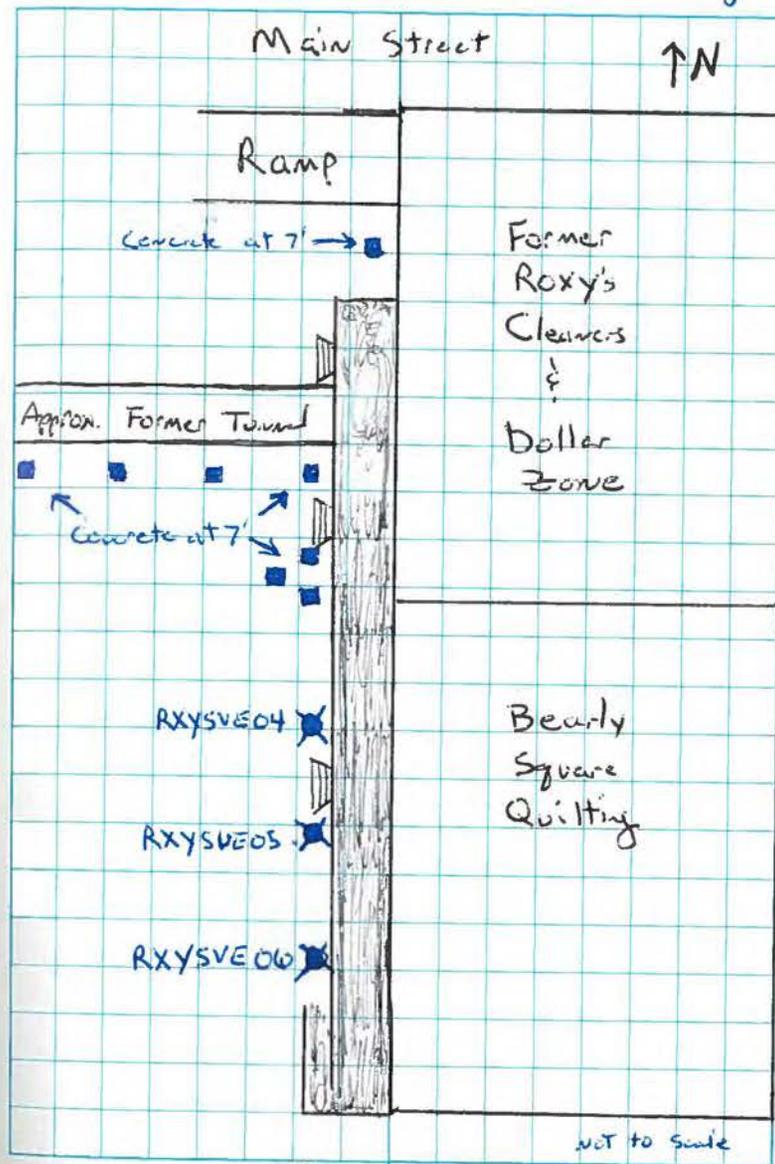
1240 JR departs Haure  
1645 JR arrives at the Helena office.  
- Joel Riebli



Location \_\_\_\_\_ Date 11/10/2015

Project / Client \_\_\_\_\_

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US Route 2



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776-023-002



- 0425 Joel Ricbli (JR) arrives at Helena office, load field truck
- 0505 JR departs the Helena office
- 0835 JR arrives at the former Roxy Cleaners in Haure, Temp ~11°F, about 1 inch of snow on the ground
- \* Spoke with Jim Gleason - talked about starting at RXYSVE01 location
- 0910 Boland Drilling (Chris Boland, Jason Posey, & Trevor Marks). Bring up the CME 55 hollow stem auger drill rig, air compressor (to perform air rotary) and their box truck/trailer
- 0915 Review HASP & conduct tailgate safety meeting. Discussed the dry cleaner, stop work, drilling locations, muster points, first extinguishers, first aid kits, pinch points, slip/trip/fall on snow/ice, p.p.g., hoses, curbs.
- 0948 Begin drilling RXYSVE01, drilling in the same location that was previously drilled on 11/10 down to 7' bgs. Boland used the hollow stem auger down to 7' bgs and the contact with the concrete. Switch out piping over to



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- on 6" air rotary piping. Use air compressor push/break through the ~4" concrete. Remove piping and go back to the 6" hollow stem auger. Use split spact to sample soil below 8' bgs. Drilled down to 13' bgs. Water table looks to be at ~12.5' bgs. The bottom 6" is the sump. Screen installed between 7.5' & 12.5' bgs. 10/20 silica sand installed around the slotted well screen. 2.5' of bentonite installed between 4.5' & 7' bgs.
- 1245 ~~with~~ Drilling pipe was cleaned. Begin drilling well ~~SUE~~ SUE well RXYSVE02. This location was previously drilled down to 7' bgs (concrete) on 11/10. This well was drilled just as RXYSVE02 (hollow stem down to 7', Air Rotary 7'-8', hollow stem 8'-13' bgs). Concrete appears to be about 6" thick. ~~with~~ sump 12.5-13' bgs wellscreen 7.5-12.5'. 10/20 silica sand around slotted screen. Well pipe cleaned
- 1420 Begin drilling well RXYSVE03. This location was previously drilled down to 7' bgs on 11/09. The concrete appears to be about 10" thick. sump = 12.5-13' bgs. slotted screen

Location HavreDate 11/30/2015Project / Client MDEQ SRS Roxy Cleaners

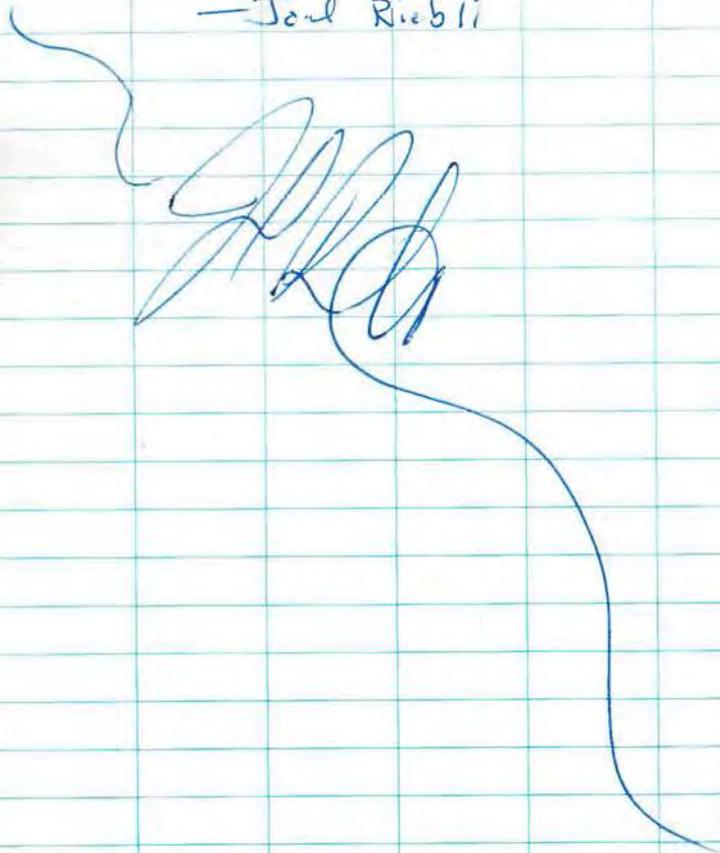
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776-023-002JR

7.5-12.5' bgs, 10/20 silica sand around  
the slotted screens.

1625 Boland drilling & JR departs  
Havre.

1805 JR arrives in Helena  
—Jarl Riebli



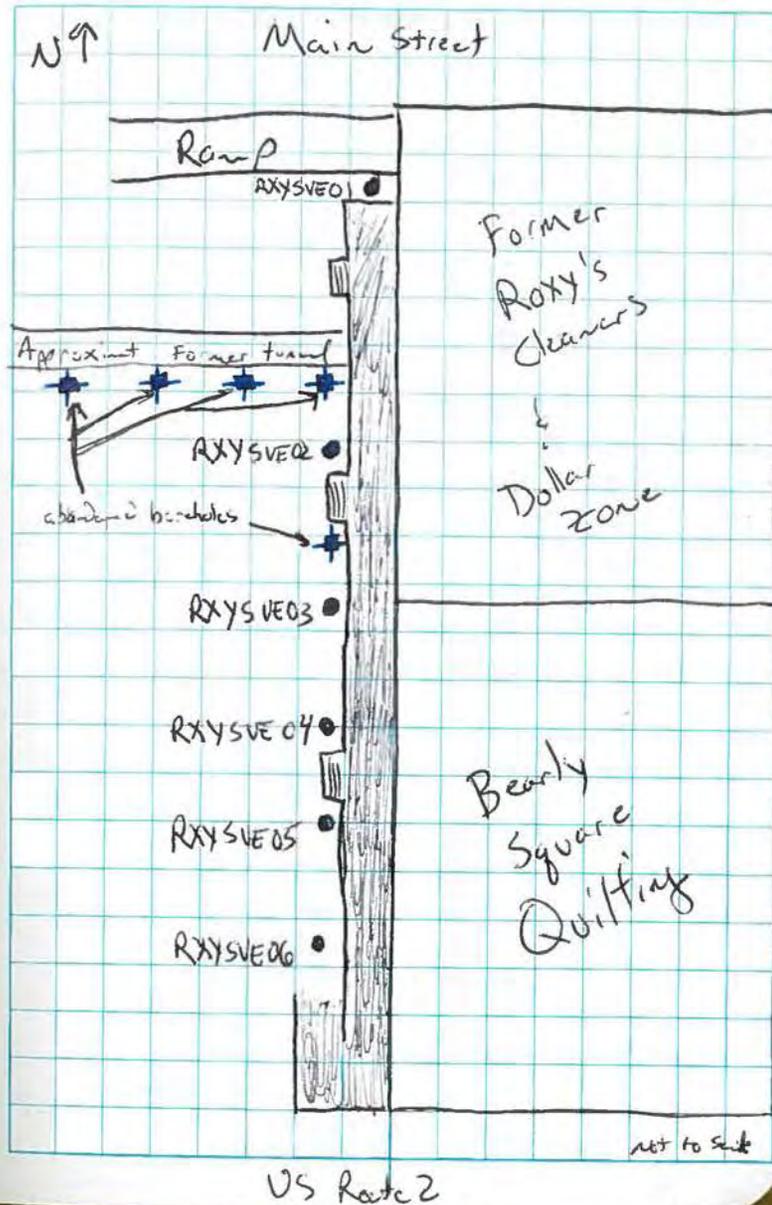
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Date 11/30/2015

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SP

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Location Helena/Havre

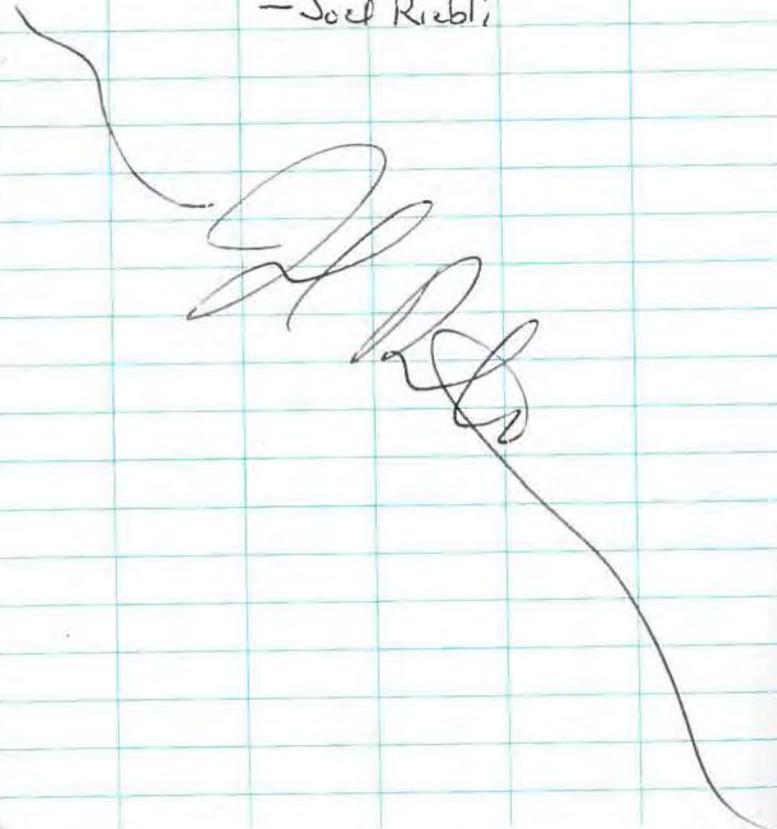
Date 12/02/2015

Project / Client MDEQ SRS Roxy Cleaners

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776-023-002

JR

- \* Call with Remington's Sue Harem. The Montana 811 utility ticket is # 15105051
  - 1350 Spoke with Remington's Jonathan Welebin. Remington has made it to Havre, plan on meeting at 0700 tomorrow
  - 1415 JR departs The Helena office
  - 1745 JR arrives in Havre.
- Joel Riebli
- 

Location

Date 12/03/2015

Project / Client

JR

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- 0655 Joel Riebli (JR) arrives at The former Roxy's Cleaners. Some ice still on the ground.
- 0658 Remington (Jonathan Welebin, Robby Orr, Joey Flowers) arrive on site. They have a bobcat 5510 with them.
- 0700 Tailgate Safety meeting. Discuss stop work authority, no six blade knives, Route to Hospital, muster points, first aid/first extinguisher/eye wash locations, Level D PPE, TCE/PCE contamination, cold stress, weather, Traffic/Pedestrians, Slip/trip/fall on icy surface conditions, Spotter, inspecting bobcat & back hoe.
- \* Planned tasks, set up work zone allowing pathway to the Bearly Square ~~to~~ store - allowing access via ramp. Going through supply and gear, around noon, early afternoon start cutting the asphalt.
- \* Discussed the width of the piping trench. Plans call for a 36 inch wide trench. When at the furthest point (RXYSVE05 & RXYSVE06) can the trench be cut less than 36 inch wide? Send an email to Jim Gleason/Andrew Vond and got back a response that it can be less than 36" wide.

20

Location Havre, MTDate 12/03/2015Project / Client MDEQ SRS Roxy CleanersPg 2/5776-023-002

1025 Rented John Deere 31056 backhoe arrives on site.

1230 Begin cutting the asphalt

1235 Mr. Hamilton stopped by the site. Discusses the trench location, keeping the ramp open for the Beady square shop. Went down in the garage and looked at the injecta areas. Rooms on the west wall will need to be hand covered as the door ways are too small to get a rig through. Multiple car's are in areas that will need to be moved. Will take a plan on where to move items to gain access for the injection rig.

~~1425 Remington using the John Deere backhoe to remove the 2" thick asphalt in the future shed and~~

1305 JR called Jim Gleason regarding seeing the basement work areas. Lots of items will need to be moved, including vehicles, bikes, storage items. Also discussed that Michael Hamilton that all asphalt between the trench & raised sidewalk are to be removed and replaced with concrete. Jim said that this was

Location \_\_\_\_\_

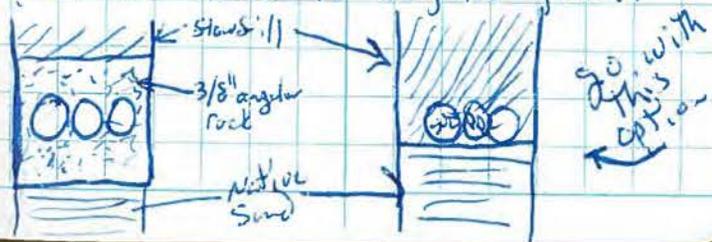
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Project / Client \_\_\_\_\_

②

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discussed with Remington (either Chester or Grant) on removing this strip of asphalt. That Mr. Hamilton is correct that the asphalt strip will be removed up to the wall and be replaced with concrete. Tom also was informed by Remington that they are not able to get 3/8" rounded pea gravel for the material ~~below~~ below and around the SVE piping in the trench. They can get 3/8" angular rock (used in concrete). Discussed using the 3/8" angular rock (possible damage to the 1/2" sch 40 SVE pipe. Also discussed having the SVE pipe on compacted native soils (sand) and covering with the slow fill (hard sand). We do not see any possible damage to the pipe using the slow fill. Decided to go with slow fill over the pipe rather than 3/8" angular gravel.



Go with this option

1425 Remington begins using the John Deere backhoe to remove the 3" thick asphalt using the bucket to strip the material within the cut/scored work area. Start in the RXY5VECI area.

Bobcat making a stockpile of the removed asphalt west of the Saton remediation system position.

1515 Noticed that the north western corner of the raised sidewalk brick wall has been chipped during asphalt removal activities. ~1/2" chip missing from the corner. Contacted Jim Gleason of the property damage incident. Remington's field supervisor Jonathan Welebir stopped work and spoke with both the backhoe and bobcat operators regarding the contact with the wall.

1530 Joel left a voice message with property owner Michael Hamilton.

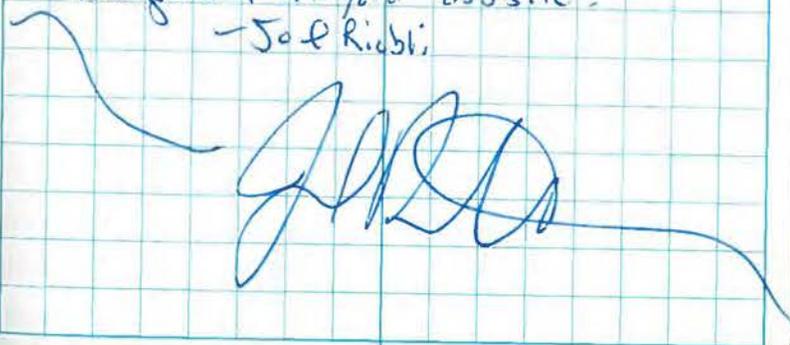
1525 Property owner Michael Hamilton stopped by the jobsite. Joel escorted Mr. Hamilton to the damage brick. Mr. Hamilton was not concerned with the brick.

Remington's Jonathan said Remington will repair the damaged brick. Mr. Hamilton asked if an additional 5' x ~30' section of asphalt could be removed and replaced with concrete. This is north of the work area will run it by Jim Gleason.

\* Send Jim Gleason an email about the 5' x 30' section of asphalt that Mr. Hamilton requested be removed and replaced with concrete. That it is between the remainder shed and ramp but out of the scope. Jim said ~~not~~ <sup>no</sup>.

1645 Begin shutting down asphalt removal activities. Call has been broken up and ~80% has been placed in a stockpile.

1715 Remington / Trihydro offsite.  
- Joel Riichi



Location Haure, MT Date 12/04/2015Project / Client MDEQ SRS Roxy CleanersPg 1/3 776-023-002

0655 Joel Riebli (JR-Trihylic) arrives at the former Roxy Cleaners. Temp ~ 31°F, mostly clear, with light winds. Forecast is calling for temps to reach in the mid 40's with winds 20-30 mph (Gust to 40).

0658 Remington Technologies (Jonathan Welch, Robby Orr, & Joey Flowers) arrive on site.

0700 Tail gate safety meeting. Discussed the weather, communication between crews, use of step work, being physically and mentally ready to work, being accountable for their actions. Went over the Hoopel, muster points, and first aid/first extinguisher/eye wash location. Discussed the property damage yesterday with the backhoe and brick wall. That do not position your self to the right of the bucket, as its jumpy. Discussed removing the asphalt in a safe and controlled speed up against the brick wall. Next starting to trench going North to South.

0740 Resume removing broken asphalt from the southern portion of the trench work zone. Once again using the bucket to transport asphalt to the stockpile.

Date 12/04/2015 25

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0815 Begin excavation work with backhoe at the remediation system shed location. Trench will go deeper (slope) towards the 6 SUE wells.

1115 Site property owner Michael Hamilton stopped by the site to look at the parking availability. There is about 10 vehicles in the parking lot that haven't moved since the drilling work on Monday. There is a vendor tending plunkets taking up 4 or 5 spots and this construction work is taking up additional parking. There is about 5 spots currently open.

1330-1400 lunch break

\* Near SUE location RXX SUE 04, concrete with rebar is below the asphalt (about 5" below) in the trench area. Switching between backhoe & bobcat with jackhammer attachment breaking up the concrete.

\* Concrete ended near location RXX SUE 05

1740 Begin shutting down

1745 Site property owner Michael Hamilton stopped by to see progress and

Location Haure, MTDate 12/04/2015Project / Client MDEQ SRS Roxy Cleaners776-023-002

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The access to The Bearly Square  
store. No issues.

1750 Remington / Trihydro off site. —

— Joel Ricbli


Date 12/05/2015 <sup>27</sup>

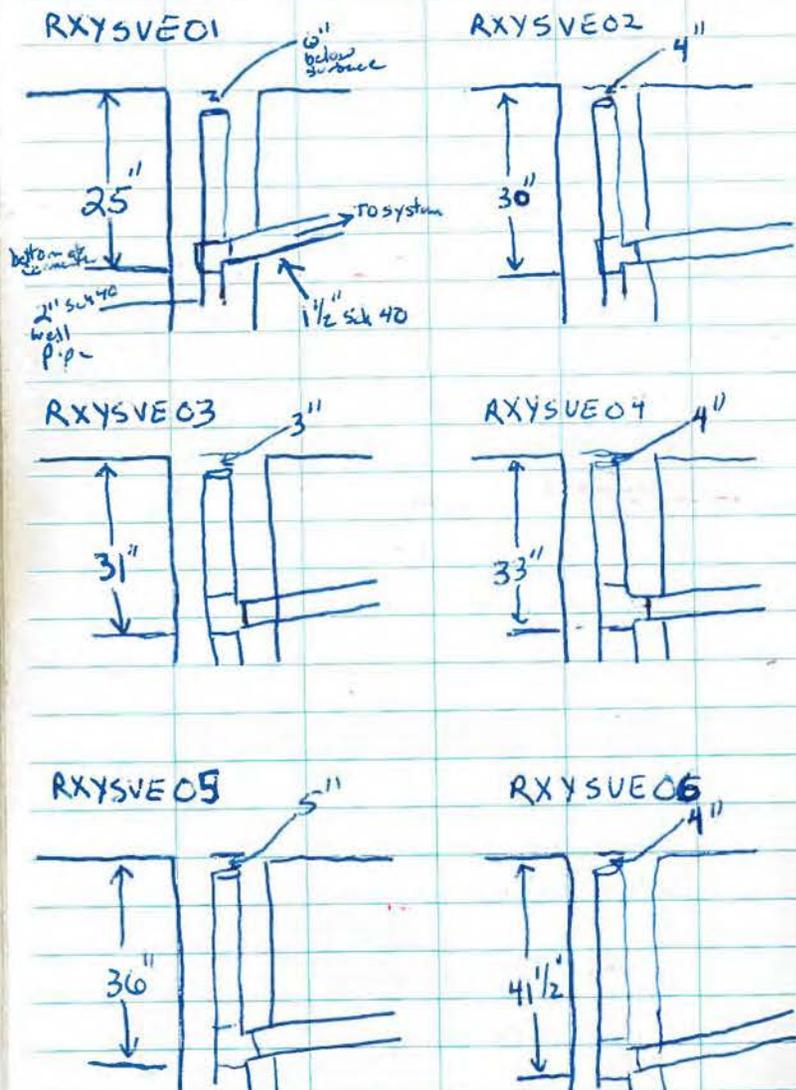
Project / Client \_\_\_\_\_

SP

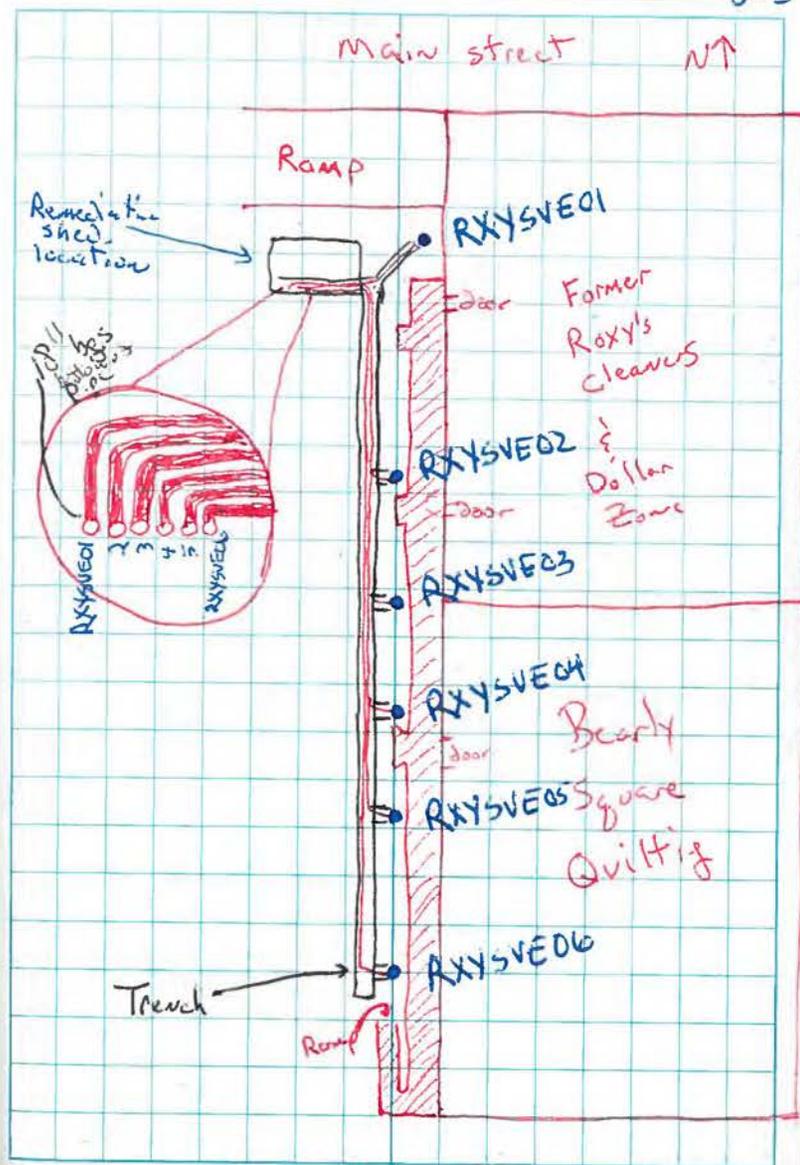
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- 0655 Joel Ricbli (JR) arrives at the Roxy Cleaners site. Two safety cones blew over last night - no issue.
- 0658 Remington Technologies (Jonathan Welebig, Robby Orr, & Joey Flowers) arrives onsite.
- 0700 Tailgate safety meeting. Discussed having the right mind set for working. Using stop work authority. Taking responsibilities for your actions. Hospital, mustar points, weather. Communicating between all parties. Maintaining access for the quilt shop. Trench safety. Rebar in trench, old gas line. Securing the site as we are not expected to work tomorrow (Sunday).
- 0730 Resume excavating the trench near location RXY SUECO
- \* Weather, clear, ~39°F, winds 10-15 mph. Forecast ~45°F, mostly sunny, winds 20-30 (gusts to 40)
- 0820 Finished excavation activities begin installing the 1 1/2" Sch 40 SUE pipe.
- 1300-1330 lunch break
- \* See notes on the piping connects to wells on next page.

SP



1040 End side activities. Remington Trihydro  
obst. meeting at 0900 tomorrow



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0850 Joel Riebli (JR) and Remington Technologies (Jonathan Wlebin, Robby Orr, & Joey Flowers) arrive on site.

0900 Tailgate safety meeting. Discussed being physically & mental ready to work, using stop work authority, being accountable for actions, communication with everyone. Hospital location, muster point locations, first aid kit/eye wash/fire extinguisher locations. PPE (level D). Any onsite personal entry work to be handled by Trihydro. Plan on performing the pressure test on the six 1 1/2" Schedule 40 pipe piping runs that start at each of the six SVE wells and go to the remediation shed. Discussed that the asphalt will be removed on Monday or Tuesday. Not sure on the excavated soils. Discussed keeping the site clean.

\* Weather, Cloudy ~50°F, winds 10-15 mph. Forecast calls for Cloudy, High at ~52°F winds 10-30 mph (gusts to 40)

0830 ~~0815~~ Begin pressure test on RXY SVE01 piping. Pressurized to 25 PSI. Packer installed in the SVE well.

1 \* Reposition the packer in the well ~~start~~ End test

0942 Start RXY SVE01 at 25 psi

Pg 2/2

0957 End RXY SVE01 pressure test; still holding 25 psi.

1023 Start 25 psi pressure test on RXY SVE02 piping

\* Found leak at quick connect end test

1028 Start RXY SVE02 pressure test.

\* slight leak - end

1043 Start RXY SVE02 pressure test.

1058 End RXY SVE02 pressure test still holding 25 psi.

1100 Start RXY SVE03 pressure test.

1115 End pressure test - passed

1116 Start RXY SVE04 pressure test.

1131 End pressure test at RXY SVE04 - passed

1134 Start RXY SVE05 pressure test

\* slight leak - reposition packer in well

1142 Start RXY SVE05 pressure test

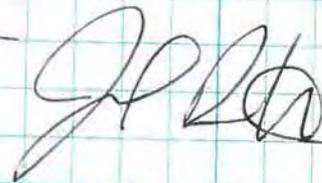
1157 End RXY SVE05 pressure test; passed

1159 Start RXY SVE06 pressure test.

1214 End RXY SVE06 pressure test, passed

1230 Remington / Trihydro off site.

— Joel Riebli



Location Havre, MTDate 12/07/2015Project / Client MDEQ SRS Roxy Cleaners

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770-023-002

0655 Joel Riebli (JR-Trihydro) arrives on site.

Remington (Jonathan Welebir, Robby Orr, &amp; Joey Flowers) arrive on site.

0700 Tailgate safety meeting. Discussed being ready to work, both mentally & physically. Being accountable, using stop work authority, Hospital locations, Muster point locations. First aid/Fire extinguisher eye wash locations. Using three points of contact entering/exiting equipment & trench. Communicating, Outsiders entering work zone to be taken care of by trihydro. Plan is to slow fill the trench, remove asphalt, six bricks, get 3/8" gravel over under the remediat shed. Rain (60%) tonight. High wind warning through Wednesday.

\* Weather 37°F, cloudy, winds 5-10 mph. Forecast ~48°F, cloudy, winds 20-30 mph (Gusts to 40), 60% chance of rain this evening.

0930 Remington made repairs to the block wall where bricks were damaged. Mixed up a batch of mortar and died it to match.

1040 Havre Redi-mix truck #1 arrives on site with Slow Fill.

1115 Havre Redi-mix Truck #2 arrives on site.

Date 12/07/15

Project / Client \_\_\_\_\_

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1145 Havre Redi Mix Truck #3 arrives on site. Truck only had 4 yds - 2 yds short.

1205 Havre Redi-mix truck #4 arrives on site with 2 yards.

1310 Havre Redi-mix delivers 3/8" pea gravel to the site.

1420 End day, Remington / Trihydro off site.  
- Joel Riebli



Location Havre, MTDate 12/08/2015Project / Client MDEQ ~~ASA-SRS~~ Roxy CleanersPg 1/2 776-023-002

0655 Joel Riebli (JR-Trihydro) arrives on site, rained overnight as the ground surface is wet with puddles. \_\_\_\_\_

0658 Remington (Jonathan Welebir, Robby Orr, & Joey Flowers) arrive on site. \_\_\_\_\_

0700 Tailgate Safety meeting: Discussed the 6 rules on safety. Hospital, First aid/eye wash/Fire extinguisher locations, water point locations. Three points of contact entrap/exiting equipment. Using eye spatter when concrete truck is on site. Hazards handling the concrete truck shut. Today's tasks: placing pea gravel in remediate system scotprint, install #4 rebar, cleaning up material next to asphalt/concrete edge. pour concrete remove asphalt/soil, cut/prepare for install of safety posts. \_\_\_\_\_

\* Weather Cloudy, 41°F, winds ~5 mph. Somewhat cloudy, ~50°F, winds 20-30 mph (casts to 40) \_\_\_\_\_

0730 Plan Siguras calls for #4 and #5 rebar under the remediation system scotprint. We are going to go with the #5 rebar since the manufacturer of the remediation shed calls for this size. Sent Jim Grewson

Location \_\_\_\_\_

Date 12/08/2015

Project / Client \_\_\_\_\_

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and email about this. \_\_\_\_\_

0900 Side dump arrives on site to take the asphalt. \_\_\_\_\_

1020 Second side dump arrives on site, this time to take the excavated soils to the landfill. \_\_\_\_\_

1050 Third side dump load arrives on site, soils. \_\_\_\_\_

1125 Havre Redi-mix arrives on site with truck load of concrete. \_\_\_\_\_

1140 Fourth side dump load arrives, takes third load of excavated soils to the landfill. \_\_\_\_\_

1315 Second Havre Redi-mix truck arrives with 4000 psi concrete. \_\_\_\_\_

1540-1610 late lunch break. \_\_\_\_\_

1710 End site activities; Remington/Trihydro off site. — Joel Riebli



Location Havre, MTDate 12/09/2015Project / Client MDEQ SRS Rocky Cleaners

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776-023-002

0655 Joel Riebli (JR - Trihydro) arrives on site. Temp 48°F, cloudy, winds v. synth. Forecast. Temp 55°F, cloudy, winds 20-30 mph (gusts to 50 mph) 20% chance of rain

0658 Reington arrives on site (Jonathan W., Robby O., and Tony F.)

0700 Tailgate safety meeting. Discussed the six safety rules, Hospital/Muster point/safety items locations. Last day on job - keep focused. V. care cutter on asphalt, keep good grip on the unit. Sweeper on the bobcat, lie at side hazard - need to plan on the direction sweeping. Forward. Bobcat/backhoe awareness. Secure gear for demobilization.

\* Borrow the bobcat sweeper attachment on the Park Hotel owner. sweep parking lot work area.

\* Cut the location of the billboards (4) with core cutter. Remove asphalt and save base material.

0835 Jim Gleason calls. Discussed the concrete pour completion. The TCE ND PEE 0.48 mg/kg lab result. Asphalt taken for recycling and the soil taken to the

Date 12/09/2015

Project / Client

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landfill. Reington is cutting the billboards locations. Will fill with sand. After the building is installed the road will be removed and the billboards will be concreted in.

Around noon tomorrow I will remove the curbs and get out the items on the new concrete pour. The curb stops will be placed and secured after the building is installed and the billboards are concreted. Mr. Hamilton might mention the stripping on the asphalt.

\* Put up caution tape around the SVE piping sticking out of the remediation building footprint.

\* Placed trash cans back on the new concrete pad and the red benches removed the ramp that went to the Beverly Square stored. The curb stops will be placed on a later date.

\* 1105 Reington departs the site.

\* 1130 JR left a voice message for Mr. Michael Hamilton. Gave update on the concrete pour, holding off on the curb stops, building should be arriving in about 10-14 days.

Location Haure, MTDate 12/09/2015Project / Client MDEQ SRS Roxy Cleaners

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776-023-002

- 1140 JR departs the site. \_\_\_\_\_  
 1150 JR departs Haure \_\_\_\_\_  
 1540 Arrived at the Helena office  
 - Joel Ricchi

Location Helena → Haure,Date 12/21/2015

Project / Client \_\_\_\_\_

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- 0815 Spoke with Jim Gleason, Rocky Mountain -  
 storage is ahead of schedule at delivery  
 the remediation shed to Haure. Call Phil  
 at 970-567-3032 as he thinks he  
 will arrive in Haure around 3:30 today.
- 0825 Spoke with Phil Lupp with Process Technology  
 supports will meet at 1500 today in  
 Haure.
- 0945 Rent Bosch rotary hammer drill and 5/8"  
 concrete bit from A-1 Rentals. \_\_\_\_\_
- 1100 JR departs the Helena office. \_\_\_\_\_
- 1445 JR arrives at the project site in Haure,  
 light snow on the ground. \_\_\_\_\_
- 1505 Phil called running a little late. \_\_\_\_\_
- 1520 Phil Lupp arrives on site with the  
 remediation shed. Looks good in the  
 transport. Phil asked that the raised  
 piping be cut down to 6" from the  
 current 2'. Used Phil's sawzall to  
 cut down the piping. Placed ~~building~~ shed  
 over piping. \_\_\_\_\_
- 1635 Phil on site. \_\_\_\_\_
- \* JR using rotary hammer drills and sets the  
 8 concrete ~~sp~~ anchors into the angle  
 iron. 1740 JR on site. \_\_\_\_\_

Location HaureDate 12/22/2015Project / Client MDEQ SRS Rocky CleanersPg 1/2 776-023-002

0800 JR arrives at the site, about 1 1/2"  
of snow fell overnight and still snowing.

\* Unable to get the 3/8" drill bit to  
work with the rented rotary hammer drill.

#0845 Rent electric drill from Haure  
Rental

\* Secure the angle iron to the building  
at the eight anchor points.

\* Connect the six pvc stub piping to  
the building piping.

1125 JR spoke with Jim Gleason about  
status update need to get some  
expanding foam for near stub piping  
and locks for PLC & electric panel.

\* Returned electric drill to Haure Rental  
total \$8.

1220 Purchased Great stuff big gap insulation  
and masterlock. From North 40. Total \$33.92

1255 Electric stopped by the site - waiting  
on paperwork before he can start.

1310 JR offsite.

1345 JR departs Haure.

1655 Arrive Helena.

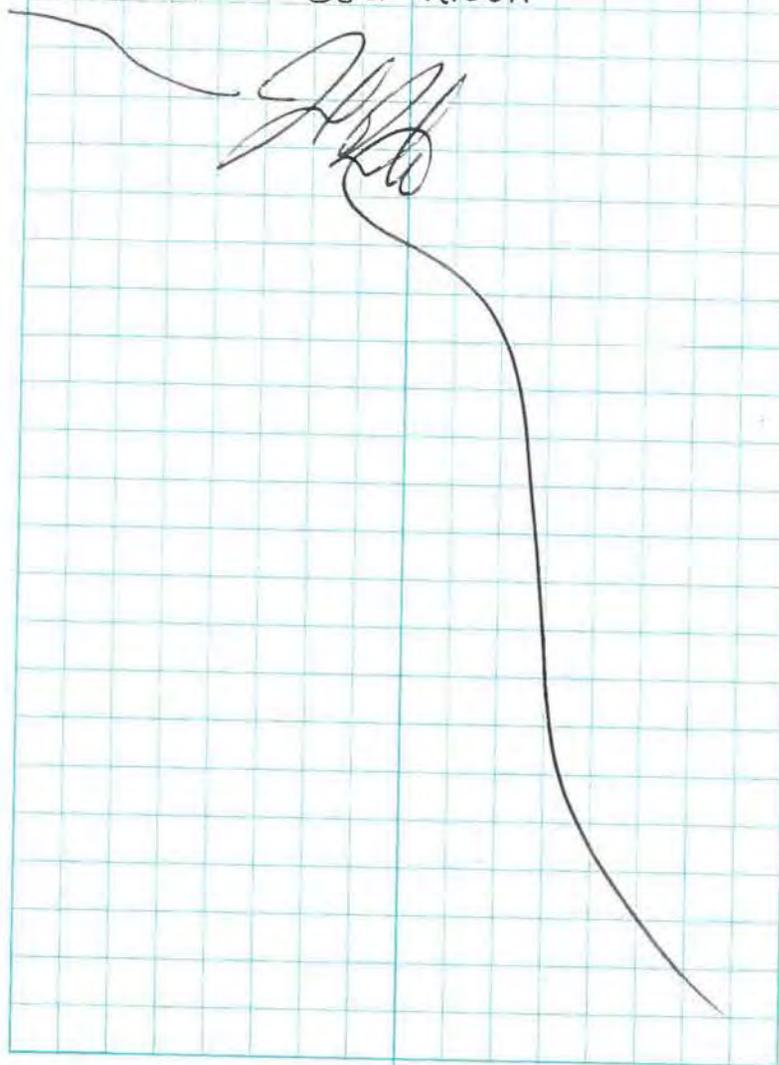
1700 Return Rotary Hammer and 5/8" drill bit  
to A-I Rental. Total \$63.75

Location HelenaDate 12/22/2015

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1725 JR arrives back at the Helena  
office. - Joel Riubli





4 Location Haure, MT Date 11/09/2015

Project / Client MDEQ SRS Roxy Cleaners

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0730 Joel Riebli (JR) purchases distilled water at grocery store. Total \$ 1.79

0740 JR arrives at the former Roxy Cleaners property.

\* Boland Drilling called in re 811 utility locate. Ticket # 15100804.

\* Charter marked no utilities in parking lot

\* Northwestern Energy marked no utilities in parking lot but marked gas line on the south edge of main street. Overhead power lines on the western side of the parking lot.

\* City of Haure - sewer line under main street - water line under US Route 2. Water line marked about 20' west of the Bearly Square Quilting building off of US Route 2. Do not know where the line goes on the parking lot.

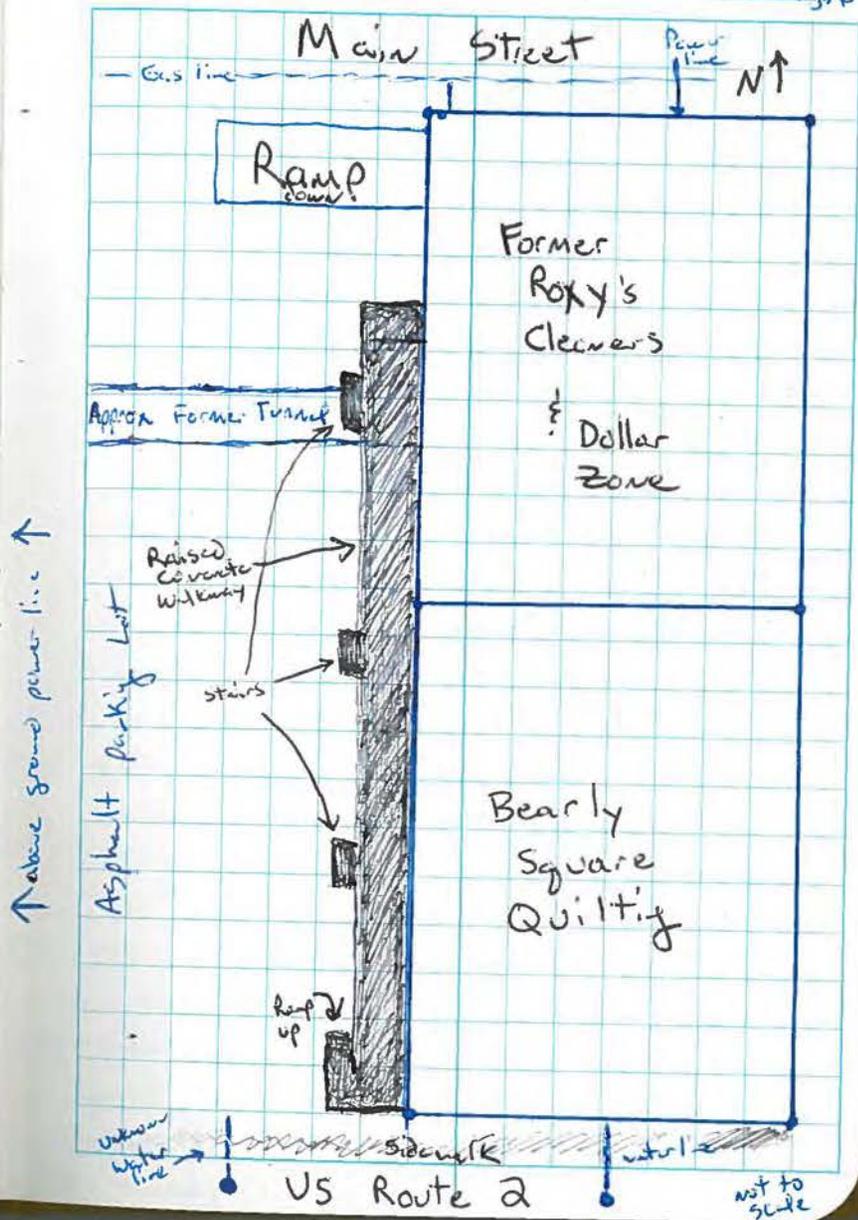
0815 Called Jim Gleason about the unknown water line that Boland will need to start - where it goes before drilling can start.

0845 Boland Drilling arrives on site. Chris Boland (Driller) & Chuck Belter (driller-helper)

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Location Havre, MT Date 11/09/2015Project / Client MDEQ SRS Roxy Cleaners

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0900 Tailgate safety meeting with Boland, discuss utility locates, the unknown water line, stop work authority, some dry cleaners contain, noise hazards, pedestrian hazards, inspecting the drill rig, slip/trip/fall, pinch points.

0915 City of Havre utility department arrives on site. said the unknown water line is shown as no longer being tied in with the water line, that the city hall building was in the parking lot and that three water lines were not connected to the water line when the water line was upgraded a few years ago. They checked to see if the valve was closed but unable to since it wouldn't budge. They did say that the water line under the Beauty Square / Dollar Zone is just south of the Beauty Square building.

\* Inspect drill rig (CME 55 hollow stem auger).

\* Calibrate the TNA 1000B FID/PID (Serial # 68692) using 100ppm methane (LOT # FAO-150A-100-3) cal gas (SP)

Location \_\_\_\_\_ Date 11/09/2015 7

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\* SVE location RXYSVE06 is Sully next to the ramp. The location was moved to the North.

1000 Boland Drilling starts drilling RXYSVE06 using a 6" diameter hollow stem auger and split spoon sampler. SEE field notes.

1150 End drilling RXYSVE06. Drilled to 125' bgs. well screen is between 7'-12' bgs. 10/20 silica sand around the slotted screen on Bentonite above the sand and screens the top 4' of the well, 10/20 sand around the pipe. Drill pipe cleaned.

1200 Start drilling RXY SVE 05 (next to one of the concrete stairs near the entrance to Beauty Square Quilting)

1350 End drilling RXY SVE 05. Drilled to 125' bgs. well screen is between 7-12' bgs with 10/20 silica sand as the filter pack. Drill pipe was cleaned.

1355 Start drilling RXY SVE 04 (next to one of the concrete stairs).

1520 End drilling RXY SVE 04. Drilled to 125' bgs with the well screen between 7-12'. 10/20 silica sand filter pack. Drill pipe cleaned. (SP)

Location Haure, VTDate 11/09/2015Project / Client MDEQ SRS Roxys Cleaners.

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776-023-002.1530 Start drilling <sup>SP</sup>~~SVE~~ RXYSVE03.

1610 AT ~7' bgs drill into concrete structure - unable to proceed; location filled with bentonite chips (hydrated).

1630 Start drilling RXYSVE03 attempt #2 (moved location about 10' to the north).

1700 AT 7' bgs drill encountered the concrete structure once again; location plugged and pipe cleaned.

1730 Boland / Trihydro OSS site - plan a meeting at 0730 tomorrow.  
-Joel Riabli

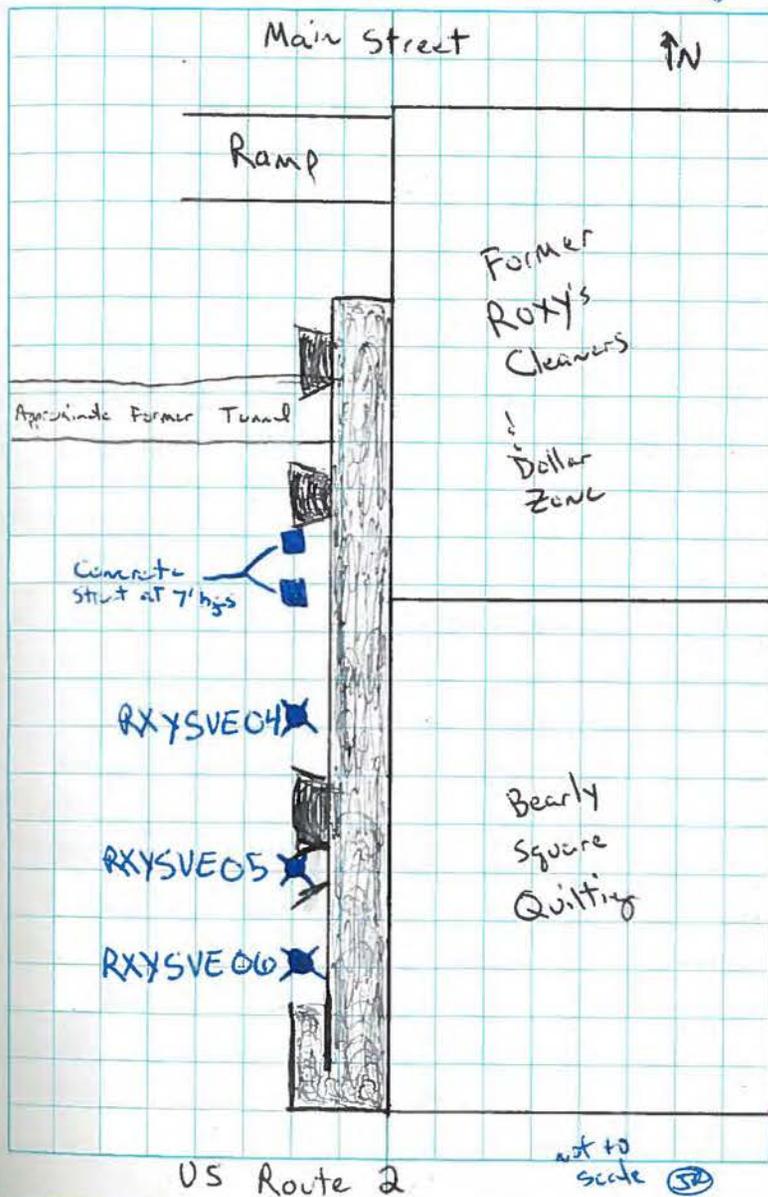

Location \_\_\_\_\_

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①

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- 0710 Joel Riebli (JR) arrives at the former Roxy's Cleaners. Light snow, ~31°F, etc.
- 0715 Boland Drilling (Chris Boland) & (Chuck Beltr) arrive on site.
- 0720 Tailgate safety meeting. Good job comming and spotting vehicles. Discussed the three remark locations, the former tunnel, the large ramp, weather conditions, stop work authority, emergency info.
- \* Boland inspects drill rig.
  - \* JR calibrates the TVA 100CB FID/PID with the 100 ppm methane calibrati gas.
- 0745 start drilling RXY SVE03 (attempt #3) ~~but~~ stepped out between the previous two attempts.
- 0800 Encountered concrete at 7' bgs. Back fill hole with bentonite (hydrated) cleaned drilling pipe.
- 0805 JR called Jim Gleason. Discussed drilling closer to SVE02 location.
- 0815 start drilling near the RXY SVE02 locati. Just south of the former tunnel.
- 0830 Encountered concrete at 7' bgs. Back filled hole with bentonite.

- 0833 JR called Jim; discussed stepping out 10' away towards the west.
- 0850 Start drilling; found concrete at 7' bgs.
- 0920 stepped out 10' additional south. Began drilling. Encountering concrete at 7' bgs.
- 0930 Called Jim; discussed stepping out to 40' from the former Roxy Cleaners building.
- 0945 Start drilling ~40' from building; Encountered concrete at 7' bgs. Back filled hole with hydrated bentonite and cleaned drill pipe.
- 1015 start drilling at RXY SVE01. Encountered concrete at 7' bgs. Back filled with hydrated bentonite.
- \* Stopped drilling need different option due to the concrete at ~7' bgs.
- 1040 Spoked with Jim. Discussed getting cost estimates using a air rotary drill rig to get through the concrete at 3' bgs.
- \* Boland using cold patch asphalt to patch the three SVE completed locations and the 8 boreholes where concrete was encountered.

Location Haure → Helena Date 11/10/2015

Project / Client MDEQ SRS Roxxy Cleaners

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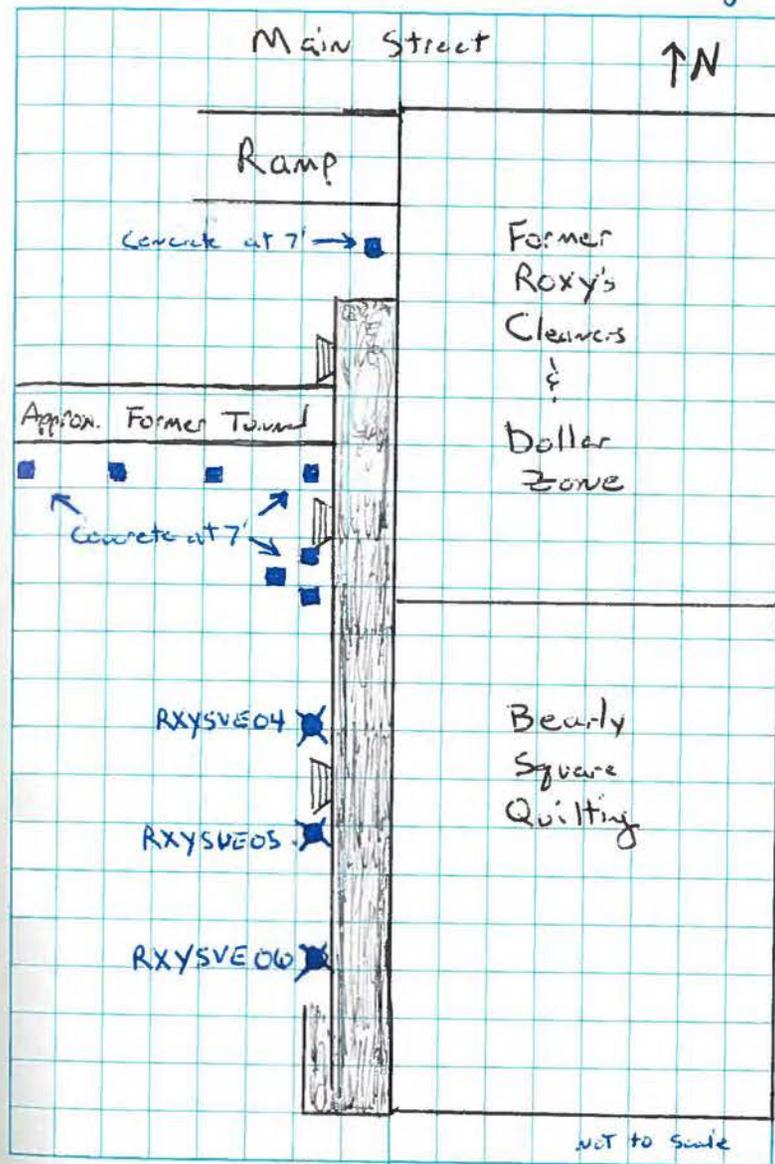
1240 JR departs Haure  
1645 JR arrives at the Helena office.  
- Joel Riebli



Location \_\_\_\_\_ Date 11/10/2015

Project / Client \_\_\_\_\_

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SP

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776-023-002



- 0425 Joel Ricbli (JR) arrives at Helena office, load field truck
- 0505 JR departs the Helena office
- 0835 JR arrives at the former Roxy Cleaners in Haure, Temp ~11°F, about 1 inch of snow on the ground
- \* Spoke with Jim Gleason - talked about starting at RXYSVE01 location
- 0910 Boland Drilling (Chris Boland, Jason Posey, & Trevor Marks). Bring up the CME 55 hollow stem auger drill rig, air compressor (to perform air rotary) and their box truck/trailer
- 0915 Review HASP & conduct tailgate safety meeting. Discussed the dry cleaner, stop work, drilling locations, muster points, first extinguishers, first aid kits, pinch points, slip/trip/fall on snow/ice, p.p.g., hoses, curbs.
- 0948 Begin drilling RXYSVE01, drilling in the same location that was previously drilled on 11/10 down to 7' bgs. Boland used the hollow stem auger down to 7' bgs and the contact with the concrete. Switch out piping over to



Pg 2/4

- on 6" air rotary piping. Use air compressor push/break through the ~4" concrete. Remove piping and go back to the 6" hollow stem auger. Use split spact to sample soil below 8' bgs. Drilled down to 13' bgs. Water table looks to be at ~12.5' bgs. The bottom 6" is the sump. Screen installed between 7.5' & 12.5' bgs. 10/20 silica sand installed around the slotted well screen. 2.5' of bentonite installed between 4.5' & 7' bgs.
- 1245 ~~with~~ Drilling pipe was cleaned. Begin drilling well ~~SUE~~ SUE well RXYSVE02. This location was previously drilled down to 7' bgs (concrete) on 11/10. This well was drilled just as RXYSVE02 (hollow stem down to 7', Air Rotary 7'-8', hollow stem 8'-13' bgs). Concrete appears to be about 6" thick. ~~with~~ sump 12.5-13' bgs well screen 7.5-12.5'. 10/20 silica sand around slotted screen. Well pipe cleaned
- 1420 Begin drilling well RXYSVE03. This location was previously drilled down to 7' bgs on 11/09. The concrete appears to be about 10" thick. sump = 12.5-13' bgs. slotted screen

Location HavreDate 11/30/2015Project / Client MDEQ SRS Roxy Cleaners

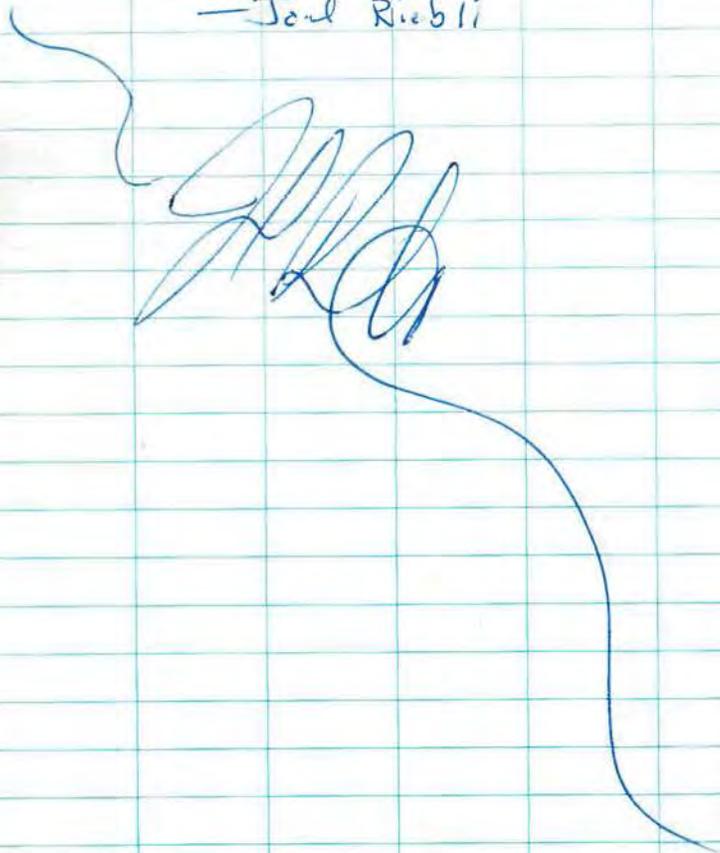
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776-023-002JR

7.5-12.5' bgs, 10/20 silica sand around  
the slotted screens.

1625 Boland drilling & JR departs  
Havre.

1805 JR arrives in Helena  
—Jarl Riebli



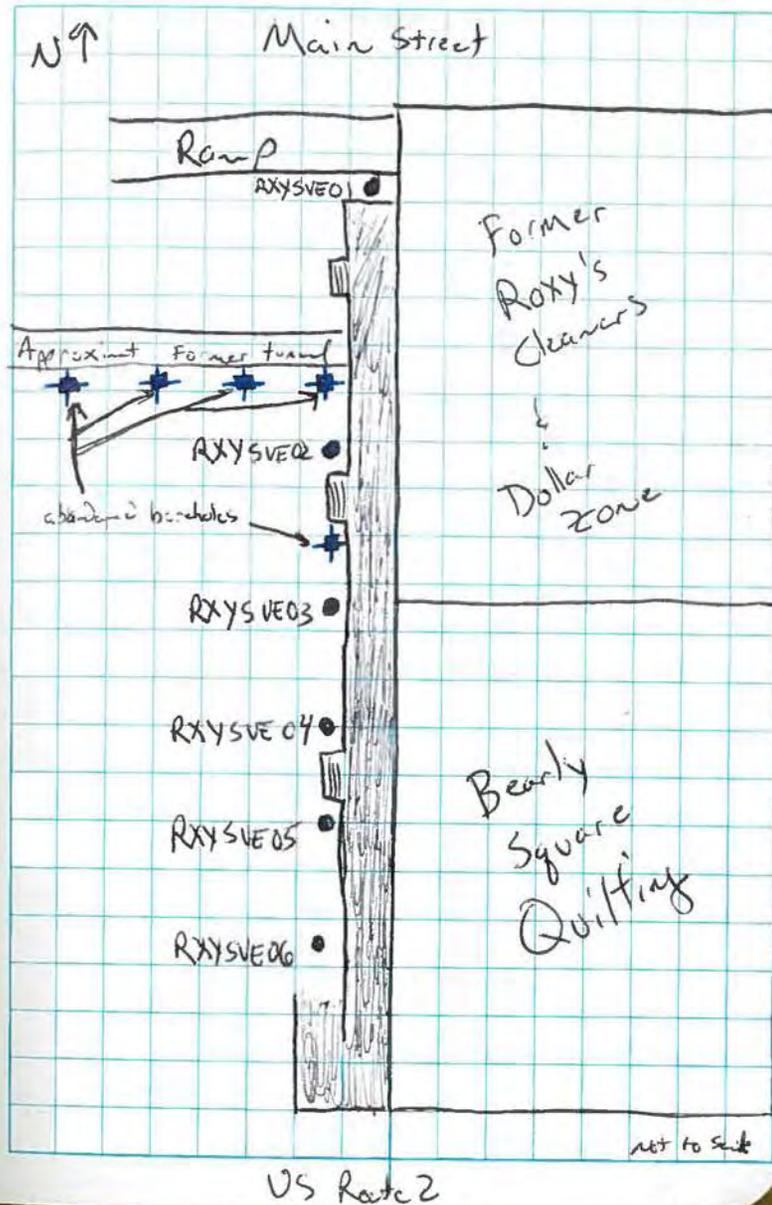
Location \_\_\_\_\_

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SP

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Location Helena/Havre

Date 12/02/2015

Project / Client MDEQ SRS Roxy Cleaners

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776-023-002

JD

- \* Call with Remington's Sue Harem. The Montana 811 utility ticket is # 15105051
  - 1350 Spoke with Remington's Jonathan Welebin. Remington has made it to Havre, plan on meeting at 0700 tomorrow
  - 1415 JR departs The Helena office
  - 1745 JR arrives in Havre.
- Joel Riebli

Location

Date 12/03/2015

Project / Client

JD

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- 0655 Joel Riebli (JR) arrives at The former Roxy's Cleaners. Some ice still on the ground.
- 0658 Remington (Jonathan Welebin, Robby Orr, Joey Flowers) arrive on site. They have a bobcat 5510 with them.
- 0700 Tailgate Safety meeting. Discuss stop work authority, no six blade knives, Route to Hospital, muster points, first aid/first extinguisher/eye wash locations, Level D PPE, TCE/PCE contamination, cold stress, weather, Traffic/Pedestrians, Slip/trip/fall on icy surface conditions, Spotter, inspecting bobcat & back hoe.
- \* Planned tasks, set up work zone allowing pathway to the Bearly Square ~~to~~ store - allowing access via ramp. Going through supply and gear, around noon, early afternoon start cutting the asphalt.
- \* Discussed the width of the piping trench. Plans call for a 36 inch wide trench. When at the furthest point (RXYSVE05 & RXYSVE06) can the trench be cut less than 36 inch wide? Send an email to Jim Gleason/Andrew Vond and got back a response that it can be less than 36" wide.

20

Location Havre, MTDate 12/03/2015Project / Client MDEQ SRS Roxy CleanersPg 2/5776-023-002

1025 Rented John Deere 31056 backhoe arrives on site.

1230 Begin cutting the asphalt

1235 Mr. Hamilton stopped by the site. Discusses the trench location, keeping the ramp open for the Beady square shop. Went down in the garage and looked at the injecta areas. Rooms on the west wall will need to be hand covered as the door ways are too small to get a rig through. Multiple car's are in areas that will need to be moved. Will take a plan on where to move items to gain access for the injection rig.

~~1425 Remington using the John Deere backhoe to remove the 2" thick asphalt in the future shed and~~

1305 JR called Jim Gleason regarding seeing the basement work areas. Lots of items will need to be moved, including vehicles, bikes, storage items. Also discussed that Michael Hamilton that all asphalt between the trench & raised sidewalk are to be removed and replaced with concrete. Jim said that this was

Location \_\_\_\_\_

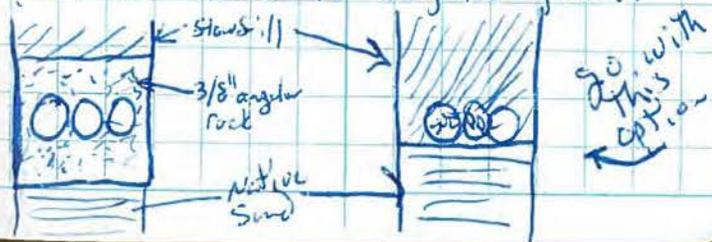
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discussed with Remington (either Chester or Grant) on removing this strip of asphalt. That Mr. Hamilton is correct that the asphalt strip will be removed up to the wall and be replaced with concrete. Tom also was informed by Remington that they are not able to get  $3/8$ " rounded pea gravel for the material ~~below~~ below and around the SVE piping in the trench. They can get  $3/8$ " angular rock (used in concrete). Discussed using the  $3/8$ " angular rock (possible damage to the  $1\frac{1}{2}$ " sch 40 SVE pipe. Also discussed having the SVE pipe on compacted native soils (sand) and covering with the slow fill (hard sand). We do not see any possible damage to the pipe using the slow fill. Decided to go with slow fill over the pipe rather than  $3/8$ " angular gravel.



Go with this option

1425 Remington begins using the John Deere backhoe to remove the 3" thick asphalt using the bucket to strip the material within the cut/scored work area. Start in the RXY5VECI area.

Bobcat making a stockpile of the removed asphalt west of the Saton remediation system position.

1515 Noticed that the north western corner of the raised sidewalk brick wall has been chipped during asphalt removal activities. ~1/2" chip missing from the corner. Contacted Jim Gleason of the property damage incident. Remington's field supervisor Jonathan Welebir stopped work and spoke with both the backhoe and bobcat operators regarding the contact with the wall.

1530 Joel left a voice message with property owner Michael Hamilton.

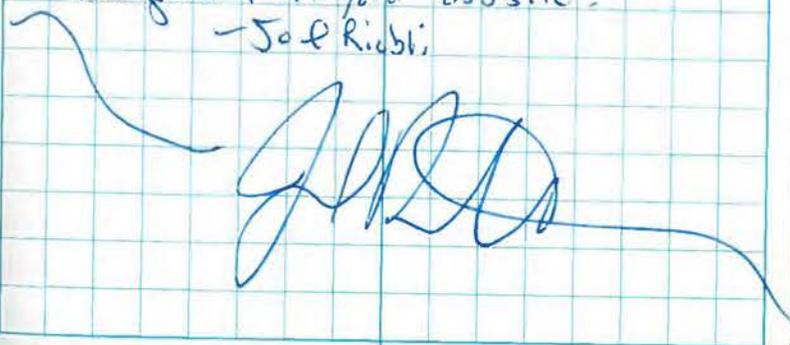
1525 Property owner Michael Hamilton stopped by the jobsite. Joel escorted Mr. Hamilton to the damage brick. Mr. Hamilton was not concerned with the brick.

Remington's Jonathan said Remington will repair the damaged brick. Mr. Hamilton asked if an additional 5' x ~30' section of asphalt could be removed and replaced with concrete. This is north of the work area will run it by Jim Gleason.

\* Send Jim Gleason an email about the 5' x 30' section of asphalt that Mr. Hamilton requested be removed and replaced with concrete. That it is between the remainder shed and ramp but out of the scope. Jim said ~~not~~ <sup>not</sup>.

1645 Begin shutting down asphalt removal activities. Call has been broken up and ~80% has been placed in a stockpile.

1715 Remington / Trihydro offsite.  
- Joel Riichi



Location Haure, MT Date 12/04/2015Project / Client MDEQ SRS Roxy CleanersPg 1/3 776-023-002

0655 Joel Riebli (JR-Trihylic) arrives at the former Roxy Cleaners. Temp ~ 31°F, mostly clear, with light winds. Forecast is calling for temps to reach in the mid 40's with winds 20-30 mph (Gust to 40).

0658 Remington Technologies (Jonathan Welch, Robby Orr, & Joey Flowers) arrive on site.

0700 Tail gate safety meeting. Discussed the weather, communication between crews, use of step work, being physically and mentally ready to work, being accountable for their actions. Went over the Hoopel, muster points, and first aid/first extinguisher/eye wash location. Discussed the property damage yesterday with the backhoe and brick wall. That do not position your self to the right of the bucket, as its jumpy. Discussed removing the asphalt in a safe and controlled speed up against the brick wall. Next starting to trench going North to South.

0740 Resume removing broken asphalt from the southern portion of the trench work zone. Once again using the bucket to transport asphalt to the stockpile.

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0815 Begin excavation work with backhoe at the remediation system shed location. Trench will go deeper (slope) towards the 6 SUE wells.

1115 Site property owner Michael Hamilton stopped by the site to look at the parking availability. There is about 10 vehicles in the parking lot that haven't moved since the drilling work on Monday. There is a vendor tending plunkets taking up 4 or 5 spots and this construction work is taking up additional parking. There is about 5 spots currently open.

1330-1400 lunch break

\* Near SUE location RXX SUE 04, concrete with rebar is below the asphalt (about 5" below) in the trench area. Switching between backhoe & bobcat with jackhammer attachment breaking up the concrete.

\* Concrete ended near location RXX SUE 05

1740 Begin shutting down

1745 Site property owner Michael Hamilton stopped by to see progress and

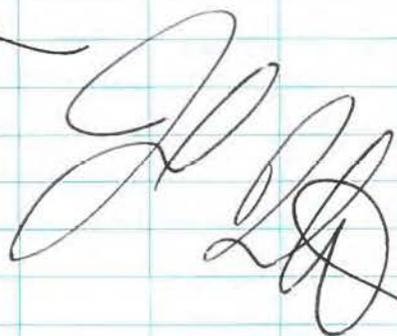
Location Haure, MTDate 12/04/2015Project / Client MDEQ SRS Roxy Cleaners776-023-002

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the access to The Bearly Square  
store. No issues.

1750 Remington / Trihydro off site. —

— Joel Ricbli


Date 12/05/2015 <sup>27</sup>

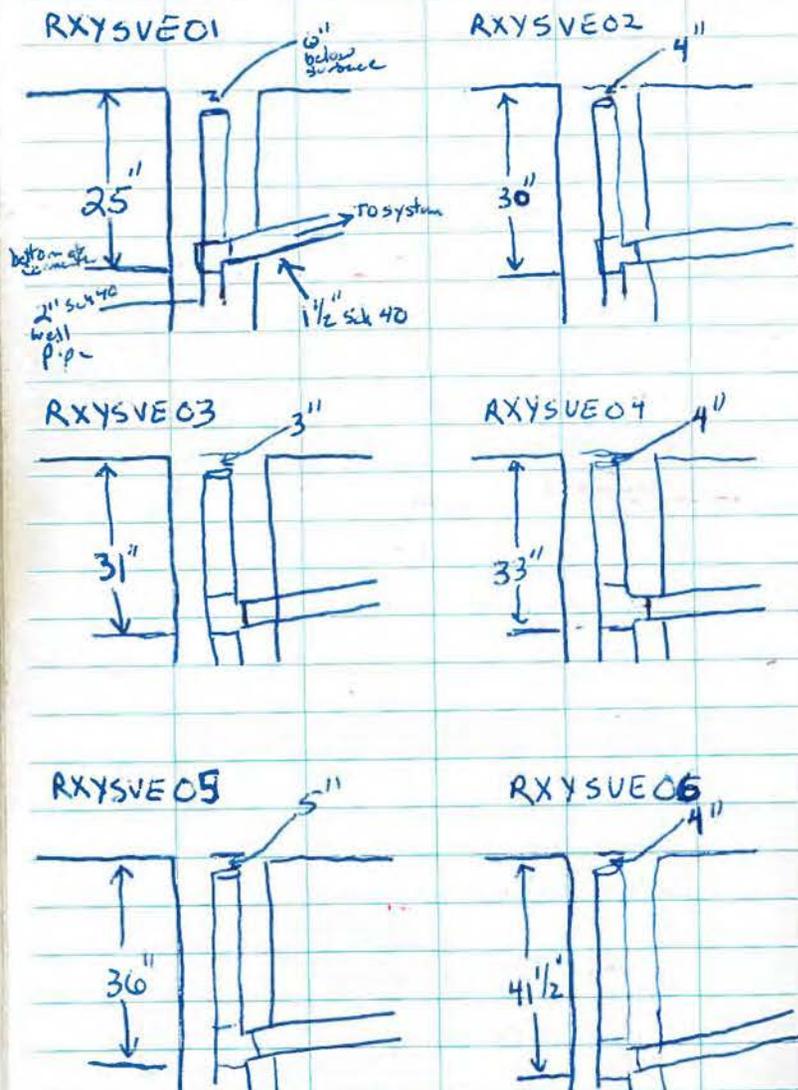
Project / Client \_\_\_\_\_

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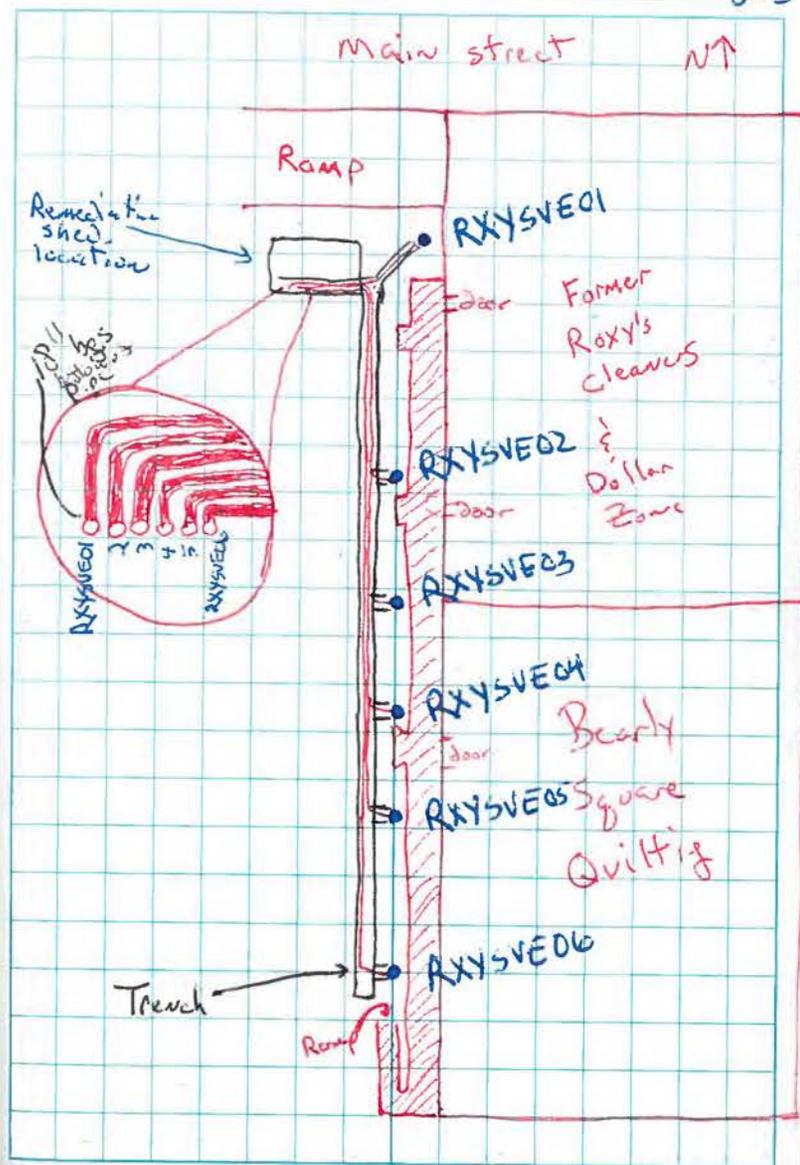
Pg 1/3

- 0655 Joel Ricbli (JR) arrives at the Roxy Cleaners site. Two safety cones blew over last night - no issue.
- 0658 Remington Technologies (Jonathan Welebig, Robby Orr, & Joey Flowers) arrives onsite.
- 0700 Tailgate safety meeting. Discussed having the right mind set for working. Using stop work authority. Taking responsibilities for your actions. Hospital, mustar points, weather. Communication between all parties. Maintaining access for the quilt shop. Trench safety. Rebar in trench, old gas line. Securing the site as we are not expected to work tomorrow (Sunday).
- 0730 Resume excavating the trench near location RXY SUECO
- \* Weather, clear, ~39°F, winds 10-15 mph. Forecast ~45°F, mostly sunny, winds 20-30 (gusts to 40)
- 0820 Finished excavation activities begin installing the 1 1/2" Sch 40 SUE pipe.
- 1300-1330 lunch break
- \* See notes on the piping connects to wells on next page.

SP



1040 End side activities. Remington Trihydro  
 obs'te. meeting at 0900 tomorrow



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0850 Joel Riebli (JR) and Remington Technologies (Jonathan Wlebin, Robby Orr, & Joey Flowers) arrive on site.

0900 Tailgate safety meeting. Discussed being physically & mental ready to work, using stop work authority, being accountable for actions, communication with everyone. Hospital location, muster point locations, first aid kit/eye wash/fire extinguisher locations. PPE (level D). Any onsite personal entry work to be handled by Trihydro. Plan on performing the pressure test on the six 1 1/2" Schedule 40 pipe piping runs that start at each of the six SVE wells and go to the remediation shed. Discussed that the asphalt will be removed on Monday or Tuesday. Not sure on the excavated soils. Discussed keeping the site clean.

\* Weather, Cloudy ~50°F, winds 10-15 mph. Forecast calls for Cloudy, High at ~52°F winds 10-30 mph (Gusts to 40)

0830 ~~0815~~ Begin pressure test on RXY SVE01 piping. Pressurized to 25 PSI. Packer installed in the SVE well.

1 \* Reposition the packer in the well ~~start~~ End test

0942 Start RXY SVE01 at 25 psi

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0957 End RXY SVE01 pressure test; still holding 25 psi.

1023 Start 25 psi pressure test on RXY SVE02 piping

\* Found leak at quick connect end test

1028 Start RXY SVE02 pressure test.

\* slight leak - end

1043 Start RXY SVE02 pressure test.

1058 End RXY SVE02 pressure test still holding 25 psi.

1100 Start RXY SVE03 pressure test.

1115 End pressure test - passed

1116 Start RXY SVE04 pressure test.

1131 End pressure test at RXY SVE04 - passed

1134 Start RXY SVE05 pressure test

\* slight leak - reposition packer in well

1142 Start RXY SVE05 pressure test

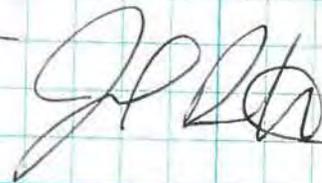
1157 End RXY SVE05 pressure test; passed

1159 Start RXY SVE06 pressure test.

1214 End RXY SVE06 pressure test, passed

1230 Remington / Trihydro off site.

— Joel Riebli



Location Havre, MTDate 12/07/2015Project / Client MDEQ SRS Roxy Cleaners

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770-023-002

0655 Joel Riebli (JR-Trihydro) arrives on site.

Remington (Jonathan Welebir, Robby Orr, &amp; Joey Flowers) arrive on site.

0700 Tailgate safety meeting. Discussed being ready to work, both mentally & physically. Being accountable, using stop work authority, Hospital locations, Muster point locations. First aid/Fire extinguisher eye wash locations. Using three points of contact entering/exiting equipment & trench. Communicating, Outsiders entering work zone to be taken care of by trihydro. Plan is to slow fill the trench, remove asphalt, six bricks, get 3/8" gravel over under the remediation shed. Rain (60%) tonight. High wind warning through Wednesday.

\* Weather 37°F, cloudy, winds 5-10 mph. Forecast ~48°F, cloudy, winds 20-30 mph (Gusts to 40), 60% chance of rain this evening.

0930 Remington made repairs to the block wall where bricks were damaged. Mixed up a batch of mortar and died it to match.

1040 Havre Redi-mix truck #1 arrives on site with Slow Fill.

1115 Havre Redi-mix Truck #2 arrives on site.

Date 12/07/15

Project / Client \_\_\_\_\_

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1145 Havre Redi Mix Truck #3 arrives on site. Truck only had 4 yds - 2 yds short.

1205 Havre Redi-mix truck #4 arrives on site with 2 yards.

1310 Havre Redi-mix delivers 3/8" pea gravel to the site.

1420 End day, Remington / Trihydro off site.  
- Joel Riebli



Location Havre, MTDate 12/08/2015Project / Client MDEQ ~~ASA-SRS~~ Roxy CleanersPg 1/2 776-023-002

0655 Joel Riebli (JR-Trihydro) arrives on site, rained overnight as the ground surface is wet with puddles. \_\_\_\_\_

0658 Remington (Jonathan Welebir, Robby Orr, & Joey Flowers) arrive on site. \_\_\_\_\_

0700 Tailgate Safety meeting: Discussed the 6 rules on safety. Hospital, First aid/eye wash/Fire extinguisher locations, water point locations. Three points of contact entrap/exiting equipment. Using eye spatter when concrete truck is on site. Hazards handling the concrete truck shut. Today's tasks: placing pea gravel in remediate system scotprint, install #4 rebar, cleaning up material next to asphalt/concrete edge. pour concrete remove asphalt/soil, cut/prepare for install of safety posts. \_\_\_\_\_

\* Weather Cloudy, 41°F, winds ~5 mph. Somewhat cloudy, ~50°F, winds 20-30 mph (casts to 40) \_\_\_\_\_

0730 Plan Siguras calls for #4 and #5 rebar under the remediation system scotprint. We are going to go with the #5 rebar since the manufacturer of the remediation shed calls for this size. Sent Jim Grewson

Location \_\_\_\_\_

Date 12/08/2015

Project / Client \_\_\_\_\_

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and email about this. \_\_\_\_\_

0900 Side dump arrives on site to take the asphalt. \_\_\_\_\_

1020 Second side dump arrives on site, this time to take the excavated soils to the landfill. \_\_\_\_\_

1050 Third side dump load arrives on site, soils. \_\_\_\_\_

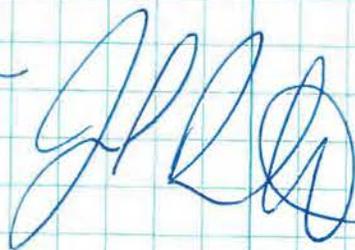
1125 Havre Redi-mix arrives on site with truck load of concrete. \_\_\_\_\_

1140 Fourth side dump load arrives, takes third load of excavated soils to the landfill. \_\_\_\_\_

1315 Second Havre Redi-mix truck arrives with 4000 psi concrete. \_\_\_\_\_

1540-1610 late lunch break. \_\_\_\_\_

1710 End site activities; Remington/Trihydro off site. — Joel Riebli



Location Havre, MTDate 12/09/2015Project / Client MDEQ SRS Rocky Cleaners

Pg 1/3

776-023-002

0655 Joel Riebli (JR - Trihydro) arrives on site. Temp 48°F, cloudy, winds v. synth. Forecast. Temp 55°F, cloudy, winds 20-30 mph (gusts to 50 mph) 20% chance of rain

0658 Reington arrives on site (Jonathan W., Robby O., and Tony F.)

0700 Tailgate safety meeting. Discussed the six safety rules, Hospital/Muster point/safety items locations. Last day on job - keep focused. V. care cutter on asphalt, keep good grip on the unit. Sweeper on the bobcat, lie at side hazard - need to plan on the direction sweeping. Forward. Bobcat/backhoe awareness. Secure gear for demobilization.

\* Borrow the bobcat sweeper attachment on the Park Hotel owner. Sweep parking lot work area.

\* Cut the location of the billboards (4) with core cutter. Remove asphalt and save base material.

0835 Jim Gleason calls. Discussed the concrete pour completion. The TCE ND PEE 0.48 mg/kg lab result. Asphalt taken for recycling and the soil taken to the

Date 12/09/2015

Project / Client

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landfill. Reington is cutting the billboards locations. Will fill with sand. After the building is installed the road will be removed and the billboards will be concreted in.

Around noon tomorrow I will remove the curbs and get out the items on the new concrete pour. The curb stops will be placed and secured after the building is installed and the billboards are concreted. Mr. Hamilton might mention the stripping on the asphalt.

\* Put up caution tape around the SVE piping sticking out of the remediation building footprint.

\* Placed trash cans back on the new concrete pad and the red benches removed the ramp that went to the Beverly Square stored. The curb stops will be placed on a later date.

\* 1105 Reington departs the site.

\* 1130 JR left a voice message for Mr. Michael Hamilton. Gave update on the concrete pour, holding off on the curb stops, building should be arriving in about 10-14 days.

Location Haure, MTDate 12/09/2015Project / Client MDEQ SRS Roxy Cleaners

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776-023-002

- 1140 JR departs the site. \_\_\_\_\_  
 1150 JR departs Haure \_\_\_\_\_  
 1540 Arrived at the Helena office  
 - Joel Ricchi

Location Helena → Haure,Date 12/21/2015

Project / Client \_\_\_\_\_

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- 0815 Spoke with Jim Gleason, Rocky Mountain -  
 storage is ahead of schedule at delivery  
 the remediation shed to Haure. Call Phil  
 at 970-567-3032 as he thinks he  
 will arrive in Haure around 3:30 today.
- 0825 Spoke with Phil Lapp with Process Technology  
 supports will meet at 1500 today in  
 Haure.
- 0945 Rent Bosch rotary hammer drill and 5/8"  
 concrete bit from A-1 Rentals. \_\_\_\_\_
- 1100 JR departs the Helena office. \_\_\_\_\_
- 1445 JR arrives at the project site in Haure,  
 light snow on the ground. \_\_\_\_\_
- 1505 Phil called running a little late. \_\_\_\_\_
- 1520 Phil Lapp arrives on site with the  
 remediation shed. Looks good in the  
 transport. Phil asked that the raised  
 piping be cut down to 6" from the  
 current 2'. Used Phil's sawzall to  
 cut down the piping. Placed ~~building~~ shed  
 over piping. \_\_\_\_\_
- 1635 Phil on site. \_\_\_\_\_
- \* JR using rotary hammer drills and sets the  
 8 concrete ~~sp~~ anchors into the angle  
 iron. 1740 JR on site. \_\_\_\_\_

Location HaureDate 12/22/2015Project / Client MDEQ SRS Rocky CleanersPg 1/2 776-023-002

0800 JR arrives at the site, about 1 1/2"  
 of snow fell overnight and still snowing.

\* Unable to get the 3/8" drill bit to  
 work with the rented rotary hammer drill.

#0845 Rent electric drill from Haure  
 Rental

\* Secure the angle iron to the building  
 at the eight anchor points.

\* Connect the six pvc stub piping to  
 the building piping.

1125 JR spoke with Jim Gleason about  
 status update need to get some  
 expanding foam for near stub piping  
 and locks for PLC & electric panel.

\* Returned electric drill to Haure Rental  
 total \$8.

1220 Purchased Great stuff big gap insulation  
 and masterlock. from North 40. Total \$33.92

1255 Electric stopped by the site - waiting  
 on paperwork before he can start.

1310 JR offsite.

1345 JR departs Haure.

1655 Arrive Helena.

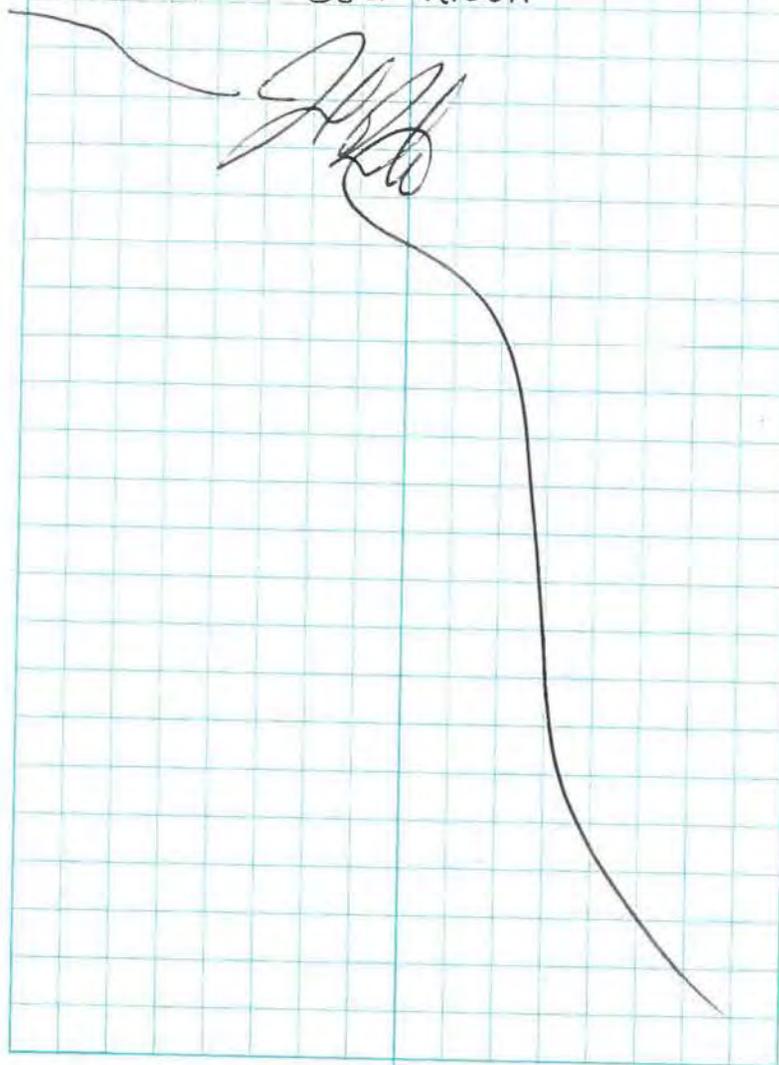
1700 Return Rotary Hammer and 5/8" drill bit  
 to A-I Rental. Total \$63.75

Location HelenaDate 12/22/2015

Project / Client \_\_\_\_\_

Pg 2/2

1725 JR arrives back at the Helena  
 office. - Joel Riabli



Location Helena → HavreDate 01/13/2016Project / Client MDEQ SRS Roxy Cleaners

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0710 Joel Riebli departs the Helena office.

0730 JR rents rotary Hammer and 7/8" concrete drill bit from AI Rentals

0735 JR departs Helena

\* Pick up portable air pump and vacuum gauges.

1050 JR returns call from Michael Hamilton leave message that I should arrive today at 1300

1300 JR arrives at the former Roxy Cleaners. About 2" of snow on the ground.

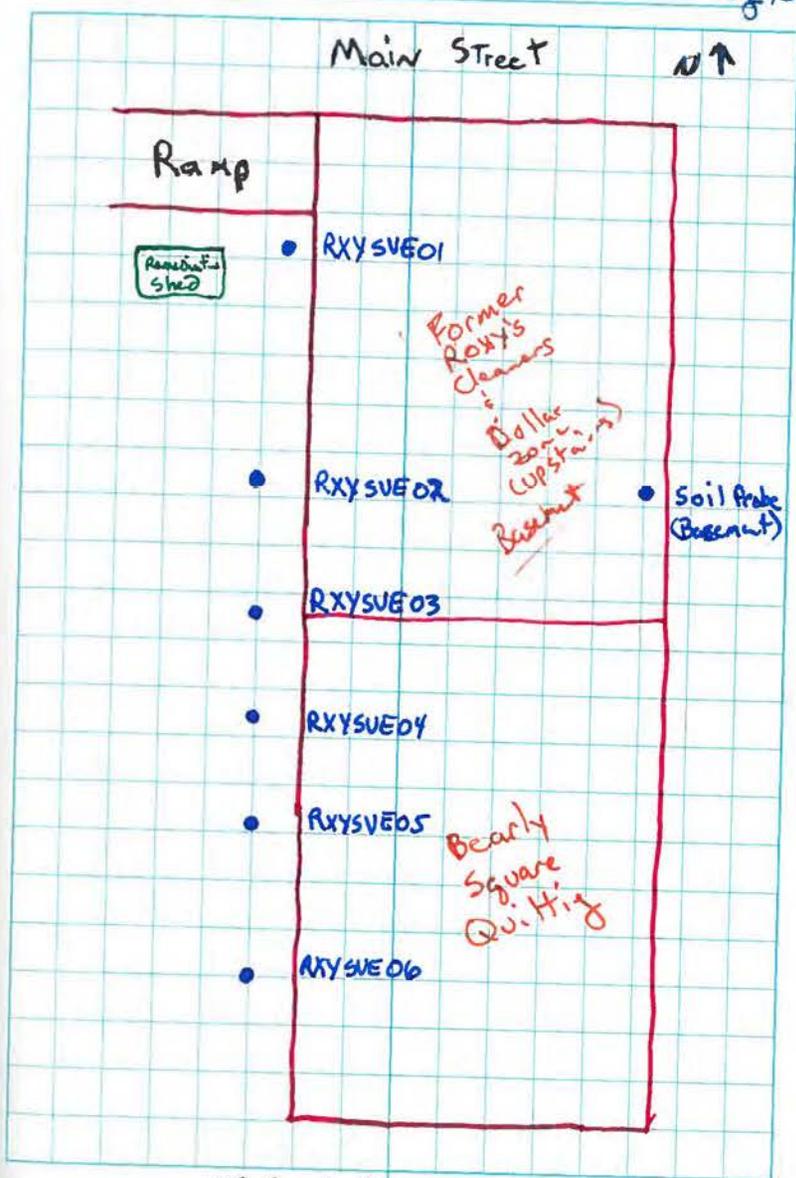
1305 meet with Michael Hamilton - locate location of where the vapor sample port should be located within Mr. Hamilton's basement. The location is on the east side of the basement (next to the print shop) and is directly east of SVE02. Hamilton has no issue with the location. Looked for the sewer line, water line, and electrical utilities. No issue with where sample port is located.

\* Using the 7/8" diameter concrete drill bit

Date 01/13/2016

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drilled through the basement concrete floor (concrete was 5" thick). Drilled to 12" bgs. Cleared out hole and concrete floor with wet/dry vac. I installed a 6" long vapor stainless steel screen, 1/4" tubing and sittings. Poured 10/20 colorado silica sand around the 6" vapor screen. Placed paper towel layer and then poured exterior anchoring cement quickrete up to the sittings.

1445 called electrician Greg Bailey that I'm on site. Greg said he would come over.

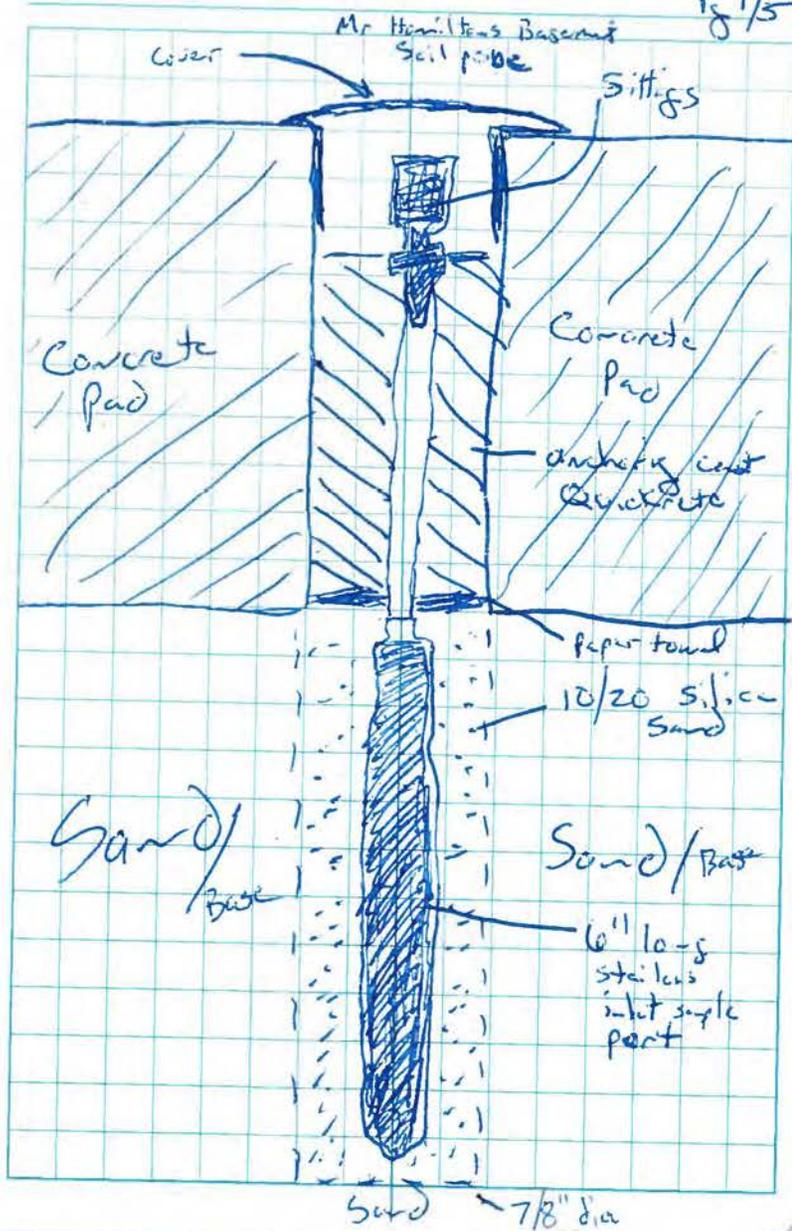
\* Changed out the 2" x 2" rubber p.p.g couplers with 1/2" x 2" rubber p.p.g couplers.

1455 Greg Bailey arrives on site. notices that Northwestern Energy hasn't installed the electrical meter. He called Northwestern Energy - had to leave messages.

1510 JR/Greg install the SVE system outlet stack on top of the system riser. Didnt install the 3' riser since live electrical wire is near the outlet.

\* JR/Greg wait for Northwestern Energy

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Location HaureDate 01/13/2016Project / Client MDEQ SRS Roxy CleanersPg 5/5 776-023-002

1610 Greg departs the site.

1630 JR departs Roxy Cleaners - still  
no electrical meter

- Joel Riebli

Location \_\_\_\_\_

Date 01/14/2016

Project / Client \_\_\_\_\_

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0750 Joel Riebli (JR) arrives at the former  
Roxy Cleaners site. The snow that  
melted yesterday is now ~ 2" thick  
ice on the monitoring wells0805 JR purchases ice melt from the nearby  
grocery store Total \$4.640810 JR arrives back on site, places ice  
melt on the monitoring wells ice0830 Opened Mr. Hamilton's basement door  
and found water falling from above  
the ceiling onto the basement floor  
near where the soil probe was located  
yesterday. About 1/3 of the basement  
has steady water. Tied Mr. Hamilton  
on his cell phone → Home phone  
but unable to get a hold of Michael.  
Tried getting Michael's attention by knocking  
on his door. Contacted Jim Gleason  
that a possible water leak in the  
former Dollar Zone is leaking into  
the basement. Flagged down a Haure  
Police officer → he said he would  
try reaching Mr. Hamilton.0920 Northwestern Energy arrives on site →  
installs the electrical meter

Location HavreDate 01/14/2016Project / Client MDEG SRS Raxy CleanersPg 2/3776-023-002

- 0930 Called Greg Bailey, let him know that the electrical meter has been installed.
- 0950 Greg Bailey arrives on site.
- 1000 JR/Greg go down the SVE system checklist to start up the treatment system.
- 1055 End system check list with Greg.
- 1115 Mr. Michael Hamilton wakes up and see water entering his basement.
- 1125 Mr. Hamilton shuts the water off in the Former Dollar Zone (Piping break in the bathroom/kitchen area) located above the basement.
- 1155-1210 Lunch
- 1300 start up the SVE system with all six SVE wells open. The combined vacuum is 83 inches of water. However see was surging in some of the SVE wells entering the remediation shed.
- 1310 Mr. Hamilton soil probe reading 0.05 inches of water vacuum with all six SVE wells open.
- 1315 ~~Reduce~~ Increase air dilution value in order to reduce the water surging

Location \_\_\_\_\_

Date 01/14/2016

Project / Client \_\_\_\_\_

Pg 3/3

- into the remediation system. ~~start~~
- 1345 Collect system readings with the combined 53 inches of vacuum being applied by the system (standing air dilution valve). See a vacuum of 0.02 inch H<sub>2</sub>O at the <sup>than the</sup> SVE soil probe. Vacuums & flow at each well:

	Vacuum	Flow
SVE01	48 inches H <sub>2</sub> O	10 cfm
SVE02	45	30
SVE03	49	22
SVE04	44	32
SVE05	46	41
SVE06	48	15

- 1410 start the 1/3 vacuum test pulling only on SVE03
- 1545 start the 2/3 vacuum test pulling only on SVE03
- 1730 Joel Riebli on site
- Joel Riebli



Location HaureDate 01/15/2016Project / Client MDEQ SRS Roxy CleanersPg 1/1776-023-002

- 0755 Joel Richli (JR) arrives at the  
Former Roxy Cleaners.
- 0815 Start the Full SVE03 only  
ROI test. Monitor'g vacuums at  
SVE01, SVE06, and soil probe.
- 0955 Start the SVE04 1/3 ROI test. —
- 1200 Start the SVE04 2/3 ROI test. —
- 1335 Called Jim Gleason - give update  
on not seeing any vacuums from  
the SVE04 ROI test, that the  
vacuum has decreased as the  
water has decreased through the  
tests. Discussed moving vacuum gauges  
from SVE01 & SVE06 to SVE03  
& SVE05.
- 1415 purchase pipe wrench from North 40  
(\$15.99) to remove the SVE01 &  
SVE06 vacuum caps
- 1610 Start SVE04 ROI test with  
monitor'g at SVE03 & SVE05
- 1710 End ROI tests.
- 1745 JR departs the site.

-Joel Richli


Location Haure → HelenaDate 01/16/2016

Project / Client \_\_\_\_\_

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- 0700 JR departs the Haure hotel.
- 1056 JR arrives in Helena
- 1055 Return the drill & drill bit at  
AI Rentals, Total \$198.
- 1115 Arrive at Helena office
- Joel Richli



Location Helena → Havre

Date 01/19/2016

Project / Client MDEQ SRS Roxy Clevers

Pg 1/2

776-023-002

0700 Joel Riebli (JR) departs The Helena office.

1025 JR arrives in Havre; snow/ice site surface conditions.

\* Marked out injection locations in Mr Michael Hamilton's basement. Unable to gain access to the workshop area.

1205-1235 Lunch

1250 Remington Technologies (Robby Orr, Josh Appelton, & Eric Conrad) arrive on site. Review Trihydro HASP and perform site walk of injection locations.

1400 Wendy Warren with last call locating arrives. checks utilities entering the site building and checks out the injection locations. Only found two areas where subsurface piping was found - near the garage door over to the pump house near injection points and near the fire wall door is a sewer line clean out. Unable to have the private location

Location

Date 01/19/2016

Project / Client

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to clear the utilities on the south side of the fire wall - will need to have auger those five locations.

1430 JR called Michael Hamilton as to when we could start coring through the basement floor on Wednesday. He asked when we would like to start. I told Mr. Hamilton if we could start at 0800, Mr. Hamilton said that it is fine to start at 0800 that he does not think that the noise would reach the apartment.

1515 Wendy departs the site.

1530 Remington departs the site, plan on meeting at 0730 tomorrow.

-Joel Riebli



Location Havre Date 01/20/2016Project / Client MDEQ SRS Roxy Cleaners

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770-023-002

- 0730 Joel Ricbli (JR) & Remington Technologies (Robby Orr, Eric Cooward, & Josh Absolon) arrive on site. Tailgate safety meeting. Discussed stop work authority, working at safe speeds, Hospital location, Muster points, First Aid Kits, eye wash, fire extinguisher locations. Discussed pinch points on the Geoprobe, 3 points contact setting in and out of trucks, using spatter moving equipment. Level D several PPE & Level C PPE mixing slick vegetable items. Staying clear of the hydraulic and injecting lines (at least 5 feet back) Went over the JSA's that Remington brought with them, they will print out the missing JSA's. Went over the Pre-Readiness Review sheet.
- 0800 Remington went and got water.
- \* Issues with sneezing hydraulic lines
- 1010 Start coring injection location A2 using the Geoprobe 420M
- \* Hydraulic issues still with the Geoprobe
- 1105 Use concrete core machine to get through A2 location
- 1135 Use Geoprobe to core down 8' at

Location \_\_\_\_\_ Date 01/20/2016

Project / Client \_\_\_\_\_

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- A2, starting to use concrete core machine at A5.
- 1210 Begin injecting 3.1% EVO into A2. inject at 8' below surface.
- ~~1215 End inject at A2, injected 425 gallons~~
- 1305 started up the SVE system: opening up SVE 01, SVE 02, & SVE 03. SVE hours = 18.7 Heat exchanger hours = 19.2
- \* Inject into A5 but it only took 100 gallons and started to surface in the nearby concrete cracks. PSI was 150 psi.
- 1400 Jim Gleason arrives on site.
- 1415 Need to move A8 as hitting board material ~18" bgs. Possible footer. Move location to the SE.
- 1500 Start injecting into A8 PSI 0-5psi
- \* ~70 gallons injected started seeping surface at the A8 borehole. Sealed it up continued injecting
- 1610 End injecting at A8. Injected 450 gallons
- \* bentonite plug in the injection borehole, surface completion using Quickrete hydraulic cement.

Location HavreDate 01/20/2016Project / Client MDEQ SRS Rocky Cleaners

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1655 Remington departs the site - meeting at 0730 tomorrow

\* JR contacted Mr. Hamilton that Remington - Trihydro has wrapped up today's activities and he can park back - there.

1705 JR off site.

- Jon Ricbli

Location \_\_\_\_\_

Date 01/21/2016

Project / Client \_\_\_\_\_

Pg 1/3

0730 Joel Ricbli (JR) & Remington Technologies (Eric Coover), Robby Orr, & Josh Abraham arrive on site. Light snow fell overnight.

\* Tailgate safety meeting: stop work authority, keeping warm, Moby fire extinguisher and eye wash down to the basement, muster points in the parking lot, emergency hospital plans, got enough sleep and are ready to work, moving items around in the basement, slip trip fell on lines, hoses, items being stored, noise from drilling and augering, three points of contact getting in and out of the basement. Light rain in the box truck, slick oil if it gets on the floor.

0800 Enter the Basement, look at sewer locations to inject at - need to move items at each point.

0810 Jim Gleason arrives on site.

\* start coring the concrete at C6

\* start coring at C3

0930 start coring at F4

0930 Jim Gleason departs the site -

Location Haute Date 01/21/2016Project / Client MDEQ SRS Raxy Clemons

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- \* Core at D4
- 1120 Geoprobe down to 8' bgs basement at C6
- 1141 Start injecting EVO into C6
- 1202 Geoprobe down to 8' bgs basement at C3
- 1216 End injecting EVO into C6; Injected 425 gallons at 3 PSI. No surfacing.
- 1218 Start injecting EVO into C3
- 1237 Geoprobe down to 8' bgs basement at D4
- 1250 End injection at C3, injected 425 gallons. Started at 50 psi and ended at 10 psi. No surfacing.
- 1255 Start injecting EVO into D4
- 1312 End first portion injection into D4 - need to get additional water mix
- 1355 Geoprobe down to 8' bgs basement at F4
- 1405 Resume injecting into D4
- 1429 End injecting into D4, took all 425 gallons. PSI 0-3; no surfacing.
- 1432 Start injecting into F4
- 1512 End injecting into F4, took all 425 gallons, no surfacing ~5 psi

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- \* Filled the boreholes of D4 & F4 with bentonite chips
  - \* Completed the surface completions at C3, C6, D4, & F4 with Quickrete hydraulic cement. Clean up all four injection areas.
  - \* Move storage items and two cars to expose 4 of 5 injection <sup>areas</sup> point <sup>(SP)</sup>
  - 1605 Called Mr. Hamilton that we would like to move the car that has some silt fires. Mr. Hamilton said he would fill up the tires tonight. He said to move his wives car and his truck out of the garage tomorrow before we start work in the basement.
  - 1620 Remington departs the site, plan meeting at 0730
  - 1645 SR departs the site.
- Joel Riebli



- 0730 Joel Riebli (JR) and Remington (Eric Cooward, Robby Orr, & Josh Abjatom) arrive.
- \* Tailgate safety meeting on stop work authority, bag Sully nested and ready to work, warming up <sup>SO</sup> when getting cold, eye wash & fire extinguisher near work zone, first aid in trucks, route to hospital, muster point at trihydro truck tailgate or the Leisure sign, procedures to turn off the mixer, heater, air compressor, pump near the box truck is an emergency, slip/trip/fall with electrical lines, hydraulic lines, injection hoses, staying back 5' from injection hose when injecting, wearing heavy protection when coring concrete, geoprobing, and injecting, and mixing injecting, three points of contact getting in and out of box truck, snow & ice surface conditions, spotter when moving equipment, driving out the Hamilton's car & truck, rolling the storage cars and motor bikes around in the

- basement. Discussed injecting four locations and since the forecast is calling for 42°F, installing the snow system bollards.
- 0755 Drive Hamilton's car and truck out of the basement and parking in parking lot.
- \* Car with no air in each tire was found with air was push clear of injection work area
- 0800 Begin using concrete 4" core at location B9
- 0814 Begin using concrete core at C10
- 0831 Begin coring at F6
- 0900 Begin coring at D8
- \* need to tighten up coring settings
- 1010 Begin coring at E10
- 1030 Geoprobe down 8' bgs basement at B9 using the Geoprobe 420m and 2" diameter rod
- 1048 Begin injecting EVO into location B9
- 1055 Geoprobe down 8' bgs basement at C10
- \* Need to move C10 over to the west of the Geoprobe it hit a scatter and can not proceed <sup>SO</sup> beyond 2' bgs

Location HaureDate 01/22/2016Project / Client MDEQ SRS Rocky CleanersPg 3/5776-023-0021105 Start coring second C10 location - move towards the <sup>west</sup>~~east~~ 2'

1120 End injecting into B9, took all 425 gallons, no surdacy, PSI less than 5psi.

1130 Start Geoprobe C10 #2

1137 Begin injecting into C10

1138 Need to move E10 over as we also are over the sector, begin coring the second E10 location (2 1/2' west)

1210 End injecting at E10, took at 425 galts no surdacy

1228 Geoprobe at F67

1302 Begin injecting into F67

1357 End injecting into F67 took all 425 gallons; less than 1/4 gallon surfaced at injection point.

\* Went for a water run

1504 Geoprobe down to 8' bgs basement at D8

\* At D8 unable to geoprobe below 5', will inject at 4 1/2' st.

1514 Begin injecting into D8

1549 End injecting into D8, took all 425 gallons; no surdacy no psi.

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1555 Geoprobe location E10 down to 8' bgs basement.

1600 Begin injecting at E10 at 7 1/2' bgs basement.

1648 End injecting at E10; Took all 425 gallons, no surdacy.

\* Filled borehole at D8 &amp; E10 with bentonite chips; hydrated the chips with water.

\* Used Quikrete hydraulic cement to finish surface completions at B9, C10, D8, F67, &amp; E10

1710 Called Michel Hamilton, asked if he would like the car &amp; truck driven back into the basement. Mr. Hamilton said he would park both vehicles but asked that they both be driven back out after the basement tomorrow morning.

1720 SVE hours: 53.8 Heat Exchanger hours: 54.2

SVE total flow = > 200 cfm KO tank = 48 in H<sub>2</sub>OSVE inlet vac = -56 in H<sub>2</sub>O. SVE dischrg = 60 in H<sub>2</sub>Ocarbon inlet pressure #1 = 28 in H<sub>2</sub>O #2 = 12 in H<sub>2</sub>O

#1 #2 #3 #4 #5 #6 PID = 0.0 ppm

cfm &lt;10 &lt;10 &lt;10 27 15 22

vac 50psi 38 50 47 50 50

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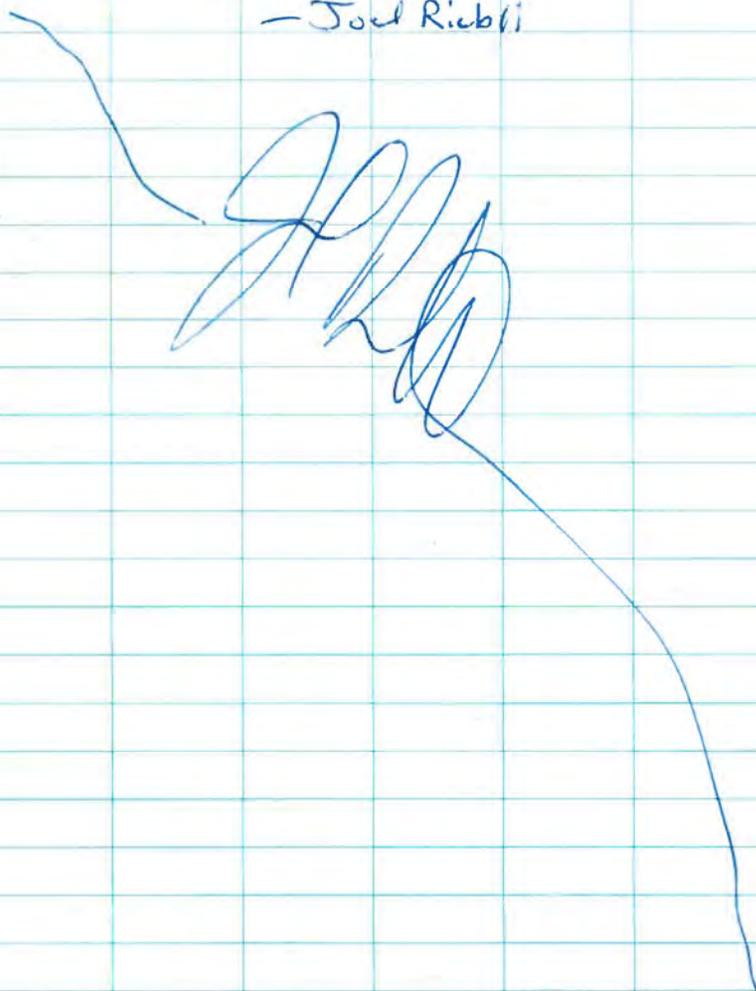
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1725 Remington departs site, meeting tomorrow  
at 0730.

1730 JR departs site.

— Joel Riebli



Location \_\_\_\_\_

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Project / Client \_\_\_\_\_

Pg 1/4

0720 Joel Riebli & Remington Technologies (Robby Orr, Eric Coenraad, & Josh Absalom) arrive on site. Very slick surface conditions.

0730 Tailgate safety meeting. Everyone is fully suited and ready to work. Stop work authority, cold temperature seat trucks to warm up, first aid at trucks, eye wash in work zone, fire extinguisher at trucks, procedures to shut down mixer, pump, heater, compressor at box truck & emergency, master points Trihydro tailgate truck or Quilt shop sign, PPE, inspect hydraulic hoses, injection hoses, Geoprobe unit, core equipment, properly stored items in basement, Hospital route, staying clear of the hydraulic hoses and injection hoses when they are in operation, scanning work zone for hazards, slip/trip/falls, any personnel near work zone to be directed to Trihydro, weather conditions.

- \* Plan on coring / Geoprobe / injecting 5 locations and marking on bollard locations
- \* Move the Hamilton's car & truck from basement and place in parking lot.

Location HaireDate 01/23/2016Project / Client MDEQ SRS Raxy CleanersPg 2/4776-023-002

0805 Start using the 4" core unit to bore through the basement concrete at locath D2

\* The 3" concrete core is not making much progress at D2 - found that two of the cutting edges are missing

0848 Called Jim Gleason - gave update on the SVE system (Running not pulling water) and injectors.

\* Remington replaces the 4" core with a 6" core resumes at D2

0928 Start coring H1 with 6" core

0942 Geoprobe at D2 using the Geoprobe 420m

0959 Start injecting EVO into D2

1002 Start coring at H5

1045 Start coring at H8

1053 End injecting into D2; took all 425 gallons. no surfacing

1103 Start Geoprobeg at H1

1114 Start injecting at H1 at 7 1/2' bgs - basement

1130 Start coring at G9

1158 End injecting at H1; took all 425 gallons. no surfacing, PSI  $\emptyset$

1220 - 1320 lunch

1330 Start Geoprobeg at H5; striking something at 18" (Footer?)

Location \_\_\_\_\_

Date 01/23/2015

Project / Client \_\_\_\_\_

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1355 Start Geoprobeg at H8, struck something at 18"

1402 Start Geoprobeg at G9 down to 8' bgs

1411 Start injection EVO at G9

1419 Step out two feet north and start coring a second H5 location, now 6' from wall.

1515 End injecting at G9; took all 425 gallons. no surfacing

1550 Start Geoprobeg at H5 location #2 reach 8' bgs - basement

1601 Start injecting at H5

1603 Start coring at H8 #2 stepped out 2' north, 6' from wall using a new 4" core cutter

1643 End injection at H5, took all 425 gallons. No surfacing. PSI  $\emptyset$

1721 Begin Geoprobeg at H8 #2, reached 8' bgs - basement

1740 Begin injecting EVO 3% into location H8

\* Stop, no injection, trip out

1800 Begin injecting EVO into H8

1843 End injecting into H8. Took all 425 gallons, no surfacing  $\emptyset$  PSI

Location Haure Date 01/23/2016Project / Client MDEQ SRS Roxy CleanedPg 7/4 776-023-002

\* Added bentonite chips to locations  
G9, H5, & H8. Pick up gear  
1920 Remington drives and parks the  
Hamilton's car & truck → park them  
in the basement. Remington departs the  
site, plan on dig surface complete  
and clean tomorrow

1920 System Readings: SVE hours = 79.5 hrs  
heat exchanger hours = 80. SVE total flow  
> 200 cfm KO Tank = 49 in H<sub>2</sub>O

SVE inlet vac = 57 in H<sub>2</sub>O SVE discharge 58

carbon inlet #1 = 28 #2 = 12

#2 #2 #3 #4 #5 #6

cfm 18 cfm 22 34 25 20 52

vac 42 in H<sub>2</sub>O 49 53 50 42 32

PID at carbon inlet #2 = 0.0 ppm

1930 Joel Riabli departs site.

- Joel Riabli


Location \_\_\_\_\_ Date 01/24/2016

Project / Client \_\_\_\_\_

Pg 7/1

0725 Joel Riabli (JR) & Remington Technology  
(Eric, Robby, & Josh) arrive on site

0730 Tailgate safety meeting. Discussed being  
ready to work, stop work authority,  
muster at Trihydro tailgate, slip/trip/fall  
on storage items, icy surface conditions  
in the parking lot, work slow moving  
item back in basement

0750 Start clean up in basement. Using  
simple green and a mop around the  
injection points

0915 Remington departs site, plan on meeting  
at 0730 tomorrow

0915 System Readings SVE hours = 93.6 hours  
heat exchanger hours = 94.1 hrs. SVE total flow  
= > 200 cfm KO tank = 50 in H<sub>2</sub>O

SVE inlet vac = 58 SVE discharge 57.5

carbon inlet #1 = 27 #2 = 12

PID carbon inlet #2 = 0.0

#2 #2 #3 #4 #5 #6

cfm 19 21 34 23 21 52

vac 42 49 53 50 42 32

0930 JR departs the site.  
- Joel Riabli

- 0720 Joel Riebli (JR) arrives on site, about 1" of snow fell over night.
- 0730 SVE System check (see spreadsheet)
- 0735 Remington Technologies (Josh, Eric, & Robby) arrive on site.
- 0735 Tailgate safety meeting. Discuss being asked and ready to work, stop work authority, Hospital location, mustar at Trihydro tailgate or Quilt shop sign, ~~SP~~ seek truck to warm up, staying hydrated, slight working surface on the ramp, three parts of contact getting into out of the box truck, emergency procedures shutting down the box truck pump, heater, compressor, valves, slip/trip/fall with electric cords, hydraulic lines, injection hoses, staying back at least 5 feet from hydraulic hoses and injection lines, Level D PPE, hearing protection, clean up work areas
- 0805 Begin using 4" core at location I3
- 0815 JR called Jim Gleason - gave update and possible diff injection at K10.

- 0950 Store core location J5
- 1030 Start Geoprobing at I3, it connects at 2' bgs - basement. Need to move the location on the other side of the sewer line.
- 1035 Start core location J7
- 1040 Start Geoprobing location J5 using the Geoprobe 420M and 2" rods. The bottom rod has a tip that when raised, lowered and injection can exit the rod into the subsurface. Geoprobe down to 8' bgs - basement raise injection to 7 1/2' bgs - basement
- 1050 Start injecting EVO into location J5
- 1120 Start core location I4 (formerly I3)
- 1054 End injecting into J5, took all 425 gallons, NO surfacing average PSI was between 8 & 12 psi.
- 1202 Start Geoprobing at J7, push rod to 8' bgs - basement
- 1208 Begin injecting at 7 1/2' at location J7. This location will get twice the injection volume.

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- 1225 Start Coring location J9
- 1354 End injecting at J7, took all 850 gallons, no surfacing
- 1355 Start coring location I10
- 1405 Geoprobe rods at location I4, push to 8' bgs - basement.
- 1415 Begin injecting at I4 at 7 1/2 bgs bent
- 1450 Start Coring the final injection location K10 using the 4" code unit
- 1525 End injecting at I4, took all 425 gallons, no surfacing
- 1538 Geoprobe down 8' bgs - basement at I10
- 1543 Start injecting EVO into location I10 at 7 1/2' bgs - basement
- 1605 Start setting surfacing at the rods - add bentonite crumbles to stop the surfacing. Unable to get a good seal. Injected 200 gallons into I10, will let the bentonite to tighten up over night.
- 1720 Remington - off site.
- 1730 JR off site

- Jed Ricbli



Location \_\_\_\_\_

Date 01/26/2016

Project / Client \_\_\_\_\_

Pg 1/3

- 0725 JR arrives on site, very icy
- 0735 JR SVE system check
- 0140 Remington Technologies (Josh, Eric, & Robby) arrive on site. They went and got water this morning
- \* Tailgate safety meeting. Rested and ready to work; stop work authority, slight ice; warm up in trucks (8 cab); three points of contact entry/exit; box truck; Hospital route; muster points are Trihydro tailgate & quilt shop sign; slip/trip/fall with the electrical cords, hydraulic hoses, injection line; stay at least 5' from hydraulic hoses & injection line when they are in operation; good house keeping; inject at low psi in the 3 remaining locations; Level D ppe (hard hat, steel toe, hearing, safety vest, gloves, safety glasses, nitrile if handling EVO and mixing concrete); extra lighting for the closet injection point; watch for the dust work in the closet; eat/drink/water/cell phone use outside exclusion zone; all visitor trihydro to handle.
- \* Plan to finish injects and clean up basement, remove all work items. Wednesday

Location HaureDate 01/26/2016Project / Client MDEQ SAS Raxy CleanersPg 2/3 776-023-002

will be belland → curb stop install.  
Discussed options on moving the curb  
stops. Remington will look at rental options.

0835 Resume injecting into location I10  
(Yesterday 200 of the 425 gallons  
of EVO was injected)

0936 End injecting at I10; injected 225  
gallons today → 200 gallon yesterday.

0949 Geoprobe at location K10 using the  
Geoprobe 420M; push rods to 8' bgs -  
basement.

0953 Start injecting EVO into location K10  
at 7 1/2' bgs basement. This is a  
double volume (850 gallons) location

\* EVO surfacing at the K10 rod; bentonite  
crumbles added to seal the surface →  
stop the injection ~~and~~ material from  
surfacing. About 1/5 gallon surfaced

1140-1235 lunch

1317 End injecting into K10, took all  
850 gallons with just the 1/5 gallon  
surfacing at the rod.

1333 Geoprobe at sil injection location  
J9, push rod to 8' bgs - basement

1339 Start injecting EVO at J9, this locati

Location \_\_\_\_\_

Date 01/26/2016 75

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is getting the sil 725 gallons (425  
normal plus 300 gallons unable to  
inject at location A5). Injecting at  
7 1/2' bgs - basement.

1415 Surface completions using Quikrete concrete

1510 End injecting at J9, took all 725  
gallons, no surfacing

\* Cleaning up work zones → finish surface  
completions. Still need to map today's  
work areas tomorrow

1640 Remington departs the site, plan on  
meeting at 0730 tomorrow

1645 JR called Mr. Michael Hamilton - gave  
update that injections are completed  
but we still have to clean up →  
map around the freshly poured concrete  
surface completions. Told Mr. Hamilton  
that since these are south of the  
fire wall → next to the apartment  
that we would wait until at least  
noon before performing this work

1700 JR off site

Jonel R. [Signature]

0720 JR arrives on site, warm about 40°F.

0730 Remington - Technologies (Eric, Josh, & Robby) arrive on site

0735 Tailgate Safety meeting. Discussed bag rested and ready to work; stop work authority; last day stay focused no need to rush and work; Hospital location; muster points; moving curb stops punch points. A little hazardous, list with knees not back; line at site pushy the asphalt; Dust mixing concrete; traffic workly in parking lot; drilly hazardous securing the curb stops to concrete; windy weather conditions.

\* Plan is to move curb stops using all four people and utilize moving straps. Drill and secure curb stops to concrete, wash parking lot, install the bollards, clean up injection points in Mr. Hamilton's basement, Basement work can't start until after noon - South of the fire wall.

0815 Remington sets water and washes the asphalt in front of the Quilt shop

\* Second load of water

\* Secure the 5 curb stops using rebar to secure to concrete.

1130 - 1215 lunch break

1225 Start mixing concrete to install the four bollards around the SVE system

1340 Call with Jim Glason, updated progress decided to take care more system ready tomorrow and then head back to Helena.

\* Bollards installed, set 18" below the asphalt surface with concrete extending to 22" bgs. Reflective tape added the the yellow steel.

\* 1510 Finish cleanly the asphalt.

1520 Mr. Hamilton arrives as the final sections of the basement have been mapped. Mr. Hamilton requested that none of his storage thus be moved back in place. That it will give him some motivation to clean and organize his basement. We did move back the items that were in the rooms south of the fire wall.

Location Haure Date 01/27/2016Project / Client MDEQ SRS Reay Cleaners

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1540 Remington Technologies wraps up work on site and departs

1541 SVE System shut down when I was looking inside the system control panel. The emergency stop button came in contact with the panel door. The SVE T.O./S.C. alarm came on. The "MC-1" tripped. Tried resetting it but it would not clear and go into the cure button - Tried resetting the emergency stop, reset button, powering down the entire system and rebooting but the "MC-1" would not let me move the tripped toggle to the "12" position.

1715 JR departs the site, system runs down.

1735 JR & Jim Gleason discuss different options to clear the "MC-1" tripped breaker. - Joel Riabli

*Joel Riabli*

Location \_\_\_\_\_ Date 01/28/2016

Project / Client \_\_\_\_\_

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0740 Joel Riabli (JR) arrives on site, very windy. The concrete poured around the billboards is now hard. Temp is 50°F with last night's winds.

0750 Restarted the SVE remediate system. I cleared the SVE T.O./S.C. "MC-1" tripped breaker by shutting down all controls, turned the service disconnect to the off position, and then was able to move the "MC-1" dial from "9" to the "12" position. Then went through the steps of restarting all phases of the system. It restarted and resume SVE operations.

\* The blower in the filter is clean and bolts remain tight.

0850 Call with Jim Gleason regarding restarting the SVE system

0930 JR departs Haure

1320 Arrive in Helena

- Joel Riabli

*Joel Riabli*

Location Havre Date 04/06/2016Project / Client MDEQ Roxy CleanersPg 1/4 776-023-002

- 0750 Departed Helena
- 1115 Arrived in Havre
- 1130 Purchased 17 gallons of distilled water at Walmart \$14.96
- 1145 Purchased 8 lbs of ice \$1.99
- 1150 Arrived at the former Roxy Cleaners. The SVE system has been down since March 27, 2016 @ 0650 with low SVE vacuum
- 1155 Restarted the SVE system.  
SVE Blower = 1302.5 hours  
Airt Exchange = 1303.0 hours
- \* Calibrated the Horiba U-52 water quality meter (T14W909Y)
- 1225 BNSF's Mont Engdahl stopped by the site to say he arrived early.
- \* Washed the bladder pump and intake meter in decon buckets (bucket one contains simple green & distilled water, the second & third buckets contain distilled water)
- 1245 JR meets up with BNSF's Mont Engdahl at monitoring well

Location \_\_\_\_\_ Date 04/07/2016

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- location RXY-HV-62. Gauged LNAPL in the well (DT LNAPL = 12.35 st b to c) (DTW = 12.41 st b to c)
- 1255 Called Jim Gleason if monitoring well RXY-HV-62 should be sampled since it contains 0.06 st of LNAPL. Jim said to sample the well. Decided to sample the well last due to the LNAPL.
- 1305 Arrive at RXY-HV-43. DTW = 11.41. Set the bladder pump intake at 15.7 st below top of casing.
- 1335 JR called Jim Gleason to confirm that only pH & conductivity are the only stabilizate criteria for GW supply. He confirmed
- 1340 sample RXY-HV-43 collected
- \* Decontaminated the bladder pump, air line, blow through cell, intake meter in the three bucket decon wash. Replaced the discharge tubing, bladder, and pump sump plate.

Location HaureDate 04/06/2016Project / Client MDEQ RXY CleanersPg 3/4776-023-002

1425 Arrived at monitoring well  
RXY-HV-41. DTW = 11.48' bmg.  
set bladder pump intake at  
14.2' bmg.

\* very small screen in purge -  
biological bugs (brown string like)  
noted in the purge

1450 Sample RXY-HV-41 (BD-1)  
Dissolved metals field filtered. Bio-  
bugs in sample collection. Samples  
placed on ice.

\* Decanned bladder pump, air line,  
introduce water, flow through cell in  
the three bucket decan wash.  
changed out the discharge tubing,  
replaced the bladder and seal plate.

1540 Arrive back over at monitoring  
well RXY-HV-02. Didn't get any  
messages from Jim Gleason. Will  
sample the well. DTW/APL = 12.35' bmg  
DTW = 12.41' bmg (0.06' LNAPL)  
set bladder pump intake at 16.2' bmg.

\* screen in purge

1605 sample RXY-HV-02, screen in  
sample collection, strong hydrocarbon odor.

Location \_\_\_\_\_

Date 04/06/2016

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Place samples on ice.

1630 Collect field blank RXY-FB-1, place  
samples on ice.

\* Clean pump, flow through cell, introduce  
water, air line in the three bucket  
decan. Change out decan.

1715 Collect equipment blank RXY-EB-1  
by pouring distilled water over cleaned  
bladder pump. Placed samples on  
ice.

1750 Mr Hamilton stopped by and asked  
how the vapor sampling results look.  
I responded that as of Monday we  
hadn't received the laboratory data  
hasn't been received.

1755 JR odd site.

\* 1905 Called Jim Gleason as received text  
mentioning not to collect RXY-HV-02  
location. Discussed the collection of the  
sample. The bugs noted at location  
RXY-HV-41

- Joel Rubli



Location HaureDate 04/07/2016Project / Client MDEQ SRS Roxy Cleaners

Pg 1/1

776-023-002

- 0800 JR arrives at Former Roxy Cleaners  
SVE System running
- 0815 Call Jim Gleason - discuss checkly  
the SVE motor checks - system O.M.
- 0850 Collect SVE system data - unable  
to get Hamilton basement vapor  
probe location
- 0900 Shut down SVE system for  
maintenance. Oil on the blower  
is good for another 1,000 hours
- 0920 Jim Gleason said to submit  
the RXY-HV-02 water sample.
- 0940 Restarted the SVE system
- 1005 Depart Roxy site.
- 1010 ~~Purchased~~ Purchased 8 lbs of ice  
\$1.99.
- 1015 Depart Haure.
- 1400 Arrived in Helena. Hand delivered  
groundwater samples to Energy labs
- 1530 Shipped the rented FID, Horiba U53,  
interface meter, bladder pump, pump  
controller back to FairWest Environmental.
- 1600 Returned rental truck. - Joel Riebli

JR

Location \_\_\_\_\_

Date 04/20/2016

Project / Client \_\_\_\_\_

Pg 1/2

- 0700 Joel Riebli (JR) departs the Trihydro Helena  
office.
- 1035 JR arrives in Haure.
- 1055 JR & Mr. Michael Hamilton trade messages  
agree to access Hamilton's basement at 1130.
- \* Placed MDEQ tag on electrical extension cord.
- 1125 Met with Mr. Hamilton - he only has  
a few minutes before he is leaving  
install magnetic vacuum gauge on the  
basement vapor port well.
- 1140 Mr. Hamilton needs to leave. Take  
vapor vacuum reading (0.02 in H<sub>2</sub>O).  
The TVA 1000 FID reads 6.22 ppm.
- 1145 Out of the basement - Mr. Hamilton departs.  
He is out of town a good part in May  
but June he will be in Haure.
- 1210 Shut down the SVE system for  
O.M. Drained knockout tank (3 gallons  
removed), greased blower, cleaned air  
filter. The blower can go until  
the next site visit before the oil needs  
changed.
- 1235 Restart the SVE system
- \* Jim Gleason called, made adjustments  
to the SVE online program. Discussed

Project / Client MDEQ SRS Reay Cleaners

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776-023-002

Mr. Hamilton's vacation in May  
and look at June for vapor sample

1320 JR departs Havre.

1655 JR arrives back in Helena.

- Joel Riebl

Project / Client \_\_\_\_\_

Pg 1/1

~1245: The SVE remediation system  
shut down due to a "KO Tank  
High High level" alarm  
- Joel Riebl

Location Helena → Havre Date 05/17/2016Project / Client MDEQ SRS Roxy Cleaners

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776-023-002

\* Joel Riebli (JR) picked up supplies in Helena.

1235 JR departs Helena

1410 JR arrives at The Roxy Cleaners in Havre. The SVE system has been down with alarm "KO Tank High High level" alarm since 05/13/2016 @ 1245. The SVE system hours = 1,745.9 & the Heat Exchanger system hours = 1,746.4 hours.

\* Drained the KO tank of fluids and changed the oil on the blower motor (@ 1745.9 hours). Both oils that were changed out still looked like the new oil - maybe slight darkening of the oil since the first oil change (2/10/16).

Greased the blower and checked the air intake filter (not all that dirty - knocked some minor dust out of it). The Belts look good.

\* Some ~~extending~~ water on top of the first activated carbon drum - not sure where the fluid is coming from since it's not below the stack or under

Location \_\_\_\_\_

Date 05/17/2016

Project / Client \_\_\_\_\_

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neither any thing. The drum under the stack is dry. Did it come from the heat exchanger? Removed about 1 gallon off the drum.

1705 Restarted the SVE system. Increased the air dilution flow as I'm assuming the groundwater table has risen due to spring time.

1755 JR departs the site.

-Joel Riebli

- \* Spoke with Jim Gleason regarding the standby water sound on top of the activity drum #1. Discussed looking inside the drum and driving the heat exchangers will work on the heat exchanger after today summer canister samples

0930 Purchased fittings to connect between the summer canisters and the SVE system on sub slab.

0935 JR arrives on site. SVE system is running great.

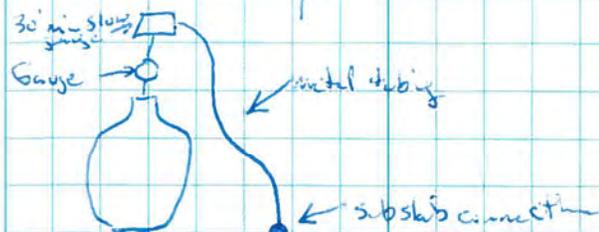
- \* Check the three summer canisters initial vacuum with digital gauge
- |          |      |   |        |     |
|----------|------|---|--------|-----|
| Canister | 884  | = | -27.53 | "Hg |
| "        | 1989 | = | -27.59 | "Hg |
| "        | 1830 | = | -27.55 | "Hg |

- \* Using teflon tape connected the gauge onto the 6 liter summer canisters, then the 30 minute slow controller then the tubing to the SVE inlet to drum #1, outlet of drum #2 and the set up to sample the Hamilton sub-slab. All fitting connects were tested

taped and the metal tubing had compression nut & sleeve connections.

1105 Mr. Hamilton opens up the basemat garage door

1115 Connect the subslab port to the summer canister set up



Start the RXY-subslab @ 1115

1117 Start the RXY-post activated drums summer canister

1118 Start the RXY-PRE activated drums summer canister sample

1145 End the RXY-Subslab sample. Disconnect the summer canister and connect the vacuum gauge on the vapor port.

1147 End the RXY-Post sample.

1148 End the RXY-PRE sample.

- \* Final digital gauge readings:  
 RXY-subslab = -2.63" Hg ; RXY-Post = -2.63" Hg ; RXY-PRE = -3.89" Hg

1230 collect system: subslab (soil probe ready) SVE system hours = 1,764.9 hrs  
 Heat Exchanger system Hours = 1,765.3 hrs  
 SVE total flow = > 200 cfm; SVE inlet vacuum = -49 in H<sub>2</sub>O, Pre-Air circulation FID = 2.8 ppm, KO tank vacuum = -45 in H<sub>2</sub>O; SVE Discharge Pressure = 18 in H<sub>2</sub>O; SVE Discharge FID = 0.8 ppm. Drum #1 pressure 10.5 in H<sub>2</sub>O; Drum #1 outlet FID = 0.6 ppm. Drum #2 pressure = 3.0 in H<sub>2</sub>O Drum #2

	Outlet FID = 0.6 ppm	#1	#2	#3	#4	#5	#6
cfm	<10	<10	14	14	22	14	
vac	-48	-52	-53	-53	-50	-50	
FID	0.1	0.4	3.0	3.6	2.0	3.2	

Soil Probe vacuum = -0.03 in H<sub>2</sub>O

Soil Probe FID = 41.2 ppm

- 1238 shut down the SVE system → removed the heat exchanger  
 drain plug - All fluids came out  
 \* Purchased fittings to drain the heat exchanger into a garden house  
 Total \$19.64 at North 40  
 \* Arrived back on site and installed the heat exchanger drain

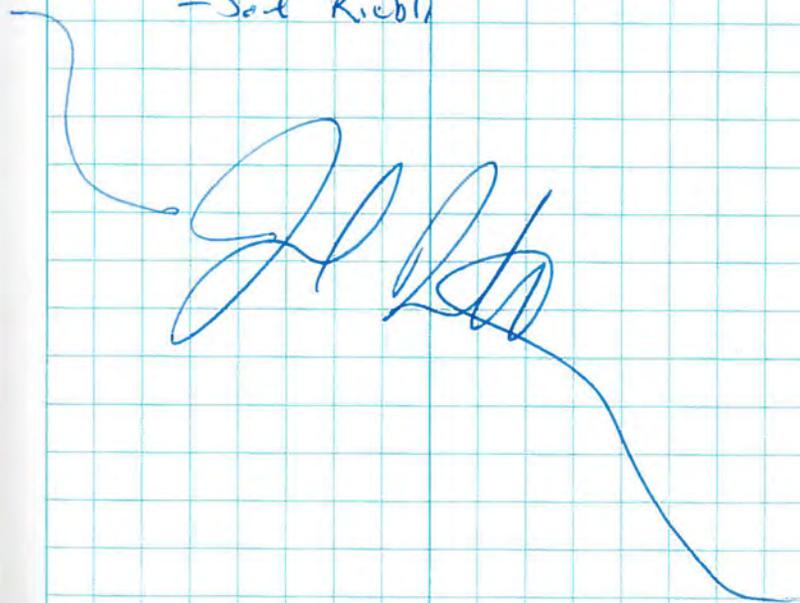
plug assemble (piping, valve, and connection to a garden house) —

1405 Restarted the SVE system - it's been reset to run 12 hours a day. —

1435 JR departs Haure —

1700 Shipped the summer canister samples to ALS in California and the FID rental at Fed Ex in Great Falls.

1855 JR arrives back in Helena. —  
 - Joel Riebli



Location Helena → Havre Date 08/23/2016Project / Client MDEQ SRSP Roxy Cleaners776-023-002

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- \* Spoke with Jim Gleason regarding groundwater supply tomorrow & system O&M

1555 Joel Riabli (JR) departs Helena

1925 JR arrives in Havre at the site.

System is down for the night.  
Unload field supplies into the system enclosure

-Joel Riabli

Location \_\_\_\_\_ Date 08/24/2016

Project / Client \_\_\_\_\_

Pg 1/4

- 0620 Joel Riabli (JR) departs the hotel  
Walmart doesn't open until 0700
- 0645 JR purchases 15 gallons of distilled water, ziploc bags, and ice from IGA; Total 26.42
- \* Arrived at the former Roxy Cleaners site. Prep for groundwater supply.
- 0745 Pete with Arcadis stopped by and said to go ahead and open HV-41, HV-43, & HV-42. To call him when done.
- \* Set up at RXY-HV-41. Depth to water 10.47 ft-bwp. Set bladder pump (new bladder, plate, o-rings) at 14.2 ft-bwp using the airline (Secard) & HV-41 discharge tubing from the April groundwater supply.
- 0759 Begin purging RXY-HV-41 at 0.15 liters per minute.
- 0815 Sample RXY-HV-41; place sample on ice. The dissolved metals was shield filtered.
- \* Decantantite the slow through cell, introduce meter, bladder pump, air line in sample ground distilled water & distilled water buckets (2)

Location Havre Date 06/24/2016Project / Client MDEQ SRS Roxy CleanersPg 2/4 776-023-002

0905 Set up at monitoring well

RXY-HV-43. Depth to water 10.46  
st-bmp. Set bladder pump inlet at  
14.4 st-bmp. New bladder, o-rings, &  
plate on pump.0923 Start purging RXY-HV-43 at 0.2 liters  
per minute.0935 Sample RXY-HV-43. Place samples  
on ice. Collect Blind Duplicate BD-1.\* Decontaminate the Slow Through cell, interface  
meter, bladder pump, air line in the three  
bucket decon wash1010 Set up at RXY-HV-02. No hydrocarbons  
gaged but strong odors. Depth to water  
11.37 st-bmp. Set bladder pump at  
15.7 st-bmp. New bladder, o-rings, &  
plate.1025 Start purging RXY-HV-02 at 0.2  
liters per minute.1040 Sample RXY-HV-02; place samples  
on ice.\* Decon the Slow Through cell, interface  
meter, bladder pump & air line1100 Collect Equipment blank EB-1 by  
pouring distilled water over the decontLocation \_\_\_\_\_ Date 06/24/2016

Project / Client \_\_\_\_\_

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air line.

☐ Called Pete w/ Arcades that Trihydro  
is finished with the three monitoring  
wells. Pete said that they are planning  
on supplying HV-41 & HV-43 next week.

☐ Pack up field supplies

1220 Called Jim Gleason regarding the need  
to modify the RXY-SVE-03 screen since  
no no. star was in the knockout  
tank & vacuum's are over 40 inches.  
Decided not to modify the screen.1240 Collect SVE system data check. Use  
PFD to read vapor readings - see  
spreadsheet.1247 Shut down the SVE system for  
maintenance\* Note unable to get a hold of  
the property owner to monitor the  
basement probe this visit☐ Knock out 2 heat exchanger units empty.  
gassed the water (needed it), air filter  
very dirty (cleaned), air intake looked  
good.

1257 Restarted the SVE system

Location HaureDate 06/24/2016Project / Client MDEQ SRS Rexy CleansPg 4/4776-023-002.

- 1325 JR departs the Haure area  
 1650 JR arrives at the Energy labs  
 → dropped off the groundwater samples  
 \* shipped the rented groundwater →  
 p.d at FedEx  
 1740 JR arrives at the Helena office  
 - Joel Riebli

Location \_\_\_\_\_

Date 07/21/2016

Project / Client \_\_\_\_\_

Pg 1/1

- 0515 Joel Riebli (JR) departs the Helena office.  
 0535 JR picks up Luke Darnall (LD).  
 0855 JR/LD arrive in Haure, rent pallet jack from Haure rental &  
 \* Arrive on site, system is running.  
 0930 Collect system operating data using a pid - see spreadsheet.  
 0950 Shut down the remediation system and perform O&M (grease blower, clean air filter, check oil knock out tank & heat exchanger tanks)  
 1055 Restarted the system but only run the system through activated carbon drum #2. Sample activated drum #1 and remove from the system piping.  
 (1020) Called shipping company - they are not delivering the two new activated drums today but tomorrow  
 (1030) Called Jim Gleason - gave update that drums will be delivered tomorrow - to restart system with drum #2 only  
 1130 JR/LD depart Haure  
 1505 Dropped LD off in North Helena  
 1530 shipped lab sample  
 1615 JR arrives at Helena office

Location Helena / Havre Date 07/22/2016Project / Client MDEQ SRS Roxy CleanersPg 1/3 776-023-002

0520 Joel Riebl (JR) departs Helena office

0535 JR picks up Luke Dornall (LD)

0850 JR/LD arrive at The Roxy Cleaners  
in Havre; System is running0920 Collect system readings using a PID -  
see sheet.

0930 Shut down remediation system

\* Install a screen reducer into RXY-  
SVE03. Made the screen go from  
5' open to just the top 18" -  
installed piping & O'ring at the bottom  
3.5' of the well

0942 Restarted the system

\* stopped by The North 40 for parts -  
didn't see what we need1115 Called shipping company to find  
out status of the delivery of  
the two activated drums - the  
shipping company couldn't get  
the driver to answer the phone1150 Spoke with Jim Gleason, The RXY-  
SVE03 reducing seems to be working  
not getting water in the system  
still no delivery truck

1400 called shipping company - they got

Location \_\_\_\_\_ Date 7/22/2016

Project / Client \_\_\_\_\_

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a hold of the delivery driver  
but he has already called it a workday.  
He said the drum delivery address doesn't  
exist → The provided cell number doesn't  
exist. I asked what number he was  
calling - They provided my cell phone number.  
I said I never received a call. They  
said they will deliver on Monday. I  
said that would not work, must be delivered  
today. They said they will look at options.

1410 Delivery driver called, said he is  
out of town but can get another  
driver to deliver today between 1700-  
1730

\* Update Jim Gleason

1705 Delivery driver called is on his way

1718 Delivery driver arrives - off load the  
two 55-gallon activated drums

1725 Return pallet Jack

1733 Shut down the remediation system  
install one of the two new drums  
into the second drum slot. So run  
our old drum #2 in the drum #2  
slot then run it through the new  
drum before exiting the system. One

Location Haure/Helena Date 07/22/2016Project / Client MDEQ SRS Roxy CleanersPg 3/3 776-023-002

new drum is not being used  
(for future changeout)

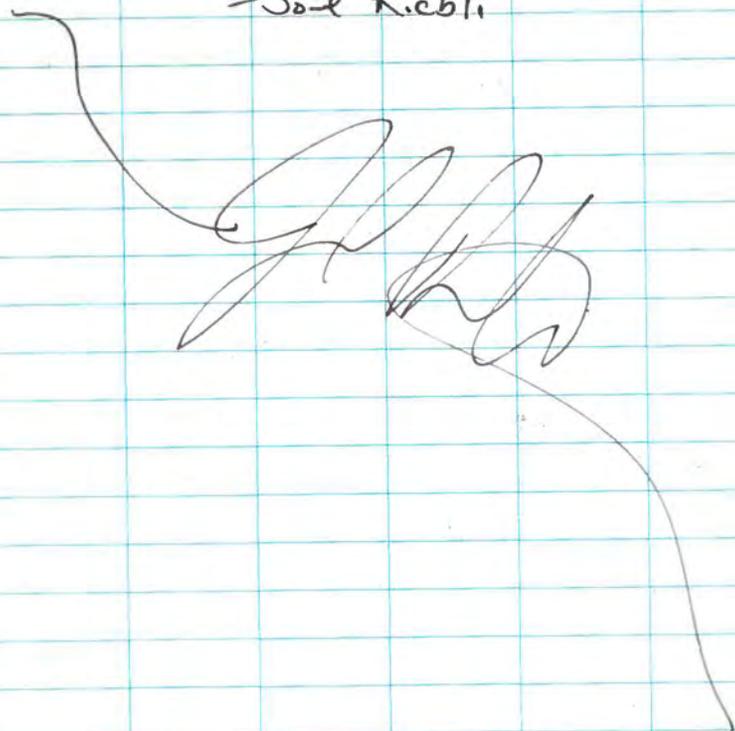
1745 Restart the remediation system

1755 SR/LD depart Haure

2115 Dropped LD odd

2130 JR arrives at the Helena office

-Joel Riebli


Location Helena/Haure Date 08/17/2016

Project / Client \_\_\_\_\_

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0715 Joel Riebli (JR) departs the Helena office.

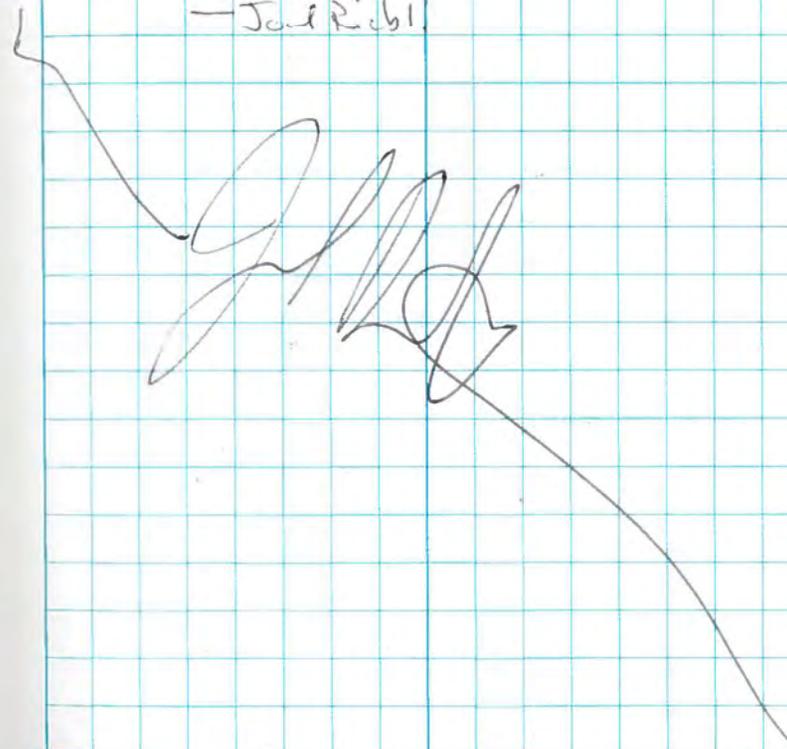
1050 JR arrives at the former Roxy Cleaners site in Haure; the SVE system is running.

\* Using a MiniRAE 3000 PID for today's readings

1140 System check using PID

1145 -1200 system down for maintenance

-Joel Riebli



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Location Helena → Havre

Date 08/26/2016

Project / Client MDEQ SRS Raxy Cleaners

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776-023-001

SR

0800 SR Bel Ricbli (SR) departs The Helena  
office

1040 SR arrives in Havre

\* Using PID Sor system checks this  
visit

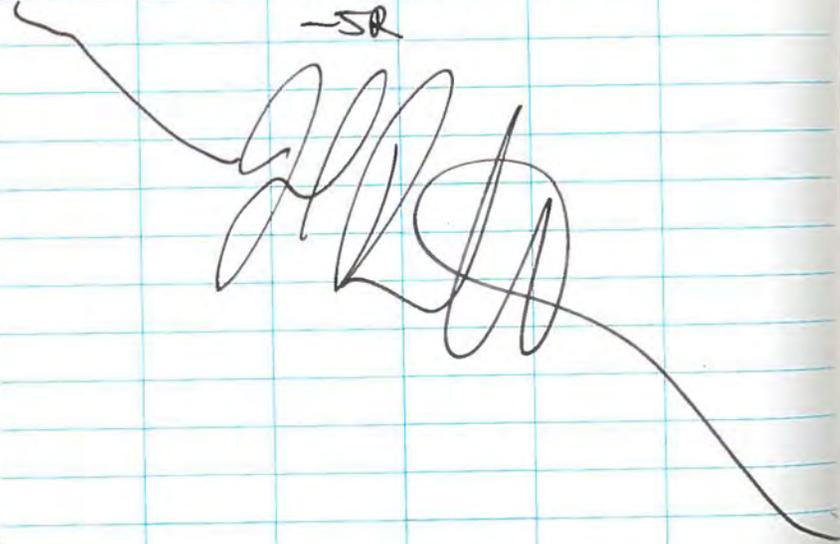
1145 Shut down system and changed out  
the 24-hr timer dial that is  
not working (Replaced under warranty).  
Also changed ~~SR~~ ~~SR~~ added some fuses  
and the control panel

1208 Restarted the SVE system

1300 SR departs Havre

1700 SR arrives in Helena

-SR



Location

Date 08/27/2016

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Project / Client

0708: System alarm — "SVE Low  
Vacuum" alarm — system down

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Location Helena → HavreDate 09/07/2016Project / Client MDEQ SRS Roxy CleanersPg 1/4 776-023-001

0505 Joel Riebl. (JR) departs

Helena

0847 JR arrives in Havre

\* Using PID to collect system readings.

0905 Ron with Korb construction arrives to check out concrete removal - removing concrete seen next to the ramp where the low spot is

0923 Restarted the down "low SVE vacuum" system alarm after performing maintenance items

\* Waiting to hear back if all the concrete will be removed, replaced with concrete or asphalt

1124 Site owner Michael Hamilton stopped by - has concern over the high and low sections of the previous poured concrete. Have call with Mr. Hamilton, Jim Gleason, &amp; Joel Riebl regarding the condition of the concrete, the drainage, → the cracking of the new pour

\* JR write for Surplus and

Location \_\_\_\_\_

Date 09/08/2016 109

Project / Client \_\_\_\_\_

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1145 Nothing to report is the remaining concrete will be removed or not, no update from Rington or Korb Construction. Depart Havre

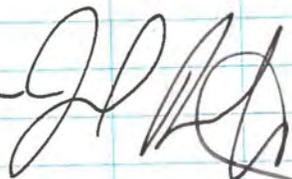
1605 JR arrives back in Helena  
- Joel Riebl.


(1500) Took the used activated carbon from the first GAC drum to the Hill County disposal landfill. The 55-gallon capacity material was taken by Brad and taken to the designated call saw final disposal - (SP)

Pg 1/1

776-023-001

- 0700 Joel Riebli (JR) departs Helena
- 1045 JR arrives on site. Korb Construction is on site and most of the concrete has been broken up in the former's poured concrete resurfacing area
- 1055 Using PID to collect system data
- 1145 changed the SVE low vacuum setting from 15 sec's to 25 sec's (can change the setting up to 30 sec's if need be)
- \* waiting to find out if asphalt will be delivered and if all the remaining concrete will be removed - some still next to the system
- 1700 check in at Hotel  
- Joel Riebli



Pg 1/1

- 0800 Joel Riebli (JR) arrives on site
- 0805 Using PID for system data
- \* still no word if asphalt / concrete will be coming today - area is ready
- 1045 Call with Jim Gleason on site ready for asphalt / concrete
- 1155 JR departs Havre
- 1600 JR arrives at the Helena office  
- Joel Riebli



Pg 1/1

776-023-001

JR

1300 Joel Riebli (JR) departs The  
Helena office

\* Stopped in Great Falls to purchase  
supplies for another project

1455 Dan Korb with Korb construction  
calls and said that the asphalt will  
be arriving around 0900 tomorrow

1845 JR arrives in Havre  
- Joel Riebli

JR

Pg 1/2

0810 Joel Riebli (JR) arrives at the  
former Roxy Cleaners. Baltrusch  
Construction is on site prep'g. The  
former concrete area for asphalt-  
smoothing out and recompact'g the  
subsurface

0840 Using PID to collect system readings -  
the first 55-gallon drum of GAC  
appears to be saturated and should be  
changed out

0845 shut down system for O&M

0900 Dan Korb of Korb construction arrives

0920 Restart the SUE system

0920 Asphalt arrives on site

0930 call with Jim Gleason regarding the  
asphalt and drum into

\* Baltrusch construction using a compactor  
plate and a road roller compaction  
machine. making a slope away from  
the raised sidewalk towards the  
parking lot

\* Clean up the parking lot of asphalt,  
dirt, rock and other debris

1530 shut down the SUE system to  
change out the RXY-Drum #2

(Drum that is saturated), move RXY-Drum #3 from the second drum position to the first drum position. Drum was in position #2 since 7/21/2014. Moved new drum # RXY-Drum #4 to the second drum position.

1600 Sample drum "RXY-Drum 2" for TCLP & VOC's

1601 Restart the SUE system with the exhaust going into drum # RXY-Drum 3 and then into # RXY-Drum 4.

1635 Depart the former Roxy Cleaners

1642 Purchased 7 lbs of ice for \$1.69 to chill the # RXY-Drum 2 TCLP & VOC GAC sample containers

1650 Check in at Hotel.

- Joel Riebli



- 0700 Joel Riebli (JR) departs Haure
- 0855 Arrive in Great Falls - Co-Serace calls and shopping for another project
- 1340 Depart Great Falls
- 1510 Arrived in Helena. Dropped off the # RXY-Drum 2 samples at Energy labs
- 1525 Shipped PID back to FairWest Environmental at FedEx
- 1610 JR arrives at Helena office
- Joel Riebli

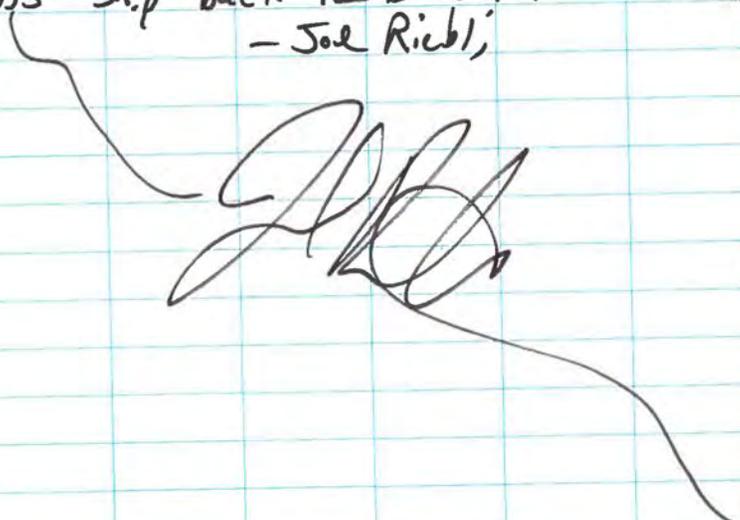


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Location Helena / HavreDate 11/22/2016Project / Client MDEQ ~~Whiting~~ Havre Roxy Cleaners

Pg 1/1

776-023-001

- 0720 Joel Riebli (JR) departs Helena office.
- 1040 SR arrives in Havre; purchase trash bags at North 40.
- 1130 System check with PID unit. see spreadsheet.
- \* System OSM (grease blower, drain KO tank, clean drain dilution filter; shutting down the system @ 1133
- 1212 Restart system
- 1250 Depart Havre
- 1025 Arrive at Helena office
- 1055 ship back PID rental at FedEx.  
- Joel Riebli,
- 

Location Helena / HavreDate 12/14/2016 117

Project / Client

Pg 1/1

- 0800 Joel Riebli (JR) departs Helena - winter driving conditions
- 1155 JR arrives in Havre
- \* System is running but everything in the shed is frozen. The buildy heater is not running - found the heater breaker tripped. Reset the breaker on the heater. The knockout tank sight tube has frozen ice in it.
- 1220 Called Jim Gleason, gave update on the tripped breaker and that the piping needs heated up the next all the ice before the system can be restarted. Think about purchasing a heater to help the buildy heater thaw out the equipment piping & parts.
- 1300 Purchased heater equipment from North 40; total \$24.98
- 1330 Property owner Michael Hamilton came by the site. discussed meeting at 11 am tomorrow to get ready for basement sample part

Pg 1/2

776-023-002

0710 Arrived at remediation system - piping is thawed out. No damage so far. The heater breaker tripping and the system freezing.

0750 Restarted the SVE system

1050 Collected system reading using PID meter. Not seeing much vapor data with PID 3 hours after start up

\* Met with Property owner Michael Hamilton, he opened the basement door so data from the vapor port could be collected. no vacuum noted detected at the sample port 3 hours after start up

1130 shut down the system and reset the operating hours from 12 on/12 off to 24 hours on. On Friday Saturday ~ -25 F air temperatures are forecast.

1155 SR departs Haure

1605 SR arrives in Helena

- Spil Riedl

JLR

Pg 1/1

0630 Joel Riebli (JR) departs Helena.

1000 JR arrives at the former Roxy Cleaners in Haure; system is running.

\* Collect system data; use PID meter.

1015 Shut down SVE system; change oil (next oil change ~ 7,500 hours). Greased blower, checked air filters and KO tank, and heat exchanger discharge.

1235 Restarted SVE system

1255 JR departs site.

1315 JR arrives at Hill County landfill and took the used carbon drum #2 to the landfill. They asked that it be placed with the trash.

\* Arrived back to the former Roxy Cleaners. Shut down the SVE system and reset the system to run 12 hours on & 12 hours off.

1405 Restarted the SVE system

1430 SR departs Haure

1635-1725 In Great Falls for another project.

1905 SR arrives at the Helena office.

JLR

- 0740 Joel Riebli departs Whitefish, MT
- 1220 Joel arrives in Haure, system is running.
- 1230 Collect system operating data.
- 1232 shut down SUE system. Grease blower motor, clear air filter (dilution), inspect inline air filter; Both knock out tank and heat exchange tanks are empty.
- 1255 Restart SUE system
- 1315 Depart SUE Haure
- 1630 Arrive in Helena.
- \* Return PID to FarWest Environmental.

Joel Riebli

- 0600 Joel Riebli (JR) departs Clancy.
- 0945 JR arrives in Haure
- \* System is running. New business is preparing to open on the north end of the building: Bear Paw Hardware.
- \* Snow: ice removal
- \* Use PID model miniRAE 3000 (# 592-001229)
- 1040 System check
- \* Check oil level (good), grease, check air filters, check for loose bolts/nuts, repair a hose.
- 1305 JR departs Haure
- \* ship PID in Great Falls
- 1700 JR arrives back in Helena.

Joel Riebli

Pg 11

\* SVE system isn't shutting down! restarting & reporting back via email through the Sensaphone system since the 2/10/17 site visit.

0705 Joel Riebli (JR) departs Helena with the street vehicle.

1040 JR arrives in Havre. The SVE system is running. The system is running in manual mode rather than Auto mode. Noticed more water in the SVE well hoses than normal.

\* Departed the site.  
1052 Purchased a 4" x 1/2" Flex Coupler from North 40. Total \$ 15.99

Arrived back on site. Use the Flex coupler and disconnect the Flex hose from the outlet of the second GAC tank and blow the water in the SVE wells back into the well.

1245 JR departs Havre

1420 JR arrives back in Helena

JRH

Pg 12

0000 Joel Riebli (JR) departs Clancy

0845 FedEx should arrive between 12-1 with the three drums. No work list needed, will use list safe (with extra charged)

1020 JR arrived at the former Roxy Cleaners. System is running

1040 Collect SVE operating data. Using a ppb mini rae pid to collect vapor concentration data.

1045 Shut down SVE system:

- greased motor
- checked oil levels (both good)
- checked for liquid in KO: heat exchanger drains.
- checked inline air filter (good)
- checked air dilute air filter (cleaned)
- checked inspected belts -> bolts (good)

1155 Restarted SVE system

1220 FedEx arrives on site with the three drums. The fittings and internal piping is the smaller low flow 2" unit not the 4" ordered

Location

Project / Client MDEQ Havre Roxxy Cleaners

Pg 2

1225 Called Jim Gleason updating on the wrong type of filtration drums arriving from Corbenair.

1235 Tried reaching Patrick Discoll at Corbenair but he is on vacation. Called and talked with Keith Miller. He is the project engineer at Colman and said that Patrick put the order in for the 2" drum style. Keith will look into what will be shipped out to the site and when. Update tomorrow as he only has one 4" ~~step~~ style drum in stock.

1320 Keith called again and is looking at various options:

- 1) shipping at three 9" drums and set the 2" returned
- 2) shipping out repeat lids and internal piping and have Trihydro change the drums from 2" to 4"

1400 JR departs Havre

1755 JR arrives back at Helena office

Joel Riebli



Location

Project / Client

Pg 1

1320 Joel Riebli (JR) departs Helena

1510-1540 purchase drum & Higs at North 40 in Great Falls.

1745 JR arrives at The Service Roxxy Cleaners in Havre. BVE System is running.

\* Collect Operating Data - Joel Riebli



Location Havre Date 03/21/2017Project / Client MDEQ Havre Roxy Cleaners

8/1/4

0700 Joel Riebel (JR) checks out of hotel.  
 \* Purchase 7 lbs of ice & 9 gallons of distilled water at group store.  
 Total \$14.24.

0720 Arrive at the former Roxy Cleaners. SVE system is running. Very windy today, blowing just around the area.

0735 Calibrated the Horiba U-52 (GW# B3AC3AVR) water quality meter.

0740 Arcadis's Pete Behrends stopped by & went over groundwater sampling locations & PPE requirements. Just call when wrapped up with activities on BNSF property.

0825 Arrive at monitoring well RXY-HV-41. Depth to water = 11.05' btoe. Total well depth = 16.53' btoe.

\* Set the bladder pump (Geotek slw # 10780) in the center of the water column; set at 13.8' btoe.

0837 Begin purging RXY-HV-41 at approximately 8.2 lpm. Blowing silt, sands, & dust off the streets and parking lots.

Date 03/21/2017

Project / Client

P2/4

0850 Sample RXY-HV-41<sup>43</sup>(BD-1)

0907 End sample collection; tried my best to keep blowing dust, silts, & sands from blowing into the water samples. The dissolved metals sample was silted & filtered.

\* Decontaminated the interface meter, Horiba U-52 water quality meter, the bladder pump, air line, & pump wire in a three bucket decon wash. First bucket is Alconox & distilled water. The second & third bucket contain distilled water. Replaced the bladder, O-rings, and base plate on the bladder pump. With new items.

0958 Arrive at monitoring well RXY-HV-43<sup>41</sup>. Still blowing dust, silt, & sands from off the street & parking lots. Depth to water = 11.18' btoe. Total well depth = 16.76' btoe.

\* Bladder pump inlet set at 14.0' btoe. Begin purging RXY-HV-43<sup>41</sup> at a

approx. purge rate of 0.21 lpm. Purge water stabilized, disconnect from water quality meter.

Location Havre, MTDate 03/21/2017Project / Client MDEQ Roxy Cleaners

Pg 3/4

1003 Sample RXY-HV-43; Pine type odor and white bugs noted in the purge; samples.

1013 End sample collection. Samples placed in cooler on ice.

Tried my best to keep blowing dust silt; sand out of the lab samples.

\* Decontaminate the water level meter, water quality meter, bladder pump, air line; pump wire in the three bucket decon stage.

1048 Arrive at RXY-HV-02. Depth to water = 12.11' btoe (No LMAPL detected but strong odors noted).

Ts + l well depth = 18.01' btoe.

\* Set the bladder pump inlet at 15.1' btoe; changed out the bladder O-rings; & base plate after decon. Screen last well.

1057 Begin purging RXY-HV-02 at approximately 0.15 lpm. Some small amounts of silt noted in the

purge & high amount of sediment. 1109 Purge stabilized, disconnect the water quality meter from purge.

Date 03/21/2017

Project / Client \_\_\_\_\_

Pg 4/4

1110 Sample RXY-HV-02.

1120 Collect field blank FB-1; dust/silts/sediments are still blowing around in the air.

1132 End sample collection at RXY-HV-02. The dissolved metal sample took a while to collect due to sediment in the purge. Samples placed on ice.

\* Decontaminate the water level meter, water quality meter, bladder pump, air line, pump wire, in the three bucket wash.

\* Called Pete to let him know that wrapped up activities on the BNSF property.

1210 Collected equipment blank EB-1 at the decon water quality meter probe.

1300 JA deposits Havre

1610 JR arrives in Helena, drop off water samples at Energy labs.

1635 Dropped off the PID & water quality meter at FedEx

1655 JR arrives at Helena office.

—Tad Riehl  
—Alec

Date 04/05/2017

Location

Project / Client MDEQ Roxy Cleaners

Pg 1

- 1305 Joel Riabli departs Helena office  
 1350 pick up rental SUV at Enterprise. Depart Helena.  
 \* Purchase sild supplies in Great Falls.  
 1817 Arrive in Haver, SUE system is running. Off load supplies in remedi. system.  
 - Joel Riabli,

Date 04/06/2017

Location

Project / Client

Pg 1/3

- 0725 Joel Riabli (JR) arrives at the former Roxy Cleaners. SUE system is running.  
 \* Pulled the three filtration drums dropped off on 03/16/2017 and placed on a pallet and secured the drums with stretch wrap.  
 0750 Property owner Michael Hamilton - stopped by and asked if I needed in his basement today as he will be gone until 6 PM. We discussed various options but later decided to give me the basement remote.  
 \* Contacted Jim Gleason about Mr. Hamilton not remembering our 1 PM appointment.  
 \* Using a PPH RAE 3000 / 594-905182 meter to monitor vapor concentrations.  
 \* 0930 Collect system opening date. Start before & after filtration. Summa canister sampling. RXY-POST & RXY-PRE  
 6L vapor samples.  
 1000 End RXY-POST & RXY-PRE sampling.  
 \* Prep for subslab vapor sampling.  
 1300 Called YRC Trucking to find out the status of the three drums →

8/2/3

Some Rxy Cleaners

YRC said they dropped the shipment yesterday in Great Falls to Reddaway trucking. Would need to send out when they are deliver to tomorrow

1310 Entered Mr. Hamiltons basement. → set up at the subslab sample port. Using the ppb RAE 3000 voc meter, Dielectric MGD-2002 helium detector, Helium party balloon gas, Clear trash bag, three way valve, syringe air hand pump, & magnetic gauge. Filled a hose up with sand to weigh down the edges of the sample area. Connected the three way valve to the sample port, syringe, tedlar bag. Picked clear trash bag over the items → added helium keeping the helium mid high between 20% & 30%. Using the syringe to pull subslab vapor out of the sample port → then pushed into the tedlar bag. (added helium when nearly 20% on the helium meter. Filled 4 1L tedlar bags of subslab

8/3

purge. VOCs from the 4<sup>th</sup> tedlar bag = 1171 ppb VOC's. helium = 1.1% (loss than 2% so acceptable). Connected a 6L source canister onto the three way valve, closing off the spring port. Start the "RXY-subslab" 6L sample. Maintaining helium constant between 20-30% under the trash bag. End "RXY-subslab" sample

1355 Out of Mr. Hamiltons basement, packed up field supplies. → cleared out the system

(1015 -1150) Groused blower motor, checked air filters, checked KO & heat exchange tanks, checked for loose bolts

1425 Seal Depante Site. - JAL Ribbi,



Former Raxy cleaners

0745 Joel Riebl (JR) swings by the site to see if the packed up three drums are still secure they still are.

615 JR arrives back on site.

1025 Mr. Hamilton drives by the site, waves, and parks in the basement.

1315 Reddaway trucking arrives on site - but driver is taking his 30 minute lunch. He doesn't have a lift safe but could have one on Monday.

1328 JR rents Fork lift from Haver Redha

1350 Reddaway uses the Fork lift to do the three new Si-truth drums with the 4" inlet/outlets. All three look good. Reddaway can't pick up the three drums as he has two other drop offs to make first.

Moved the three drums with 4" connection (Realite 2 two GAC) into the remnant shed.

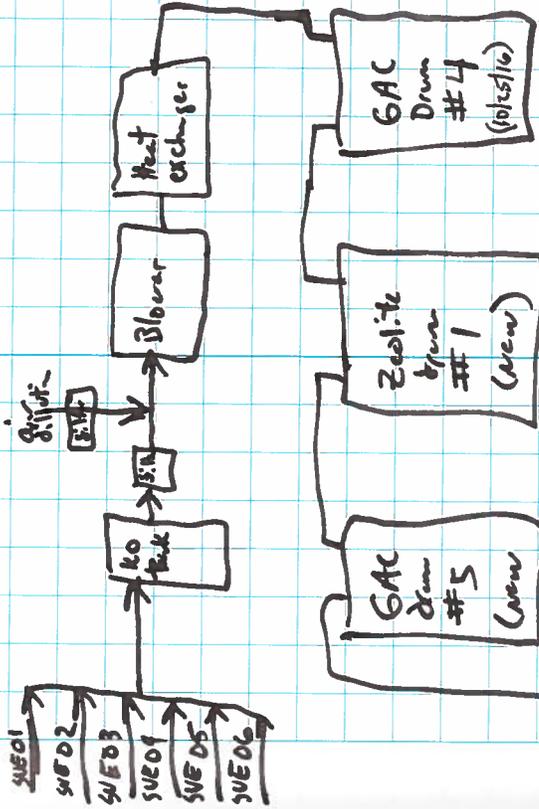
1430 Reddaway picks up the three 2" connection drums pallet. Fork lift is called in for pickup

pg 1/2

pg 2/2

\* Set up the system by installing one new GAC drum and one new Realite drum to the old GAC drum.

1450 Collect RAXY-Drum 3" GAC Sample from old drum.



extend out system

1525 JR departs there

\* ship some emister samples - Great Falls F-Dex

1930 JR arrives back at Helena office

Handwritten signature

Location \_\_\_\_\_

Project / Client \_\_\_\_\_

MDEQ Havre Solvent Site

Former Roxy Cleaners

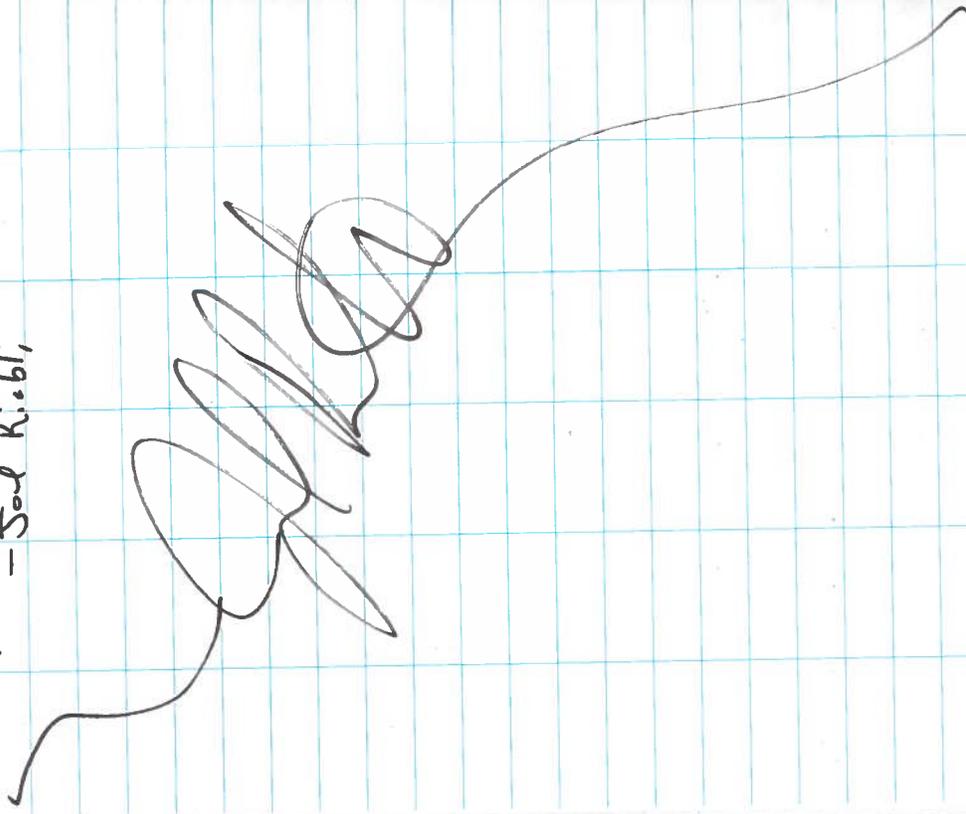
Pg 1

0855 Joul Riebl (~~SR~~) dropped out

The "RXY - Drum 3" media carbon-

sample sit Energy labs in Helena.

- Joul Riebl,



Location \_\_\_\_\_

Project / Client \_\_\_\_\_

Empty grid area for notes on page 137.



# Indoor Air Sampling Field Data Sheet

Prepared by the Montana Department of Environmental Quality											
Site ID:		Start Weather: See RXY01 Sample		Start Outdoor Air Temp: 45°F		Start Atmospheric Pressure: 30.00 in Hg					
Project Name: Rocky Mt DEQ Site		End Weather: See RXY01 Sample sheet		End Outdoor Air Temp: 32°F		End Atmospheric Pressure: 30.20 in Hg					
Sample Location: Gravel		Date: 3/16/16		Field Personnel: S. SEITZ		Recorded by: S. SEITZ					
Canister and Sample Information											
Start Date	Start Time	End Date	End Time	Sample ID	Canister ID	Flow Controller #	Vacuum Gauge #	Initial Vacuum	Final Vacuum	Pre-Sample Indoor Air Temp	Post-Sample Indoor Air Temp
3/16/16	1215	3/17/16	1215	RXY02	Entek 17984 AS01067	FCR00112	same	-27.25	-6.25	≈ 55°F	≈ 40°F
3/16/16	1215	3/17/16	1215	RXY03 - Duplicate	Silvaco R0601 RES-TEK	FCR00067	same	-26.75	-9.00	≈ 55°F	≈ 40°F
Comments:											

# Ambient Outdoor Air Sampling Field Data Sheet

Prepared by the Montana Department of Environmental Quality									
Site ID:									
Project Name:	Roxey SRS Site - MT DEQ								
Sample location:	Ambient air outside ramp								
Date:	3/16/17								
Field Personnel:	S. SEITZ								
Recorded by:	S. SEITZ								
Canister and Sample Information									
Start Date	Start Time	End Date	End Time	Sample ID	Canister ID	Flow Controller #	Vacuum Gauge #	Initial Vacuum	Final Vacuum
3/16/14	12:20	3/17/16	12:20	RXY04	CAS 003174 AC01208	FRG FCR00086 ← same		-24.75	-19.10
Start Weather: Sunny, windy, clear, visibility 10 miles Start Air Temp: 45°F Start Atmospheric Pressure: 30.00 in Hg wind = WNW 27 mph									
End Weather: 32°F Cloudy, small snow flurries, visibility 2 miles End Air Temp: 30.20 in Hg 32°F End Atmospheric Pressure: 30.20 in Hg wind = NNW 16 mph									
Comment/location description:									





OCCUPIED DWELLING QUESTIONNAIRE

Indoor Air Assessment Survey

Date: 3/16/2017

1. Name: Michael

Address: 437 1st Street
Have MT - Basement garage & residence

Home Phone: Work Phone:

2. What is the best time to call to speak with you? At: Work or Home ?

3. Are you the Owner [X], Renter, Other (please specify) of this Home/Structure? If you are not the owner, please provide owner contact information

4. Total number of occupants/persons at this location? 2
Number of Children NA Ages

5. How long have you lived at this location? 1996 Since approx 20 years

General Home Description

6. Type of Home/Structure (check only one): Single Family Home, Duplex [X], Apartment, Townhouse, Other

7. Home/Structure Description: Number of floors: 1
Basement [X] NA - is the basement of build's
Crawlspace
Partial Crawlspace/Basement % of each
Slab On Grade
Other

8. Age of Home/Structure: 1915/1914 years, Not Sure/Unknown

9. General Above-Ground Home/Structure construction (check all that apply): Wood [X], Brick [X], Concrete, Cement block, Other
(above) walls

10. Foundation Construction (check all that apply): Concrete Slab [X], Fieldstone, Concrete Block, Elevated Above Ground/Grade, Other

11. Do you have Private Well  or Cistern ? *NO*  
 If yes, please describe location, use, and current condition \_\_\_\_\_  
 \_\_\_\_\_
12. Do you have a Septic System? Yes  No  Not Used  Unknown   
 If yes, what is the construction type? \_\_\_\_\_  
 Where is it located? \_\_\_\_\_  
 When was the last time it was serviced? \_\_\_\_\_  
 Do you (or have you ever) use(d) any degreaser for your septic system? Yes  No   
 If yes, when was the last application? \_\_\_\_\_
13. Do you have standing water outside of your home? (pond, ditch, etc.) Yes  No

**Basement Description (please check all boxes that apply):**

14. Is the basement Finished  or Unfinished ?
15. If finished, how many rooms are in the basement? *about 11*  
 What are rooms used for? Bedrooms  Family Room  Storage   
 Other *Kitchen, living, dining*
16. If not finished, do you plan on finishing in the future? Yes  No  *NA*
17. Is the basement floor (check all that apply) Concrete , Tile , Carpeted , Dirt ,  
 Other
18. Are the basement walls Poured Concrete , Cement Block , Stone , Wood ,  
 Brick , Other
19. Does the basement have a moisture problem?  
 Yes, frequently (3 or more times/year)   
 Yes, occasionally (1-2 times/year)   
 Yes, rarely (less that 1 time/year)   
 No   
 Describe the moisture problem \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_
20. Does the basement ever flood?  
 Yes, frequently (3 or more times/year)   
 Yes, occasionally (1-2 times/year)   
 Yes, rarely (less that 1 time/year)   
 No
21. Does the basement have any of the following? Floor Cracks , Wall Cracks , Sump ,  
 Floor Drain , Other Hole/Opening In Floor   
 Describe \_\_\_\_\_

*old elevator shaft*

22. Are any of the following used or stored in the basement (check all that apply):  
Paint  Paint Stripper/Remover  Paint Thinner  Metal Degreaser/Cleaner   
Gasoline  Diesel Fuel  Solvents  Glue  Laundry Spot Removers   
Drain Cleaners  Pesticides  *heavy solvents not new*  
Other equipment with fuel tanks (chain saw, lawn mower, snow blower, etc.)  *yes propane*  
Other products with/containing Volatile Organic Compounds, describe: \_\_\_\_\_  
*Sometimes have used a solvent/degreaser inside horse shops - none new*

23. Have you recently (within the last six months) done any painting or remodeling in your home?  
Yes  No   
If yes, specify what was done, where in the home, and what month:

*tongue oil near sink*

24. Have you installed new carpeting in your home within the last year? Yes  No   
If yes, when and where? \_\_\_\_\_

25. Do you regularly use or work in a dry cleaning service?  
Yes, use dry-cleaning regularly (at least weekly)  *Bi-weekly*  
Yes, use dry-cleaning infrequently (monthly or less)   
Yes, work at a dry cleaning service   
No

26. Does anyone in your home use solvents at work?  
Yes  If yes, how many persons?  
No  If no, go to question 28 *Rarely*

27. If yes for question 26, are the work clothes washed at home? Yes  No  *NA*

28. Where is the washer/dryer located?  
Basement  *off kitchen*  
Upstairs Utility Room   
Kitchen   
Garage   
Use a Laundromat   
Other, please specify  \_\_\_\_\_

29. If you have a dryer, is it vented to the outdoors? Yes  No

30. What type (s) of home heating do you have (check all that apply)  
Fuel type: Gas , Oil , Electric , Wood , Coal ,  
Other  \_\_\_\_\_

Heat conveyance system: Forced Hot Air   
Forced Hot Water   
Steam   
Radiant Floor Heat   
Wood Stove   
Coal Furnace   
Fireplace   
Other  \_\_\_\_\_

31. Does your home have (or had in the past) a storage tank for storage of Gasoline , Fuel Oil , Propane   
 If yes, where is/was it located? NA  
 How is/was the tank filled? \_\_\_\_\_  
 Is there staining near the tank? Yes  No
32. Do you have air conditioning? Yes  No   
 Central Air Conditioning   
 Window Air Conditioning Unit(s)   
 Other (please specify) \_\_\_\_\_
33. Do you use any of the following? Room Fans  <sup>Central exhaust fan</sup>, Ceiling Fans , Attic Fan
34. Do you ventilate using the fan-only mode of your central air conditioning or forced air heating system? Yes  No
35. Has your home had termite or other pesticide treatment? Yes  No  Unknown   
 If yes, please specify type of pest controlled spraying for crickets - annually - owner  
 And approximate date of service 2015
36. Water heater type: Gas  Electric , by Furnace ,  
 Other (please describe) \_\_\_\_\_
37. Water heater location: Basement , Upstairs Utility Room , Garage ,  
 Other (please specify) shop - in residence same as A/race
38. What type of cooking appliance do you have? Electric , Gas   
 Other (please describe) \_\_\_\_\_
39. Is there a stove exhaust hood present? Yes  No   
 Does it vent to the outdoors? Yes  No  NA no vent down draft - inside
40. Smoking in Home:  
 None , Rare (only guests) , Moderate (residents, light smokers) ,  
 Heavy (at least one heavy smoker in household)  in garage
41. If yes to question 40, what is smoked?  
 Cigarettes  Cigars   
 Pipe  Other
42. Do you regularly use air fresheners? Yes  No
43. Does anyone in the home have indoor home hobbies or crafts involving:  
 Heating , Soldering , Welding , Model Glues , Paints ,  
 Spray Paint , Wood Finishing , Other  NA

44. General family/home use of consumer products (please circle appropriate).  
 Assume that: Never = never used, Hardly ever = less than once/month,  
 Occasionally = about once/month, Regularly = about once/week,  
 and Often = more than once/week.

Product	Frequency of Use				
	Never	Hardly ever	Occasionally	Regularly	Often
Spray-on deodorant		<input checked="" type="checkbox"/>			
Aerosol deodorizers		<input checked="" type="checkbox"/>			
Insecticides		<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Disinfectants		<input type="checkbox"/>		<input checked="" type="checkbox"/>	
Window cleaners		<input type="checkbox"/>		<input checked="" type="checkbox"/>	
Nail polish remover		<input type="checkbox"/>		<input checked="" type="checkbox"/>	
Hair sprays		<input type="checkbox"/>		<input checked="" type="checkbox"/>	
Candles		<input type="checkbox"/>		<input checked="" type="checkbox"/>	
Incense	<input checked="" type="checkbox"/>	<input type="checkbox"/>			

45. Please check weekly household cleaning practices:

Dusting

Dry Sweeping

Vacuuming

Polishing (furniture, etc.)

Washing/Waxing Floors

Other (describe)

46. Other comments:

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47. Chemical Inventory/Summary

Chemical/Chemical Product (consumer name)

Amount present in home

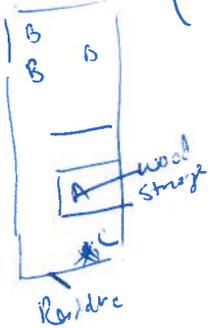
- a) Small engine oil (20 oz)
- b) Wood spray aerosol (12 oz can)
- c) CLR (24 oz bathroom cleaner)
- d) Triflon lubricant
- e) Insect Spray 2 containers
- f) Lacquer thinner, (pt.)
- g) Ooops-remover (pt)
- h) Polymer Coating (1 half gal)
- i) ~~Calib~~ / S.i. cure / wood cement / adhesive (various)
- j) Old English
- k) Chrome cleaner / Brass / Metal Polish
- l) Stains / Polys - 10 cans
- m) Spray varnish / enamel  $\approx 6$  cans
- n) glaze, paint sealants  $\approx 15$
- o) Reef Cement - 1 gallon

} Garage shelf 1 (west)

} Garage shelf 2 (middle)

} Garage shelf 3 (east)

A  
Wood storage / chemical storage



storage shelves near w. garage door B

1 propane tank

Antifreeze

Car cleaners -  $\approx 10$

Function seal - tire 1 can

Fuel stabilizer -  $\approx 4$

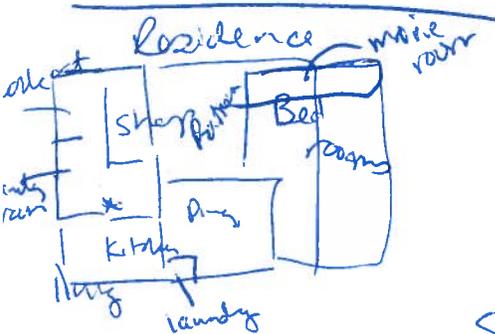
House glue

gasoline - cleaner in tank  $\approx 4$  oz open

aerosol marking paint  $\approx 3$

liquid asphalt coating (roof) cement - 1 5 gal  $\approx$   
3-4 1 gal

C\* Solar salt - 24 bags 50 lb



Dish soap lysol, unclor, kitchen sink  
Household - cleaner, bleach, laundry - laundry room  
bleach

Bathroom cleaner  $\rightarrow$  CLR - tub/bowl cleaner  
glass cleaner, ajax

Shop vac - 3 spray adhesives, lubricant spray - several gal



OCCUPIED DWELLING QUESTIONNAIRE

Indoor Air Assessment Survey

Date: 3/1/2017

1. Name: Mike Hamilton

Address:

417 1st St. Havre, MT 59501

Home Phone: Work Phone:

2. What is the best time to call to speak with you? NA At: Work or Home ?

3. Are you the Owner, Renter, Other (please specify) of this Home/Structure? If you are not the owner, please provide owner contact information Sharnai & Michael Hamilton (yes Mike owner)

4. Total number of occupants/persons at this location? 2 Number of Children Ages

5. How long have you lived at this location? Since 1994/1996

bought merged in

General Home Description

6. Type of Home/Structure (check only one): Single Family Home, Duplex, Apartment, Townhouse, Other Residential & Commercial above

7. Home/Structure Description: Number of floors: 2 Basement Residence Crawlspace Partial Crawlspace/Basement % of each 9600, 4800 Residence Slab On Grade Other Grade is commercial

8. Age of Home/Structure: 1913/1915 Built years, Not Sure/Unknown

9. General Above-Ground Home/Structure construction (check all that apply): Wood, Brick, Concrete, Cement block, Other Wooden Facade - Beam -

10. Foundation Construction (check all that apply): Concrete Slab, Fieldstone, Concrete Block, Elevated Above Ground/Grade, Other

11. Do you have Private Well  or Cistern ? *NO well*  
If yes, please describe location, use, and current condition city water

12. Do you have a Septic System? Yes  No  Not Used  Unknown   
If yes, what is the construction type? city sewer  
Where is it located? \_\_\_\_\_  
When was the last time it was serviced? \_\_\_\_\_  
Do you (or have you ever) use(d) any degreaser for your septic system? Yes  No   
If yes, when was the last application? \_\_\_\_\_

13. Do you have standing water outside of your home? (pond, ditch, etc.) Yes  No

**Basement Description (please check all boxes that apply):**

14. Is the basement Finished  or Unfinished ? *4800 sq ft - Remains is storage/garage*

15. If finished, how many rooms are in the basement? \_\_\_\_\_  
What are rooms used for? Bedrooms  Family Room  Storage   
Other \_\_\_\_\_

16. If not finished, do you plan on finishing in the future? Yes  No

17. Is the basement floor (check all that apply) Concrete , Tile , Carpeted , Dirt ,  
Other  North Street in House

18. Are the basement walls Poured Concrete , Cement Block , Stone , Wood ,  
Brick , Other

19. Does the basement have a moisture problem?  
Yes, frequently (3 or more times/year)   
Yes, occasionally (1-2 times/year)   
Yes, rarely (less than 1 time/year)   
No

Describe the moisture problem \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

20. Does the basement ever flood?  
Yes, frequently (3 or more times/year)   
Yes, occasionally (1-2 times/year)   
Yes, rarely (less than 1 time/year)  *Roof drain in NE side of garage can leak during storm runoff (water gone in about a day)*  
No

21. Does the basement have any of the following? Floor Cracks , Wall Cracks , Sump ,  
Floor Drain , Other Hole/Opening In Floor   
Describe to sewer in home

22. Are any of the following used or stored in the basement (check all that apply):  
Paint  Paint Stripper/Remover  Paint Thinner  Metal Degreaser/Cleaner   
Gasoline  Diesel Fuel  Solvents  Glue  Laundry Spot Removers   
Drain Cleaners  Pesticides  *↑ household style*  
Other equipment with fuel tanks (chain saw, lawn mower, snow blower, etc.)  *vehicles/cars w/ fuel tanks*  
Other products with/containing Volatile Organic Compounds, describe: \_\_\_\_\_

23. Have you recently (within the last six months) done any painting or remodeling in your home?  
Yes  No   
If yes, specify what was done, where in the home, and what month: \_\_\_\_\_

24. Have you installed new carpeting in your home within the last year? Yes  No   
If yes, when and where? \_\_\_\_\_

25. Do you regularly use or work in a dry cleaning service?  
Yes, use dry-cleaning regularly (at least weekly)   
Yes, use dry-cleaning infrequently (monthly or less)   
Yes, work at a dry cleaning service   
No

26. Does anyone in your home use solvents at work?  
Yes  If yes, how many persons?  
No  If no, go to question 28

27. If yes for question 26, are the work clothes washed at home? Yes  No  *NA*

28. Where is the washer/dryer located?  
Basement  *Utility Room (floor drain)*  
Upstairs Utility Room   
Kitchen   
Garage   
Use a Laundromat   
Other, please specify  \_\_\_\_\_

29. If you have a dryer, is it vented to the outdoors? Yes  No

30. What type (s) of home heating do you have (check all that apply)  
Fuel type: Gas , Oil , Electric , Wood , Coal ,  
Other  \_\_\_\_\_

Heat conveyance system:  
Forced Hot Air   
Forced Hot Water   
Steam   
Radiant Floor Heat   
Wood Stove   
Coal Furnace   
Fireplace   
Other  \_\_\_\_\_

31. Does your home have (or had in the past) a storage tank for storage of Gasoline , Fuel Oil , Propane   
If yes, where is/was it located? Maybe historic  
(North wall near garage door) not within line of ownership  
How is/was the tank filled? \_\_\_\_\_

Is there staining near the tank? Yes  No

32. Do you have air conditioning? Yes  No   
Central Air Conditioning   
Window Air Conditioning Unit(s)   
Other (please specify) \_\_\_\_\_

33. Do you use any of the following? Room Fans , Ceiling Fans , Attic Fan  no part of furnace

34. Do you ventilate using the fan-only mode of your central air conditioning or forced air heating system? Yes  No  HVAC Fresh air exchanger

35. Has your home had termite or other pesticide treatment? Yes  No  Unknown   
If yes, please specify type of pest controlled \_\_\_\_\_  
And approximate date of service \_\_\_\_\_

36. Water heater type: Gas , Electric , by Furnace ,  
Other (please describe) \_\_\_\_\_

37. Water heater location: Basement , Upstairs Utility Room , Garage ,  
Other (please specify) Residence

38. What type of cooking appliance do you have? Electric , Gas   
Other (please describe) \_\_\_\_\_

39. Is there a stove exhaust hood present? Yes  No  Down draft  
Does it vent to the outdoors? Yes  No

40. Smoking in Home:  
None , Rare (only guests) , Moderate (residents, light smokers) ,  
Heavy (at least one heavy smoker in household)

41. If yes to question 40, what is smoked?  
Cigarettes  Cigars  Rarely in garage w/ guests  
Pipe  Other

42. Do you regularly use air fresheners? Yes  No

43. Does anyone in the home have indoor home hobbies or crafts involving:  
Heating , Soldering , Welding , Model Glues , Paints ,  
Spray Paint , Wood Finishing , Other  \_\_\_\_\_

shop area

44. General family/home use of consumer products (please circle appropriate). Assume that: Never = never used, Hardly ever = less than once/month, Occasionally = about once/month, Regularly = about once/week, and Often = more than once/week.

Product	Frequency of Use				
Spray-on deodorant	<u>Never</u>	Hardly ever	Occasionally	Regularly	Often
Aerosol deodorizers	<u>Never</u>	Hardly ever	Occasionally	Regularly	Often
Insecticides	Never	Hardly ever	<u>Occasionally</u>	Regularly	Often
Disinfectants	Never	Hardly ever	Occasionally	<u>Regularly</u>	Often
Window cleaners	Never	Hardly ever	Occasionally	<u>Regularly</u>	Often
Nail polish remover	Never	Hardly ever	Occasionally	<u>Regularly</u>	Often
Hair sprays	Never	Hardly ever	Occasionally	Regularly	<u>Often</u>
Candles	Never	Hardly ever	Occasionally	<u>Regularly</u>	Often
Incense	<u>Never</u>	Hardly ever	Occasionally	Regularly	Often

45. Please check weekly household cleaning practices:

Dusting

Dry Sweeping

Vacuuming

Polishing (furniture, etc.)  *Rarely*

Washing/Waxing Floors  *Vacuuming*

Other (describe)

46. Other comments:

19,200 sq ft from Cadastral - lot  
 Commercial / Residential  
 ↑ ↑  
 main floor basement 8,320 sq ft.  
 for building  
 Assessment Code 0000007071  
 Gco code 12-4441-08-01-44-03-0000

Chemical/Chemical Product (consumer name)

Amount present in home

- a) See pictures for inventory.
  - b)
  - c) Storage in Garage
  - d) Includes paints, paint thinner, glues/epoxy,
  - e) propane (used in garage for cooking), tar
  - f) for roofing, spray paint, Round-up
  - g)
  - h)
  - i) (B) Cleaning products (Kitchen & Bathroom & garage office
  - j)
  - k) Windex / windex, WD/CO dish washes, clorox,
  - l) toilet bowl, comet, hairspray, Mr. Clean/Bubbles, Lysol
  - m)
  - n) Glues - in storage room in house (utility room, C
  - o)
- WD-40, glues, wood, spray glue, tapes, epoxy, silicon/sealants,

primarily in storage in Garage (A)

Laundry Room (D)

Detergent, spot remover, Mr. Clean, polish furniture  
 Chem Dry - Removers (solvents)  
 Chlorox bleach, big cleaner, woolite



# Indoor Air Sampling Field Data Sheet

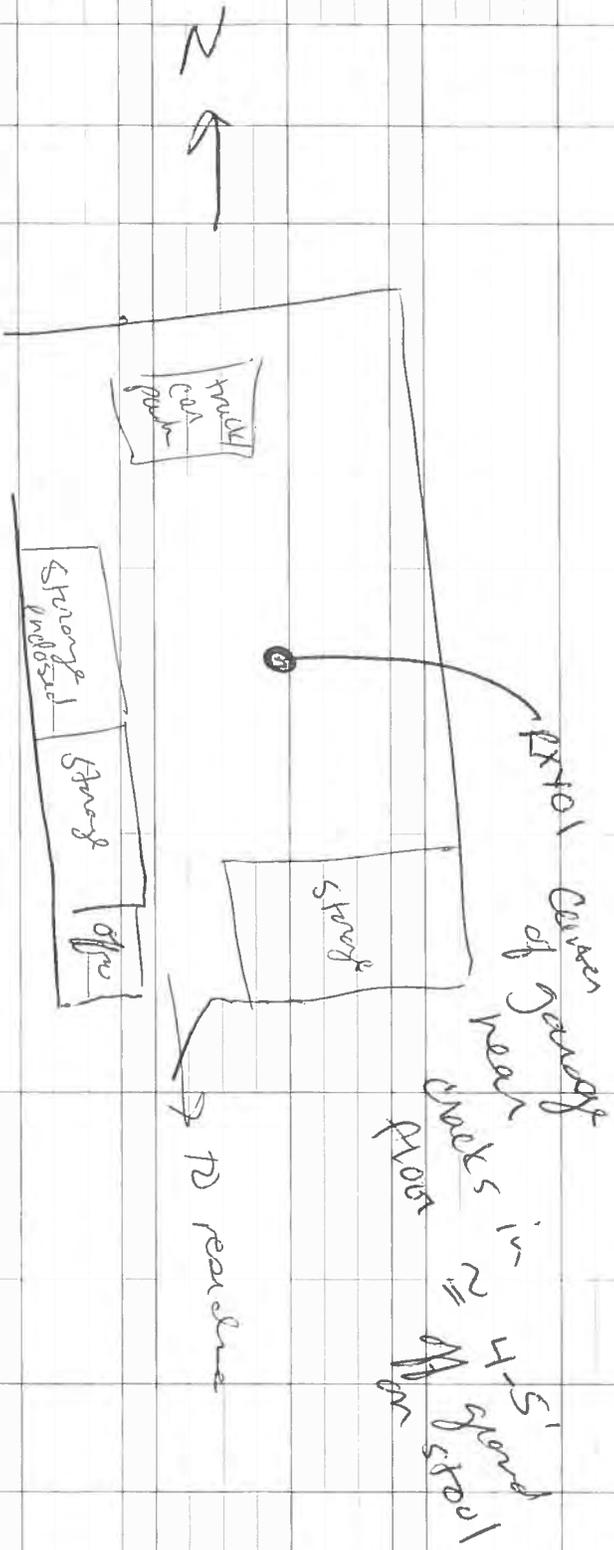
Prepared by the Montana Department of Environmental Quality

Site ID: <i>RXY</i>		Start Weather: <i>See ambient air</i>									
Project Name: <i>RXY WTP</i>		Start Outdoor Air Temp: <i>RXY 04 Sheet</i>									
Sample Location: <i>RXY 01</i>		Start Atmospheric Pressure:									
Date: <i>3/1/2017</i>		End Weather: <i>↓</i>									
Field Personnel: <i>S. SEITZ</i>		End Outdoor Air Temp:									
Recorded by: <i>"</i>		End Atmospheric Pressure:									
Canister and Sample Information											
Start Date	Start Time	End Date	End Time	Sample ID	Canister ID	Flow Controller #	Vacuum Gauge #	Initial Vacuum	Final Vacuum	Pre-Sample Indoor Air Temp	Post-Sample Indoor Air Temp
<i>3/1/17</i>	<i>12:10</i>	<i>3/2/17</i>	<i>12:10</i>	<i>RXY01</i>	<i>AS01001</i>	<i>FLA00174</i>	<i>—</i>	<i>-9764</i>	<i>-031</i>	<i>≈ 60°F</i>	<i>≈ 60°F</i>
Comments: <i>Inside garage @ ≈ 60°F</i>											
<i>Center of garage</i>											

# Indoor Air Sampling Field Data Sheet

Description of Sample Locations (s):

Location Sketch:



# Indoor Air Sampling Field Data Sheet

Prepared by the Montana Department of Environmental Quality

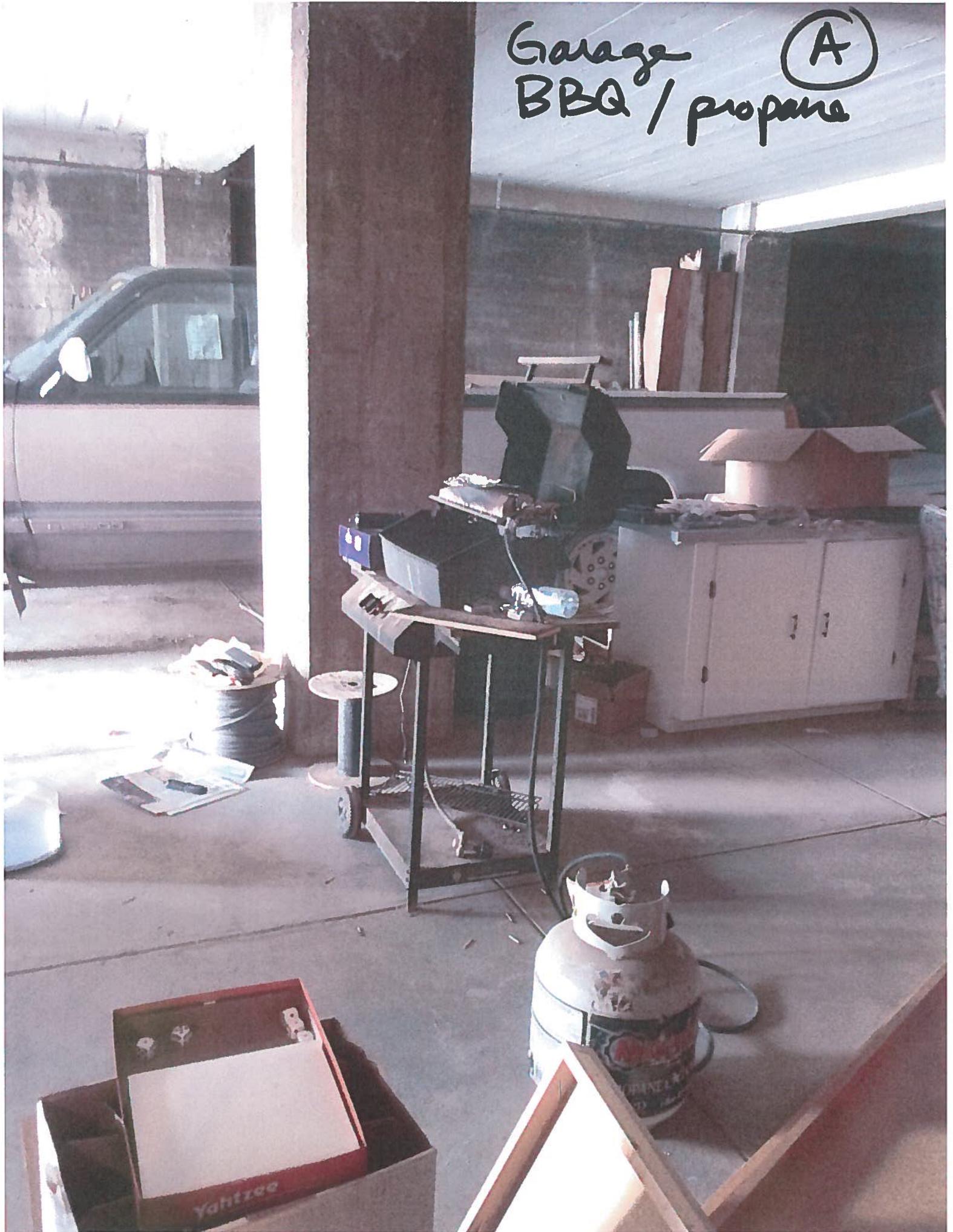
Site ID:		Project Name:		Sample Location:		Date:		Field Personnel:		Recorded by:	
Rexxy		Rexxy MT DEQ		Rexxy 02 and Rexxy 03		3/11/2017		S. SEITZ		" "	
Start Weather:		Start Outdoor Air Temp:		Start Atmospheric Pressure:		End Weather:		End Outdoor Air Temp:		End Atmospheric Pressure:	
Canister and Sample Information											
Start Date	Start Time	End Date	End Time	Sample ID	Canister ID	Flow Controller #	Vacuum Gauge #	Initial Vacuum	Final Vacuum	Pre-Sample Indoor Air Temp	Post-Sample Indoor Air Temp
3/11/17	12:15	<del>3/21/17</del> 3/21/17	11:45	RXY 02	AS60929	FA60977	—	-27.62 -28.03	-3.70	≈ 70°F	≈ 70°F
3/11/17	12:15	3/21/17	11:45	RXY 03	AS61035	FA60856	—	-27.63	-5.07	≈ 70°F	≈ 70°F
<p>↑</p> <p>Sights from Shooter was or private Greatest duplicate X marks where looked for CMT and T when CMT</p>											
Comments:											
Indoor Air of residence in game room											
RXY03 is duplicate for RXY02											







Garage  
BBQ / propane (A)



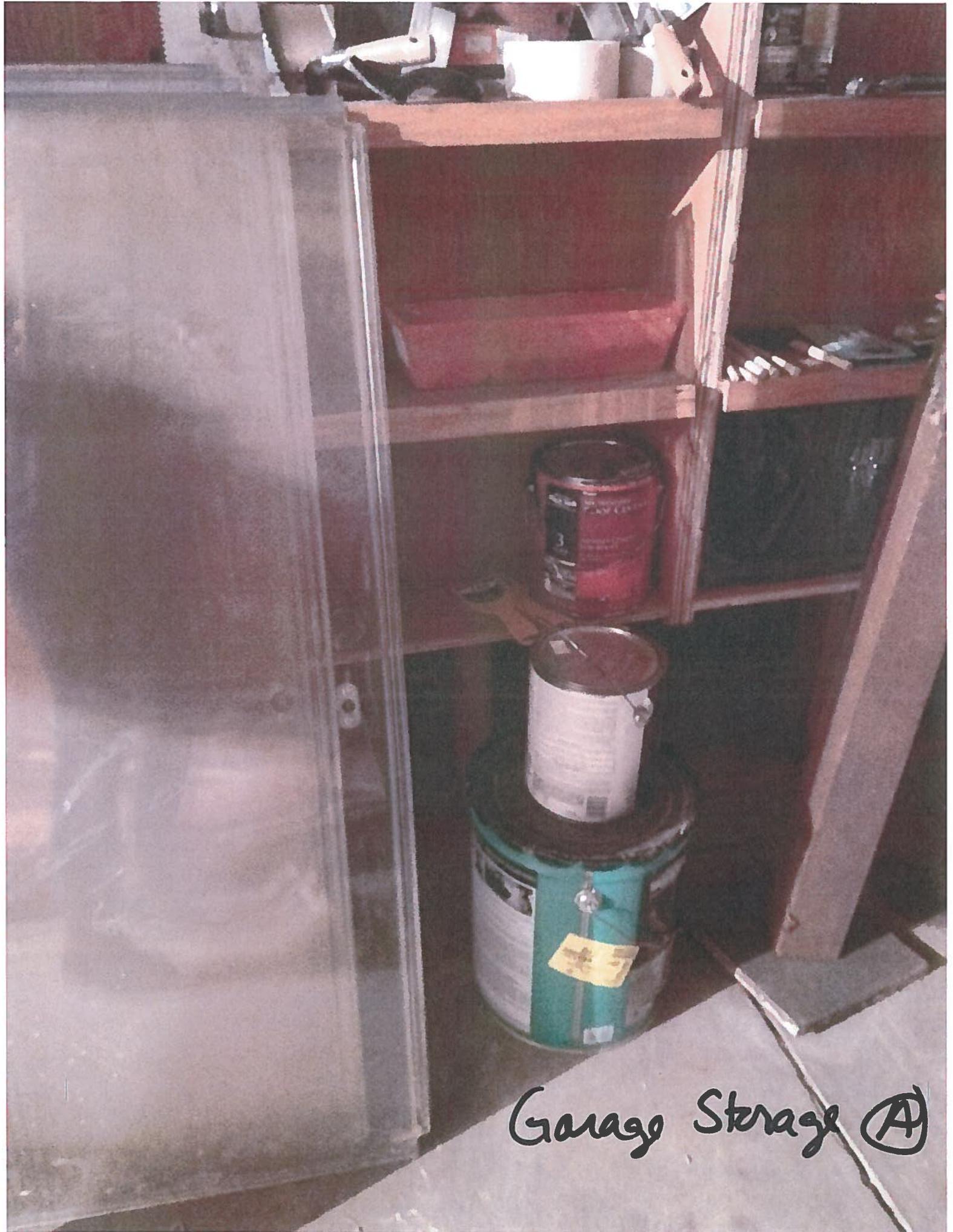
Garage Storage (A)







Garage Storage (8)



Garage Storage (A)

Kitchen Storage (B)



Bathroom Storage (B)



# Garage Office Storage (B)



Horse Storage

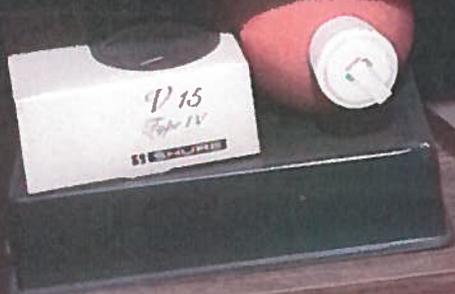
(C)



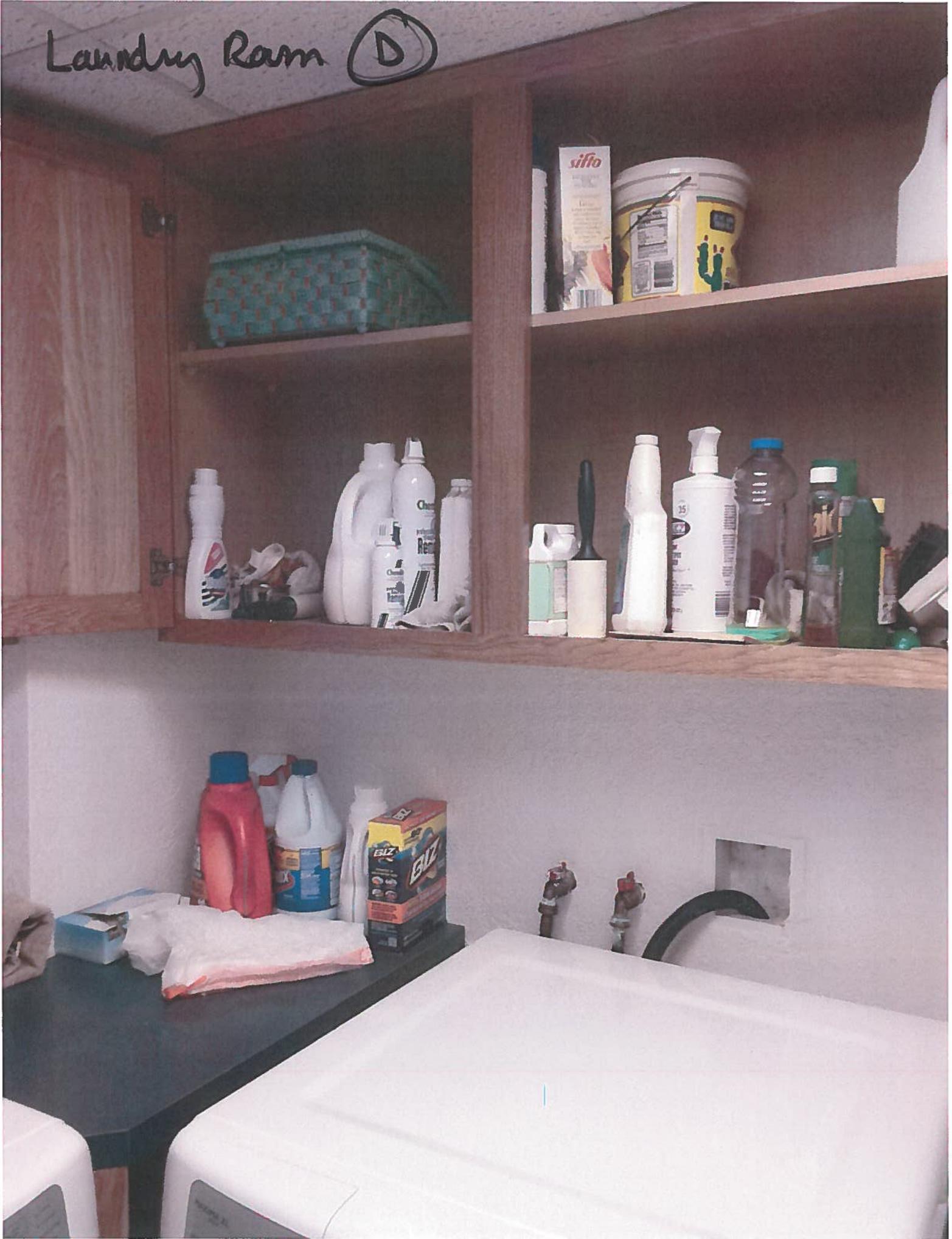
# House Storage (C)



TICKET  
KEEP  
COUPON  
NOGOOD



Laundry Room (D)



Laundry Room (D)



Laundry Room (D)



Ambient Air  
Sample location



**APPENDIX B**  
**PHOTOGRAPHS**

**ROXY'S CLEANERS INTERIM ACTION  
HAVRE, MT**



**Project:** Roxy Cleaners      **Date:** 12/3/2015

**Project:** Roxy Cleaners      **Date:** 12/3/2015



**Project:** Roxy Cleaners      **Date:** 12/3/2015

**Project:**      **Date:** 12/3/2015

**ROXY'S CLEANERS INTERIM ACTION  
HAVRE, MT**



**Project:** Roxy Cleaners      **Date:** 12/3/2015

**Project:**      **Date:** 4/20/2017



**Project:**      **Date:** 4/20/2017















**ROXY'S CLEANERS INTERIM ACTION (SVE INSTALLATION)  
HAVRE, MT**



Injection Event

Project:

Date: 4/20/2017



Injection Event

Project:

Date: 4/20/2017



Injection Event

Project:

Date: 4/20/2017

**ROXY'S CLEANERS INTERIM ACTION (SVE INSTALL)  
HAVRE, MT**



Project: Date: 4/20/2017

Project: Date: 4/20/2017



Project: Date: 4/20/2017

Project: Date: 4/20/2017

**ROXY'S CLEANERS INTERIM ACTION (SVE INSTALL)  
HAVRE, MT**



Project: Date: 4/20/2017

Project: Date: 4/20/2017



Project: Date: 4/20/2017

Project: Date: 4/20/2017

**ROXY'S CLEANERS INTERIM ACTION (SVE INSTALL)  
HAVRE, MT**



Project: Date: 4/20/2017

Project: Date: 4/20/2017



Project: Date: 4/20/2017

Project: Date: 4/20/2017

**ROXY'S CLEANERS INTERIM ACTION (SVE INSTALL)  
HAVRE, MT**



Project: Date: 4/20/2017

Project: Date: 4/20/2017



Project: Date: 4/20/2017

Project: Date: 4/20/2017

**ROXY'S CLEANERS INTERIM ACTION (SVE INSTALL)  
HAVRE, MT**



Project: Date: 4/20/2017

Project: Date: 4/20/2017



Project: Date: 4/20/2017

Project: Date: 4/20/2017

**ROXY'S CLEANERS INTERIM ACTION (SVE INSTALL)  
HAVRE, MT**



Project: Date: 4/20/2017

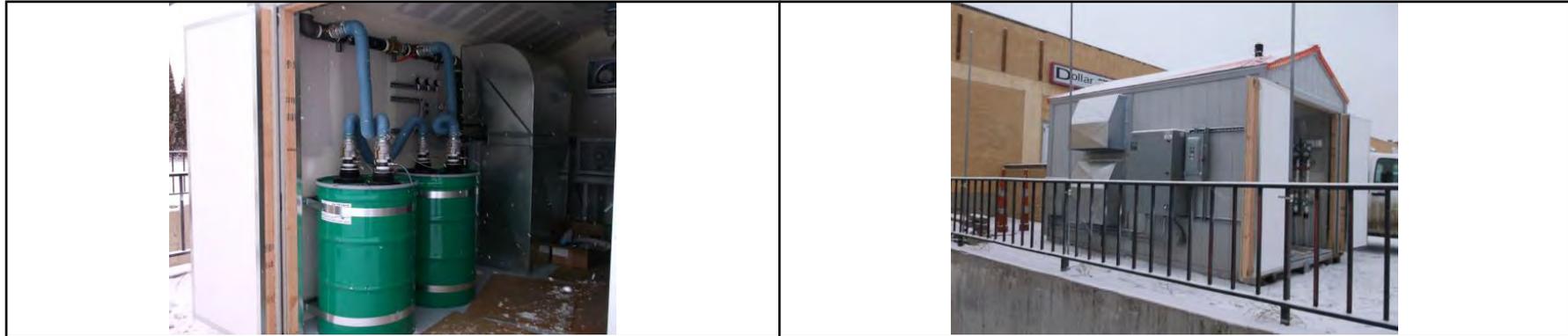
Project: Date: 4/20/2017



Project: Date: 4/20/2017

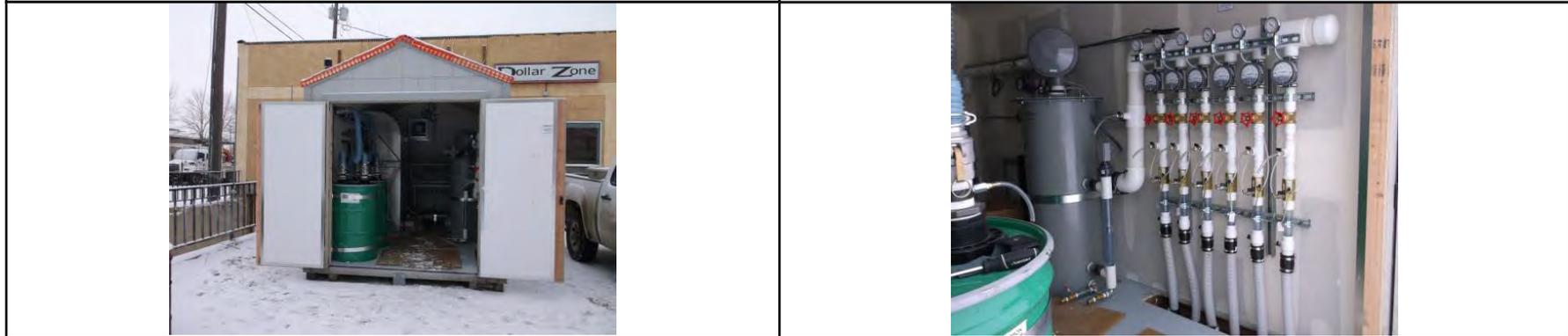
Project: Date: 4/20/2017

**ROXY'S CLEANERS INTERIM ACTION (SVE INSTALL)  
HAVRE, MT**



Project: Date: 4/20/2017

Project: Date: 4/20/2017



Project: Date: 4/20/2017

Project: Date: 4/20/2017

**ROXY'S CLEANERS INTERIM ACTION (SVE INSTALL)  
HAVRE, MT**



Project:

Date: 4/20/2017

Project:

Date:

**APPENDIX C**

**COMMUNICATION LOG**

CONTACTED	DATE	BY	METHOD	SUBJECT/OUTCOME
M. Hamilton	9/14/2015	Gleason	email	confirmation of basement layout/ parameters
M. Hamilton	9/16/2015	Gleason	phone	call from Mr. Hamilton in response to email
M. Hamilton	10/7/2015	Gleason	email	update on anticipated schedule
M. Hamilton	10/26/2015	Gleason	email	query about pavement restoration material (asphalt or concrete)
M. Hamilton	11/3/2015	Gleason	phone	followup on previous email, requesting response
M. Hamilton	11/30/2015	Joel	In person	went over the completed and potential SVE well locations
M. Hamilton	12/3/2015	Joel	In person	Went over trench location, shed position, walked basement layout, reviewed injection point figure, showed damage to chipped brick on north end of raised sidewalk brick wall.
M. Hamilton	12/4/2015	Joel	In person	Looked at the parking availability for Bearly Square shoppers; about 5 spots open. Also looked at access to entering Bearly Square after the trench was dug; ramp is open.
M. Hamilton	12/9/2015	Joel	Left voice message	Left a message given update wrapping up the concrete work; that the curb stops will be installed in a few weeks after the building is brought up to the site.
M. Hamilton	1/5/2016	Gleason	Text	Requested that Mr. Hamilton call or message back a convenient time to discuss upcoming work.
M. Hamilton	1/6/2016	Gleason	phone	Mr. Hamilton called to discuss schedule for upcoming work
M. Hamilton	1/13/2016	Joel	In person	Picked out a spot to install the soil probe in basement; Hamilton provided his remote to garage door.
M. Hamilton	1/14/2016	Joel	In person	Flooding in basement from leak in the former Dollar Zone; called Hamilton and later met up with the owner on the leak.
M. Hamilton	1/15/2016	Joel	In person	Hamilton wanted to know how the testing was going; he said to keep the garage door remote for work next week as he will not be back until late on Tuesday.
M. Hamilton	1/19/2016	Joel	phone	Called Mr. Hamilton as to when we could start injection work on 1/20, he said 0800 is fine.
M. Hamilton	1/20/2016	Joel	In person	Mr. Hamilton walked through the injection work area, was checking the progress.
M. Hamilton	1/21/2016	Joel	In person	Mr. Hamilton walked through the injection work area, was checking the progress; discussed working on the five southern most injection points on Monday. He asked that we drive his wives car and his truck out of the basement before we start working on 1/22.
M. Hamilton	1/21/2016	Joel	phone	Called Mr. Hamilton that we would like to move his three storage cars around but one has four flat tires; Hamilton said he would air up the car with the flat tires tonight.
M. Hamilton	1/22/2016	Joel	phone	Called Mr. Hamilton asked if he would like for Trihydro to park his truck and car back in the basement. Michael said he would park both. He did ask that we drive and park both vehicles tomorrow morning.
Mr & Mrs. Hamilton	1/23/2016	Joel	In person	Both Mr. and Mrs. Hamilton visited the injection work, Mr. Hamilton asked that we park both car and truck back in the basement tonight.
M. Hamilton	1/26/2016	Joel	phone	Called Mr. Hamilton giving an update that injections are completed but that some injection areas will be cleaned up tomorrow.
M. Hamilton	1/27/2016	Joel	In person	Mr. Hamilton inspected the installation of the bollards. Returned the garage remote to Mr. Hamilton. He asked when Trihydro would be back next, I told him sometime in February; that we would notify him prior so that we could monitor the soil probe located in the basement.
M. Hamilton	2/3/2016	Joel	phone	Called to see if Hamilton will be home on Wednesday February 10 during the next site visit; he will be home but it might be closer to 1 pm before we could access the basement.
M. Hamilton	2/10/2016	Matt / Joel	In person	Mr. Hamilton dropped the garage remote off and met with Matt; discussed collecting vapor samples; Hamilton told Trihydro where to drop off remote when done.
M. Hamilton	3/4/2016	Joel	In person	Mr. Hamilton wanted to know if the system was running as advertised; he wanted to know if another company was going to be performing the indoor air sampling on Wednesday - told Hamilton that Trihydro would be performing the indoor air sampling.
M. Hamilton	3/16/2016	Sarah / Joel	In person	Introduced Sarah and Mr. Hamilton.
M. Hamilton	3/24/2016	Joel	In person	Mr. Hamilton dropped by the system and wanted to know if it was doing it's job. Mr. Hamilton asked when the project would be completed, I told Mr. Hamilton that it will take a little time for the injections to work.
M. Hamilton	4/6/2016	Joel	In person	Mr. Hamilton dropped by the system and asked if Trihydro has received the vapor data back the recent sampling.
M. Hamilton	4/20/2016	Joel	In person	Mr. Hamilton opened up the basement for monitoring of the vapor probe; he will be on vacation in mid May. He asked how the treatment system was going.
M. Hamilton	5/4/2016	Gleason	email	Notified Mr. Hamilton of upcoming sampling and need to gain basement access
M. Hamilton	5/5/2016	Gleason	email	Mr. Hamilton's response to email of 5/4, advising of his schedule
M. Hamilton	5/10/2016	Gleason	email	Notified Mr. Hamilton of Joel's schedule, response from Mr. Hamilton to advise of his schedule
M. Hamilton	5/10/2016	Joel	email	Set up meeting with Mr. Hamilton to gain access to the soil probe for about an hour on 5/18 for summa canister sampling
M. Hamilton	5/17/2016	Joel	In person	Mr. Hamilton dropped by the system when the oil was being changed on the blower motor, asked if the sampling can be collected right now. Discussed sampling tomorrow around 1130
M. Hamilton	5/18/2016	Joel	In person	Mr. Hamilton opened up the basement for sampling.
M. Hamilton	6/22/2016	Joel	Text & Voice Message	Left a message and sent a text to see if I can monitor the basement vapor port; didn't hear back from Mr. Hamilton.
M. Hamilton	7/26/2016	Gleason	email	Email to Mr. Hamilton reassuring him that the concrete work that he expressed a concern about would be addressed
M. Hamilton	7/28/2016	Gleason	email	Response from Mr. Hamilton thanking us for addressing the concrete issue
M. Hamilton	8/17/2016	Joel	In person	Met with Mr. Hamilton and measured readings in the basement.
M. Hamilton	9/17/2016	Joel	In person	Mr. Hamilton stopped by to discuss the condition of the concrete in front of the ramp; had a call with Jim Gleason/Michael/Joel discussing the issue
M. Hamilton	12/14/2016	Joel	In person	Mr. Hamilton stopped the remediation system and discussed meeting at 11 am tomorrow to check the basement sample port.
M. Hamilton	12/15/2016	Joel	In person	Met with Mr. Hamilton and measured readings in the basement.
M. Hamilton	2/8/2017	Gleason	email	Email to schedule indoor air sampling
M. Hamilton	2/16/2017	Gleason	email	Received email response to my email of 2/8/17
M. Hamilton	2/27/2017	Sarah	Text	Text to Mike to plan for Vapor Intrusion sampling
M. Hamilton	2/28/2017	Sarah	Text	Multiple texts between Mike and Sarah confirming availability and meeting time for Vapor Intrusion sampling on 3/1/2017 and 3/2/2017
M. Hamilton	2/28/2017	Sarah	Text	Text from Mike confirming availability for Vapor Intrusion sampling on 3/1/2017 and 3/2/2017
M. Hamilton	3/1/2017	Sarah	Text	Texts to/from Sarah and Mike for arrival time and meeting around 11:15am on 3/1/2017
M. Hamilton	3/1/2017	Sarah	In person	Mike met with Sarah for VI sampling and building questionnaire at around 11:15 - stayed until around 12:45 pm
M. Hamilton	3/2/2017	Sarah	In person	Early texts to confirm meeting time followed by Mike meeting with Sarah for VI sampled checks and removal of samples. Sarah met Mike at his residence around 11am and was out of there by 12:30pm.
M. Hamilton	3/15/2017	Joel	Emails	Traded emails with Mr. Hamilton regarding visiting the site on 3/16/17 and 3/21/17; he wasn't sure if he would be around early enough on 3/16 to have the basement open, is not available for 3/21.
M. Hamilton	3/28/2017	Gleason	Email	Email to Mr. Hamilton requesting basement access for 4/6 or 4/7- Mr. Hamilton responded that 4/6 would work, 4/7 would not.

**APPENDIX D**

**HEALTH AND SAFETY PLAN**

**HEALTH AND SAFETY PLAN**  
**ENVIRONMENTAL ACTIVITIES**  
**MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY**  
**ROXY'S CLEANERS**  
**HAVRE, MT**

---

**September 15, 2015**

**Project #: 776-023-002**

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**SUBMITTED BY:** Trihydro Corporation

1252 Commerce Drive, Laramie, WY 82070

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## memorandum

**To:** Project Team Members  
**From:** Mr. Jim Gleason  
**Date:** September 15, 2015  
**Re:** Site Health and Safety Orientation:  
Roxy's Cleaners Solvent Site

---

### INTRODUCTION

The Roxy's Cleaners Site (RCS) Project is a chlorinated solvent remediation project performed for the Montana Department of Environmental Quality (MDEQ) Remediation Division. Trihydro Corporation (Trihydro) provides technical review and oversight of field events for MDEQ at several projects in Montana.

### PROJECT /SITE HISTORY

The RCS Remediation Project addresses soil and groundwater contamination associated with a former dry cleaning facility. Contaminates of concern at the site are chlorinated solvents which include perchloroethene (PCE), trichloroethene (TCE), cis-1, 2-dichloroethene (cis-1, 2-DCE), and vinyl chloride. In addition, methane vapors are expected to be generated during the implementation of the enhanced bioremediation portion of the project. Field activities may include oversight of soil vapor extraction (SVE) wells, SVE pilot testing, monitoring well installation, groundwater, soil, and indoor air sampling, and bioremediation injections.

### WORK SCOPE

Trihydro is responsible for installing the SVE system, performing bioremediation injections, SVE system O&M, groundwater, soil, and indoor air sampling, and sampling SVE system influent and effluent.

### MINIMUM PERSONAL PROTECTIVE EQUIPMENT (PPE)

The minimum PPE to enter the site is listed below. However, refer to the HASP and task-specific Job Safety Analysis (JSA) for other anticipated PPE.

- Leather boots
- Safety glasses
- Hard hat
- Work gloves

### TRAINING/DRUG SCREENING REQUIREMENTS

Training requirements include Occupational Safety and Health Administration (OSHA) 40-hour training, supervisor training, and applicable refresher training. Trihydro drug screening requirements apply to this project. The drug consortium applies to project team members who must be enrolled and screened before site entry. In accordance with the Trihydro Drug and Alcohol Policy described in the HASP Reference Manual, at no time



The drug consortium applies to project team members who must be enrolled and screened before site entry. In accordance with the Trihydro Drug and Alcohol Policy described in the HASP Reference Manual, at no time while on duty may employees use or be under the influence of alcohol, narcotics, intoxicants, or similar mind-altering substances to include prescription medications. Employees found under the influence or consumption of substances are to be immediately removed from the jobsite. Trihydro reserves the right to test for substance abuse. As part of implementing Trihydro's program to deter alcohol, drug, and substance abuse, each employee may be requested to submit to urine, blood, or other medical tests at any time, with or without notice. Employees are further subject to "for cause" drug, alcohol, or substances testing. "Cause" is determined if the company has reason to believe that the covered worker has used alcohol or illegal drugs or has misused prescription medication or over-the-counter drugs. Key reasons for testing may include the following: accidents, injuries, near misses, excessive absences, tardiness, altercations, lengthy absences, possession of drugs, or thefts. This policy applies to Trihydro employees and subcontractors.

**Drug testing facilities:**

In accordance with the Trihydro Drug and Alcohol Policy described in the HASP Reference Manual, at no time while on duty may employees use or be under the influence of alcohol, narcotics, intoxicants, or similar mind-altering substances to include prescription medications. Employees found under the influence or consumption of substances are to be immediately removed from the jobsite. Trihydro reserves the right to test for substance abuse. As part of implementing Trihydro's program to deter alcohol, drug, and substance abuse, each employee may be requested to submit to urine, blood, or other medical tests at any time, with or without notice. Employees are further subject to "for cause" drug, alcohol, or substances testing. "Cause" for a test is to be found if the company has reason to believe that the covered worker has used alcohol or illegal drugs or has misused prescription medication or over-the-counter drugs. Key reasons for testing may include the following: accidents, injuries, near misses, excessive absences, tardiness, altercations, lengthy absences, possession of drugs, or thefts. This policy applies to Trihydro employees and subcontractors.

Drug testing facilities:

Northern Montana Hospital	30 West 13 <sup>th</sup> Street	Havre	MT (406) 262-1241
Bullhook Community Health	521 4th Street	Havre	MT (406) 395-4305

**MOBILE PHONE AND ELECTRONIC DEVICES SAFETY**

Mobile phone(s) are defined as cellular and other mobile telephones and other similar electronic communication devices which facilitate both simplex (push-to-talk) and duplex (multi-directional simultaneous conversations), to include global positioning devices (GPS), when those devices are being used for voice communication, text messaging, electronic mail, and other operations requiring active manipulation of the device, including operation of the devices in hands free or hand held modes. For the purposes of this standard, two-way radios that are only capable of simplex communication (push-to-talk) are excluded from the definition of mobile phones.



Project Team Members  
Health and Safety Plan Introduction  
September 15, 2015  
Page 2

The following are specifically prohibited:

- Use of mobile phones by drivers while operating a company vehicle on public roadways.
- Use of mobile phones by drivers while operating a personal vehicle on company business.
- Use of mobile phones by drivers while operating a motor vehicle on company business, unless allowable areas and circumstances are designated by applicable work site rules and instructions (such as areas restricted from public access inside an operating facility or controlled area).

776-023-002

# HASP REVIEW PROCESS



This document has been developed by the Corporate Health and Safety Team followed by peer review in accordance with the Trihydro Corporation (Trihydro) Writing-Style Manual (WSM) policy by the project management and an authorized final reviewer on behalf of the Health and Safety Team.

Health and Safety:

Todd Forry

Reviewer's Name

A handwritten signature in black ink that reads "Todd J. Forry".

Reviewer's Signature

8/31/15

Date

Project Manager:

Jim Gleason

Final Reviewer's Name

Final Reviewer's Signature

Date

# PRE-ENTRY BRIEFING ACKNOWLEDGEMENT



I certify that I have read and understand the contents of this Health and Safety Plan (HASP), Environmental Activities, Montana Department of Environmental Quality, Havre, Montana 59501, and reviewed appropriate Job Safety Analysis (JSA) forms, Montana Department of Environmental Quality-specific safety documents, and Trihydro safety policies, procedures, plans, and documents for hazards that may be encountered on this project. Check the reason block if this is for initial entry, because of a change in the HASP, or to recognized hazards as outlined in Section 7 of this HASP.

**Name/Signature**

**Reason**

**Date**

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# 1.0 EMERGENCY RESPONSE PLAN

Because of the near proximity of medical assistance (approximately 3-4 minute response), this site does not assign site personnel to provide first aid.

Because of the distance from the nearest medical assistance (more than 3-4 minute response), this site requires training and assigned site personnel to provide first aid.

The following personnel are trained in CPR and first aid:

Joel Riebli

---

Luke Darnell

---

Charles VanHeuvelen

---

Emergency response will be carried out immediately whenever there is a personal injury, fire, or explosion. Field team members that sight or suspect a fire, explosion, or other potential risk to employee or environmental health will notify the Trihydro Corporation (Trihydro) Project Manager (PM) immediately. A first-aid kit and fire extinguisher will be maintained on site.

Trihydro employees will be familiar with emergency procedures at the job site. Site emergency procedures will be reviewed with team members during the morning kick-off safety meeting. Site workers will be instructed to immediately stop work when a hazard is discovered.

A primary line of communication with emergency services will be established before work commencement. A secondary form is highly encouraged. Forms of communication include, but are not limited to, land line telephone, cellular telephone with verified acceptable signal strength, two-way radios, etc.



The following information is provided in the event of an emergency.

### 1.1 SITE EVACUATION PROCEDURES

**Site Alarms**

N/A

*Type*

*Description*

Fire

\_\_\_\_\_

Chemical Release

\_\_\_\_\_

Evacuation

\_\_\_\_\_

Severe Weather

\_\_\_\_\_

All Clear

\_\_\_\_\_

Other:

\_\_\_\_\_

**Site Evacuation Routes**

Primary:

Upwind and cross wind from the hazard

\_\_\_\_\_

Alternate:

As discussed at daily tailgate safety meeting

\_\_\_\_\_

**Site Assembly Areas**

Primary:

As discussed at daily tailgate safety meeting

\_\_\_\_\_

Alternate:

Fleet vehicle

\_\_\_\_\_



## 1.2 EMERGENCY CONTACT LIST

### Local Emergency Services

Police Emergency/Station.....	911/ (406) 265-4361
Fire Department Emergency/Station .....	911/ (406) 265-6511
Ambulance Emergency/Station .....	911/ (406) 265-6511
Hospital (Northern Montana Hospital).....	(406) 265-2211
Montana Highway Patrol.....	(406) 265-6420
Poison Control.....	(800) 222-1222
Call Before You Dig.....	811
WorkCare™ Incident Intervention (24-hours) .....	(888) 449-7787

### Company Contacts

Project Manager (PM),(Jim Gleason).....	(307) 745-7474
Project Health & Safety Officer (PHSO), (Joel Riebli).....	(307) 760-2793
Risk Management (after hours) .....	(307) 760-1849
Safety Coordinator (after hours).....	(307) 760-8269
Safety Response Line (24/7).....	(307) 755-4888
Safety FAX .....	(307) 460-7428

### Client Contacts

Kate Fry .....	Office: (406) 444-6426
----------------	------------------------

### Federal/Government Contacts

Environmental Protection Agency (EPA) Hotline.....	(800) 621-8431
National Institute of Occupational Safety and Health (NIOSH) Hotline.....	(800) 356-4674
Occupational Safety and Health Administration (OSHA).....	(202) 219-8148
OSHA Hotline .....	(800) 321-6742
National Response Center (report spills and chemical releases) .....	(800) 424-8802
CHEMTREC (24-hour Hazardous Materials Communications Center) .....	(800) 262-8200
ChemTel (for hazardous materials information).....	(800) 255-3924



### 1.3 INCIDENT AND ACCIDENT REPORTING

Trihydro employees will report verbally and in writing, to Trihydro's PM and Corporate Health and Safety (H&S) Office, incidents or near misses resulting in personal or public injury, environmental impact, or property damage to Montana Department of Environmental Quality operated site, materials, or equipment, including motor vehicles owned by Trihydro, its subcontractors, or Montana Department of Environmental Quality. Regarding accident, incidents, or near misses, verbal reports will be made as soon as possible after the situation is under control followed by written reports to the Montana Department of Environmental Quality PM through the Trihydro PM or Director. A copy of the "Near Miss Report" form can be found as **Appendix A**. A near miss is an event that, given a change in time or position, could have resulted in an incident.

Examples of incidents and near misses which will be reported are as follows:

- Environment (e.g., spills, releases, odor complaints, permit exceedances, process upsets)
- Injury/illness (e.g., injuries, illnesses, first aids, recordables, lost workday cases, fatalities, non-injuries – document only, non-occupational)
- Property damage/loss (e.g., fires, explosions, loss of well control, business interruptions, abnormal operations, production loss/reduction)
- Quality (e.g., customer complaints, contaminations, off specification)
- Security (e.g., vandal – damages, burglaries, break and enters, robberies, thefts, public disturbances, trespasses)
- Vehicle (e.g., vehicle accidents, cars/pickups/trucks, barges/boats/ships, aircraft, rail cars, tankers/transport, cranes/fork trucks)

Incident and accident reporting is important for the following reasons:

- Collects information that Trihydro can use to calculate statistics and other information for tracking accident trends
- Helps identify training needs; problems with work procedures; and needs for personal protective, safety, and emergency equipment
- Collects information necessary for completing investigation and insurance reports and complying with regulatory requirements
- Identifies weaknesses in company and site safety programs

Reports of incidents or accidents will be prepared immediately after the event occurs. This is necessary to verify that important evidence is not lost or disturbed and details are not forgotten by those involved. The “Accident/Incident Investigation Report” form can be found as **Appendix B**.



## **1.4 INCIDENT RESPONSE**

### **1.4.1 VEHICLE ACCIDENT**

- The individual discovering the accident is to provide or coordinate immediate care for personnel, safety, and vehicle security.
- The individual discovering the accident is to initiate or coordinate the notification process:
  - Notify police/ambulance (911)
  - Notify the Trihydro H&S Office using the Safety Response Line (307) 755-4888
  - Notify the PM
  - Notify the supervisor
  - Notify the client as directed by the PM
  - Notify the rental car agency as directed by the PM (if applicable)
- If medical treatment is required, notify WorkCare™ (888) 449-7787
- Complete drug and alcohol testing as soon as possible (within 3 hours); coordinate with H&S Team
- Complete and file reports within 12 hours

### **1.4.2 INCIDENT**

- Stop work and provide immediate care for personnel, safety, and site security
- The individual discovering the accident is to initiate or coordinate the notification process:
  - Notify police/ambulance (911), if applicable
  - Notify the Trihydro H&S Office using the Safety Response Line (307) 755-4888
  - Notify the PM
  - Notify the supervisor
  - Notify the client as directed by the PM
  - Notify site managers as directed by the PM
- If medical treatment is required, notify WorkCare™ (888) 449-7787
- Complete and file reports within 12 hours

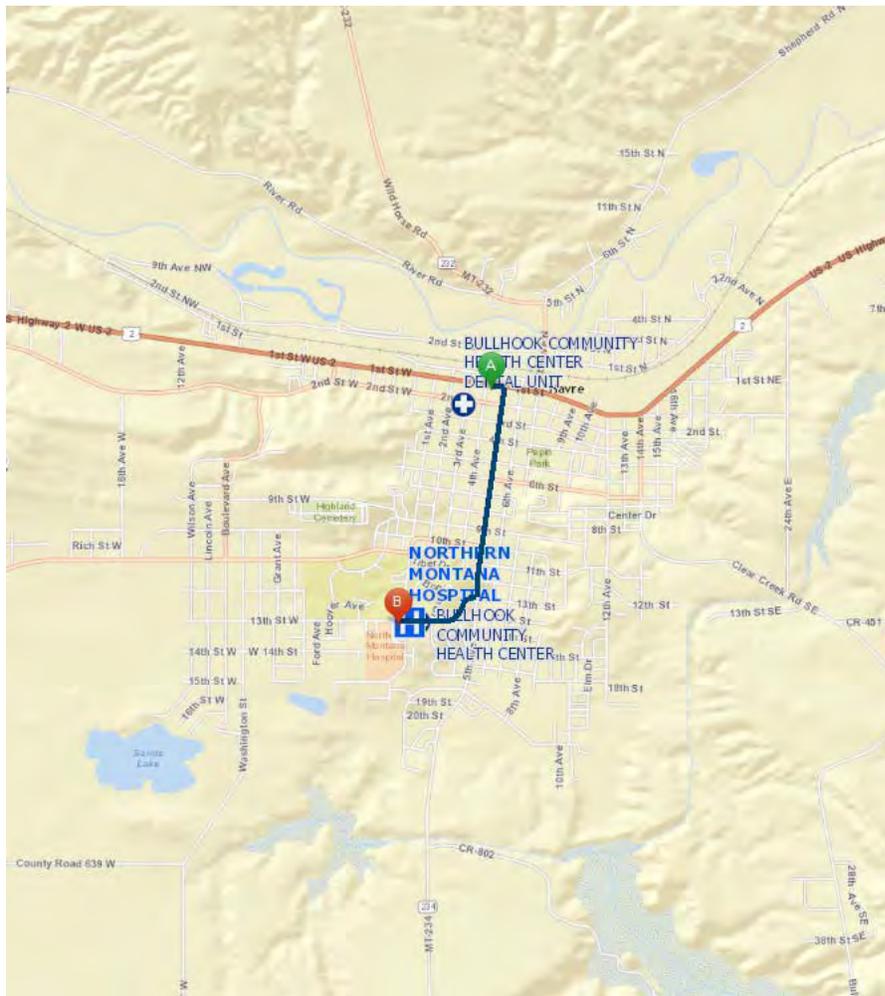


- Before returning to work, the employee will:
  - Notify the PM and supervisor
  - Assess and analyze the conditions for safety
  - Take applicable corrective actions to prevent recurrence

## **1.5 HOSPITAL ROUTES**

Primary routes from the project site to the hospital can be found on Figures 1-1 through 1-6.

**FIGURE 1-1. PRIMARY HOSPITAL ROUTE**



**Directions to Hospital**

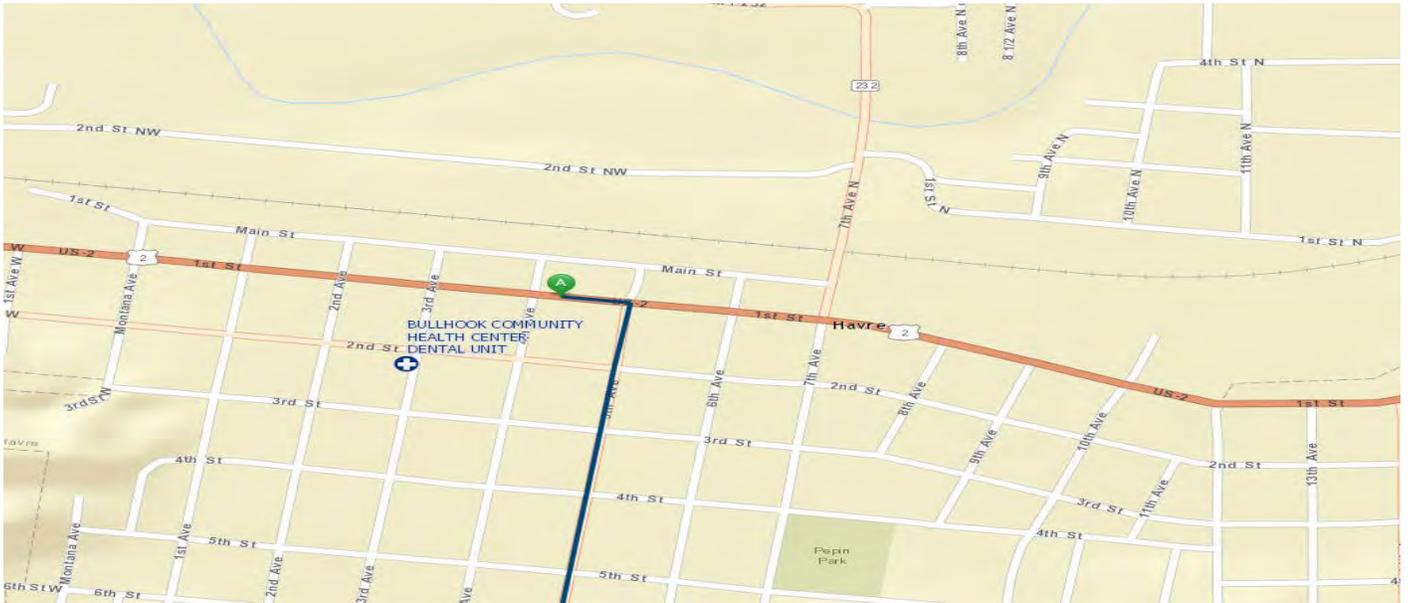
Hospital Name: Northern Montana Hospital  
 Address: 30 13th St, Havre, MT 59501  
 Telephone Number: (406) 265-2211

***SUMMARY***

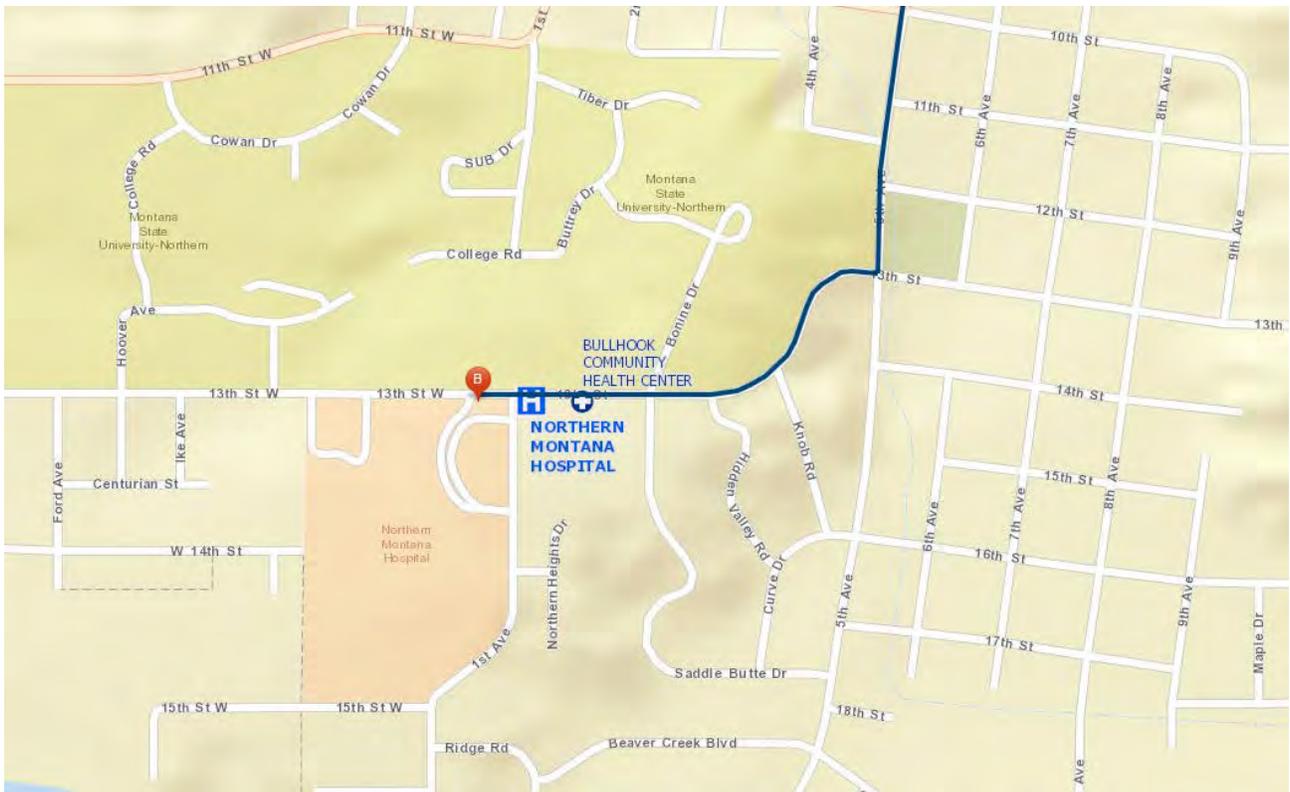
Driving distance: 1.28 miles  
 Trip duration: 4 minutes

<u>Mile</u>	<u>Instruction</u>	<u>For</u>	<u>Toward</u>
	<b>Start at 425 1<sup>st</sup> St</b>		
	Go east on 1 <sup>st</sup> St. (US-2)	0.05 mi	5 <sup>th</sup> Ave
	Turn right on 5 <sup>th</sup> Ave	0.87 mi	
	Turn right on 13 <sup>th</sup> St	0.35 mi	
	Arrive 30 13 <sup>th</sup> Street, Havre, MT 59501		

**FIGURE 1-2. PRIMARY HOSPITAL ROUTE START POINT**



**FIGURE 1-3. PRIMARY HOSPITAL ROUTE DESTINATION POINT**



## 2.0 INTRODUCTION

### 2.1 REFERENCES

The 29 Code of Federal Regulations (CFR) 1910 General Industry standards, 1910.120, Hazardous Waste Operations and Emergency Response (HAZWOPER), will dictate the primary information contained within this HASP where section 1910.120(b)(1)(ii)(C) states that “a site-specific safety and health plan which need not repeat the employer's standard operating procedures required in paragraph (b)(1)(ii)(F)” and will contain the elements listed under 1910.120(b)(4)(ii).

The following states have approved state OSHA plans. PMs need to be familiar with the state plans that apply to their project sites and understand the more restrictive standards to stay in compliance:

- Alaska
- Arizona
- California
- Connecticut
- Hawaii
- Illinois
- Indiana
- Iowa
- Kentucky
- Maryland
- Michigan
- Minnesota
- Nevada
- New Jersey
- New Mexico
- New York
- North Carolina
- Oregon
- Puerto Rico
- South Carolina
- Tennessee
- Utah
- Vermont
- Virgin Islands
- Virginia
- Washington
- Wyoming

*NOTE: The Connecticut, Illinois, New Jersey, New York, and Virgin Islands plans cover public sector (State & local government) employment only.*

### 2.2 APPLICATION

This HASP applies to the site specified and those tasks and operations identified in Section 2.0.

### 2.3 PURPOSE

Trihydro personnel will use this plan as a guidance tool for developing action plans after conducting hazards analysis for the specific daily tasks to be performed. Subcontractors may wish to use this plan as a guideline. However, subcontractors will have their own HASP developed by their respective companies. The primary responsibility for employee safety lies with each company for its own employees. However, each field team member within the separate companies are responsible for identifying and correcting H&S hazards so members work together as safely as possible.



## 2.4 REQUIRED DOCUMENTATION

Project work will comply with applicable sections of the Occupational Safety and Health Administration (OSHA), state, Trihydro, and client standards, policies, procedures, and plans. The more stringent standards will apply. This HASP and supportive documentation will be kept on site in accordance with 29 CFR 1910.120(b)(4)(i).

Trihydro employees and subcontractors that are covered by contractual agreements with Trihydro performing tasks outlined in this HASP need to have a thorough understanding of supportive documentation. The following documents will accompany this HASP as supportive documentation:

- Job Safety Analysis (JSA) oriented to the site tasks and operations outlined in this HASP. See **Appendix C**.
- Montana Department of Environmental Quality-specific H&S policies, procedures, or plans relevant to the tasks outlined in this HASP. See **Appendix D**.
- Material Safety Data Sheets (MSDSs / Safety Data Sheets (SDSs)). See **Appendix E**.

### 2.4.1 JOB SAFETY ANALYSIS (JSA)

JSA forms are living documents to assist in hazard awareness and in task preparation. Employees are expected to review JSA forms before work commencement, have the JSA at the task site, and revise the JSA when discrepancies are noted. The following JSA forms are included in **Appendix C**:

- |  |   |   |
|--|---|---|
| <input type="checkbox"/> Air Knife Borehole Clearance    | <input type="checkbox"/> Forklift Operations                  | <input type="checkbox"/> Soil Sub-Sampling                  |
| <input type="checkbox"/> Air/Knife/Vacuum Extraction     | <input type="checkbox"/> Fueling Vehicles                     | <input checked="" type="checkbox"/> SUMMA Canister Sampling |
| <input type="checkbox"/> Asbestos ID and Burial          | <input type="checkbox"/> Geoprobe/Geopunch Sampling           | <input type="checkbox"/> Surface Water Sampling             |
| <input type="checkbox"/> Asphalt Placement Observation   | <input type="checkbox"/> GPS Surveying                        | <input type="checkbox"/> Tank Demolition                    |
| <input type="checkbox"/> Boating                         | <input type="checkbox"/> Groundwater Gauging                  | <input type="checkbox"/> Vacuum Trailer Operations          |
| <input type="checkbox"/> Confined Space Entry            | <input checked="" type="checkbox"/> Groundwater Sampling      | <input type="checkbox"/> Vehicle Operation                  |
| <input type="checkbox"/> Contaminated Soil Cleanup       | <input type="checkbox"/> Hand Auger Soil Sampling             | <input type="checkbox"/> Voltage and Ground Test            |
| <input checked="" type="checkbox"/> Contractor Oversight | <input type="checkbox"/> Heavy Equipment Operations           | <input type="checkbox"/> Weed Control                       |
| <input type="checkbox"/> Drilling                        | <input type="checkbox"/> Hydraulic Direct Push Sampler        | <input type="checkbox"/> Well Abandonment                   |
| <input checked="" type="checkbox"/> Drilling Oversight   | <input type="checkbox"/> Hydroknifing                         | <input type="checkbox"/> Well Bailing                       |
| <input type="checkbox"/> Dump Truck Loading              | <input type="checkbox"/> Pump/Motor/Leads Installation        | <input type="checkbox"/> Well Rehabilitation                |
| <input type="checkbox"/> Dump Truck Operations           | <input checked="" type="checkbox"/> Site Visit                | <input type="checkbox"/> Well Replacement                   |
| <input type="checkbox"/> Excavation Observation          | <input checked="" type="checkbox"/> Other: Remediation System |   |
| <input type="checkbox"/> Flume Sampling                  | <input type="checkbox"/> Other:                               |   |



## 2.4.2 MATERIAL SAFETY DATA SHEETS (MSDSs) / SAFETY DATA SHEETS (SDSs)

The following MSDSs/SDSs are included in **Appendix E**:

- |  |   |  |  |
|--|---|--|--|
| <input type="checkbox"/> Acetone                   | <input type="checkbox"/> Ethyl Benzene        | <input checked="" type="checkbox"/> Methane                  | <input type="checkbox"/> Selexol                       |
| <input type="checkbox"/> Acrylonitrile             | <input type="checkbox"/> Fly/Coal Ash         | <input type="checkbox"/> Methane, Compressed                 | <input type="checkbox"/> Simple Green                  |
| <input type="checkbox"/> Anhydrous Ammonia         | <input type="checkbox"/> Fuel Oil             | <input type="checkbox"/> Methanol                            | <input type="checkbox"/> S-K 105 Solvent               |
| <input type="checkbox"/> Aniline                   | <input type="checkbox"/> Gasoline             | <input type="checkbox"/> Methyl Methacrylate                 | <input type="checkbox"/> Sodium Hydroxide              |
| <input type="checkbox"/> Aromatic 100              | <input type="checkbox"/> Granite Rock Dust    | <input type="checkbox"/> Methyl Propyl Ketone                | <input type="checkbox"/> Sodium Nitrate                |
| <input type="checkbox"/> Aromatic 150              | <input type="checkbox"/> Grease               | <input type="checkbox"/> Methylene Chloride                  | <input type="checkbox"/> Sodium Phosphate<br>Monobasic |
| <input type="checkbox"/> Asbestos                  | <input type="checkbox"/> Heptane              | <input type="checkbox"/> Methyl Isobutyl Ketone              | <input type="checkbox"/> Sulfuric Acid                 |
| <input type="checkbox"/> Bentonite                 | <input type="checkbox"/> Hexane               | <input type="checkbox"/> Mineral Spirits                     | <input type="checkbox"/> Surflan                       |
| <input type="checkbox"/> Benzene                   | <input type="checkbox"/> Hexanone             | <input type="checkbox"/> Motor Oil                           | <input type="checkbox"/> Survey Marker Paint           |
| <input type="checkbox"/> BTEX Calibration Gas      | <input type="checkbox"/> Hydraulic Oil/Fluid  | <input type="checkbox"/> MTBE                                | <input type="checkbox"/> Tack                          |
| <input type="checkbox"/> Cadmium                   | <input type="checkbox"/> Hydrocarbons         | <input type="checkbox"/> Natural Gas                         | <input type="checkbox"/> Tetrahydrofuran               |
| <input type="checkbox"/> Celtone                   | <input type="checkbox"/> Hydrochloric Acid    | <input type="checkbox"/> Nitric Acid                         | <input type="checkbox"/> Toluene                       |
| <input type="checkbox"/> Chrome                    | <input type="checkbox"/> Hydrofluoric Acid    | <input type="checkbox"/> Nitrogen, Compressed                | <input type="checkbox"/> Trichloroethane               |
| <input type="checkbox"/> Coal                      | <input type="checkbox"/> Hydrogen             | <input type="checkbox"/> Nitrogen, Liquid                    | <input type="checkbox"/> Triethylamine                 |
| <input type="checkbox"/> Coal Fly Ash              | <input type="checkbox"/> Hydrogen, Compressed | <input type="checkbox"/> Oxygen, Compressed                  | <input type="checkbox"/> Trimethyl Benzene             |
| <input type="checkbox"/> Coke                      | <input type="checkbox"/> Hydrogen Chloride    | <input type="checkbox"/> Perchloric Acid                     | <input type="checkbox"/> Used Oil                      |
| <input type="checkbox"/> Condensate                | <input type="checkbox"/> Hydrogen Sulfide     | <input type="checkbox"/> Phosphoric Acid                     | <input type="checkbox"/> Vinyl Chloride                |
| <input type="checkbox"/> Crude Oil                 | <input type="checkbox"/> Isobutane            | <input type="checkbox"/> Phthalic Anhydride                  | <input type="checkbox"/> Xylene                        |
| <input checked="" type="checkbox"/> Dichloroethane | <input type="checkbox"/> Isobutylene          | <input type="checkbox"/> Propane                             |  |
| <input type="checkbox"/> Diesel Fuel               | <input type="checkbox"/> Isopropyl Alcohol    | <input checked="" type="checkbox"/> Other: tetrachloroethene |  |
| <input type="checkbox"/> Dimethyl Sulfide          | <input type="checkbox"/> Kerosene             | <input type="checkbox"/> Other: _____                        |  |
| <input type="checkbox"/> DIPE                      | <input type="checkbox"/> Lead                 | <input type="checkbox"/> Other: _____                        |  |
| <input type="checkbox"/> Ethanol                   | <input type="checkbox"/> Lead Acid (Battery)  | <input type="checkbox"/> Other: _____                        |  |

## 2.5 TRAINING REQUIREMENTS

Federal and state OSHA training requirements apply.

Trihydro employees and subcontractors that are covered by contractual agreements with Trihydro performing tasks outlined in this HASP need to meet the training requirements outlined in OSHA 29 CFR 1910.120(e)(3). The best solution is for employees and subcontractors to have certification in the 40-hour HAZWOPER course and, if staff will be performing supervisory duties, the 8-hour supervisor's course.

The following railroad properties training requirements apply. Specify: \_\_\_\_\_  N/A

Alaska Railroad	Florida East Coast Rail	Tacoma Rail
Burlington Northern Santa Fe Railway	Idaho Northern & Pacific	Tillman & Jackson Railway
Canadian National	Metra Commuter Railroad	Union Pacific Railroad
City of Ottawa	Nebraska Central	Utah Transit Authority
Conrail	New Orleans & Gulf Coast Railway	Wichita

## 2.6 PHYSICAL QUALIFICATIONS

### 2.6.1 PERSONAL QUALIFICATIONS

Trihydro employees will be physically, medically, and emotionally qualified to perform the duties to which they are assigned. Some factors to be considered in making work assignments are activity knowledge, strength, endurance, agility, coordination, and visual and hearing acuity. Trihydro employees will be able to read and understand English.

At no time while on duty may employees use or be under the influence of alcohol, narcotics, intoxicants, or similar mind-altering substances. Employees found under the influence or consumption of substances will be immediately removed from the jobsite. Trihydro reserves the right to test for substance abuse. As part of implementing the Company's program to deter alcohol, drug, and substance abuse, each employee may be requested to submit to a urine, blood, or other medical test at any time, with or without notice. All employees are further subject to "for cause" drug, alcohol, or substances testing. "Cause" is determined if the Company has reason to believe that a covered worker has used illegal drugs or has misused alcohol, prescription medication, or over-the-counter drugs. Such reason may be, but is not limited to, the following: accidents, injuries, near misses, excessive absences, tardiness, altercations, lengthy absences, possession of drugs, or thefts. This policy applies to, but is not limited to, Trihydro employees and subcontractors.



Operators of equipment or vehicles will be able to read and understand the signs, signals, and operating instructions in use. Where permits are required to operate specified equipment, the employee will have the permit on hand.

### **2.6.2 MEDICAL SURVEILLANCE REQUIREMENTS**

In accordance with 29 CFR 1910.120(f), Trihydro employees and subcontractors that are covered by contractual agreements with Trihydro performing tasks outlined in this HASP will meet the following medical surveillance requirements with medical examinations and consultations:

- Before assignment.
- Project field-team members at least once every 12 months.
- At termination of employment or reassignment.
- As soon as possible upon notification by an employee that the employee has developed signs or symptoms indicating possible overexposure to hazardous substances or health hazards, or that the employee has been injured or exposed above the permissible exposure limits or published exposure levels in an emergency situation.

### **2.6.3 EXPOSURE-ASSESSMENT PLAN**

As a component of Trihydro's H&S Management System, the H&S Team coordinates annual exposure sampling events for hazardous environments per the corporate Exposure Assessment Plan. The results are compiled, analyzed, recorded, and reported to management and employees per the plan.

## **2.7 PRE-ENTRY BRIEFING**

In accordance with 29 CFR 1910.120(b)(4)(iii), Trihydro employees and subcontractors that are covered by contractual agreements with Trihydro performing tasks outlined in this HASP will receive a pre-entry briefing:

- Before initiating site activities
- Before work activities if there are changes to this HASP
- Before work activities if there are changes to the recognized hazards (i.e., seasonal changes, new hazardous substance exposure, etc.)

Trihydro employees and subcontractors will complete the *Pre-Entry Briefing Acknowledgement Form* portion of this HASP after each pre-entry briefing.



## **2.8 DAILY SAFETY BRIEFINGS**

The site PM, or assigned project supervisor, will conduct a daily site safety briefing covering the scope of work (general type of work), tasks for the shift, PPE, associated chemicals and their hazard controls, site and task associated hazards, permits needed, special equipment/techniques, communications, hospital information, and any special topics. The “Daily Tailgate Safety Meeting” form will be used to document the meeting; see **Appendix F**.

Subcontractors will be included in the daily safety briefings to provide effective coordination between Trihydro and contracted employees.

## **2.9 EFFECTIVENESS OF THE SITE HEALTH AND SAFETY PLAN (HASP)**

In accordance with 29 CFR 1910.120 (4)(iv), inspections should be conducted by the PSHSO as necessary to determine the effectiveness of the site HASP. Deficiencies in the effectiveness of the site HASP will be corrected by the employer.

The “Health and Safety Plan Effectiveness Audit Form,” found on the H&S Forms Web page, will be used to annotate and report deficiencies to the Corporate H&S Team.



## 3.0 SITE TASKS AND OPERATIONS

The following activities are anticipated to be performed at this site:

- Installing the SVE system
- Performing bioremediation injections
- Groundwater, soil, and indoor air sampling
- Sampling SVE system influent and effluent

### 3.1 SITE SECURITY

For client controlled sites, Trihydro employees and subcontractors will follow the client's security policies and procedures. At any time a Trihydro employee or subcontractor observes a breach in site security measures or suspicious activities that contradict security protocol, the client specified notification process will be initiated followed by reporting the situation to the Trihydro site PM.

Where Trihydro has responsibilities for security, a daily inspection of security measures will be conducted. Breaches in site security measures or suspicious activities that contradict security protocol, the situation will be reported to the Trihydro site PM.

## 4.0 PERSONNEL RESPONSIBILITIES

### 4.1 PROJECT TEAM RESPONSIBILITIES

Project personnel who have responsibility for the oversight of this project are:

<u>Position</u>	<u>Name</u>
Project Director:	Craig Carlson
Project Manager (PM):	Jim Gleason
Project Site Manager:	Joel Riebli
Project Site Health and Safety Officer (PSHSO)*	Joel Riebli
Trihydro Team Members:	Andrew Vann
	Sarah Seitz
	Bryce Dorr
	Luke Darnell
	Charles VanHeuvelen

\*The PSHSO will be a member who is present at the project site.

The project team responsibilities are listed below. It is the responsibility of the PM to verify that the field team has access to this HASP and supportive documentation, and reads the safety procedures. It is the individual's responsibility to bring to the attention of the PM, or Corporate H&S Manager, portions of this HASP and related training that he/she does not fully understand.

Site employees and subcontractors will conduct safety meetings at appropriate intervals to verify that personnel are fully informed of potential hazards. Attendance at safety meetings is to be documented, and attendance sheets signed by personnel in attendance. The attendance sheets will be retained by Trihydro and made available to the appropriate client representative on request. Trihydro's "Daily Tailgate Safety Meeting" form can be found as **Appendix F**.



#### **4.1.1 PROJECT MEMBERS**

Trihydro is a strong advocate for Behavior-Based Safety (BBS) where the “one team” approach to safety is highly supported. Project members, to include subcontractors, are expected to perform Work-Site Self-Assessments, conduct task observations, exercise the right of Stop Work Authority and to refuse unsafe work, review JSA forms, and report any unsafe conditions; all to promote the highest level of safety.

#### **4.1.2 TRIHYDRO PROJECT DIRECTOR**

The responsibilities of the project director with respect to safety are as follows:

- Verify that Trihydro field team personnel have read and understand this HASP
- Make available to the field team personnel the data known to him/her on this project site

#### **4.1.3 TRIHYDRO PROJECT MANAGER (PM)**

The responsibilities of the PM with respect to safety are as follows:

- *Verify acceptable cellular reception at site before work commencement.*
- *Verify route from site to hospital by driving the published route.*
- Coordinate initial site safety training for project team personnel as described in this document.
- Verify that field team personnel have read and understand this HASP.
- Verify that Trihydro field team personnel have the required materials needed before the start date to meet the requirements of this specific site HASP.
- Make available to the field team personnel and the appropriate client representative H&S information relevant to this project.

#### **4.1.4 TRIHYDRO SITE PROJECT MANAGER**

The responsibilities of the site PM with respect to safety are as follows:

- *Verify acceptable cellular reception at site before work commencement*
- *Verify there are no route obstructions (i.e., construction) from the site to the hospital*
- Conduct the daily safety briefing



- Coordinate efforts and communicate site tasks with other site contractors
- Establish communications between other site contractors via phone or radio to enhance coordination in the event of an emergency

#### **4.1.5 TRIHYDRO PROJECT SITE HEALTH AND SAFETY OFFICER (PSHSO)**

The responsibilities of the Trihydro PSHSO with respect to safety are as follows:

- Verify that work performed by Trihydro is conducted in accordance with safe practices outlined in this HASP
- Communicate to workers what is expected of them
- Note weather conditions
- Identify and schedule training
- Calibrate air and personal monitoring equipment
- Identify and remove hazards where possible
- Monitor activities for the proper use of PPE specified in this HASP, such as respirators with appropriate filters and/or canisters, protective coveralls, gloves, safety boots, protective eyewear, ear plugs, and hard hats
- Make PPE equipment available
- Monitor PPE usage, storage, maintenance, and replace when necessary
- Verify that safety equipment to be used by field team personnel is maintained in usable condition
- Use only safe work practices
- Initiate emergency phone calls when an emergency or accident requires medical attention
- Correct unsafe conditions and behaviors immediately
- Conduct additional H&S meetings deemed necessary
- Report problems to the PM

#### **4.1.6 TRIHYDRO FIELD TEAM MEMBERS**

The responsibilities of the Trihydro field-team members with respect to safety are as follows:

- Become thoroughly familiar with this HASP and its supportive documentation
- Actively participate in this project HASP

- Follow safety standards and safe work practices set by Trihydro, the client, and regulatory agencies
- Refuse to perform work when unsafe conditions exist
- Report potential hazards to the PSHSO
- Immediately report potential hazards, accidents, incidents, injuries, and illnesses to the PSHSO
- Inform PM of contact lens use
- Inform the PM if allergic to insect stings/bites or other biological hazards
- Inform the Trihydro Health Insurance Portability and Accountability Act (HIPAA) Officer of the Risk Management Office if on medication that can impair their physical and/or cognitive abilities to perform their duties
- Use PPE when needed
- Inspect PPE and safety equipment before use
- Have required equipment operating permits on person
- Be familiar with the location, type, and operation of site and facility emergency equipment and procedures

#### **4.1.7 SUBCONTRACTOR TEAM MEMBERS**

The responsibilities of the subcontractor-team members with respect to safety are as follows:

- Perform work safely
- Read and understand subcontractor HASPs
- Adhere to applicable HASP protocol
- Provide applicable H&S monitoring
- Report unsafe acts to Trihydro's PSHSO
- Properly inspect and maintain heavy equipment and other machines in compliance with applicable sections of the federal and State Occupational H&S Codes
- Supply and maintain PPE specified in this HASP, such as respirators with appropriate filters and/or canisters, protective coveralls, gloves, safety boots, protective eyewear, ear plugs, and hard hats
- Enforce corrective action in cooperation with the client and Trihydro's PSHSO
- Inform Trihydro's PSHSO of the presence of potential health or safety hazards

- Be aware and alert for signs and symptoms of potential exposure to site contaminants and climatic or acoustic stress
- Inspect PPE and safety equipment before use
- Inform PM of contact lens use
- Inform the PM if allergic to insect stings/bites or other biological hazards
- Inform their company HIPAA Officer if on medication that can impair their physical and/or cognitive abilities to perform their duties
- Have required equipment operating permits on person
- Be familiar with the location, type, and operation of site and facility emergency equipment and procedures



## 5.0 PERSONAL PROTECTIVE EQUIPMENT (PPE)

Personnel will understand and follow the Trihydro PPE Program. **Tables 5-1 and 5-2** provide more guidelines on PPE selection.

The following is a list of PPE anticipated to be used on this site based on the listed tasks, operations, and provided JSA forms:

### ***Eye and Face Protection***

- Safety Glasses
- Face Shield
- Chemical Goggles

### ***Body Protection***

- Fire-Retardant Clothing
- Tyvek Coveralls
- Chemical-Resistant Coveralls
- Chemical-Resistant Apron
- High-Visibility Safety Vest
- Cooling Vest
- Lightning-Strike Indicator

### ***Water Safety***

- Personal Flotation Device
- Waders
- Other:*** \_\_\_\_\_
- Other:*** \_\_\_\_\_

### ***Hand Protection***

- Industrial Work Gloves
- Chemical-Resistant Gloves
- Laceration-Resistant Gloves

### ***Fall Protection***

- Barriers/Guard Rails
- Body Harness w/Lanyards
- Anchorage Devices

### ***Foot Protection***

- Leather Boots
- Safety-Toed Boots
- Chemical-Resistant Boots

### ***Head Protection***

- Hard Hat
- Hard-Hat Liner

### ***Respiratory Protection\****

- Half-Face Respirator
- Full-Face Respirator
- Chemical Cartridge
- Particulate Filter
- Cartridge/Filter Combo
- Ammonia Cartridge
- H<sub>2</sub>S Escape Cartridge
- Asbestos Filter

### ***Hearing Protection***

- Ear Plugs
- Ear Muffs

### ***Biological Protection***

- First-Aid Kit
- Blood-borne Pathogen Spill Kit
- Insect Repellent
- Snake Gaiters

\*Assigned Protection Factors (APF) for determining Maximum Use Concentrations (MUC) and for appropriate respirator selection can be found in the **Table 5-3** titled “Respirator Assigned Protection Factor (APF).”



## 6.0 AIR (AREA) AND PERSONAL MONITORING, AND ENVIRONMENTAL SAMPLING

The following is a list of monitoring/sampling devices expected to be used on this site for the listed tasks and operations:  N/A

**Air (Area) Monitoring**  N/A

- Photo-Ionization Detector
- Combustible Gas Indicator
- Multi-Gas Detector
- Flame Ionization Detector
- Colorimetric Tube

\_\_\_\_\_  
(Specify)

Other:

\_\_\_\_\_  
(Specify)

**Personal Monitoring**  N/A

- H<sub>2</sub>S Monitor
- Ammonia Monitor
- Multi-Gas Detector
- Colorimetric Tube

\_\_\_\_\_  
(Specify)

Other:

\_\_\_\_\_  
(Specify)

**Environmental Sampling**  N/A

- DO/ORP Meter
- pH Meter
- Turbidity Meter
- Conductivity Meter
- Temperature Gauge

Photo-Ionization Detector (PID)

Flame-Ionization Detector (FID)

Other:

\_\_\_\_\_  
(Specify)

### 6.1 AIR (AREA) MONITORING

To protect employees from hazardous atmospheric conditions, air sampling and monitoring utilizing the appropriate monitoring device, whether single or multiple gas detectors, will be conducted in the work zone if a potential or actual hazardous atmospheric condition is suspected. An assessment of the work zone includes, but is not limited to, the configuration of the surrounding area that could hold hazardous gases, any nearby processes that produce toxic vapors, wind direction, and the possibility of oxygen depletion or enrichment. A hazardous atmosphere is defined as 1) oxygen percentage less than 19.5% and over 23.5%; 2) Lower Explosive Limits (LEL) of 20% or more (10% for confined space and trenching); and 3) exceeding the Permissible Exposure Levels (PEL) of toxic substances.

The preferred air monitoring device will be of an active design using a pump that introduces the air sample to the gas detecting apparatus. The order of air sampling is: 1) oxygen percentage; 2) LELs; and 3) toxic substances. Air



sampling will be conducted in a “tiered” manner where the sampling is conducted at intervals allowing adequate time for the device to make an accurate reading. For example, when vertically sampling a confined space, pause every 2-3 feet long enough for the device to read the atmosphere correctly.

The manufacturer’s manual for the specific device will be kept on site for reference.

### **6.1.1 AIR MONITORING ACTION LEVELS**

When using a PID/FID for air monitoring, refer to **Tables 6-1 and 6-2**, for PID and FID Organic Vapor Action Levels and Responses.

### **6.1.2 FREQUENCY**

The frequency of air sampling/monitoring is:

- Upon area entry by the sampler and before team entry
- Continuously (minimum every 15 minutes) if the oxygen level is below 20% or above 23%, LEL is above 15% (5% for confined space and trenching), and/or half of the PEL of toxic substances
- Periodically, such as every 2 hours, if deemed safe, but with a potential hazard

### **6.1.3 CALIBRATION, BUMP TESTING, AND MAINTENANCE**

Each instrument will be bump tested at the beginning of each day with the manufacturer’s recommended calibration gas. Calibration will be performed at a minimum quarterly or sooner if exposed to large doses of contaminants. Trihydro equipment will be calibrated and maintained by the Corporate H&S Team unless otherwise dictated by the team. Rental equipment will be calibrated and maintained by the rental company.

### **6.1.4 DEVICE TYPES**

There are various methods for sampling and monitoring atmospheric conditions where the operator will be trained in their use and the appropriate equipment will be utilized so that the device is capable of detecting the specific site hazard. For area monitoring, it is best to use active devices where the detector is pump driven passing the atmospheric sample across the detecting component.

#### **6.1.4.1 PHOTO-IONIZATION DETECTOR (PID)**

A type of Organic Vapor Meter (OVM) known as a PID will be used during this project if hydrocarbon-impacted materials are encountered. The PID used for this project will be equipped with a 10.0 eV lamp or greater. Monitoring will be conducted using one PID per work zone. Areas downwind of the work zone will also be monitored, if necessary, to verify organic vapor emissions do not impact off-site areas.

#### **6.1.4.2 COMBUSTIBLE GAS INDICATOR**

A Combustible Gas Indicator (CGI) may be used in lieu of a PID in the field to provide site monitoring (one instrument per work zone with potential hydrocarbon contamination). The instrument can be used to measure hydrocarbon vapor concentrations.

#### **6.1.4.3 MULTI-GAS DETECTOR**

A multiple gas detector can be taken into the field to provide site monitoring (one instrument per work zone) to sample and monitor the work zone area. The multi-gas detector will be set up to monitor oxygen levels, LEL, and Hydrogen Sulfide.

#### **6.1.4.4 DIRECT READING COLORIMETRIC INDICATOR TUBES**

For short-term measurements, direct reading colorimetric tubes are available to measure the so-called spot concentrations of specific gases. A wide range of different gases and vapors can be detected and measured, e.g.,: determining and measuring concentration peaks, measuring personal exposure in the inhalation area, detecting leaks in pipelines, gas installations etc., and air analysis in sewers, shafts and confined spaces.

#### **6.1.4.5 FLAME-IONIZATION DETECTOR (FID)**

An FID is a direct-reading monitoring device that ionizes gases and vapors with an oxy-hydrogen flame and measures the differing electrical currents generated.

### **6.2 PERSONAL MONITORING**

The methods for monitoring the atmospheric conditions in a worker's breathing zone are very similar to area sampling and monitoring. Again, the operator will be trained in their use and the appropriate equipment will be utilized so that the device is capable of detecting the specific site hazard. Personal monitoring devices will be worn in the breathing zone of the employee.

The manufacturer's manual for the specific device will be kept on site for reference.

### **6.2.1 FREQUENCY**

Personal exposure monitoring will be conducted on a continuous basis (minimum every 15 minutes) if there is a potential exposure risk.

### **6.2.2 CALIBRATION, BUMP TESTING, AND MAINTENANCE**

Non-disposable instruments will be bump tested at the beginning of each day with the manufacturer's recommended calibration gas. Calibration will be performed at a minimum quarterly or sooner if exposed to large doses of contaminants. Trihydro equipment will be calibrated and maintained by the Corporate H&S Team unless otherwise dictated by the team. Rental equipment will be calibrated and maintained by the rental company, or by Trihydro employees if calibration equipment is available.

Employees are to perform a daily function test on disposable personal monitors before commencing work on site.

Calibration results are to be recorded on an "Air Monitoring Equipment Calibration Tracking Form."

Bump testing and function test results are to be recorded on a "Personal Detector Bump Check Record."

### **6.2.3 DEVICE TYPES**

The same devices used for air monitoring can be used for personal monitoring. However, typically, personal monitors are smaller in size and are usually passive devices (not pump driven). The devices can be single gas detectors or multiple.

#### **6.2.3.1 HYDROGEN SULFIDE (H<sub>2</sub>S) DETECTOR**

Project members are to wear a hydrogen sulfide (H<sub>2</sub>S) detector when on site. The low-level alarm is to be set at 10 ppm and the high-level at 15 ppm. The action levels are listed in **Table 6-3**.

The manufacturer's manual for the specific device will be kept on site for reference.

### 6.2.3.2 MULTI-GAS DETECTOR

A multiple gas detector can be taken into the field to provide personal monitoring (one instrument per person or group) to sample and monitor the work atmosphere. The multi-gas detector will be set up to monitor, at a minimum, oxygen (O<sub>2</sub>) levels, LEL, and chemical PELs. The multi-gas detector will monitor for potential hazardous atmospheres of:

- <19.5% O<sub>2</sub>
- >20% LEL (>10% for permit-confined space operations)
- >PEL
  - H<sub>2</sub>S (low alarm set at 10 ppm, high alarm 15 ppm)
  - CO (alarm set at 35 ppm)

The manufacturer's manual for the specific device will be kept on site for reference.

## 6.3 ENVIRONMENTAL SAMPLING

Multiple hazards should be considered when preparing for environmental sampling activities. Hazards may include but are not limited to calibration solutions, calibration gases, sample locations, sampling environment, sample media, and sampling activities. Before completing environmental sampling the appropriate JSA form should be completed by the sampling team and reviewed by the PM. JSA forms would cover, but not be limited to, sampling activities, equipment calibration, and sampling equipment maintenance. Environmental sampling and the development of JSA forms may be completed for a variety of media and should be completed in general accordance with site specific Sampling and Analysis Plans (SAP), Quality Assurance Project Plan (QAPP), and or the USEPA Groundwater RCRA groundwater monitoring guidelines.

### 6.3.1 TECHNIQUES

Environmental sampling techniques should be completed in general accordance with site specific SAPs, QAPPs, and or the USEPA Groundwater Sampling Technical Guidance Document (TGD).

### 6.3.2 INSTRUMENTATION

The manufacturer's manual for the specific devices used will be kept on site for reference. Caution will be used whenever using chemicals or compressed gases for calibration of monitoring equipment. Use recommended PPE based upon potential hazards as defined in the job specific JSA.

#### **6.3.2.1 DO/ORP METER**

A combination Dissolved Oxygen (DO) and Oxidation Reduction Potential (ORP) meter will be used at the site during groundwater sampling. The DO meter is an electronic device in which oxygen diffuses across a membrane in a submerged probe, to complete an electrical circuit. It records the dissolved oxygen concentration in milligrams per liter or percentage saturation. ORP meters measure the very small voltages generated when the measuring probe is placed in water in the presence of an oxidizing agent. The electrode is made of platinum or gold, which reversibly loses its electrons to the oxidizer. A voltage is generated which is compared to a silver electrode in a silver salt solution, similar to a pH probe. The more oxidizer available, the greater the comparative voltage generated between the two probes.

#### **6.3.2.2 PH METER**

A pH meter is a high impedance voltmeter for the measurement of electrode potential.

#### **6.3.2.3 TURBIDITY METER**

A turbidity meter will be used at the site during groundwater sampling. Turbidity refers to the concentration of un-dissolved, suspended particles present in a liquid and is a measure of the clarity of a sample. Turbidity measurement is achieved by analyzing the amount of light refracted from suspended particles such as clay, silt, and organic material.

#### **6.3.2.4 CONDUCTIVITY METER**

A conductivity meter will be used at the site during groundwater sampling. Conductivity is the ability of a material to conduct electric current and is measured by placing two plates (enclosed in the meter end) in the sample, a potential is applied across the plates, and the current that passes through the solution is measured.

#### **6.3.2.5 TEMPERATURE METER**

A temperature meter will be used at the site during groundwater sampling. Temperature refers to the kinetic energy of molecules making up substance, vibrating and bouncing against each other. Temperature meters measure temperature by reading the current across the sensor after a potential is applied across the sensor. The meter then converts the current reading into temperature.

#### **6.3.2.6 PHOTO-IONIZATION DETECTOR (PID)**

A type of OVM known as a PID will be used during this project if hydrocarbon-impacted materials are encountered. The PID used for this project will be equipped with a 10.6 eV lamp or greater. Monitoring will be conducted using one

PID per work zone. Areas downwind of the work zone will also be monitored, if necessary, to verify organic vapor emissions do not impact off-site areas.

#### **6.3.2.7 FLAME-IONIZATION DETECTOR (FID)**

An FID is a direct-reading monitoring device that ionizes gases and vapors with an oxy-hydrogen flame and measures the differing electrical currents generated.

#### **6.3.3 CALIBRATION AND MAINTENANCE**

Each instrument will be tested at the beginning of each day in accordance with the manufacturer's recommendations. Calibration will be performed in accordance with the manufacturer's recommendations or sooner if warranted. Trihydro equipment will be calibrated and maintained by field personnel on a daily basis. Rental equipment will be calibrated and maintained at a minimum according to manufacturer's recommendations. Field equipment will be calibrated to the extent practicable before use each sampling day.



## 7.0 SITE CONTROL PLAN

Entry into a hazardous environment requires the “buddy system” of two personnel where each employee is observed by the other to provide rapid assistance in the event of an emergency. *If there are no actual or potential exposures to hazards that would incapacitate the individual, then refer to the Lone Worker Safety Procedures.*

The following are recognized hazards at the site throughout the project period; personnel will be familiar with the associated health and safety policy, procedure, or plan corresponding to each hazard.

- |  |   |   |
|--|---|---|
| <b><i>Physical Hazards</i></b>   | <input type="checkbox"/> Chemical Hazards                                   | <input type="checkbox"/> Powered Industrial Trucks        |
| <input type="checkbox"/> Machine Guarding                                | <input type="checkbox"/> Asbestos Hazards                                   | <input type="checkbox"/> Confined Space Entry             |
| <input type="checkbox"/> High Pressurized/Temperature Process            | <b><i>Natural Disaster</i></b>  | <b><i>Biological Hazards</i></b>                          |
| <input type="checkbox"/> Lock Out / Tag Out                              | <input type="checkbox"/> Earthquake   | <input checked="" type="checkbox"/> Blood-borne Pathogens |
| <input checked="" type="checkbox"/> Housekeeping                         | <input type="checkbox"/> Tornado  | <input checked="" type="checkbox"/> Hantavirus            |
| <input checked="" type="checkbox"/> Ground Level Slips, Trips, and Falls | <b><i>Climate Hazards</i></b>   | <input checked="" type="checkbox"/> Histoplasmosis        |
| <input type="checkbox"/> Falls from Heights                              | <input type="checkbox"/> Heat Stress  | <input checked="" type="checkbox"/> Psittacosis           |
| <input checked="" type="checkbox"/> Knife Safety                         | <input type="checkbox"/> Cold Stress  | <input type="checkbox"/> Chiggers                         |
| <input type="checkbox"/> Ladder Use                                      | <input checked="" type="checkbox"/> Ergonomic Hazards                       | <input type="checkbox"/> Stinging Insects                 |
| <b><i>Electrical Hazards</i></b>   | <input type="checkbox"/> Acoustical Hazards                                 | <input type="checkbox"/> Fire Ants                        |
| <input type="checkbox"/> Overhead-Power Lines                            | <input type="checkbox"/> Dust Hazards                                       | <input type="checkbox"/> Lyme Disease (Ticks)             |
| <input type="checkbox"/> Inclement Weather/Lightning                     | <input type="checkbox"/> Excavation Hazards                                 | <input type="checkbox"/> West Nile Virus                  |
| <input type="checkbox"/> Utilities Clearance                             | <input type="checkbox"/> Drilling Activities                                | <input type="checkbox"/> Snakes                           |
| <input type="checkbox"/> Water Hazards                                   | <b><i>Traffic Hazards</i></b>   | <input type="checkbox"/> Spiders                          |
| <input type="checkbox"/> Fire/Explosion Hazards                          | <input checked="" type="checkbox"/> Driving Safety                          | <input type="checkbox"/> Scorpions                        |
| <input type="checkbox"/> Hot Works                                       | <input type="checkbox"/> Vehicular Safety                                   | <input type="checkbox"/> Poison Oak/Ivy/Sumac             |
|  | <input type="checkbox"/> Contaminated Soil Truck Removal/Hauling Operations | <input type="checkbox"/> Rabies                           |
|  |   | <input type="checkbox"/> Alligators                       |

## 7.1 HAZARD CONTROL HIERARCHY – ORDER OF PRECEDENCE

Site hazards and hazards resulting from investigation and remediation activities may be controlled using one or more of the control measures listed below. The order of precedence is as follows:

- **Engineering Controls:** A major component of the design phase is to select safety features to eliminate a hazard and render it fail-safe or provide redundancy using backup components. Examples of engineering controls include, but are not limited to: mechanical ventilation; sound-proofing; machine guarding; etc.
- **Administrative Controls:** Hazards that cannot be totally eliminated by engineering controls can be controlled through administrative controls. Examples of administrative controls include, but not limited to: warning signs; personnel change out; specialized training; established procedures; etc.
- **Personal Protective Equipment (PPE):** To protect workers from injury, the last method in the order of precedence is the use of PPE. Employees need to understand that the use of PPE does not remove the risk. PPE such as hard hats, gloves, eye protection, life jackets, and other protective equipment can be bulky, cumbersome, and heavy where often it is discarded or not used, rendering this method ineffective without proper controls.

## 7.2 SAFE WORK PRACTICES

The following section presents procedures on how to address the hazards expected to be encountered during site activities for this project. During times when site operations are under the observation of a Trihydro representative, Trihydro will notify contractor personnel on site and a client representative if an unsafe condition is observed.

### 7.2.1 STOP WORK AUTHORITY/RIGHT-TO-REFUSE UNSAFE WORK PROGRAM

Employees not only have the right to refuse unsafe work, they also have the right to stop unsafe practices of others. The stop work authority program gives any employee working onsite the ability to stop all work related to a specific activity being performed in a manner in which there is an imminent danger to personnel, property, or the environment. All employees and contractors are responsible for participating in the stop work authority program.

The stop work order is binding until either the employee who stopped the work or the site PM rescinds the order. The site PM is the only individual who can overrule the employee who initially stopped the work.

*NOTE: The requirements and responsibilities identified in the stop work authority program may cross company boundaries. For example, a Trihydro employee may identify a subcontractor performing an unsafe act or creating an unsafe condition and stop the work, or vice versa. Any unsafe act or condition identified must be investigated and corrected by either the employee who stopped the work or the site PM.*



Any employee who identifies an unsafe act or condition that warrants a stop work order shall immediately conduct the following:

- Notify affected employees (includes workers in the general area)
- Take the appropriate actions necessary to protect workers, the public, the environment, and the property
- Notify immediate supervisor
- Notify site PM if different from immediate supervisor

Affected employees will immediately comply with the stop work order until either the employee who stopped the work or the site PM rescinds the order.

Every stop work order will be investigated and corrected as soon as possible. Individuals involved in the investigation will be determined by the site PM. The results of the investigation shall be communicated to all affected employees including the employee who initially stopped the work and the site PM.

No employee will receive any kind of reprisal, retribution, or discipline for exercising a stop work authority.

### **7.2.2 WORK AREA EVALUATION FOR CONFINED SPACES**

The project team will evaluate their work areas for confined spaces using the “Work Area Evaluation for Confined Spaces,” **Appendix G**. The form is used to determine if there are non-regulated spaces, confined spaces, or permit-required confined spaces in the work area. The project team will use completed forms to communicate the type and location of the spaces to team members. Completed forms will be kept in the project folder.

The project team will re-evaluate their work areas if the space configuration or hazards change.

### **7.2.3 HAND-INJURY PREVENTION**

Employees are expected to assess their tasks for physical, chemical, and thermal hand hazards and implement engineering and administrative controls, and PPE, or a combination of the three.



### 7.2.3.1 ENGINEERING CONTROLS

Engineering controls prevent the physical placement of the employee's hand in harm's way. An example is machine guarding to protect from hazards such as those created by point of operation (area on a machine where work is actually performed), ingoing nip points, rotating parts, flying chips, and sparks.

### 7.2.3.2 ADMINISTRATIVE CONTROLS

Administrative controls are designed to make an individual aware of the hazard and, therefore, limit their exposure. Administrative controls may include training, labeling, signs, and safe work practices and procedures.

### 7.2.3.3 PERSONAL PROTECTIVE EQUIPMENT (PPE)

Gloves can protect against chemical exposure, lacerations, and thermal hazards. However, employees need to understand that one type of glove does not protect against all hazards. Employees need to match the right glove material with each application or task. This includes assessing the job for chemical exposures, pinch points, laceration hazards, thermal risks, abrasion exposure, puncture risks, and then selecting the appropriate glove based on material, thickness, length, and other traits. Clients may have strict guidelines for proper glove selection, so get with your PM for more details.

**Table 7-1** provides employees with more glove selection guidance.

***Warning: Loose fitting clothing, including loose fitting gloves and unbuttoned sleeve cuffs, must not be worn around rotating or moving equipment such as, but not limited to, power transmission shafts, pulleys, feed rolls, drill presses, power augers, and rotating stock!***

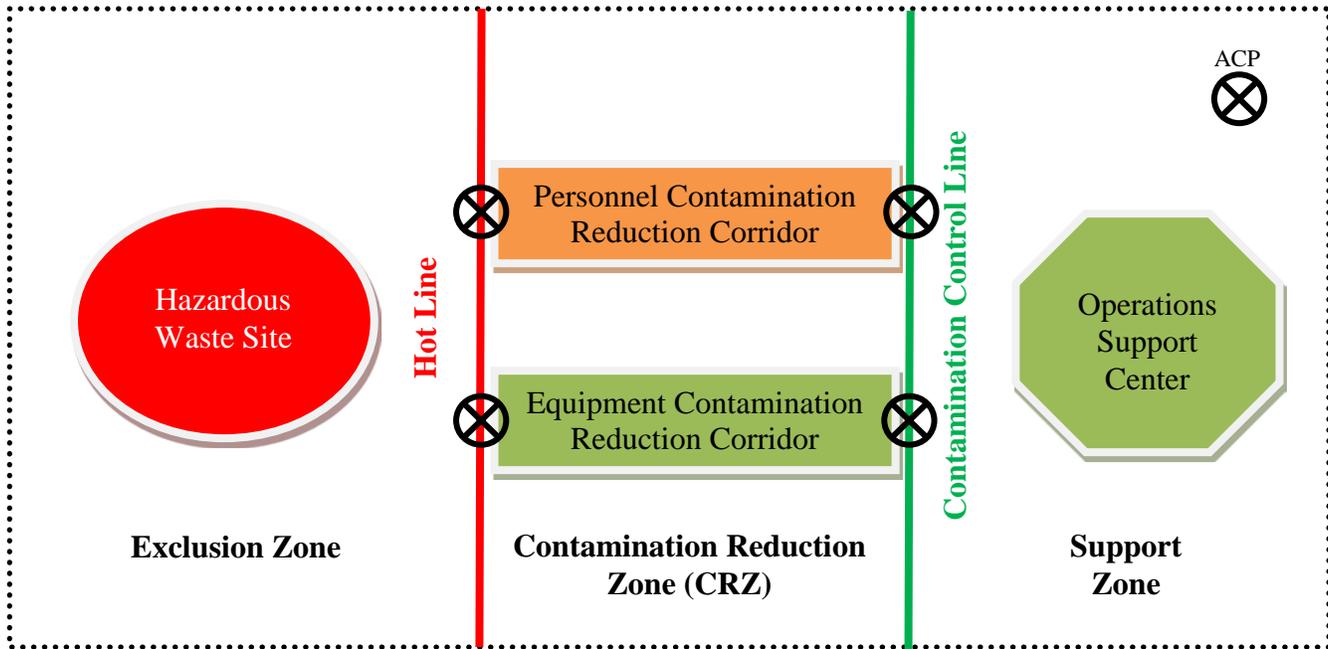
## 7.3 WORK ZONE ACCESS

The work zone is defined as the area within a 30-foot radius of persons working in the area. Barricades and other entry restricting equipment will be used at the discretion of the PM or PSHSO to prevent the work zone entry of unauthorized personnel. Only authorized personnel will be permitted to enter the work zone. Authorized personnel will include those who have duties requiring their presence in the work zone. The Trihydro PM has the right to require unauthorized personnel to exit the work zone.

Pedestrian and vehicle traffic control plans will be developed and documented as an addendum to the HASP when the potential exists for pedestrian and/or vehicular traffic to pass through or nearby the work zones. The control plans will provide: pedestrian/vehicle diversions around or away from the work zones; clear guidance through the diversion; and

prevent pedestrian/vehicle/work zone interaction that would result in incidents. Requirements for submitting traffic control plans with controlling authorities need to be completed in accordance with their guidelines.

### 7.3.1 HAZWOPER EXCLUSION ZONE ACCESS



During HAZWOPER operations, it may be necessary to set up work zones to control chemical exposures. The Exclusion Zone (or hot zone) is the area with actual or potential contamination and the highest potential for exposure to hazardous substances. Therefore, the Exclusion Zone requires the highest level of PPE determined for the area. If workers are entering the Exclusion Zone under suspected or actual immediately dangerous to life and health conditions, there must be one standby rescuer in the same level of protection for each entrant. Standby rescuers are staged in the Support Zone (or are cold zone ready) to enter the Exclusion Zone at a moment's notice.

Exclusions zones will vary based on the tasks performed on a daily basis. If multiple exclusions zones are established, wind direction and topographical layout need to be considered to prevent exposing workers in other work zones.

Work zones must be well-marked and the boundaries visible. Work zone boundaries are established after evaluating the potential for hazardous substances to migrate through air, soil, or water.

Smoking, eating, drinking, and applying makeup or lotions within the Exclusion or Contamination Reduction Zones is prohibited.

Workers are to enter the Exclusion Zone through the CRZ (or warm zone) via the Access Control Points (ACP). Workers are to exit the Exclusion Zone through the CRZ personnel decontamination stations while equipment is decontaminated at the equipment decontamination stations.

#### **7.3.1.1 BUDDY SYSTEM AND COMMUNICATIONS**

Workers in the Exclusion Zone are to use the “buddy system” to facilitate a quicker response in the event of an emergency. Exclusion Zone entrants need to work in groups so as to have effective communication with one another and have visual contact to monitor others for signs and symptoms of exposure and other emergencies. Key responsibilities of buddies are to:

- Provide partners with assistance
- Observe partners for signs of chemical or heat exposure
- Periodically checking partners’ PPE
- Notify the PM or other site employees if emergency assistance is needed

The PM needs to establish effective communication with the Exclusion Zone entrants before entry. Various systems can be used to include:

- Radio: including FM and CB (intrinsically safe for explosive atmospheres)
- Noisemakers: such as bells, air horns, megaphones, sirens, whistles
- Visual signals: such as flags, hand signals, lights, signal boards, body movements

#### **7.3.2 WORK PERMITS**

Work permits may or may not be required on project sites; however, the client reserves the right to regulate specific areas by the use of work permits such as general work permits, hot work permits, high hazard permits, and permit-required confined space permits. If the client has specific permit requirements, or if hot works or permit-required confined space operations are anticipated, review the Trihydro and client specific procedures before initiating the tasks.

#### **7.3.3 LONE WORKER SAFETY PROCEDURES**

To provide an effective means of communication between a single field team member and the project management group, site Lone Worker Safety Procedures will be established by the PM. The primary consideration is the type of activities that will be performed that could result in exposure to an incapacitating situation. *If there are no expected or*

*potential exposures to hazards that would incapacitate the individual, then Lone Worker Safety Procedures are acceptable.*

The following criteria need to be met before performing tasks at the project site under the Lone Worker Safety Procedures:

- Perform a Work Site Self-Assessment to determine if the task has high risk that would require the buddy system.
- Verify that cellular phone use in the work area does not pose an additional hazard or is not against the client's policy.
- The lone worker needs to possess a cellular phone that is turned on, kept on person, and charged. If working in a noisy environment, set the phone to vibrate.
- Cellular phone reception needs to be verified to be at a sufficient level. If cellular coverage is not sufficient, a booster needs to be issued to the individual.
- Supervisors away from the office will carry a cellular phone, turned on, kept on person, and charged.
- The lone worker needs to carry identification (ID) on their person and in vehicles (company ID badge, driver's license, etc.).
- If the client policies require, company vehicles need to have the company name and office phone number displayed.

The following communication protocol needs to be implemented:

- Field personnel would advise their supervisors of their work schedule.
- The lone worker needs to contact supervision at the start of the day, mid-day, and a final status report call at the end of the day. The client will be notified in accordance with their policies.
- The communication with additional contacts, such as family and friends, is encouraged.
- If a lone worker misses a scheduled communication, they need to be contacted to verify their status within 15 minutes of the scheduled check in time. If the lone worker does not answer after three call attempts, a person will be sent to the work site to check on their status.

## **7.4 PHYSICAL HAZARDS**

PPE is designed to protect field team personnel from some physical hazards expected at the work site. However, the field team personnel will be aware of potential physical hazards and remain alert during field work. The following procedures will be implemented to minimize the potential for injury from physical hazards.

### **7.4.1 MACHINE GUARDING**

Machine guarding will be designed to prevent hands, arms, or any other part of an employee's body from making contact with dangerous moving parts or from entering the point of operation. A guard will not only prevent accidental contact, but will prevent employees from intentionally going around or bypassing the guard.

### **7.4.2 HIGH PRESSURIZED/TEMPERATURE PROCESSES**

Potential energy can be released from various pressurized or high temperature process equipment or components that could result in injury or death. When conducting environmental activities, no team member, unless trained and authorized by the client, is to conduct lockout/ tag-out (LOTO) activities on equipment located on site.

Below is list of procedures to follow when working around pressurized/high temperature processes. Notify the applicable client representative or your PM if you identify items listed below.

- Look for evidence of oil or air leaks on the surfaces of flexible hoses or at the point at which the hose in question joins the metal end couplings.
- Look for abnormal deformation of the outer covering of hydraulic hoses.
- Look for leakage at connections.
- Look for evidence of abrasive wear that could have reduced the pressure retaining capabilities of the hose or tube affected.

Allow equipment to cool before conducting environmental activities.

LOTO may be required depending on the type of work being conducted on or around the equipment. Contact the applicable Montana Department of Environmental Quality representative before conducting work on equipment to provide proper training under OSHA CFR 1910.147 regulations.

### 7.4.3 LOCKOUT / TAG OUT (LOTO)

Maintenance activities requiring lock out of hazardous energies (LOTO) is expected to be conducted by Trihydro subcontractors. Applicable team members will follow the site/equipment procedure and additional requirements in the client LOTO Program. Lock out is preferred over tag out. Trihydro team members and subcontractors will follow LOTO procedures for each piece of equipment serviced during site activities. If a LOTO procedure is not posted or you have questions on the written procedure contact Trihydro's PSHSO before servicing the equipment. ***Employees will not conduct maintenance, repair, or inspection on equipment without first being trained on the LOTO procedures and, second, verifying energy sources have been de-energized.*** Each trained "authorized" employee shall have their own lock and tag. (Trihydro's PSHSO is responsible for administering the proper LOTO equipment, training the field team members on the procedure, and checking procedures are followed).

If a piece of equipment has a single energy source, the basic steps for LOTO can be followed without the need for written procedures. If the equipment is complex or has multiple energy sources, then there must be equipment-specific written procedures kept at the place where maintenance is performed. If there are multiple pieces of equipment that are very similar, such as well pumps, then a single written procedure can cover that "family" of equipment.

Equipment powered by a single electrical cord does not fall under LOTO procedures as long as all the following is followed:

- The cord is within reach
- The cord is in view
- If neither can be maintained, then a lockout device will be applied

The basic steps for lock out are as follows:

1. Review applicable Montana Department of Environmental Quality LOTO policies
2. Develop JSA forms for work to be conducted
3. Notify affected individuals that equipment will be shut down
4. Turn off equipment requiring service
5. Locate the equipment-specific energy source
6. Lock out the energy source to the equipment using energy isolation devices and dissipate stored energy

- Each Trihydro employee performing the work will place their lock on the energy isolation device. If multiple employees will be working on the equipment, a gang hasp will be used to allow the employees to place their lock on it to control the energy source.
  - Lock-out locks and keys are provided by Trihydro. Each employee working on the equipment will have a lock with a single key controlled by that employee.
7. Place a tag-out tag on the lock, initial, provide a contact number, and date it
  8. Dissipate residual energy
  9. Verify that the area is clear and try starting the equipment to confirm that the equipment is dead
    - If proper lock out is verified, then servicing may be conducted.
    - If proper lock out is not verified, do not proceed and notify the Trihydro PM immediately.
  10. After maintenance is complete, replace guards, shields, and other safety devices and remove tools and other equipment from the equipment area
  11. Verify personnel are clear of the equipment area
  12. Remove locks and tags
  13. Re-start the system

#### **7.4.4 HOUSEKEEPING**

The first requirement for safe field operation is that the field team understands and fulfills the responsibility for maintenance and “housekeeping” during site environmental activities.

##### **7.4.4.1 GENERAL HOUSEKEEPING**

- Suitable storage locations will be provided for tools, materials, and supplies so that tools, materials, and supplies can be conveniently and safely handled without hitting or falling on a member of the crew or a visitor.
- Work areas, platforms, walkways, scaffolding, and other access ways will be kept free of material, debris, obstructions, and substances such as ice, grease, or oil that could cause a surface to become slick or otherwise hazardous.
- Gasoline will not be stored in portable containers other than a non-sparking, red container with flame arrester in the fill spout and having the word “gasoline” easily visible on the container.



- Store and secure necessary equipment outside the work zone until use is required.
- Mitigate icy conditions within the work zone and along pathways.

#### **7.4.5 GROUND LEVEL SLIPS, TRIPS, AND FALLS**

To prevent slips, trips, and falls, take extra precaution if you encounter the following situations:

- Loose, irregular surfaces, such as gravel, shifting floor tiles, and uneven sidewalks can make it difficult to maintain your footing.
- Oil, grease, and other liquids can make walking surfaces extremely slick.
- Obstructed aisles or walkways present tripping hazards or require frequent changes of direction, which can throw you off balance.
- Insufficient light can make it difficult to see obstacles and notice changes in the walking surface.
- Shoes with slick soles provide insufficient traction.
- Carrying items can both obstruct your vision and impair your balance.
- Inattention and distraction interfere with your awareness of these hazards and increase your risk of injury.
- For snow covered terrain, follow already established safe trails.

#### **7.4.6 FALLS FROM HEIGHTS**

Workers will be protected from falls when working at heights of 4 feet or more above the ground or next lower working elevation when covered by General Industry standards, 6 feet when covered by Construction standards, and 3 feet when covered by Mining Safety and Health Administration (MSHA) standards. The primary means of fall protection is through engineering controls such as guardrails and barricades. Other methods include life lines and netting. In the event that fall hazards are encountered on the site, and if standard engineered fall protection is not feasible, Trihydro workers will use a Personal Fall Arrest System (PFAS).

- A PFAS consists of a full-body harness and shock-absorbing lanyard equipped with double-locking snaps. As of January 1, 1998, the 1994 OSHA rule prohibits the use of body belts as part of a personal fall arrest system.
- During the use of a PFAS, workers will utilize the buddy system where the second team member will remain on a nearby working platform as an observer to summon rescue services in the event of a fall.
- A relief step device that helps prevent suspension trauma will be incorporated into the PFAS.

- Only locking-type snap hooks will be permitted for use in personal fall arrest systems and positioning systems as of the same date.
- The lanyard will be attached to the D-ring in the center of the back or other manufacturer approved D-rings.
- Practicing “back biting” where the lanyard is wrapped around the anchorage point and snapped back on itself is unauthorized unless the lanyard is designed specifically for the practice.
- Tie-off will be to a structural member capable of supporting a 5,000-pound load in the event of a fall.
- The tie-off point will be as high as practical above the head.
- The lanyard can be no longer than 6 feet.
- Employees working near electrical equipment will use nylon or other non-conductive lanyards. Steel slings will not be used.
- PFAS equipment will be protected from damage and kept in good repair. Equipment involved in a fall will be immediately removed from service.
- Trihydro employees exposed to fall hazards will be trained in this procedure.

Fall protection equipment will be inspected before each use utilizing the Trihydro ***Fall Protection Equipment Inspection Form***, found on the H&S Forms Web page, which completed forms are filed in the project folder.

#### **7.4.7 KNIFE SAFETY**

Only self-retracting utility (safety) knives are to be used by Trihydro employees and subcontractors. Self-retracting (safety) knives add an important safety feature to the design. Like standard utility knives they can adjust quickly to different cutting depths and will let the blade retract completely into the handle when not in use. The difference is that the spring-loaded blades are pushed out of the knife body with finger pressure and then retract automatically when the pressure is released. This added safety feature will help keep our employees safer on the job site.

Here are some safety tips that apply when using utility knives:

- Once the blade is engaged into the material, release the finger pressure to allow blade retraction once material is cut.
- Use a sharp blade.
- Keep your free hand away from the line of cut.



- When making cuts on a surface below you, stand or kneel to one side of the line of the cut.
- Pull the knife toward you when making a cut on a flat surface. Because pulling motions are stronger and more positive than pushing motions, your knife is less likely to slip.
- When using a straight edge to guide a cut, either clamp it down or keep your free hand well away from the cutting path of the knife. Be sure the straight edge is thick enough to prevent the knife from "riding up" over the edge.
- With thicker materials, make several passes, cutting a little deeper into the material with each pass.
- Many tasks require a knife edge, but not a sharp point. For these tasks you can add protection against puncture wounds by using a rounded-tip blade.
- Use "imbedded" blades when possible such as for strapping, shrink wrap, and twine.
- Use scissor-type cutters (pipe cutter) when possible, such as with piping, hosing, and tubing.



Self-retracting Knife



Imbedded Blade



Pipe Cutter

## 7.5 ELECTRICAL HAZARDS

The potential exists for field team personnel to encounter electrical hazards, particularly during site activities. The following procedures will be implemented to minimize the potential for injury from electrical hazards.

### 7.5.1 ELECTRICAL-QUALIFIED PERSONS

Only qualified persons are authorized to construct, repair, maintain, and operate electrical equipment and installations where the individual would be within 3 feet of live (energized), exposed components. This does not include removal of an electrical source to machinery/equipment for the purpose of controlling hazardous energy sources (LOTO) under 29 CFR 1910.147.

A qualified person is one who has the skills and knowledge related to the construction and operation of electrical equipment and installations. The qualified person will have undergone safety training to recognize and avoid hazards per the National Fire Protection Association (NFPA) Standard 70E.

### **7.5.2 EXTENSION CORDS (FLEXIBLE POWER CORDS)**

Extension cords are for temporary use only (no more than 24 hours). Cords are to be inspected before use for cut insulation, exposed wiring, and missing grounding plugs; defective cords will be repaired or replaced.

Employees are to protect extension cords from damage and chaffing. Cords strung across roadways will have a protective system covering the cord.

Extension cords are to be of a continuous cord; plugging one extension cord into another is not authorized.

Extension cords need to be selected on power tool ratings so as not to overheat the cord or damage the power tool. See **Table 7-2** for extension cord ratings.

### **7.5.3 GROUND FAULT CIRCUIT INTERRUPTERS (GFCI)**

Power tools and extension cords used in construction activities or in damp environments will be outfitted with a GFCI adapter or plugged into a GFCI outlet. The GFCI adapter is to be installed at the outlet before the extension cord or power tool.

If the use of a GFCI can pose a greater threat to employees, such as when using magnetic-mounted power tools, employees are to coordinate with the H&S Team before tool or equipment use.

Employees are to inspect and test the GFCI before use.

### **7.5.4 OVERHEAD-POWER LINES**

Overhead power lines pose a potential hazard when there is a possibility of contact. A 10-foot minimum clearance shall be maintained between equipment and energized lines with a power rating of 50 kV or less and then an additional 4 inches for every 10 kV over 50 kV. If the appropriate clearance cannot be maintained, the power lines shall be de-energized.

For drilling activities, the minimum clearance distance from the drill mast and overhead power lines is 20 feet.

**Table 7-3** provides energized-line and equipment clearances.

### **7.5.5 INCLEMENT WEATHER/LIGHTNING**

If thunder is heard within 30 seconds of sighting lightning, the lightning is close enough to be dangerous – seek shelter. Wait 30 minutes or more after the last lightning flash before leaving shelter.

### **7.6 UTILITIES CLEARANCE**

Utilities, above and below ground, will be identified by type (electrical, natural gas, steam, telecommunications, etc.), rating, and location and annotated on the “Utilities Locate Acknowledgement Form,” **Appendix H**, whenever they are deemed a hazard for tasks performed (e.g., excavations, drilling, equipment movement, etc.)

### **7.7 WATER HAZARDS**

When operating from a boat, employees will follow safe boating procedures. Participants will wear personal-flotation devices (PFDs). Additionally, everyone on a boat should know how to swim. Operation of a boat and surface water inspections are to be performed by at least two individuals, never alone. Extremely rapid currents, high winds, or excessive debris in the water, may cause the cancellation of boat operations should the PM or authorized supervisor deem such a measure necessary.

When the water is too shallow for a boat’s draft, a surface water investigation will be conducted with the use of hip waders. A PFD will be worn if deep or swiftly moving water is encountered while wearing hip waders.

### **7.8 FIRE/EXPLOSION HAZARDS**

The potential exists for field team personnel to encounter fire/explosion hazards during site activities. The following additional precautions will be implemented to minimize the potential for fire or explosion:

- Use explosion-proof tools.
- After air vacuum and visual clearance procedures, (where applicable) drilling activities will proceed slowly for the first 5 feet to minimize damage to underground lines.
- If monitoring equipment detects organic vapors at or above 20% of the LEL of flammable gases, vapors, or mists, ignition sources will be eliminated.
- The possession of cameras, weapons, or explosives is prohibited without proper authorization from the appropriate Montana Department of Environmental Quality representative.
- If abnormal fire, smoke, or heat emanate from areas on site, the field team personnel will immediately evacuate the area.



### 7.8.1 HOT WORKS

Hot works is expected to be conducted onsite during this project. Hot works includes welding, torch cutting, grinding, and other spark or heat producing operations.

When performing hot works, field team personnel are required to follow Trihydro's, or the client's, Hot Works Policy. A hot works permit is required for temporary operations that involve open flames or produces heat and/or sparks. Hot work operations include welding, torch cutting, grinding, and other spark or heat producing operations. The hot works permit is intended to prevent fire detection system from accidentally activating, prevent losses from accidentally igniting the client's property, and to provide the safety of individuals working in the area where hot works is being performed. A copy of hot work permits used during site activities will be filed in the project file.

### 7.9 CHEMICAL HAZARDS

Governmental regulations require that Trihydro has one easy reference for important information regarding hazardous substances in the workplace. This information is contained on labels and in SDSs/MSDSs for each substance in the workplace. OSHA has updated the requirements for SDSs (formerly known as MSDSs), but will not fully regulate the new format until June 1, 2015. Also, OSHA has updated the requirements for labeling of hazardous chemicals under its Hazard Communication Standard (HSC). As of June 1, 2015, all labels will be required to have pictograms [consists of a symbol on a white background framed within a red boarder and represents a distinct hazard(s)], a signal word, hazard and precautionary statements, the product identifier, and supplier identification. Until that time, labels can be in the form of the National Fire Protection Agency (NFPA) diamond on buildings or the Hazardous Information System (HIMS) guidelines for containers with the hazards ranging from zero (no risk) to four (highest risk).

If a hazardous material is encountered that the employee is not familiar with, the employee will review the SDS/MSDS for that material. Read labels and the SDS/MSDS carefully, follow warnings and instructions, understand the signs of exposure and first aid response, use the correct protective clothing and equipment when directed, learn emergency procedures, and practice safe work habits. Employees will direct questions about a hazardous material to the PSHSO.

Site-chemical hazards and their associated exposure limits that employees may encounter are listed in **Table 7-4**.

- Hydrocarbon liquids and gases, which may adversely affect human health through injection, skin contact, and inhalation.
- Acidic and caustic solids or liquids, which may adversely affect human health through skin contact and inhalation.

If you have questions regarding chemicals located at the client's site, contact the PM.



The following procedures will be implemented to minimize potential harm from chemicals:

- The Trihydro PM will refer to the National Institute for Occupational Safety and Health (NIOSH) Pocket Guide to Chemical Hazards for the proper response to hazardous organic chemicals if field team personnel complain of irritation, giddiness, headache, or nausea.
- Copies of SDSs can be found in **Appendix E**.
- If organic vapors are encountered, organic vapor measurement should be taken every 15 minutes in the breathing zone within the site. Employees need to refer to **Tables 6-1 and 6-2** “PID and FID Organic Vapor Action Levels and Responses.”
- Trihydro’s PSHSO will instruct field team members to stop work and leave the work zone if there are indications of the exposure to acidic or alkaline substances (eye, nose, throat, or skin irritation; holes in clothes).
- Trihydro’s PSHSO will instruct the field team members complaining of these symptoms to immediately flush the area of the body exhibiting the symptoms with cool or cold water.
- Trihydro’s PSHSO will determine the pH of the apparent offending substance.
- If the pH is less than 1 or greater than 12 standard units, the field team personnel will be required to wear Tyvek coveralls, chemical resistant gloves, chemical resistant boots, splash goggles, and half-mask respirators with acid and particulate cartridges.
- Trihydro’s PSHSO will instruct the field team personnel to minimize contact with the acidic or caustic substance.
- Chemicals will be stored with compatible chemicals in an area with secondary containment that will not allow a spill to enter into the environment.
- Chemicals not in their original container will be kept in a container compatible with the chemical and labeled with an HIMS label.

### 7.9.1 SITE CHEMICALS OF CONCERN

Based on historical environmental sampling data for the site, chemicals of concern at the site include the individual compounds present in petroleum hydrocarbons, including volatile and semi-volatile organic compounds and heavy metals in soil and groundwater. The primary chemicals that were detected at concentrations above cleanup standards include those listed in **Table 7-4**. This table is used as a reference; defer to the [NIOSH Pocket Guide to Chemical Hazards](#) and/or the MSDS provided in **Appendix E**.



## 7.9.2 HAZARDOUS WASTE

Hazardous waste will be collected in containers compatible with the waste, stored in an area with secondary containment that will not allow a spill to enter into the environment, stored with compatible wastes, and labeled indicating the waste nomenclature and collection start date.

Site-hazardous waste and contaminants found in refinery wastes and wastewater are listed in **Tables 7-5 and 7-6**.

## 7.10 ASBESTOS HAZARDS

There is a potential for asbestos exposure at this site; therefore, employees need to be aware of asbestos potential hazards. Once asbestos fibers are trapped in the body, the fibers can cause serious health hazards. The most common way for asbestos fibers to enter the body is through inhalation. If asbestos is disturbed during site activity employees will immediately evacuate the area and notify the appropriate client personnel.

## 7.11 NATURAL DISASTERS

### 7.11.1 EARTHQUAKES

Stay as safe as possible during an earthquake. Be aware that some earthquakes are actually foreshocks and a larger earthquake might occur. Minimize your movements to a few steps to a nearby safe place and stay indoors until the shaking has stopped and you are sure exiting is safe.

#### 7.11.1.1 IF INDOORS

- **DROP** to the ground; take **COVER** by getting under a sturdy table or other piece of furniture; and **HOLD** on until the shaking stops. If there isn't a table or desk near you, cover your face and head with your arms and crouch in an inside corner of the building.
- Stay away from glass, windows, outside doors and walls, and anything that could fall, such as lighting fixtures or furniture.
- Use a doorway for shelter only if it is in close proximity to you and if you know it is a strongly supported, load-bearing doorway.
- Stay inside until shaking stops and it is safe to go outside.
- Be aware that the electricity may go out or the sprinkler systems or fire alarms may turn on.
- **DO NOT** use the elevators.

### **7.11.1.2 IF OUTDOORS**

- Stay there.
- Move away from buildings, streetlights, and utility wires.
- Once in the open, stay there until the shaking stops.

### **7.11.1.3 IF IN A MOVING VEHICLE**

- Stop as quickly as safety permits and stay in the vehicle. Avoid stopping near or under buildings, trees, overpasses, and utility wires.
- Proceed cautiously once the earthquake has stopped. Avoid roads, bridges, or ramps that might have been damaged by the earthquake.

### **7.11.1.4 IF TRAPPED UNDER DEBRIS**

- Do not light a match.
- Do not move about or kick up dust.
- Cover your mouth with a handkerchief or clothing.
- Tap on a pipe or wall so rescuers can locate you. Use a whistle if one is available. Shout only as a last resort. Shouting can cause you to inhale dangerous amounts of dust.

## **7.11.2 TORNADOS**

If you are under a tornado WARNING, seek shelter immediately!

### **7.11.2.1 IF INDOORS**

- Go to a pre-designated shelter area such as a safe room, basement, storm cellar, or the lowest building level.
- If there is no basement, go to the center of an interior room on the lowest level (closet, interior hallway) away from corners, windows, doors, and outside walls.
- Put as many walls as possible between you and the outside.
- Get under a sturdy table and use your arms to protect your head and neck. Do not open windows.

### **7.11.2.2 IF IN A VEHICLE, TRAILER, OR MOBILE HOME**

- Get out immediately and go to the lowest floor of a sturdy, nearby building or a storm shelter. Mobile homes, even if tied down, offer little protection from tornadoes.

### **7.11.2.3 IF OUTDOORS WITH NO SHELTER**

- Lie flat in a nearby ditch or depression and cover your head with your hands. Be aware of the potential for flooding.
- Do not get under an overpass or bridge; you are safer in a low, flat location.
- Never try to outrun a tornado in urban or congested areas in a car or truck. Instead, leave the vehicle immediately for safe shelter.
- Watch out for flying debris. Flying debris from tornadoes causes most fatalities and injuries.

## **7.12 CLIMATE HAZARDS**

During day-to-day field work, on-site personnel will be alert for the signs and symptoms of climatic stress. Field team members will be observed for the following signs and symptoms of climatic stress:

- Change in body temperature
- Profuse sweating (or absence of sweating when sweating is expected)
- Skin color change
- Shivering
- Disorientation or slurring of speech
- Vision problems
- Muscle cramps or spasms

### **7.12.1 HEAT STRESS**

Heat stress is the increased heart rate, body temperature, respiration, and perspiration that results when the body works to reduce unwanted heat.

#### **7.12.1.1 HEAT STROKE**

Heat stroke is the most serious level of heat stress and can be lethal. During heat stroke, moisture from sweat is not available to stimulate evaporative cooling. Some symptoms of heat stroke include:

- Extremely high body temperature
- Red, hot, dry skin (sweating is absent)



- Strong, rapid pulse
- Convulsions or collapse
- Delirium, disorientation, or unconsciousness

The most important emergency measures to take in the event of heat stroke are:

- Call for emergency help.
- Cool the victim rapidly; get the victim to a shaded area until emergency help is available.
- If the victim is conscious, administer liquids, but never give alcoholic beverages or stimulants such as coffee or tea.
- If emergency help is not available, seek medical attention during or immediately following the cooling process.

#### **7.12.1.2 HEAT EXHAUSTION**

Heat exhaustion is not as severe as heat stroke but can lead to heat stroke if not treated properly. Some symptoms of heat exhaustion include:

- |  |   |
|--|---|
| ▪ Body temperature is normal or slightly deviant from normal | ▪ Weak pulse                                |
| ▪ Profuse sweating   | ▪ Fatigue, dizziness or giddiness, fainting |
| ▪ Pale, clammy skin  | ▪ Muscle cramps                             |
|  | ▪ Nausea or vomiting                        |

The most important emergency measures to take in the event of heat exhaustion to prevent heat stroke are:

- Cool the victim in shade or indoors
- Have the victim lie down with feet slightly elevated
- Loosen clothing
- If conscious, administer an electrolyte solution, such as Gatorade, every 15 minutes unless vomiting occurs
- If symptoms persist or recur, seek medical attention

### 7.12.1.3 PREVENTION OF HEAT STRESS

The work schedule should be paced based on weather conditions. There should be adequate rest periods when electrolyte solutions are available, as it may be necessary to replace body fluids and electrolytes as often as every 15 minutes. Air thermometers and oral medical thermometers should be available.

Clothing should be light and reflective and a sunscreen with at least a sun protection factor (SPF) of 15 should cover areas of the body that are exposed to direct sunlight. In the case of perspiration, the sunscreen should be re-applied as necessary. It should be remembered that a thin layer of clouds is not a form of protection against sunburn, as ultraviolet rays penetrate thin cloud layers.

The effects of heat and humidity are shown in **Table 7-7**.

### 7.12.2 COLD STRESS

Cold stress is when the body's core temperature drops below 96.8°F (36°C). Cold stress occurs when the body is unable to compensate for excessive heat loss. Cold stress includes frostbite and hypothermia. Symptoms include pain in the extremities, mental confusion, tripping, and falling. This can occur in temperatures below 50°F, especially in people performing physical labor. Wind chill factor also needs to be taken into consideration (see the **Table 7-8**).

The most important emergency measures to take in the event of cold stress are:

- Individuals suffering from cold stress should move to a heated area.
- The outer layer of clothing should be removed and the remainder of clothing loosened.
- Wet clothing should be replaced with dry clothing.
- The individual should be instructed to rest until the symptoms are no longer recognizable.
- If the symptoms appear critical, persist, or get worse, immediate medical attention will be sought.

#### 7.12.2.1 FROSTBITE

Frostbite occurs when body parts freeze. Hands, feet, ears, nose, lips, cheeks, and chin are the most vulnerable to frostbite. There are three stages of frostbite: 1) shallow skin, 2) intermediate skin and underlying tissues, and 3) deep frostbite to the bone. The symptoms include:

- The skin changing from red to pale or waxy
- Tingling, stinging, and cold sensations

- Gradual numbness
- Deep frostbite has a cold, solid feel with pale color

First aid for frostbite includes:

- Move the person to a warm area. Put affected body parts in warm water (105 - 110 degrees F) until skin becomes flushed. No hotter or additional damage will result.
- After warming, the injured area should be wrapped in sterile gauze, keeping affected fingers and toes separated.
- If you cannot guarantee that the tissue will stay warm, do not warm the tissue until it can be kept warm.
- If normal sensations haven't returned within 30 minutes, seek medical attention.
- ***DO NOT RUB OR MASSAGE!*** (Have the person move or exercise the affected areas as soon as possible).

#### 7.12.2.2 HYPOTHERMIA

Hypothermia occurs when heat loss causes the body temperature to lower. Rapid warming is urgently needed to prevent death. The symptoms include:

- Severe shivering (shivering decreases as body temperature lowers)
- Disorientation
- An uncaring attitude
- Slower breathing
- Slow speech
- Forgetfulness
- Loss of manual dexterity
- Pupil dilation at 86°F body temperature
- Eventual unconsciousness and death at body temperatures of 80°F and lower

First aid for hypothermia includes:

- Rest in a warm, sheltered area
- If hypothermia advances beyond shivering, get immediate medical help

- Remove wet clothing and apply heat to the body
- Drink warm water and eat warm food if conscious

### **7.12.2.3 PREVENTION OF COLD STRESS**

To prevent cold stress, wear layers of clothing to keep warm and dry and protect the head, hands, and feet from cold. The work rate should not be so high as to cause heavy sweating that will result in wet clothing. Cooling power of the wind is shown in **Table 7-8**.

## **7.13 ERGONOMIC HAZARDS**

The interaction of personnel with their working environment at this site may present potential hazards, such as incorrect lifting of heavy loads, equipment vibrations, improper twisting, or improper body positioning. The aforementioned conditions are potential factors during site activities. Personnel should position themselves properly, lift with the legs when lifting equipment or heavy objects, and rely on the buddy system for assistance in lifting loads that are awkward or too heavy for one person. Back strain, the most common ergonomic hazard in the field, may be avoided if site workers ask for assistance when needed. It is expected that employees will seek assistance when lifting loads exceeding 50 pounds.

### **7.13.1 LIFTING PROCEDURES**

Back injuries can happen as quickly as one wrong move. Lifting and carrying objects can be safer if:

- Plan the route before lifting the load and remove obstacles.
- When lifting items from below arm level, bend your knees, not your back, to lower your body to the object.
- Bring the load as close as possible to the body before lifting.
- Grip firmly with your hands (not just fingers) and keep your arms and elbows tucked in for more strength.
- Lift by letting your legs push you up, not your back.
- Check that you can see where you are going and move slowly enough to avoid bumping into other objects.
- Do not twist your body while carrying heavy objects; twisting is a major cause of injury. If you need to change directions, move your feet in that direction first.
- Lifting is safest when you keep your back straight and your stomach muscles tight. Staying in good physical condition and getting proper exercise are also important.

Loads should be broken down to movable weights, routes planned, and legs used to do the work. Help should be obtained or a handcart or other device used if an object is too heavy.

#### **7.14 ACOUSTICAL HAZARDS**

When working around site equipment, the potential exists for team members to be exposed to noise levels above the OSHA exposure limit of 85 decibels on an 8-hour TWA. Trihydro and OSHA require the use of hearing protection when working in areas where the exposure limit is equal to or greater than 85 decibels on an 8-hour TWA. To provide adequate hearing protection, Trihydro team members should wear hearing protection while working around mechanical equipment on site. Field team personnel will not use headphones during work.

#### **7.15 DUST HAZARDS**

The generation of dust and fugitive emissions will be prevented when possible and controlled when necessary. Work practices may be adjusted in a manner to minimize dust generation. Personnel will avoid working in dust by positioning themselves upwind of intrusive activities. Hazardous dust will be controlled by suppression with water where it poses a risk to workers or community. Throughout site activities, dust areas should be watered, as needed, to minimize dust.

#### **7.16 EXCAVATION HAZARDS**

Daily inspections of excavations will be made by a competent person as defined in the OSHA 29 CFR 1926.650 utilizing the Trihydro Daily Excavation and Trench Inspection Form.

##### **7.16.1 COMPETENT PERSON**

A competent person must be on site to do the following:

- Conduct inspections of the excavations, adjacent areas, and protective systems before the start of work; as needed throughout the shift; and daily for potential cave-ins, failures, hazardous atmospheres, or other hazards.
- Take prompt corrective action or remove employees from the hazard.
- The competent person must be able to demonstrate the following:
  - The ability to recognize possible hazards associated with excavation work and to test for hazardous atmospheres
  - Knowledge of the current safety orders pertaining to excavation and trenching

- The ability to analyze and classify soils
- Knowledge of the design and use of protective systems
- The authority and ability to take prompt corrective action when conditions change

### **7.16.2 EMERGENCY RESCUE EQUIPMENT**

Emergency rescue equipment, such as breathing apparatus, a safety harness and line, or a basket stretcher, shall be readily available where hazardous atmospheric conditions exist or may reasonably be expected to develop during work in an excavation. This equipment shall be attended when in use.

Employees entering bell-bottom pier holes, or other similar deep and confined footing excavations, shall wear a harness with a lifeline securely attached to it. The lifeline shall be separate from any line used to handle materials, and shall be individually attended at all times while the employee wearing the lifeline is in the excavation.

### **7.16.3 PROTECTION FROM UNDERGROUND UTILITIES**

Before commencing excavation operations, the existence and location of underground pipes, electrical equipment, telephone, gas lines, etc. will be determined and documented.

### **7.16.4 PROTECTION FROM HAZARDOUS ATMOSPHERES**

- For excavations greater than 4 feet in depth where oxygen deficiency (atmospheres containing less than 19.5 percent oxygen) or a hazardous atmosphere exists or could reasonably be expected to exist, such as in excavations in landfill areas or excavations in areas where hazardous substances are stored nearby, the atmospheres in the excavation shall be tested before employees enter.
- If flammable/combustible vapors reach or exceed 20% of the LEL, operations will be suspended, ignition sources eliminated, and the area will be ventilated if the concentration until the LEL is reduced below 10%. The project team will use a combustible gas meter to make this determination.

### **7.16.5 PROTECTION OF EMPLOYEES FROM LOOSE ROCK, SOIL, AND OBJECTS**

- Personnel entry into excavations 5-feet deep or greater is only permitted if the necessary protective systems are in place using shoring methods or sloping and benching will be compliant with the OSHA CFR 1926 Subpart P, Appendix B.

- Excavations greater than 4-feet deep that require personnel to enter will have sufficient means of ingress and egress (stairs, ladders, ramps) within a maximum travel distance of 25 feet. If ladders are provided they must be secured and extend at least 3 feet above grade.
- Excavations greater than 20-feet deep shall be designed by a registered professional engineer.
- Spoils will be placed at least 2 feet from the edge of the excavation or removed entirely.
- Objects will be kept a minimum distance of 2 feet from the edge.
- Where the stability of adjacent structures (buildings, walls, footers, foundations, or other structures) is endangered by excavation operations, a registered professional engineer shall determine the measures necessary to protect employees and the structure.

#### **7.16.6 FALL PROTECTION**

Where employees or equipment are required or permitted to cross over excavations over 6-feet deep, walkways or bridges with standard guardrails are to be provided.

Adequate physical barrier protection is to be provided at remotely located excavations. Wells, pits, shafts, etc., are to be barricaded or covered. Perimeter protection constructed of a physical barrier that prevents entry into the work zone placed at a distance not closer than 6 feet from the edge of the excavation and displays adequate warning. Upon completion of exploration and other similar operations, temporary wells, pits, shafts, etc., are to be backfilled.

#### **7.16.7 PROTECTION FROM HAZARDS ASSOCIATED WITH WATER ACCUMULATION**

Employees are not work in excavations in which there is accumulated water, or in excavations in which water is accumulating, unless adequate precautions have been taken to protect employees against the hazards posed by water accumulation. The precautions necessary to protect employees adequately vary with each situation, but could include special support or shield systems to protect from cave-ins, water removal to control the level of accumulating water, or use of a safety harness and lifeline.

If water is controlled or prevented from accumulating by the use of water removal equipment, the water removal equipment and operations is to be monitored by a competent person to ensure proper operation.

### **7.16.8 STABILITY OF ADJACENT STRUCTURES**

Where the stability of adjoining buildings, walls, or other structures is endangered by excavation operations, support systems such as shoring, bracing, or underpinning shall be provided to ensure the stability of such structures for the protection of employees.

Excavation below the level of the base or footing of any foundation or retaining wall that could be reasonably expected to pose a hazard to employees shall not be permitted except when:

- A support system, such as underpinning, is provided to ensure the safety of employees and the stability of the structure; or
- The excavation is in stable rock; or
- A registered professional engineer has approved the determination that such excavation work will not pose a hazard to employees.

Sidewalks, pavements, and appurtenant structure is not to be undermined unless a support system or another method of protection is provided to protect employees from the possible collapse of such structures.

### **7.16.9 ACCESS AND EGRESS**

A stairway, ladder, ramp, or other safe means of egress is to be located in trench excavations that are 4 feet or more in depth so as to require no more than 25 feet of lateral travel for employees.

- Structural ramps that are used solely by employees as a means of access or egress from excavations are to be designed by a competent person. Structural ramps used for access or egress of equipment is be designed by a competent person qualified in structural design, and is to be constructed in accordance with the design.
- Ramps and runways constructed of two or more structural members are to have the structural members connected together to prevent displacement.
- Structural members used for ramps and runways are to be of uniform thickness.
- Cleats or other appropriate means used to connect runway structural members are to be attached to the bottom of the runway or be attached in a manner to prevent tripping.
- Structural ramps used in lieu of steps are to be provided with cleats or other surface treatments to the top surface to prevent slipping.

#### **7.16.10 EXPOSURE TO VEHICULAR TRAFFIC**

Employees exposed to public vehicular traffic are to be provided with, and wear, warning vests or other suitable garments marked with or made of reflectorized or high-visibility material.

#### **7.16.11 EXPOSURE TO FALLING LOADS**

Employees are to be permitted underneath loads handled by lifting or digging equipment. Employees are required to stand away from vehicles being loaded or unloaded to avoid being struck by spillage or falling materials. Operators may remain in the cabs of vehicles being loaded or unloaded when the vehicles are equipped to provide adequate protection for the operator during loading and unloading operations.

#### **7.16.12 WARNING SYSTEM FOR MOBILE EQUIPMENT**

When mobile equipment is operated adjacent to an excavation, or when such equipment is required to approach the edge of an excavation, and the operator does not have a clear and direct view of the edge of the excavation, a warning system such as barricades, hand or mechanical signals, or stop logs is to be used. If possible, the grade should be away from the excavation.

#### **7.16.13 INSPECTION**

Daily inspections of excavations, the adjacent areas, and protective systems are to be made by a competent person for evidence of a situation that could result in possible cave-ins, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions. These inspections are only required when employee exposure can be reasonably anticipated (e.g., entry into excavation or working near edges).

- Before the start of work
- As needed throughout the shift
- After rain storms or other hazard increasing occurrence

Where the competent person finds evidence of a situation that could result in a possible cave-in, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions, exposed employees are to be removed from the hazardous area until the necessary precautions have been taken to ensure their safety.



## **7.17 DRILLING ACTIVITIES**

Before any subsurface activities, Trihydro employees involved will complete Trihydro's Subsurface Utility Location and Excavation best practices training. When performing hollow stem auger, flight auger, air rotary, casing hammer, mud rotary, sonic, or direct push drilling operations, the following applies:

### **7.17.1 GENERAL SAFETY AND EMERGENCY RESPONSE**

- Before work is begun, including rig set up, a tailgate safety meeting, review of site specific H&S plan, and job hazard review must be conducted at the site.
- The job hazard analysis must be specific to the rig to be utilized.
- A first-aid kit must be available in an easily accessible area away from the drilling operation. Its location must be reviewed during the tailgate safety meeting.
- Work cannot be performed if lightning strikes are observed in the area.

### **7.17.2 PERSONAL PROTECTIVE EQUIPMENT (PPE)**

- Minimum required PPE for drilling jobs includes hard hat, safety shoes with steel toes, safety glasses or goggles, gloves and hearing protection.
- Appropriate PPE must be worn to prevent irritation or contamination of the skin when handling potentially contaminated articles and spoils.
- Hearing protection must be worn in the Exclusion Zone or when working within 20 feet of the operating rig.
- Secure loose clothing, hair wraps, strings on jackets and hoods, and shoelaces. Jewelry is not allowed to be worn. Eliminate protruding tools from tool belts.

### **7.17.3 EQUIPMENT SAFETY**

- The drilling contractor will complete a checklist daily to verify equipment is in safe and operable condition. The checklist must be available on site for review.
- Rig controls and levers, including emergency shut-off, should be legibly labeled. Wherever possible, pinch points will be identified and labeled.
- Adequate cribbing must be in place under the leveling jacks and outriggers to prevent tip-over or sinking into unstable soil.



- Secure the rig when it is in position; set brakes and/or locks, chock wheels or tracks as conditions require.
- The Exclusion Zone must be marked with a continuous barrier where the potential for site visitation by the public or other pedestrians exists.
- The Exclusion Zone(s) should be large enough to safely accommodate workers and drilling equipment.
- Check for adequate overhead clearance before raising the mast. Work in proximity to overhead power lines must address risk of contact with lines.
- Travel with the mast of the drill rig in the raised or partially raised position is unauthorized.
- The drilling rig must be equipped with an operable emergency shut-off or “kill” switch. Persons working within the Exclusion Zone must know the location and operation of the emergency shut-off switch. The functionality of emergency shut-off switches must be tested at the start of each work day.
- Whip checks or anti-whip devices must be in place on pressurized hose lines.
- Augers, drill rods, or down-hole equipment must be cleaned when the drill rig is in neutral, the engine is idle, and the machinery has stopped rotating.
- Repair to rigs must be done by a person trained and qualified to perform the repair.
- Do not perform maintenance or refueling while the equipment is operating.
- Work must cease if cables or cable clamps become damaged or frayed.
- No body part is allowed within 12 inches of a turning auger.
- Broken or substandard equipment must not be brought to the site. Equipment that becomes broken must be tagged as such and must not be used.
- Equipment must not be used if guards are not in place.
- Work areas must be kept in a clean and orderly condition. Tools and equipment must be stored properly when not in use.
- A worker must not attempt to move a load unassisted if the weight and bulk exceeds the capability of the worker. Loads greater than 50 pounds must not be repeatedly moved by a single person.

- Vertical storage of drill rods and augers is not allowed unless the rig is specifically designed to accommodate this practice.
- Drilling rods and augers may not be removed in multiple sections. Drilling rods and augers must be broken down at each joint as they are removed from the hole. Manual tools must not be used in combination with powered rotation.

#### **7.17.4 DRILL-SITE CLEARANCE**

To protect buried utilities and exposing employees to the hazards associated with utility strikes, a summary of Trihydro’s drill-site clearance procedure is listed below. Trihydro’s *Drill Site Clearance Procedures and Drilling Safety Guide* will be used for drilling and/or geoprobings activities. Before any subsurface activities, Trihydro employees involved will complete Trihydro’s Subsurface Utility Location and Excavation best practices training. Procedures may vary based on the PM’s assessment of the area, tasks, and geological makeup.

- The drilling contractor will contact the appropriate “Call Before You Dig” one-call notification center at least 2 business days before excavation and/or drilling work is scheduled to begin.
- Locations of known utility lines will be clearly marked (using electronic locating methods) at each proposed drill site.
- Conduct a thorough review of available subsurface utility-location maps for each proposed drill site.
- If the activities listed above show no conflicts, pothole each of the proposed drill sites to a minimum diameter no less than that of the proposed borehole to be drilled. Pothole to the maximum “utility window” depth or 10 feet below ground surface, whichever is deeper, using a hybrid air vacuum rig with hydro vacuum capabilities.
- If environmental soil-quality samples are required within the “utility window,” air vacuum to the desired sample depth and use a hand auger to retrieve the sample.
- Visually confirm that no buried utilities or other subsurface obstructions are present in each pothole to the maximum depth of the “utility window.”
- If no buried utilities or other obstructions are encountered, the proposed drill site is “cleared” for drilling.
- Before raising the mast on the drilling rig at each location, look for overhead lines. A 20-foot minimum clearance shall be maintained from overhead power lines, or per the client’s requirements, whichever is greater. If the appropriate clearance cannot be maintained, the power lines shall be de-energized. If impracticable, or infeasible, contact the Corporate H&S Team for guidance.

- During drilling activities, proceed slowly for the first 5 feet.
- Stop drilling activities if resistance is encountered.

### **7.17.5 HOUSEKEEPING DURING DRILLING OPERATIONS**

- Do not store or transport tools, materials, or supplies within or on the mast (derrick) of the drill rig.
- Pipe, drill rods, casing, augers, and similar drilling tools will be stacked on racks or sills in an orderly fashion to prevent spreading, rolling, or sliding.
- Penetration, or other driving hammers, will be placed at a safe location on the ground or secured to prevent movement when not in use.
- Controls, control linkages, warning and operation lights, and lenses should be stored free of oil, grease, and/or ice.
- Keep support vehicles, unnecessary equipment, and unnecessary personnel outside of the work zone.

## **7.18 TRAFFIC HAZARDS**

### **7.18.1 DRIVING SAFETY**

Driving safety is required to protect the field team personnel from work-related injuries and accidents. Compliance with site, local, state, and federal traffic laws is required. Workers should drive defensively by continually watching for hazardous conditions, understanding how to defend against them, and taking action in time to avoid problems. Keep eyes and attention on the road and others and adjust speed and driving to changing weather and traffic conditions.

- Trihydro employees who, as a part of their duties, operate vehicles on public roads will hold a valid, properly classed driver's license and possess an acceptable driving record.
- Only vehicles designed for off-road operations will be allowed to leave improved roads and then only within the manufacturer's guidelines and the vehicle's capabilities and limitations. When operating off trail, the use of a spotter will be used. If a spotter is not available, then a ground recon of the intended route will be conducted by the driver before driving the area.
- Vehicles will be parked to allow the driver to pull forward to preventing the need for backing. If the vehicle needs to be backed, the driver will use a spotter or, in the absence of a spotter, perform a ground recon for obstacles before entering the vehicle and backing.

- Trihydro employees who, as a part of their duties drive corporate, rental vehicles, or personal vehicles for Trihydro business, will be 3-D Driving (defensive driving) certified before driving on corporate business. Refresher training is required every 2 years.
- Employees are expected to complete a Journey Assessment Form found on the Trihydro H&S Web site before departure when leaving their local area.
- Employees operating a vehicle, personal, rental, or fleet, on company business will not use a cell phone, Blackberry, or other electronic device while operating the vehicle.
- Site workers are required to wear seat belts when operating or riding in vehicles.
- It is a violation of Trihydro's safety policy for employees to operate a vehicle with illegal drugs in his/her system or while impaired by alcohol, prescription drugs, or over-the-counter medications.
- Vehicles and other mobile equipment will operate within posted speed limits, and only in areas necessary to perform work, and will observe roadblocks and caution signs.
- Vehicles may be left running only for the purposes of operating auxiliary equipment or lights or for diesel engine warming, and then only when the driver can verify the vehicle is secure with the transmission in park or neutral, wheels chocked, and the parking brake set.
- Vehicles parked on sloped surfaces will have the transmission in park, or placed in first gear for manual transmissions, wheels chocked, and the parking brake set.
- When parking heavy equipment, such as front loaders and other excavation equipment, the driver will lower the buckets, blades, or other hydraulically driven attachments to the ground, place the vehicle in park, and set the parking brakes.
- Vehicle operators will not drive over unprotected hoses or exposed piping.
- Employees will enter and exit through the gates or pathway provided and designated for this use.
- Keys to unattended vehicles and equipment will be left in the ignition so the vehicles and equipment can be moved as necessary (on unsecured sites, this is at the discretion of the PM). Where applicable, vehicles and/or equipment are described as unattended anytime the driver is not at the controls of the vehicle.
- Upon notification of a release of flammable vapors, fire, or other immediate dangers, the operator will immediately shut down sources of ignition under his/her control. No attempt to start or move vehicles in the area will be made until conditions are safe for re-entry.

## 7.18.2 VEHICULAR SAFETY

The protection of project-team members from vehicular hazards while on site is crucial. The following actions should take place to provide a high level of protection from injuries caused by contact with vehicles and heavy equipment.

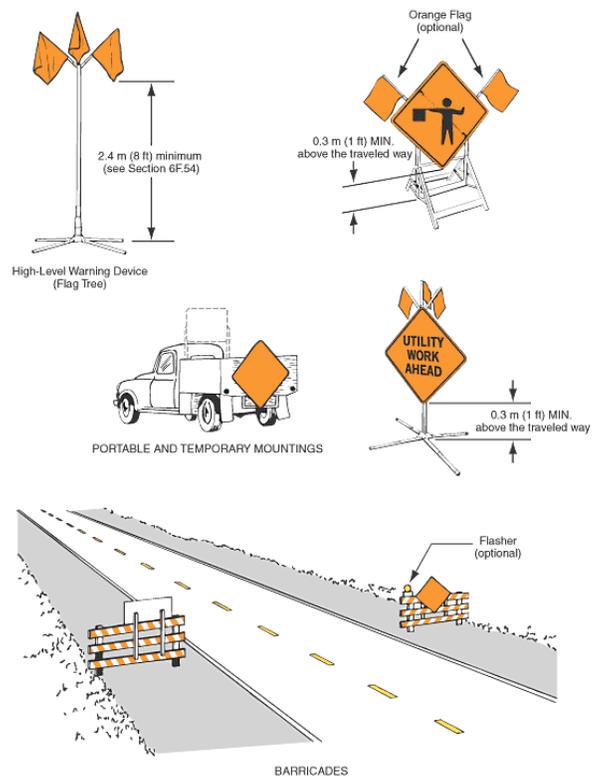
- Activities conducted in or near roadways will be barricaded and guarded.
  - Backed up trucks and work vehicles can provide an effective barrier for worker protection in the work zone. Trucks should be positioned between the working area and the flow of traffic. Be sure to allow enough space between the vehicle and the closest workers to prevent the vehicle from being pushed into workers if it is hit.

Traffic control devices will be installed before work begins in accordance with the U.S. Department of Transportation (USDOT) Manual on Uniform Traffic Control Devices (MUTCD), Chapter 6F, Temporary Traffic Control Zone Devices

(<http://mutcd.fhwa.dot.gov/hm/2003r1r2/part6/part6f1.htm>).

- The MUTCD defines traffic control devices as signs, signals, markings, and other devices used to regulate, warn, or guide road users, placed on, over, or adjacent to a street, highway, pedestrian facility, or bikeway.
- Traffic control devices used on street and highway construction, maintenance, utility, or incident management operations will conform to the MUTCD.
- Work site warning signs will be placed far enough from the work zone so that drivers will have time to read the messages and react before they reach the work area (see **Table 7-9**). On urban streets, the effective placement of the first warning sign should range from 4 to 8 times the speed limit with the high end of the range being used when speeds are relatively high. When a single advance warning sign is used (in cases such as low-speed residential streets), the advance warning area can be as short as 100 feet. When two or more advance warning signs are used on higher-speed streets, such as major arterials, the advance warning area should extend a greater distance. The distance from the work zone to the first sign is listed in column A. The distance from the first sign to the second is listed in column B. The distance from the second sign to the third is listed in column C (The third sign is the first one in a three-sign series encountered by a driver approaching a TTC zone).

Figure 6F-2. Methods of Mounting Signs Other Than on Posts



- Signs mounted on barricades, or other portable supports, will be no less than 1 foot above the traveled way (See MUTCD Figure 6F-2).
- Traffic cones can be used to guide and direct traffic around or through the work areas during daylight hours. The devices will be installed before the work begins. At least one advance warning sign will be used to explain the cones. Flags inserted in the top of the cones increase their visibility.
- Backed up and stationery vehicles and trucks can also serve as warning devices when equipped with flashing high intensity emergency lights (a revolving light or strobe light above the cab).
- During sampling activities, one person should function as a flagger to divert traffic while another collects the samples.
- Flaggers and work crew will wear high visibility vests.
- Site heavy equipment will have backup warning devices.

### **7.18.3 POWERED INDUSTRIAL TRUCKS (FORKLIFTS, ETC.)**

Powered industrial trucks includes fork trucks, tractors, platform lift trucks, motorized hand trucks, and other specialized industrial trucks powered by electric motors or internal combustion engines.

In accordance with OSHA CFR 1910.178(l), no employee is allowed to operate a powered industrial truck without receiving the proper training and certification. Refresher training is required every 3 years, when an employee is observed operating a powered industrial truck unsafely, an employee is operating a powered industrial truck and involved in an accident, the operator has received an evaluation that reveals that the operator is not operating the truck safely, the operator is assigned to drive a different type of truck, or a condition in the workplace changes in a manner that could affect safe operation of the truck.

## **7.19 CONTAMINATED SOIL REMOVAL/HAULING OPERATIONS**

During contaminated soil removal operations, a *Contaminated Soil Removal Plan* will be developed, where relevant, to address the following issues and submitted to the client PM before work commencement:

- |                         |                     |
|-------------------------|---------------------|
| ▪ Dust/vapor control    | ▪ Traffic control   |
| ▪ Excavation hazards    | ▪ Truck routing     |
| ▪ Hazardous atmospheres | ▪ Utility clearance |
| ▪ Chemical hazards      | ▪ Asbestos hazards  |

## 7.20 CONFINED SPACE ENTRY

See Section 9.0.

## 7.21 BIOLOGICAL HAZARDS

### 7.21.1 BLOOD-BORNE PATHOGENS

Workers may be at risk of developing various types of illnesses, such as the human immunodeficiency (HIV) and hepatitis B (HBV) and C (HCV) viruses, due to their exposure to blood-borne pathogens and other potentially infectious materials in the workplace.

Universal precautions, engineering, and work practice controls will be used to eliminate or minimize employee exposure. Universal precaution is the practice of treating bodily fluids as contaminated. Where occupational exposure remains after institution of these controls, PPE will also be used.

Trihydro will provide hand-washing facilities accessible to employees where feasible. When provision of hand-washing facilities is not feasible, Trihydro will provide an appropriate hand cleanser in conjunction with clean cloth/paper towels or antiseptic towelettes. When antiseptic cleansers or towelettes are used, hands will be washed with soap and running water as soon as feasible. Employees will wash their hands and other skin with soap and water, or flush mucous membranes with water immediately or as soon as feasible following contact of such body areas with blood or other potentially infectious materials.

Project sites will have on hand a blood-borne pathogen clean up kit and personnel should be trained before its use.

If field team members are exposed to body fluids, they will report the incident immediately to Trihydro's PM, who will fill out Trihydro's "Exposure Incident Report" found in **Appendix I**.

### 7.21.2 HANTAVIRUS

Hantavirus pulmonary syndrome (HPS) is a rare but serious, and often deadly, lung infection. Hantaviruses are found in rodents in different parts of the world where the Sin Nombre virus is carried by the deer mouse, the cotton rat, and perhaps other rodents common throughout North America. The Sin Nombre virus is passed to humans by saliva, urine, and droppings of infected rodents.

The best way to prevent HPS is to:

- Avoid contact with rodents and avoid inhaling dust that might be contaminated with rodent saliva, urine, or droppings.
- Use safety precautions when cleaning indoor or outdoor areas that might be contaminated with rodent saliva, urine, or droppings. Do not stir up and breathe dust. Before cleaning, wet down potentially contaminated areas with a disinfectant (such as bleach or alcohol). While cleaning, wear rubber gloves and disinfect them after use. Dust masks that cover the nose and mouth can also help.
- When participating in outside activities, stay clear of rodents and their burrows and nests. Open up and air out outbuildings before entering or cleaning. Remove garbage and trash before leaving.

### 7.21.3 HISTOPLASMOSIS

Although histoplasmosis is usually associated with bird and bat droppings, it actually is caused by a fungus. You can only get it by inhaling dust from decayed droppings or contaminated soil. Anyplace where bird or bat droppings have collected is a likely source of the “Histo” fungus. Prevention is the best solution for exposure.

- Avoid creating dust that will put the fungus in the air where it can be inhaled.
- Try not to disturb soil rich in bird droppings.
- When work requires the removal of contaminated soils, do so with wet sweeping and vacuuming with a high efficiency particulate air (HEPA) filter.
- Soil should be placed in heavy-duty plastic bags or other secure containers for disposal.

### 7.21.4 PSITTACOSIS

Psittacosis is an infectious disease in humans that has mild, non-specific, flu-like symptoms. Psittacosis refers to infections or diseases caused by *Chlamydia psittaci*, one of several microorganisms in the genus *Chlamydia*. This disease can be transmitted from infected birds, either wild or domestic birds or poultry, to humans.

Sick birds show signs of:

- Sleepiness
- Weight loss
- Diarrhea
- Shivering
- Breathing difficulties

Humans can become infected with *Chlamydia psittaci* by breathing in the organism when the urine, respiratory secretion, or dried feces of infected birds is aerosolized (i.e., dispersed in the air as very fine droplets or dust particles).

Other sources of exposure include mouth-to-beak contact, a bite from an infected bird, and handling the plumage and tissues of infected birds.

### **7.21.5 CHIGGERS**

Chiggers are most often found in low, damp areas where vegetation is heavy, although some species prefer dry areas. Chiggers seem to be most abundant in areas covered with shrubs and small trees where rodents are numerous. Chiggers occur in pockets or islands because a female will lay all her eggs in one spot. Chiggers may be a problem when working in grassy areas at project locations. The application of DEET can help prevent bites from these insects.

*WARNING: Do not apply DEET on flame-resistant clothing (FRC); it makes the clothing flammable. Use Pyrethrin on FRC.*

If a chigger bite is experienced, the bite should be washed with soap and water and then a commercial preparation of medication for chigger bites should be applied. The clothes that were worn when the bite(s) occurred should be placed in a plastic bag for temporary storage until they can be laundered.

### **7.21.6 STINGING INSECTS**

Stinging insects are limited to the order Hymenoptera, which includes wasps, bees, and ants where only females can sting. Social hymenopterans, including yellow jackets, bumble bees, honey bees, and fire ants have individuals in the colony whose task it is to defend the nest. If the nest is disturbed, these individuals will defend it vigorously. In addition, foraging members of the colony will also sting if they are disturbed or injured as they go about their activities. Some, such as the yellow jacket, are much more liable to attack than others.

#### **7.21.6.1 SINGLE STINGS**

The body responds to the venom of stings with redness and swelling at the sting site. The area is quite likely to itch. Oral and topical antihistamines should help prevent or reduce the itching and swelling. Try not to rub or scratch the sting site, because microbes from the surface of the skin could be introduced into the wound and result in an infection.

If the stinger remains in the skin, remove it as quickly as possible, because venom continues to enter the skin from the stinger for 45 to 60 seconds following a sting. If removed within 15 seconds of the sting, the severity of the sting is reduced. After the stinger is removed, wash the wound and treat it with an over-the-counter products or simply a cold compress to alleviate the pain. Aerosol or cream antihistamine preparations that contain a skin coolant can also help.



If the sting is followed by severe symptoms, or if it occurs on the neck or mouth, seek medical attention immediately because swelling in these areas of the body can cause suffocation.

#### **7.21.6.2 MULTIPLE STINGS**

Occasionally, a person becomes involved in a situation where he or she is stung many times before being able to flee. Humans can be killed if stung enough times in a single incident. Honeybees' toxic dose is estimated to be 8.6 stings per pound of body weight.

#### **7.21.6.3 RENAL INSUFFICIENCY**

A potentially life-threatening result of multiple stings may occur days after the incident where the kidneys become clogged and the patient is in danger of dying from kidney failure. It is important for persons who have received many stings at one time to discuss this secondary effect with their doctors. Patients should be monitored for a week or two following an incident involving multiple wasp or bee stings.

#### **7.21.6.4 ANAPHYLAXIS**

A small percentage of the population is allergic to wasp or bee stings. Allergic reactions to bee and wasp stings can develop anywhere on the body and may include non-life-threatening reactions such as hives, swelling, nausea, vomiting, abdominal cramps, and headaches. Life-threatening reactions such as shock, dizziness, unconsciousness, difficulty in breathing, and laryngeal blockage resulting from swelling in the throat require immediate medical care. Symptoms can begin immediately following the sting or up to 30 minutes later and may last for hours.

Anaphylaxis, if treated in time, usually can be reversed by the effects of epinephrine (adrenaline) injected into the body. Individuals who are aware that they are allergic to stings should notify the PM and carry epinephrine in either a normal syringe (sting kit) or in an auto-injector (Epi-Pen<sup>®</sup>) whenever they think they may encounter stinging insects.

#### **7.21.6.5 AFRICANIZED HONEY BEES**

Africanized honeybees look nearly identical to the European honeybees.

Africanized bees defend their colonies more vigorously than do European bees. The colonies are easily disturbed (sometimes just by being nearby). When they do sting, many more bees may participate. Once disturbed, Africanized honeybees will continue to attack for a long distance.

Africanized bees:

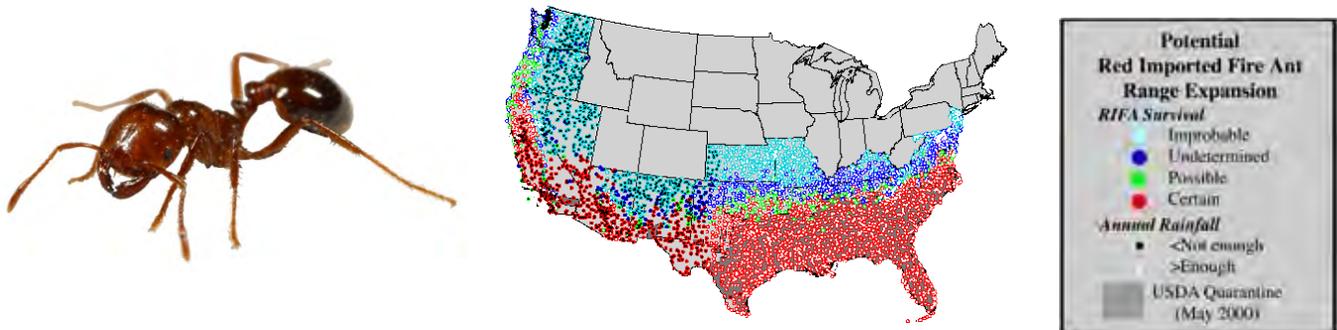
- Respond quickly and sting in large numbers
- Can sense a threat from people or animals 50 feet or more from nest
- Sense vibrations from power equipment 100 feet or more from nest
- Will pursue an enemy ¼ mile or more
- Swarm frequently to establish new nests
- Nest in small cavities and sheltered areas



### 7.21.7 FIRE ANTS

The red imported fire ant (RIFA) is an invasive species of insect. The ant is distinguished by its ten-segmented antennae, which have two-segmented clubs. The ants range from reddish-brown to dark brown in color and from 3 to 6 mm in length.

Human health problems arise as a result of people being stung by RIFA. RIFA stings usually result in the formation of a white pustule, which takes 10 days to heal. If the pustule ruptures before healing, the wound and surrounding area may become infected. Sensitive individuals may have an allergic reaction to the stings, perhaps resulting in anaphylactic shock or, in extreme cases, death.



### **7.21.8 LYME DISEASE (TICKS)**

Tick-borne pathogens present a significant field hazard and in some areas account for many serious field incidents. These procedures should be applied during field activities – even in areas that are predominantly paved but with bordering vegetation.

#### **7.21.8.1 HAZARD CONTROL**

The methods for controlling exposure to ticks include, in order of most preferred to least:

- Avoiding tick habitats and ceasing operations in heavily infested areas.
- Reducing tick abundance through habitat disruption or application of acaricide.
- Personal protection through use of repellants and protective clothing.
- Frequent tick inspections and proper hygiene.

#### **7.21.8.2 FIRST AID AND MEDICAL TREATMENT**

Tick bites should be treated with first aid. Clean and wash hands and disinfect the bite site after removing embedded tick by use of tweezers. Consult a healthcare professional if infection or symptoms and effects of tick-borne illnesses develop (“target” or “bull’s eye rash”).

#### **7.21.8.3 TICK IDENTIFICATION**

There are four varieties of hard-bodied ticks that have been associated with tick-borne pathogens. These tick varieties include: Deer (Black-Legged) Tick; Lone Star Tick; Dog Tick; and Rocky Mountain Wood Tick.

The following ticks can be considered a hazard at the project site:



Deer Tick (Range in Green)



Lone Star Tick (Range in Green)



Dog Tick (Range in Yellow)



Rocky Mountain Wood Tick (Range in Yellow)

### 7.21.9 WEST NILE VIRUS

The West Nile virus (WNV) is a virus transmitted by mosquitoes to other animals normally through a mosquito bite. The most likely route of WNV infection to humans is through the bite of an infected mosquito. It is recommended that workers use standard infection control precautions when working with humans or animals suspected or known to be infected with WNV. Also follow standard infection control procedures when handling sick or dead animals.

Most human WNV infections cause either no symptoms or a mild, flu-like illness. The most severely affected patients may develop an inflammation of the brain called encephalitis. These severe cases are very rare in humans. Persons over age 50 are at higher risk of severe illness following infection.

### 7.21.10 SNAKES

There are four common species of poisonous snakes in the United States: Copperhead, Coral Snake, Cottonmouth, and Rattle Snake. To see a list of snakes found in the project site state, see **Appendix J**.



### Copperhead

Chestnut color dominates overall, with darker cross-bands of rich browns that become narrower on top and widen at the bottom. The top of the head is a coppery color. *Eastern Gulf States, Texas, Arkansas, Maryland, North Florida, Illinois, Oklahoma, Kansas, Ohio, New York, Alabama, Tennessee, and Massachusetts.*



### Coral Snake

Beautifully marked with bright blacks, reds, and yellows. To identify the species, remember that when red touches yellow it is a coral snake. *Southeast North Carolina, Gulf States, west central Mississippi, Florida, Florida Keys, and west to Texas. Another genus of coral snake is found in Arizona.*



### Cottonmouth

Colors are variable. Adults are uniformly olive brown or black. The young and sub-adults are strongly cross banded with dark brown. *All Gulf states, Southeast Virginia, west central Alabama, south Georgia, Illinois, east central Kentucky, south central Oklahoma, Texas, North and South Carolina, Florida, and the Florida Keys.*



### Rattle Snake

2 types call the US home - the eastern and western diamondback. The Western Diamondback is shown and has a darker color. *The western diamondback resides in Southeast California, Oklahoma, Texas, New Mexico, and Arizona while the eastern diamondback resides in Coastal areas of North Carolina, South Carolina, Louisiana and Florida*

## 7.21.10.1 PREVENTING SNAKE BITES

Follow these simple rules to reduce the chance of accidental snakebite:

- Do not put your hands into dark places, such as rock crevices, heavy brush, or hollow logs, without first investigating.
- Do not step over a fallen tree. Step on the log and look to see if there is a snake resting on the other side.
- Do not walk through heavy brush or tall grass without looking down. Look where you are walking.
- Wear snake gators – a thick wrap that protects the lower leg.

## 7.21.10.2 EMERGENCY RESPONSE

Venomous snake bites should be considered life-threatening. When someone has been bitten by a venomous snake, time is of the essence. If possible, call ahead to the emergency room so anti-venom can be ready when the victim arrives. Do the following:

- Seek medical help immediately by contacting WorkCare™ Incident Intervention for assistance at (888) 449-7787.
- Keep the victim calm, restrict movement, and keep the affected area below heart level to reduce the flow of venom.

- Remove rings or constricting items; the affected area will swell.
- Wash the bite area with soap and water.
- Cover the bite with clean, moist dressing to reduce swelling and discomfort.
- Monitor the vital signs (pulse, temperature, breathing, blood pressure) of the victim. If there are signs of shock, lay the victim flat and cover with a warm blanket.
- **DO NOT** apply a tourniquet.
- **DO NOT** apply a cold compress to the bite area.
- **DO NOT** cut into the bite.
- **DO NOT** give the victim stimulants or pain medications unless instructed by a medical physician.
- **DO NOT** give the victim anything by mouth.
- **DO NOT** raise the bite area above the level of the victim's heart.
- **DO NOT** try to suction the venom—doing so may cause more harm than good.

### 7.21.11 SPIDERS

Only a few spiders are dangerous to humans with the two problematic spiders in the United States being the Brown Recluse and Black Widow spiders. Bites from spiders may feel like a pinprick and may not even be noticed, but within hours, swelling at the site and breathing problems may occur. Emergency help should be immediately sought. A cloth dampened with cold water or filled with ice may be applied to the bite while awaiting help.

#### 7.21.11.1 BROWN RECLUSE (LOXOSCELES RECLUSA)

It is usually between ¼ in and ¾ in, but may grow larger. It is brown and sometimes an almost deep yellow color and usually has markings on the dorsal side of its cephalothorax, with a black line coming from it that looks like a violin with the neck of the violin pointing to the rear of the spider, resulting in the nickname "fiddleback spider" or "violin spider". Coloring varies from light tan to brown and the violin marking may not be visible.



Most bites are minor with no necrosis (tissue damage). However, a small number of bites produce severe dermonecrotic lesions (skin tissue damage), and, sometimes, severe systemic symptoms, including organ damage. Rarely, the bite may also produce a systemic condition with occasional fatalities. A minority of brown recluse spider bites form a necrotizing ulcer that destroys soft tissue and may take months to heal, leaving deep scars.

First aid involves the application of an ice pack to control inflammation, the application of aloe vera to soothe and help control the pain, and prompt medical care.

### 7.21.11.2 BLACK WIDOW (LATRODECTUS SPP)

Adult female black widow spiders are gloss black with an hourglass shaped marking on the underside of its abdomen which is red and male black widow spiders' hourglass color is yellow to white to various shades of orange and red. A large female black widow spider can grow to about 1.5 inches, counting leg span. Male black widow spiders are half the size of the female or smaller (third picture from left). They have longer legs and a smaller abdomen in relation to their body size. They are also usually dark brown with varying colors of stripes/dots, with no hourglass mark. Adult males can be distinguished from juvenile females by their more-slender body, longer legs, and large pedipalps (second pair of appendages) typical of most other male spiders.



Female Black Widow



Female Black Widow



Male Black Widow



Black Widow Nest

Although their venom is extremely potent, (15 times more potent than that of the rattlesnakes), these spiders are not especially large. When the venom is diffused throughout the body of a healthy, mature human, it usually does not amount to a fatal dose, though it can produce the very unpleasant symptoms of latrodectism (abdominal muscle pain and spasms). Deaths in healthy adults from *Latrodectus* bites are relatively rare.

### 7.21.12 SCORPIONS

Scorpions are venomous arthropods of the class Arachnida and are considered relatives of the spiders, mites, ticks, and harvestmen. There are approximately 1,300 species of scorpions worldwide, characterized by an elongated body and a segmented tail that is tipped with a venomous stinger.

Despite their bad reputation, only one species in the United States, the *Centruroides exilicauda* (Arizona bark scorpion), have venom potent enough to be considered dangerous to humans. It is found over much of Arizona, areas of California, Nevada, New Mexico, Utah in the U.S., and northwestern Mexico.

The venom of this scorpion may produce a painful, tingling, burning sensation at the sting site. Serious reaction may produce numbness, difficulty swallowing, a thick tongue, blurred vision, roving eye movements, seizures, salivation, and difficulty breathing. Death may occur.

#### 7.21.12.1 TREATMENT

- Wash the sting with soap and water and remove all jewelry.
- Apply cool compresses.
- Acetaminophen (Tylenol) 1-2 tablets every 4 hours may be given to relieve pain. Avoid aspirin and ibuprofen (Advil, Motrin).
- Antibiotics are not helpful.
- Do not cut into the wound or apply suction.
- Seek medical care



#### 7.21.13 POISON OAK/IVY/SUMAC

Reaction to poisonous shrubs is an allergic response and ranges from no reaction to a severe “rhus” dermatitis. Rhus is the class of poisonous plants which also includes poison ivy and poison sumac, mango, and other urushiol containing plants.

Shrubs are usually 12" to 30" high, or a tree-climbing vine, with triple leaflets and short, smooth hair underneath. Early berries are fuzzy and white; later, dun-colored. Plants are red and dark green in spring and summer with yellowing



leaves anytime, especially in dry areas. Leaves may achieve bright reds in fall, but the plant loses its (yellowed, then brown) leaves in winter, leaving toxic stems. All parts of the plant remain toxic throughout the seasons.

Primary contamination results from contact with bruised or broken plant parts that release "toxicodendrol," an oily resin containing the toxic chemical "urushiol."



Poison Ivy



Poison Sumac



Poison Oak

The best way to prevent exposure is to recognize the plants and avoid working in areas where poisonous shrubs are present. If you will work in areas with poisonous shrubs, contact your PSHSO to determine the best procedures to prevent contamination.

#### 7.21.13.1 FIRST AID

If there is exposure, use the following first aid procedures or others you may find to alleviate the pain and itch.

- Keep your hands away from your eyes, mouth, and face
- Do not scratch or rub the rash
- Apply one of these to the skin rash:
  - Calamine (not Caladryl) lotion
  - Zinc oxide ointment
  - Paste made with baking soda - mix 3 teaspoons of baking soda with 1 teaspoon of water
- Take an over-the-counter antihistamine such as Benadryl, as stated on the label

If self-care/first aid measures do not bring relief, or for extreme cases of exposure, contact your doctor.

#### **7.21.14 RABIES**

Rabies is a deadly disease caused by a virus that attacks the central nervous system of warm-blooded animals (mammals). Once symptoms appear, rabies is almost fatal. If left untreated, rabies is fatal to humans.

Mammals can carry rabies, but wild animals carry the highest risk of being rabid. Skunks, raccoons, foxes, and bats are the most common carriers. Beavers, rabbits, chipmunks, squirrels, rats, and mice are less likely to be rabid. Rabies is spread from an infected animal to another animal or person by saliva. This could happen through biting, contact with an open wound, or contact with a mucus membrane (mouth, nasal cavity, eyes).

If you are bitten or scratched by an animal or get saliva from a rabies-suspect animal into an open wound or onto a mucous membrane, wash the wound thoroughly with soap and water, seek medical attention immediately, and call Animal Control. If the animal is killed or found dead, preserve it by refrigeration as soon as possible. Report bites to the Public Health Department and Work Care immediately. Disinfect surfaces contaminated with tissues or fluids from a rabies-suspect animal with 10 percent solution of household bleach in water (1 part bleach to 9 parts water).

#### **7.21.15 ALLIGATORS**

These reptiles occupy freshwater swamps and marshes, rivers, lakes and smaller bodies of water in the southeastern states of Alabama, Arkansas, North and South Carolina, Florida, Georgia, Louisiana, Mississippi, Oklahoma, and Texas. They can also tolerate a reasonable degree of salinity and are occasionally found in brackish water around mangrove swamps.

A bite could result in serious infection as the mouth is awash with bacteria. Regardless of how minor a bite appears, consult a physician immediately.

To keep safe, alligator specialists offer these tips:

- Never feed an alligator. Most problem gators have been fed, which causes them to lose their fear of people.
- When in alligator habitat, stay alert, particularly at key feeding times near dawn and dusk.
- Don't swim or wade if possible. If you have to, be sure to scan the water carefully for lurking gators. They can look like logs floating just under the surface.
- When boating, don't dangle arms or legs in the water.



- Stay at least 35 feet from an alligator on land; they can move quickly.
- Do not disturb babies or nests, which look like big mounds; mother alligators closely guard their nests.

## 8.0 DECONTAMINATION PROCEDURES

- As a tenant on a Montana Department of Environmental Quality site, an evaluation was conducted to determine the potential for hazardous substance contamination during Trihydro tasks at this site. That evaluation indicates that ***there is no potential*** of contamination of a sufficient quantity to require decontamination planning, equipment, and procedures outlined in 29 CFR 1910.120. For that reason, no decontamination program is implemented at this site. Employee training on how to respond and take protective measures during incidental releases of hazardous substances are provided consistent with the Hazard Communication Standard, 29 CFR 1910.1200.
- As a tenant on a Montana Department of Environmental Quality site, an evaluation was conducted to determine the potential for hazardous substance contamination during Trihydro tasks at this site. That evaluation indicates that ***there is a potential*** of contamination of a sufficient quantity to require decontamination planning, equipment, and procedures.

In compliance with 29 CFR 1910.120(b)(4)(ii)(G) and 1910.120(k), the decontamination chapter of the HASP describes how personnel and equipment are decontaminated when they leave the Exclusion Zone. This chapter also describes how residual waste from decontamination processes is disposed. Decontamination procedures are designed to achieve an orderly, controlled removal or neutralization of contaminants that may accumulate on personnel or equipment. These procedures minimize worker contact with contaminants and protect against the transfer of contaminants outside designated work zones. They also extend the useful life of PPE by reducing the amount of time that contaminants contact and permeate PPE surfaces. The decontamination procedures described below are designed to meet the requirements of 1910.120(k) and include project-specific information about:

- The location and type of project decontamination facilities
- General and specific decontamination procedures for personnel and PPE
- General and specific decontamination procedures for equipment
- Disposal of residual waste from decontamination
- The monitoring procedures used to evaluate the effectiveness of decontamination

The PSHSO is responsible for the oversight and implementation of project decontamination procedures and is responsible for validating their effectiveness.

## 8.1 EFFECTIVENESS OF DECONTAMINATION

The PSHSO is responsible for monitoring the effectiveness of decontamination procedures either through swipe testing, lab analysis, or both.

## 8.2 DECONTAMINATION FACILITIES

Decontamination is conducted in the CRZ. The CRZ acts as a buffer between the Exclusion Zone and the Support Zone. The location and design of decontamination stations minimize the spread of contamination beyond these stations. Separate facilities are used for personnel and for equipment. A decontamination location will be established in a geographical area that will minimize the exposure of uncontaminated employees or equipment to contaminated employees or equipment. It is recommended to establish a primary and secondary decontamination area based on terrain, site facilities, and environmental factors such as wind.

In general, items entering the Exclusion Zone on the site will either be decontaminated or properly discarded upon exit from the Exclusion Zone. Personnel will enter and exit the Exclusion Zone through the decontamination area. Before demobilization, contaminated equipment will be decontaminated and inspected by the Trihydro PM, or designate, before it is moved into the Support Zone. Materials that are generated by decontaminated procedures will be stored in a designated area in the Exclusion Zone until disposal arrangements are made.

## 8.3 PERSONNEL DECONTAMINATION

The Trihydro PSHSO will monitor decontamination procedures to determine their effectiveness, will verify the appropriate use of PPE, and staff have been sufficiently trained in decontamination procedures.

- Based on the nature of the hazards and duration of work, showers, and change rooms requirements outlined in 29 CFR 1910.141 *are not necessary and are not provided for workers.*
- Based on the nature of the hazards and/or duration of work, showers, and change rooms consistent with the requirements of 29 CFR 1910.141 *are provided for workers.*

The following are general decontamination procedures established and implemented during this project:

- Decontamination is required for workers exiting a contaminated area. Personnel may re-enter the Support Zone only after undergoing the decontamination procedures described in the next section.



- Used protective clothing is decontaminated, cleaned, laundered, maintained, and/or replaced as needed to verify its effectiveness.
- PPE that requires maintenance or parts replacement is decontaminated before repairs or service.
- PPE is decontaminated or prepared for disposal on the premises. Personnel who handle contaminated equipment have been trained in the proper means to do so to avoid hazardous exposure.
- Workers are required and trained to immediately exit the work zone, perform applicable decontamination procedures, shower, and change into uncontaminated clothing if their permeable clothing is splashed or becomes wetted with a hazardous substance.
- Procedures for decontamination waste disposal meet applicable local, state, and federal regulations.

### **8.3.1 STEPS FOR DECONTAMINATION**

#### ***Station 1 Equipment Drop***

Deposit equipment used on-site on plastic drop cloths. These items will be decontaminated or discarded as waste before removal from the Exclusion Zone.

#### ***Station 2 Outer Boot and Outer Glove Wash and Rinse***

Scrub outer boots (if utilized) and outer gloves with decontamination solution or detergent water. Rinse off using water.

#### ***Station 3 Outer Boot and Glove Removal***

Remove outer boots (or boot covers) and gloves. If disposable, deposit in a container with plastic liner. If non-disposable, place in a clean dry place.

#### ***Station 4 Respiratory Protection Removal***

Remove hard hat and respirator face-piece and deposit on a clean surface. Air purifying cartridges will be discarded daily, if appropriate. Wash and rinse respirator at least daily. Wipe off and store respiratory gear in a clean dry location.

#### ***Station 5 Inner Glove Removal***

Remove inner gloves. Deposit in container for disposal.

### ***Station 6 Protective Clothing Removal***

Protective cotton coveralls will be placed in a marked container for cleaning as needed. Tyvek or poly-coated coveralls will be deposited in a container with a plastic liner that is properly marked.

### ***Station 7 Field Wash***

- Thoroughly wash hands, forearms and face with biodegradable soap and water.
- Eating, drinking or practices that increase the probability of hand to mouth transfer and/or ingestion of materials is prohibited in areas where the possibility of contamination exists and is permitted only in the designated break area. Personnel will not wear or bring dirty/contaminated clothing into the clean support area.

## **8.4 EQUIPMENT DECONTAMINATION**

Tools, equipment, and machinery from the Exclusion Zone or CRZ are decontaminated in the CRZ before removal to the Support Zone. Equipment decontamination procedures are designed to minimize the potential for hazardous skin or inhalation exposure, cross-contamination, and chemical incompatibilities.

The following are general equipment decontamination procedures established and implemented during this project.

### **8.4.1 GENERAL EQUIPMENT DECONTAMINATION PROCEDURES**

- Equipment in the Exclusion Zone that can be used again, that is still operable, and that will not pose an increased exposure hazard during re-use is left in Exclusion Zone until it is no longer needed. This eliminates unnecessary decontamination and reduces the potential for physical transfer of contaminants outside the Exclusion Zone.
- Decontamination is required for equipment exiting a contaminated area. Equipment may re-enter the Support Zone only after undergoing equipment decontamination procedures.
- Equipment that is transported regularly between the contaminated and clean areas of the facility (e.g., monitoring equipment) is carefully decontaminated each time it is removed from the Exclusion Zone and the effectiveness of decontamination is monitored to reduce the likelihood that contamination will be spread outside designated work zones.
- Equipment that cannot be successfully decontaminated is disposed of as hazardous waste.

## **8.5 DISPOSITION OF DECONTAMINATION WASTES**

Equipment used for decontamination will be decontaminated or disposed of with the established waste streams. Established waste streams are those specified in the work plan. Discarded clothing (PPE) will be disposed of along with the waste streams.

## **8.6 EMERGENCY DECONTAMINATION**

Site personnel who are contaminated and need medical treatment will be decontaminated before being transported to a medical facility if decontamination does not delay life-saving treatment or aggravate the injury.

When emergency decontamination is performed, contaminated protective clothing and equipment is washed, rinsed, and/or cut off. If an emergency victim is grossly contaminated with extremely toxic or corrosive material, the victim will be wrapped in blankets, plastic, or rubber to reduce potential exposure to other personnel.

Offsite medical treatment personnel will be alerted to the chemicals and hazards to which a victim has been potentially exposed. This will be done by sending relevant MSDSs/SDSs and other applicable hazard data with the victim or by having the victim accompanied by personnel who are familiar with the incident and the hazards.

## 9.0 CONFINED SPACE ENTRY PROCEDURES

Confined spaces ("non-permit confined space") are defined as meeting *all of the following*:

- Is large enough and so configured that an employee can bodily enter and perform assigned work.
- Has limited or restricted means for entry or exit.
- Is not designed for continuous employee occupancy.

Some Montana Department of Environmental Quality sites may view certain boating operations as confined spaces; coordinate with a client site representative before conducting boating activities.

A Permit Required Confined Space ("permit space") is defined as a confined space that has one or more of the following characteristics:

- Contains or has a potential to contain a hazardous atmosphere that is defined as:
  - Having flammable gas, vapor, or mist in excess of 10 percent of its lower flammable limit (LFL).
  - An airborne combustible dust at a concentration that meets or exceeds its LFL.
  - An atmospheric oxygen concentration below 19.5 percent or above 23.5 percent.
  - An atmospheric concentration of substances for which could result in employee exposure in excess of its dose or PEL.
  - Other atmospheric condition that is immediately dangerous to life or health.
- Contains a material that has the potential for engulfing an entrant.
- Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section.
- Contains other recognized serious safety or health hazard.

Confined spaces are initially considered "permit required" until an evaluation is conducted using the Trihydro "Confined Space Evaluation Form." No individual is allowed to enter a confined space, serve as an attendant outside of a confined space, or other confined space duties without proper training. Training requirements can be found in the OSHA CFR 1910.146(g).



## 9.1 CONFINED SPACE OPERATIONS

Confined space operations require:

- Initial evaluation to determine if the space is a permit-required confined space
- Barricades to prevent unauthorized entry and to eliminate fall hazards
- Objects will be kept away from the opening edge to prevent falling object hazards

## 9.2 PERMIT-REQUIRED CONFINED SPACE OPERATIONS

In addition, permit-required confined space operations require:

- Coordination with the client site administrative and emergency response personnel.
- Identify and evaluate hazards.
- Develop and implement the means, procedures, and practices necessary for safe permit space entry operations.
- Verify appropriate training for those conducting permit-required confined space operations.
- Complete line-breaking, blanking, or LOTO.
- Complete a permit and maintain required documentation at the permit space to include authorized entrant logs. The client's permit has precedence over the Trihydro permit.
- Perform atmospheric testing.
- Purging, inerting, flushing, or ventilating the permit space as necessary to eliminate or control atmospheric hazards.
- Provide the attendant with air monitoring equipment.
- Provide pedestrian, vehicle, or other barriers as necessary to protect entrants from external hazards.
- Verify conditions in the permit space are acceptable for entry throughout the duration of an authorized entry.
- Verify rescue services are available and current on annual training. ***If rescue services respond to another site, the permit-required confined space operations will cease until rescue services has been re-established.***
- Establish adequate communications with rescue services and entrants.
- Provide emergency rescue equipment if not provided by rescue services.
- Providing appropriate PPE.

- Provide adequate illumination.
- Provide equipment for safe entry and egress.

Upon completion of permit-required confined space operations, staff will be accounted for, permit space entrances will be properly closed, the client and rescue services notified, and the permit and associated documentation completed and kept on file for 1 year.

## 10.0 SPILL CONTAINMENT PROGRAM

### 10.1 RESULTS OF EVALUATION FOR POTENTIAL SPILLS

As a tenant on the client site, an evaluation was conducted to determine there is a potential for hazardous substance spills of Trihydro hazardous materials at this site. That evaluation indicates that *there is no potential for a hazardous substance spill of a sufficient quantity* to require containment planning, equipment, and procedures.

As a tenant on the client site, an evaluation was conducted to determine there is a potential for hazardous substance spills of Trihydro hazardous materials at this site. That evaluation indicates that *there is a potential for a hazardous substance spill of a sufficient quantity* to require containment planning, equipment, and procedures. For that reason, a spill containment program is implemented at this site. Employee training on how to respond and take protective measures during incidental releases of hazardous substances are provided consistent with the Hazard Communication Standard, 29 CFR 1910.1200.

### 10.2 TRIHYDRO OWNED HAZARDOUS MATERIALS SPILL PLAN

In the event Trihydro personnel introduce hazardous materials onto the project site, or obtain responsibility of a hazardous materials inventory through the project, in accordance with OSHA 29 CFR 1910.120(j)(1)(viii), Handling Drums and Containers, a spill control kit, capable of handling the entire anticipated amount of hazardous materials, will be available on-site for use in the event of the uncontrolled release of materials considered potentially hazardous to site personnel, the community, or the environment. The spill control kit is considered a temporary provision to be used by site personnel to control the spread of contamination. The spill kit should be used by personnel only if they are properly protected from exposure to the spill constituents and trained on the use of the kit.

During project planning, the nearby populace exposure needs to be taken into consideration. Depending on the daily influences, such as wind direction and speed, community activities such as parades or school activities, the daily tasks need to be evaluated for possible community exposure in the event of a spill. These issues, with corrective actions, will be discussed in the daily safety briefing before work commencement.

## TABLES

TABLE 5-1. CRITERIA FOR SELECTION OF PERSONAL PROTECTION LEVEL

Protection Level	Equipment	Protection Provided	Should Be Used When	Limiting Criteria
<p><b>A</b></p>	<p><b>RECOMMENDED:</b></p> <ul style="list-style-type: none"> <li>▪ Pressure demand, full facepiece SCBA or pressure demand supplied air respirator with escape SCBA</li> <li>▪ Fully encapsulating chemical-resistant suit</li> <li>▪ Inner chemical-resistant gloves</li> <li>▪ Chemical resistant safety boots/shoes</li> <li>▪ Two way radio communications</li> </ul> <p><b>OPTIONAL:</b></p> <ul style="list-style-type: none"> <li>▪ Cooling unit</li> <li>▪ Coveralls</li> <li>▪ Long cotton underwear</li> <li>▪ Hard hat</li> <li>▪ Disposable gloves and boot covers</li> </ul>	<p>The highest available level of respiratory, skin, and eye protection.</p>	<p>The chemical substance has been identified and requires the highest level of protection for skin, eyes, and the respiratory system based on either:</p> <ol style="list-style-type: none"> <li>1. Measured (or potential for) high concentration of atmospheric vapors, gases, or particles</li> </ol> <p style="text-align: center;">Or</p> <ol style="list-style-type: none"> <li>2. Site operations and work functions involving a high potential for splash, immersion, or exposure to unexpected vapors, gases, or particulates of materials that are harmful to skin or capable of being absorbed through the intact skin.</li> </ol> <p>Substances with a high degree of hazard to the skin are known or suspected to be present, and skin contact is possible.</p> <p>Operations must be conducted in confined, poorly ventilated areas until the absence of conditions requiring Level A protection is determined.</p>	<p>Fully encapsulating suit material must be compatible with the substances involved.</p>

TABLE 5-1. CRITERIA FOR SELECTION OF PERSONAL PROTECTION LEVEL (cont.)

Protection Level	Equipment	Protection Provided	Should Be Used When	Limiting Criteria
<b>B</b>	<p><b>RECOMMENDED:</b></p> <ul style="list-style-type: none"> <li>▪ Pressure demand, full facepiece SCBA or pressure demand supplied air respirator with escape SCBA</li> <li>▪ Chemical-resistant clothing (overalls and long-sleeved jacket; hooded, one- or two-piece chemical splash suit; disposable chemical resistant one piece suit)</li> <li>▪ Inner and outer chemical resistant gloves</li> <li>▪ Chemical resistant safety-boots/shoes</li> <li>▪ Hard hat</li> <li>▪ Two way radio communication</li> </ul> <p><b>OPTIONAL:</b></p> <ul style="list-style-type: none"> <li>▪ Coveralls</li> <li>▪ Disposable boot covers</li> <li>▪ Face shield</li> <li>▪ Long cotton underwear</li> </ul>	<p>The same level of respiratory protection but less skin protection than Level A. It is the minimum level recommended for initial site entries until the hazards have been further identified.</p>	<p>The type and atmospheric concentration of substances have been identified and require a high level of respiratory protection, but less skin protection. This involves atmospheres:</p> <ol style="list-style-type: none"> <li>1. With IDLH concentrations of specific substances that do not represent a severe skin hazard</li> </ol> <p style="text-align: center;">Or</p> <ol style="list-style-type: none"> <li>2. Do not meet the criteria for use of air-purifying respirators                             <ul style="list-style-type: none"> <li>▪ Atmosphere contains less than 19.5 percent oxygen.</li> <li>▪ Presence of incompletely identified vapors or gases is indicated by direct-reading organic vapor detection instrument, but vapors and gases are not suspected of containing high levels of chemicals harmful to skin or capable of being absorbed through the intact skin.</li> </ul> </li> </ol>	<p>Use only when the vapor or gases present are not suspected of containing high concentrations of chemicals that are harmful to skin or capable of being absorbed through the intact skin.</p> <p>Use only when it is highly unlikely that the work being done will generate either high concentrations of vapors, gases, or particulates, or splashes of material that will affect exposed skin.</p>

TABLE 5-1. CRITERIA FOR SELECTION OF PERSONAL PROTECTION LEVEL (cont.)

Protection Level	Equipment	Protection Provided	Should Be Used When	Limiting Criteria
<p><b>C</b></p>	<p><b>RECOMMENDED:</b></p> <ul style="list-style-type: none"> <li>▪ Full facepiece, air purifying, canister-equipped respirator</li> <li>▪ Chemical-resistant clothing (overalls and long-sleeved jacket; hooded, one- or two-piece chemical splash suit; disposable chemical resistant one piece suit)</li> <li>▪ Inner and outer chemical resistant gloves</li> <li>▪ Chemical resistant safety boots/shoes</li> <li>▪ Hard hat</li> <li>▪ Two way radio communication</li> </ul> <p><b>OPTIONAL:</b></p> <ul style="list-style-type: none"> <li>▪ Coveralls</li> <li>▪ Disposable boot covers</li> <li>▪ Face shield</li> <li>▪ Escape mask</li> <li>▪ Long cotton underwear</li> </ul>	<p>The same level of skin protection as Level B, but a lower level of respiratory protection.</p>	<p>The atmospheric contaminants, liquid splashes, or other direct contact will not adversely affect any exposed skin.</p> <p>The types of air contaminants have been identified, concentrations measured, and a canister is available that can remove the contaminant.</p> <p>All criteria for the use of air-purifying respirators are met.</p>	<p>Atmospheric concentration of chemicals must not exceed IDLH levels</p> <p>The atmosphere must contain at least 19.5 percent oxygen</p>

TABLE 5-1. CRITERIA FOR SELECTION OF PERSONAL PROTECTION LEVEL (cont.)

Protection Level	Equipment	Protection Provided	Should Be Used When	Limiting Criteria
<b>D</b>	<p><b>RECOMMENDED:</b></p> <ul style="list-style-type: none"> <li>▪ Coveralls</li> <li>• Safety boot/shoes</li> <li>• Safety glasses or chemical splash goggles</li> <li>• Hard hat</li> </ul> <p><b>OPTIONAL:</b></p> <ul style="list-style-type: none"> <li>▪ Gloves</li> <li>▪ Escape mask</li> <li>• Face shield</li> </ul>	<p>No respiratory protection</p> <p>Minimal skin protection.</p>	<p>The atmosphere contains no known hazard</p> <p>Work functions preclude splashes, immersion, or the potential for unexpected inhalation or contact with hazardous levels of any chemicals.</p>	<p>This level should not be used in the exclusive Zone.</p> <p>The atmosphere must contain at least 19.5 percent oxygen.</p>

**TABLE 5-2. PERSONAL PROTECTIVE EQUIPMENT (PPE) SELECTION**

Task	Personnel	Respirator	Tyvek Coveralls <sup>1</sup>	Protective Gloves	Chemical-Resistant Gloves <sup>2</sup>	Chemical-Resistant Boots <sup>2</sup>	Safety Glasses	Chemical Goggles or Face Shield <sup>3</sup>	Ear Plugs/ Muffs	Hard Hat <sup>4</sup>
Excavation and Drilling Operations in Contaminated Soils	Contractor Crew	Available for use	Yes <sup>5</sup>	Industrial Work Gloves	Yes	Yes	Yes	Available for use	Yes	Yes
	Engineer/ Chemist	Available for use	Available for use	Industrial Work Gloves	Available for use	Yes	Yes	Available for use	Yes	Yes
	Surveyors	Available for use	Available for use	Industrial Work Gloves	Available for use	Yes	Yes	Available for use	Yes	Yes
Decontamination Operations	Sampling Team	Available for use	Available for use	Industrial Work Gloves	Yes	Yes	Yes	Available for use	Yes	Yes
Soil, Gas, and Liquid Sampling	Sampling Team	Available for use	Available for use	Industrial Work Gloves, Laceration-proof	Available for use	Available for use	Yes	Available for use	Available for use	Yes
LDAR	Sampling Team	Available for use	Available for use	Industrial Work Gloves	Available for use	No	Yes	Available for use	Yes	Yes

<sup>1</sup> For chemical splash hazards

<sup>2</sup> Not required if soil or water is not visibly contaminated, if PID measurements of the soil samples are below 1000 ppm, and if pH measurements are between 2 and 12 standard units.

<sup>3</sup> For chemical splash hazards or flying debris. Face shield over safety glasses may be used in lieu of chemical goggles; however, safety glasses must be worn in conjunction with the face shield for flying debris.

<sup>4</sup> If falling-objects or head-impact hazards exist.

<sup>5</sup> Coveralls are to be taped to gloves and boots to minimize exposure pathways to contaminants.

**TABLE 5-3. RESPIRATOR ASSIGNED PROTECTION FACTOR (APF)**

Assigned Protection Factors <sup>5</sup>					
Respirator Type <sup>1,2</sup>	Quarter Mask	Half Mask	Full Face	Helmet/Hood	Loose-Fitting
Air Purifying	5	10 <sup>3</sup>	10/50 <sup>4</sup>	-----	-----
PAPR	-----	50 <sup>4</sup>	50 <sup>4</sup>	25 <sup>4</sup>	25 <sup>4</sup>
SAR					
• Negative Pressure (Demand)	-----	10	50	-----	-----
• Continuous Flow	-----	50	50	25 <sup>4</sup>	-----
• Pressure Demand	-----	1,000	2,000	-----	-----
• Pressure Demand with auxiliary pressure-demand SCBA (Escape Tank)	-----	-----	10,000	-----	-----
SCBA					
• Negative Pressure (Demand)	-----	-----	50	-----	-----
• Pressure Demand	-----	-----	10,000	-----	-----

<sup>1</sup> May use respirators assigned for higher concentrations in lower concentrations or when required use is independent of concentration.

<sup>2</sup> These APFs are only effective when employer has a continuing, effective respirator program per 1910.134.

<sup>3</sup> This APF category includes filtering face pieces and elastomeric face pieces.

<sup>4</sup> With appropriate gas/vapor cartridge and N-100, R-110, or P-100 filters.

<sup>5</sup> These APFs do not apply to escape-only respirators.

**Negative Pressure Respirator:** A tight-fitting respirator in which the air pressure inside the face piece is negative during inhalation with respect to the ambient air pressure outside the respirator.

**Demand Respirator:** A respirator in which the pressure inside the face piece in relation to the immediate environment is positive during exhalation and negative during inhalation.

**Pressure Demand Respirator:** A respirator in which the pressure inside the face piece in relation to the immediate environment is positive during both inhalation and exhalation.

**Continuous Flow:** A respirator that maintains air flow at all times, rather than only on demand. However, it may not maintain positive pressure within the mask at all times. Negative pressure conditions may occur during inhalation involving strenuous activity.

## TABLE 6-1. PID ORGANIC VAPOR ACTION LEVELS AND RESPONSES



### Purpose

This table lists air monitoring action levels to be used in the field during direct measurement of total organic vapors (TOV) in the breathing zone using a photo ionization detector (PID) to determine Permissible Exposure Limits (PEL), and describes the responses required when action levels are exceeded. PID action levels for Trihydro projects fall under two categories: petroleum hydrocarbon sites, or chlorinated hydrocarbon sites. Separate action level tables are available for each of these site categories. The table for petroleum hydrocarbon sites lists action levels based on benzene exposure limits, and the table for chlorinated hydrocarbon sites lists action levels based on vinyl chloride exposure limits.

For reference, the occupational exposure limits used in establishing action levels in the tables below include Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PEL), OSHA Short Term Exposure Limits (STEL) or ceiling limits, and National Institute of Occupational Safety and Health (NIOSH) Immediate Danger to Life and Health (IDLH) concentrations. In addition, OSHA's 1910.1017, vinyl chloride standard, was referenced for the chlorinated hydrocarbon graph and table. Correction factors used to calculate action levels were taken from [RAE Systems Technical Note TN-106](#), rev 13d, wh.01-05.

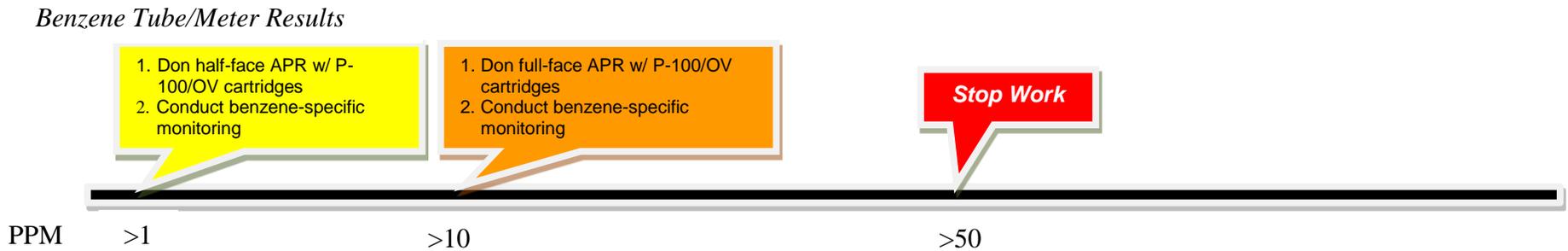
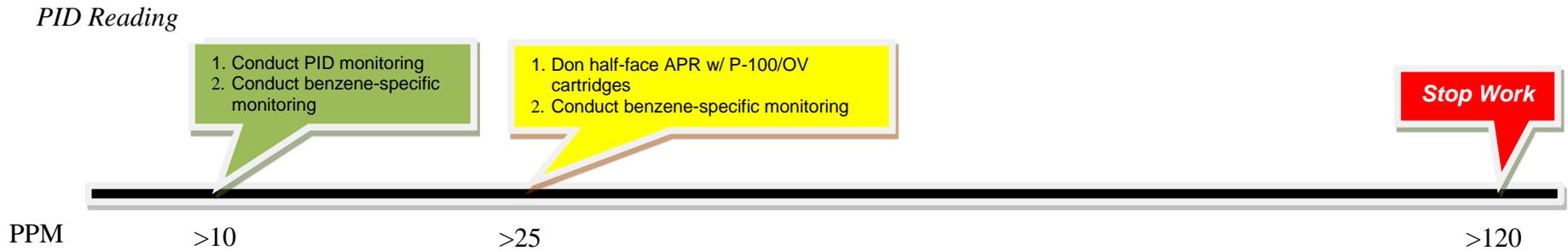
If both tables apply to a particular site, the lower of the two exposure limits will be used.

Notes for tables:

1. PID = Photo ionization detector
2. Benzene to be measured using colorimetric detector tubes or benzene-specific direct reading instrument (such as UltraRAE), vinyl chloride to be measured using colorimetric detector tubes
3. APR = Air purifying respirator
4. P-100/OV = Particulate rated filter P-100/organic vapor combination respirator cartridges

## Summary Graph, PID Action Levels, Petroleum Hydrocarbon Sites (10.6 eV Lamp calibrated with 100 ppm isobutylene)

Based on benzene PEL of 1 ppm, STEL of 5 ppm, IDLH of 500 ppm, and correction factor of 0.53.



## PID Action Levels, Petroleum Hydrocarbon Sites (10.6 eV Lamp calibrated with 100 ppm isobutylene)

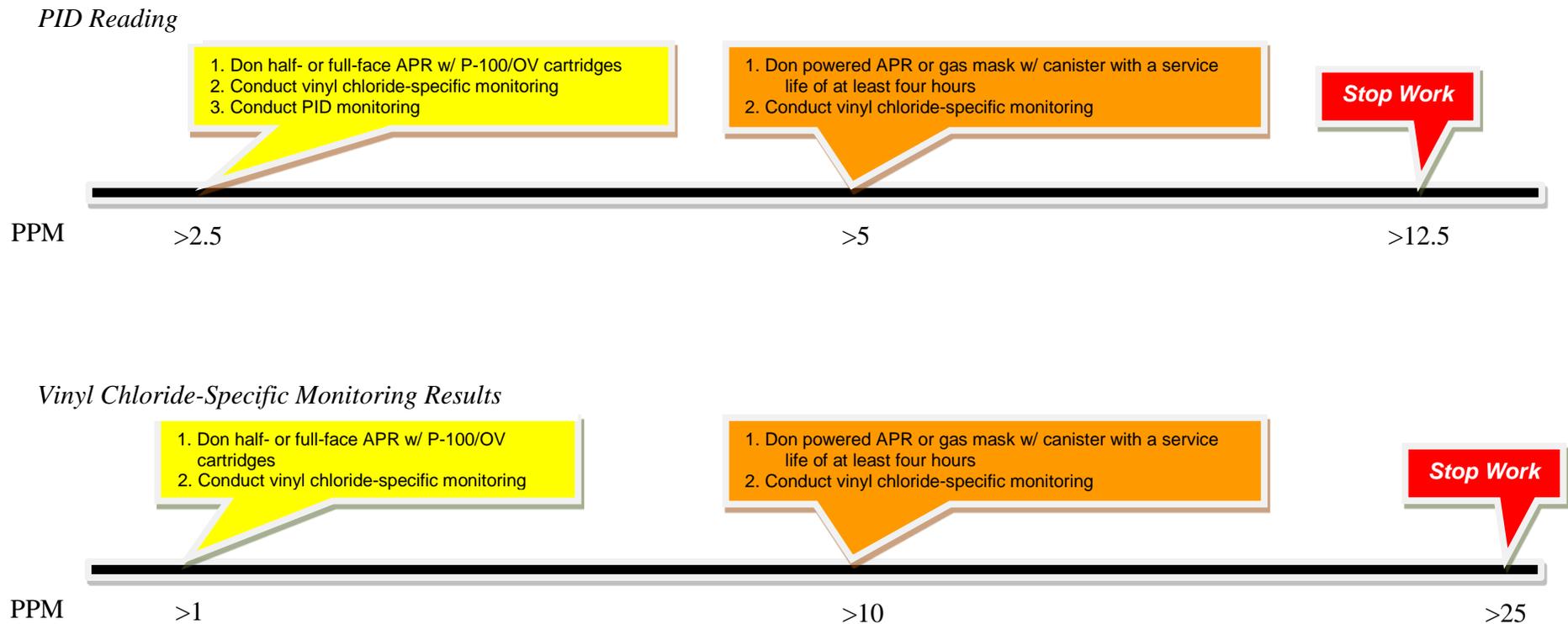
10.6 eV Lamp calibrated with 100 ppm isobutylene span gas

Reference: Benzene STEL of 5 ppm, IDLH of 500 ppm, and correction factor of 0.53

PID <sup>(1)</sup> Reading (ppm)	Duration of Reading	Action(s)
0 to 10	5 minutes sustained	Conduct PID monitoring
>10 to 25	5 minutes sustained	<ol style="list-style-type: none"> <li>1. Conduct PID monitoring</li> <li>2. Conduct periodic benzene-specific monitoring<sup>(2)</sup> <ol style="list-style-type: none"> <li>a. Benzene &gt;1 to 10 ppm – don ½ face APR<sup>(3)</sup> with P-100/OV cartridges<sup>(4)</sup></li> </ol> </li> </ol>
>25 to 120	5 minutes sustained	<ol style="list-style-type: none"> <li>1. Don ½ face APR with P-100/OV cartridges</li> <li>2. Conduct PID monitoring</li> <li>3. Conduct periodic benzene-specific monitoring<sup>(2)</sup> <ol style="list-style-type: none"> <li>a. Benzene below 1 ppm – doff APR</li> <li>b. Benzene &gt;1 to 10 ppm – maintain ½ face APR with P-100/OV cartridges</li> <li>c. Benzene &gt;10 to 50 ppm – don full face APR with P-100/OV cartridges</li> <li>d. Benzene &gt;50 ppm – stop work and evacuate area; notify Trihydro H&amp;S Team to discuss engineering controls, atmosphere-supplied respirators, and/or additional monitoring</li> </ol> </li> </ol>
>120	1 minute sustained	<ol style="list-style-type: none"> <li>1. Stop work and evacuate area</li> <li>2. Notify Trihydro H&amp;S Team to discuss engineering controls, atmosphere-supplied respirators, and/or additional monitoring</li> </ol>

## Summary Graph, PID Action Levels, Chlorinated Hydrocarbon (10.6 eV Lamp calibrated with 100 ppm isobutylene)

Based on vinyl chloride Ceiling of 5 ppm and PID correction factor of 2.0.



## PID Action Levels and Responses: Chlorinated Hydrocarbon Sites

10.6 eV Lamp calibrated with 100 ppm isobutylene span gas

Reference: Vinyl chloride Ceiling of 5 ppm, and correction factor of 2.0.

PID <sup>(1)</sup> Reading (ppm)	Duration of Reading	Action(s)
0 to 0.5	5 minutes sustained	Conduct PID monitoring
>0.5 to 2.5	5 min sustained	<ol style="list-style-type: none"> <li>1. Conduct PID monitoring</li> <li>2. Conduct periodic vinyl chloride-specific monitoring<sup>(2)</sup> <ol style="list-style-type: none"> <li>a. Vinyl chloride &gt;1 to 10 ppm – don half- or full-face APR<sup>(3)</sup> with P-100/OV cartridges<sup>(4)</sup></li> </ol> </li> </ol>
>2.5 to 5	5 min sustained	<ol style="list-style-type: none"> <li>1. Don half- or full-face APR with P-100/OV cartridges</li> <li>2. Conduct PID monitoring</li> <li>3. Conduct periodic vinyl chloride-specific monitoring<sup>(2)</sup> <ol style="list-style-type: none"> <li>a. Vinyl chloride below 1 ppm – doff APR</li> <li>b. Vinyl chloride &gt;1 to 10 ppm – maintain half- or full-face APR with P-100/OV cartridges</li> <li>c. Vinyl chloride &gt;10 to 25 ppm – don a powered air-purifying respirator (APAPR) having a hood, helmet, or full- or half-face piece, or a gas mask with a front-or back-mounted canister with a service life of at least four hours.</li> <li>d. Vinyl chloride &gt;25 ppm – stop work and evacuate area; notify Trihydro H&amp;S Team to discuss engineering controls, atmosphere-supplied respirators, and/or additional monitoring</li> </ol> </li> </ol>
>5 to 12.5	5 min sustained	<ol style="list-style-type: none"> <li>1. Don a powered air-purifying respirator (PAPR) having a hood, helmet, or full- or half-face piece, or a gas mask with a front-or back-mounted canister with a service life of at least four hours.</li> <li>2. Conduct PID monitoring</li> <li>3. Conduct periodic vinyl chloride-specific monitoring<sup>(2)</sup> <ol style="list-style-type: none"> <li>a. Vinyl chloride below 1 ppm – doff APR</li> <li>b. Vinyl chloride &gt;1 to 10 ppm – maintain half- or full-face APR with P-100/OV cartridges</li> <li>c. Vinyl chloride &gt;10 to 25 ppm – maintain a powered air-purifying respirator (PAPR) having a hood, helmet, or full- or half-face piece, or a gas mask with a front-or back-mounted canister with a service life of at least four hours.</li> <li>d. Vinyl chloride &gt;25 ppm – stop work and evacuate area; notify Trihydro H&amp;S Team to discuss engineering controls, atmosphere-supplied respirators, and/or additional monitoring</li> </ol> </li> </ol>
>12.5	1 minute sustained	<ol style="list-style-type: none"> <li>1. Stop work and evacuate area</li> <li>2. Notify Trihydro H&amp;S Team to discuss engineering controls, atmosphere-supplied respirators, and/or additional monitoring</li> </ol>

## TABLE 6-2. FID ORGANIC VAPOR ACTION LEVELS AND RESPONSES



### Purpose

This table lists air monitoring action levels to be used in the field during direct measurement of total organic vapors (TOV) in the breathing zone using a flame ionization detector (FID) to determine Permissible Exposure Limits (PEL), and describes the responses required when action levels are exceeded. FID action levels for Trihydro projects fall under two categories: petroleum hydrocarbon sites, or chlorinated hydrocarbon sites. Separate action level tables are available for each of these site categories. The table for petroleum hydrocarbon sites lists action levels based on benzene exposure limits, and the table for chlorinated hydrocarbon sites lists action levels based on vinyl chloride exposure limits.

For reference, the occupational exposure limits used in establishing action levels in the tables below include Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PEL), OSHA Short Term Exposure Limits (STEL) or ceiling limits, and National Institute of Occupational Safety and Health (NIOSH) Immediate Danger to Life and Health (IDLH) concentrations. In addition, OSHA's 1910.1017, vinyl chloride standard, was referenced for the chlorinated hydrocarbon graph and table. FID response factors used to calculate action levels were taken from Thermo Environmental Instruments Inc., TVA Response Factors, P/N 50039, 8-23-00.

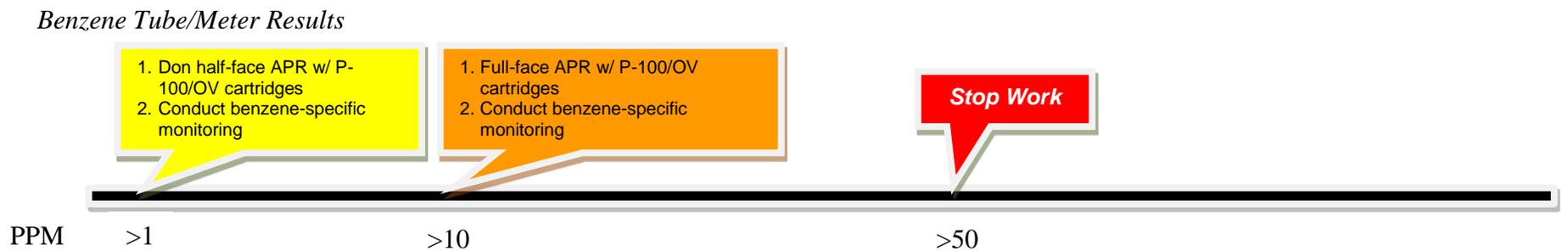
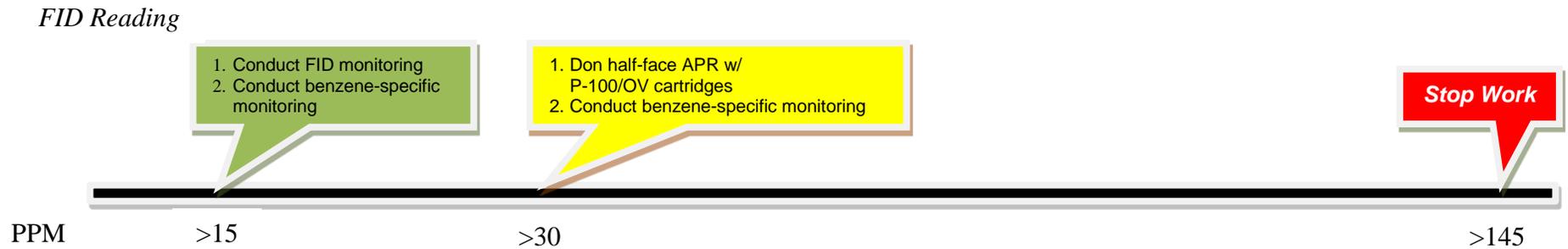
If both tables apply to a particular site, the lower of the two exposure limits will be used.

Notes for the tables:

1. FID = Flame ionization detector
2. Benzene to be measured using colorimetric detector tubes or benzene-specific direct reading instrument (such as UltraRAE), vinyl chloride to be measured using colorimetric detector tubes
3. APR = Air purifying respirator
4. P-100/OV = Particulate rated filter P-100/organic vapor combination respirator cartridges

## Summary Graph, FID Action Levels, Petroleum Hydrocarbon Sites (Thermo Electron TVA-1000B FID calibrated with 100 ppm methane)

Based on benzene PEL of 1 ppm, STEL of 5 ppm, IDLH of 500 ppm, and correction factor of 0.35.



## FID Action Levels and Responses: Petroleum Hydrocarbon Sites

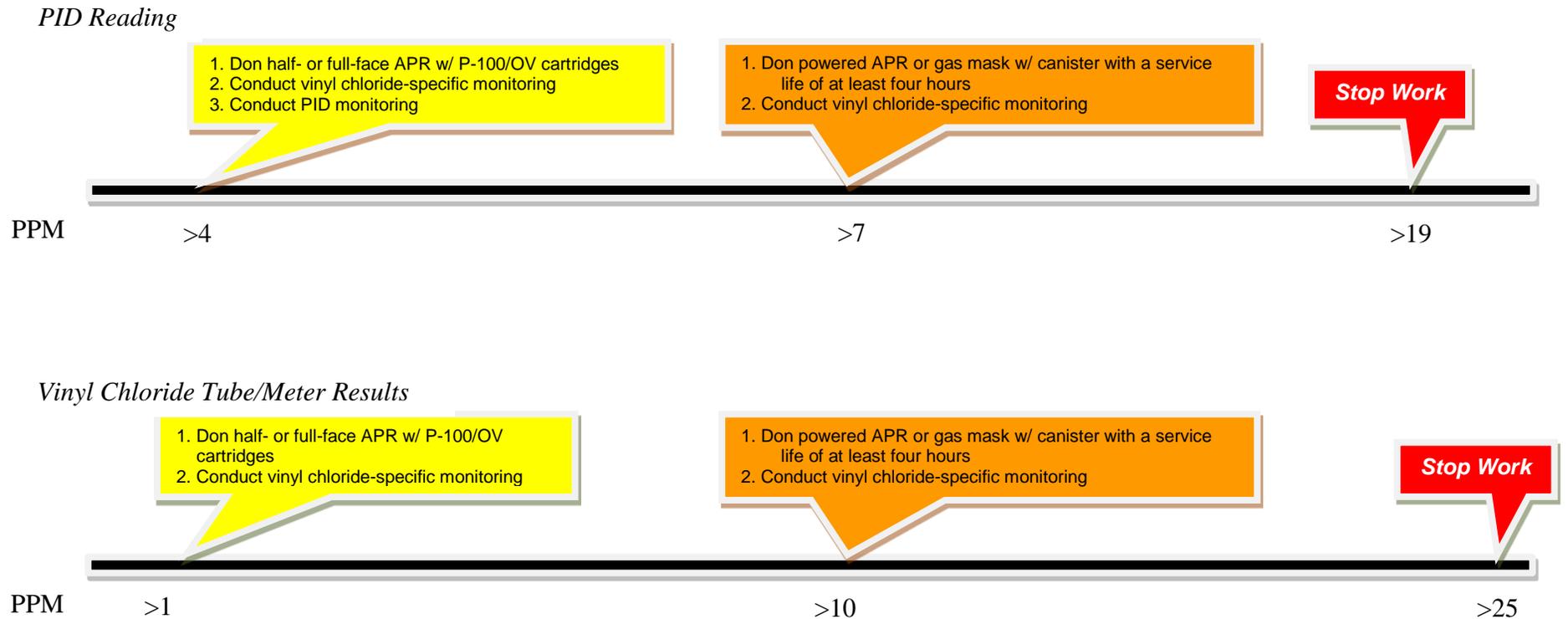
Thermo Electron TVA-1000B FID calibrated with 100 ppm methane span gas

Reference: Benzene STEL of 5 ppm, IDLH of 500 ppm, and correction factor of 0.35

FID <sup>(1)</sup> Reading (ppm)	Duration of Reading	Action(s)
0 to 15	5 minutes sustained	Conduct periodic FID monitoring
>15 to 30	5 minutes sustained	<ol style="list-style-type: none"> <li>1. Conduct FID monitoring</li> <li>2. Conduct periodic benzene-specific monitoring<sup>(2)</sup> <ol style="list-style-type: none"> <li>a. Benzene detected &gt;1 to 10 ppm – don ½ face APR<sup>(3)</sup> with P-100/OV cartridges<sup>(4)</sup></li> </ol> </li> </ol>
>30 to 145	5 minutes sustained	<ol style="list-style-type: none"> <li>1. Don ½ face APR with P-100/OV cartridges</li> <li>2. Conduct FID monitoring</li> <li>3. Conduct periodic benzene-specific monitoring<sup>(2)</sup> <ol style="list-style-type: none"> <li>a. Benzene below 1 ppm – doff APR</li> <li>b. Benzene &gt;1 to 10 ppm – maintain ½ face APR with P-100/OV cartridges</li> <li>c. Benzene &gt;10 to 50 ppm – don full face APR with P-100/OV cartridges</li> <li>d. Benzene &gt;50 ppm – stop work and evacuate area; notify Trihydro H&amp;S Team to discuss engineering controls and/or additional monitoring</li> <li>e. Trihydro H&amp;S Department to discuss engineering controls, atmosphere-supplied respirators, and/or additional monitoring</li> </ol> </li> </ol>
>145	1 minute sustained	<ol style="list-style-type: none"> <li>1. Stop work and evacuate area</li> <li>2. Notify Trihydro H&amp;S Team to discuss engineering controls, atmosphere-supplied respirators, and/or additional monitoring</li> </ol>

## Summary Graph, FID Action Levels, Chlorinated Hydrocarbon (Thermo Electron TVA-1000B FID calibrated with 100 ppm methane)

Based on vinyl chloride Ceiling of 5 ppm and FID correction factor of 1.3.



## FID Action Levels and Responses: Chlorinated Hydrocarbon Sites

Thermo Electron TVA-1000B FID calibrated with 100 ppm methane span gas

Reference: Vinyl chloride Ceiling of 5 ppm, and correction factor of 1.3.

PID <sup>(1)</sup> Reading (ppm)	Duration of Reading	Action(s)
1 to 2.5	5 min sustained	<ol style="list-style-type: none"> <li>3. Conduct continuous PID monitoring</li> <li>4. Conduct vinyl chloride-specific monitoring<sup>(2)</sup> – every 15 minutes</li> <li>5. Don half- or full-face APR<sup>(3)</sup> with P-100/OV cartridges<sup>(4)</sup> if vinyl chloride detected at &gt;1 to 10 ppm</li> </ol>
2.6 to 5	5 min sustained	<ol style="list-style-type: none"> <li>4. Don half- or full-face APR with P-100/OV cartridges</li> <li>5. Conduct continuous PID monitoring</li> <li>6. Conduct vinyl chloride-specific monitoring<sup>(2)</sup> – every 15 minutes               <ol style="list-style-type: none"> <li>a. Vinyl chloride below 1 ppm – doff APR</li> <li>b. Vinyl chloride &gt;1 to 10 ppm – maintain half- or full-face APR with P-100/OV cartridges</li> <li>c. Vinyl chloride &gt;10 to 25 ppm – don a powered air-purifying respirator (APAPR) having a hood, helmet, or full- or half-face piece, or a gas mask with a front-or back-mounted canister with a service life of at least four hours.</li> <li>d. Vinyl chloride &gt;25 ppm – stop work and evacuate area; notify Trihydro H&amp;S Team to discuss engineering controls, atmosphere-supplied respirators, and/or additional monitoring</li> </ol> </li> </ol>
6 to 12.5	5 min sustained	<ol style="list-style-type: none"> <li>4. Don a powered air-purifying respirator (PAPR) having a hood, helmet, or full- or half-face piece, or a gas mask with a front-or back-mounted canister with a service life of at least four hours.</li> <li>5. Conduct continuous PID monitoring</li> <li>6. Conduct vinyl chloride-specific monitoring<sup>(2)</sup> – every 15 minutes               <ol style="list-style-type: none"> <li>a. Vinyl chloride &gt;10 to 25 ppm – maintain a powered air-purifying respirator (PAPR) having a hood, helmet, or full- or half-face piece, or a gas mask with a front-or back-mounted canister with a service life of at least four hours.</li> <li>b. Vinyl chloride &gt;25 ppm – stop work and evacuate area; notify Trihydro H&amp;S Team to discuss engineering controls, atmosphere-supplied respirators, and/or additional monitoring</li> </ol> </li> </ol>
>12.5	1 minute sustained	<ol style="list-style-type: none"> <li>3. Stop work and evacuate area</li> <li>4. Notify Trihydro H&amp;S Team to discuss engineering controls, atmosphere-supplied respirators, and/or additional monitoring</li> </ol>
FID <sup>(1)</sup> Reading (ppm)	Duration of Reading	Action(s)
0 to 0.75	5 minutes sustained	Conduct FID monitoring

>0.75 to 4	5 min sustained	<ol style="list-style-type: none"> <li>1. Conduct FID monitoring</li> <li>2. Conduct vinyl chloride-specific monitoring<sup>(2)</sup> <ol style="list-style-type: none"> <li>a. Vinyl chloride detected &gt;1 to 10 ppm – don half- or full-face APR<sup>(3)</sup> with P-100/OV cartridges<sup>(4)</sup></li> </ol> </li> </ol>
>4 to 7	5 min sustained	<ol style="list-style-type: none"> <li>1. Don half- or full-face APR with P-100/OV cartridges</li> <li>2. Conduct FID monitoring</li> <li>3. Conduct periodic vinyl chloride-specific monitoring<sup>(2)</sup> <ol style="list-style-type: none"> <li>a. Vinyl chloride below 1 ppm – doff APR</li> <li>b. Vinyl chloride &gt;1 to 10 ppm – maintain half- or full-face APR with P-100/OV cartridges</li> <li>c. Vinyl chloride &gt;10 to 25 ppm – don a powered air-purifying respirator (APAPR) having a hood, helmet, or full- or half-face piece, or a gas mask with a front-or back-mounted canister with a service life of at least four hours.</li> <li>d. Vinyl chloride &gt;25 ppm – stop work and evacuate area; notify Trihydro H&amp;S Team to discuss engineering controls, atmosphere-supplied respirators, and/or additional monitoring</li> </ol> </li> </ol>
>7 to 19	5 min sustained	<ol style="list-style-type: none"> <li>1. Don a powered air-purifying respirator (PAPR) having a hood, helmet, or full- or half-face piece, or a gas mask with a front-or back-mounted canister with a service life of at least four hours.</li> <li>2. Conduct FID monitoring</li> <li>3. Conduct periodic vinyl chloride-specific monitoring<sup>(2)</sup> <ol style="list-style-type: none"> <li>a. Vinyl chloride &gt;10 to 25 ppm – maintain a powered air-purifying respirator (PAPR) having a hood, helmet, or full- or half-face piece, or a gas mask with a front-or back-mounted canister with a service life of at least four hours.</li> <li>b. Vinyl chloride &gt;25 ppm – stop work and evacuate area; notify Trihydro H&amp;S Team to discuss engineering controls, atmosphere-supplied respirators, and/or additional monitoring</li> </ol> </li> </ol>
>19	1 minute sustained	<ol style="list-style-type: none"> <li>1. Stop work and evacuate area</li> <li>2. Notify Trihydro H&amp;S Team to discuss engineering controls, atmosphere-supplied respirators, and/or additional monitoring</li> </ol>

**TABLE 6-3. HYDROGEN SULFIDE ACTION LEVELS**

<b>Hydrogen Sulfide Detector Reading</b>	<b>Action</b>
10 ppm	Investigate the source and attempt to eliminate
15 ppm	Evacuate the area, determine the source, attempt to eliminate
20 ppm	Do not enter

**TABLE 7-1. PROTECTIVE GLOVE GUIDE**

Protection	Glove Material	Applications
Lacerations	Dyneema <sup>®</sup> , Kevlar <sup>®</sup> , fiber-metal blends, metal mesh, SuperFabric <sup>®</sup> , steel core, and Vectran	Cut-resistance: designed to protect hands from direct or indirect contact with sharp edges such as glass, metal, ceramics, and other materials. Many cut resistant gloves are manufactured to provide protection from a <i>SLASH</i> from sharp items like knives/blades. However, they may provide very little, if any, puncture-resistance from a pointed item like a needle, unless specifically designed for puncture resistance.
Needle Stick	HEX ARMOR <sup>®</sup> , DAMASCUS V-Force™ X4	Puncture protection. Ideal for correctional facility pat-downs/searches, customs officers, federal/state/city/municipal/university employees, luggage searches, hospital laundry and sharps handling.
Vibrations	DECADE <sup>®</sup> Gelfom™, AirGlove™	Provides padding at the palm, fingers and thumb to help neutralize the force of heavy impacts, reducing the chance of injury.
Extreme high temperatures	Best <sup>®</sup> CharGuard™, ZETEX <sup>®</sup> , Kevlar <sup>®</sup> , Nomex <sup>®</sup> , Crusader Flex <sup>®</sup> , thermal knit, Terry Cloth, heavy weight cotton	For intermittent handling of hot objects. Ideal for hot castings for intermittent heat, lab sampling with hot glassware or moldings, plastic molding manufacturing, plant maintenance controls. Temperature protection ranges vary.
Extreme low temperatures	Best <sup>®</sup> Snow Man™, thermal knit, Terry Cloth, heavy weight cotton	For intermittent handling of hot objects.
Awareness	High visibility	Protective gloves made of a high visibility color help enhance hand position awareness; the color of the gloves is rotated on a quarterly basis. This prevents complacency for a particular color and can improve attentiveness.
Chemical	Butyl	A synthetic rubber material that offers the highest permeation resistance to gas and water vapors. Especially suited for use with esters and ketones.
	Neoprene	A synthetic rubber material that provides excellent tensile strength and heat resistance. Neoprene is compatible with some acids and caustics. It has moderate abrasion resistance.
	Nitrile	A synthetic rubber material that offers chemical and abrasion resistance—a very good general-duty glove. Nitrile also provides protection from oils, greases, petroleum products and some acids and caustics.
	PVC (Polyvinyl chloride)	A synthetic thermoplastic polymer that provides excellent resistance to most acids, fats, and petroleum hydrocarbons. Good abrasion resistance.
	PVA (Polyvinyl alcohol)	A water-soluble synthetic material that is highly impermeable to gases. Excellent chemical resistance to aromatic and chlorinated solvents. This glove cannot be used in water or water-based solutions.

**TABLE 7-1. PROTECTIVE GLOVE GUIDE (cont.)**

<b>Protection</b>	<b>Glove Material</b>	<b>Applications</b>
	Viton®	A fluoroelastomer material that provides exceptional chemical resistance to chlorinated and aromatic solvents. Viton is very flexible, but has minimal resistance to cuts and abrasions.
	SilverShield®/4H	A lightweight, flexible laminated material that resists permeation from a wide range of toxic and hazardous chemicals. It offers the highest level of overall chemical resistance, but has virtually no cut resistance.

**TABLE 7-2. EXTENSION CORD RATINGS**

<b>Cord Length (ft.)</b>	<b>Gauge</b>	<b>Max Amps</b>
25	18	10
25	16	13
25	14	15
50	18	5
50	16	10
50	14	15
75	18	5
75	16	10
75	14	15
100	16	5
100	12	15
125	16	5
125	12	15
150	16	5
150	12	13

**TABLE 7-3. ENERGIZED POWER LINE CLEARANCE**

<b>Task</b>	<b>Minimum Clearance Between Equipment and Energized Lines</b>
Heavy equipment in transit with no load and boom lowered for overhead power lines with voltages less than 50, 000 volts	4'
Heavy equipment in transit with no load and boom lowered for overhead power lines with voltages over 50, 000 volts	10'
Heavy equipment in transit with no load and boom lowered for overhead power lines with for voltages up to and including 750,000 volts	16'
Setup/operations near overhead power lines up to 50,000 volts	10'
Setup/operations near overhead power lines over 50,000 volts	10' plus 0.4 inches for each additional 1,000 volts over 50,000 volts
Drilling operations	20'



**TABLE 7-6. CHEMICAL CONTAMINANTS IN REFINERY WASTES AND WASTEWATER**

<b>Metals</b>		
Antimony	Butyl benzyl phthalate	
Arsenic	Chrysene	
Barium	Cyclohexane	
Beryllium	Dibenz(a,h)acridine	
Cadmium	Dibenz(a,h)anthracene	
Chromium	Di(n)butyl phthalate	
Cobalt	Dichlorobenzenes	
Lead	Diethyl phthalate	
Mercury	7,12-Dimethylbenz(a)-anthracene	
Nickel	Dimethyl phthalate	
Selenium	Di(n)octyl phthalate	
Vanadium	Fluoranthene	
<b><u>Volatiles</u></b>	Indene	
Benzene	Methyl chrysene	
Carbon disulfide	2-Methylnaphthalene	
Chlorobenzene	Naphthalene	
Chloroform	Phenanthrene	
1,2-Dichloroethane	Pyrene	
1,4-Dioxane	Pyridine	
Ethylbenzene	Quinoline	
Ethylene dibromide (1,2-Dibromoethane)		
methyl ethyl ketone		
Styrene		
Toluene		
Xylene (m, o, and p)		
<b>Semi-Volatile Base/Neutral Extractable Compounds</b>		
Anthracene		
Benzo(a)anthracene		
Benzo(b)fluoranthene		
Benzo(a)pyrene		
Bis(2-ethylhexyl)phthalate		
	<b>Semi-Volatile Acid-Extractable Compounds</b>	
	Benzenethiol	
	Cresols	
	2,4-Dimethylphenol	
	2,4-Dinitrophenol	
	4-Nitrophenol	
	Phenol	
	<b>Acidic/Caustic Compounds</b>	
	Hydrofluoric acid	
	Sodium hydroxide	
	Sulfuric acid	

\* This list (with the exception of the acidic/alkaline compounds) is commonly referred to as the "Modified Skinner List," and was developed by the U.S. Environmental Protection Agency and American Petroleum Institute

**TABLE 7-7. HEAT INDEX CHART**

Heat index (HI) is sometimes referred to as the "apparent temperature." The HI, given in degrees F, is a measure of how hot it feels when relative humidity (RH) is added to the actual air temperature.

HEAT INDEX °F													
Temp.	RELATIVE HUMIDITY (%)												
	40	45	50	55	60	65	70	75	80	85	90	95	100
110	136												
108	130	137											
106	124	130	137										
104	119	124	131	137									
102	114	119	124	130	137								
100	109	114	118	124	129	136							
98	105	109	113	117	123	128	134						
96	101	104	108	112	116	121	126	132					
94	97	100	103	106	110	114	119	124	129	135			
92	94	96	99	101	105	108	112	116	121	126	131		
90	91	93	95	97	100	103	106	109	113	117	122	127	132
88	88	89	91	93	95	98	100	103	106	110	113	117	121
86	85	87	88	89	91	93	95	97	100	102	105	108	112
84	83	84	85	86	88	89	90	92	94	96	98	100	103
82	81	82	83	84	84	85	86	88	89	90	91	93	95
80	80	80	81	81	82	82	83	84	84	85	86	86	87

Category	Heat Index	Possible heat disorders for people in high risk groups
Extreme Danger	130°F or higher	Heat stroke or sunstroke likely.
Danger	105 - 129°F	Sunstroke, muscle cramps, and/or heat exhaustion likely. Heatstroke possible with prolonged exposure and/or physical activity.
Extreme Caution	90 - 105°F	Sunstroke, muscle cramps, and/or heat exhaustion possible with prolonged exposure and/or physical activity.
Caution	80 - 90°F	Fatigue possible with prolonged exposure and/or physical activity.

Reference: NOAA's National Weather Service, 06/15/2006, [http://www.crh.noaa.gov/jkl/?n=heat\\_index\\_calculator](http://www.crh.noaa.gov/jkl/?n=heat_index_calculator)

**TABLE 7-8. WIND CHILL CHART**

**LOW TEMPERATURE + WIND SPEED + WETNESS = INJURIES AND ILLNESS**

Wind Speed	Ambient Temperature (F°)																	
	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

*Frostbite occurs in 15 minutes or less*

Reference: NOAA's National Weather Service, 01/07/2009, <http://www.crh.noaa.gov/ddc/?n=windchill>



**TABLE 7-9. TRAFFIC-CONTROL SIGN PLACEMENT**

Road Type	Distance Between Signs (Feet)		
	A	B	C
Urban (low speed)*	100	100	100
Urban (high speed)*	350	350	350
Rural	500	500	500
Expressway/Freeway	1,000	1,500	2,640

\* Speed category to be determined by highway agency

**TABLE 10-1. HAZARDOUS MATERIALS INVENTORY**

Location	Hazardous Substance	Potential maximum qty of spill	Potential to Require Emergency Response	Available Spill Containment Equipment	Equipment Location
			<input type="checkbox"/> Yes <input type="checkbox"/> No		
			<input type="checkbox"/> Yes <input type="checkbox"/> No		
			<input type="checkbox"/> Yes <input type="checkbox"/> No		
			<input type="checkbox"/> Yes <input type="checkbox"/> No		
			<input type="checkbox"/> Yes <input type="checkbox"/> No		
			<input type="checkbox"/> Yes <input type="checkbox"/> No		
			<input type="checkbox"/> Yes <input type="checkbox"/> No		

**APPENDIX A**

**NEAR MISS REPORT**

# NEAR MISS REPORT



Please fill in ***all*** blanks with as much detail as possible. If you have any questions or need assistance, contact Trihydro Corporate Health and Safety at (307) 745-7474. Send completed form via email or FAX to (307) 755-4956.

## General Information

Near Miss Date: \_\_\_\_\_ Time: \_\_\_\_\_  AM  PM

Reported Date: \_\_\_\_\_ Time: \_\_\_\_\_  AM  PM

Work Type: \_\_\_\_\_

Project Client: \_\_\_\_\_ Project Manager: \_\_\_\_\_

Project Site: \_\_\_\_\_ Project Number: \_\_\_\_\_

Investigation Date: \_\_\_\_\_ Time: \_\_\_\_\_  AM  PM

Supervisor: \_\_\_\_\_

Supervisor's employer and email if not employed by Trihydro Corporation: \_\_\_\_\_

Worker: \_\_\_\_\_ Time at Present Job: \_\_\_\_\_

Worker's employer and email if not employed by Trihydro Corporation: \_\_\_\_\_

Employee Status:  Full Time  Part Time

Near Miss Location: \_\_\_\_\_

*Street* *City* *State/Zip*

## Near Miss Information

Employee's Specific Activities: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Near Miss Report

Equipment, Materials, or Chemicals Used: \_\_\_\_\_

Near Miss Description: \_\_\_\_\_

Near Miss Reported to: \_\_\_\_\_

Weather:  Clear  Cloudy  Cyclonic  Dusty  Partly Cloudy  Ice  Hail  Indoor  Windy  
 Mist  Lightning  Overcast  Fog  Hazy  Rain  Sleet  Snow  Thunderstorm

Lighting:  Dawn  Day  Dusk  Indoor  Night

**Witness #1**  Client Employee  Trihydro Employee  Contractor: (Company) \_\_\_\_\_

Name: \_\_\_\_\_ Telephone No: \_\_\_\_\_

**Witness #2**  Client Employee  Trihydro Employee  Contractor: (Company) \_\_\_\_\_

Name: \_\_\_\_\_ Telephone No: \_\_\_\_\_

**Witness #3**  Client Employee  Trihydro Employee  Contractor: (Company) \_\_\_\_\_

Name: \_\_\_\_\_ Telephone No: \_\_\_\_\_

**Witness #4**  Client Employee  Trihydro Employee  Contractor: (Company) \_\_\_\_\_

Name: \_\_\_\_\_ Telephone No: \_\_\_\_\_

## Cause Analysis

Root Cause Analysis (RCA) Table			
1	Lack of skill or knowledge	5	Doing the job according to procedures or acceptable practices take more time/effort
2	Lack of or inadequate operational procedures	6	Short-cutting procedures or acceptable practices is reinforced or tolerated
3	Inadequate communication of expectations regarding procedures or acceptable practices	7	In the past, did not follow procedures or acceptable practices and no incident occurred (injury, product quality incident, equipment damage, regulatory assessment, or production delay)
4	Inadequate tools or equipment	8	External factors

CF No.	RCA No.	Contributing Factors (CF) (Any factors that contributed to the near miss, but not the root cause):
1		
2		
3		
4		
5		
6		
7		
8		

\*(Refer to RCA table)

## Corrective Actions

Immediate Actions Taken:

CF No.	Solution(s)	Responsible Person	Due Date	Completed
1				<input type="checkbox"/>
2				<input type="checkbox"/>
3				<input type="checkbox"/>
4				<input type="checkbox"/>
5				<input type="checkbox"/>
6				<input type="checkbox"/>
7				<input type="checkbox"/>
8				<input type="checkbox"/>



**APPENDIX B**

**ACCIDENT/INCIDENT INVESTIGATION REPORT**

# ACCIDENT/INCIDENT INVESTIGATION REPORT



## General Information

Incident Type: *Incident*  *Near Miss*

Primary Incident Type: *Injury/Illness*  *Motor Vehicle Accident*  *Property / Equipment Damage*   
*Environmental*  *Exposure*  *Other*

Occurrence Date: \_\_\_\_\_ Occurrence Time: \_\_\_\_\_  AM  PM

Date Reported: \_\_\_\_\_ Time Reported: \_\_\_\_\_  AM  PM

Reported By: \_\_\_\_\_ Telephone: \_\_\_\_\_

Occurrence Location: \_\_\_\_\_ On Site:  Off Site:

Stop Work Involved: *Yes*  *No*  SSE Involved: *Yes*  *No*

Police Notified: *N/A*  *Yes*  *No*

Transportation to medical facility: *N/A*  *Yes*  *No*

*If yes, provide the following* Facility Name: \_\_\_\_\_

Medical treatment received: *N/A*  *Yes*  *No*

Description of Incident: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

*Individuals involved (Company Employee, Subcontractor Employee, Client Employee, Member of the Public, Witnesses)*

<i>Name</i>	<i>Organization</i>	<i>Title</i>	<i>Telephone</i>

**Vehicle Incident Details:**

Check any that apply: **Company Vehicle Involved**

**Non-Company Vehicle Involved**

Vehicle Information: Vehicle #: \_\_\_\_\_ Vehicle VIN: \_\_\_\_\_  
License Plate #: \_\_\_\_\_ Vehicle Make/Model: \_\_\_\_\_  
Vehicle Year \_\_\_\_\_ Vehicle Color: \_\_\_\_\_  
If Rental Vehicle, Rental Company: \_\_\_\_\_  
# of Passengers: \_\_\_\_\_ Names: \_\_\_\_\_

Driver Information First Name: \_\_\_\_\_ Last Name: \_\_\_\_\_  
Address: \_\_\_\_\_  
City \_\_\_\_\_ State: \_\_\_\_\_ Zip Code: \_\_\_\_\_  
Phone # 1: \_\_\_\_\_ Phone # 2: \_\_\_\_\_  
License Plate #: \_\_\_\_\_ Vehicle VIN: \_\_\_\_\_  
Vehicle Year \_\_\_\_\_ Vehicle Make/Model: \_\_\_\_\_  
Vehicle Color: \_\_\_\_\_ Driver License #: \_\_\_\_\_  
# of Passengers: \_\_\_\_\_ Names: \_\_\_\_\_  
Insurance Company: \_\_\_\_\_ Phone: \_\_\_\_\_  
Insurance Agent: \_\_\_\_\_ Phone: \_\_\_\_\_  
Policy # \_\_\_\_\_ Exp. Date: \_\_\_\_\_

Details: Weather: Clear  Rain  Fog  Wind  Other   
Road Condition: Clear  Wet  Icy  Debris  Other   
Light Condition: Dawn  Day:  Dusk  Dark   
Estimated Speeds \_\_\_\_\_

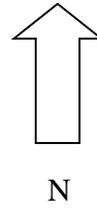
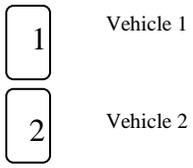
Attending Police: Office Name: \_\_\_\_\_ Badge #: \_\_\_\_\_  
Division: \_\_\_\_\_ Phone # \_\_\_\_\_

Tow Truck Operator: Company: \_\_\_\_\_ Phone #: \_\_\_\_\_  
Drivers Name: \_\_\_\_\_  
Address Towed To: \_\_\_\_\_

Citation Issued: **Yes**  **No**

*Accident/Incident Investigation Report*

Diagram: include streets, traffic controls, visual obstacles, etc.



Accident/Incident Investigation Report

**Environmental/Exposure Incident Details:**

Agent:      Chemical/Substance       Explosion       Noise       Radiation       Vibration   
Medium:     Air       Soil       Ground Water       Surface Water   
Effect On:   People       Vegetation       Animals       Structures       Equipment       Materials

Substance Information:

Name of Substance	Amount	Unit of Measure

PPE Worn:    *Yes*       *No*

List PPE: \_\_\_\_\_

Response Details:

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With any incident/accident:

Initial Notifications must be made to:

- Police, Ambulance, 911 (if applicable)
- H&S Team
- Risk Management
- Project Manager (PM)
- Supervisor
- Client (as directed by the PM)
- Site Managers (as directed by the PM)

If medical treatment is needed:

- Contact WorkCare™ at (888) 449-7787
- Coordinate drug/alcohol testing within 3 hours
- Complete the Accident/Incident Reporting Form and a SPOT report for submittal to the H&S Team.

If after hours, contact the Safety Response number at (307) 755-4888.

**APPENDIX C**

**JOB SAFETY ANALYSIS (JSA) FORMS**

# JOB SAFETY ANALYSIS



For JSA development procedures, visit the Health & Safety Website at <http://intranet.trihydro.com/HS/default.aspx?Content=JSA&Section=SafetyResources&Title=Safety Resources>.

## Seed JSA Development Information:

Job Description: Construction/Demolition Contractor Oversight

Seed JSA Template Version Date: February 8, 2011

Seed JSA Development Team: John Trotter

## Project Seed JSA Adaption Review Process (Seed JSA modifications made for the project):

Project Name: Roxy's Cleaners	Site Location: Havre, MT	Project Number: 776-023-002
<b>Project Management Reviewer Name</b>	<b>Signature</b>	<b>Date (MM/DD/YYYY)</b>
Jim Gleason		
<b>Health and Safety Team Reviewer Name</b>	<b>Signature</b>	<b>Date (MM/DD/YYYY)</b>

## Site-specific Information (completed daily, on site, and prior to job start by the task manager):

<b>Weather conditions:</b>		<b>Approx. temp:</b>		<b>Approx. wind direction/speed:</b>	/
<b>Site-specific revisions made by:</b>	<b>Position/Title:</b>	<b>Date (MM/DD/YYYY)</b>	<b>Primary Contact Number</b>		
			( ) -		
<b>Team briefed on:</b>	<input type="checkbox"/> Daily Safety Briefing	<input type="checkbox"/> Right to Refuse Unsafe Work	<input type="checkbox"/> Stop Work Authority		

## Personal Protective Equipment (PPE) Anticipated (complete applicable boxes):

<b>Eye and Face Protection</b>	<b>Foot Protection</b>	<b>Fall Protection</b>
Safety glasses, dust-proof safety glasses	Safety-toed boots Chemical-resistant over boots	
<b>Head Protection</b>	<b>Biological Protection</b>	<b>Respiratory Protection</b>
Hard hat	Insect repellent	Air-purifying respirator with organic vapors/acid gases cartridge/P100 filter
<b>Hearing Protection</b>	<b>High Visibility Clothing</b>	<b>Protective Clothing</b>
Ear plugs	Vest or jacket	Chemical-resistant clothing, fire-retardant clothing (FRC)
<b>Hand Protection</b>	<b>Water Safety Devices</b>	<b>Other</b>
Industrial gloves, chemical-resistant gloves		Sunscreen

## Safety Tools/Equipment/Instruments Anticipated (complete applicable boxes):

<b>Safety Knives</b>	<b>Ventilation</b>	<b>Barricades or Access Control</b>
		Work Zone Delineation
<b>Communications</b>	<b>Atmospheric Monitoring Devices</b>	<b>Other</b>
Radio	Air monitoring, personal detector, colorimetric tubes.	

## Specialized/Site-Specific Safety Training Required:

## Permits Required:

Job Steps		Potential Hazard(s)	Critical Action(s)
1.	Walking around the site.	<ul style="list-style-type: none"> <li>A. Slips, trips, falls</li> <li>B. Temperature stress</li> <li>C. Biological hazards</li> <li>D. Vehicular traffic</li> <li>E. Heavy/construction equipment</li> <li>F. Flying/falling debris and other objects</li> </ul>	<ul style="list-style-type: none"> <li>A. Maintain good housekeeping practices to eliminate slip/trip/fall hazards. Watch footing and where you are walking. Stay alert to holes, debris, and tools. Be aware of location of structures and operating equipment. Take extra caution in rainy or muddy conditions; keep boots dry or use rubber boots.</li> <li>B. Dress in layers for cold weather or loose-fitting light clothing for hot weather, but within constraints of HASP. Drink plenty of water or other hydrating liquids (i.e., not sodas).</li> <li>C. Look before you reach or step; watch for small animals, rodents, snakes, insects, and spiders. Try to avoid and do not antagonize. Use insect repellent and mosquito nets as appropriate. Do not spray DEET on FRCs.</li> <li>D. Watch for and be aware of vehicular traffic related to contractors. Develop a traffic control plan. Wear high-visibility vest or clothing.</li> <li>E. Establish a work zone to prevent entry of nonessential and unauthorized personnel. Do not drive in the path of operating equipment. Make yourself visible and wear high visibility vest or clothing. Yield to heavy/construction equipment until eye contact is made with operator and you are given the signal to proceed. Stay out of immediate area near heavy equipment. If you need to approach a piece of equipment, do not enter from the blind spots; stay a safe distance away until eye contact is made with the operator.</li> <li>F. Be aware of potential flying/falling objects. Wear hard hat and safety-toed boots. Wear safety glasses with side shields to keep flying debris out of eyes. Wear dust-proof safety glasses if airborne dust is a hazard. Take caution when removing glasses so particles do not fall from glasses into eyes.</li> </ul>
2.	Observe and document construction/demolition activity.	<ul style="list-style-type: none"> <li>A. Struck by equipment</li> <li>B. High noise level</li> <li>C. Temperature stress</li> <li>D. Severe weather</li> <li>E. Chemical exposure</li> <li>F. Biological hazards</li> <li>G. Slips, trips and falls</li> </ul>	<ul style="list-style-type: none"> <li>A. Establish a work zone to prevent entry of nonessential and unauthorized personnel. Do not drive in the path of operating equipment. Make yourself visible and wear high-visibility vest or clothing. Yield to heavy/construction equipment until eye contact is made with operator and you are given the signal to</li> </ul>

Job Steps	Potential Hazard(s)	Critical Action(s)
		<p>proceed. Stay out of immediate area near heavy equipment. If you need to approach a piece of equipment, do not enter from the blind spots; stay a safe distance away until eye contact is made with the operator.</p> <p>B. Hearing protection required within 25 feet of operating heavy construction equipment or when employees cannot maintain a normal conversation at a 2-foot interval.</p> <p>C. Take frequent breaks. Drink plenty of clear, non-caffeinated fluids. Know signs and symptoms of heat/cold stress. Maintain vigilance of signs and symptoms in other team members.</p> <p>D. Locate nearest severe weather shelter/strong structure before beginning field work. Suspend fieldwork if lightning occurs within 10 miles of site, or if a severe weather warning issued.</p> <p>E. Understand what chemical hazards exist on site. Stay clear of hazardous atmospheres. If you must enter, perform air monitoring and wear personal detectors designed for the specific contaminants. Wear chemical-resistant PPE such as respirators, gloves, clothing, and boots, dependent on the type and level of contamination.</p> <p>F. Inspect area for hazardous plants and organisms. Avoid such areas if possible. Wear clothing that covers potentially affected body parts. Seal pant legs against contact with plants and to prevent access by organisms. Use insect/tick repellent whenever possible. Do not spray DEET on FRCs.</p> <p>G. Maintain good housekeeping practices to eliminate slip/trip/fall hazards. Keep path clear. Survey walking path before entering into area. Be aware of ground tripping hazards. Be aware of slick, wet ground surfaces. Utilize caution when walking down slopes.</p>



# JOB SAFETY ANALYSIS



For JSA development procedures, visit the Health & Safety Website at <http://intranet.trihydro.com/HS/default.aspx?Content=JSA&Section=SafetyResources&Title=Safety Resources>.

## Seed JSA Development Information:

Job Description: Drilling

Seed JSA Template Version Date: February 8, 2011

Seed JSA Development Team: Grant Price, Heidi Bowen-Morris, John Moore

## Project Seed JSA Adaption Review Process (Seed JSA modifications made for the project):

Project Name: Roxy's Cleaners	Site Location: Havre, Montana	Project Number: 776-023-002
<b>Project Management Reviewer Name</b>	<b>Signature</b>	<b>Date (MM/DD/YYYY)</b>
Jim Gleason		
<b>Health and Safety Team Reviewer Name</b>	<b>Signature</b>	<b>Date (MM/DD/YYYY)</b>

## Site-specific Information (completed daily, on site, and prior to job start by the task manager):

<b>Weather conditions:</b>		<b>Approx. temp:</b>		<b>Approx. wind direction/speed:</b>	/
<b>Site-specific revisions made by:</b>	<b>Position/Title:</b>	<b>Date (MM/DD/YYYY)</b>	<b>Primary Contact Number</b>		
			( ) -		
<b>Team briefed on:</b>	<input type="checkbox"/> Daily Safety Briefing	<input type="checkbox"/> Right to Refuse Unsafe Work	<input type="checkbox"/> Stop Work Authority		

## Personal Protective Equipment (PPE) Anticipated (complete applicable boxes):

<b>Eye and Face Protection</b>	<b>Foot Protection</b>	<b>Fall Protection</b>
Safety glasses, dust-proof safety glasses	Safety-toed boots	
<b>Head Protection</b>	<b>Biological Protection</b>	<b>Respiratory Protection</b>
Hard hat	Snake gaiters, insect repellent	Air-purifying respirator with organic vapors/acid gases cartridge/P100 filter
<b>Hearing Protection</b>	<b>High Visibility Clothing</b>	<b>Protective Clothing</b>
Ear plugs	Vest or jacket	Fire-Retardant Clothing (FRC)
<b>Hand Protection</b>	<b>Water Safety Devices</b>	<b>Other</b>
Industrial work gloves, laceration-resistant gloves, chemical resistant gloves		Sunscreen

## Safety Tools/Equipment/Instruments Anticipated (complete applicable boxes):

<b>Safety Knives</b>	<b>Ventilation</b>	<b>Barricades or Access Control</b>
Utility, Acetate Liner Cutter		Work Zone Delineation
<b>Communications</b>	<b>Atmospheric Monitoring Devices</b>	<b>Other</b>
	Personal H <sub>2</sub> S monitor, LEL/O <sub>2</sub> Meter, PID	

## Specialized/Site-Specific Safety Training Required:

--

## Permits Required:

--

Job Steps		Potential Hazard(s)	Critical Action(s)
1.	Utility locates.	<ul style="list-style-type: none"> <li>A. Utility strike</li> <li>B. Biological hazards (spiders, stinging insects, poisonous snakes, scorpions, etc.)</li> <li>C. Temperature stress</li> </ul>	<ul style="list-style-type: none"> <li>A. Contact One-Call (811) and locate underground utilities at least 48 hours prior to off-site drilling. If a given utility is not registered with One-Call systems, contact a private locates service for utilities located on private property/other suspect utilities.  Visually locate overhead utilities and buried utilities and stay clear of these lines. Use a utility checklist to verify potential utilities have been located and marked.</li> <li>B. Survey area for snakes, scorpions, and other hazards while walking site. Maintain the area around equipment/structures/wells clear of vegetation by a 2' radius to prevent harborage of biological hazards. Thoroughly inspect equipment for insects and signs of insect activity. Use an insecticide if insects are present (follow manufacturer's directions). Do not spray DEET on FRCs. Wear work gloves to protect against stings/bites. Wear snake gaiters in areas with poisonous snakes.</li> <li>C. Dress in layers for cold weather or loose-fitting light clothing for hot weather, but within constraints of HASP. Drink plenty of water or other hydrating liquids (i.e., not sodas).</li> </ul>
2.	Drill rig inspection.	<ul style="list-style-type: none"> <li>A. Inadequate inspection</li> <li>B. Hand lacerations</li> <li>C. Pinch points</li> <li>D. Head struck-against</li> <li>E. Slips/trips/falls</li> </ul>	<ul style="list-style-type: none"> <li>A. Review driller's inspection checklist. Note the locations and verify by testing that drill rig kill switches are in working order. Verify safety latches on winch hooks, check for worn cathead rope or frayed cable, check for presence of an adequate number of cable connectors on winch lines.</li> <li>B. Inspect rig for sharp edges and remove, if possible. Wear industrial work gloves.</li> <li>C. Keep hands clear of pinch points. Label pinch points. Wear industrial work gloves.</li> <li>D. Stay alert of equipment proximity. Wear hard hat during inspection.</li> <li>E. Remove debris and slip/trip hazards from work zone. Keep tools organized and out of pathway. Implement good housekeeping practices.</li> </ul>
3.	Mobilize to sample location.	<ul style="list-style-type: none"> <li>A. Vehicular traffic</li> <li>B. Overhead utility strikes</li> <li>C. Other site activities</li> </ul>	<ul style="list-style-type: none"> <li>A. Follow posted speed limits, traffic signs, and restrictions. Become familiarized with the site. Be aware of site activities. Watch for and be</li> </ul>

Job Steps		Potential Hazard(s)	Critical Action(s)
			<p>aware of vehicular traffic related to contractors. Develop a traffic control plan. Wear high visibility vest or clothing.</p> <p>B. Heavy equipment needs to remain a minimum 4' from energized overhead power lines (and other utilities) while in transport. If required to encroach within the restricted zone, power lines must be de-energized or insulated by the utility company/authorized electrician.</p> <p>C. Familiarize yourself with ongoing and current site activities. Visually check drilling locations prior to setting up. Make sure path to the intended location is stable for a drill rig and has adequate vertical and lateral clearance.</p>
4.	Set up at sample location	<p>A. Overhead utilities strike</p> <p>B. Backing rig: struck-by, property damage</p> <p>C. Personal injury: unauthorized entrants</p> <p>D. Moving rig</p>	<p>A. Begin by walking site location and identifying overhead lines. Heavy equipment must remain 10' minimum from energized overhead power lines when erected (20' for COP; 30' for Frontier). If required to encroach within the restricted zone, power lines must be de-energized or insulated by the utility company/authorized electrician.</p> <p>B. If it is necessary to back up, use a spotter; verify spotter and driver use standard hand signals. Spotter to wear high visibility vest and stay in view of driver. Survey the area for obstacles prior to backing.</p> <p>C. Establish a work zone large enough to encompass the rig in the event it tips over. Unauthorized personnel and non-essential workers are to remain out of the work zone.</p> <p>D. Set up rig on even ground, if possible. Set parking brake and extend outriggers. Use outrigger cribbing for unstable or previously disturbed ground. Use wheel chocks on slopes.</p>
5.	Observe drilling.	<p>A. High noise level</p> <p>B. Flying debris</p> <p>C. Struck-by</p> <p>D. Slip/trips/falls</p> <p>E. Equipment failure</p> <p>F. Severe weather</p>	<p>A. Hearing protection required within 25 feet of operating equipment or when employees cannot maintain a normal conversation at a 2-foot interval.</p> <p>B. Stay away from rotating augers. Verify that "skirt" is in place on air rotary rigs to prevent cuttings from becoming airborne.</p> <p>C. Personnel are not to stand under suspended loads.</p> <p>D. Keep work area clear of tools and equipment.</p> <p>E. Establish the work zone large enough to encompass the rig</p>

Job Steps		Potential Hazard(s)	Critical Action(s)
			<p>height in the event of tip-over and to prevent rig or rig components contacting personnel in the event of equipment failure. Prevent entry of non-essential or unauthorized personnel.</p> <p>F. Locate nearest severe weather shelter/strong structure before beginning field work. Suspend fieldwork if lightning occurs within 10 miles of site or severe weather warning issued.</p>
6.	Sample collection	<p>A. Injury from drill rig moving and powered parts</p> <p>B. Struck-by: dropping steel samplers</p> <p>C. Slips, trips, and falls</p> <p>D. Lacerations to hands</p> <p>E. Chemical hazards</p> <p>F. Pinch hazards</p>	<p>A. Identify emergency shut-offs and verify functionality of each prior to sampling activities. Review drilling/Geoprobe rig emergency procedures. Keep a safe distance from moving and powered parts. Only authorized and essential personnel are allowed in the work zone.</p> <p>B. Sample over a tailgate to prevent dropped parts from contacting feet. Wear safety-toed boots.</p> <p>C. Keep work area clean and clear of equipment, tools, spoils, etc. Keep area clear of ice, snow, gravel, etc. that could present a slip/trip hazard.</p> <p>D. Use Geoprobe acetate liner cutter to cut liner. Wear cut-resistant gloves.</p> <p>E. Wear nitrile gloves when handling soil samples. If visual staining is observed, do not directly smell sample to identify odor. Wear H<sub>2</sub>S detector for soils high in sulfur.</p> <p>F. Wear leather work gloves when transporting and opening sample equipment.</p>
7.	Breakdown at drilling location.	<p>A. Overhead utilities and obstructions</p> <p>B. Slips/trips/falls</p> <p>C. Bystander safety</p>	<p>A. Observe overhead lines and obstructions when lowering mast and tightening winch lines. Use spotter as needed when lowering mast and leaving work area.</p> <p>B. Keep work area clear of tools and equipment.</p> <p>C. Keep bystanders at a safe distance. Remove work area barricades as last item before leaving the work area.</p>
8.	Transfer of impacted drilling waste.	<p>A. Overhead utilities and obstructions</p> <p>B. Slips/trips/falls</p> <p>C. Dropping heavy items</p>	<p>A. When using roll-off containers or dump body trucks, use a spotter to watch for overhead lines and obstructions when containers or dump beds are being lowered or lifted. Stage roll-off containers in an area that is free of overhead obstructions and personnel not working on the project. Use a spotter when utilizing backhoe or similar equipment to transport or dump drums into roll-off</p>

Job Safety Analysis (JSA)

Job Steps		Potential Hazard(s)	Critical Action(s)
			containers. Keeps a safe distance from the soil loading/transfer area. Check that the driller uses safe work practices when transferring soils to the roll-off box. B. Maintain the work areas in a neat and orderly manner. Clean up loose or spilled soils. C. Use mechanical lifting methods when handling drums and similar containers. Personnel are not to stand beneath suspended loads including heavy equipment buckets.
9.	Air rotary specific.	A. Fluid/splashes from surging borehole B. High pressure air hoses	A. In addition to standard PPE, use additional eye protection such as face-shields and/or goggles. Stay back from the borehole as much as the tasks will allow. B. Check that whip-checks are in place on all high pressure air hose connection including the compressor/hose connection. Do not stand near hose connections while the compressor is being used. Observe (from a safe distance) nearby boreholes/wells for the potential ejection of water/solids while compressor is in use. Observe other subsurface structures that have the potential of being damaged for any changes in condition. Stop work in the event that the pressurized air impacts the above discussed items.
10.	Auger specific.	A. Rotating equipment (augers, catheads, etc.) B. Pinch points (augers)	A. Check that augers are stopped before attempting to collect any cuttings. Keep a safe distance from rotating equipment. Do not wear loose clothing or jewelry near rotating equipment. B. Wear steel-toed boots and laceration-resistant gloves.

Prior to work, I have read and understand the PPE, safety tools/equipment/instruments, and associated permits needed for this task. I also understand the job steps, potential hazards, and critical actions identified for employee task and hazard awareness. I agree to have this JSA on site and identify daily variances and understand I can make pen and ink changes to meet those variances. JSAs used at the task site that contain pen-and-ink changes (“dirtying up”) are to be kept in the project folder for record.

**Name**

**Signature**

**Date**

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# JOB SAFETY ANALYSIS



For JSA development procedures, visit the Health & Safety Website at <http://intranet.trihydro.com/HS/default.aspx?Content=JSA&Section=SafetyResources&Title=Safety Resources>.

## Seed JSA Development Information:

Job Description: Groundwater Sampling

Seed JSA Template Version Date: March 7, 2011

Seed JSA Development Team: Jeremy Sell, Justin Simon, Tyson Markham

## Project Seed JSA Adaption Review Process (Seed JSA modifications made for the project):

Project Name: Roxy's Cleaners	Site Location: Havre, Montana	Project Number: 776-023-002
<b>Project Management Reviewer Name</b>	<b>Signature</b>	<b>Date (MM/DD/YYYY)</b>
Jim Gleason		
<b>Health and Safety Team Reviewer Name</b>	<b>Signature</b>	<b>Date (MM/DD/YYYY)</b>

## Site-specific Information (completed daily, on site, and prior to job start by the task manager):

<b>Weather conditions:</b>		<b>Approx. temp:</b>		<b>Approx. wind direction/speed:</b>	/
<b>Site-specific revisions made by:</b>	<b>Position/Title:</b>	<b>Date (MM/DD/YYYY)</b>	<b>Primary Contact Number</b>		
			( ) -		
<b>Team briefed on:</b>	<input type="checkbox"/> Daily Safety Briefing	<input type="checkbox"/> Right to Refuse Unsafe Work	<input type="checkbox"/> Stop Work Authority		

## Personal Protective Equipment (PPE) Anticipated (complete applicable boxes):

<b>Eye and Face Protection</b>	<b>Foot Protection</b>	<b>Fall Protection</b>
Safety glasses	Leather Boots	
<b>Head Protection</b>	<b>Biological Protection</b>	<b>Respiratory Protection</b>
Hard Hat	Snake gaiters, insect repellent	
<b>Hearing Protection</b>	<b>High Visibility Clothing</b>	<b>Protective Clothing</b>
	Vest or Jacket	Fire-Retardant Clothing (FRC)
<b>Hand Protection</b>	<b>Water Safety Devices</b>	<b>Other</b>
Industrial work gloves, chemical-resistant gloves		sunscreen

## Safety Tools/Equipment/Instruments Anticipated (complete applicable boxes):

<b>Safety Knives</b>	<b>Ventilation</b>	<b>Barricades or Access Control</b>
Imbedded blade (hook) knife		Traffic cones
<b>Communications</b>	<b>Atmospheric Monitoring Devices</b>	<b>Other</b>
	Personal H <sub>2</sub> S Detector	

## Specialized/Site-Specific Safety Training Required:

Burlington Northern Santa Fe railyard

## Permits Required:

Job Steps		Potential Hazard(s)	Critical Action(s)
1.	Open well	<ul style="list-style-type: none"> <li>A. Struck-by traffic</li> <li>B. Slips/Trips/Falls</li> <li>C. Biological hazards (spiders, stinging insects, poisonous snakes, scorpions, etc.)</li> <li>D. Chemical hazards (exposure to H<sub>2</sub>S)</li> <li>E. Pinch hazards</li> <li>F. Temperature stress</li> </ul>	<ul style="list-style-type: none"> <li>A. Park vehicle on an angle between well and same-lane of traffic as protection and about 10 – 20' from well, based on traffic speed. Set traffic cone ~50 behind vehicle to alert traffic. Wear a high visibility vest or jacket.</li> <li>B. Survey ground and walking path for trip and slip hazards.</li> <li>C. Survey area for snakes, scorpions, and other hazards while approaching well. Maintain the area around wells clear of vegetation by a 2' radius to prevent harborage of biological hazards. Thoroughly inspect well casing for insects and signs of insect activity. Use an insecticide if insects are present (follow manufacturer's directions). Do not spray DEET on FRCs. Wear work gloves to protect against stings/bites. Wear snake gaiters in areas with poisonous snakes.</li> <li>D. Stand upwind when opening well. Wear an H<sub>2</sub>S meter that has been tested for the day. Wear chemical PPE, including nitrile gloves and safety glasses.</li> <li>E. Avoid pinch points such as hinges, lids, or caps. Wear work gloves.</li> <li>F. Dress in layers for cold weather or loose-fitting light clothing for hot weather, but within constraints of HASP. Drink plenty of water or other hydrating liquids (i.e., not sodas).</li> </ul>
2.	Gauge well	A. Refer to Gauging Fluid Levels JSA	A. Refer to Gauging Fluid Levels JSA
3.	Purge well if bailer sampling	A. Refer to Purge Well JSA	A. Refer to Purge Well JSA
4.	Label bottles	A. Refer to Bottle Preparation JSA	A. Refer to Bottle Preparation JSA
5.	Sample groundwater	<ul style="list-style-type: none"> <li>A. Lacerations from broken VOA</li> <li>B. Chemical exposure</li> <li>C. Pinch points</li> </ul>	<ul style="list-style-type: none"> <li>A. Inspect VOAs after unpacking. They are not to be shipped from the lab with glass-to-glass contact. Inspect for scratches or cracks; discard if present. Close VOA by holding at the very bottom and top with 3 fingers each; do not over tighten.</li> <li>B. Mixing of water and sample bottle preservatives creates a chemical reaction producing hazardous vapors. Maintain body upwind from sample bottle and vapors so as not to inhale the vapors. Wear nitrile gloves, safety glasses, and use the appropriate flow-through device for bailer sampling.</li> <li>C. When conducting low-flow sampling, pinch points are present when connecting hoses to peristaltic</li> </ul>



# JOB SAFETY ANALYSIS



For JSA development procedures, visit the Health & Safety Website at <http://intranet.trihydro.com/HS/default.aspx?Content=JSA&Section=SafetyResources&Title=Safety Resources>.

## Seed JSA Development Information:

Job Description: Remediation System O&M

Seed JSA Template Version Date: February 21, 2011

Seed JSA Development Team: Grant Price, Heidi Bowen-Morris, John Moore

## Project Seed JSA Adaption Review Process (Seed JSA modifications made for the project):

Project Name: Roxy's Cleaners	Site Location: Havre, Montana	Project Number: 776-023-002
<b>Project Management Reviewer Name</b>	<b>Signature</b>	<b>Date (MM/DD/YYYY)</b>
Jim Gleason		
<b>Health and Safety Team Reviewer Name</b>	<b>Signature</b>	<b>Date (MM/DD/YYYY)</b>

## Site-specific Information (completed daily, on site, and prior to job start by the task manager):

<b>Weather conditions:</b>		<b>Approx. temp:</b>		<b>Approx. wind direction/speed:</b>	/
<b>Site-specific revisions made by:</b>	<b>Position/Title:</b>	<b>Date (MM/DD/YYYY)</b>	<b>Primary Contact Number</b>		
			( ) -		
<b>Team briefed on:</b>	<input type="checkbox"/> Daily Safety Briefing	<input type="checkbox"/> Right to Refuse Unsafe Work	<input type="checkbox"/> Stop Work Authority		

## Personal Protective Equipment (PPE) Anticipated (complete applicable boxes):

<b>Eye and Face Protection</b>	<b>Foot Protection</b>	<b>Fall Protection</b>
Safety glasses	Safety-toed boots	
<b>Head Protection</b>	<b>Biological Protection</b>	<b>Respiratory Protection</b>
Hard hat	Snake gaiters, insect repellent	Air-purifying respirator with organic vapors/acid gases cartridge/P100
<b>Hearing Protection</b>	<b>High Visibility Clothing</b>	<b>Protective Clothing</b>
Ear plugs	Vest or jacket	Fire-Retardant Clothing (FRC)
<b>Hand Protection</b>	<b>Water Safety Devices</b>	<b>Other</b>
Industrial work gloves, laceration-resistant gloves, chemical resistant gloves		Sunscreen

## Safety Tools/Equipment/Instruments Anticipated (complete applicable boxes):

<b>Safety Knives</b>	<b>Ventilation</b>	<b>Barricades or Access Control</b>
		Work Zone Delineation
<b>Communications</b>	<b>Atmospheric Monitoring Devices</b>	<b>Other</b>
	Personal H <sub>2</sub> S monitor, LEL/O <sub>2</sub> Meter, PID	

## Specialized/Site-Specific Safety Training Required:

NFPA 70E for work on live electrical components.

## Permits Required:

Job Steps		Potential Hazard(s)	Critical Action(s)
1.	General Work Activity	<ul style="list-style-type: none"> <li>A. Personal injury: unauthorized entrants</li> <li>B. Exposure to hazardous energies and unexpected equipment startup</li> <li>C. Vehicle and pedestrian hazards</li> <li>D. Hazardous atmospheres</li> <li>E. Confined spaces</li> <li>F. Ergonomic hazards</li> <li>G. Slips, trips, falls</li> <li>H. Biological hazards (spiders, stinging insects, poisonous snakes, scorpions, etc.)</li> <li>I. Temperature stress</li> </ul>	<ul style="list-style-type: none"> <li>A. Establish a work zone. Unauthorized personnel and non-essential workers are to remain out of the work zone. Lock the doors to remediation system, including the equipment room, the control room, and/or the shed when authorized personnel are not present or are not able to monitor the doors continuously.</li> <li>B. Lockout / tagout procedures are mandatory when performing maintenance on equipment or replacing equipment. Maintenance includes, but is not limited to, cleaning equipment, changing oil, and tightening belts. Replacing equipment includes, but is not limited to, changing gaskets and O-rings. When testing equipment, lockout / tagout procedures may be appropriate dependent upon the circumstances as determined by the technician in charge.</li> <li>C. Traffic control plans are required for work in areas with vehicular or pedestrian traffic. Refer to the traffic control plan located in the HASP. Face oncoming traffic in parking areas and other high traffic zones. Wear traffic safety vest in traffic zones.</li> <li>D. Understand the exposure potential in the various work zones. If there is a potential for hazardous atmospheres, conduct periodic air sampling in accordance with the HASP. Wear personal H<sub>2</sub>S meter where there is a potential for H<sub>2</sub>S exposure.</li> <li>E. Evaluate potential confined spaces using the Trihydro Confined Space Evaluation form. Do not enter permit-required confined spaces without additional training and guidance from the H&amp;S team.</li> <li>F. Use mechanical lifting devices. Use two people for loads greater than 50 pounds or when the size prevents easy handling. Use proper lifting techniques.</li> <li>G. Remove debris and slip/trip hazards from work zone. Keep tools organized and out of pathways. Implement good housekeeping practices.</li> <li>H. Survey area for snakes, scorpions, and other hazards while walking site. Maintain the area around equipment/structures/wells clear of vegetation by a 2' radius to</li> </ul>

Job Steps		Potential Hazard(s)	Critical Action(s)
			<p>prevent harborage of biological hazards. Thoroughly inspect equipment for insects and signs of insect activity. Use an insecticide if insects are present (follow manufacturer's directions). Do not spray DEET on FRCs. Wear work gloves to protect against stings/bites. Wear snake gaiters in areas with poisonous snakes.</p> <p>I. Dress in layers for cold weather or loose-fitting light clothing for hot weather, but within constraints of HASP. Drink plenty of water or other hydrating liquids (i.e., not sodas).</p>
2.	Gauge water levels and product thickness (where applicable) in wells	<p>A. Inhalation of chemicals</p> <p>B. Dermal exposure to chemical hazards</p> <p>C. Repetitive motion or back strain</p> <p>D. Traffic hazards/personnel being struck by a vehicle</p>	<p>A. Stand upwind. Monitor exposure levels in the breathing zone in accordance with the HASP. Take breaks as necessary and alternate field staff conducting work, if possible.</p> <p>B. Wear chemical-resistant PPE in accordance with HASP.</p> <p>C. Use proper lifting techniques and tools.</p> <p>D. Use staff for traffic control when possible. Maintain traffic control and face oncoming traffic. Use fleet vehicle as protection.</p>
3.	Collect samples in accordance with sampling plan	<p>A. Back strain</p> <p>B. Inhalation of chemicals</p> <p>C. Dermal exposure to chemical hazards</p> <p>D. Chemical exposure from improper labeling or storage</p> <p>E. Injury from broken sample bottle (e.g., cuts, acid burn, exposure to contamination)</p>	<p>A. Use mechanical lifting devices when feasible. Seek assistance when lifting. Use proper lifting techniques.</p> <p>B. Stand upwind. Monitor exposure levels in the breathing zone in accordance with the HASP.</p> <p>C. Wear chemical-resistant gloves.</p> <p>D. Label samples in accordance with sampling plan. Keep samples stored in proper containers, at correct temperature, and away from work area.</p> <p>E. Inspect bottles for scratches or crack. Labs are to ship bottles without glass-to-glass contact. Handle bottles carefully.</p>
4.	Perform routine maintenance on blower	<p>A. Electrocution</p> <p>B. Burns from exposure to hot metal or oil</p> <p>C. Back strain</p>	<p>A. Follow lockout/tagout procedures.</p> <p>B. Allow the equipment to cool prior to maintenance.</p> <p>C. Use proper working positions.</p>
5.	Clean oil/water separator and/or air stripper	<p>A. Inhalation of chemicals</p> <p>B. Dermal exposure to chemical hazards</p> <p>C. Electrocution</p> <p>D. Back strain</p>	<p>A. Verify there is adequate ventilation in building or trailer to keep levels below PELs. Monitor air in accordance with the HASP.</p> <p>B. Don chemical-resistant PPE including splash protection.</p> <p>C. Follow lockout/tagout procedures.</p> <p>D. Seek assistance with lifting, if available. Use proper lifting</p>

Job Safety Analysis (JSA)

Job Steps		Potential Hazard(s)	Critical Action(s)
			technique.
6.	Clean transfer and/or submersible pump impeller/housing	A. Inhalation of chemicals B. Dermal exposure to chemical hazards C. Back Strain	A. Verify there is adequate ventilation to keep levels below PELs. Monitor air in accordance with the HASP. B. Don chemical-resistant PPE, including splash protection. C. Seek assistance with lifting, if available. Use proper lifting technique.
7.	Remove / clean submersible pneumatic pumps	A. Inhalation of chemicals B. Dermal exposure to chemical hazards C. Personal injury from exposure to high pressure air/water D. Back strain	A. Verify there is adequate ventilation to keep levels below PELs. Monitor air in accordance with the HASP. B. Don chemical-resistant PPE, including splash protection. C. Follow lockout/tagout procedures. D. Seek assistance with lifting, if available. Use proper lifting technique.
8.	Troubleshooting electrical components and/or control systems	A. Electrocution	A. Follow lockout/tagout procedures, where appropriate. Restrict this task to NFPA 70E trained, experienced technicians.
9.	Clean site/demobilize	A. Traffic hazards B. Safety hazards left on-site C. Lifting hazards	A. Use buddy system as necessary to remove traffic control. B. Leave site clean of refuse and debris. Notify station personnel or property owner of facility status and work team departure (as necessary). C. Seek assistance with lifting, if available. Use proper lifting technique.

Prior to work, I have read and understand the PPE, safety tools/equipment/instruments, and associated permits needed for this task. I also understand the job steps, potential hazards, and critical actions identified for employee task and hazard awareness. I agree to have this JSA on site and identify daily variances and understand I can make pen and ink changes to meet those variances. JSAs used at the task site that contain pen-and-ink changes ("dirtying up") are to be kept in the project folder for record.

**Name**

**Signature**

**Date**

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# JOB SAFETY ANALYSIS



For JSA development procedures, visit the Health & Safety Website at <http://intranet.trihydro.com/HS/default.aspx?Content=JSA&Section=SafetyResources&Title=Safety Resources>.

## Seed JSA Development Information:

Job Description: Site visit/tour

Seed JSA Template Version Date: February 21, 2011

Seed JSA Development Team: John Trotter

## Project Seed JSA Adaption Review Process (Seed JSA modifications made for the project):

Project Name: Roxy's Cleaner	Site Location: Havre, Montana	Project Number: 776-023-002
<b>Project Management Reviewer Name</b>	<b>Signature</b>	<b>Date (MM/DD/YYYY)</b>
Jim Gleason		
<b>Health and Safety Team Reviewer Name</b>	<b>Signature</b>	<b>Date (MM/DD/YYYY)</b>

## Site-specific Information (completed daily, on site, and prior to job start by the task manager):

<b>Weather conditions:</b>		<b>Approx. temp:</b>		<b>Approx. wind direction/speed:</b>	/
<b>Site-specific revisions made by:</b>	<b>Position/Title:</b>	<b>Date (MM/DD/YYYY)</b>	<b>Primary Contact Number</b>		
			( ) -		
<b>Team briefed on:</b>	<input type="checkbox"/> Daily Safety Briefing	<input type="checkbox"/> Right to Refuse Unsafe Work	<input type="checkbox"/> Stop Work Authority		

## Personal Protective Equipment (PPE) Anticipated (complete applicable boxes):

<b>Eye and Face Protection</b>	<b>Foot Protection</b>	<b>Fall Protection</b>
Safety glasses w/side shields	Safety-toed boots	
<b>Head Protection</b>	<b>Biological Protection</b>	<b>Respiratory Protection</b>
Hard hat	Snake gaiters, insect repellent	
<b>Hearing Protection</b>	<b>High Visibility Clothing</b>	<b>Protective Clothing</b>
Ear plugs	Vest or jacket	Fire-Retardant Clothing (FRC)
<b>Hand Protection</b>	<b>Water Safety Devices</b>	<b>Other</b>
Work gloves		Ice traction footwear, sunscreen

## Safety Tools/Equipment/Instruments Anticipated (complete applicable boxes):

<b>Safety Knives</b>	<b>Ventilation</b>	<b>Barricades or Access Control</b>
<b>Communications</b>	<b>Atmospheric Monitoring Devices</b>	<b>Other</b>
Radio	Personal H <sub>2</sub> S monitor	

## Specialized/Site-Specific Safety Training Required:

## Permits Required:

Job Steps		Potential Hazard(s)	Critical Action(s)
1.	Arriving at site	<ul style="list-style-type: none"> <li>A. Site emergencies</li> <li>B. Noise</li> <li>C. Slip/Trip/Fall</li> <li>D. Low obstacles</li> <li>E. Loss of phone contact/location with site supervisor</li> </ul>	<ul style="list-style-type: none"> <li>A. Sign in at the client site location, take note of emergency evacuation routes and muster area locations.</li> <li>B. Use hearing protection if site equipment is in operation.</li> <li>C. Watch steps for ice/snow and wear traction devices; watch for slip and trip hazards.</li> <li>D. Be aware of pipe/conduit in the area.</li> <li>E. Return to the check-in location and regain contact.</li> </ul>
2.	Site visit	<ul style="list-style-type: none"> <li>A. Traffic hazards</li> <li>B. Slip/Trip/Fall</li> <li>C. Operations hazards</li> <li>D. Biological hazards (spiders, stinging insects, poisonous snakes, scorpions, etc.)</li> <li>E. Temperature stress</li> </ul>	<ul style="list-style-type: none"> <li>A. Park vehicle defensively for protection from traffic; wear high-visibility clothing.</li> <li>B. Wear safety-toed boots or sturdy footwear and watch for slip and trip hazards; wear traction devices.</li> <li>C. Note site hazards and remain clear of ongoing operations, unless otherwise noted.</li> <li>D. Survey area for snakes, scorpions, and other hazards while walking site. Maintain the area around equipment/structures/wells clear of vegetation by a 2' radius to prevent harborage of biological hazards. Thoroughly inspect equipment for insects and signs of insect activity. Use an insecticide if insects are present (follow manufacturer's directions). Do not spray DEET on FRCs. Wear work gloves to protect against stings/bites. Wear snake gaiters in areas with poisonous snakes.</li> <li>E. Dress in layers for cold weather or loose-fitting light clothing for hot weather, but within constraints of HASP. Drink plenty of water or other hydrating liquids (i.e., not sodas).</li> </ul>
3.	Leaving site	<ul style="list-style-type: none"> <li>A. Noise</li> <li>B. Slip/Trip/Fall</li> <li>C. Low obstacles</li> <li>D. Loss of phone contact/location with site supervisor</li> <li>E. Site emergencies</li> </ul>	<ul style="list-style-type: none"> <li>A. Use hearing protection if site equipment is in operation.</li> <li>B. Watch steps for ice/snow and wear traction devices; watch for slip and trip hazards.</li> <li>C. Be aware of pipe/conduit in the area.</li> <li>D. Return to the check-in location and regain contact.</li> <li>E. Sign out at the client site location to make sure the client is aware of your departure</li> </ul>



# JOB SAFETY ANALYSIS



For JSA development procedures, visit the Health & Safety Website at <http://intranet.trihydro.com/HS/default.aspx?Content=JSA&Section=SafetyResources&Title=Safety Resources>.

## Seed JSA Development Information:

Job Description: SUMMA Canister Air Sampling

Seed JSA Template Version Date: February 21, 2011

Seed JSA Development Team: Allison Riffel, Matt Jones

## Project Seed JSA Adaption Review Process (Seed JSA modifications made for the project):

Project Name: Roxy's Cleaners	Site Location: Havre, Montana	Project Number: 776-023-002
<b>Project Management Reviewer Name</b>	<b>Signature</b>	<b>Date (MM/DD/YYYY)</b>
Jim Gleason		
<b>Health and Safety Team Reviewer Name</b>	<b>Signature</b>	<b>Date (MM/DD/YYYY)</b>

## Site-specific Information (completed daily, on site, and prior to job start by the task manager):

<b>Weather conditions:</b>		<b>Approx. temp:</b>		<b>Approx. wind direction/speed:</b>	/
<b>Site-specific revisions made by:</b>	<b>Position/Title:</b>	<b>Date (MM/DD/YYYY)</b>	<b>Primary Contact Number</b>		
			( ) -		
<b>Team briefed on:</b>	<input type="checkbox"/> Daily Safety Briefing	<input type="checkbox"/> Right to Refuse Unsafe Work	<input type="checkbox"/> Stop Work Authority		

## Personal Protective Equipment (PPE) Anticipated (complete applicable boxes):

<b>Eye and Face Protection</b>	<b>Foot Protection</b>	<b>Fall Protection</b>
Safety glasses		
<b>Head Protection</b>	<b>Biological Protection</b>	<b>Respiratory Protection</b>
	Snake gaiters, insect repellent	
<b>Hearing Protection</b>	<b>High Visibility Clothing</b>	<b>Protective Clothing</b>
	High-visibility vests	Fire-Retardant Clothing (FRC)
<b>Hand Protection</b>	<b>Water Safety Devices</b>	<b>Other</b>
Leather work gloves		Sunscreen

## Safety Tools/Equipment/Instruments Anticipated (complete applicable boxes):

<b>Safety Knives</b>	<b>Ventilation</b>	<b>Barricades or Access Control</b>
		Caution tape and traffic cones/wooden stakes
<b>Communications</b>	<b>Atmospheric Monitoring Devices</b>	<b>Other</b>

## Specialized/Site-Specific Safety Training Required:

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## Permits Required:

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Job Steps		Potential Hazard(s)	Critical Action(s)
1.	Establish sampling area	<ul style="list-style-type: none"> <li>A. Vehicular traffic</li> <li>B. Moving vehicle</li> <li>C. Slips/Trips/Falls</li> <li>D. Unauthorized entry of personnel and vehicles</li> <li>E. Hand laceration/splinters/struck-by while driving wooden stakes</li> <li>F. Flying wooden debris while driving stakes</li> <li>G. Struck by hammer head while driving wooden stakes</li> <li>H. Carbon monoxide exposure</li> <li>I. Biological hazards (spiders, stinging insects, poisonous snakes, scorpions, etc.)</li> <li>J. Temperature stress</li> </ul>	<ul style="list-style-type: none"> <li>A. Park fleet vehicle on angle as a barrier between team members and same-lane traffic. Set up traffic cone 25-50' from vehicle to warn traffic of work zone. Wear high-visibility vests.</li> <li>B. Set steering wheel to the far left or right so if vehicle moves out of park, it will travel away from personnel and traffic. Set parking brake. Chock wheels if parked on a slope.</li> <li>C. Survey area for slip/trip/fall hazards and remove if possible. Choose the safest walk path to sampling area. Implement good housekeeping practices.</li> <li>D. Establish a work zone using caution tape and traffic cones/wooden stakes. Non-essential and unauthorized personnel are to remain outside the work zone.</li> <li>E. Wear protective gloves while driving stakes. Hold stake a few inches below the stake top to prevent hitting your hand if stake is missed when hammering.</li> <li>F. Wear safety glasses with side shields.</li> <li>G. Inspect hammer prior to use: look for cracked handle or loose hammer head.</li> <li>H. If vehicle is parked up wind, turn off engine to prevent carbon monoxide exposure.</li> <li>I. Survey area for snakes, scorpions, and other hazards while walking site. Maintain the area around equipment/structures/wells clear of vegetation by a 2' radius to prevent harborage of biological hazards. Thoroughly inspect equipment for insects and signs of insect activity. Use an insecticide if insects are present (follow manufacturer's directions). Do not spray DEET on FRCs. Wear work gloves to protect against stings/bites. Wear snake gaiters in areas with poisonous snakes.</li> <li>J. Dress in layers for cold weather or loose-fitting light clothing for hot weather, but within constraints of HASP. Drink plenty of water or other hydrating liquids (i.e., not sodas).</li> </ul>
2.	Set up SUMMA canister	<ul style="list-style-type: none"> <li>A. Pinch points</li> <li>B. Hand lacerations</li> <li>C. Hand injuries from hand tools</li> <li>D. Exposure to air contaminants</li> <li>E. Damaged components</li> </ul>	<ul style="list-style-type: none"> <li>A. Keep fingers and hands clear of pinch points when making connections.</li> <li>B. Check equipment and connections for sharp edges; remove if possible. Wear work gloves if sharp edges</li> </ul>

Job Steps		Potential Hazard(s)	Critical Action(s)
			cannot be removed. C. Inspect hand tools for damage prior to use. Verify the right tool for the task. D. Do not open sampling ports, if applicable, prior to connecting canister. E. Verify connections are made without cross-threading.
3.	Disconnect SUMMA canister	A. Hand lacerations B. Exposure to air contaminants	A. Wear work gloves if sharp edges cannot be removed. B. Close sampling ports, if applicable, prior to disconnecting canister.
4.	Deconstruct sampling area	A. Vehicular traffic B. Hand laceration/splinters, struck-by while pulling wooden stakes C. Trip hazards from broken stakes. D. Punctures from broken stakes.	A. Maintain a vigilance of traffic while deconstructing sampling area. Wear high-visibility vests. Leave traffic cone to the rear of the vehicle until rest of task is completed. B. Wear protective gloves while pulling stakes. Keep body/face clear of stake while pulling to prevent contact after clearing the ground. C. If the remaining stake cannot be completely removed, use hammer to break off excess stake and pound remaining stake into the ground. Wear safety glasses with side shields. D. Dull the broken end of the stake by pounding with a hammer. Wear safety glasses with side shields.

Prior to work, I have read and understand the PPE, safety tools/equipment/instruments, and associated permits needed for this task. I also understand the job steps, potential hazards, and critical actions identified for employee task and hazard awareness. I agree to have this JSA on site and identify daily variances and understand I can make pen and ink changes to meet those variances. JSAs used at the task site that contain pen-and-ink changes (“dirtying up”) are to be kept in the project folder for record.

**Name**

**Signature**

**Date**

_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

**APPENDIX D**

**MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY-SPECIFIC HEALTH AND SAFETY  
POLICIES, PROCEDURES, AND PLANS  
(BRIDGING DOCUMENT)**

## **Bridging of Trihydro Corporation and Subcontractor Safety Requirements to Montana Department of Environmental Quality Policies and Procedures**

The Site-Specific Health and Safety Plan (HASP) for project site work conducted at the Montana Department of Environmental Quality site located in Havre, Montana 59501, includes this attachment for “bridging” the policies and procedures of the site with safe work practices of Trihydro Corporation (Trihydro) and its subcontractors.

**Purpose:** To verify that Trihydro and its subcontractors understand and comply with written policies and procedures of Montana Department of Environmental Quality, as applicable to the work of Trihydro and its subcontractors in the site environment. Where Trihydro, its subcontractors, and Montana Department of Environmental Quality have similar safe work practices and procedures, the more restrictive and protective safe work practices are the only procedures implemented.

**Implementation:** The included table lists Montana Department of Environmental Quality policies and procedures in existence at the site. Many of these topics are also covered in Trihydro’s site and corporate health and safety policies and plans.

The Montana Department of Environmental Quality site policies and procedures listed in the table are those that are applicable to the work of Trihydro and its subcontractors. The more restrictive and protective site policies and procedures and safe work practices, whether Montana Department of Environmental Quality, Trihydro, or subcontractor, supersede and take precedence over similar practices discussed in Trihydro Site and Corporate Health and Safety Plans or subcontractor safety procedures. Trihydro and Trihydro subcontract personnel who perform field services at the site must read, understand, and comply with these policies and procedures. However, if Trihydro, subcontractor, or Montana Department of Environmental Quality personnel have doubts about the adequacy of the policies and procedures covering safe performance of the work, stop work immediately and contact the Trihydro Project Site Manager and Site Safety Officer. Work will not proceed until the Trihydro PM Manager or Site Safety Officer has discussed the matter with Montana Department of Environmental Quality personnel and provided the affected Trihydro and subcontractor personnel with further instructions about how to proceed.

**Contractor Regulations and Safety Manual Content**

The following list of safety policies and procedures make up the content of the basic safety policies and procedures and safety manuals at the site.  N/A

The client may add or delete other safety policies and procedures as determined by the specific work a contractor is performing.

Title

**APPENDIX E**

**SAFETY DATA SHEETS (SDSs) / MATERIAL SAFETY DATA SHEETS (MSDSs)**

# MATERIAL SAFETY DATA SHEET

---

## 1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

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**MATHESON TRI-GAS, INC.**  
**959 ROUTE 46 EAST**  
**PARSIPPANY, NEW JERSEY 07054-0624**

**EMERGENCY CONTACT:**  
**CHEMTREC 1-800-424-9300**  
**INFORMATION CONTACT:**  
**973-257-1100**

**SUBSTANCE: VINYLIDENE CHLORIDE**

**TRADE NAMES/SYNONYMS:**

MTG MSDS 239; 1,1-DICHLOROETHENE; 1,1-DICHLOROETHYLENE; VDC; VINYLIDENE CHLORIDE MONOMER; VINYLIDENE DICHLORIDE; VINYLIDENE CHLORIDE, INHIBITED; RCRA U078; UN 1303; C2H2CL2; MAT25070; RTECS KV9275000

**CHEMICAL FAMILY:** halogens

**CREATION DATE:** Jan 24 1989

**REVISION DATE:** Dec 08 2005

---

## 2. COMPOSITION, INFORMATION ON INGREDIENTS

---

**COMPONENT:** VINYLIDENE CHLORIDE  
**CAS NUMBER:** 75-35-4  
**PERCENTAGE:** >99.9

**COMPONENT:** 4-METHOXYPHENOL  
**CAS NUMBER:** 150-76-5  
**PERCENTAGE:** 0.02000

---

## 3. HAZARDS IDENTIFICATION

---

**NFPA RATINGS (SCALE 0-4):** HEALTH=2 FIRE=4 REACTIVITY=2

**EMERGENCY OVERVIEW:**

**COLOR:** colorless

**PHYSICAL FORM:** volatile liquid

**ODOR:** faint odor, sweet odor

**MAJOR HEALTH HAZARDS:** harmful if swallowed, respiratory tract irritation, skin irritation, eye irritation, central nervous system depression



**PHYSICAL HAZARDS:** Flammable liquid and vapor. Vapor may cause flash fire. May polymerize. Containers may rupture or explode. May form peroxides during prolonged storage.

**POTENTIAL HEALTH EFFECTS:**

**INHALATION:**

**SHORT TERM EXPOSURE:** irritation, symptoms of drunkenness, lung congestion, liver damage, convulsions

**LONG TERM EXPOSURE:** kidney damage, tumors

**SKIN CONTACT:**

**SHORT TERM EXPOSURE:** irritation (possibly severe)

**LONG TERM EXPOSURE:** same as effects reported in short term exposure

**EYE CONTACT:**

**SHORT TERM EXPOSURE:** irritation (possibly severe), eye damage

**LONG TERM EXPOSURE:** same as effects reported in short term exposure

**INGESTION:**

**SHORT TERM EXPOSURE:** symptoms of drunkenness, liver damage

**LONG TERM EXPOSURE:** same as effects reported in short term exposure

---

## 4. FIRST AID MEASURES

---

**INHALATION:** If adverse effects occur, remove to uncontaminated area. Give artificial respiration if not breathing. Get immediate medical attention.

**SKIN CONTACT:** Wash skin with soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention, if needed. Thoroughly clean and dry contaminated clothing and shoes before reuse.

**EYE CONTACT:** Flush eyes with plenty of water for at least 15 minutes. Then get immediate medical attention.

**INGESTION:** If a large amount is swallowed, get medical attention.

---

## 5. FIRE FIGHTING MEASURES

---

**FIRE AND EXPLOSION HAZARDS:** Severe fire hazard. The vapor is heavier than air. Vapors or gases may ignite at distant ignition sources and flash back. Vapor/air mixtures are explosive above flash point. Containers may rupture or explode if exposed to heat.

**EXTINGUISHING MEDIA:** alcohol resistant foam, carbon dioxide, regular dry chemical, water

Large fires: Use alcohol-resistant foam or flood with fine water spray.

**FIRE FIGHTING:** Move container from fire area if it can be done without risk. Cool containers with water spray until well after the fire is out. Stay away from the ends of tanks. For fires in cargo or storage area: Cool

containers with water from unmanned hose holder or monitor nozzles until well after fire is out. If this is impossible then take the following precautions: Keep unnecessary people away, isolate hazard area and deny entry. Let the fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tanks due to fire. For tank, rail car or tank truck: Evacuation radius: 800 meters (1/2 mile). Do not attempt to extinguish fire unless flow of material can be stopped first. Flood with fine water spray. Do not scatter spilled material with high-pressure water streams. Cool containers with water spray until well after the fire is out. Apply water from a protected location or from a safe distance. Avoid inhalation of material or combustion by-products. Stay upwind and keep out of low areas. Water may be ineffective.

**FLASH POINT:** 14 F (-10 C)

**LOWER FLAMMABLE LIMIT:** 5.6%

**UPPER FLAMMABLE LIMIT:** 11.4%

**AUTOIGNITION:** 855 F (457 C)

**FLAMMABILITY CLASS (OSHA):** IA

---

## 6. ACCIDENTAL RELEASE MEASURES

---

### **AIR RELEASE:**

Reduce vapors with water spray. Stay upwind and keep out of low areas.

### **SOIL RELEASE:**

Dig holding area such as lagoon, pond or pit for containment. Dike for later disposal. Absorb with sand or other non-combustible material.

### **WATER RELEASE:**

Collect with absorbent into suitable container. Collect spilled material using mechanical equipment.

### **OCCUPATIONAL RELEASE:**

Avoid heat, flames, sparks and other sources of ignition. Remove sources of ignition. Stop leak if possible without personal risk. Reduce vapors with water spray. Small spills: Absorb with sand or other non-combustible material. Collect spilled material in appropriate container for disposal. Large spills: Dike for later disposal. Keep unnecessary people away, isolate hazard area and deny entry. Stay upwind and keep out of low areas. Notify Local Emergency Planning Committee and State Emergency Response Commission for release greater than or equal to RQ (U.S. SARA Section 304). If release occurs in the U.S. and is reportable under CERCLA Section 103, notify the National Response Center at (800)424-8802 (USA) or (202)426-2675 (USA).

---

## 7. HANDLING AND STORAGE

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**STORAGE:** Store and handle in accordance with all current regulations and standards. Subject to storage regulations: U.S. OSHA 29 CFR 1910.106. Grounding and bonding required. Store in a cool, dry place. Store in a well-ventilated area. Keep in the dark. Keep separated from incompatible substances. Store outside or in a detached building. Store with flammable liquids. Store in a tightly closed container. Containers must have overpressure release device. Avoid heat, flames, sparks and other sources of ignition. Keep separated

from incompatible substances. Monitor inhibitor content. Avoid exposure to low temperatures or freezing. May form explosive peroxides. Store in a tightly closed container. Avoid contact with light. Store in a cool, dry place. Monitor inhibitor content. Do not evaporate or distill to dryness. Keep separated from incompatible substances.

---

## 8. EXPOSURE CONTROLS, PERSONAL PROTECTION

---

### **EXPOSURE LIMITS:**

#### **VINYLDENE CHLORIDE:**

1 ppm (4 mg/m<sup>3</sup>) OSHA TWA (vacated by 58 FR 35338, June 30, 1993)

5 ppm ACGIH TWA

NIOSH TWA (lowest feasible concentration)

**VENTILATION:** Provide local exhaust ventilation system. Ventilation equipment should be explosion-resistant if explosive concentrations of material are present. Ensure compliance with applicable exposure limits.

**EYE PROTECTION:** Wear splash resistant safety goggles. Provide an emergency eye wash fountain and quick drench shower in the immediate work area.

**CLOTHING:** Wear appropriate chemical resistant clothing.

**GLOVES:** Wear appropriate chemical resistant gloves.

**RESPIRATOR:** The following respirators and maximum use concentrations are drawn from NIOSH and/or OSHA.

#### **At any detectable concentration -**

Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.

Any supplied-air respirator with full facepiece and operated in a pressure-demand or other positive-pressure mode in combination with a separate escape supply.

#### **Escape -**

Any air-purifying respirator with a full facepiece and an organic vapor canister.

Any appropriate escape-type, self-contained breathing apparatus.

#### **For Unknown Concentrations or Immediately Dangerous to Life or Health -**

Any supplied-air respirator with full facepiece and operated in a pressure-demand or other positive-pressure mode in combination with a separate escape supply.

Any self-contained breathing apparatus with a full facepiece.

---

## 9. PHYSICAL AND CHEMICAL PROPERTIES

---

**PHYSICAL STATE:** liquid

**COLOR:** colorless

**PHYSICAL FORM:** volatile liquid

**ODOR:** faint odor, sweet odor  
**MOLECULAR WEIGHT:** 96.64  
**MOLECULAR FORMULA:** C<sub>2</sub>H<sub>2</sub>CL<sub>2</sub>  
**BOILING POINT:** 86-90 F (30-32 C)  
**FREEZING POINT:** -188 F (-122 C)  
**VAPOR PRESSURE:** 400 mmHg @ 14.8 C  
**VAPOR DENSITY (air=1):** 3.4  
**SPECIFIC GRAVITY (water=1):** 1.213  
**WATER SOLUBILITY:** 0.04% @ 20 C  
**PH:** Not available  
**VOLATILITY:** Not available  
**ODOR THRESHOLD:** 500 ppm  
**EVAPORATION RATE:** Not available  
**COEFFICIENT OF WATER/OIL DISTRIBUTION:** Not available  
**SOLVENT SOLUBILITY:**  
**Soluble:** organic solvents

---

## 10. STABILITY AND REACTIVITY

---

**REACTIVITY:** May form explosive peroxides. Avoid contact with temperatures above -40 C. Avoid contact with heat, air, light or moisture and monitor inhibitor content. May polymerize. Closed containers may rupture violently.

**CONDITIONS TO AVOID:** Avoid heat, flames, sparks and other sources of ignition. Containers may rupture or explode if exposed to heat.

**INCOMPATIBILITIES:** metals, acids, oxidizing materials

**HAZARDOUS DECOMPOSITION:**

Thermal decomposition products: phosgene, halogenated compounds, oxides of carbon

**POLYMERIZATION:** May polymerize. Avoid contact with heat or light and monitor inhibitor content.

---

## 11. TOXICOLOGICAL INFORMATION

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**VINYLDENE CHLORIDE:**

**TOXICITY DATA:**

10000 mg/m<sup>3</sup> inhalation-rat LC<sub>50</sub>; 200 mg/kg oral-rat LD<sub>50</sub>

**CARCINOGEN STATUS:** IARC: Human Inadequate Evidence, Animal Limited Evidence, Group 3;

ACGIH: A4 -Not Classifiable as a Human Carcinogen

**LOCAL EFFECTS:**

Irritant: inhalation, skin, eye

**ACUTE TOXICITY LEVEL:**

Toxic: inhalation, ingestion

**TARGET ORGANS:** central nervous system, liver  
**TUMORIGENIC DATA:** Available.  
**MUTAGENIC DATA:** Available.  
**REPRODUCTIVE EFFECTS DATA:** Available.

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## 12. ECOLOGICAL INFORMATION

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**ECOTOXICITY DATA:**

**FISH TOXICITY:** 74000 ug/L 96 hour(s) LC50 (Mortality) Bluegill (*Lepomis macrochirus*)

**INVERTEBRATE TOXICITY:** 224000 ug/L 96 hour(s) LC50 (Mortality) Opossum shrimp (*Mysidopsis bahia*)

**ALGAL TOXICITY:** >712000 ug/L 96 hour(s) EC50 (Photosynthesis) Diatom (*Skeletonema costatum*)

**ENVIRONMENTAL SUMMARY:** Moderately toxic to aquatic life.

---

## 13. DISPOSAL CONSIDERATIONS

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Subject to disposal regulations: U.S. EPA 40 CFR 262. Hazardous Waste Number(s): U078. Hazardous Waste Number(s): D029. Dispose of in accordance with U.S. EPA 40 CFR 262 for concentrations at or above the Regulatory level. Regulatory level- 0.7 mg/L. Dispose in accordance with all applicable regulations.

---

## 14. TRANSPORT INFORMATION

---

**U.S. DOT 49 CFR 172.101:**

**PROPER SHIPPING NAME:** Vinylidene chloride, stabilized

**ID NUMBER:** UN1303

**HAZARD CLASS OR DIVISION:** 3

**PACKING GROUP:** I

**LABELING REQUIREMENTS:** 3



**CANADIAN TRANSPORTATION OF DANGEROUS GOODS:**

**SHIPPING NAME:** Vinylidene chloride, stabilized

**UN NUMBER:** UN1303

**CLASS:** 3

**PACKING GROUP/RISK GROUP:** I

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## 15. REGULATORY INFORMATION

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**U.S. REGULATIONS:**

**CERCLA SECTIONS 102a/103 HAZARDOUS SUBSTANCES (40 CFR 302.4):**

**VINYLDINE CHLORIDE: 100 LBS RQ**

**SARA TITLE III SECTION 302 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355.30):** Not regulated.

**SARA TITLE III SECTION 304 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355.40):** Not regulated.

**SARA TITLE III SARA SECTIONS 311/312 HAZARDOUS CATEGORIES (40 CFR 370.21):**

ACUTE: Yes

CHRONIC: Yes

FIRE: Yes

REACTIVE: Yes

SUDDEN RELEASE: Yes

**SARA TITLE III SECTION 313 (40 CFR 372.65):**

**VINYLDINE CHLORIDE**

**OSHA PROCESS SAFETY (29CFR1910.119):** Not regulated.

**STATE REGULATIONS:**

**California Proposition 65:** Not regulated.

**CANADIAN REGULATIONS:**

**WHMIS CLASSIFICATION:** BD2

**NATIONAL INVENTORY STATUS:**

**U.S. INVENTORY (TSCA):** Listed on inventory.

**TSCA 12(b) EXPORT NOTIFICATION:**

**VINYLDENE CHLORIDE**

**CAS NUMBER:** 75-35-4

SECTION 4

**4-METHOXYPHENOL**

**CAS NUMBER:** 150-76-5

SECTION 4

**CANADA INVENTORY (DSL/NDL):** Not determined.

---

**16. OTHER INFORMATION**

---

**MSDS SUMMARY OF CHANGES**

**8. EXPOSURE CONTROLS, PERSONAL PROTECTION**

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# Safety Data Sheet

**Product :**

**Methane**

Page :1/4

MSDS Nr : 078A\_AL

Version : 1.01

Date : 31/07/2002

## 1 IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY

MSDS Nr	078A_AL
Product name	Methane
Chemical formula	CH <sub>4</sub>
Company identification	see heading and/or footer see paragraph 16 "OTHER INFORMATION"
Emergency phone numbers	see heading and/or footer see paragraph 16 "OTHER INFORMATION"

## 2 COMPOSITION/INFORMATION ON INGREDIENTS

Substance/Preparation	Substance.
Components/Impurities	Contains no other components or impurities which will influence the classification of the product.
CAS Nr	00074-82-8
EEC Nr (from EINECS)	200-812-7

## 3 HAZARDS IDENTIFICATION

Hazards identification	Compressed gas Extremely flammable
------------------------	---------------------------------------

## 4 FIRST AID MEASURES

Inhalation	In high concentrations may cause asphyxiation. Symptoms may include loss of mobility/consciousness. Victim may not be aware of asphyxiation. In low concentrations may cause narcotic effects. Symptoms may include dizziness, headache, nausea and loss of co-ordination. Remove victim to uncontaminated area wearing self contained breathing apparatus. Keep victim warm and rested. Call a doctor. Apply artificial respiration if breathing stopped.
------------	--

## 5 FIRE FIGHTING MEASURES

Specific hazards	Exposure to fire may cause containers to rupture/explode.
Hazardous combustion products	Incomplete combustion may form carbon monoxide.
Suitable extinguishing media	All known extinguishants can be used.
Specific methods	If possible, stop flow of product. Move away from the container and cool with water from a protected position.

# Safety Data Sheet

**Product :**

**Methane**

Page :2/4

MSDS Nr : 078A\_AL

Version : 1.01

Date : 31/07/2002

Do not extinguish a leaking gas flame unless absolutely necessary. Spontaneous/explosive re-ignition may occur. Extinguish any other fire.

Special protective equipment for fire fighters

In confined space use self-contained breathing apparatus.

## 6 ACCIDENTAL RELEASE MEASURES

Personal precautions

Wear self-contained breathing apparatus when entering area unless atmosphere is proved to be safe.

Evacuate area.

Ensure adequate air ventilation.

Eliminate ignition sources.

Environmental precautions

Try to stop release.

Clean up methods

Ventilate area.

## 7 HANDLING AND STORAGE

Handling and storage

Ensure equipment is adequately earthed.

Suck back of water into the container must be prevented.

Purge air from system before introducing gas.

Do not allow backfeed into the container.

Use only properly specified equipment which is suitable for this product, its supply pressure and temperature. Contact your gas supplier if in doubt.

Keep away from ignition sources (including static discharges).

Segregate from oxidant gases and other oxidants in store.

Refer to supplier's container handling instructions.

Keep container below 50°C in a well ventilated place.

## 8 EXPOSURE CONTROLS/PERSONAL PROTECTION

Personal protection

Ensure adequate ventilation.

Do not smoke while handling product.

## 9 PHYSICAL AND CHEMICAL PROPERTIES

Molecular weight

16

Melting point

-182 °C

Boiling point

-161 °C

Critical temperature

-82 °C

Relative density, gas

0.6 (air=1)

Relative density, liquid

0.42 (water=1)

Vapour Pressure 20°C

Not applicable.

# Safety Data Sheet

**Product :**

**Methane**

Page :3/4

MSDS Nr : 078A\_AL

Version : 1.01

Date : 31/07/2002

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Solubility mg/l water	26 mg/l
Appearance/Colour	Colourless gas
Odour	None
Autoignition temperature	595 °C
Flammability range	5-15 vol% in air.

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## 10 STABILITY AND REACTIVITY

Stability and reactivity	Can form explosive mixture with air. May react violently with oxidants.
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## 11 TOXICOLOGICAL INFORMATION

General	No known toxicological effects from this product.
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## 12 ECOLOGICAL INFORMATION

General	No known ecological damage caused by this product.
Global warming factor	21

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## 13 DISPOSAL CONSIDERATIONS

General	Do not discharge into areas where there is a risk of forming an explosive mixture with air. Waste gas should be flared through a suitable burner with flash back arrestor. Do not discharge into any place where its accumulation could be dangerous. Contact supplier if guidance is required.
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---

## 14 TRANSPORT INFORMATION

Proper shipping name	Methane, compressed
UN Nr	1971
Class/Div	2.1
ADR/RID Classification code	2, 1°F
ADR/RID Hazard Nr	23
Labelling ADR	Label 3: flammable gas
Other transport information	Avoid transport on vehicles where the load space is not separated from the driver's compartment. Ensure vehicle driver is aware of the potential hazards of the load and knows what to do in the event of an accident or an emergency. Before transporting product containers ensure that they are firmly secured and: - cylinder valve is closed and not leaking

# Safety Data Sheet

**Product :**

**Methane**

Page :4/4

MSDS Nr : 078A\_AL

Version : 1.01

Date : 31/07/2002

- valve outlet cap nut or plug (where provided) is correctly fitted
- valve protection device (where provided) is correctly fitted
- there is adequate ventilation.
- compliance with applicable regulations.

## 15 REGULATORY INFORMATION

Number in Annex I of Dir 67/548	601-001-00-4.
EC Classification	F+;R12
-Symbols	F+: Extremely flammable
-Risk phrases	R12 Extremely flammable.
-Safety phrases	S9 Keep container in well ventilated place. S16 Keep away from ignition sources - No smoking. S33 Take precautionary measures against static discharges.

## 16 OTHER INFORMATION

Ensure all national/local regulations are observed.

Ensure operators understand the flammability hazard.

The hazard of asphyxiation is often overlooked and must be stressed during operator training.

Before using this product in any new process or experiment, a thorough material compatibility and safety study should be carried out.

Details given in this document are believed to be correct at the time of going to press. Whilst proper care has been taken in the preparation of this document, no liability for injury or damage resulting from its use can be accepted.

This Safety Data Sheet has been established in accordance with the applicable European Directives and applies to all countries that have translated the Directives in their national laws.

This MSDS is for information purposes only and is subject to change without notice. [Prior to purchase of products, please contact your local Air Liquide office for a complete MSDS (with Manufacturer's name and emergency phone number).]

**End of document.**

**Number of pages :4**

MSDS Number: **T0767** \* \* \* \* \* *Effective Date: 05/19/08* \* \* \* \* \* *Supersedes: 08/16/05*

From: Mallinckrodt Baker, Inc.  
222 Red School Lane  
Phillipsburg, NJ 08865



24 Hour Emergency Telephone: 908-859-2151  
CHEMTREC: 1-800-424-9300

National Response in Canada  
CANUTEC: 613-996-6666

Outside U.S. and Canada  
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

# TETRACHLOROETHYLENE

## 1. Product Identification

**Synonyms:** ethylene tetrachloride; tetrachloroethene; perchloroethylene; carbon bichloride; carbon dichloride

**CAS No.:** 127-18-4

**Molecular Weight:** 165.83

**Chemical Formula:** Cl<sub>2</sub>C:CCl<sub>2</sub>

**Product Codes:**

J.T. Baker: 9218, 9360, 9453, 9465, 9469

Mallinckrodt: 1933, 8058

## 2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Tetrachloroethylene	127-18-4	99 - 100%	Yes

## 3. Hazards Identification

### Emergency Overview

**WARNING! HARMFUL IF SWALLOWED, INHALED OR ABSORBED THROUGH SKIN. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS CENTRAL NERVOUS SYSTEM, LIVER AND KIDNEYS. SUSPECT CANCER HAZARD. MAY CAUSE CANCER. Risk of cancer depends on level and duration of exposure.**

**SAF-T-DATA<sup>(tm)</sup>** Ratings (Provided here for your convenience)  
-----

Health Rating: 2 - Moderate (Poison)

Flammability Rating: 0 - None

Reactivity Rating: 1 - Slight

Contact Rating: 2 - Moderate (Life)

Lab Protective Equip: GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES

Storage Color Code: Blue (Health)

  
-----**Potential Health Effects**  
-----**Inhalation:**

Irritating to the upper respiratory tract. Giddiness, headache, intoxication, nausea and vomiting may follow the inhalation of large amounts while massive amounts can cause breathing arrest, liver and kidney damage, and death. Concentrations of 600 ppm and more can affect the central nervous system after a few minutes.

**Ingestion:**

Not highly toxic by this route because of low water solubility. Used as an oral dosage for hookworm (1 to 4 ml). Causes abdominal pain, nausea, diarrhea, headache, and dizziness.

**Skin Contact:**

Causes irritation to skin. Symptoms include redness, itching, and pain. May be absorbed through the skin with possible systemic effects.

**Eye Contact:**

Causes irritation, redness, and pain.

**Chronic Exposure:**

May cause liver, kidney or central nervous system damage after repeated or prolonged exposures.

Suspected cancer risk from animal studies.

**Aggravation of Pre-existing Conditions:**

Persons with pre-existing skin disorders or eye problems or impaired liver or kidney function may be more susceptible to the effects of the substance. The use of alcoholic beverages enhances the toxic effects.

---

## 4. First Aid Measures

**Inhalation:**

Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

**Ingestion:**

Aspiration hazard. If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. Get medical attention immediately.

**Skin Contact:**

Wash skin with soap or mild detergent and water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Call a physician.

**Eye Contact:**

Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

**Note to Physician:**

Do not administer adrenaline or epinephrine to a victim of chlorinated solvent poisoning.

## 5. Fire Fighting Measures

**Fire:**

Not considered to be a fire hazard but becomes hazardous in a fire situation because of vapor generation and possible degradation to phosgene (highly toxic) and hydrogen chloride (corrosive). Vapors are heavier than air and collect in low-lying areas.

**Explosion:**

Not considered to be an explosion hazard. Containers may explode when involved in a fire.

**Fire Extinguishing Media:**

Use any means suitable for extinguishing surrounding fire. Water spray may be used to keep fire exposed containers cool.

**Special Information:**

In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

---

## 6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Neutralize with alkaline material (soda ash, lime), then absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

---

## 7. Handling and Storage

Store in a cool, dry, ventilated area away from sources of heat or ignition. Isolate from flammable materials. Protect from direct sunlight. Wear special protective equipment (Sec. 8) for maintenance break-in or where exposures may exceed established exposure levels. Wash hands, face, forearms and neck when exiting restricted areas. Shower, dispose of outer clothing, change to clean garments at the end of the day. Avoid cross-contamination of street clothes. Wash hands before eating and do not eat, drink, or smoke in workplace. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

---

## 8. Exposure Controls/Personal Protection

**Airborne Exposure Limits:**

-OSHA Permissible Exposure Limit (PEL):

100 ppm (TWA), 200 ppm (ceiling),

300 ppm/5min/3-hour (max)

-ACGIH Threshold Limit Value (TLV):

25 ppm (TWA), 100 ppm (STEL); listed as A3, animal carcinogen

**Ventilation System:**

A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of

the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

**Personal Respirators (NIOSH Approved):**

If the exposure limit is exceeded, wear a supplied air, full-facepiece respirator, airlined hood, or full-facepiece self-contained breathing apparatus.

**Skin Protection:**

Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

**Eye Protection:**

Use chemical safety goggles and/or full face shield where dusting or splashing of solutions is possible. Maintain eye wash fountain and quick-drench facilities in work area.

---

## 9. Physical and Chemical Properties

**Appearance:**

Clear, colorless liquid.

**Odor:**

Ethereal odor.

**Solubility:**

0.015 g in 100 g of water.

**Specific Gravity:**

1.62 @ 20C/4C

**pH:**

No information found.

**% Volatiles by volume @ 21C (70F):**

100

**Boiling Point:**

121C (250F)

**Melting Point:**

-19C (-2F)

**Vapor Density (Air=1):**

5.7

**Vapor Pressure (mm Hg):**

18 @ 25C (77F)

**Evaporation Rate (BuAc=1):**

0.33 (trichloroethylene = 1)

---

## 10. Stability and Reactivity

**Stability:**

Stable under ordinary conditions of use and storage. Slowly decomposed by light. Deteriorates rapidly in warm, moist climates.

**Hazardous Decomposition Products:**

Carbon dioxide and carbon monoxide may form when heated to decomposition. Hydrogen chloride gas and phosgene gas may be formed upon heating. Decomposes with moisture to yield trichloroacetic acid and hydrochloric acid.

**Hazardous Polymerization:**

Will not occur.

**Incompatibilities:**

Strong acids, strong oxidizers, strong alkalis, especially NaOH, KOH; finely divided metals, especially

zinc, barium, lithium. Slowly corrodes aluminum, iron and zinc.

**Conditions to Avoid:**

Moisture, light, heat and incompatibles.

## 11. Toxicological Information

Oral rat LD50: 2629 mg/kg; inhalation rat LC50: 4100 ppm/6H; investigated as a tumorigen, mutagen, reproductive effector.

-----\Cancer Lists\-----			
Ingredient	---NTP Carcinogen---		IARC Category
	Known	Anticipated	
Tetrachloroethylene (127-18-4)	No	Yes	2A

## 12. Ecological Information

**Environmental Fate:**

When released into the soil, this material is expected to quickly evaporate. When released into the soil, this material may leach into groundwater. When released into the soil, this material may biodegrade to a moderate extent. When released to water, this material is expected to quickly evaporate. When released into water, this material is not expected to biodegrade. This material is not expected to significantly bioaccumulate. When released into the air, this material may be moderately degraded by reaction with photochemically produced hydroxyl radicals.

**Environmental Toxicity:**

The LC50/96-hour values for fish are between 1 and 10 mg/l. The LC50/96-hour values for fish are between 10 and 100 mg/l. This material is expected to be toxic to aquatic life.

## 13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

## 14. Transport Information

**Domestic (Land, D.O.T.)**

-----  
**Proper Shipping Name:** TETRACHLOROETHYLENE

**Hazard Class:** 6.1

**UN/NA:** UN1897

**Packing Group:** III

**Information reported for product/size:** 4L

**International (Water, I.M.O.)****Proper Shipping Name:** TETRACHLOROETHYLENE**Hazard Class:** 6.1**UN/NA:** UN1897

Packing Group: III

**Information reported for product/size:** 4L**International (Air, I.C.A.O.)****Proper Shipping Name:** TETRACHLOROETHYLENE**Hazard Class:** 6.1**UN/NA:** UN1897

Packing Group: III

**Information reported for product/size:** 4L

## 15. Regulatory Information

-----\Chemical Inventory Status - Part 1\-----				
Ingredient	TSCA	EC	Japan	Australia
Tetrachloroethylene (127-18-4)	Yes	Yes	Yes	Yes

-----\Chemical Inventory Status - Part 2\-----				
Ingredient	Korea	DSL	NDSL	Phil.
Tetrachloroethylene (127-18-4)	Yes	Yes	No	Yes

-----\Federal, State & International Regulations - Part 1\-----				
Ingredient	-SARA 302- RQ	TPQ	-----SARA 313----- List	Chemical Catg.
Tetrachloroethylene (127-18-4)	No	No	Yes	No

-----\Federal, State & International Regulations - Part 2\-----			
Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8 (d)
Tetrachloroethylene (127-18-4)	100	U210	No

Chemical Weapons Convention: No      TSCA 12(b): No      CDTA: No  
 SARA 311/312: Acute: Yes      Chronic: Yes      Fire: No      Pressure: No  
 Reactivity: No      (Pure / Liquid)

**WARNING:**

THIS PRODUCT CONTAINS A CHEMICAL(S) KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER.

**Australian Hazchem Code:** 2[Z]**Poison Schedule:** None allocated.**WHMIS:**

This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

## 16. Other Information

**NFPA Ratings:** Health: **2** Flammability: **0** Reactivity: **0**

**Label Hazard Warning:**

WARNING! HARMFUL IF SWALLOWED, INHALED OR ABSORBED THROUGH SKIN. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS CENTRAL NERVOUS SYSTEM, LIVER AND KIDNEYS. SUSPECT CANCER HAZARD. MAY CAUSE CANCER. Risk of cancer depends on level and duration of exposure.

**Label Precautions:**

Do not get in eyes, on skin, or on clothing.

Do not breathe vapor or mist.

Keep container closed.

Use only with adequate ventilation.

Wash thoroughly after handling.

**Label First Aid:**

If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. In all cases call a physician.

**Product Use:**

Laboratory Reagent.

**Revision Information:**

No Changes.

**Disclaimer:**

\*\*\*\*\*

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\*\*\*\*\*

**Prepared by:** Environmental Health & Safety

Phone Number: (314) 654-1600 (U.S.A.)

## Material Safety Data Sheet

Science Stuff, Inc.  
1104 Newport Avenue  
Austin, TX 78753

Phone (512) 837-6020  
Chemtrec 800-424-9300  
24 Hour Emergency Assistance

Section 1 Identification					
Product Number:	C2925				
Product Name:	1,1,1-Trichloroethane Laboratory Grade	Health:	3		
Trade/Chemical Synonyms:		Flammability:	0		
Formula:	CH <sub>2</sub> CCl <sub>3</sub>	Reactivity:	0		
RTECS:	KJ2975000	Hazard Rating:	Least Slight Moderate High Extreme		
C.A.S	CAS# 71-55-6		0	1	2
			3	4	
		NA = Not Applicable NE = Not Established			
Section 2 Component Mixture					
Sara 313	Component	CAS Number	%	Dim	Exposure Limits:
<input checked="" type="checkbox"/>	1,1,1-Trichloroethane	CAS# 71-55-6	100%	W/W	350 ppm OSHA TWA, 450 ppm OSHA STEL
Section 3 Hazard Identification (Also see section 11)					
May be harmful if swallowed. May cause irritation. Avoid breathing vapors, or dusts. Use with adequate ventilation. Avoid contact with eyes, skin, and clothes. Wash thoroughly after handling.					
Section 4 First Aid Measures					
May be harmful if swallowed. May cause irritation. Avoid breathing vapors, or dusts. Use with adequate ventilation. Avoid contact with eyes, skin, and clothes. Wash thoroughly after handling.					
FIRST AID: SKIN: Remove contaminated clothing. Wash exposed area with soap and water. if irritation persists, seek medical attention.					
EYES: Wash eyes with plenty of water for at least 15 minutes, lifting lids occasionally. Seek Medical Aid. INHALATION: Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen					
INGESTION: If swallowed, induce vomiting immediately after giving two glasses of water. Never give anything by mouth to an unconscious person.					
Section 5 Fire Fighting Measures					
Fire Extinguisher Type:	Water spray, Carbon dioxide, dry chemical.				
Fire/Explosion Hazards:	Vapor may travel considerable distance to source of ignition and flash back.				
Fire Fighting Procedure:	Wear self-contained breathing apparatus and protective clothing to prevent contact with skin and clothing.				
Section 6 Accidental Release Measures					
Evacuate area. Wear self-contained breathing apparatus and protective clothing. Eliminate all sources of ignition.					
Section 7 Handling and Storage					
Store in a cool dry well ventilated area. Keep away from heat and flame. Do not get in eyes, on skin, or on clothing.					
Section 8 Exposure Controls & Personal Protection					
Respiratory Protection:NIOSH/MSHA-approved respirator					
Mechanical: <input type="checkbox"/> Solvent resistant gloves as neoprene or nitrile					
Hand Protection: <input type="checkbox"/>					
Ventilation: Local Exhaust: <input checked="" type="checkbox"/> Eye Splash Protection: Goggles					
Other Protective Equipment: Wear appropriate clothing to prevent skin exposure					
Section 9 Physical and Chemical Properties					
Melting Point:	-45°C	Specific Gravity:	1.300		
Boiling Point:	72-88°C	Percent Volatile by Volume:	>99		
Vapor Pressure:	135 mm Hg @25°C	Evaporation Rate:	0.35		
Vapor Density:	4.54	Evaporation Standard:	Ether =1		
Solubility in Water:	Negligible	Auto ignition Temperature:	Information not available		
Appearance and Odor:	Clear, colorless liquid with organic odor	Lower Flamm. Limit in Air:	7%		
Flash Point:	Information not available	Upper Flamm. Limit in Air:	15%		
Section 10 Stability and Reactivity Information					
Stability: Stable with heat, sparks, flames, or other sources of ignition.					
Conditions to Avoid: Avoid contact with heat, sparks, flames, or other sources of ignition.					
Materials to Avoid: Oxidizing materials,caustic soda,caustic potash.					
Hazardous Decomposition Products: hydrogen chloride and traces of phosgene					
Hazardous Polymerization:Will Not Occur					
Condition to Avoid:None known					
Section 11 Additional Information					
DANGER!! The vapors of this material can be ignited in a closed poorly ventilated area. This material can					

produce toxic fumes when ignited. Effects of over exposure:irritation of the eyes,skin and upper respiratory tract. Chronic:none are listed by the manufacturer. Target organs: eyes,skin,upper respiratory tract, central nervous system. Conditions aggravated/target organs. Persons with pre-existing eye,skin or respiratory conditions may be more susceptible.

DOT Classification: 1,1,1-Trichloroethane, 6.1, UN2831,PG III

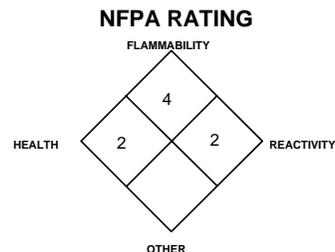
DOT regulations may change from time to time. Please consult the most recent version of the relevant regulations.

Revision	Date Entered:	Approved by:
No:0.1	1/1/2003	WPF

The information contained herein is believed to be accurate and is offered in good faith for the user's consideration and investigation. No warranty is expressed or implied regarding the completeness or accuracy of this information, whether originating from Science Stuff, Inc. or from an alternate source. Users of this material should satisfy themselves by independent investigation of current scientific and medical information that this material may be safely handled.

## MATERIAL SAFETY DATA SHEET

Prepared to U.S. OSHA, CMA, ANSI and Canadian WHMIS Standards



### **PART I** *What is the material and what do I need to know in an emergency?*

#### 1. PRODUCT IDENTIFICATION

**CHEMICAL NAME; CLASS:** **VINYL CHLORIDE - CH<sub>2</sub>CHCl**  
**Document Number:** 001067

**PRODUCT USE:** For general analytic/synthetic chemical uses.

**SUPPLIER/MANUFACTURER'S NAME:** AIRGAS INC.  
**ADDRESS:** 259 N. Radnor-Chester Road  
 Suite 100  
 Radnor, PA 19087-5283

**BUSINESS PHONE:** 1-610-687-5253  
**EMERGENCY PHONE:** 1-800-949-7937  
 International: 423-479-0293

**DATE OF PREPARATION:** November 20, 1997  
**REVISION DATE:** January 3, 2001

#### 2. COMPOSITION and INFORMATION ON INGREDIENTS

CHEMICAL NAME	CAS #	mole %	EXPOSURE LIMITS IN AIR					
			ACGIH		OSHA		IDLH ppm	OTHER
			TLV ppm	STEL ppm	PEL ppm	STEL ppm		
Vinyl Chloride	75-01-4	> 99.9%	5, A1 (Confirmed Human Carcinogen)	NE	1	5, C (15 minutes)	NE	NIOSH: Carcinogen; Reduce exposure to lowest feasible level.  Carcinogen: IARC-1; MAK-A1; NTP-1; OSHA-X; NIOSH-X
Maximum Impurities		< 0.1%	None of the trace impurities in this product contribute significantly to the hazards associated with the product. All hazard information pertinent to this product has been provided in this Material Safety Data Sheet, per the requirements of the OSHA Hazard Communication Standard (29 CFR 1910.1200) and State equivalent standards.					

NE = Not Established

C = Ceiling Limit

See Section 16 for Definitions of Terms Used

NOTE: All WHMIS required information is included. It is located in appropriate sections based on the ANSI Z400.1-1993 format.

### 3. HAZARD IDENTIFICATION

**EMERGENCY OVERVIEW:** Vinyl Chloride is a colorless, liquefied, toxic, flammable gas with a sweet, ethereal odor. Vinyl Chloride is a known human carcinogen and is toxic by all routes of exposure. Contact with the skin and eyes will result in irritation. Inhalation of Vinyl Chloride may produce symptoms of drowsiness, blurred vision, staggering gait and tingling and numbness in the extremities. Contact with the liquid may result in frostbite. Both the liquid and gas pose a serious fire hazard when accidentally released. Vinyl Chloride polymerizes readily when exposed to air, sunlight, heat or oxygen and so can form dangerous explosive air/gas mixtures. Flame or high temperature impinging on a localized area of the cylinder of Vinyl Chloride can cause the cylinder to rupture without activating the cylinder's relief devices. Provide adequate fire protection during emergency response situations.

**SYMPTOMS OF OVEREXPOSURE BY ROUTE OF EXPOSURE:**

The most significant routes of overexposure for Vinyl Chloride are by inhalation or skin and eye contact. The following paragraphs describe symptoms of exposure by route of exposure.

**INHALATION:** Vinyl Chloride acts as a general anesthetic in concentrations over 500 ppm. Overexposure to low levels of Vinyl Chloride will result in dizziness, light-headedness, euphoria, nervousness, drowsiness, headache, blurred vision, impaired hearing and confusion. Acute exposures to 1000 ppm will slowly produce symptoms such as staggering gait and tingling in the hands and feet. Overexposure to extremely high concentrations (greater than 70,000 ppm) of Vinyl Chloride may cause unconsciousness and death, with possible liver, spleen, and kidney damage.

**SKIN CONTACT:** The gas is mildly irritating to exposed skin. Accidental spraying of the liquid gas may cause burns from freezing, due to rapid evaporation.

**EYE CONTACT:** Vinyl Chloride gas is mildly irritating to the eyes. Accidental spraying of the liquid into the eye(s) may cause burns from freezing, due to rapid evaporation.

**OTHER POTENTIAL HEALTH EFFECTS:** Contact with liquid or rapidly expanding gases (which are released under high pressure) may cause frostbite. Symptoms of frostbite include change in skin color to white or grayish-yellow. The pain after such contact can quickly subside.

**HEALTH EFFECTS OR RISKS FROM EXPOSURE:** An Explanation in Lay Terms. Overexposure to Vinyl Chloride may cause the following health effects:

**ACUTE:** The most significant hazard associated with Vinyl Chloride is inhalation of vapors, which can produce symptoms of central nervous system depression, such as dizziness, light-headedness, headache, nervousness confusion and impairment of vision and hearing. Overexposure to extremely high concentrations may cause unconsciousness and death, with possible liver, spleen, and kidney damage. Contact with liquid or rapidly expanding gases may cause frostbite.

**CHRONIC:** Long-term exposure to low levels of Vinyl Chloride causes angiosarcoma of the liver, which is a rare form of liver cancer. Chronic exposure to Vinyl Chloride has been associated with cancers of the brain, lungs and blood-forming and lymphatic systems. In the past, chronic exposure to high levels of Vinyl Chloride has resulted in acro-osteolysis (a type of degenerative bone disease) and reports of increased frequency of chromosomal changes. These symptoms have been reduced significantly due to current stringent handling procedures. Refer to Section 11 (Toxicology Information) of this MSDS for additional information.

**TARGET ORGANS:** Central nervous system, liver, spleen, kidneys, respiratory system and, potentially, the reproductive system.

HAZARDOUS MATERIAL INFORMATION SYSTEM			
HEALTH		(BLUE)	2
FLAMMABILITY		(RED)	4
REACTIVITY		(YELLOW)	2
PROTECTIVE EQUIPMENT			X
EYES	RESPIRATORY	HANDS	BODY
	See Section 8		See Section 8
For routine industrial applications			

**See Section 16 for Definition of Ratings**

#### 4. FIRST-AID MEASURES

**RESCUERS SHOULD NOT ATTEMPT TO RETRIEVE VICTIMS OF EXPOSURE TO VINYL CHLORIDE WITHOUT ADEQUATE PERSONAL PROTECTIVE EQUIPMENT. At a minimum, Self-Contained Breathing Apparatus and Fire-Retardant Personal Protective equipment should be worn. Adequate fire protection must be provided during rescue situations.**

Remove victim(s) to fresh air, as quickly as possible. Only trained personnel should administer supplemental oxygen and/or cardio-pulmonary resuscitation, if necessary.

**SKIN EXPOSURE:** Immediately flush affected area with water for at least 15 minutes. Contact with the liquid or rapidly expanding gases can cause frostbite. In the event of frostbite, medical attention must be sought. Frozen tissue is painless and appears waxy, with a possible yellow color. Frozen tissue will become swollen, painful and prone to infection when thawed. If the frozen part of the body has been thawed by the time medical attention has been obtained, cover the area with a dry sterile dressing and a large bulky protective covering.

**EYE EXPOSURE:** In the event of contact with the eyes, flush the affected eye(s) with running water for at least 15 minutes. Victims of eye exposure should be taken to medical attention immediately.

---

#### 5. FIRE-FIGHTING MEASURES

**FLASH POINT (Open Cup):** -77.8°C (-108°F)

**AUTOIGNITION TEMPERATURE:** 472.0°C (881.6°F)

**FLAMMABLE LIMITS (in air by volume, %):**

Lower (LEL): 4.0%

Upper (UEL): 22.0%

**FIRE EXTINGUISHING MATERIALS:** Extinguish Vinyl Chloride fires by shutting off the source of the gas. Water spray should be used to cool fire-exposed containers, structures and equipment. Use carbon dioxide, foam or dry chemicals as extinguishing media, if possible.

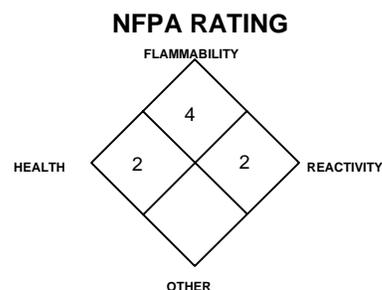
**UNUSUAL FIRE AND EXPLOSION HAZARDS:** Extremely flammable gas. Very dangerous fire hazard when exposed to heat, flame or powerful oxidizers. If stored for prolonged periods of time in the absence of sufficient polymerization inhibitor, dangerous peroxide compounds may form by oxidization with atmospheric oxygen in the presence of various contaminants. Contact with metals such as copper, aluminum and certain catalytic impurities can cause violent polymerization. Explosion hazard in confined spaces. During a fire, toxic gases (i.e. hydrogen chloride, carbon dioxide, carbon monoxide, and traces of phosgene) may be produced.

**DANGER!** Fires impinging (direct flame) on the outside surface of unprotected cylinders of Vinyl Chloride can be very dangerous. Exposure to fire could cause a catastrophic failure of the cylinder releasing the contents into a fireball and explosion of released gas. The resulting fire and explosion can result in severe equipment damage and personnel injury or death over a large area around the cylinder. For massive fires in large areas, use unmanned hose holder or monitor nozzles; if this is not possible, withdraw from area and allow fire to burn.

**Explosion Sensitivity to Mechanical Impact:** Not sensitive.

**Explosion Sensitivity to Static Discharge:** Static discharge may cause Vinyl Chloride to ignite explosively.

**SPECIAL FIRE-FIGHTING PROCEDURES:** Structural firefighters must wear Self-Contained Breathing Apparatus and full protective equipment. Because of the potential for a BLEVE, evacuation of non-emergency personnel is essential. If the flow of gas cannot be stopped, it is better to allow the gas to burn rather than form potentially explosive air/gas hazard. If the fire is extinguished before the flow of gas can be stopped, the gas can explosively re-ignite. If water is not available for cooling or protection of cylinder exposures, evacuate the area. Refer to the North American Emergency Response Guidebook (Guide #116P) for additional information.



**See Section 16 for Definition of Ratings**

---

## 6. ACCIDENTAL RELEASE MEASURES

**SPILL AND LEAK RESPONSE:** Evacuate immediate area. Uncontrolled releases should be responded to by trained personnel using pre-planned procedures. Proper protective equipment should be used. In case of a gas release, clear the affected area, protect people, and respond with trained personnel.

Eliminate any possible sources of ignition, and provide maximum explosion-proof ventilation. If the gas is leaking from cylinder or valve, contact the supplier. Adequate fire protection must be provided. Use only non-sparking tools and equipment during the response.

Minimum Personal Protective Equipment should be **Level B: fire-retardant protective clothing, gloves and Self-Contained Breathing Apparatus**. Use only non-sparking tools and equipment.

Locate and seal the source of the leaking gas. Protect personnel attempting the shut-off with water-spray. Allow the gas to dissipate. Combustible gas concentration must be below 10% of the LEL (4%) prior to entry. Monitor the surrounding area for combustible gas levels and oxygen level. The atmosphere must have levels of Vinyl Chloride below those listed in Section 2 (Information and Composition on Ingredients) and at least 19.5 percent oxygen before personnel can be allowed in the area without Self-Contained Breathing Apparatus. Attempt to close the main source valve prior to entering the area. If this does not stop the release (or if it is not possible to reach the valve), allow the gas to release in-place or remove it to a safe area and allow the gas to be released there.

**THIS IS AN EXTREMELY FLAMMABLE GAS, WHICH IS ALSO TOXIC AND A KNOWN HUMAN CARCINOGEN.** Protection of all personnel and the area must be maintained.

---

## **PART III** *How can I prevent hazardous situations from occurring?*

---

### 7. HANDLING and STORAGE

**WORK PRACTICES AND HYGIENE PRACTICES:** As with all chemicals, avoid getting Vinyl Chloride IN YOU. Do not eat or drink while handling chemicals. Be aware of any signs of exposure as indicated in Section 2 (Composition and Information on Ingredients); exposures to fatal concentrations of Vinyl Chloride could occur rapidly.

**NOTE:** Refer to the OSHA Vinyl Chloride Standard (29 CFR 1910.1017) for specific requirements associated with the use of this gas. The Action Level for Vinyl Chloride is 0.5 ppm. In workplaces where employees are exposed above the Action Level, the OSHA requirements for monitoring, establishment of regulated areas, methods of compliance, respiratory protection, emergency response protocol, medical surveillance, training, and record-keeping must be followed.

**STORAGE AND HANDLING PRACTICES:** Entrances to regulated areas (as defined by the OSHA Vinyl Chloride Standard) must be posted with legible signs which reads as follows:

<p><b>CANCER-SUSPECT AGENT AREA AUTHORIZED PERSONNEL ONLY</b></p>
---

Vinyl Chloride should be used in a well-ventilated area, preferably in a hood with forced ventilation. Store in cool, dry, well-ventilated area, away from sources of heat, ignition and direct sunlight. Do not allow area where cylinders are stored to exceed 52°C (125°F). Cylinders should be separated from oxygen cylinders, or other oxidizers, by a minimum distance of 20 ft., or by a barrier of non-combustible material at least 5 ft. high, having a fire-resistance rating of at least 0.5 hours. Isolate from other incompatible chemicals (refer to Section 10, Stability and Reactivity).

Storage areas must meet national electrical codes for Class 1 Hazardous Areas. Post "No Smoking or Open Flames" signs in storage or use areas. Consider installation of leak detection and alarm for storage and use areas. Have appropriate extinguishing equipment in the storage area (i.e. sprinkler system, portable fire extinguishers). This gas is heavier than air and will accumulate in low areas. Do not store below ground level.

Steel is recommended for all piping, storage tanks and equipment used with Vinyl Chloride. Copper and its alloys and aluminum should never be used in equipment used with Vinyl Chloride due to the potential for violent polymerization with these materials.

Keep the smallest amount on-site as is necessary. Full and empty cylinders should be segregated. Use a first-in, first-out inventory system to prevent full containers from being stored for long periods of time.

## 7. HANDLING and STORAGE (Continued)

**STORAGE AND HANDLING PRACTICES (continued):** Use non-sparking ventilation systems, approved explosion-proof equipment, and appropriate electrical systems. Electrical equipment used in gas-handling operations, or located in storage areas, should be non-sparking or explosion proof. Use a check valve in the discharge line to prevent hazardous backflow. Never tamper with pressure relief devices in valves and cylinders.

**SPECIAL PRECAUTIONS FOR HANDLING GAS CYLINDERS:** Protect cylinders against physical damage. Use a check valve or trap in the discharge line to prevent hazardous backflow. Cylinders should be stored upright and be firmly secured to prevent falling or being knocked over. Cylinders can be stored in the open, but in such cases, should be protected against extremes of weather and from the dampness of the ground to prevent rusting. Never tamper with pressure relief devices in valves and cylinders. Electrical equipment should be non-sparking or explosion proof. The following rules are applicable to work situations in which cylinders are being used:

**Before Use:** Move cylinders with a suitable hand-truck. Do not drag, slide or roll cylinders. Do not drop cylinders or permit them to strike each other. Secure cylinders firmly. Leave the valve protection cap, if provided, in-place until cylinder is ready for use.

**During Use:** Use designated CGA fittings and other support equipment. Do not use adapters. Do not heat cylinder by any means to increase the discharge rate of the product from the cylinder. Use check valve or trap in discharge line to prevent hazardous backflow into the cylinder. Do not use oils or grease on gas-handling fittings or equipment.

**After Use:** Close main cylinder valve. Replace valve protection cap, if provided. Mark empty cylinders "EMPTY".

**NOTE:** Use only DOT or ASME code containers. Earth-ground and bond all lines and equipment associated with Vinyl Chloride. Close valve after each use and when empty. Cylinders must not be recharged except by or with the consent of owner. For additional information refer to the Compressed Gas Association Pamphlet P-1, *Safe Handling of Compressed Gases in Containers*. Additionally, refer to CGA Bulletin SB-2 "Oxygen Deficient Atmospheres".

**PROTECTIVE PRACTICES DURING MAINTENANCE OF CONTAMINATED EQUIPMENT:** Follow practices indicated in Section 6 (Accidental Release Measures). Make certain application equipment is locked and tagged-out safely. Purge gas handling equipment with inert gas (i.e. nitrogen) before attempting repairs.

---

## 8. EXPOSURE CONTROLS - PERSONAL PROTECTION

**VENTILATION AND ENGINEERING CONTROLS:** Use with adequate ventilation. A hood with forced ventilation is preferred, due to the significant toxicity and flammability hazards of Vinyl Chloride. Installation of automatic monitoring equipment to detect the level of Vinyl Chloride and potentially explosive air-gas mixtures is highly recommended.

**RESPIRATORY PROTECTION:** Maintain exposure levels of Vinyl Chloride below the levels listed in Section 2 (Composition and Information on Ingredients) and oxygen levels above 19.5% in the workplace. During an emergency situation, before entering the area, check for flammable gas level as well as oxygen-deficient atmospheres. Use supplied air respiratory protection if Vinyl Chloride levels exceed exposure limits and if oxygen level is below 19.5% or during emergency response to a release of Vinyl Chloride. If respiratory protection is required, follow the requirements of the Federal OSHA Respiratory Protection Standard (29 CFR 1910.134), or equivalent State standards. The following are NIOSH recommendations for respiratory protection for concentration of Vinyl Chloride in air.

### **CONCENTRATION**

AT ANY DETECTABLE CONCENTRATION:

ESCAPE:

### **RESPIRATORY EQUIPMENT**

Positive pressure, full-facepiece Self-Contained Breathing Apparatus (SCBA) or positive pressure, full-facepiece Supplied Air Respirator (SAR) with an auxiliary positive pressure SCBA.

Gas mask with canister to protect against Vinyl Chloride, or escape-type SCBA.

**NOTE:** Follow the specific respiratory selection guidelines of the OSHA Vinyl Chloride Standard in regulated areas (as defined by 29 CFR 1910.1017).

**EYE PROTECTION:** Splash goggles or safety glasses and face shield when handling the liquid or gas.

**HAND PROTECTION:** Wear leather gloves when handling cylinders of Vinyl Chloride. Chemical resistant gloves should be worn when using Vinyl Chloride.

**BODY PROTECTION:** Use body protection appropriate for task. Chemical resistant material is recommended for protection against contamination with Vinyl Chloride. Safety shoes are recommended when handling cylinders. Response to leaks requires the use of fire retardant clothing. Transfer of large quantities under pressure may require protective equipment appropriate to protect employees from gas spraying, as well as fire-retardant items.

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## 9. PHYSICAL and CHEMICAL PROPERTIES

GAS DENSITY @ 21.1°C (70°F) and 1 atm: 0.160 lb/ft<sup>3</sup> (2.56 kg/m<sup>3</sup>)

LIQUID DENSITY @ 21.1°C (70°F) and 1 atm: 56.71 lb/ft<sup>3</sup> (908.41 kg/m<sup>3</sup>)

SPECIFIC GRAVITY @ 15°C (59°F) air = 1: 2.15

EVAPORATION RATE (nBuAc = 1): Not applicable.

FREEZING/MELTING POINT @ 1 atm: -153.9°C (-245°F)

EXPANSION RATIO: Not applicable.

SOLUBILITY IN WATER wt/wt @ 1 atm/25°C (77°F): 0.00114

COEFFICIENT WATER/OIL DISTRIBUTION: Log K<sub>ow</sub> = 0.6 (calculated).

BOILING POINT @ 1 atm: -13.4°C (7.93°F)

pH: Not applicable.

VAPOR PRESSURE @ 21.1°C (70°F) psig: 35.3

ODOR THRESHOLD: 2000 ppm

SPECIFIC VOLUME (ft<sup>3</sup>/lb): 6.25

APPEARANCE AND COLOR: Colorless gas with a sweet, ethereal odor.

HOW TO DETECT THIS SUBSTANCE (warning properties): The odor is not a reliable warning property. In terms of leak detection, fittings and joints can be painted with a soap solution to detect leaks, which will be indicated by a bubble formation.

---

## 10. STABILITY and REACTIVITY

STABILITY: Stable with polymerization inhibitor. Without an inhibitor, storage for prolonged periods of time can form potentially hazardous peroxides by oxidization with atmospheric oxygen in the presence of a variety of contaminants.

DECOMPOSITION PRODUCTS: Decomposition products of Vinyl Chloride include the following toxic gases: carbon monoxide, carbon dioxide and hydrogen chloride gas and trace amounts of phosgene.

MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE: Vinyl Chloride is incompatible with strong oxidizers, copper and its alloys, aluminum, certain catalytic impurities, oxides of nitrogen. Vinyl Chloride can react violently with all these materials.

HAZARDOUS POLYMERIZATION: Hazardous polymerization can occur in the presence of air, sunlight or heat. Vinyl Chloride can cause violent polymerization in the presence of strong oxidizers. Vinyl Chloride also polymerizes violently upon contact with copper and its alloys, aluminum and certain catalytic impurities.

CONDITIONS TO AVOID: Contact with incompatible materials and exposure to heat, sparks and other sources of ignition. Cylinders exposed to high temperatures or direct flame can rupture or burst.

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## PART IV *Is there any other useful information about this material?*

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## 11. TOXICOLOGICAL INFORMATION

**TOXICITY DATA:** The following information is for Vinyl Chloride (gas).

Microsomal Mutagenicity Assay-Salmonella typhimurium 1 ppH

Cytogenetic Analysis-Human: HeLa cell 10 mmol/L

Inhalation-Man TCLo: 30 mg/m<sup>3</sup> (5 years male): Reproductive effects

Inhalation-Man TCLo: 200 ppm/14 years: Carcinogenic effects,

Oral-Rat TDLo: 1 ppm/4 hours and 3463 mg/kg/52 weeks, intermittent: Carcinogenic effects

Inhalation-Rat TCLo: 10,000 ppm/4 hours (12-18 days preg): Carcinogenic effects, Teratogenic effects

Intraperitoneal-Rat TDLo: 21 mg/kg/65 weeks, intermittent: Equivocal tumorigenic agent

Subcutaneous-Rat TDLo: 21 mg/kg/6765 weeks, intermittent: Equivocal tumorigenic agent

Oral-Rat LD<sub>50</sub>: 500 mg/kg

Inhalation-Mouse TCLo: 50 ppm/30 weeks: Carcinogenic effects

Inhalation-Hamster TCLo: 50 ppm/4H/30 weeks: Carcinogenic effects

Inhalation-Rat TC: 50 ppm/7H/26 weeks: Carcinogenic effects

Inhalation-Rat TC: 100 ppm/7H/26 weeks: Carcinogenic effects

Inhalation-Mouse TC: 50 ppm/47 weeks I: Carcinogenic effects

Oral-Rat TD: 34 g/kg/3 years, Intermittent: Carcinogenic effects

Inhalation-Mouse TC: 50 ppm/6H/4 weeks: Carcinogenic effects

Inhalation-Mouse TC: 50 ppm/4H/30 weeks: Carcinogenic effects

Inhalation-Rat TC: 250 ppm/2 Years, Intermittent: Carcinogenic effects  
Inhalation-Human TC: 300 mg/m<sup>3</sup>/ weeks: Carcinogenic effects, Blood effects

Inhalation-Rat TC: 5 ppm/4H/52 weeks: Carcinogenic effects

Inhalation Rat TC: 50 ppm/6H-43 weeks: Carcinogenic effects

SUSPECTED CANCER AGENT: Vinyl Chloride is a known human carcinogen, which is listed by the following agencies: IARC-1 (Carcinogenic to Humans); MAK-A1 (Capable of Inducing Malignant Tumors/Human Evidence); NTP-1 (Known to be a Carcinogen); OSHA-X (Carcinogen); ACGIH-A1 (Confirmed Human Carcinogen); NIOSH-X (Carcinogen); Cal-OSHA (Carcinogen).

IRRITANCY OF PRODUCT: Vinyl Chloride can be mildly irritating to eyes and skin. Contact with the liquid or rapidly expanding gases can cause frostbite to exposed tissue.

SENSITIZATION TO THE PRODUCT: Vinyl Chloride is not known to be a sensitizer to humans upon prolonged or repeated contact.

## 11. TOXICOLOGICAL INFORMATION (Continued)

REPRODUCTIVE TOXICITY INFORMATION: Listed below is information concerning the effects of Vinyl Chloride on the human reproductive system.

Mutagenicity: Human mutation data are reported for Vinyl Chloride.

Embryotoxicity: There is insufficient evidence currently available to categorize Vinyl Chloride as embryotoxic to humans.

Teratogenicity: There is insufficient evidence currently available to categorize Vinyl Chloride as teratogenic to humans.

Reproductive Toxicity: Vinyl chloride is reported to produce adverse effects on the human reproductive system (i.e. changes in spermatogenesis).

*A mutagen is a chemical which causes permanent changes to genetic material (DNA) such that the changes will propagate through generation lines. An embryotoxin is a chemical which causes damage to a developing embryo (i.e. within the first eight weeks of pregnancy in humans), but the damage does not propagate across generational lines. A teratogen is a chemical which causes damage to a developing fetus, but the damage does not propagate across generational lines. A reproductive toxin is any substance which interferes in any way with the reproductive process.*

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Conditions relating to the target organs may be aggravated by overexposures to Vinyl Chloride. See Section 3 (Hazard Identification) for information on these conditions.

RECOMMENDATIONS TO PHYSICIANS: Administer oxygen, if necessary. Treat symptoms and eliminate exposure. Refer to the OSHA Vinyl Chloride Standard (29 CFR 1910.1017; paragraph K and Appendix A) for specific information on Medical Surveillance requirements (i.e. for the general physical exam, medical history, serum specimens, specific tests, and re-examination protocol).

BIOLOGICAL EXPOSURE INDICES (BEIs): Currently, Biological Exposure Indices (BEIs) are not applicable for Vinyl Chloride.

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## 12. ECOLOGICAL INFORMATION

ENVIRONMENTAL STABILITY: This gas will be dissipated rapidly in well-ventilated areas. There are limited data indicating the Vinyl Chloride is resistant to biodegradation in aerobic systems. Evaporation half-life from water is 0.45-2.5 hours.

EFFECT OF MATERIAL ON PLANTS or ANIMALS: This gas can be harmful to animal life. Suspected toxic effects on a variety of test animals during clinical studies indicate adverse effects on the central nervous system and liver. Plants may be damaged by frost produced in the presence of rapidly expanding gases. Additional data on the effects of Vinyl Chloride on plants are available as follows:

Increased production of hydrogen peroxide in germinating seeds exposed to Vinyl Chloride gas decreased their sulfhydryl content and thereby produced adverse effects and abnormalities in growth. Threshold levels of Vinyl Chloride were greater than 200 ppm and saturation level was 1000 ppm.

EFFECT OF CHEMICAL ON AQUATIC LIFE: The effect of Vinyl Chloride effects on aquatic life is not fully known. The following data are available for Vinyl Chloride.

Estimated Bioconcentration Factor of 7. Reported water solubility of 2,700 mg/L. Based on the BCF, Vinyl Chloride is not expected to significantly bioconcentrate in aquatic organisms.

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## 13. DISPOSAL CONSIDERATIONS

PREPARING WASTES FOR DISPOSAL: Product removed from the cylinder must be disposed of in accordance with appropriate Federal, State, and local regulations. Return cylinders with residual product to Airgas. Do not dispose locally.

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## 14. TRANSPORTATION INFORMATION

THIS MATERIAL IS HAZARDOUS AS DEFINED BY 49 CFR 172.101 BY THE U.S. DEPARTMENT OF TRANSPORTATION.

<u>PROPER SHIPPING NAME:</u>	Vinyl chloride, inhibited
<u>HAZARD CLASS NUMBER and DESCRIPTION:</u>	2.1 (Flammable Gas)
<u>UN IDENTIFICATION NUMBER:</u>	UN 1086
<u>PACKING GROUP:</u>	Not Applicable
<u>DOT LABEL(S) REQUIRED:</u>	Flammable Gas (Note: Per the requirements of the OSHA Vinyl Chloride Standard, 29 CFR 1910.1017, the additional legend "Cancer-Suspect Agent" must be applied near the label or placard).

## 11. TOXICOLOGICAL INFORMATION (Continued)

NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (2000): 116P

MARINE POLLUTANT: Vinyl Chloride is not classified by the DOT as a Marine Pollutant (as defined by 49 CFR 172.101, Appendix B).

TRANSPORT CANADA TRANSPORTATION OF DANGEROUS GOODS REGULATIONS: THIS MATERIAL IS CONSIDERED AS DANGEROUS GOODS. Use the above information for the preparation of Canadian Shipments.

## 15. REGULATORY INFORMATION

SARA REPORTING REQUIREMENTS: Vinyl Chloride is subject to the reporting requirements of Sections 302, 304 and 313 of Title III of the Superfund Amendments and Reauthorization Act, as follows:

COMPONENT	SARA 302 (40 CFR 355, Appendix A)	SARA 304 (40 CFR Table 302.4)	SARA 313 (40 CFR 372.65)
Vinyl Chloride	NO	YES	YES

U.S. SARA THRESHOLD PLANNING QUANTITY: Not applicable.

U.S. CERCLA REPORTABLE QUANTITY (RQ): Vinyl Chloride = 1 lb.

CANADIAN DSL INVENTORY: Vinyl Chloride is listed on the DSL Inventory.

U.S. TSCA INVENTORY STATUS: Vinyl Chloride is listed on the TSCA Inventory.

OTHER U.S. FEDERAL REGULATIONS: Vinyl Chloride is regulated under 28 CFR 1910.1017 (OSHA Vinyl Chloride Standard). Vinyl Chloride is subject to the reporting requirements of Section 112(r) of the Clean Air Act. The Threshold Quantity for this gas is 10,000 pounds. Depending on specific operations involving the use of Vinyl Chloride, the regulations of the Process Safety Management of Highly Hazardous Chemicals may be applicable (29 CFR 1910.119). Under this regulation Vinyl Chloride is listed in Appendix A of this Standard and the threshold quantity for Vinyl Chloride is 15,000 pounds.

U.S. STATE REGULATORY INFORMATION: Vinyl Chloride is covered under specific State regulations, as denoted below:

**Alaska - Designated Toxic and Hazardous Substances:** Vinyl Chloride.

**California - Permissible Exposure Limits for Chemical Contaminants:** Vinyl Chloride.

**Florida - Substance List:** Vinyl Chloride.

**Illinois - Toxic Substance List:** Vinyl Chloride.

**Kansas - Section 302/313 List:** Methyl Chloride.

**Massachusetts - Substance List:** Vinyl Chloride.

**Michigan - Critical Materials Register:** Vinyl Chloride.

**Minnesota - List of Hazardous Substances:** Vinyl Chloride.

**Missouri - Employer Information/Toxic Substance List:** Vinyl Chloride.

**New Jersey - Right to Know Hazardous Substance List:** Vinyl Chloride.

**North Dakota - List of Hazardous Chemicals, Reportable Quantities:** Vinyl Chloride.

**Pennsylvania - Hazardous Substance List:** Vinyl Chloride.

**Rhode Island - Hazardous Substance List:** Vinyl Chloride.

**Texas - Hazardous Substance List:** Vinyl Chloride.

**West Virginia - Hazardous Substance List:** Vinyl Chloride.

**Wisconsin - Toxic and Hazardous Substances:** Vinyl Chloride.

CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT (PROPOSITION 65): Vinyl Chloride is on the Proposition 65 lists. **WARNING:** Contains a chemical known to the State of California to cause cancer.

LABELING:

**DANGER:**

CANCER SUSPECT AGENT.

FLAMMABLE LIQUID AND GAS UNDER PRESSURE.

CAN FORM EXPLOSIVE MIXTURES WITH AIR.

MAY CAUSE LIVER, KIDNEY, SPLEEN AND OTHER ORGAN DAMAGE.

MAY CAUSE IRRITATION TO EYES, SKIN, AND MUCOUS MEMBRANES.

MAY CAUSE FROSTBITE.

Do not breathe gas.

Do not get liquid in skin, in eyes, or on clothing.

Keep away from heat, flames, and sparks.

Store and use with adequate ventilation in closed systems.

Cylinder temperature should not exceed 52°C (125°F).

Close valve after each use and when empty.

Use in accordance with the Material Safety Data Sheet.

## 15. REGULATORY INFORMATION (Continued)

LABELING (continued):

**NOTE:**

Suck-back into cylinder may cause rupture.  
Always use a back flow preventative device in piping.

**FIRST-AID:**

**IF INHALED:** Remove to fresh air. If not breathing, give artificial respiration, If breathing is difficult, give oxygen, Call a physician.

**IN CASE OF CONTACT,** immediately flush eyes or skin with water for at least 15 minutes while removing contaminated clothing and shoes. Call a physician. Wash clothing before reuse. (Discard contaminated shoes)

**IN CASE OF FROSTBITE,** obtain immediate medical attention.

DO NOT REMOVE THIS PRODUCT LABEL.

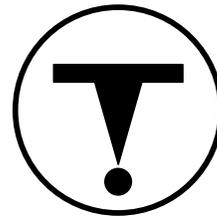
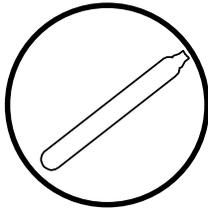
CANADIAN WHMIS SYMBOLS:

**Class A:** Compressed Gas.

**Class B1:** Flammable Gas

**Class D1B** Materials Causing Immediate and Serious Toxic Effects

**Class D2A:** Other Toxic Material



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## 16. OTHER INFORMATION

**PREPARED BY:**

**Airgas - SAFECOR**

The information contained herein is based on data considered accurate. However, no warranty is expressed or implied regarding the accuracy of these data or the results to be obtained from the use thereof. AIRGAS, Inc. assumes no responsibility for injury to the vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, AIRGAS, Inc. assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in his use of the material.

## DEFINITIONS OF TERMS

A large number of abbreviations and acronyms appear on a MSDS. Some of these which are commonly used include the following:

**CAS #:** This is the Chemical Abstract Service Number which uniquely identifies each constituent. It is used for computer-related searching.

### EXPOSURE LIMITS IN AIR:

**ACGIH** - American Conference of Governmental Industrial Hygienists, a professional association which establishes exposure limits.

**TLV - Threshold Limit Value** - an airborne concentration of a substance which represents conditions under which it is generally believed that nearly all workers may be repeatedly exposed without adverse effect. The duration must be considered, including the 8-hour **Time Weighted Average (TWA)**, the 15-minute **Short Term Exposure Limit**, and the instantaneous **Ceiling Level**. Skin absorption effects must also be considered.

**OSHA** - U.S. Occupational Safety and Health Administration.

**PEL - Permissible Exposure Limit** - This exposure value means exactly the same as a TLV, except that it is enforceable by OSHA. The OSHA Permissible Exposure Limits are based in the 1989 PELs and the June, 1993 Air Contaminants Rule (Federal Register: 58: 35338-35351 and 58: 40191). Both the current PELs and the vacated PELs are indicated. The phrase, "Vacated 1989 PEL," is placed next to the PEL which was vacated by Court Order.

**IDLH - Immediately Dangerous to Life and Health** - This level represents a concentration from which one can escape within 30-minutes without suffering escape-preventing or permanent injury.

**The DFG - MAK** is the Republic of Germany's Maximum Exposure Level, similar to the U.S. PEL. **NIOSH** is the National Institute of Occupational Safety and Health, which is the research arm of the U.S. Occupational Safety and Health Administration (**OSHA**). NIOSH issues exposure guidelines called **Recommended Exposure Levels (RELs)**. When no exposure guidelines are established, an entry of **NE** is made for reference.

### HAZARD RATINGS:

**HAZARDOUS MATERIALS IDENTIFICATION SYSTEM:** Health Hazard: **0** (minimal acute or chronic exposure hazard); **1** (slight acute or chronic exposure hazard); **2** (moderate acute or significant chronic exposure hazard); **3** (severe acute exposure hazard; onetime overexposure can result in permanent injury and may be fatal); **4** (extreme acute exposure hazard; onetime overexposure can be fatal). Flammability Hazard: **0** (minimal hazard); **1** (materials that require substantial pre-heating before burning); **2** (combustible liquid or solids; liquids with a flash point of 38-93°C [100-200°F]); **3** (Class IB and IC flammable liquids with flash points below 38°C [100°F]); **4** (Class IA flammable liquids with flash points below 23°C [73°F] and boiling points below 38°C [100°F]). Reactivity Hazard: **0** (normally stable); **1** (material that can become unstable at elevated temperatures or which can react slightly with water); **2** (materials that are unstable but do not detonate or which can react violently with water); **3** (materials that can detonate when initiated or which can react explosively with water); **4** (materials that can detonate at normal temperatures or pressures).

**NATIONAL FIRE PROTECTION ASSOCIATION:** Health Hazard: **0** (material that on exposure under fire conditions would offer no hazard beyond that of ordinary combustible materials); **1** (materials that on exposure under fire conditions could cause irritation or minor residual injury); **2** (materials that on intense or continued exposure under fire conditions could cause temporary incapacitation or possible residual injury); **3** (materials that can on short exposure could cause serious temporary or residual injury); **4** (materials that under very short exposure could cause death or major residual injury). Flammability Hazard and Reactivity Hazard: Refer to definitions for "Hazardous Materials Identification System".

### FLAMMABILITY LIMITS IN AIR:

Much of the information related to fire and explosion is derived from the **National Fire Protection Association (NFPA)**. Flash Point - Minimum temperature at which a liquid gives off sufficient vapors to form an ignitable mixture with air. Autoignition Temperature: The minimum temperature required to initiate combustion in air with no other source of ignition. LEL - the lowest percent of vapor in air, by volume, that will explode or ignite in the presence of an ignition source. UEL - the highest percent of vapor in air, by volume, that will explode or ignite in the presence of an ignition source.

### TOXICOLOGICAL INFORMATION:

Possible health hazards as derived from human data, animal studies, or from the results of studies with similar compounds are presented. Definitions of some terms used in this section are: **LD<sub>50</sub>** - Lethal Dose (solids & liquids) which kills 50% of the exposed animals; **LC<sub>50</sub>** - Lethal Concentration (gases) which kills 50% of the exposed animals; **ppm** concentration expressed in parts of material per million parts of air or water; **mg/m<sup>3</sup>** concentration expressed in weight of substance per volume of air; **mg/kg** quantity of material, by weight, administered to a test subject, based on their body weight in kg. Data from several sources are used to evaluate the cancer-causing potential of the material. The sources are: **IARC** - the International Agency for Research on Cancer; **NTP** - the National Toxicology Program, **RTECS** - the Registry of Toxic Effects of Chemical Substances, **OSHA** and **CAL/OSHA**. IARC and NTP rate chemicals on a scale of decreasing potential to cause human cancer with rankings from 1 to 4. Subrankings (2A, 2B, etc.) are also used. Other measures of toxicity include **TDL<sub>0</sub>**, the lowest dose to cause a symptom and **TCL<sub>0</sub>** the lowest concentration to cause a symptom; **TDo**, **LDLo**, and **LDo**, or **TC**, **TCo**, **LCLo**, and **LCo**, the lowest dose (or concentration) to cause death. **BEI** - Biological Exposure Indices, represent the levels of determinants which are most likely to be observed in specimens collected from a healthy worker who has been exposed to chemicals to the same extent as a worker with inhalation exposure to the TLV.

### REGULATORY INFORMATION:

This section explains the impact of various laws and regulations on the material. **EPA** is the U.S. Environmental Protection Agency. **WHMIS** is the Canadian Workplace Hazardous Materials Information System. **DOT** and **TC** are the U.S. Department of Transportation and the Transport Canada, respectively. **Superfund Amendments and Reauthorization Act (SARA)**; the **Canadian Domestic Substances List (DSL)**; the U.S. **Toxic Substance Control Act (TSCA)**; Marine Pollutant status according to the **DOT**; California's Safe Drinking Water Act (**Proposition 65**); the **Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund)**; and various state regulations. This section also includes information on the precautionary warnings which appear on the material's package label.

**APPENDIX F**

**DAILY TAILGATE SAFETY MEETING FORM**

# DAILY TAILGATE SAFETY MEETING



NOTE: A new tailgate meeting must be conducted if conditions, location, or personnel change.

Date: \_\_\_\_\_ Time: \_\_\_\_\_  a.m.  p.m. Location: \_\_\_\_\_ (city, state)

Project Name: \_\_\_\_\_ Client: \_\_\_\_\_

Current Objective/Description: \_\_\_\_\_

## Commitment to Safety

1. I will protect myself for me, my family, Trihydro, clients, and contractors by watching for and mitigating risky behaviors, exercising stop-work authority to prevent incidents and injuries and by complying with Trihydro and client policies, procedures, and JSAs/JLAs
2. I understand that safety is my personal responsibility and that working safely is a key component in providing quality work.
3. I will set an example for my fellow employees, contractors, clients, and family by working safely.
4. I will drive defensively and "Safely for My Family," abiding by Trihydro and client policies and applicable laws and regulations.
5. I will "slow down" appropriately to work at a pace that will allow me and others to complete each task efficiently and safely.
6. I will hold myself accountable for my safety and the safety of those around me. I will think about the safety of me, my coworkers, contractors, and our clients before I conduct each task.



*\* Stop Work Authority (SWA) – "Everyone has the authority and obligation to immediately stop all unsafe work."*

## Identify High-Hazard Work:

- |   |   |   |   |
|---|---|---|---|
| <input type="checkbox"/> Hot Work             | <input type="checkbox"/> Elevated/overhead work | <input type="checkbox"/> Boat / over-water operations                           | <input type="checkbox"/> Work involving equipment within 15' of active overhead electrical line or pole supporting an electric line |
| <input type="checkbox"/> LOTO                 | <input type="checkbox"/> Excavations - any      | <input type="checkbox"/> Demolition, removal of pipelines and buried structures |   |
| <input type="checkbox"/> Confined Space Entry | <input type="checkbox"/> Drilling - any         |   |   |

## Associated and Identified Hazards:

- |  |   |   |   |
|--|---|---|---|
| <input type="checkbox"/> Abrasions, cuts, scrapes      | <input type="checkbox"/> Earthquake           | <input type="checkbox"/> High-pressure processes    | <input type="checkbox"/> Pinch points         |
| <input type="checkbox"/> Allergies (self & co-workers) | <input type="checkbox"/> Electrical           | <input type="checkbox"/> High-temperature processes | <input type="checkbox"/> Power tools          |
| <input type="checkbox"/> Asbestos                      | <input type="checkbox"/> Equipment failure    | <input type="checkbox"/> High wind                  | <input type="checkbox"/> Pulled into          |
| <input type="checkbox"/> Biological                    | <input type="checkbox"/> Ergonomic            | <input type="checkbox"/> Laceration                 | <input type="checkbox"/> Radiation/X-ray      |
| <input type="checkbox"/> Buried utilities              | <input type="checkbox"/> Excavations in area? | <input type="checkbox"/> Lightning                  | <input type="checkbox"/> Security             |
| <input type="checkbox"/> Burn hazards                  | <input type="checkbox"/> Falling              | <input type="checkbox"/> Loud noise                 | <input type="checkbox"/> Severe weather       |
| <input type="checkbox"/> Chemical exposure             | <input type="checkbox"/> Fire/explosion       | <input type="checkbox"/> Machine guarding           | <input type="checkbox"/> Scaffolds            |
| <input type="checkbox"/> Cold stress                   | <input type="checkbox"/> H <sub>2</sub> S     | <input type="checkbox"/> Motor vehicle crash        | <input type="checkbox"/> Slips, trips, falls  |
| <input type="checkbox"/> Compressed gases              | <input type="checkbox"/> Hand injury          | <input type="checkbox"/> No locking/fixed blades    | <input type="checkbox"/> Subsurface utilities |
| <input type="checkbox"/> Crane or lifting equipment    | <input type="checkbox"/> Heat stress          | <input type="checkbox"/> Overexertion               | <input type="checkbox"/> Traffic              |
| <input type="checkbox"/> Drilling in area?             | <input type="checkbox"/> Heavy equipment      | <input type="checkbox"/> Overhead utilities         | <input type="checkbox"/> Water                |
|  |   | <input type="checkbox"/> Pedestrian                 | <input type="checkbox"/> Other: _____         |

## See it! Identify Current Objective Hazards:

### Assess Trihydro's 3 Most Serious Risks

- |  |  |
|--|--|
|  | <input type="checkbox"/> Traffic/Heavy Equipment |
|  | <input type="checkbox"/> Hazardous Atmosphere    |
|  | <input type="checkbox"/> Utility Contact         |

### Assess Trihydro's 5 Most Frequent Risks

- |  |  |
|--|--|
|  | <input type="checkbox"/> Hand Injuries       |
|  | <input type="checkbox"/> Lifting             |
|  | <input type="checkbox"/> Biological Hazards  |
|  | <input type="checkbox"/> Chemical Exposure   |
|  | <input type="checkbox"/> Slips, trips, falls |

### Other Hazards

- |  |   |
|--|---|
|  | <input type="checkbox"/> Weather            |
|  | <input type="checkbox"/> Working at Heights |

**Personal Protective Equipment (PPE):**

- |  |  |  |                                |
|--|--|--|--------------------------------|
| <input type="checkbox"/> Hard hat              | <input type="checkbox"/> Arm sleeves           | <input type="checkbox"/> Dust mask                   | Other special equipment:       |
| <input type="checkbox"/> Safety glasses        | <input type="checkbox"/> High visibility vest  | <input type="checkbox"/> Respirator                  | <input type="checkbox"/> _____ |
| <input type="checkbox"/> Safety toed boots     | <input type="checkbox"/> Rain gear             | Cartridges/filters:                                  | <input type="checkbox"/> _____ |
| <input type="checkbox"/> Ear plugs (as needed) | <input type="checkbox"/> Rubber boots          | <input type="checkbox"/> VOC/H <sub>2</sub> S escape | <input type="checkbox"/> _____ |
| <input type="checkbox"/> Face shield           | <input type="checkbox"/> SCBA                  | <input type="checkbox"/> H <sub>2</sub> S monitor    | <input type="checkbox"/> _____ |
| <input type="checkbox"/> Fall protection       | <input type="checkbox"/> Snake chaps           | <input type="checkbox"/> Bump test                   | <input type="checkbox"/> _____ |
| <input type="checkbox"/> Gloves (as needed)    | <input type="checkbox"/> Sunscreen (as needed) | <input type="checkbox"/> FRCs/Nomex                  | <input type="checkbox"/> _____ |
|  |  | <input type="checkbox"/> Tyvek®                      | <input type="checkbox"/> _____ |
|  |  | <input type="checkbox"/> Insect repellent            | <input type="checkbox"/> _____ |
|  |  | *Do not apply DEET to FRCs*                          | <input type="checkbox"/> _____ |

**Before Beginning Work:**

- |   |  |
|---|--|
| <input type="checkbox"/> Sign in and out of process unit <input type="checkbox"/> N/A   | <input type="checkbox"/> Review the JSA and "dirty up" if necessary  |
| <input type="checkbox"/> HASP reviewed & acknowledged   | <input type="checkbox"/> Weather forecast: <input type="checkbox"/> Hot <input type="checkbox"/> Cold <input type="checkbox"/> Inclement |
| <input type="checkbox"/> Locate the nearest evacuation point and a secondary location   | Wind Direction: _____  |
| <input type="checkbox"/> Identify the nearest fire extinguisher, eyewash station, first aid kit, and Material Safety Data Sheets (MSDS) | <input type="checkbox"/> Employee(s) are wearing proper PPE  |
| <input type="checkbox"/> Identify CPR/AED/first aid certified employees   | <input type="checkbox"/> Perform a "self check" on each personal H <sub>2</sub> S monitor  |
| <input type="checkbox"/> If lone worker, implement lone worker procedures <input type="checkbox"/> N/A                                  | <input type="checkbox"/> Perform a Work-Site Self Assessment (WSSA)  |
| <input type="checkbox"/> Identify SSE, visitor(s), or guest(s) <input type="checkbox"/> N/A   | <input type="checkbox"/> Review the dashboard emergency flyer for the specific site; place in a visible location inside vehicle          |
| <input type="checkbox"/> Determine and acquire necessary permits <input type="checkbox"/> N/A   | <input type="checkbox"/> Barricade work zone (as needed)   |
| Permit required: _____  | <input type="checkbox"/> Review WorkCare Injury Accident Program card  |
|   | <input type="checkbox"/> PPE Action Levels (PID: 10ppm)  |

**Safe Vehicle Use:**

- |   |  |  |
|---|--|--|
| <input type="checkbox"/> Pre-inspection complete            | <input type="checkbox"/> Mileage sheet filled out          | <input type="checkbox"/> GOAL sticker in window        |
| <input type="checkbox"/> Seat belt                          | <input type="checkbox"/> No cell phones used while driving | <input type="checkbox"/> Spotter used (if available)   |
| <input type="checkbox"/> Follow all speed and traffic rules | <input type="checkbox"/> Parked in a safe location         | <input type="checkbox"/> First move forward, backed in |
| <input type="checkbox"/> Emergency brake used               | <input type="checkbox"/> Orange cone used                  | <input type="checkbox"/> Load secured in vehicle       |
| <input type="checkbox"/> Keys left in vehicle               | <input type="checkbox"/> Chock tires (if needed)           | <input type="checkbox"/> 3D-Driving (every 2 years)    |
| <input type="checkbox"/> Trailer Safety Inspection form     | <input type="checkbox"/> Other: _____                      | <input type="checkbox"/> Other: _____                  |

**Site-Specific Comments:** \_\_\_\_\_

**Positive Reinforcement (R+):** \_\_\_\_\_

**Signatures:**

Meeting Conducted By: \_\_\_\_\_ (designated project on-site safety responder) Company: \_\_\_\_\_

Printed Name	Signature	Company	Attended Mid-Day Safety Focus	Is this worker new on-site?
1.			<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
2.			<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
3.			<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
4.			<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
5.			<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
6.			<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
7.			<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
8.			<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No

**APPENDIX G**

**WORK-AREA EVALUATION FOR CONFINED SPACES**

# WORK-AREA EVALUATION FOR CONFINED SPACES



Date: \_\_\_\_\_

Project Site: \_\_\_\_\_

Client: \_\_\_\_\_

Project Number: \_\_\_\_\_

## SECTION 1: CONFINED SPACE (CS) EVALUATION

TRUE FALSE

- |    |               |  |                          |                          |
|----|---------------|--|--------------------------|--------------------------|
| 1. | Size          | Is the space large enough and so configured that an employee can bodily enter and perform assigned work? | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. | Access/Egress | Are there limited or restricted means of access or egress?   | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. | Occupancy     | The space is <i>not</i> designed for continuous human occupancy.   | <input type="checkbox"/> | <input type="checkbox"/> |

If *all three* answers are **“TRUE,”** this is considered a confined space; continue with Sections 2 and 3.

If at least one answer is **“FALSE,”** this is considered a non-regulated space; continue to Section 3.

## SECTION 2: PERMIT-REQUIRED CONFINED SPACE (PRCS) EVALUATION

YES NO

- |    |        |  |                          |                            |
|----|--------|--|--------------------------|----------------------------|
| 4. | Hazard | A. Is there a potential for or an actual hazardous atmosphere?<br>If yes, explain: _____   | <input type="checkbox"/> | <input type="checkbox"/>   |
|    |        | B. Is there a potential for engulfment or entrapment?<br>If yes, explain: _____  | <input type="checkbox"/> | <input type="checkbox"/>   |
|    |        | C. Is the internal configuration such that an entrant may be trapped or asphyxiated?<br>If yes, explain: _____                                       | <input type="checkbox"/> | <input type="checkbox"/>   |
|    |        | D. Does the work space contain any other safety or health hazard (e.g., mechanical, chemical, thermal, electrical, etc.)?<br>If yes, identify: _____ | <input type="checkbox"/> | <input type="checkbox"/>   |
|    |        | E. Is the work space identified as a permit-required confined space by the client (warning sign, location map, etc.)?                                | <input type="checkbox"/> | <input type="checkbox"/> * |

\*If “NO,” consider contacting the client and advising them of the unidentified permit-required confined space.

## SECTION 3: SPACE DESIGNATION

Based on the answers to the above questions, designate the type of confined space identified:

- The work area has been evaluated for confined spaces; none were identified.
- The work area has been evaluated for confined spaces; the following confined space(s) was identified:

Confined Space Location: \_\_\_\_\_ Identification: \_\_\_\_\_

Confined Space Description: \_\_\_\_\_

- The space is designated:
1.  Non-regulated space (“FALSE” was checked for one or more question in Section 1)
  2.  Confined space, no permit required (“TRUE” was checked for *all* questions in Section 1)
  3.  Permit-required confined space (“TRUE” was checked for *all* questions in Section 1 *and* “YES” was checked for at least one question in Section 2)

Evaluation performed by: \_\_\_\_\_

*Print Full Name*

*Signature*

## Instructions

### Work-Area Evaluation for Confined Spaces

The project team must evaluate each work area to determine if confined spaces are present.

#### Section 1: Confined Space Evaluation

If the project team identifies a space that is classified as a confined space, they are to designate which type and communicate the evaluation to the PM.

To classify a space as a *confined space*, **all three** of the following criteria must be met:

Size: Is the space large enough and so configured that an employee can bodily enter and perform assigned work?

Access/Egress: Are there limited or restricted means of access or egress? Can the employee easily egress (exit) the space if there is an emergency? Can rescue personnel easily enter the space?

Occupancy: Is the space **not** designed for continuous human occupancy? Is the space only designed to house equipment? Are there normal-sized doorways and windows?

If the space is classified as a *confined space*, the next step is to evaluate it as a *permit-required confined space*.

#### Section 2: Permit-Required Confined Space Evaluation

To classify a *confined space* as a *permit-required confined space*, **any** of the following criteria must be met:

1. Contains or has a potential to contain a hazardous atmosphere:
  - A. Flammable gas, vapor, or mist in excess of 10 percent of its lower flammable limit (LFL);
  - B. Airborne combustible dust at a concentration that meets or exceeds its LFL;  
**NOTE:** This concentration may be approximated as a condition in which the dust obscures vision at a distance of 5 feet or less.
  - C. Atmospheric oxygen concentration below 19.5 percent or above 23.5 percent;
  - D. Atmospheric concentration of any toxic substance above its permissible exposure limit (PEL); or
  - E. Any other atmospheric condition that is immediately dangerous to life or health.
2. Contains a material that has the potential for engulfing an entrant;
3. Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor that slopes downward and tapers to a smaller cross-section; or
4. Contains any other recognized serious safety or health hazard.

#### Section 2: Space Designation

If there are no confined spaces identified in the work area, check the box indicating so and file the form.

If there are confined spaces identified in the work area:

1. Check the box indicating so.
2. Give the location, identification, and a description of the confined space (e.g., tank farm 1, MW-01, monitoring well vault).
3. Designate if the space is a non-regulated space, confined space, or permit-required confined space.
4. Communicate the evaluation to the PM and project-team members.
5. File the form in the project filing system.

**APPENDIX H**

**UTILITIES LOCATE ACKNOWLEDGEMENT**



# UTILITIES LOCATE ACKNOWLEDGEMENT



Utilities Locate Area Map



By signing below, I verify that I have located and marked the specified utilities within the boundaries of the project site as indicated on the map above.

Utility Located:     Gas     Electric     Sewer     Communication     Water     Other: \_\_\_\_\_

\_\_\_\_\_  
 Company                                      Name                                      Signature                                      Date

Utility Located:     Gas     Electric     Sewer     Communication     Water     Other: \_\_\_\_\_

\_\_\_\_\_  
 Company                                      Name                                      Signature                                      Date

Utility Located:     Gas     Electric     Sewer     Communication     Water     Other: \_\_\_\_\_

\_\_\_\_\_  
 Company                                      Name                                      Signature                                      Date

Utility Located:     Gas     Electric     Sewer     Communication     Water     Other: \_\_\_\_\_

\_\_\_\_\_  
 Company                                      Name                                      Signature                                      Date

Utility Located:     Gas     Electric     Sewer     Communication     Water     Other: \_\_\_\_\_

\_\_\_\_\_  
 Company                                      Name                                      Signature                                      Date

**APPENDIX I**

**EXPOSURE INCIDENT REPORT**



**EXPOSED EMPLOYEE MEDICAL RELEASE:**

**I AFFIRM THAT THE INFORMATION IN THIS REPORT IS CORRECT, AND AUTHORIZE MY EMPLOYER TO RELEASE ALL RELEVANT MEDICAL RECORDS TO THE HEALTH CARE PROVIDER WHO WILL PERFORM THE MEDICAL EVALUATION AND FOLLOW-UP FOR THIS EXPOSURE INCIDENT. I UNDERSTAND THAT ALL INFORMATION COLLECTED DURING THIS EVALUATION AND THE CONTENTS OF THIS REPORT WILL REMAIN CONFIDENTIAL.**

**Employee signature** \_\_\_\_\_

**Date:** \_\_\_\_\_

**APPENDIX J**

**POISONOUS SNAKES ASSOCIATED BY STATE**

## Poisonous Snakes Associated by State

<u>Snake</u>	<u>State</u>	<u>Snake</u>	<u>State</u>
<input type="checkbox"/> Arizona Black Rattlesnake 	AZ, NM, TX	<input type="checkbox"/> Arizona Coral Snake 	AZ
<input type="checkbox"/> Arizona Ridgenose Rattlesnake 	AZ, NM	<input type="checkbox"/> Banded Rock Rattlesnake 	AZ, NM, TX
<input type="checkbox"/> Canebrake Rattlesnake 	AL, FL, GA, LA, MS, NC, SC	<input type="checkbox"/> Colorado Desert Sidewinder 	AZ, CA
<input type="checkbox"/> Copperhead 	AL, AR, CT, DE, FL, GA, IL, IN, KS, KY, LA, MA, MS, MO, NE, NJ, NY, NV, OH, OK, PA, RI, SC, TN, TX, VA, WV	<input type="checkbox"/> Coral Snake 	AL, AZ, AR, FL, GA, LA, MS, NC, NM, SC, TX,

## Poisonous Snakes Associated by State

<u>Snake</u>	<u>State</u>	<u>Snake</u>	<u>State</u>
<input type="checkbox"/> Cottonmouth 	AL, AR, FL, GA, IL, KY, LA, MS, MO, OK, NC, SC, TN, TX, VA	<input type="checkbox"/> Desert Massasauga Rattlesnake 	AZ, CO, NM, TX
<input type="checkbox"/> Eastern Diamondback 	AL, FL, GA, LA, MS, NC, SC	<input type="checkbox"/> Eastern Massasauga Rattlesnake 	IL, IN, IA, MI, MN, MO, NY, OH, PA, WI
<input type="checkbox"/> Grand Canyon Rattlesnake 	AZ	<input type="checkbox"/> Great Basin Rattlesnake 	AZ, CA, ID, NV, OR, UT
<input type="checkbox"/> Hopi Rattlesnake 	AZ	<input type="checkbox"/> Mojave Rattlesnake 	AZ, CA, NM, NV, TX, UT

## Poisonous Snakes Associated by State

<u>Snake</u>	<u>State</u>	<u>Snake</u>	<u>State</u>
<input type="checkbox"/> Mojave Desert Sidewinder 	AZ, CA, NV, UT	<input type="checkbox"/> Northern Blacktail Rattlesnake 	AZ, NM, TX
<input type="checkbox"/> Pacific Rattlesnake 	CA, ID, OR, WA	<input type="checkbox"/> Prairie Rattlesnake 	AZ, CO, ID, IA, KS, MT, NE, ND, NM, OK, SD, TX, UT, WY
<input type="checkbox"/> Pygmy Rattlesnake 	AL, AR, FL, GA, LA, MS, MO, NC, OK, SC, TN, TX	<input type="checkbox"/> Red Diamond Rattlesnake 	CA
<input type="checkbox"/> Sidewinder 	AZ, CA, NV, UT	<input type="checkbox"/> Sonoran Desert Sidewinder 	AZ

## Poisonous Snakes Associated by State

<u>Snake</u>	<u>State</u>	<u>Snake</u>	<u>State</u>
<input type="checkbox"/> Speckled Rattlesnake 	AZ, CA, NV, UT	<input type="checkbox"/> Tiger Rattlesnake 	AZ
<input type="checkbox"/> Timber Rattlesnake 	AL, AR, DE, GA, IL, IN, IA, KS, KY, MA, MN, MS, MO, NE, NJ, NY, NC, OH, OK, PA, RI, SC, TN, TX, VT, VA, WV, WI	<input type="checkbox"/> Twin-Spotted Rattlesnake 	AZ
<input type="checkbox"/> Western Diamondback Rattlesnake 	AZ, AR, CA, OK, NM, TX	<input type="checkbox"/> Western Massasauga Rattlesnake 	IA, KS, MO, NE, OK, TX
<input type="checkbox"/> Western Rattlesnake 	AZ, CA, CO, ID, NV, OR, UT, WA		

## APPENDIX E

### SITE-SPECIFIC SCREENING LEVEL CALCULATIONS FOR INDOOR AIR

**Site-specific  
Composite Worker Equation Inputs for Air**

<b>Variable</b>	<b>Value</b>
TR (target cancer risk) unitless	0.0000033
THQ (target hazard quotient) unitless	1
AT <sub>w</sub> (averaging time)	365
EF <sub>w</sub> (exposure frequency) d/yr	250
ED <sub>w</sub> (exposure duration) years	25
ET <sub>w</sub> (exposure time) hours	8
LT (lifetime) yr	78

Output generated 28AUG2015:11:59:54

**Site-specific**

**Composite Worker Screening Levels (RSL) for Air**

ca=Cancer, nc=Noncancer, ca\* (Where nc SL < 100 x ca SL),  
ca\*\* (Where nc SL < 10 x ca SL), max=SL exceeds ceiling limit (see User's Guide), sat=SL exceeds csat,  
Smax=Soil SL exceeds ceiling limit and has been substituted with the max value (see User's Guide),  
Ssat=Soil inhalation SL exceeds csat and has been substituted with the csat

**Chemical**

Tetrachloroethylene

Trichloroethylene

Vinyl Chloride

Output generated 28AUG2015:11:59:54

CAS Number	Mutagen?	VOC?	Inhalation Unit Risk ( $\mu\text{g}/\text{m}^3$ ) <sup>-1</sup>	IUR Ref	Chronic RfD ( $\text{mg}/\text{kg}\cdot\text{day}$ )	Chronic RfD Ref	Chronic RfC ( $\text{mg}/\text{m}^3$ )	Chronic RfC Ref
127-18-4	No	Yes	2.60E-07		6.00E-03		4.00E-02	
79-01-6	Yes	Yes	4.10E-06		5.00E-04		2.00E-03	
75-01-4	Yes	Yes	4.40E-06		3.00E-03		1.00E-01	

Carcinogenic SL  
TR=3.3E-6  
(ug/m<sup>3</sup>)

1.73E+02

Noncarcinogenic SL  
HI=1  
(ug/m<sup>3</sup>)

1.75E+02

Screening  
Level  
(ug/m<sup>3</sup>)

1.73E+02 ca\*\*

1.10E+01

8.76E+00

8.76E+00 nc

1.02E+01

4.38E+02

1.02E+01 ca\*

**Inhalation Unit Risk Toxicity Metadata**

**Chemical**

Tetrachloroethylene

Trichloroethylene

Vinyl Chloride

Output generated 28AUG2015:11:59:54

<b>CASNUM</b>	<b>Inhalation Unit Risk (<math>\mu\text{g}/\text{m}^3</math>)<sup>-1</sup></b>	<b>Toxicity Source</b>
127-18-4	0.00000026	IRIS
79-01-6	0.0000041	IRIS
75-01-4	0.0000044	IRIS

**EPA Cancer Classification**

likely to be carcinogenic in humans by all routes of exposure

carcinogenic to humans

Known/likely human carcinogen

Inhalation Unit Risk Tumor Type
Hepatocellular adenomas or carcinomas
Multiple
Liver angiosarcomas, angiomas, hepatomas, and neoplastic nodules

**Inhalation Unit Risk Target Organ**

liver

Multiple

Liver

Inhalation Unit Risk Species
------------------------------

mouse
-------

Multiple
----------

Rat
-----

**Inhalation Unit Risk Method**

Multistage model with linear extrapolation from the point of departure (BMCL10), followed by extrapolation to humans using the PBPK model of Chiu and Ginsberg (2011)

Multiple

LED 10/ linear method

Inhalation Unit Risk Route	Inhalation Unit Risk Treatment Duration
NA	NA
NA	NA
NA	NA

**Inhalation Unit Risk Study Reference**

JISA

Multiple

Maltoni et al. 1981, Maltoni et al. 1984

Inhalation Unit Risk Study Date
1993
Multiple
NA

**Oral Slope Factor Toxicity Metadata**

**Chemical**

Tetrachloroethylene

Trichloroethylene

Vinyl Chloride

Output generated 28AUG2015:11:59:54

<b>CASNUM</b>	<b>Oral Slope Factor (mg/kg-day)<sup>-1</sup></b>	<b>Toxicity Source</b>
127-18-4	0.0021	IRIS
79-01-6	0.046	IRIS
75-01-4	0.72	IRIS

**EPA Cancer Classification**

likely to be carcinogenic in humans by all routes of exposure

carcinogenic to humans

Known/likely human carcinogen

Oral Slope Factor	Tumor Type
	Hepatocellular adenomas or carcinomas
	Derived from IUR
	Total of liver angiosarcoma, hepatocellular carcinoma, and neoplastic nodules

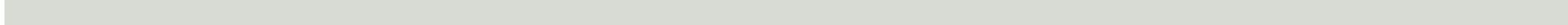


**Oral Slope Factor Target Organ**

Liver

Derived from IUR

Liver



Oral Slope Factor Species
mouse
Derived from IUR
Rat

**Oral Slope Factor Method**

Multistage model with linear extrapolation from the point of departure (BMDL10), followed by route-to-route extrapolation to the oral route and interspecies extrapolation using

Derived from IUR

LMS method

Oral Slope Factor Route	Oral Slope Factor Treatment Duration
NA	NA
NA	NA
NA	NA

**Oral Slope Factor Study Reference**

JISA

Derived from IUR

Feron et al.

**Oral Slope Factor Study Date**

1993

Derived from IUR

1981

**Oral Chronic Toxicity Metadata**

**Chemical**

Tetrachloroethylene

Trichloroethylene

Vinyl Chloride

Output generated 28AUG2015:11:59:54

<b>CASNUM</b>	<b>Chronic Oral Reference Dose (mg/kg-day)</b>	<b>Toxicity Source</b>
127-18-4	0.006	IRIS
79-01-6	0.0005	IRIS
75-01-4	0.003	IRIS

**Oral Chronic Reference Dose Basis**

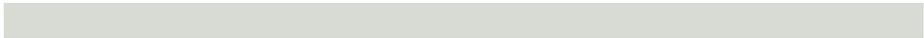
LOAEL: Multiple

Multiple: Multiple

NOAEL (HED): 0.09 mg/kg-day



Oral Chronic Reference Dose Confidence Level
medium
High
Medium



**Oral Chronic Reference Dose Critical Effect**

Neurotoxicity (color vision) (reaction time, cognitive effects)

Multiple

Liver cell polymorphism

**Oral Chronic Reference Dose Target Organ**

Nervous System

Multiple

Liver



Oral Chronic Reference Dose Modifying Factor	Oral Chronic Reference Dose Uncertainty Factor
1	1000
1	Multiple
1	30



Oral Chronic Reference Dose Species	Oral Chronic Reference Dose Route
human	NA
Multiple	NA
Rat	NA

**Oral Chronic Reference Dose Study Duration**

NA

NA

NA

**Oral Chronic Reference Dose Study Date**

Multiple

Multiple

2006

**Oral Chronic Reference Dose Study Reference**

Multiple

Multiple

Til et al. 1983, Til et al. 1991

**Inhalation Chronic Toxicity Metadata**

**Chemical**

Tetrachloroethylene

Trichloroethylene

Vinyl Chloride

Output generated 28AUG2015:11:59:54

CASNUM	Chronic Inhalation Reference Concentration (mg/m <sup>3</sup> )
127-18-4	0.04
79-01-6	0.002
75-01-4	0.1



<b>Toxicity Source</b>
IRIS
IRIS
IRIS



**Inhalation Chronic Reference Concentration Basis**

LOAEL3: Multiple

Multiple: Multiple

NOAEL (HEC): 2.5 mg/m<sup>3</sup>

**Inhalation Chronic Reference Concentration Confidence Level**

medium

High

Medium

Inhalation Chronic Reference Concentration Critical Effect
--

Neurotoxicity (color vision) (reaction time, cognitive effects)
---

Multiple
----------

Liver cell polymorphism
-------------------------

**Inhalation Chronic Reference Concentration Target Organ**

Nervous System

Multiple

Liver

Inhalation Chronic Reference Concentration Modifying Factor
---

1
---

1
---

1
---

<b>Inhalation Chronic Reference Concentration Uncertainty Factor</b>
1000
Multiple
30



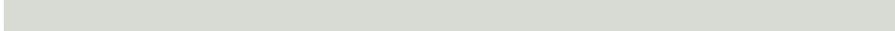
**Inhalation Chronic Reference Concentration Species**

human
Multiple
Rat





Inhalation Chronic Reference Concentration Route
NA
NA
NA



**Inhalation Chronic Reference Concentration Study Duration**

NA

NA

NA

**Inhalation Chronic Reference Concentration Study Date**

Multiple

Multiple

**Inhalation Chronic Reference Concentration Study Reference**

Multiple

Multiple

Til et al. 1991, Til et al. 1983

**Site-specific  
Resident Equation Inputs for Air**

<b>Variable</b>	<b>Value</b>
TR (target cancer risk) unitless	0.0000033
ED <sub>resa</sub> (exposure duration - resident) year	26
THQ (target hazard quotient) unitless	1
LT (lifetime - resident) year	78
EF <sub>resa</sub> (exposure frequency) day/year	350
ED <sub>0-2</sub> (exposure duration first phase) year	2
ED <sub>2-6</sub> (exposure duration second phase) year	4
ED <sub>6-16</sub> (exposure duration third phase) year	10
ED <sub>16-26</sub> (exposure duration fourth phase) year	10
EF <sub>0-2</sub> (exposure frequency first phase) day/year	350
EF <sub>2-6</sub> (exposure frequency second phase) day/year	350
EF <sub>6-16</sub> (exposure frequency third phase) day/year	350
EF <sub>16-26</sub> (exposure frequency fourth phase) day/year	350
ET <sub>0-2</sub> (exposure time first phase) hr/day	24
ET <sub>2-6</sub> (exposure time second phase) hr/day	24
ET <sub>6-16</sub> (exposure time third phase) hr/day	24
ET <sub>16-26</sub> (exposure time fourth phase) hr/day	24
ET <sub>resa</sub> (exposure time) hour/day	24

Output generated 28AUG2015:11:54:23

**Site-specific**

**Resident Screening Levels (RSL) for Air**

ca=Cancer, nc=Noncancer, ca\* (Where nc SL < 100 x ca SL),  
ca\*\* (Where nc SL < 10 x ca SL), max=SL exceeds ceiling limit (see User's Guide), sat=SL exceeds csat,  
Smax=Soil SL exceeds ceiling limit and has been substituted with the max value (see User's Guide),  
Ssat=Soil inhalation SL exceeds csat and has been substituted with the csat

**Chemical**

Tetrachloroethylene

Trichloroethylene

Vinyl Chloride

Output generated 28AUG2015:11:54:23

CAS Number	Mutagen?	VOC?	Inhalation Unit Risk ( $\mu\text{g}/\text{m}^3$ ) <sup>-1</sup>	IUR Ref	Chronic RfD ( $\text{mg}/\text{kg}\cdot\text{day}$ )	Chronic RfD Ref	Chronic RfC ( $\text{mg}/\text{m}^3$ )	Chronic RfC Ref
127-18-4	No	Yes	2.60E-07		6.00E-03		4.00E-02	
79-01-6	Yes	Yes	4.10E-06		5.00E-04		2.00E-03	
75-01-4	Yes	Yes	4.40E-06		3.00E-03		1.00E-01	

Carcinogenic SL  
TR=3.3E-6  
(ug/m<sup>3</sup>)

3.97E+01

1.76E+00

5.68E-01

Noncarcinogenic SL  
HI=1  
(ug/m<sup>3</sup>)

4.17E+01

2.09E+00

1.04E+02

Screening  
Level  
(ug/m<sup>3</sup>)

3.97E+01 ca\*\*

1.76E+00 ca\*\*

5.68E-01 ca

**Inhalation Unit Risk Toxicity Metadata**

**Chemical**

Tetrachloroethylene

Trichloroethylene

Vinyl Chloride

Output generated 28AUG2015:11:54:23

<b>CASNUM</b>	<b>Inhalation Unit Risk (<math>\mu\text{g}/\text{m}^3</math>)<sup>-1</sup></b>	<b>Toxicity Source</b>
127-18-4	0.00000026	IRIS
79-01-6	0.0000041	IRIS
75-01-4	0.0000044	IRIS

**EPA Cancer Classification**

likely to be carcinogenic in humans by all routes of exposure

carcinogenic to humans

Known/likely human carcinogen

Inhalation Unit Risk Tumor Type
Hepatocellular adenomas or carcinomas
Multiple
Liver angiosarcomas, angiomas, hepatomas, and neoplastic nodules

**Inhalation Unit Risk Target Organ**

liver

Multiple

Liver

Inhalation Unit Risk Species
mouse
Multiple
Rat

**Inhalation Unit Risk Method**

Multistage model with linear extrapolation from the point of departure (BMCL10), followed by extrapolation to humans using the PBPK model of Chiu and Ginsberg (2011)

Multiple

LED 10/ linear method

Inhalation Unit Risk Route	Inhalation Unit Risk Treatment Duration
NA	NA
NA	NA
NA	NA

**Inhalation Unit Risk Study Reference**

JISA

Multiple

Maltoni et al. 1981, Maltoni et al. 1984

Inhalation Unit Risk Study Date
1993
Multiple
NA

**Oral Slope Factor Toxicity Metadata**

**Chemical**

Tetrachloroethylene

Trichloroethylene

Vinyl Chloride

Output generated 28AUG2015:11:54:23

<b>CASNUM</b>	<b>Oral Slope Factor (mg/kg-day)<sup>-1</sup></b>	<b>Toxicity Source</b>
127-18-4	0.0021	IRIS
79-01-6	0.046	IRIS
75-01-4	0.72	IRIS

**EPA Cancer Classification**

likely to be carcinogenic in humans by all routes of exposure

carcinogenic to humans

Known/likely human carcinogen

Oral Slope Factor	Tumor Type
	Hepatocellular adenomas or carcinomas
	Derived from IUR
	Total of liver angiosarcoma, hepatocellular carcinoma, and neoplastic nodules



**Oral Slope Factor Target Organ**

Liver

Derived from IUR

Liver



Oral Slope Factor Species
mouse
Derived from IUR
Rat

**Oral Slope Factor Method**

Multistage model with linear extrapolation from the point of departure (BMDL10), followed by route-to-route extrapolation to the oral route and interspecies extrapolation using

Derived from IUR

LMS method

Oral Slope Factor Route	Oral Slope Factor Treatment Duration
NA	NA
NA	NA
NA	NA

**Oral Slope Factor Study Reference**

JISA

Derived from IUR

Feron et al.

Oral Slope Factor Study Date
1993 Derived from IUR 1981

**Oral Chronic Toxicity Metadata**

**Chemical**

Tetrachloroethylene

Trichloroethylene

Vinyl Chloride

Output generated 28AUG2015:11:54:23

<b>CASNUM</b>	<b>Chronic Oral Reference Dose (mg/kg-day)</b>	<b>Toxicity Source</b>
127-18-4	0.006	IRIS
79-01-6	0.0005	IRIS
75-01-4	0.003	IRIS

**Oral Chronic Reference Dose Basis**

LOAEL: Multiple

Multiple: Multiple

NOAEL (HED): 0.09 mg/kg-day



Oral Chronic Reference Dose Confidence Level
medium
High
Medium



**Oral Chronic Reference Dose Critical Effect**

Neurotoxicity (color vision) (reaction time, cognitive effects)

Multiple

Liver cell polymorphism

**Oral Chronic Reference Dose Target Organ**

Nervous System

Multiple

Liver



Oral Chronic Reference Dose Modifying Factor	Oral Chronic Reference Dose Uncertainty Factor
1	1000
1	Multiple
1	30



Oral Chronic Reference Dose Species	Oral Chronic Reference Dose Route
human	NA
Multiple	NA
Rat	NA

**Oral Chronic Reference Dose Study Duration**

NA

NA

NA

**Oral Chronic Reference Dose Study Date**

Multiple

Multiple

2006

**Oral Chronic Reference Dose Study Reference**

Multiple

Multiple

Til et al. 1983, Til et al. 1991

**Inhalation Chronic Toxicity Metadata**

**Chemical**

Tetrachloroethylene

Trichloroethylene

Vinyl Chloride

Output generated 28AUG2015:11:54:23



<b>CASNUM</b>
127-18-4
79-01-6
75-01-4



Chronic Inhalation Reference Concentration (mg/m<sup>3</sup>)

0.04

0.002

0.1



Toxicity Source
IRIS
IRIS
IRIS



**Inhalation Chronic Reference Concentration Basis**

LOAEL3: Multiple

Multiple: Multiple

NOAEL (HEC): 2.5 mg/m<sup>3</sup>

**Inhalation Chronic Reference Concentration Confidence Level**

medium

High

Medium

Inhalation	Chronic Reference Concentration	Critical Effect
------------	---------------------------------	-----------------

Neurotoxicity (color vision) (reaction time, cognitive effects)
---

Multiple
----------

Liver cell polymorphism
-------------------------

**Inhalation Chronic Reference Concentration Target Organ**

Nervous System

Multiple

Liver

**Inhalation Chronic Reference Concentration Modifying Factor**

1  
1  
1

<b>Inhalation Chronic Reference Concentration Uncertainty Factor</b>
1000
Multiple
30

Inhalation Chronic Reference Concentration Species
--

human
-------

Multiple
----------

Rat
-----

**Inhalation Chronic Reference Concentration Route**

NA

NA

NA

Inhalation Chronic Reference Concentration Study Duration
NA
NA
NA

**Inhalation Chronic Reference Concentration Study Date**

Multiple

Multiple

**Inhalation Chronic Reference Concentration Study Reference**

Multiple

Multiple

Til et al. 1991, Til et al. 1983

**APPENDIX F**  
**SVE WELL LOGS**

**TRIHYRO CORPORATION**  
**FIELD BORING LOG**

Project & Project Number: <u>MDEQ SRS Roxy's Cleaners 776-023-002</u>	Date: <u>4/30/2015</u>
Project Location/Address: <u>417 1st Street, Havre, MT</u>	Drilling Company: <u>Boland Drilling</u>
Client: <u>MDEQ</u>	Driller: <u>Chris Boland</u>
Weather: <u>Sunny, 18°F, Winds 75 mph</u>	Rig Type / Method: <u>CME 55 Hollowstem / Air Rotary</u>
Logged by: <u>Jack Riebel</u>	Sample Method (circle one): Direct Push <u>Split Spoon</u> Shelby Tube Other:
Logger's Signature: <u>[Signature]</u>	Surface Elevation: Casing Elevation: GE Elevation:
	Equipment List: <u>MiniRAE 3000 PID</u>

**BORING ID:** RXY SVE 01

**Boring Location:**

Interval (ft bgs)	Texture - Grain Size		Color			Plasticity	Consistency	Moisture	Odor	PID Interval/Reading	Additional Comments (Odor descriptor, sheen, nodules, structure, vegetation, etc.)
	Major	Minor	Major	Modifier							
<u>0-3"</u> <u>Asphalt</u>	GVL - F M C Sand - F M C Silt Clay	Grvly Sandy Silty Clayey	Black Gray - L M D Brn - L M D Red - L M D Other	Red Gray Rust Other %	Brown Green Yellow	High Moderate Low Non --	Very Soft Soft Firm Hard Very Hard	Dry Moist Saturated --	Strong Moderate Slight None Noted		<u>Top 3" asphalt</u>
<u>3"-7'</u>	GVL - F M C Sand - F M C Silt Clay	Grvly Sandy Silty Clayey	Black Gray - L M D Brn - L M D Red - L M D Other	Red Gray Rust Other %	Brown Green Yellow	High Moderate Low Non --	Very Soft Soft Firm Hard Very Hard	Dry Moist Saturated --	Strong Moderate Slight None Noted		<u>3"-7' previously hollowstem augered and backfilled on 11/10</u>
<u>7'-74"</u> <u>Concrete</u>	GVL - F M C Sand - F M C Silt Clay	Grvly Sandy Silty Clayey	Black Gray - L M D Brn - L M D Red - L M D Other	Red Gray Rust Other %	Brown Green Yellow	High Moderate Low Non --	Very Soft Soft Firm Hard Very Hard	Dry Moist Saturated --	Strong Moderate Slight None Noted		<u>~4" concrete layer</u>
<u>8'-10'</u>	GVL - F M C <u>Sand - F M C</u> Silt Clay	Grvly Sandy <u>Silty</u> Clayey	Black Gray - L M D <u>Brn - L M D</u> Red - L M D Other	Red Gray Rust Other %	Brown Green Yellow	High <u>Moderate</u> Low Non --	Very Soft <u>Soft</u> Firm Hard Very Hard	<u>Dry</u> Moist Saturated --	Strong Moderate Slight <u>None Noted</u>	<u>1ppm</u>	<u>Vegetation roots at 9'</u> <u>5/7/7/5</u>
<u>10'-12'</u>	GVL - F M C <u>Sand - F M C</u> Silt Clay	<u>Grvly</u> Sandy Silty Clayey	Black Gray - L M D <u>Brn - L M D</u> Red - L M D Other	Red Gray Rust Other %	Brown Green Yellow	High <u>Moderate</u> Low Non --	Very Soft <u>Soft</u> Firm Hard Very Hard	Dry <u>Moist</u> Saturated --	Strong Moderate Slight <u>None Noted</u>	<u>3ppm</u>	<u>4/5/8/4</u>
<u>12'-13'</u>	GVL - F M C <u>Sand - F M C</u> Silt Clay	Grvly Sandy <u>Silty</u> <u>Clayey</u>	Black Gray - L M D <u>Brn - L M D</u> Red - L M D Other	Red Gray Rust Other %	Brown Green Yellow	High <u>High</u> Moderate Low Non --	Very Soft <u>Soft</u> Firm Hard Very Hard	Dry <u>Moist</u> <u>Saturated</u> --	Strong Moderate Slight <u>None Noted</u>	<u>2ppm</u>	<u>Saturated at 12.5'</u> <u>1/2</u>
	GVL - F M C Sand - F M C Silt Clay	Grvly Sandy Silty Clayey	Black Gray - L M D Brn - L M D Red - L M D Other	Red Gray Rust Other %	Brown Green Yellow	High Moderate Low Non --	Very Soft Soft Firm Hard Very Hard	Dry Moist Saturated --	Strong Moderate Slight None Noted		

**TRIHEDRO CORPORATION**  
**FIELD BORING LOG**

Sheet 1 of 1 Sheets

Project & Project Number: <u>MDEQ SRS Roxys Cleaners 776-023-002</u>		Date: <u>11/30/2015</u>
Project Location/Address: <u>417 1st Street, Keure, MT</u>		Drilling Company: <u>Boland Drilling</u>
Client: <u>MDEQ</u>		Driller: <u>Chris Drilling</u>
Weather: <u>Sunny, 27°F, winds &gt; 5mph</u>		Rig Type / Method: <u>CME 55 Hollowstem / Air Rotary</u>
Logged by: <u>Scott Richli</u>		Sample Method (circle one): <u>Direct Push</u> <del>Split Spoon</del> <del>Shelby Tube</del> Other:
Logger's Signature: 		Surface Elevation: _____ Casing Elevation: _____ GE Elevation: _____
		Equipment List: _____

**BORING ID:** RXYSUE02

**Boring Location:**

Interval (ft bgs)	Texture - Grain Size		Color			Plasticity	Consistency	Moisture	Odor	PID Interval/Reading	Additional Comments (Odor descriptor, sheen, nodules, structure, vegetation, etc.)
	Major	Minor	Major	Modifier							
<u>0-3"</u> <u>Asphalt</u>	GVL - F M C Sand - F M C Silt Clay	Grvly Sandy Silty Clayey	Black Gray - L M D Brn - L M D Red - L M D Other	Red Gray Rust Other	Brown Green Yellow	High Moderate Low Non --	Very Soft Soft Firm Hard Very Hard	Dry Moist Saturated -- --	Strong Moderate Slight None Noted		<u>Top 3" asphalt</u>
<u>3-7'</u>	GVL - F M C Sand - F M C Silt Clay	Grvly Sandy Silty Clayey	Black Gray - L M D Brn - L M D Red - L M D Other	Red Gray Rust Other	Brown Green Yellow	High Moderate Low Non --	Very Soft Soft Firm Hard Very Hard	Dry Moist Saturated -- --	Strong Moderate Slight None Noted		<u>Area previously hollowstem cased and bgs sealed on 11/10</u>
<u>7'-7 1/2"</u> <u>Concrete</u>	GVL - F M C Sand - F M C Silt Clay	Grvly Sandy Silty Clayey	Black Gray - L M D Brn - L M D Red - L M D Other	Red Gray Rust Other	Brown Green Yellow	High Moderate Low Non --	Very Soft Soft Firm Hard Very Hard	Dry Moist Saturated -- --	Strong Moderate Slight None Noted		<u>26" concrete layer</u>
<u>8-10'</u>	GVL - F M C <del>Sand - F M C</del> Silt Clay	Grvly Sandy Silty <u>Clayey</u>	Black Gray - L M D <u>Brn - L M D</u> Red - L M D Other	Red Gray Rust Other	Brown Green Yellow	High <u>Moderate</u> Low Non --	Very Soft Soft <u>Firm</u> Hard Very Hard	<u>Dry</u> Moist Saturated -- --	Strong Moderate Slight <u>None Noted</u>	<u>0.8 ppm</u>	<u>2/2/11/7</u>
<u>10'-12'</u>	GVL - F M C <del>Sand - F M C</del> Silt Clay	Grvly Sandy <u>Silty</u> Clayey	Black Gray - L M D <u>Brn - L M D</u> Red - L M D Other	Red Gray Rust Other	Brown Green Yellow	High <u>Moderate</u> Low Non --	Very Soft Soft <u>Firm</u> Hard Very Hard	<u>Dry</u> Moist Saturated -- --	Strong Moderate Slight <u>None Noted</u>	<u>2 ppm</u>	<u>4/4/3/3</u>
<u>12'-13'</u>	GVL - F M C <del>Sand - F M C</del> Silt Clay	Grvly Sandy Silty <u>Clayey</u>	Black Gray - L M D <u>Brn - L M D</u> Red - L M D Other	Red Gray Rust Other	Brown Green Yellow	High <u>Moderate</u> Low Non --	Very Soft Soft <u>Firm</u> Hard Very Hard	Dry <u>Moist</u> <u>Saturated</u> -- --	Strong Moderate Slight <u>None Noted</u>	<u>1.8 ppm</u>	<u>Saturated at 12.5'</u>  <u>2/1</u>
	GVL - F M C Sand - F M C Silt Clay	Grvly Sandy Silty Clayey	Black Gray - L M D Brn - L M D Red - L M D Other	Red Gray Rust Other	Brown Green Yellow	High Moderate Low Non --	Very Soft Soft Firm Hard Very Hard	Dry Moist Saturated -- --	Strong Moderate Slight None Noted		

**TRIHYDRO CORPORATION**  
**FIELD BORING LOG**

Project & Project Number: <u>MDEQ SRS Roxys Cleaners 776-023-002</u>		Date: <u>11/30/2015</u>
Project Location/Address: <u>417 1<sup>st</sup> Street, Haver, MA</u>		Drilling Company: <u>Beland Drilling</u>
Client: <u>MDEQ</u>		Driller: <u>Chris Beland</u>
Weather: <u>Sunny, ~29°C, Calm</u>		Rig Type / Method: <u>CME 55 Hollow stem / air rotary</u>
Logged by: <u>Joel Ricci</u>		Sample Method (circle one): Direct Push <u>Split Spoon</u> Shelby Tube Other:
Logger's Signature: <u>[Signature]</u>		Surface Elevation: Casing Elevation: GE Elevation:
Equipment List: <u>MINIRAE 3000 PID</u>		

**BORING ID:** RXYSVE03

**Boring Location:**

Interval (ft bgs)	Texture - Grain Size		Color			Plasticity	Consistency	Moisture	Odor	PID Interval/Reading	Additional Comments (Odor descriptor, sheen, nodules, structure, vegetation, etc.)
	Major	Minor	Major	Modifier							
<u>0-3"</u> <u>Asphalt</u>	GVL - F M C Sand - F M C Silt Clay	Grvly Sandy Silty Clayey	Black Gray - L M D Brn - L M D Red - L M D Other	Red Gray Rust Other	Brown Green Yellow %	High Moderate Low Non --	Very Soft Soft Firm Hard Very Hard	Dry Moist Saturated -- --	Strong Moderate Slight None Noted --		<u>Top 3" is asphalt</u>
<u>3"-7'</u>	GVL - F M C Sand - F M C Silt Clay	Grvly Sandy Silty Clayey	Black Gray - L M D Brn - L M D Red - L M D Other	Red Gray Rust Other	Brown Green Yellow %	High Moderate Low Non --	Very Soft Soft Firm Hard Very Hard	Dry Moist Saturated -- --	Strong Moderate Slight None Noted --		<u>3"-7' previously augered on 11/9/2015</u>
<u>~7'-7'10"</u> <u>Concrete</u>	GVL - F M C Sand - F M C Silt Clay	Grvly Sandy Silty Clayey	Black Gray - L M D Brn - L M D Red - L M D Other	Red Gray Rust Other	Brown Green Yellow %	High Moderate Low Non --	Very Soft Soft Firm Hard Very Hard	Dry Moist Saturated -- --	Strong Moderate Slight None Noted --		<u>~10" concrete</u>
<u>8'-10'</u>	GVL - F M C <u>Sand - F M C</u> Silt Clay	Grvly Sandy <u>Silty</u> Clayey	Black Gray - L M D <u>Brn - L M D</u> Red - L M D Other	Red Gray Rust Other	Brown Green Yellow %	High <u>Moderate</u> Low Non --	Very Soft Soft <u>Firm</u> Hard Very Hard	<u>Dry</u> Moist Saturated -- --	Strong Moderate <u>Slight</u> None Noted --	<u>0.2 ppm</u>	<u>6/8/4/8</u>
<u>10'-12'</u>	GVL - F M C <u>Sand - F M C</u> Silt Clay	Grvly Sandy <u>Silty</u> Clayey	Black Gray - L M D <u>Brn - L M D</u> Red - L M D Other	Red Gray Rust Other	Brown Green Yellow %	High <u>Moderate</u> Low Non --	Very Soft Soft <u>Firm</u> Hard Very Hard	<u>Dry</u> Moist Saturated -- --	Strong Moderate <u>Slight</u> None Noted --	<u>2 ppm</u>	<u>3/4/4/4</u>
<u>12'-13'</u>	GVL - F M C <u>Sand - F M C</u> Silt Clay	Grvly Sandy <u>Silty</u> Clayey	Black Gray - L M D <u>Brn - L M D</u> Red - L M D Other	Red Gray Rust Other	Brown Green Yellow %	High Moderate <u>Low</u> Non --	Very Soft Soft <u>Firm</u> Hard Very Hard	Dry <u>Moist</u> <u>Saturated</u> -- --	Strong Moderate <u>Slight</u> None Noted --	<u>2 ppm</u>	<u>Saturated at 12.5'</u> <u>2/2</u>
	GVL - F M C Sand - F M C Silt Clay	Grvly Sandy Silty Clayey	Black Gray - L M D Brn - L M D Red - L M D Other	Red Gray Rust Other	Brown Green Yellow %	High Moderate Low Non --	Very Soft Soft Firm Hard Very Hard	Dry Moist Saturated -- --	Strong Moderate Slight None Noted --		

**TRIHYDRO CORPORATION**  
**FIELD BORING LOG**

Sheet 1 of 1 Sheets

Project & Project Number: <u>MDEQ SRS ROXY'S CLEANERS 776-023-002</u>	Date: <u>11/09/2015</u>
Project Location/Address: <u>417 1<sup>st</sup> Street, Haver, MT</u>	Drilling Company: <u>Boland Drilling</u>
Client: <u>MDEQ</u>	Driller: <u>Chris Boland</u>
Weather: <u>cloudy, ~40°F, calm</u>	Rig Type / Method: <u>CME 55 Hollow stem auger</u>
Logged by: <u>Jack Richi</u>	Sample Method (circle one): Direct Push <u>Split Spoon</u> Shelby Tube Other:
Logger's Signature: <u>[Signature]</u>	Surface Elevation: Casing Elevation: GE Elevation:
	Equipment List: <u>TVA 10003 FID/PID</u>

**BORING ID:** RXYSUE04

**Boring Location:**

Interval (ft bgs)	Texture - Grain Size		Color		Plasticity	Consistency	Moisture	Odor	PID/FID Interval/Reading	Additional Comments (Odor descriptor, sheen, nodules, structure, vegetation, etc.)
	Major	Minor	Major	Modifier						
<u>Top 3" depth</u> <u>1'-3'</u>	<u>GVL - F M C</u> <u>Sand</u> F M C Silt Clay	Grvly Sandy Silty <u>Clayey</u>	Black Gray - L M D <u>Brn - L M D</u> Red - L M D Other	Red Brown Gray Green Rust Yellow Other %	High <u>Moderate</u> Low Non --	Very Soft Soft <u>Firm</u> Hard Very Hard	<u>Dry</u> Moist Saturated --	Strong Moderate Slight <u>None Noted</u>	<u>7.9/15</u>	<u>wood piece at 2.5'</u> <u>Blow count 5/9/7/7</u>
<u>3'-5'</u>	<u>GVL - F M C</u> <u>Sand</u> F M C Silt Clay	Grvly Sandy <u>Silty</u> Clayey	Black Gray - L M D <u>Brn - L M D</u> Red - L M D Other	Red Brown Gray Green Rust Yellow Other %	High Moderate <u>Low</u> Non --	Very Soft <u>Soft</u> Firm Hard Very Hard	<u>Dry</u> Moist Saturated --	Strong Moderate Slight <u>None Noted</u>	<u>8.1/21</u>	<u>Blow count 2/3/3/5</u>
<u>5'-7'</u>	<u>GVL - F M C</u> Sand - F M C Silt <u>Clay</u>	Grvly Sandy <u>Silty</u> Clayey	Black Gray - L M D <u>Brn - L M D</u> Red - L M D Other	Red Brown Gray Green Rust Yellow Other %	High <u>Moderate</u> Low Non --	Very Soft <u>Soft</u> Firm Hard Very Hard	<u>Dry</u> Moist Saturated --	Strong Moderate Slight <u>None Noted</u>	<u>8.2/15</u>	<u>Blow count 4/4/4/8</u>
<u>7'-9'</u>	<u>GVL - F M C</u> Sand - F M C Silt <u>Clay</u>	Grvly Sandy <u>Silty</u> Clayey	Black Gray - L M D <u>Brn - L M D</u> Red - L M D Other	Red Brown Gray Green Rust Yellow Other %	High <u>Moderate</u> Low Non --	Very Soft <u>Soft</u> Firm Hard Very Hard	<u>Dry</u> Moist Saturated --	Strong Moderate Slight <u>None Noted</u>	<u>4.4/68</u>	<u>Blow count 3/5/5/7</u>
<u>9'-11'</u>	<u>GVL - F M C</u> <u>Sand</u> F M C Silt Clay	Grvly Sandy <u>Silty</u> Clayey	Black Gray - L M D <u>Brn - L M D</u> Red - L M D Other	Red Brown Gray Green Rust Yellow Other %	High <u>Moderate</u> Low Non --	Very Soft <u>Soft</u> Firm Hard Very Hard	<u>Dry</u> <u>Moist</u> Saturated --	Strong Moderate Slight <u>None Noted</u>	<u>3.8/18</u>	<u>Blow count 4/7/7/8</u>
<u>11-12</u>	<u>GVL - F M C</u> <u>Sand</u> F M C Silt Clay	Grvly Sandy <u>Silty</u> Clayey	Black Gray - L M D <u>Brn - L M D</u> Red - L M D Other	Red Brown Gray Green Rust Yellow Other %	High <u>Moderate</u> Low Non --	Very Soft <u>Soft</u> Firm Hard Very Hard	<u>Dry</u> <u>Moist</u> Saturated --	Strong Moderate Slight <u>None Noted</u>	<u>3.3/67</u>	<u>Blow count 5/10</u>
	<u>GVL - F M C</u> Sand - F M C Silt Clay	Grvly Sandy Silty Clayey	Black Gray - L M D Brn - L M D Red - L M D Other	Red Brown Gray Green Rust Yellow Other %	High Moderate Low Non --	Very Soft Soft Firm Hard Very Hard	<u>Dry</u> Moist Saturated --	Strong Moderate Slight None Noted		

**TRIHYDRO CORPORATION**  
**FIELD BORING LOG**

Sheet 1 of 1 Sheets

Project & Project Number: <u>MDEQ SRS ROXY'S Cleaners 776-023-002</u>		Date: <u>11/09/2015</u>
Project Location/Address: <u>417 1st Street, Haver, MA</u>		Drilling Company: <u>Boiland Drilling</u>
Client: <u>MDEQ</u>		Driller: <u>Chris Boiland</u>
Weather: <u>cloudy ~40°F, ~5mph winds</u>		Rig Type / Method: <u>CME 55 Hollowstem auger</u>
Logged by: <u>Scott Richi</u>		Sample Method (circle one): Direct Push <u>Split Spoon</u> Shelby Tube Other:
Logger's Signature: <u>[Signature]</u>		Surface Elevation: Casing Elevation: GE Elevation:
Equipment List: <u>TVA M00B F2D/P2D</u>		

**BORING ID:** RXYSVE 05

**Boring Location:**

Interval (ft bgs)	Texture - Grain Size		Color		Plasticity	Consistency	Moisture	Odor	210/RED PID Interval/Reading	Additional Comments (Odor descriptor, sheen, nodules, structure, vegetation, etc.)
	Major	Minor	Major	Modifier						
<u>1'-2'</u>	<u>GVL - FMC</u> Sand - F M C Silt Clay	Grvly <u>Sandy</u> Silty Clayey	<u>Black</u> Gray - L M D Brn - L M D Red - L M D Other	Red Brown Gray Green Rust Yellow Other %	High Moderate <u>Low</u> Non	Very Soft Soft <u>Firm</u> Hard Very Hard	<u>Dry</u> Moist Saturated --	Strong Moderate Slight <u>None Noted</u>	<u>72/15</u>	<u>Top 3" asphalt</u>  <u>Blow count 7/20</u>
<u>2'-3'</u>	<u>GVL - FMC</u> Sand - F M C Silt Clay	Grvly <u>Sandy</u> Silty Clayey	<u>Black</u> Gray - L M D Brn - L M D Red - L M D Other	Red Brown Gray Green Rust Yellow Other %	High Moderate <u>Low</u> Non	Very Soft Soft <u>Hard</u> <u>Hard</u> Very Hard	<u>Dry</u> Moist Saturated --	Strong Moderate Slight <u>None Noted</u>	<u>83/27</u>	<u>Blow count 7/5/4/5</u>
<u>3'-5'</u>	<u>GVL - FMC</u> <u>Sand</u> F M C Silt Clay	Grvly Sandy <u>Silty</u> Clayey	<u>Black</u> Gray - L M D <u>Brn - L M D</u> Red - L M D Other	Red Brown Gray Green Rust Yellow Other %	High Moderate <u>Low</u> Non	Very Soft <u>Soft</u> Firm Hard Very Hard	<u>Dry</u> Moist Saturated --	Strong Moderate Slight <u>None Noted</u>	<u>75/15</u>	<u>Blow count 1/5/7/6</u>
<u>5'-8'</u>	<u>GVL - FMC</u> <u>Sand</u> F M C Silt Clay	Grvly Sandy Silty <u>Clayey</u>	<u>Black</u> Gray - L M D <u>Brn - L M D</u> Red - L M D Other	Red Brown Gray Green Rust Yellow Other %	High Moderate Low Non	Very Soft <u>Soft</u> Firm Hard Very Hard	<u>Dry</u> <u>Moist</u> Saturated --	Strong Moderate Slight <u>None Noted</u>	<u>78/29</u>	<u>Blow count 2/2/5/7</u>
<u>7'-9'</u>	<u>GVL - FMC</u> Sand - F M C <u>Silt</u> Clay	Grvly <u>Sandy</u> Silty Clayey	<u>Black</u> Gray - L M D <u>Brn - L M D</u> Red - L M D Other	Red Brown Gray Green Rust Yellow Other %	High Moderate <u>Low</u> Non	Very Soft <u>Soft</u> Firm Hard Very Hard	<u>Dry</u> <u>Moist</u> Saturated --	Strong Moderate Slight <u>None Noted</u>	<u>76/30</u>	<u>Blow count 4/4/5/7</u>
<u>9'-11'</u>	<u>GVL - FMC</u> Sand - F M C <u>Silt</u> Clay	Grvly <u>Sandy</u> Silty Clayey	<u>Black</u> Gray - L M D <u>Brn - L M D</u> Red - L M D Other	Red Brown Gray Green Rust Yellow Other %	High Moderate <u>Low</u> Non	Very Soft <u>Soft</u> Firm Hard Very Hard	<u>Dry</u> <u>Moist</u> Saturated --	Strong Moderate Slight <u>None Noted</u>	<u>76/30</u>	<u>Blow count 4/4/5/7</u>
<u>11'-12'</u>	<u>GVL - FMC</u> <u>Sand</u> F M C Silt Clay	Grvly Sandy <u>Silty</u> Clayey	<u>Black</u> Gray - L M D <u>Brn - L M D</u> Red - L M D Other	Red Brown Gray Green Rust Yellow Other %	High Moderate <u>Low</u> Non	Very Soft <u>Soft</u> Firm Hard Very Hard	<u>Dry</u> <u>Moist</u> Saturated --	Strong Moderate Slight <u>None Noted</u>	<u>80/31</u>	<u>Blow count 8/11</u>

**TRIHYRO CORPORATION**  
**FIELD BORING LOG**

Project & Project Number: <u>MDEQ SRS Rexy's Cleaners 776-023-002</u>	Date: <u>11/03/2015</u>
Project Location/Address: <u>417 1st Street, Haverhill, MA</u>	Drilling Company: <u>Beland Drilling</u>
Client: <u>MDEQ</u>	Driller: <u>Chris Beland</u>
Weather: <u>Cloudy ~ 30°F, Slight winds</u>	Rig Type / Method: <u>CME 55 Hollowstem auger</u>
Logged by: <u>Joel R. Cobl</u>	Sample Method (circle one): <u>Direct Push</u> <u>Split Spoon</u> Shelby Tube Other:
Logger's Signature: <u>[Signature]</u>	Surface Elevation: _____ Casing Elevation: _____ GE Elevation: _____
	Equipment List: <u>TVA 10003 FID/PID</u>

**BORING ID:** RXYSUE06

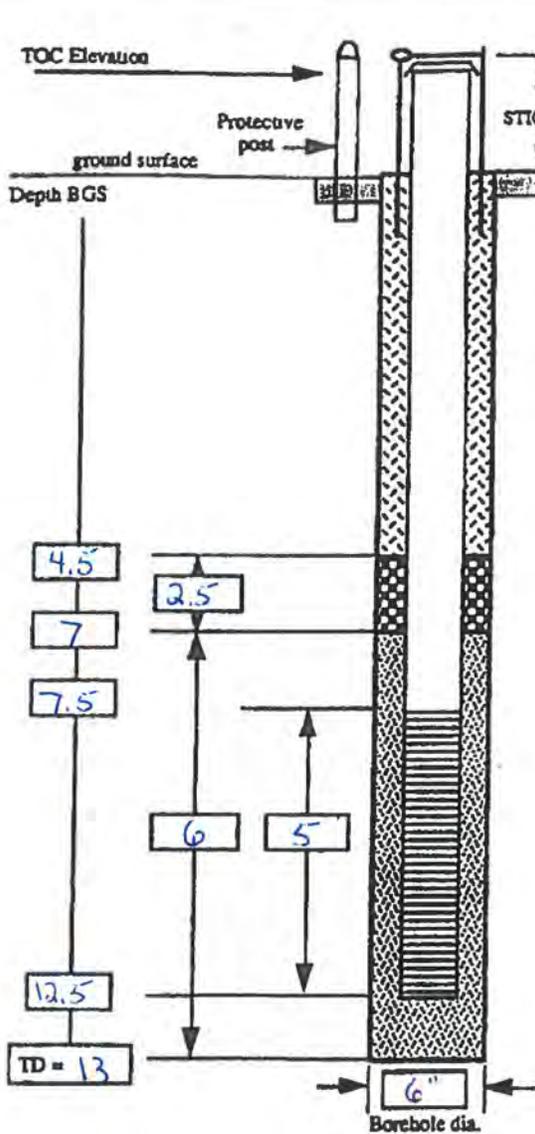
**Boring Location:**

Interval (ft bgs)	Texture - Grain Size		Color			Plasticity	Consistency	Moisture	Odor	PID Interval/Reading	Additional Comments (Odor descriptor, sheen, nodules, structure, vegetation, etc.)
	Major	Minor	Major	Modifier							
<u>1-3'</u>	<u>GVL - F M C</u> <u>Sand - F M C</u> <u>Silt</u> <u>Clay</u>	<u>Grvly</u> <u>Sandy</u> <u>Silty</u> <u>Clayey</u>	<u>Black</u> <u>Gray - L M D</u> <u>Brn - L M D</u> <u>Red - L M D</u> <u>Other</u>	<u>Red</u> <u>Gray</u> <u>Rust</u> <u>Other</u> <u>%</u>	<u>Brown</u> <u>Green</u> <u>Yellow</u> <u>Other</u> <u>%</u>	<u>High</u> <u>Moderate</u> <u>Low</u> <u>Non</u> <u>--</u>	<u>Very Soft</u> <u>Soft</u> <u>Firm</u> <u>Hard</u> <u>Very Hard</u>	<u>Dry</u> <u>Moist</u> <u>Saturated</u> <u>--</u> <u>--</u>	<u>Strong</u> <u>Moderate</u> <u>Slight</u> <u>None Noted</u> <u>--</u>	<u>70/20</u>	<u>Top three inches asphalt</u>  <u>Blow count 4/4/4/4</u>
<u>3-5'</u>	<u>GVL - F M C</u> <u>Sand - F M C</u> <u>Silt</u> <u>Clay</u>	<u>Grvly</u> <u>Sandy</u> <u>Silty</u> <u>Clayey</u>	<u>Black</u> <u>Gray - L M D</u> <u>Brn - L M D</u> <u>Red - L M D</u> <u>Other</u>	<u>Red</u> <u>Gray</u> <u>Rust</u> <u>Other</u> <u>%</u>	<u>Brown</u> <u>Green</u> <u>Yellow</u> <u>Other</u> <u>%</u>	<u>High</u> <u>Moderate</u> <u>Low</u> <u>Non</u> <u>--</u>	<u>Very Soft</u> <u>Soft</u> <u>Firm</u> <u>Hard</u> <u>Very Hard</u>	<u>Dry</u> <u>Moist</u> <u>Saturated</u> <u>--</u> <u>--</u>	<u>Strong</u> <u>Moderate</u> <u>Slight</u> <u>None Noted</u> <u>--</u>	<u>72/28</u>	<u>Low recovery</u>  <u>Blow count 2/2/1/1</u>
<u>5-7'</u>	<u>GVL - F M C</u> <u>Sand - F M C</u> <u>Silt</u> <u>Clay</u>	<u>Grvly</u> <u>Sandy</u> <u>Silty</u> <u>Clayey</u>	<u>Black</u> <u>Gray - L M D</u> <u>Brn - L M D</u> <u>Red - L M D</u> <u>Other</u>	<u>Red</u> <u>Gray</u> <u>Rust</u> <u>Other</u> <u>%</u>	<u>Brown</u> <u>Green</u> <u>Yellow</u> <u>Other</u> <u>%</u>	<u>High</u> <u>Moderate</u> <u>Low</u> <u>Non</u> <u>--</u>	<u>Very Soft</u> <u>Soft</u> <u>Firm</u> <u>Hard</u> <u>Very Hard</u>	<u>Dry</u> <u>Moist</u> <u>Saturated</u> <u>--</u> <u>--</u>	<u>Strong</u> <u>Moderate</u> <u>Slight</u> <u>None Noted</u> <u>--</u>	<u>75/20</u>	<u>Blow count 2/3/5/7</u>
<u>7-9'</u>	<u>GVL - F M C</u> <u>Sand - F M C</u> <u>Silt</u> <u>Clay</u>	<u>Grvly</u> <u>Sandy</u> <u>Silty</u> <u>Clayey</u>	<u>Black</u> <u>Gray - L M D</u> <u>Brn - L M D</u> <u>Red - L M D</u> <u>Other</u>	<u>Red</u> <u>Gray</u> <u>Rust</u> <u>Other</u> <u>%</u>	<u>Brown</u> <u>Green</u> <u>Yellow</u> <u>Other</u> <u>%</u>	<u>High</u> <u>Moderate</u> <u>Low</u> <u>Non</u> <u>--</u>	<u>Very Soft</u> <u>Soft</u> <u>Firm</u> <u>Hard</u> <u>Very Hard</u>	<u>Dry</u> <u>Moist</u> <u>Saturated</u> <u>--</u> <u>--</u>	<u>Strong</u> <u>Moderate</u> <u>Slight</u> <u>None Noted</u> <u>--</u>	<u>10/20</u>	<u>Blow count 5/5/4/6</u>
<u>9-11</u>	<u>GVL - F M C</u> <u>Sand - F M C</u> <u>Silt</u> <u>Clay</u>	<u>Grvly</u> <u>Sandy</u> <u>Silty</u> <u>Clayey</u>	<u>Black</u> <u>Gray - L M D</u> <u>Brn - L M D</u> <u>Red - L M D</u> <u>Other</u>	<u>Red</u> <u>Gray</u> <u>Rust</u> <u>Other</u> <u>%</u>	<u>Brown</u> <u>Green</u> <u>Yellow</u> <u>Other</u> <u>%</u>	<u>High</u> <u>Moderate</u> <u>Low</u> <u>Non</u> <u>--</u>	<u>Very Soft</u> <u>Soft</u> <u>Firm</u> <u>Hard</u> <u>Very Hard</u>	<u>Dry</u> <u>Moist</u> <u>Saturated</u> <u>--</u> <u>--</u>	<u>Strong</u> <u>Moderate</u> <u>Slight</u> <u>None Noted</u> <u>--</u>	<u>78/22</u>	<u>Blow count 0/9/9/7</u>
<u>11-12</u>	<u>GVL - F M C</u> <u>Sand - F M C</u> <u>Silt</u> <u>Clay</u>	<u>Grvly</u> <u>Sandy</u> <u>Silty</u> <u>Clayey</u>	<u>Black</u> <u>Gray - L M D</u> <u>Brn - L M D</u> <u>Red - L M D</u> <u>Other</u>	<u>Red</u> <u>Gray</u> <u>Rust</u> <u>Other</u> <u>%</u>	<u>Brown</u> <u>Green</u> <u>Yellow</u> <u>Other</u> <u>%</u>	<u>High</u> <u>Moderate</u> <u>Low</u> <u>Non</u> <u>--</u>	<u>Very Soft</u> <u>Soft</u> <u>Firm</u> <u>Hard</u> <u>Very Hard</u>	<u>Dry</u> <u>Moist</u> <u>Saturated</u> <u>--</u> <u>--</u>	<u>Strong</u> <u>Moderate</u> <u>Slight</u> <u>None Noted</u> <u>--</u>	<u>28/11</u>	<u>Blow count 2/6</u>
	<u>GVL - F M C</u> <u>Sand - F M C</u> <u>Silt</u> <u>Clay</u>	<u>Grvly</u> <u>Sandy</u> <u>Silty</u> <u>Clayey</u>	<u>Black</u> <u>Gray - L M D</u> <u>Brn - L M D</u> <u>Red - L M D</u> <u>Other</u>	<u>Red</u> <u>Gray</u> <u>Rust</u> <u>Other</u> <u>%</u>	<u>Brown</u> <u>Green</u> <u>Yellow</u> <u>Other</u> <u>%</u>	<u>High</u> <u>Moderate</u> <u>Low</u> <u>Non</u> <u>--</u>	<u>Very Soft</u> <u>Soft</u> <u>Firm</u> <u>Hard</u> <u>Very Hard</u>	<u>Dry</u> <u>Moist</u> <u>Saturated</u> <u>--</u> <u>--</u>	<u>Strong</u> <u>Moderate</u> <u>Slight</u> <u>None Noted</u> <u>--</u>		

# MONITOR WELL INSTALLATION DIAGRAM

Project: MDEQ SAS Roxy's Cleaners  
 Location: Haver, MT  
 Contractor: Beland Drilling  
 Driller: Chris Beland  
 Well Coordinates: \_\_\_\_\_

Monitor Well No: AXY5VE01  
 Borehole No: \_\_\_\_\_  
 Date Constructed: 11/30/2015  
 Observed by: Seal Richi  
 Sheet 1 of 1



**PROTECTIVE CSG**  
 Material/Type \_\_\_\_\_  
 Diameter \_\_\_\_\_  
 Stick-up \_\_\_\_\_  
 Water Tight Seal (Y/N) \_\_\_\_\_  
 Weep Hole (Y/N) \_\_\_\_\_

**SURFACE PAD**  
 Composition & Size Flush mounted

**RISER PIPE**  
 Type Sch 40 PVC  
 Diameter 2"  
 Total Length (TOC to TOS) \_\_\_\_\_

**GROUT** Sand  
 Composition & Proportions 10/20 Silica Sand  
Colorado Silica  
 Tremied (Y/N)   
 Interval \_\_\_\_\_

**CENTRALIZERS (Y/N)**   
 Depth(s) \_\_\_\_\_

**SEAL**  
 Type Bentonite  
 Source Enviro Plug Hole Plug  
 Setup/Hydration Time \_\_\_\_\_  
 Vol. Fluid Added \_\_\_\_\_  
 Tremied (Y/N)

**FILTER PACK**  
 Type Silica Sand  
 Amt Used 5 bags  
 Tremied (Y/N)   
 Source Colorado Silica  
 Gr. Size Dist. 10/20

**SCREEN**  
 Type Sch 40 PVC  
 Diameter 2"  
 Slot Size & Type 0.010 slotted  
 Interval BGS 5'

**SLUMP (Y/N)**   
 Interval BGS \_\_\_\_\_  
 Length 6"  
**Bottom CAP (Y/N)**

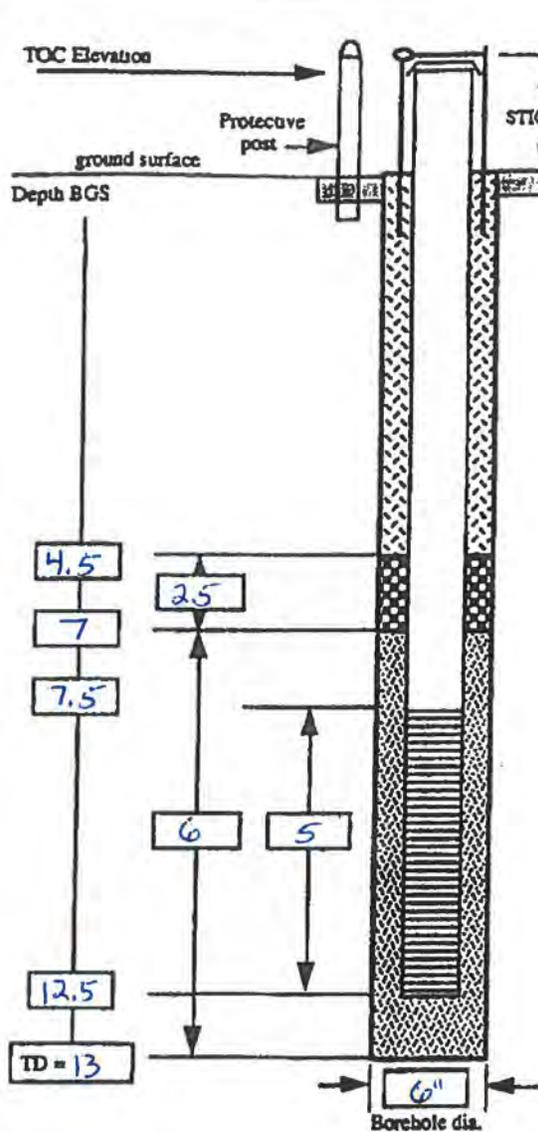
REMARKS

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

# MONITOR WELL INSTALLATION DIAGRAM

Project: MDEQ SRS Roxy's Cleaners  
 Location: Havre, MT  
 Contractor: Beland Drilling  
 Driller: Chris Beland  
 Well Coordinates: \_\_\_\_\_

Monitor Well No: RXYSVE02  
 Borehole No: \_\_\_\_\_  
 Date Constructed: 11/30/2015  
 Observed by: Jack Rubli  
 Sheet 1 of 1



~~PROTECTIVE CSG~~  
 Material/Type \_\_\_\_\_  
 Diameter \_\_\_\_\_  
 Stick-up \_\_\_\_\_  
 Water Tight Seal (Y/N) \_\_\_\_\_  
 Weep Hole (Y/N) \_\_\_\_\_

~~SURFACE PAD~~  
 Composition & Size Flush no. 1-2

RISER PIPE  
 Type Sch 40 PVC  
 Diameter 2"  
 Total Length (TOC to TOS) \_\_\_\_\_

~~GRIT~~ sand  
 Composition & Proportions 10/20 silica sand  
Colorado silica  
 Treated (Y/N) (N)  
 Interval \_\_\_\_\_

~~CENTRALIZERS~~ (Y/N) (N)  
 Depth(s) \_\_\_\_\_

SEAL  
 Type Bentonite  
 Source Essex Plug material 1 bag  
 Setup/Hydration Time \_\_\_\_\_ Vol. Fluid Added \_\_\_\_\_  
 Treated (Y/N) (N)

FILTER PACK  
 Type 10/20 silica sand  
 Amt Used 5 bags  
 Treated (Y/N) (N)  
 Source Colorado silica  
 Gr. Size Dist. 10/20

SCREEN  
 Type Sch 40 PVC  
 Diameter 2"  
 Slot Size & Type 0.010 slotted  
 Interval BGS 5' with collar

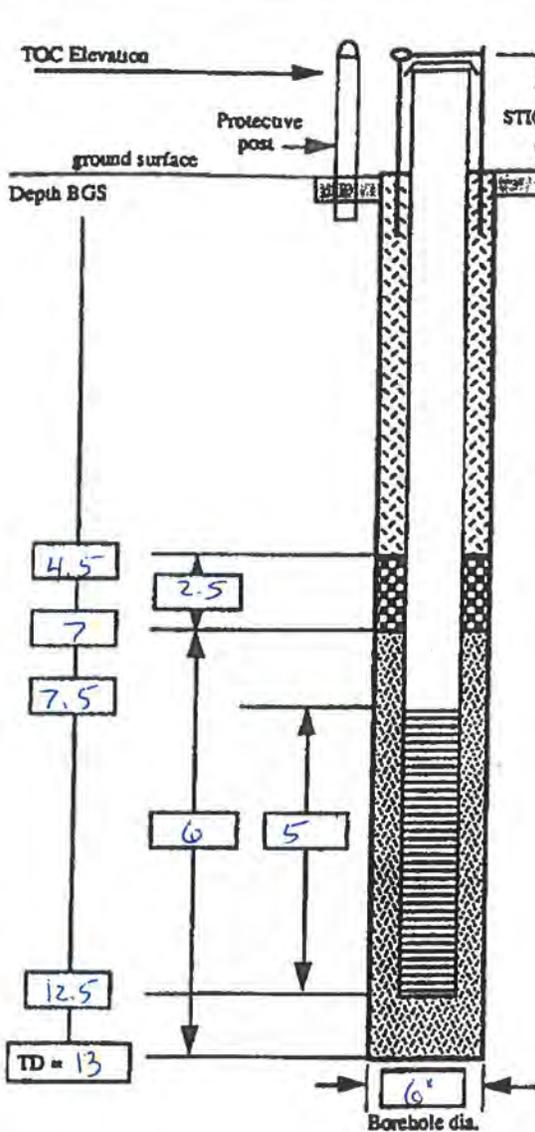
SLUMP (Y/N) (N)  
 Interval BGS \_\_\_\_\_ Length 6"  
 Bottom CAP (Y/N) (N)

REMARKS

# MONITOR WELL INSTALLATION DIAGRAM

Project: MDEQ SRS Reay's Cleanups  
 Location: Haver, MT  
 Contractor: Bolton Drilling  
 Driller: Chris Bolton  
 Well Coordinates: \_\_\_\_\_

Monitor Well No: RXY5UE03  
 Borehole No: \_\_\_\_\_  
 Date Constructed: 11/30/2015  
 Observed by: Scott Rubin  
 Sheet 1 of 2



### PROTECTIVE CSG

Material/Type \_\_\_\_\_  
 Diameter \_\_\_\_\_  
 Stick-up  Water Tight Seal (Y/N)  
                    Weep Hole (Y/N)

### SURFACE PAD

Composition & Size Flush mounted

### RISER PIPE

Type Sch 40 PVC  
 Diameter 2"  
 Total Length (TOC to TOS) \_\_\_\_\_

### GROUT

Composition & Proportions 10/20 silica sand  
   Colorado silica  
 Tremied (Y/N)   
 Interval \_\_\_\_\_

### CENTRALIZERS (Y/N)

Depth(s) \_\_\_\_\_

### SEAL

Type Bentonite  
 Source Hulsberg  
 Seap/Hydration Time \_\_\_\_\_ Vol. Fluid Added \_\_\_\_\_  
 Tremied (Y/N)

### FILTER PACK

Type silica sand  
 Amt Used 5 bags  
 Tremied (Y/N)   
 Source Colorado silica  
 Gr. Size Dist. 10/20

### SCREEN

Type Sch 40 PVC  
 Diameter 2"  
 Slot Size & Type 0.010 slotted  
 Interval BGS 5'

### SLIMP (Y/N)

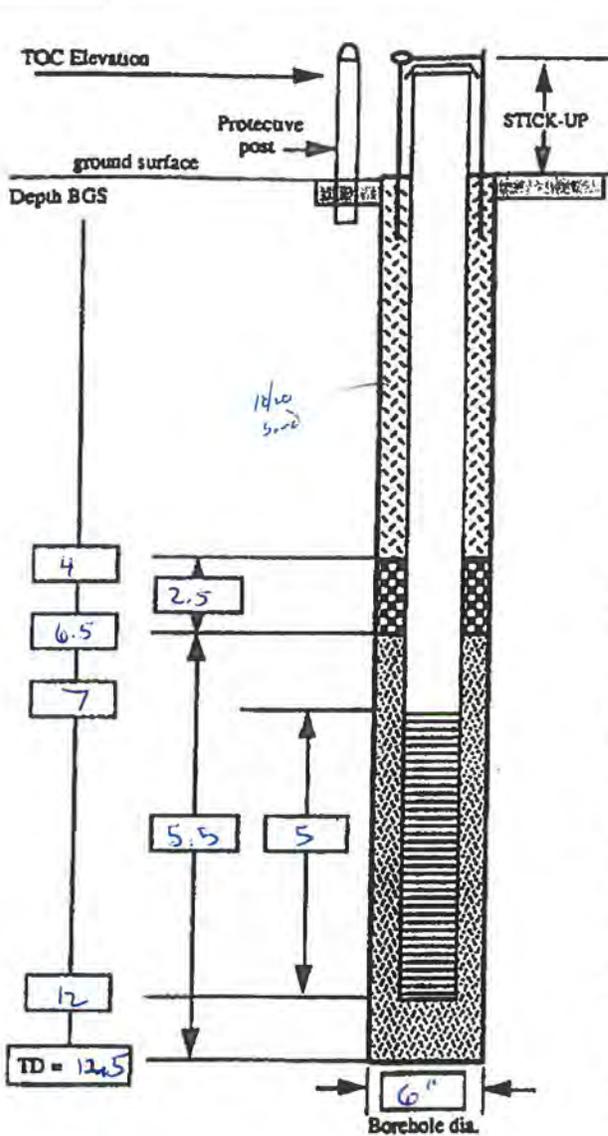
Interval BGS \_\_\_\_\_ Length 6"  
 Bottom CAP

REMARKS

# MONITOR WELL INSTALLATION DIAGRAM

Project: MDEQ SAS Rxy's Cleaners  
 Location: Haver, MT  
 Contractor: Boiled Drillers  
 Driller: Chris Beland  
 Well Coordinates: \_\_\_\_\_

Monitor Well No: RXY5UE07  
 Borehole No: \_\_\_\_\_  
 Date Constructed: 11/9/2015  
 Observed by: Seal Riehl  
 Sheet 1 of 1



**PROTECTIVE CSG**  
 Material/Type \_\_\_\_\_  
 Diameter \_\_\_\_\_  
 Stick-up \_\_\_\_\_  
 Water Tight Seal (Y/N) \_\_\_\_\_  
 Weep Hole (Y/N) \_\_\_\_\_

**SURFACE PAD**  
 Composition & Size Flush mounted

**RISER PIPE**  
 Type Sch 40 PVC  
 Diameter 2"  
 Total Length (TOC to TOS) \_\_\_\_\_

**GRAIT** Sand  
 Composition & Proportions 10/20 silica sand  
Colorado Silica  
 Treated (Y/N) \_\_\_\_\_  
 Interval \_\_\_\_\_

**CENTRALIZERS (Y/N)**  
 Depth(s) \_\_\_\_\_

**SEAL**  
 Type Bentonite  
 Source Enviro Plug medium  
 Setup/Hydration Time \_\_\_\_\_ Vol. Fluid Added \_\_\_\_\_  
 Treated (Y/N) \_\_\_\_\_

**FILTER PACK**  
 Type 10/20 silica sand  
 Amt Used \_\_\_\_\_  
 Treated (Y/N) \_\_\_\_\_  
 Source Colorado silica  
 Gr. Size Dist. 10/20

**SCREEN**  
 Type Sch 40 PVC  
 Diameter 2"  
 Slot Size & Type 0.010 slot  
 Interval BGS 5'

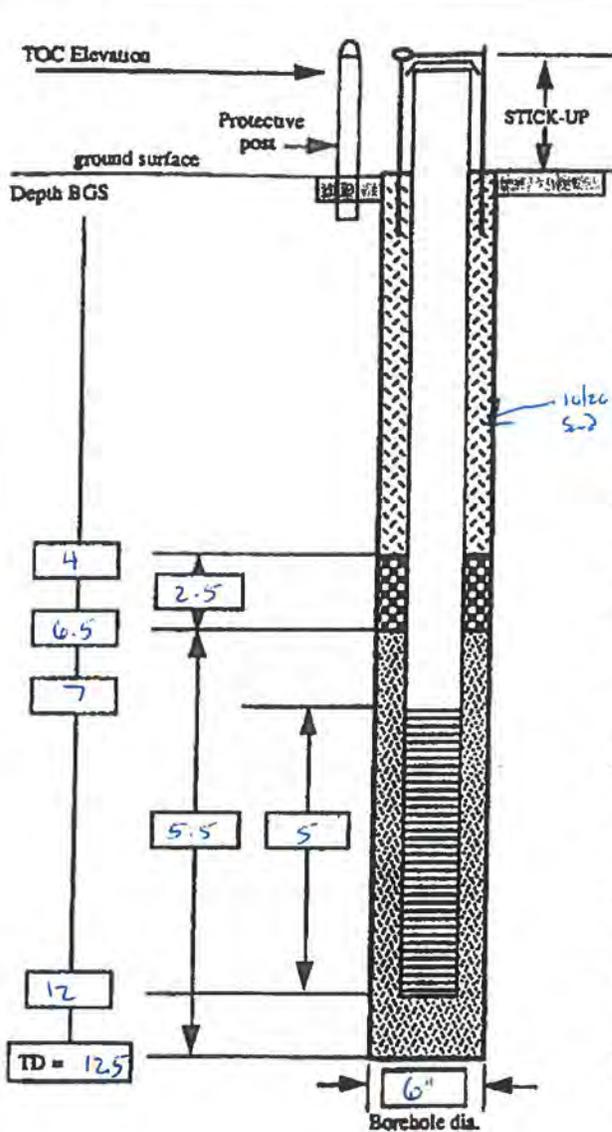
**SUMP** (Y/N) \_\_\_\_\_  
 Interval BGS \_\_\_\_\_ Length 6"  
 Bottom CAP (Y/N) \_\_\_\_\_

REMARKS

# MONITOR WELL INSTALLATION DIAGRAM

Project: MDEQ SRS Axy's Cleaners  
 Location: Haver, MI  
 Contractor: Beland Drillers  
 Driller: Chris Beland  
 Well Coordinates: \_\_\_\_\_

Monitor Well No: RXYSUE05  
 Borehole No: \_\_\_\_\_  
 Date Constructed: 11/9/2015  
 Observed by: Scott Riehl  
 Sheet 1 of 1



### PROTECTIVE CSG

Material/Type \_\_\_\_\_  
 Diameter \_\_\_\_\_  
 Stick-up \_\_\_\_\_  
 Water Tight Seal (Y/N) \_\_\_\_\_  
 Weep Hole (Y/N) \_\_\_\_\_

### SURFACE PAD

Composition & Size Flush mounted

### RISER PIPE

Type 2" sch 40 PVC  
 Diameter 2  
 Total Length (TOC to TOS) \_\_\_\_\_

### GRIT

Composition & Proportions 10/20 silica sand  
Colorado Silica  
 Tremied (Y/N) (N)  
 Interval \_\_\_\_\_

### CENTRALIZERS (Y/N)

Depth(s) \_\_\_\_\_

### SEAL

Type Benlate  
 Source Enviro Plug medium  
 Setup/Hydration Time \_\_\_\_\_ Vol. Fluid Added \_\_\_\_\_  
 Tremied (Y/N) \_\_\_\_\_

### FILTER PACK

Type 10/20 silica sand  
 Amt Used \_\_\_\_\_  
 Tremied (Y/N) (N)  
 Source Colorado Silica  
 Gr. Size Dist. 10/20

### SCREEN

Type 2" sch 40 PVC with 0.010 slot  
 Diameter 2  
 Slot Size & Type 0.010 PVC slot  
 Interval BGS 6

### SUMP

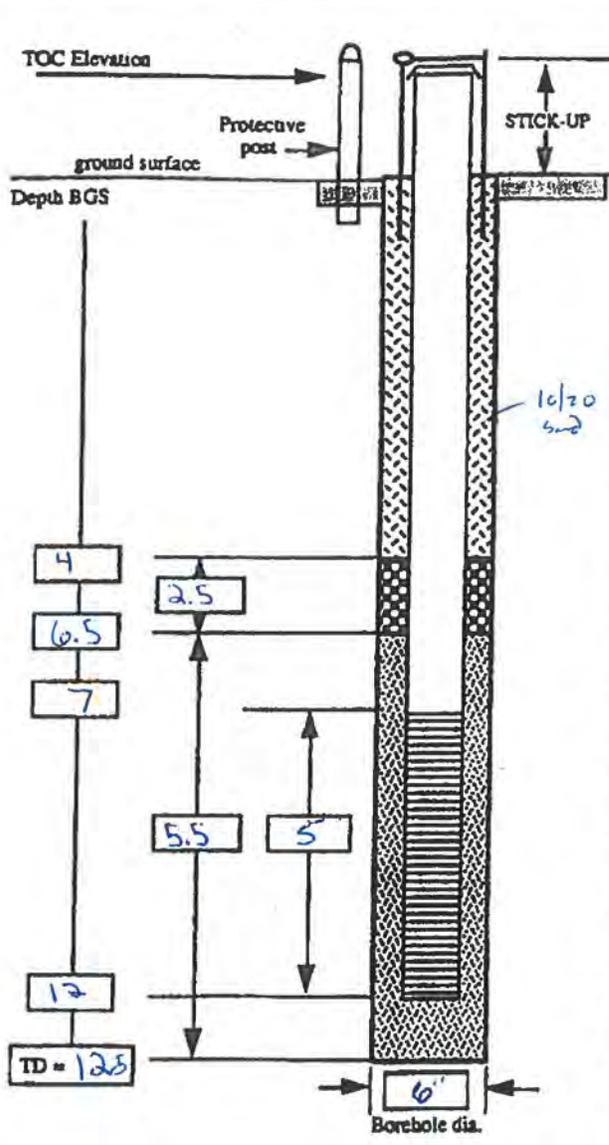
Interval BGS \_\_\_\_\_ Length 6"  
 Bottom CAP (Y/N) \_\_\_\_\_

REMARKS

# MONITOR WELL INSTALLATION DIAGRAM

Project: MDEQ Roxy's Cleaners  
 Location: Haver MT  
 Contractor: Beland Drillers  
 Driller: Chris Beland  
 Well Coordinates: \_\_\_\_\_

Monitor Well No: RXYSVE06  
 Borehole No: \_\_\_\_\_  
 Date Constructed: 11/9/2015  
 Observed by: Joel Rebl  
 Sheet 1 of 1



**PROTECTIVE CSG**  
 Material/Type \_\_\_\_\_  
 Diameter \_\_\_\_\_  
 Stick-up \_\_\_\_\_  
 Water Tight Seal (Y/N) \_\_\_\_\_  
 Weep Hole (Y/N) \_\_\_\_\_

**SURFACE PAD**  
 Composition & Size Flush mounted

**RISER PIPE**  
 Type 2" sch. 40 PVC  
 Diameter 2"  
 Total Length (TOC to TOS) \_\_\_\_\_

**GROUT Sand**  
 Composition & Proportions 10/20 silica sand  
Colorado silica  
 Tremied (Y/N) \_\_\_\_\_  
 Interval \_\_\_\_\_

**CENTRALIZERS (Y/N)**  
 Depth(s) \_\_\_\_\_

**SEAL**  
 Type Bentonite  
 Source Enviro Plug medium  
 Seal/Hydration Time \_\_\_\_\_ Vol. Fluid Added \_\_\_\_\_  
 Tremied (Y/N) \_\_\_\_\_

**FILTER PACK**  
 Type 10/20 silica sand  
 Amt Used \_\_\_\_\_  
 Tremied (Y/N) \_\_\_\_\_  
 Source Colorado silica  
 Gr. Size Dist. 10/20

**SCREEN**  
 Type 2" sch 40 PVC  
 Diameter 2"  
 Slot Size & Type 0.010 slot  
 Interval BGS 5'

**SLUMP (Y/N)**  
 Interval BGS \_\_\_\_\_ Length 6"  
 Bottom CAP (Y/N) \_\_\_\_\_

REMARKS

# UTILITY LOCATE TRACKING



Project Name: Roxy Project Number: 776-  
 Excavation/Drilling Contractor: Boland Drilling Trihydro Representative: Joel Ricchi  
 Project Location and Description: Have, MT Former Day Cleaners  
 Utility Locate Ticket Number: 15100804 Date Locate Submitted: 11/4/15  
 Locate Deadline: 11/7/15 Locate Expiration Date: 11/13/15 Date(s) Renewed: \_\_\_\_\_

1	Company	Contact Name	Contact Method	Phone No./Email	Date
	<u>Charter</u>		<input type="checkbox"/> Phone Call <input type="checkbox"/> Email <input checked="" type="checkbox"/> Site Visit <input type="checkbox"/> No Response	<u>Marked no consist</u>	<u>before 11/9</u>
Utility Located		<input type="checkbox"/> Gas <input type="checkbox"/> Electric <input type="checkbox"/> Sewer <input checked="" type="checkbox"/> Communication <input type="checkbox"/> Water <input type="checkbox"/> Other: _____			
2	Company	Contact Name	Contact Method	Phone No./Email	Date
	<u>City of Have</u>		<input type="checkbox"/> Phone Call <input type="checkbox"/> Email <input checked="" type="checkbox"/> Site Visit <input type="checkbox"/> No Response	<u>Water lines - side walk not old</u>	<u>11/9</u>
Utility Located		<input type="checkbox"/> Gas <input type="checkbox"/> Electric <input checked="" type="checkbox"/> Sewer <input type="checkbox"/> Communication <input checked="" type="checkbox"/> Water <input type="checkbox"/> Other: _____			
3	Company	Contact Name	Contact Method	Phone No./Email	Date
	<u>Northwestern Energy</u>		<input type="checkbox"/> Phone Call <input type="checkbox"/> Email <input checked="" type="checkbox"/> Site Visit <input type="checkbox"/> No Response	<u>Marked no consist</u>	<u>before 11/9</u>
Utility Located		<input type="checkbox"/> Gas <input checked="" type="checkbox"/> Electric <input type="checkbox"/> Sewer <input type="checkbox"/> Communication <input type="checkbox"/> Water <input type="checkbox"/> Other: _____			
4	Company	Contact Name	Contact Method	Phone No./Email	Date
	<u>Northwestern Energy</u>		<input type="checkbox"/> Phone Call <input type="checkbox"/> Email <input type="checkbox"/> Site Visit <input type="checkbox"/> No Response	<u>Gas line is in the north street</u>	<u>before 11/9</u>
Utility Located		<input checked="" type="checkbox"/> Gas <input type="checkbox"/> Electric <input type="checkbox"/> Sewer <input type="checkbox"/> Communication <input type="checkbox"/> Water <input type="checkbox"/> Other: _____			
5	Company	Contact Name	Contact Method	Phone No./Email	Date
			<input type="checkbox"/> Phone Call <input type="checkbox"/> Email <input type="checkbox"/> Site Visit <input type="checkbox"/> No Response		
Utility Located		<input type="checkbox"/> Gas <input type="checkbox"/> Electric <input type="checkbox"/> Sewer <input type="checkbox"/> Communication <input type="checkbox"/> Water <input type="checkbox"/> Other: _____			
6	Company	Contact Name	Contact Method	Phone No./Email	Date
			<input type="checkbox"/> Phone Call <input type="checkbox"/> Email <input type="checkbox"/> Site Visit <input type="checkbox"/> No Response		
Utility Located		<input type="checkbox"/> Gas <input type="checkbox"/> Electric <input type="checkbox"/> Sewer <input type="checkbox"/> Communication <input type="checkbox"/> Water <input type="checkbox"/> Other: _____			
7	Company	Contact Name	Contact Method	Phone No./Email	Date
			<input type="checkbox"/> Phone Call <input type="checkbox"/> Email <input type="checkbox"/> Site Visit <input type="checkbox"/> No Response		
Utility Located		<input type="checkbox"/> Gas <input type="checkbox"/> Electric <input type="checkbox"/> Sewer <input type="checkbox"/> Communication <input type="checkbox"/> Water <input type="checkbox"/> Other: _____			
8	Company	Contact Name	Contact Method	Phone No./Email	Date
			<input type="checkbox"/> Phone Call <input type="checkbox"/> Email <input type="checkbox"/> Site Visit <input type="checkbox"/> No Response		
Utility Located		<input type="checkbox"/> Gas <input type="checkbox"/> Electric <input type="checkbox"/> Sewer <input type="checkbox"/> Communication <input type="checkbox"/> Water <input type="checkbox"/> Other: _____			

Note: Completed forms should be stored in the project file. Additional tracking boxes are provided on the back of this form.

# Excavation, Drilling, and Utility-Locating Checklist

Task	Date	Initials
<b>A. Excavation-site planning:</b>		
1. The local One Call regulations have been checked for local utility-notification requirements (e.g., 48 hours vs. 72 hours).	11/4	Belong
2. Per the local One Call regulations, list the responsible party (generally the excavation/drilling contractor) for requesting and verifying completion of utility locates below:	11/4	Belong
3. The property owner and/or business owner has been notified of the excavation schedule.	11/4	Trihydro
4. Each proposed excavation site or "area of interest" has been delineated for utility-line locators using white spray paint and/or wooden stakes/lathes with white flagging.		
5. Public-utility locates have been requested by calling One Call at least 48 hours (72 hours in some states) before work is scheduled to begin, and the request includes depths, as available.	11/4	Belong
6. Each utility company has been notified of the excavation schedule and invited to review the proposed excavation sites.		
7. On-site meetings have been scheduled with the appropriate representatives of critical utility facilities (e.g., gas/oil pipelines, high-voltage cables, fiber-optic lines).		
8. Private-utility locates—including fuel lines; tanks; and water, sewer, gas, electricity, and other utilities—have been requested.		
9. The property owner was contacted to determine if he/she knows of privately owned subsurface facilities within 5 feet of the proposed excavation sites. (Review locations with the manager/owner.) Examples of privately owned facilities that are not commonly marked on private property include:	11/4	Found locates Trihydro
a) Water and sewer laterals		
b) Gas lines		
c) Power lines (including those for landscape/yard lighting, pool and spa lines, and "out building" lines)		
d) Irrigation lines		
e) Communication lines (cable, telephone, Internet)		
f) Propane tank lines		
10. The proposed excavation sites have been reviewed by the appropriate stakeholders (e.g., owner, tenant, driller, excavator) and the Trihydro project manager.	11/9	Belong / Trihydro
11. Proposed excavation sites have been visually inspected, and available plans and aerial photos have been reviewed for evidence of potential utilities.		
12. A scaled site plan showing the proposed excavation sites relative to subsurface utilities has been prepared and is available for stakeholder/Management review.		
13. The basis for each buried utility line's location and the accuracy of the data defining the utility location are documented on the site plan.		
14. The proposed excavation sites are at least 5 feet from subsurface utilities shown on the building plans.		
15. The proposed excavation sites are at least 5 feet from subsurface utilities shown on public right-of-way / street-improvement plans. [Note: Work with utility companies to determine if they require a representative present during excavation activities.]		
16. The proposed excavation sites are at least 7 feet from the pad surrounding underground storage tanks (USTs) shown on the building plans.		
17. The utility-locate ticket number is available on site.		
18. A traffic-control plan has been prepared if appropriate. Note: If the project area encompasses a public street or right of way, the local and/or state authority must approve the traffic control plan before fieldwork begins.		
19. Arrangements have been made to contact the appropriate personnel if utility-line repairs are needed. (Who must be contacted if a line is unexpectedly damaged?)		
20. Contact information is in place and readily available with the driller, excavator, and other project stakeholders.		
21. The client and other relevant stakeholders (if any) have been notified of the excavation planning/pre-planning steps and results.		
22. A detailed work scope was developed by the project team and reviewed by the Project Director and Contracting Team.		
		Project Director (excavation-site planning tasks)

# Excavation, Drilling, and Utility-Locating Checklist

Task	Date	Initials
<b>B. Utility-line marking:</b>		
1. Electrical circuits are energized during utility-line marking for subsurface power lines (e.g., circuits on timers or light-sensing switches).		
2. Public-utility lines have been marked using electronic techniques appropriate to the project site (e.g., ground-penetrating radar, geophysical survey) if part of the client-approved work scope and project budget.		
3. Private-utility lines have been marked using electronic techniques appropriate to the project site (e.g., ground-penetrating radar, geophysical survey) if part of the client-approved work scope and project budget.		
4. Verify that One Call locators marked their facilities in the designated excavation area or provided notification that they do not have any facilities near the proposed excavation sites.	11/9	Trihydro
5. One Call was contacted to request a "refresh" if utility-locate markings are missing, difficult to see, or more than 14 days old (7 days in some states). "Refresh" markings must be performed by the original marking organization.		
	Project Director (utility-line marking tasks)	
<b>C. Job walk:</b>		
1. Visual verification that each proposed excavation site does not lie on a line connecting two similar-looking manhole covers (e.g., sanitary sewers or storm drains). (Consider having the line snaked to confirm their locations.)		
2. Visual verification that each proposed excavation site does not lie on a line with any water, gas, electrical meters, utility cleanouts, or other utility boxes in the surrounding areas.	11/9	JR
3. Visual verification that the pavement near each proposed excavation site has not subsided or give the appearance it may be covering a previous excavation (e.g., linear cracks or sagging curbs).	11/9	JR
4. Visual verification that each proposed excavation has adequate overhead clearance for the excavation equipment (e.g., at least 10 feet from overhead-utility lines and/or reasonable distance from canopies).	11/9	JR
5. Fences and fields have been checked for markers, signs, posts, valves, stub outs, etc.	11/9	JR
6. Surface structures such as tank batteries, wells, valves, phone pedestals, and electrical junction boxes have been checked for evidence of subsurface utilities.	11/9	JR
7. Observed evidence of subsurface utilities has been photographed, sketched, or otherwise documented.	11/9	JR
8. Proposed excavation sites have been "walked"/reviewed by the excavation contractor, Trihydro project manager, and other stakeholders (e.g., client representative, property owner, tenant).	11/9	JR/Bal
9. Proposed excavation sites are located at least 5 feet from marked utilities (i.e., the "tolerance zone"), or written approval to excavate within the 5-foot tolerance zone has been obtained from the appropriate utility owner. In no case shall a proposed excavation be located closer than 2 feet from the outside edge of a marked utility. (Note: The tolerance zone is measured from the outside edge of a subsurface structure—not its centerline.)	11/9	JR/Bal
10. Verify that the excavation contractor (with help from appropriate utility-line locators, if part of the client-approved work scope) has walked each proposed excavation site to verify all expected utility-line markings are present.	11/9	JR/Bal
11. Traffic-control devices, safety barricades, caution tape, and other safety-management devices are in place as needed to protect project personnel.		
	Project Director (job-walk tasks)	
<b>D. Daylighting / potholing / "soft digging":</b>		
1. The proposed excavation sites located within the "tolerance zone" (and sites located outside the "tolerance zone" when required by the client) have been potholed to a depth below the anticipated utility zone using "minimally intrusive excavation methods" such as vacuum excavation (either air-entrainment or water-jet) and careful hand-tool use.		
2. Monitoring and emergency equipment is available on site when hazardous atmospheres are expected to be encountered in the potholing excavations.		
3. A list of emergency-contact names/numbers is maintained at the potholing excavation site.		
4. The project health and safety plan addresses potential hazards and safety-performance requirements related to utility-clearance operations.		
5. The location of and directions to the nearest hospital are known by all members of the project team.		

# Excavation, Drilling, and Utility-Locating Checklist

Task	Date	Initials
6. Representatives of utility owners that requested to be on site for utility locates are present.		
7. Pothole excavations have been visually checked with a flashlight by the excavation contractor, Trihydro project manager, or her/his designee.		
8. Utilities adjacent to the excavation or that cross the excavation have been daylighted using "minimally intrusive excavation methods."		
9. The areal extent of the excavation-clearance pothole has been verified to extend at least 120% beyond the outside diameter of the largest-diameter down-hole tool to be used in the borehole, or at least 2 feet on each side of daylighted/exposed lines, whichever is greater.		
10. If vacuum excavation (e.g., air knife, air vac, hydro-vac) is not available to daylight utility lines, verify that the non-conductive probe method was used as follows: Scratch the ground no more than 10 inches deep above the utility and then probe the scratched area. If the utility isn't found in the scratched area, repeat the first step until the utility is located. Once the utility is found, its depth must be continually verified with the probe until 2 feet of soil remain above the utility. Carefully hand dig the remaining overburden to expose the utility.		
11. The soil encountered in the excavation-clearance pothole has been verified to be free of bedding material (e.g., clean gravel, clean sand, aggregate base [gravelly sand with ~10% fines], or other non-native-looking material) that could indicate the presence of a previously installed utility line.		
12. Excavation work within 2 feet of an underground utility was "hand dug."		
13. Once the utility lines were exposed and the excavations were safe to enter, the exposed lines (including their protective coating) was examined for damage.		
14. The condition of each utility line exposed during daylighting was documented, and the documentation was forwarded to the Trihydro project manager to place in the project file.		
15. If a utility line was damaged in any way, it was reported to the utility owner and Trihydro project manager and documented in the project file.		
16. Damage to a utility line was documented and repaired before it was reburied. The utility owner signed off on the repairs.		
17. Employees entering the excavation followed the procedures described in the Trihydro "Trenching and Excavation Program" and used the Trihydro "Daily Excavation/Trench Inspection Report" to document excavation condition.		
18. The location of daylighted utilities was documented and photographed after daylighting was completed and before the pothole excavation was backfilled.		
19. Locations for hand digging within the "tolerance zone" were noted.		
Project Director (daylighting/potholing tasks):		
<b>E. Excavation (including drilling):</b>		
1. The appropriate permits have been obtained for the work (e.g., hot-work permits, entry permits).		
2. The utility-owner and/or agency representatives that requested to be on site during excavation work are present. (Trihydro Utility Locate Acknowledgement Form)		
3. A safety kickoff meeting was conducted with the excavation contractor to review roles/responsibilities, work activities, anticipated hazards, this checklist, and emergency-response procedures before starting excavation work the site. The safety kickoff meeting was documented in the project file.	11/9	JR/B.L.
4. A daily tailgate safety meeting was conducted and documented in the project file. Verify weather conditions, safety hazards, PPE requirements, job duties, communication, hand signals, etc.	11/9	JR/B.L.
5. JSAs covering the work to be done are in place and have been reviewed, "marked up" where appropriate, and acknowledged by the excavation project-team members.	11/9	JR/B.L.
6. Site workers have been reminded to look for hazardous conditions, processes, and activities, and that they are authorized to stop work if they see an unsafe condition.	11/9	JR/B.L.
7. The emergency-response plan has been reviewed by all excavation project-team members (e.g., contact numbers, evacuation muster points, hospital routes).	11/9	JR/B.L.
8. The excavation contractor has checked the excavation sites relative to overhead utilities, subsurface-utility locates, and adjacent surface structures.	11/9	B.L.
9. The excavation contractor has acknowledged the potential location of each subsurface utility marked in the excavation areas.	11/9	B.L.
10. Proper traffic control and exclusion zones have been established.		
11. The excavation equipment (e.g., drill rig, backhoe) has been inspected for proper operation and condition.	11/9	B.L.
12. Emergency equipment (fire extinguisher, first aid kit, emergency shut-off switch, etc.) has been checked, is readily available, and is in working order.	11/9	JR/B.L.



**MONTANA 811**

<b>Ticket No:</b>	15105051	<b>2 FULL BUSINESS DAYS</b>	<b>NEW TICKET</b>
<b>Transmit Date:</b>	11/19/2015	<b>Time:</b> 15:50	<b>Op:</b> orportia
<b>Original Call Date:</b>	11/19/2015	<b>Time:</b> 15:44	<b>Op:</b> orportia
<b>Work to Begin Date:</b>	11/24/2015	<b>Time:</b> 00:00	

**Caller Information**

<b>Company:</b>	REMMINGTON TECHNOLOGIES	<b>Fax Phone:</b>	
<b>Contact Name:</b>	SUE HAREM	<b>Contact Phone:</b>	(970) 278-1646 Ext:
<b>Contact Address:</b>	8100 ARKINS CT	<b>Best Time to Call:</b>	
	LOVELAND, CO 80538	<b>Contact Email:</b>	sharem@remminglontech.net
<b>Alt. Contact Name:</b>	CELL	<b>Alt. Contact Phone:</b>	(970) 488-0136

**Dig Site Information**

**Type of Work:** TRENCHING  
**Work Being Done For:** TRIHYDRO CORP

**Dig Site Location**

**State:** MT      **County:** HILL      **Place:** HAVRE  
**Address:** 417  
**Street:** 1ST ST  
**Nearest Intersecting Street:** 5TH AVE

**Location of Work:**

EXCAVATION SITE IS ON THE N SIDE OF THE ROAD. MARK EVERYTHING WITHIN 50FT OF W SIDE OF BLDG FROM MAIN ST ON N SIDE OF PROP TO 1ST ON S SIDE OF PROP AT ABV ADD

**Remarks:**

BEST INFORMATION AVAILABLE

**Attachment:**

<b>Twp:</b>	<b>Rng:</b>	<b>Sect-Qtr:</b>
Twp: 32N	Rng: 16E	Sect-Qtr: 8-NE,5-SE
<b>TickCoord Lat:</b>	<b>Lon:</b>	
ExCoord NW Lat: 48.5541652	Lon: -109.6765672	SE Lat: 48.5531739      Lon: -109.675307

**Members**

District Code	Company Name	Marking Concerns	Damage/Repair	Customer Service
ATTCBL19	CHARTER COMMUNICATIONS	(406)431-0859	(866)200-8216	(866)200-6216
HAVRE02	CITY OF HAVRE	(406)265-4941	(406)265-4941	(406)265-4941
HILLRD01	HILL COUNTY ROAD DEPT	(406)265-8507	(406)265-8507	(406)265-8507
MPC40	NORTHWESTERN ENERGY	(888)467-2353	(888)467-2353	(888)467-2669
MTDOT13	MONTANA D.O.T. - HAVRE	(406)262-5500	(406)262-5500	(406)262-5500
QLNMT25	CTLQL-CENTURYLINK		(800)573-1311	(800)283-4237

## **APPENDIX G**

### **SVE SYSTEM OPERATION DOCUMENTATION**

## SVE SYSTEM DESIGN REQUIREMENTS

- Six extraction wells nominally 25-30 feet apart
- Depth-to-water (DTW) estimated to be approximately 12 feet based on data from BN railyard
- Lithology expected to be primarily sand, based on data from BN railyard
- Estimated max flow per well 25 cfm
- Provide for filtering of vinyl chloride
- Filter canisters located on pressure side of blower to maximize vacuum. i.e. no pressure drop across filter drums
- Heat exchanger required as blower discharge is approximately 197 deg F, and would shorten life of charcoal filter material
- System to be housed in intrinsically-safe enclosure (Class I, DIV.2) with control panel on outside of building
- Electrical service required to be 3-phase, 120/240 VAC, 4-wire, 100 amp
- Typical sound readings outside system shed 70 – 85 dB at 3 feet from building

**Operations And  
Maintenance Manual  
For An SVE System**

Trihydro Corporation  
Havre, MT

December 2015

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## APPENDICES

- Major Equipment List
- System As-Built Drawings
- Control System Documentation
- Sparge System I/O Manuals
- Process Instrumentation I/O Manuals
- Misc. Equip. Manuals

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## 1 INTRODUCTION

This document provides a description of a turnkey air sparge system fabricated by Process Technology Support, LLC for Trihydro Corporation (Trihydro) located in Laramie, Wyoming. The system was manufactured per specifications provided by Trihydro for a site located in Havre, Montana. Information provided in the manual includes the following:

- Description of major system components.
- Start-up, shutdown, and troubleshooting procedures.
- Routine Equipment Maintenance.
- Major Equipment List.
- System As-Built Drawings.
- Control System Documentation.
- Equipment Installation and Operations Manuals.

## 2 SYSTEM DESCRIPTION

### 2.1 SVE System

The SVE system consists of the following equipment.

- One (1) Dresser Roots Model URAI-47 positive displacement vacuum blower belt driven by 15 HP, 230/480 VAC, 3 phase, Class 1, Div 2 rated motor.
- One (1) ACA-4361-3E Active Heat Exchanger with a 1 HP, 230/480 vac, XP motor.
- One (1) 70 gallon moisture knockout tank with 28 gallon storage capacity at high level shut down. Includes clear PVC stillwell with high level float switch (wired intrinsically safe), internal baffle and demister element, two (2) ¾-inch drain ports, and 6-inch cleanout port.
- One (1) 3-inch inline filter between the manifold and blower, to protect the blower from particulates.
- One (1) 3-inch venturi flow sensor and magnehelic flow gauge calibrated for 0-200 scfm to measure total SVE flow including bleed air.
- One (1) 2-inch bleed air inlet filter and control valve located on exterior of building.
- One (1) 3-inch premium grade discharge silencer on blower discharge.
- Seven (7) 3/8-inch sample ports, one located on the KO tank inlet piping, one located on the blower inlet piping, one located on the heat exchanger discharge piping. One on each of the carbon vessel “IN” ports and one on each of the carbon vessel “OUT” ports.
- Two (2) vacuum gauges (0-200 inches w.c. range), one connected to the KO tank inlet piping and one connected to the blower inlet piping.
- One (1) 2-inch vacuum relief valve, initially set at 12.5 inches Hg.
- One (1) low vacuum switch (wired intrinsically safe), initially set at 20 inches w.c., connected to the KO tank inlet piping.

- Two (2) temperature switch gauges, one measuring the SVE discharge temperature, and one measuring the heat exchanger discharge temperature.
- One (1) pressure gauge (0-100 inches w.c. range) measuring SVE blower discharge pressure.
- Two (2) pressure gauges (0-30 inches w.c. range) measuring carbon vessel inlet pressures.
- One (1) 4-inch SCH 40 PVC extraction manifold with six (6) SVE extraction manifold lines, each consisting of the following components:
  - One (1) 1.5-inch in-line venturi flow sensor connected to magnehelic flow gauge calibrated for 0-50 SCFM.
  - One (1) 1.5-inch" flow control gate valve.
  - One (1) inlet vacuum gauge (0-200 inch w.c. range).
  - One (1) 3/8-inch sample port with 3/16-inch I.D. Tygon tubing connection.
  - 2 inch flex hose and a 2-inch fernco, to connect to a 2-inch PVC subsurface pipe stub up.

Drawings M1 – M4 located in the Appendix under the System As-Built Drawings tab, show the SVE system components and layout. Blower performance curves for standard conditions are provided in the Appendix under the SVE System tab. Variations in actual blower performance from the values predicted on the performance chart will occur based on elevation, actual atmospheric pressure, inlet temperature, relative humidity, and other factors.

**Note:** All SVE manifold flow indicator gauges were calibrated to display flow in scfm at standard conditions of 14.7 psia and 70 deg Fahrenheit. If actual operating conditions at the flow meters vary from the specified calibration conditions, flow readings recorded at the gauge indicators should be corrected based on actual operating pressure/vacuums and temperatures to obtain a corrected SCFM flow reading. Correction charts/equations for the flow sensors are provided in the Appendix under the Process Instrumentation Tab.

**Caution!!!** – The SVE flow indicators are not rated for exposure to moisture. Isolation valves provided on the venturi flow sensors should be closed off when not taking measurements to minimize potential for entrained moisture or condensation from collecting inside the gauges. Re-open valves when taking flow measurements.

## **2.2 Equipment Enclosure and Electrical Power System**

The SVE/Air Sparge system enclosure consists of a pre-engineered 14-ft long x 8-ft wide wood frame enclosure with 7-ft 4-inch high side walls. The building walls and ceiling were insulated and finished using R13 insulation and 5/8-inch Type X drywall. An exhaust fan and intake vents were installed to ventilate the equipment room. A UL 508A/698A listed control panel was mounted on the building exterior to control the SVE system. All equipment was pre-wired to the control panel. All electrical work inside the process room was completed by a licensed electrician in accordance with NEC requirements for a Class 1, Division 2, Group D environment.

A 100 amp fused service disconnect was supplied on the exterior of the building for connecting 240 VAC, three-phase power to the system. The 240 VAC system loads consist of the SVE blower, heat exchanger, and building heater. The 120 VAC system loads consist of the lighting, exhaust fan, GFI outlet, and control power. The building light switch, located on the control panel swing out door activates the equipment room light.

### **3 System Controls**

The system controls are housed within a UL listed 42-inch wide x 30-inch tall x 12-inch deep NEMA 3R electrical enclosure mounted to the outside of the building. Major control components housed within the enclosure include the following:

- UL Listed 508A/698A control panel.
- One (1) 42" x 30" x 12" NEMA 3R control panel enclosure.
- Two (2) Hand-Off-Auto Switches for the SVE Blower and Heat Exchanger.
- One (1) 24-hr. timer for SVE blower control.
- Two (2) Hour meters to record SVE blower and heat exchanger run time.
- Eight (8) Red LED alarm indicators (see alarm descriptions below).
- Three (3) Emergency Stop buttons, located near the heat exchanger in the equipment room, near the KO Tank, and on the control panel.
- One (1) Reset pushbutton for resetting system alarms.
- One (1) Control Power On/Off switch.
- One (1) Building Lights On/Off switch.
- One (1) Heat Exchanger Bypass Off/On switch.
- One (1) power monitor to protect the blower motors from undervoltage, overvoltage, phase loss, phase imbalance, and phase reversal conditions.
- One (1) surge arrester to protect the control panel components from voltage spikes.
- One (1) fused Main Power Service Disconnect (located on building exterior).
- Two (2) Type E motor controllers to control the SVE Blower and Heat Exchanger.
- Three (3) intrinsically safe (I.S.) barrier relays to provide I.S. circuits for process switches located inside the classified area of the building.
- One (1) thermostatically controlled panel heater.
- One (1) Sensaphone Sentinel autodialer.
- One (1) Option Cloudgate cellular modem.
- Various control relays, circuit breakers, fuse blocks, and terminal blocks.

#### **3.1 Remediation System Control Narrative**

##### *3.1.1 SVE Blower Operation*

When the three position (H-O-A) switch for the SVE blower is placed in the HAND position, all control interlocks for the blower will be overridden (with the exception of the thermal overload, short circuit, and the Emergency Stop functions), and the blower will immediately activate. When the SVE Blower (H-O-A) switch is in AUTO, the SVE blower will normally be activated, subject to the configuration of the 24-hr. timer. The operational conditions which will prevent activation of the SVE blower when in the AUTO mode are as follows:

- SVE blower 24-hr. timer is configured so that the blower and heat exchanger are off.
- Heat Exchanger deactivated (for any reason)\*.

- Emergency Stop Activated.

The alarm situations listed below will deactivate the SVE blower and activate and latch on a red alarm light after the specified time delay has expired with a continuous alarm condition.

- K.O. Tank High High Level Alarm. (10 sec delay)
- SVE Low Vacuum Alarm. (15 sec delay)
- SVE Blower High Temperature Alarm. (10 sec delay)
- Heat Exchanger High Temperature Alarm. (10 sec delay)
- Power Monitor Alarm. (adj. delay, non-latching)
- Surge Arrester Alarm. (no delay, non-latching)
- SVE blower T.O./Short Circuit Alarm. (no delay)
- Heat Exchanger T.O./Short Circuit Alarm. (no delay)

\*If the Heat Exchanger Bypass switch is used, this does not apply.

### *3.1.2 SVE Blower 24 hr Timer Cycle Control*

When the H-O-A switch for the blower is placed in the AUTO position, the corresponding 24 hour timer control mounted adjacent to the (H-O-A) switch allows the SVE blower to be automatically cycled on or off at specific times of the day depending on timer configurations. The timer is set for the actual time of day by manually rotating the timer wheel CW to align the correct time of day with the small white arrow located on the inner portion of the timer disc. The timer is programmed for ON/OFF operation by positioning the black tripper tabs located around the perimeter of the timer. When a tripper tab is pushed in towards the center of the timer (orange disc exposed) the equipment will be activated for the corresponding time interval and when a tab is pushed outward (orange disc hidden) the equipment will be de-activated. Each tripper tab corresponds to 15 minutes of either on or off time.

### *3.1.3 Heat Exchanger*

When the three position (H-O-A) switch for the heat exchanger is placed in the HAND position all control logic for the blower will be overridden (with the exception of the motor thermal overload, short circuit, and the Emergency Stop functions), and the heat exchanger will immediately activate. When the Heat Exchanger (H-O-A) switch is in the AUTO position, the heat exchanger will normally be activated unless the following operational conditions exist:

- Emergency Stop Activated.
- 24-hr. timer is configured so that the SVE blower and heat exchanger are off.

The alarm situations listed below will deactivate the heat exchanger and activate and latch on the appropriate red alarm light after the specified time delay has expired with a continuous alarm condition.

- Any of the alarms mentioned in the SVE section above.

- Heat exchanger T.O./Short Circuit. Alarm. (no delay)

#### *3.1.4 Power Monitor Function*

A power phase/voltage monitor located inside the control panel disconnects control power to the SVE motor and heat exchanger motor in the event of low voltage, high voltage, phase loss, or phase reversal. The power monitor alarm is non-latching in order to allow the equipment to automatically restart once the power supply returns to normal.

**Note – An adjustable (0 to 300 seconds) time delay setting located on the front of the power monitor is used to allow for start-up delay of the system after power returns to normal specs to avoid rapid ON/OFF cycling of the system if numerous power fluctuations occur. This off delay will occur every time power is cycled to the system.**

#### *3.1.5 Surge Arrester Function*

A surge arrester was included in the control panel, connected to the service power distribution block, to provide a degree of protection for the motors and control panel components from lightning strikes and voltage surges on the incoming power lines. If a surge event occurs, the plug in modules in the surge arrester are designed to shunt the surge to ground. If a plug in module gets damaged during a surge to the point where it is no longer protecting the power line it is connected to, a red indicator flag will appear behind the clear window on the affected module, and the alarm light will indicate that the surge arrester alarm has occurred. The module must be replaced. To replace the affected module, turn off the power at the Main System Power Disconnect. Then pull the defective module from the surge arrester base and insert a new module. Once the new module has been inserted properly and power has been restored to the system, the surge arrester alarm will automatically reset.

#### *3.1.6 Emergency Stop Function*

Three emergency stop (E-Stop) pushbuttons were provided with the system with one located on the control panel swing out door, one located inside the equipment room near the heat exchanger, and one located inside the equipment room near the KO tank. Activation of any of the E-stop push buttons deactivates the SVE blower and heat exchanger regardless of the position of the (H-O-A) switches.

**!!! CAUTION !!!**

**THE E-STOP FUNCTION DOES NOT DISCONNECT THE MAIN POWER SUPPLY TO THE CONTROL PANEL. PORTIONS OF THE CONTROL PANEL ARE STILL ENERGIZED AFTER THE E-STOP BUTTON IS ACTIVATED.**

*3.1.7 Reset Button Function*

In the event any latching system alarm as listed in previous sections is activated continuously for the specified period of time, the SVE blower and/or air heat exchanger will be latched OFF until the alarm condition is removed and the RESET button located on the panel door is manually activated.

**Notes:**

In the event an SVE Blower, or Heat Exchanger thermal overload/short circuit alarm is activated, the black knob on the affected motor controller will move to the TRIPPED position (10:00 position). The alarm latch must be cleared by first turning the black knob located on the affected motor controller to the OFF (9:00) position, then back to the ON (12:00) position, and then activating the RESET button located on the control panel.

In order to restart the system after an E-stop button has been pushed in, the E-stop button must be turned clockwise to release the E-stop button.

**!!! CAUTION!!**

**RESETTING AN ALARM OR RELAEASING THE E-STOP BUTTON COULD AUTOMATICALLY RESTART SYSTEM EQUIPMENT. MAKE SURE ALL PERSONNEL ARE CLEAR BEFORE PUSHING ALARM RESET BUTTON.**

*3.1.8 Telemetry*

System telemetry is included to alert selected contacts of a change in system status. System alarms, blower run status, and heat exchanger run status are monitored by the autodialer. The Sentinel installation and operation manual included later in this document describes how to change alarm notifications and who is contacted in the event of an alarm.

The second part of the system telemetry is the cellular modem. The antenna for the cellular modem is shipped detached from the modem itself. It is important to reconnect the antenna before powering the modem. When installing the antenna, the antenna should be raised high enough to clear the roof of the system for optimal reception.

## **4 System Start-Up/Shutdown Procedures**

Information provided in this section describes recommended procedures to follow during system start-up and shutdown. A summary of system warnings and cautions described below should be thoroughly reviewed by all personnel responsible for performing work on the system.

**!!! WARNING !!!**

**FAILURE TO HEED THESE WARNINGS AND CAUTIONS OUTLINED IN THIS SECTION MAY RESULT IN EQUIPMENT DAMAGE, PERSONNEL INJURY, OR DEATH!!!**

### **4.1 System Warnings!!!! / Cautions!!!!**

Power supply to the system consists of 120/240 vac, three-phase, 4-wire electrical power. Troubleshooting procedures involving electrical controls and instrumentation should only be performed by a trained and qualified personnel member or an electrician.

**!!! WARNING !!!**

**DO NOT TURN ON THE MAIN SYSTEM POWER DISCONNECT SUPPLYING POWER TO THE SYSTEM UNTIL THE INITIAL START-UP AND POWER VERIFICATION PROCEDURES OUTLINED BELOW HAVE BEEN COMPLETED**

- A licensed electrician should be hired to extend the appropriate electrical service to the system electrical load center in accordance with local, state and national codes and regulations.
- The electrical contractor must make certain that the electrical service connected to the system is provided with a suitable earth ground and connected to the main disconnect and control panel in accordance with local, state and national electrical codes and regulations.
- All motors must be checked for proper rotation prior to putting the system into operation. Procedures for checking blower rotation are outlined in the start-up procedures outlined below.
- Tripping of short circuit protection devices such as fuses, motor circuit protectors, circuit breakers, or VFDs is an indication of serious problems or faults with the equipment operations or electrical system. Further troubleshooting should be performed by trained personnel or an electrician.
- Operation of equipment by placing the (H-O-A) switch in the HAND position bypasses all system safety interlocks designed to protect equipment and personnel, except where noted above. Equipment should be operated in HAND position only by a trained operator to make

system adjustments and conduct troubleshooting procedures. **UNDER NO CIRCUMSTANCES SHOULD ANY PIECE OF EQUIPMENT BE LEFT OPERATING UNATTENDED WITH THE (H-O-A) SWITCHES IN THE HAND POSITION.**

- The main power safety disconnect switch should be placed in the OFF position and padlocked and tagged any time work is being performed on motors, blowers or other electrical equipment inside the building.
- Piping off the discharge of blower equipment can reach high temperatures. Care should be taken to avoid contact with blowers and discharge piping runs. When performing maintenance that requires working in close proximity to blowers or discharge piping, it is recommended that the system be deactivated for a period of time to allow equipment and piping to cool down prior to working on equipment.

#### **4.2 Initial System Equipment Set-Up**

A packing slip was shipped with system describing parts shipped loose for installation after system delivery and for future system maintenance. Prior to system start-up, make sure to make all system parts shipped loose with the system are installed as described below.

- Remove the plug from the SVE stack coupling and install the stack completely before starting system.
- Install temperature sensor and flow sensor (if supplied) into the ports on the exhaust stack. Typically these components are removed from the stack and tied off at a location near to the SVE switch box prior to shipping.
- Flexible pipe couplers and 2-inch clear PVC hose was supplied to connect customers SVE line stub-ups to the SVE manifold. The clear PVC hose should be cut to length to fit between the pipe stub-up and the corresponding SVE manifold line. The flexible couplers are installed halfway over both ends of the hose and clamped. The other side of each flexible coupler is then clamped onto the pipe.
- If supplied, mount building anchor brackets to concrete slab using supplied concrete anchor bolts at locations shown on drawings and then attach to building 4x4 woods skids using supplied lag bolts.

#### **4.3 Initial System Start-Up and Power Verification Procedure**

A trained and qualified personnel member or an electrician should be on-site to go through initial system start-up and power verification procedures outlined below.

**!!! WARNING !!!**

**DO NOT TURN ON THE MAIN SYSTEM POWER DISCONNECT UNTIL THE FOLLOWING PROCEDURE HAS BEEN COMPLETED. FAILURE TO FOLLOW THESE INSTRUCTIONS MAY RESULT IN SERIOUS DAMAGE TO THE SYSTEM.**

1. Make sure all circuit breakers inside the control panel are placed in the **OFF** position (**switch handles down**).
2. Make sure all motor controller devices located inside the control panel are placed in the **OFF** position (**black knob handle turned to sideways (9:00) position**).
3. Make sure all H-O-A switches and ON/OFF switches on the swing-out panel door are placed in the **OFF** position.
4. Locate the Surge Arrester inside the control panel and remove the four (4) Surge Arrestor plug-in modules. Make sure to note which module goes in which slot so they can be re-installed in the proper position at the end of this procedure. **!!! Warning !!! Placement of the modules in the wrong position on a system with a wild leg will result in module failure.**
5. With the control panel door closed and latched, place the Main Service Disconnect switch in the **ON** position.
6. Open the control panel door and swing-out panel door and check voltages at the Main Power Distribution Block located inside the control panel. Measure voltage between all three phases and between each phase and the neutral block to verify proper voltage is being supplied to the system.
7. **If the supplied power is three phase and possibly contains a wild leg, it MUST be verified that the wild leg phase is connected to L2 at the control panel main power distribution block BEFORE any of the system circuit breakers, motor controllers, or equipment H-O-A switches are turned ON.**

**!!! WARNING!!!**

**IF THE WILD LEG IS NOT CONNECTED TO L2 AT THE CONTROL PANEL MAIN DISTRIBUTION BLOCK, SEVERE DAMAGE TO EQUIPMENT WILL OCCUR WHEN THE POWER DISCONNECT IS TURNED ON.**

**DO NOT PROCEED WITH START-UP UNTIL A QUALIFIED PERSONNEL MEMBER OR ELECTRICIAN CAN CHANGE THE INCOMING POWER LEAD CONNECTIONS SO THAT THE WILD LEG IS CONNECTED TO L2 AT THE CONTROL PANEL POWER DISTRIBUTION BLOCK.**

8. Check status of the LED located on the face of power monitor located inside control panel. A summary of the conditions identified by the LED status is provided below.
- Green Steady: Power normal/ power monitor relay activated
  - Green Flashing: Power up and start delay in progress
  - Red Steady: Phase imbalance
  - Red Flashing: Under voltage / Over voltage
  - Amber Steady: Phase Reversal
  - Amber Flashing: Phase Loss
  - Green–Red Alternating: Under voltage / Over voltage trip pending
  - Red –Amber Alternating: Nominal voltage setting error

There is a 50% chance the Power Monitor will detect a phase reversal condition. If this is the case, turn the Main System Disconnect OFF and swap L1 and L3 leads at the Power Distribution Block inside the control panel or at the load side of the Main System Disconnect. If the Power Monitor is detecting some other fault condition, power supply to the system should be investigated by an electrician or by the electrical utility company.

9. Once the Power Monitor LED is steady GREEN, and it has been verified that, if present, the wild leg is connected to L2 at the panel, the power being supplied to the system is acceptable.
10. Turn OFF the Main Power Disconnect and re-install the surge arrester modules back into the proper slots on the surge arrestor base module.
11. After surge arrester modules have been re-installed, turn the Main Power Disconnect switch back to the **ON** position.
12. Turn all circuit breakers and motor controller switches to the **ON** position.
13. Turn on the Control Power switch ON/OFF switch to the **ON** position. Leave all of the other H-O-A and ON/OFF switches in the **OFF** position.
14. The system is now ready for start-up. Continue with individual equipment start-up procedures as described below.

#### **4.4 HVAC/Lighting Equipment Start-Up Procedure (Refer to Dwgs. M1 – M4)**

1. Turn the Building Light switch to the ON position to activate the interior building light.
2. Verify that the Equipment Heater is set to approximately 40 degrees Fahrenheit. The Building Heater Thermostat is located on the bottom front of the Building Heater.
3. Verify that the Building Fan Thermostat, located in the control panel, is set to around 80-85 degrees Fahrenheit.

#### **4.5 SVE System Start-Up Procedure (Refer to Dwgs. M1 – M4)**

1. Open the SVE manual bleed air valve and each extraction line control valve to the full open position by turning CCW.
2. As part of initial start-up procedures, proper rotation of the blowers must be verified. To check blower rotation, bump the motor by momentarily switching the H-O-A switch to the HAND position while another person monitors the equipment. Proper rotation of the SVE blower can be verified by checking for vacuum at an inlet sample port, seeing if the rain cap on the exhaust stack flips up or by checking to see if the motor fan rotation matches the rotation arrow marked on the blower (if marked). If the blower rotation is not correct, use the Main System Power Disconnect to turn OFF power to the system. Then swap any two motor leads at bottom of the motor controller contactor. After swapping motor leads, make sure wire connections at contactor are secured inside terminal connection and not placed behind the terminals connections. Tighten connections securely.

**CAUTION!!!! Do not allow blower to run in wrong direction for more than few seconds or serious damage may result.**

3. Set the 24 Hour Timer. Timer operation is described in Section 3.1.2.
4. Place the SVE blower (H-O-A) switch in AUTO position, then set the heat exchanger (H-O-A) switch in the AUTO position. Both the SVE blower and Heat Exchanger should activate along with their respective green run lights at this time.
5. With the SVE blower (H-O-A) switch in AUTO, gradually adjust bleed air valve and set flows at individual extraction lines to desired flow and vacuum values. If adjustments in individual extraction lines results in excessive high vacuum at the blower inlet, lower system vacuum by opening the bleed air valve.
6. During the initial adjustment of the system, you may need to lengthen the time delay of the SVE Low Vacuum Alarm. This can be done by adjusting the timer dial of Time Delay Relay #2 (TDR2) in the control panel up to a maximum of 30 seconds.

#### **SVE System Shutdown Procedure**

1. Turn all (H-O-A) switches to the OFF position.
2. If the system is to be shut down during the winter months, make sure all liquid is drained from the KO tank and process lines.

#### **4.6 Troubleshooting Procedures**

## **EQUIPMENT WILL NOT START – NO ALARM INDICATORS**

- Check that Main System Disconnect switch is in **ON** position.
- Check that all circuit breakers inside control panel are placed in the **ON** position (BREAKER SWITCH PUSHED UP). If a breaker is tripped the switch will be halfway between the **ON** and **OFF** position even though it may appear to still be in the **ON** position. Flip the circuit breakers switches to the **OFF** position and then back to the **ON** position.
- Check and make sure that the black knob on all Motor Controller switches located inside the panel are placed in the **ON** position (vertical position). If a motor controller has tripped out due to a fault, the knob will be at a 45 degree angle.
- Check and make sure the Control Power Switch is **ON**
- Check that (H-O-A) switches are in the **AUTO** position.
- Check and make sure that 24 hr timer controls if supplied are set properly for equipment to be **ON**.
- Check and make sure that the E-stop buttons in the equipment room or at the control panel have not been activated (pushed in).
- Check status of small LED located on front of power monitor (motor saver) located inside the control panel. If LED on the face of the power monitor (motor saver) is green, 3Ø power being supplied to the blower circuit is within acceptable limits. If LED is not GREEN or is OFF power to the system is either OFF or outside normal operating ranges. Check voltage of incoming power at the main disconnect, after the fuses in the main disconnect and at the main power distribution terminal block inside the local control panel.
- If three-phase power is acceptable, check 120 vac power being supplied to control panel by measuring voltage between terminal blocks labeled as 1 and N. Check fused terminal blocks for blown fuses (the red LED on the front of the fuse block will illuminate when the fuse has blown).
- If voltage measurement indicates no 120 vac power, re-check 10 amp control panel circuit breaker, and position of Control Power ON/OFF switch. If still do not have 120 vac power call factory for technical support.

## **5 ROUTINE EQUIPMENT MAINTENANCE**

Recommendations for a general maintenance schedule for the system are provided below. Detailed manufacturer's maintenance schedules and procedures are provided in the equipment

manuals supplied in Appendix A and should be thoroughly reviewed in addition to this section. Completion of all maintenance procedures and documentation of system operating parameters (i.e. operating runtimes, pressures, vacuums, temperatures, flow rates, and equipment maintenance activities) should be documented on a regular basis in a logbook.

### **SVE System Routine Maintenance**

#### *After First 100 hours*

- Check all mounting hardware for tightness.
- Check and clean/replace inline filter.

#### *Each Visit*

- Monitor blower for excessive or unusual noise or vibration.
- Monitor blower exhaust temp, inlet vacuum, and flow rate and compare to previous operational data to detect abnormal operating conditions.
- Check/clean out heat exchanger intake vent and building intake vents (\*\* required to maintain building cooling and heat exchanger efficiency).
- Open heat exchanger drain valve to relieve any condensate build up.

#### *Quarterly (Approximately every 2,200 hrs)*

- Replace inline and bleed air filters if visual inspection indicates change needed.
- Check/clean internal KO tank demister element.
- Verify proper operation of vacuum relief valve (VRV).
- Check blower mounting hardware and piping for tightness.

#### *Oil Change (Approximately every 2000-3000 hrs)*

- First oil change after 100 hours of run time.
- Use Dresser Roots ISO-VG-320 or equivalent oils.
- Only fill the oil halfway in the sight glasses (approximately 10.8 ounces per change)
- See pages 8 and 17 of the Roots O&M manual (included later in this document) for complete manufacturer's recommendations.

### **Control System Maintenance**

#### *Quarterly*

- Test all control system alarm interlocks to verify proper operation. Manually simulate actual alarm condition for all alarm interlocks to verify that proper system shutdown occurs as outlined in the control narrative.

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## APPENDICES

- **Major Equipment List**
- **Equipment As-Built Drawings**
- **Control System I/O Manuals**
- **SVE System I/O Manuals**
- **Air Sparge System I/O Manuals**
- **Process Instrumentation I/O Manuals**
- **Miscellaneous Equipment I/O Manuals**

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## **MAJOR EQUIPMENT LIST**

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**SVE REMEDIATION SYSTEM EQUIPMENT LIST  
TRIHYRO CORPORATION  
HAVRE, MT**

**SVE SYSTEM COMPONENTS**

**SVE Blower**

Manufacturer: Howden Roots  
 Model No.: 47 U-RAI DSL  
 Serial No.: 1511924815  
 Part No.: T3035402L

**SVE Blower Motor**

Manufacturer:	TECO-WESTINGHOUSE	Cat. No.:	EP0154
HP:	15	Hz.:	60
Voltage:	230/460	PH:	3
Frame:	254T	Nema Nom EFF	92.4
Amps:	34.6/17.3	Max. Amb.	40 deg C
Duty:	Cont	Weight:	299 lbs
SF:	1.15	Encl:	TEFC
RPM:	1765	Des.:	B
Code:	G	Pole:	4
Serial No.:	WZH6149052 009	Temp. Code:	T3B
Type:	AEHH8N		

**Knockout Tank**

Manufacturer: Process Technology Support  
 Tank Capacity: 70 Gallon  
 Capacity at High-High Level: 28 Gallon

**Knockout Tank Float Switch**

Manufacturer: Dwyer Instruments  
 Model No.: F7-SS2

**SVE Low Vacuum Switch**

Manufacturer: Dwyer Instruments  
 Model: 1823-80  
 Initial Setpoint: 20" w.c.

**SVE Vacuum Relief Valve**

Manufacturer: Kunkle  
 Model Number: 215VH  
 Set Point: 12.5" Hg

**SVE Blower Discharge Temperature Switchgauge**

Manufacturer: Dwyer Instruments  
 Model: RRT3300U  
 Range: 0-300 Deg. F

**Heat Exchanger Discharge Temperature Switchgauge**

Manufacturer: Dwyer Instruments  
 Model: RRT3250U  
 Range: 32-248 Deg. F.

**SVE Discharge Silencer**

Manufacturer: Stoddard Silencers  
 Model No.: D33H-3

**SVE REMEDIATION SYSTEM EQUIPMENT LIST**  
**TRIHYDRO CORPORATION**  
**HAVRE, MT**

**SVE Inline Filter**

Manufacturer: Solberg Manufacturing, Inc.  
Model No.: CSL-238-300C  
Replacement Filter: 238P

**SVE Bleed Air Filter/Silencer**

Manufacturer: Solberg Manufacturing, Inc.  
Model No.: FS-30P-200  
Replacement Filter: 30P

**SVE Extraction Line Venturi Sensors - Qty.6**

Manufacturer: Gerand Engineering Co.  
Model: 1 1/2"-505

**SVE Extraction Line Flow Indicator- Qty.6**

Manufacturer: Dwyer Instruments, Inc.  
Cat. No.: 2SQRT  
Scale Calibration: 10.3" w.c.= 50 CFM @ P=14.7 psia, T=70 deg F

**SVE Total Inlet Flow Venturi Sensor**

Manufacturer: Gerand Engineering Co.  
Model: 3"-745

**SVE Total Flow Indicator- Qty. 1**

Manufacturer: Dwyer Instruments, Inc.  
Cat. No.: 2SQRT-MP  
Scale Calibration: 2.9" w.c.= 200 CFM @ P=14.7 psia, T=70 deg F

**Heat Exchanger**

Supplier: American Industrial Heat Transfer  
Serial No.: 1764083  
Model: ACA-4361-3E

**Heat Exchanger Motor**

Manufacturer:	Baldor	Serial No.:	F1506030476
Spec:	35E352N025G1	Cat. No.:	M7032
HP:	1	Volts:	230/460
RPM:	1155	Amps:	3.8/1.9
Hz.:	60	T. Code:	T2C

**CONTROL PANEL COMPONENTS**

**UL Control Panel Information**

Applicable Standard, File Number: UL 698A, E254125  
Assigned UL Panel Number: CF-388131

**Control Panel Enclosure**

Manufacturer:	Saginaw	
Catalog Number:	NEMA 4/12 Enclosure	SCE-42EL3012LP
	Sub panel	SCE-42P30

**Power Phase/Voltage Monitor (Motor Saver)**

Manufacturer: Macromatic  
Part Number: PMPU  
Line Voltage Range: 190-480V 3PH Monitor

**Surge Arrester**

Manufacturer: Phoenix Contact  
Model: 2859453  
High Leg Module: 2859602

**Control Switch - Qty. 14**

Manufacturer:	Automation Direct	
Model:	GCX1262-120L	Lit 3-position H-O-A switch ( Qty 2 )
	GCX1252-120L	Lit 2-position on/off switch ( Qty 3 )
	GCX1102	Push button switch
	ECX2051-127L	Red Pilot Light ( Qty 8 )

**SVE REMEDIATION SYSTEM EQUIPMENT LIST  
TRIHYDRO CORPORATION  
HAVRE, MT**

**Hour Meters - Qty. 2**

Manufacturer: Redington  
Part No.: 2PPV6

**24 Hour Timer**

Manufacturer: Diehl  
Model No.: TA-4079

**Circuit Breakers - Individual Circuits**

Manufacturer:	Eaton	
Model (CB-1, Equipment Room Heater):	FAZ-C15-2-NA	2 Pole, 15 Amp
Model (CB-2, GFI Outlet):	FAZ-C20-1-NA	1 Pole, 20 amp
Model (CB-3, Bldg. Lights):	FAZ-C10-1-NA	1 Pole, 10 amp
Model (CB-4, Equipment Room Exhaust Fan):	FAZ-C05-1-NA	1 Pole, 5 amp
Model (CB-5, Control Power):	FAZ-C10-1-NA	1 Pole, 10 amp

**SVE Blower Motor Controller (MC1)**

Manufacturer:	Fuji	
Model:	BM3VHB-040	Manual Controller
	SC-E2-110VAC	Contactora

**Heat Exchanger Motor Controller (MC2)**

Manufacturer:	Fuji	
Model:	BM3RHB-004	Manual Controller
	SC-E02-110VAC	Contactora

**Emergency Stop Button - Qty. 3**

Manufacturer: Automation Direct  
Model: GCX1131

**Control Relay**

Manufacturer:	Automation Direct	
Model:	783-3C-120A	3PDT Relay (CR 3, 9, 10)
	782-2C-120A	DPDT Relay (CR 1, 2, 4, 5, 6, 7, 8)
	781-1C-120A	SPDT Relay (CR 11, 12, 13)
	Timer Relays	MS4SM-AP-ADC

**Intrinsically Safe Barrier - Qty. 3**

Manufacturer: Pepperl-Fuchs  
Model: KFA5-SR2-EX2.W

**SVE REMEDIATION SYSTEM EQUIPMENT LIST**  
**TRIHYRO CORPORATION**  
**HAVRE, MT**

**MISCELLANEOUS EQUIP**

**Equipment Room Light Fixture - Qnty. 2**

Manufacturer:  
Model: 1586K45  
Area Rating: Class 1, Div. 2  
Replacement Bulb: 300W, 120 VAC

**Equipment Room Exhaust Fan Thermostat**

Manufacturer: Johnson Controls  
Part No.: A19ABC-24E

**Equipment Room Exhaust Fan - 12" Diameter**

Manufacturer: Dayton Electric  
Model: 10D995  
Area Rating: Class 1, Div. 2

**Equipment Room Heater**

Manufacturer: CCI Thermal  
Model: XB2-4200T2D31T  
Area Rating: Class 1, Div. 2, Group D

**Electrical Disconnect**

Manufacturer: Siemens  
Model: GF323NR 100A 250V 3 Pole NEMA 3R.  
Fuses: LLNRK100

**Telemetry:**

Manufacturer: Sensaphone  
Part No.: SCD-1200-CLKIT1  
Antenna: FGD-CELL\_ANT

## **EQUIPMENT AS-BUILT DRAWINGS**

Mechanical Drawings:

M1, M2, M3, M4 - Equipment Floor plan and Elevations

Building Drawings:

B1-A, B2, B3 – Building Exterior Elevations

Process Flow and Instrumentation Drawings:

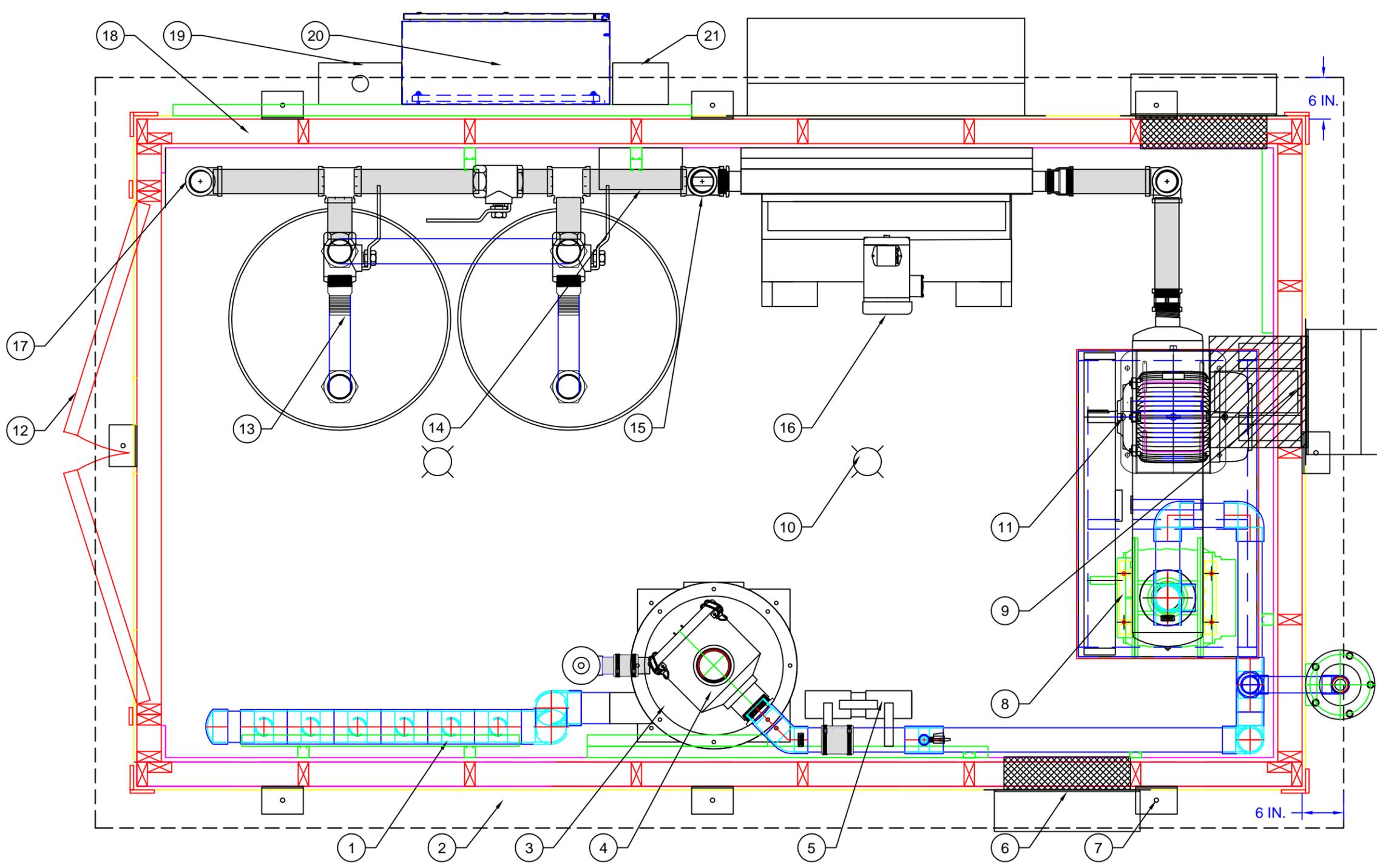
P1, P2, P3 – Process Flow and Instrumentation Diagrams

Electrical Drawings:

E-1 – Single Line Electrical Drawing

CP2, 3, 4, 5, 6, 7 - Control Panel Schematics

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- EQUIPMENT LIST**
- 1) SVE MANIFOLD (6 EXTRACTION LINES)
  - 2) 9'X15' CONCRETE SLAB
  - 3) 70 GALLON KO TANK
  - 4) 3" INLINE FILTER
  - 5) 2000W XP HEATER WITH INTEGRAL TSTAT
  - 6) BUILDING INTAKE VENT (1 TYP. 2)
  - 7) BUILDING ANCHOR (1 TYP. 8)
  - 8) ROOTS DRESSER URAI-47-DSL PD SVE BLOWER
  - 9) 12" XP EXHAUST FAN
  - 10) 300W XP LIGHT FIXTURE (1 TYP. 2)
  - 11) 15HP 3PH TEFC MOTOR
  - 12) WOOD DOUBLE DOOR WITH LOCKABLE LATCH
  - 13) GPC 385 CARBON VESSEL (1 TYP. 2)
  - 14) SVE SWITCHBOX AND GAUGE CLUSTER
  - 15) HEAT EXCHANGER DISCHARGE PIPING TO CARBON VESSELS
  - 16) AMERICAN INDUSTRIAL HEAT EXCHANGER (AIHTI MODEL ACA 4361-3E) WITH INLET/OUTLET DUCTING (NOT SHOWN)
  - 17) CARBON VESSEL EXHAUST STACK (STACK EXTENDS AT LEAST 12' ABOVE GRADE)
  - 18) BUILDING WALL WITH WALL CAVITY INSULATION AND FIRE RATED INTERIOR DRYWALL
  - 19) 100A, 208/240 VAC, 3PH, NEMA 3R FUSED DISCONNECT
  - 20) 42" x 30" x 12" NEMA 3R CONTROL PANEL (UL 508A/698A Listed)
  - 21) CELL 682 CELLULAR TELEMETRY UNIT

**EQUIPMENT PLANVIEW**  
SCALE: 3/4" = 1'

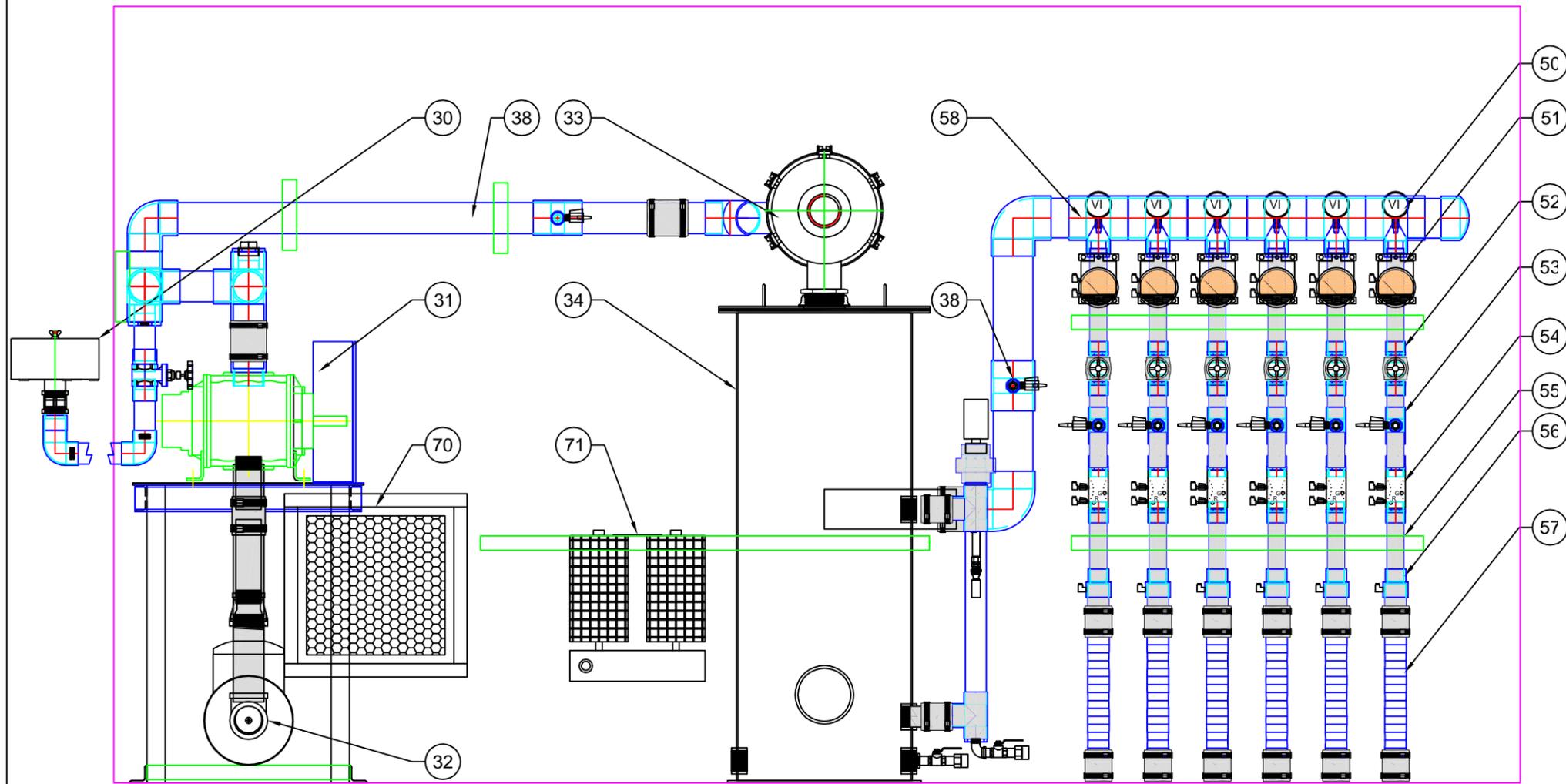
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CS	10/14/2015	SUBMITTAL
CS	12/29/2015	AS-BUILT

Trihydro Corporation  
Turnkey SVE Remediation System  
Havre, MT



EQUIPMENT PLANVIEW  
DETAILS

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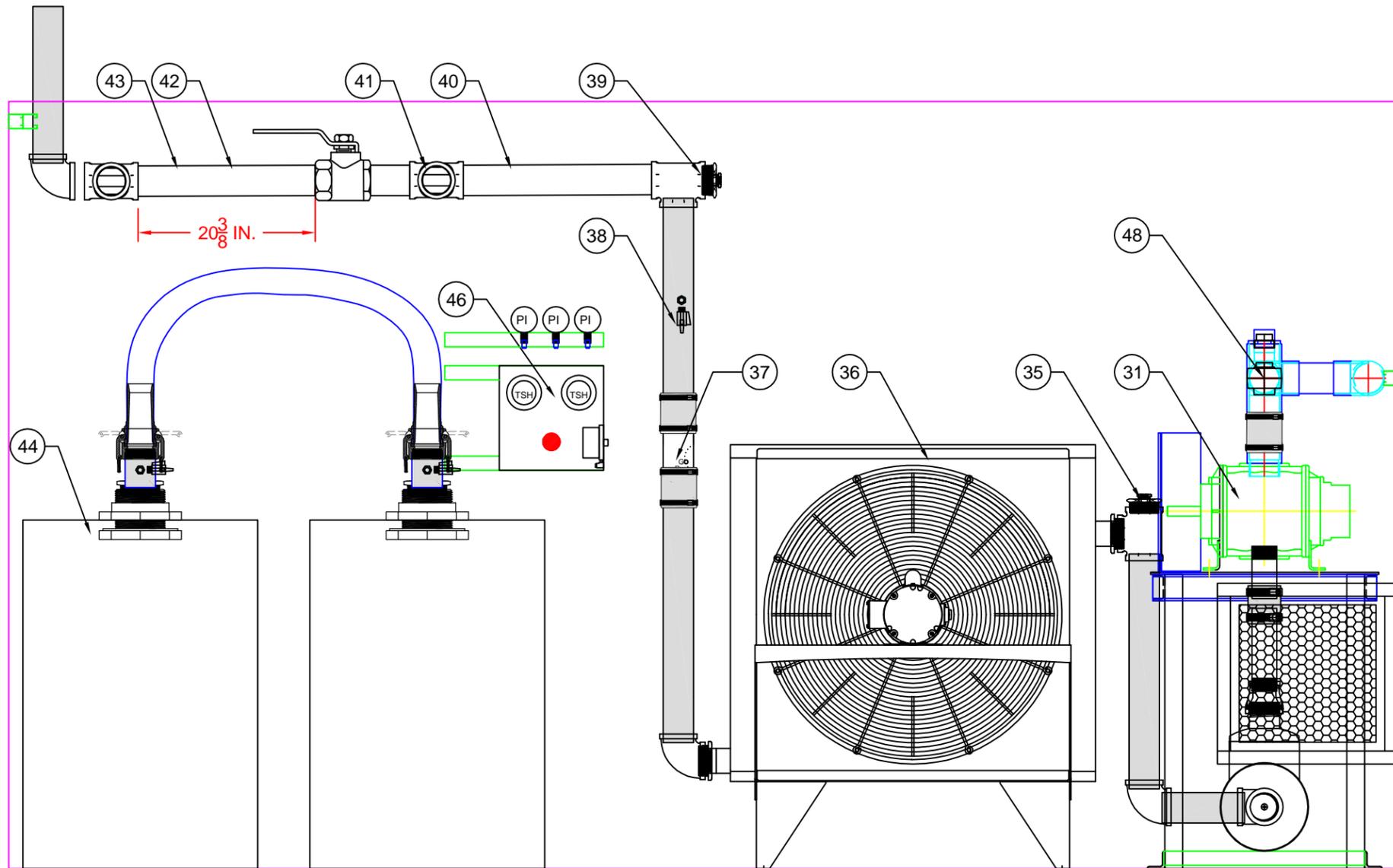
**SOUTH WALL INTERIOR ELEVATIONS**  
SCALE: 3/4" = 1'

- SVE EQUIPMENT LIST**
- 30) 2" BLEED AIR FILTER/SILENCER
  - 31) ROOTS DRESSER URAI-47-DSL PD SVE BLOWER
  - 32) 3" INLINE SILENCER
  - 33) 3" INLINE FILTER
  - 34) 70 GALLON KO TANK
  - 35) SVE BLOWER DISCHARGE TEMPERATURE PORT
  - 36) AMERICAN INDUSTRIAL HEAT EXCHANGER (AIHTI MODEL ACA 4361-3E)
  - 37) 3" VENTURI FLOW SENSOR
  - 38) 3/8" SAMPLE PORT WITH 1/4" ID TUBE CONNECTION
  - 39) HEAT EXCHANGER DISCHARGE TEMPERATURE PORT
  - 40) CARBON VESSEL INLET ISOLATION VALVE W/ SAMPLE PORT
  - 41) CARBON VESSEL ISOLATION VALVE
  - 42) CARBON VESSEL DISCHARGE ISOLATION VALVE W/ SAMPLE PORT
  - 43) EXHAUST STACK (STACK EXTENDS AT LEAST 12' ABOVE GRADE)
  - 44) CARBON VESSEL
  - 45) HEAT EXCHANGER INLET AND OUTLET DUCTING
  - 46) SVE SWITCH BOX - INCLUDES SVE LOW VACUUM SWITCH AND TEMPERATURE SWITCHGAUGES. SVE SYSTEM GAUGES - INCLUDES KO TANK INLET VACUUM GAUGE (TBD" W.C.), INLINE FILTER D.P. GAUGE (0-20" W.C. D.P.), SVE TOTAL FLOW GAUGE (TBD SCFM), AND BLOWER INLET VACUUM GAUGE (TBD" W.C.)
  - 47) SVE VACUUM RELIEF VALVE
- EQUIPMENT LIST - SVE EXTRACTION LINE (TYP. 6)**
- 50) VACUUM GAUGE, 100" W.C.
  - 51) MAGNEHELIC FLOW GAUGE, 50 SCFM
  - 52) 1.5" GATE VALVE
  - 53) 3/8" SAMPLE PORT WITH 1/4" ID TUBE CONNECTION
  - 54) 1.5" VENTURI FLOW SENSOR, CONNECTED TO FLOW GAUGE VIA IMPULSE TUBING)
  - 55) 2" CLEAR PVC PIPE
  - 56) VACUUM GAUGE PORT (CONNECTED TO VACUUM GAUGE VIA IMPULSE LINE)
  - 57) 2" FLEXIBLE VACUUM HOSE
  - 58) SVE EXTRACTION MANIFOLD HEADER- 4" SCH 40 PVC
- EQUIPMENT LIST - BUILDING EQUIPMENT**
- 70) BUILDING INTAKE VENT (1 TYP. 2)
  - 71) 2000W XP HEATER WITH INTEGRAL TSTAT
  - 72) 12" XP EXHAUST FAN



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CS	10/14/2015	SUBMITTAL			
CS	12/29/2015	AS-BUILT			
ACAD file: Trihydro-Havre_MT_SYSLO.dwg			DWG. NO.:	M2	



NORTH WALL INTERIOR ELEVATIONS  
SCALE: 3/4" = 1'

**SVE EQUIPMENT LIST**

- 30) 2" BLEED AIR FILTER/SILENCER
- 31) ROOTS DRESSER URAI-47-DSL PD SVE BLOWER
- 32) 3" INLINE SILENCER
- 33) 3" INLINE FILTER
- 34) 70 GALLON KO TANK
- 35) SVE BLOWER DISCHARGE TEMPERATURE PORT
- 36) AMERICAN INDUSTRIAL HEAT EXCHANGER (AIHTI MODEL ACA 4361-3E)
- 37) 3" VENTURI FLOW SENSOR
- 38) 3/8" SAMPLE PORT WITH 1/4" ID TUBE CONNECTION AND PRESSURE GAUGE PORT
- 39) HEAT EXCHANGER DISCHARGE TEMPERATURE PORT
- 40) CARBON VESSEL INLET ISOLATION VALVE W/ SAMPLE PORT
- 41) CARBON VESSEL CAMLOCK CONNECTION
- 42) CARBON VESSEL SYSTEM CAMLOCK CONNECTION
- 43) EXHAUST STACK (STACK EXTENDS AT LEAST 12' ABOVE GRADE)
- 44) CARBON VESSEL
- 45) HEAT EXCHANGER INLET AND OUTLET DUCTING
- 46) SVE SWITCH BOX - INCLUDES SVE LOW VACUUM SWITCH AND TEMPERATURE SWITCHGAUGES. SVE SYSTEM GAUGES - INCLUDES KO TANK INLET VACUUM GAUGE (TBD" W.C.), INLINE FILTER D.P. GAUGE (0-20" W.C. D.P.), SVE TOTAL FLOW GAUGE (TBD SCFM), AND BLOWER INLET VACUUM GAUGE (TBD" W.C.)
- 47) SVE VACUUM RELIEF VALVE

**EQUIPMENT LIST - SVE EXTRACTION LINE (TYP. 6)**

- 50) VACUUM GAUGE, 100" W.C.
- 51) MAGNEHELIC FLOW GAUGE, 50 SCFM
- 52) 1.5" GATE VALVE
- 53) 3/8" SAMPLE PORT WITH 1/4" ID TUBE CONNECTION
- 54) 1.5" VENTURI FLOW SENSOR, CONNECTED TO FLOW GAUGE VIA IMPULSE TUBING)
- 55) 2" CLEAR PVC PIPE
- 56) VACUUM GAUGE PORT (CONNECTED TO VACUUM GAUGE VIA IMPULSE LINE)
- 57) 2" FLEXIBLE VACUUM HOSE
- 58) SVE EXTRACTION MANIFOLD HEADER- 4" SCH 40 PVC

**EQUIPMENT LIST - BUILDING EQUIPMENT**

- 70) BUILDING INTAKE VENT (1 TYP. 2)
- 71) 2000W XP HEATER WITH INTEGRAL TSTAT
- 72) 12" XP EXHAUST FAN

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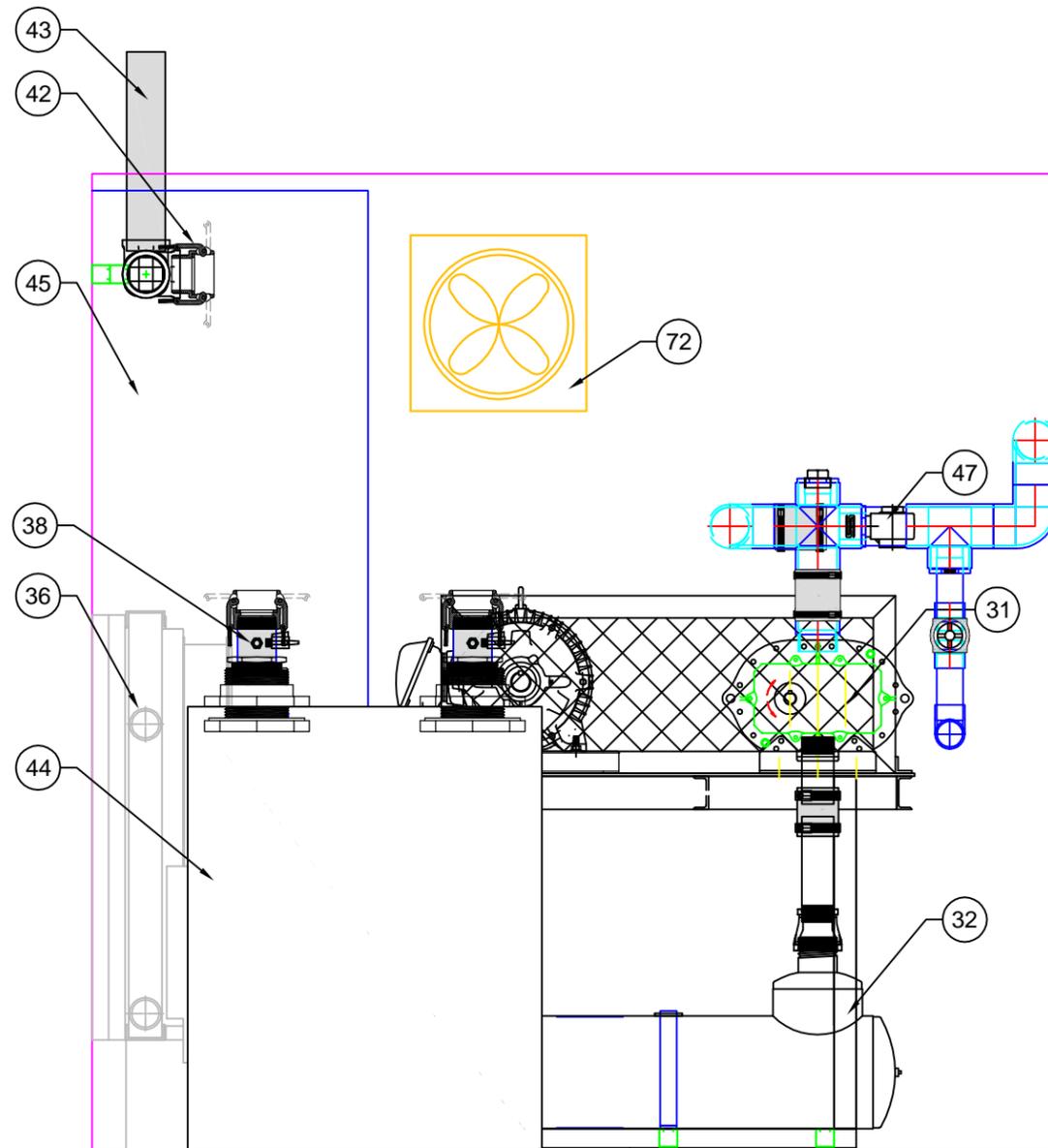
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CS	10/14/2015	SUBMITTAL
CS	12/29/2015	AS-BUILT

Trihydro Corporation  
Turnkey SVE Remediation System  
Havre, MT

INTERIOR ELEVATION  
DETAILS

ACAD file:  
Trihydro-Havre\_MT\_SYSLO.dwg

DWG. NO.: M3



**EAST WALL INTERIOR ELEVATIONS**  
SCALE: 3/4" = 1'

**SVE EQUIPMENT LIST**

- 30) 2" BLEED AIR FILTER/SILENCER
- 31) ROOTS DRESSER URAI-47-DSL PD SVE BLOWER
- 32) 3" INLINE SILENCER
- 33) 3" INLINE FILTER
- 34) 70 GALLON KO TANK
- 35) SVE BLOWER DISCHARGE TEMPERATURE PORT
- 36) AMERICAN INDUSTRIAL HEAT EXCHANGER (AIHTI MODEL ACA 4361-3E)
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- 42) CARBON VESSEL SYSTEM CAMLOCK CONNECTION
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**EQUIPMENT LIST - SVE EXTRACTION LINE (TYP. 6)**

- 50) VACUUM GAUGE, 100" W.C.
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- 55) 2" CLEAR PVC PIPE
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- 57) 2" FLEXIBLE VACUUM HOSE
- 58) SVE EXTRACTION MANIFOLD HEADER- 4" SCH 40 PVC

**EQUIPMENT LIST - BUILDING EQUIPMENT**

- 70) BUILDING INTAKE VENT (1 TYP. 2)
- 71) 2000W XP HEATER WITH INTEGRAL TSTAT
- 72) 12" XP EXHAUST FAN



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Havre, MT

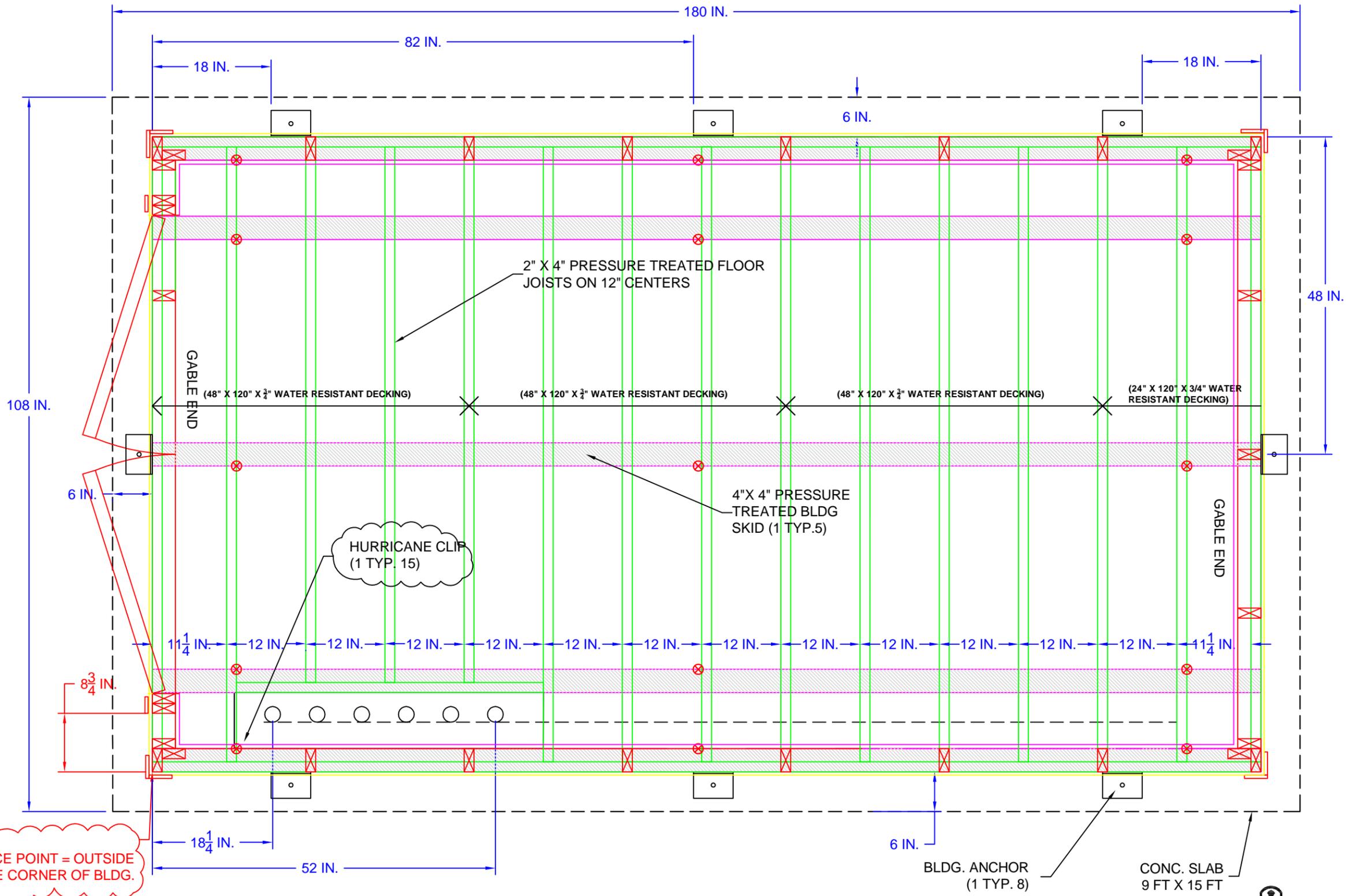
INTERIOR ELEVATION  
DETAILS

ACAD file:  
Trihydro-Havre\_MT\_SYSLO.dwg

DWG. NO.: M4

## **BLUE DIVIDER SHEET**

## **BLUE DIVIDER SHEET**



REFERENCE POINT = OUTSIDE SILL PLATE CORNER OF BLDG.

BUILDING PLANVIEW  
SCALE: 3/4" = 1'

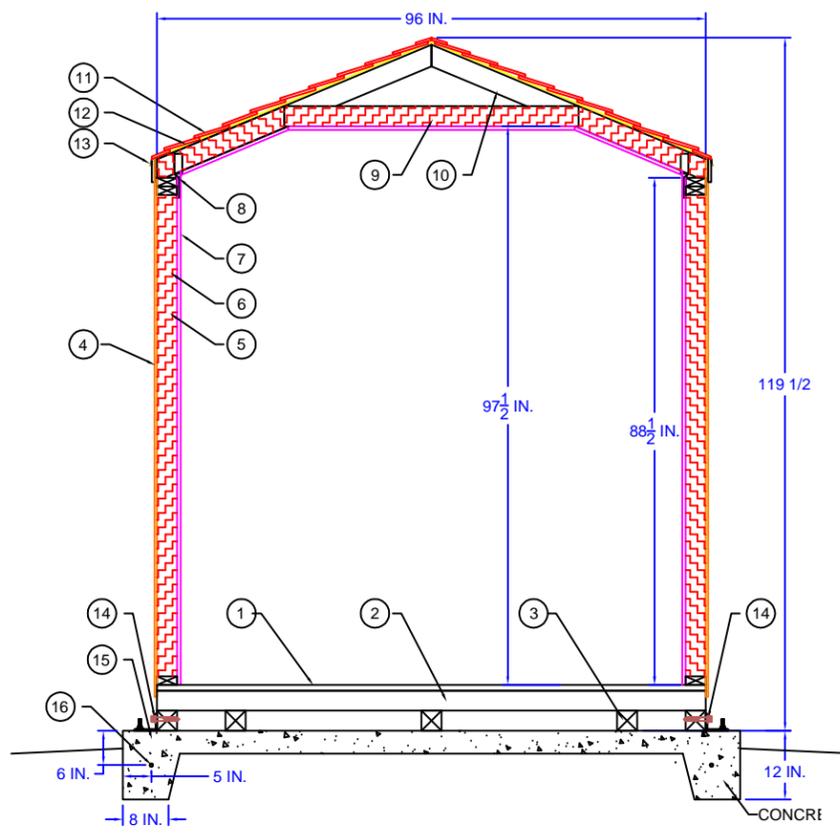


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CS	10/14/2015	SUBMITTAL

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Turnkey SVE Remediation System  
Havre, MT

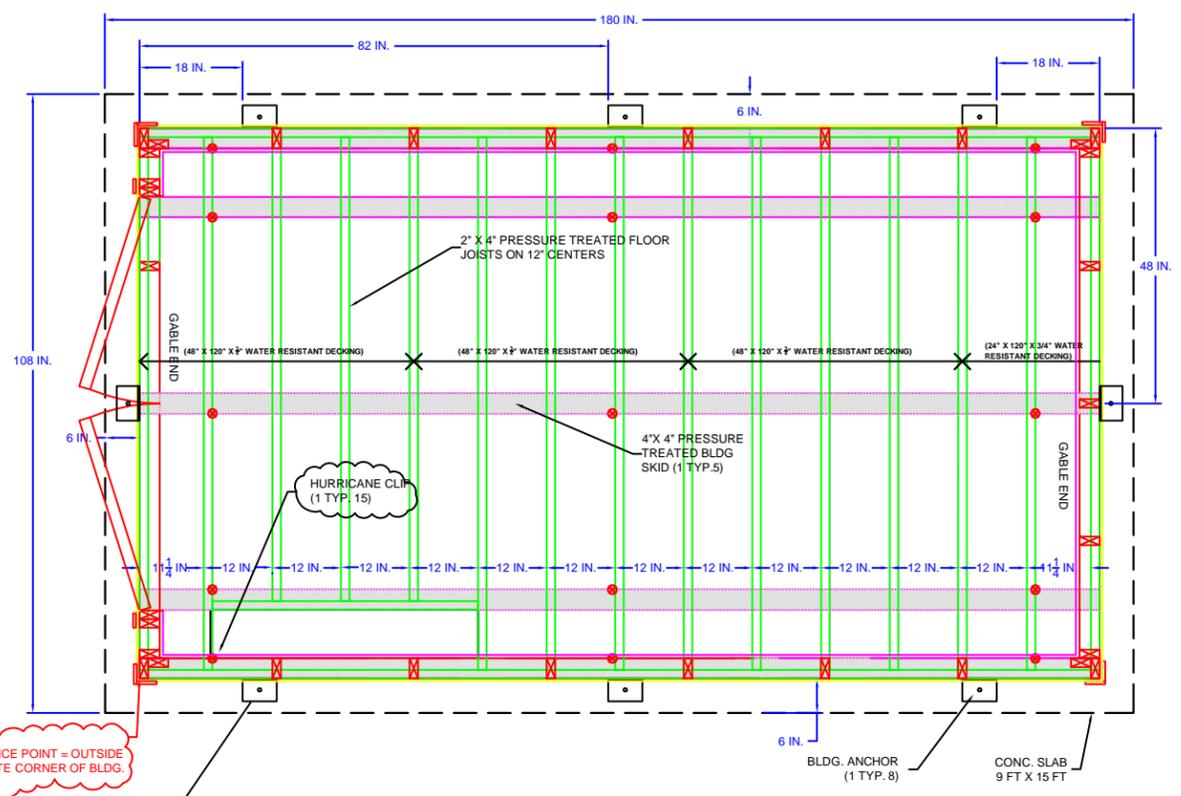
PIPING STUB-UP DETAILS WITH BUILDING OVERLAY	
ACAD file: Trihydro-Havre_MT_SYSL0.dwg	DWG. NO.: B1-A



**BUILDING SECTION DETAIL**  
SCALE: 3/8" = 1'

**BUILDING CROSS-SECTION DESCRIPTION**

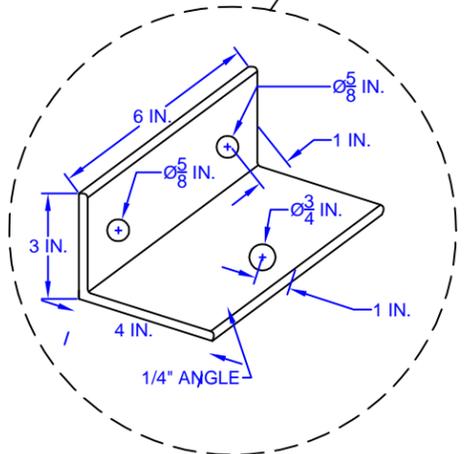
- (1): 3/4" WATER RESISTANT TONGUE AND GROOVE FLOORING
- (2): 2" X 4" PRESSURE TREATED FLOOR JOISTS (12" O.C.)
- (3): 4" X 4" PRESSURE TREATED BUILDING SUPPORT SKIDS
- (4): T1-11 EXTERIOR SIDING
- (5): 2" X 4" WALL FRAMING (24" O.C.)
- (6): R13 INSULATION IN ALL WALL AND CEILING CAVITIES
- (7): 5/8" TYPE X DRYWALL
- (8): HURRICANE CLIPS (INSTALL ON ALL ROOF RAFTERS)
- (9): 2" X 4" CROSS-TIES (INSTALL ACROSS ALL RAFTERS)
- (10): 2" X 4" ROOF RAFTERS (12 O.C., 5/12 PITCH)
- (11): DIMENSIONAL 30 YEAR SHINGLES
- (12): 7/16" OSB SHEATHING
- (13): DRIP EDGE
- (14): BUILDING ANCHOR (SEE NOTES)
- (15): MONOLITHIC, 3,000 LB, FIBER REINFORCED CONCRETE SLAB.
- (16.) #4 REBAR



**BUILDING PLANVIEW**  
SCALE: 3/8" = 1'

- NOTES**
- 1.) BUILDING TO BE ANCHORED TO CONCRETE SLAB AT EIGHT (8) LOCATIONS USING 4" x 3" x 1/4" ANGLE IRON BRACKETS AS SHOWN IN BUILDING ANCHOR DETAIL.
  - 2.) ATTACH BRACKET TO BUILDING WOOD SKIDS AT LOCATIONS SHOWN USING TWO (2) 1/2-INCH DIA. X 4-INCH LONG GALVANIZED WOOD LAG BOLTS (ASTM GRADE A36) PER BRACKET.
  - 3.) ATTACH BRACKET TO CONCRETE SLAB USING 5/8- INCH X 5-INCH" LONG EXPANSION ANCHOR WITH MIN. 4-INCH EMBEDMENT (USE RED HEAD CONCRETE ANCHORS OR APPROVED EQUALS).
  - 4.) BLOCK OUT OPENINGS IN SLAB FOR PIPING STUB-UPS AS SHOWN ON SLAB PLANVIEW DRAWING.
  - 5.) \*\* PTS WILL SHIP ITEMS 1-3 WITH THE SYSTEM\*\*

**BUILDING DESIGN CRITERIA**  
ROOF SNOWLOAD: 49 PSF  
BASIC WIND SPEED: 90 MPH (3-SECOND GUST)



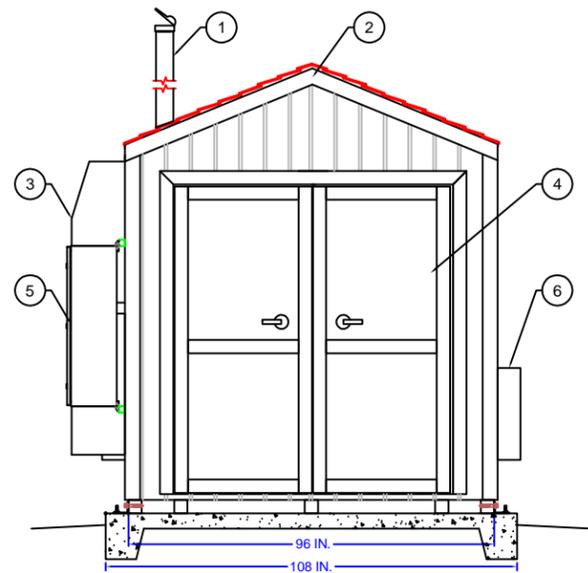
**BUILDING ANCHOR DETAIL**  
SCALE: NTS



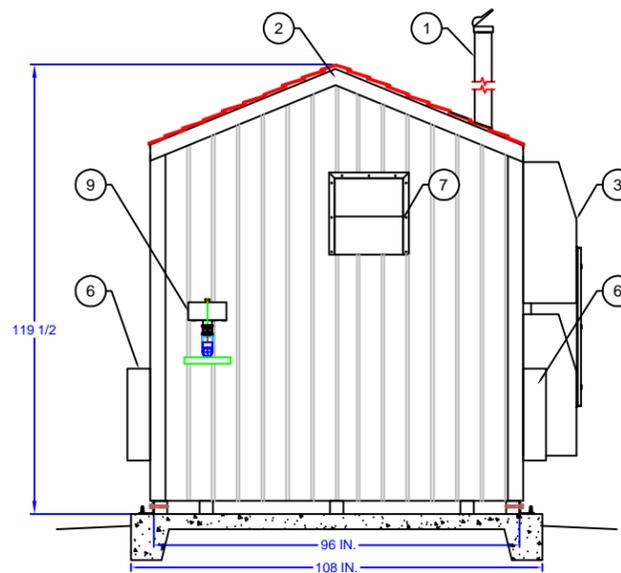
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CS	10/14/2015	SUBMITTAL		

ACAD file: **Trihydro-Havre\_MT\_SYSLO.dwg** DWG. NO.: B2

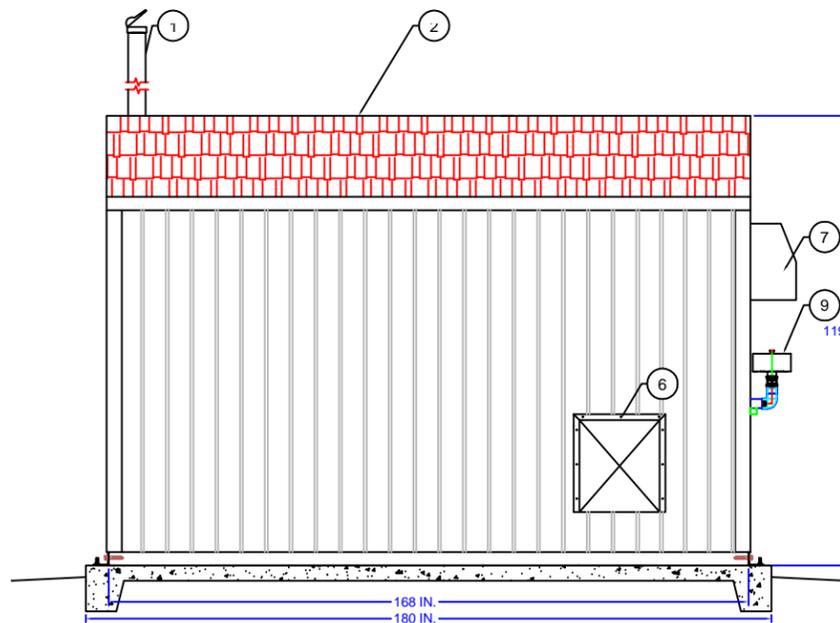


**WEST WALL ELEVATION**  
SCALE: 1/4" = 1'

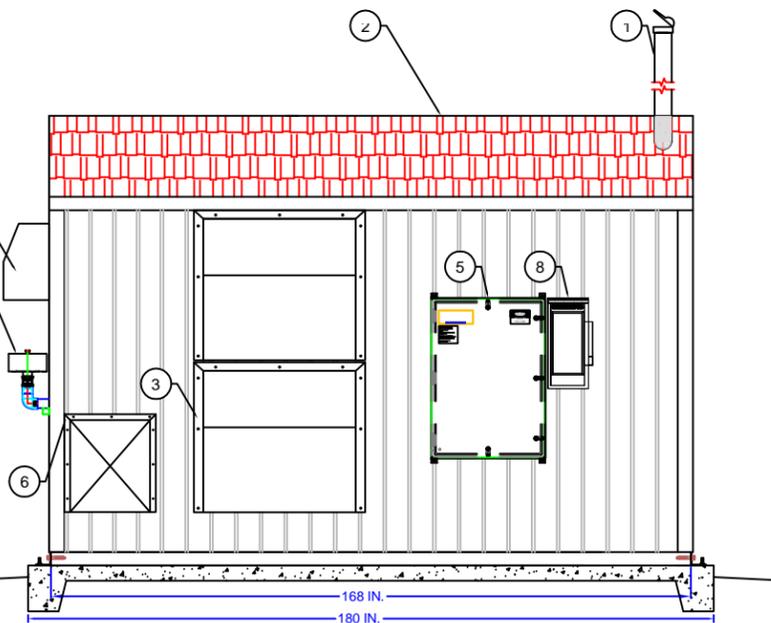


**EAST WALL ELEVATION**  
SCALE: 1/4" = 1'

- SYSTEM EQUIPMENT**
- 1) SVE EXHAUST STACK - 12' MIN. ABOVE GRADE, INCLUDES RAIN CAP
  - 2) 8' x 14' WOOD FRAME BUILDING
  - 3) HEAT EXCHANGER WEATHERHOOD (TYP. 2.)
  - 4) WOOD DOUBLE DOORS
  - 5) 42"X 30" X12" NEMA 3R MAIN CONTROL PANEL (UL 508A/698A LISTED)
  - 6) INTAKE VENT WEATHERHOOD (TYP. 2)
  - 7) EXHAUST FAN WEATHERHOOD
  - 8) 240VAC, 100A, THREE PHASE, FUSED, OUTDOOR RATED DISCONNECT SWITCH
  - 9) SVE BLEED AIR FILTER/SILENCER



**SOUTH WALL ELEVATION**  
SCALE: 1/4" = 1'



**NORTH WALL ELEVATION**  
SCALE: 1/4" = 1'



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CS	10/14/2015	SUBMITTAL

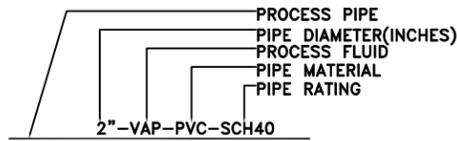
Trihydro Corporation  
Turnkey SVE Remediation System  
Havre, MT

EXTERIOR ELEVATION  
DETAILS

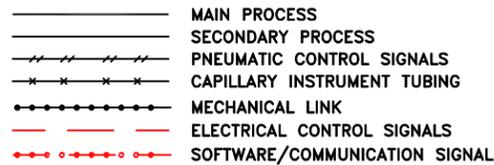
## **BLUE DIVIDER SHEET**

## **BLUE DIVIDER SHEET**

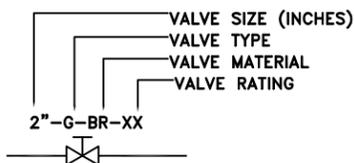
**PROCESS PIPING IDENTIFICATION**



**PROCESS LINES**



**VALVE IDENTIFICATION**



**PROCESS FLUID ABBREVIATIONS**

- VAP.....VAPOR
- CA.....COMPRESSED AIR
- PA.....PROCESS AIR
- IA.....INSTRUMENT AIR
- PW.....PROCESS WATER
- WW.....WELL WATER
- TF.....TOTAL FLUIDS
- PR.....PRODUCT
- CON.....CONDENSATE
- CC.....CHEMICAL ADDITIVES
- NG.....NATURAL GAS
- C3.....PROPANE
- XX.....NOT SPECIFIED

**PIPING & VALVE MATERIALS**

- CS.....CARBON STEEL
- GA.....GALVANIZED STEEL
- 304SS.....304 STAINLESS STEEL
- 316SS.....316 STAINLESS STEEL
- PVC.....POLYVINYLCHLORIDE
- CPVC.....CHLORINATED POLYVINYLE CHLORIDE
- CU.....COPPER
- BR.....BRASS
- HDPE.....HIGH DENSITY POLYETHYLENE
- LDPE.....LOW DENSITY POLYETHYLENE
- PP.....POLYPROPYLENE
- XX.....NOT SPECIFIED

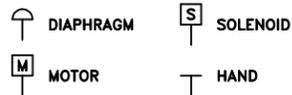
**PIPE & VALVE RATING/SPECS**

- SCH40.....SCHEDULE 40
- SCH80.....SCHEDULE 80
- SCH160.....SCHEDULE 160
- 125.....CLASS 125
- 150.....CLASS 150
- 200.....CLASS 200
- 300.....CLASS 300
- 350.....CLASS 350
- XX.....NOT SPECIFIED

**VALVE TYPE**

- A.....BUTTERFLY
- B.....BALL
- C.....CHECK
- D.....DAMPER
- G.....GATE
- K.....KNIFE GATE OR SLIDE
- L.....GLOBE
- N.....NEEDLE
- P.....PLUG OR COCK
- P.....PLUG OR COCK

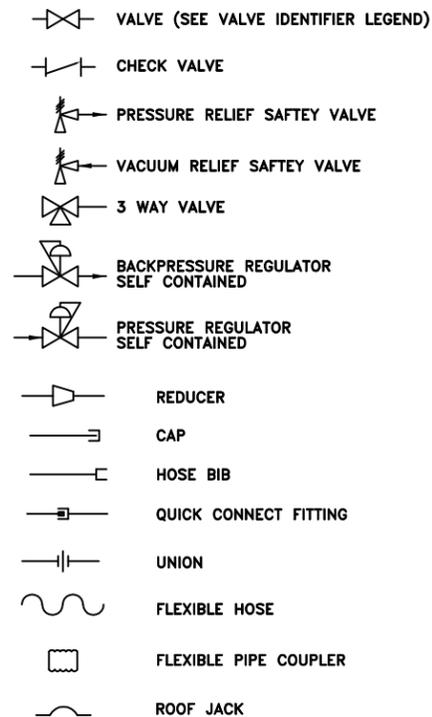
**VALVE OPERATOR SYMBOLS**



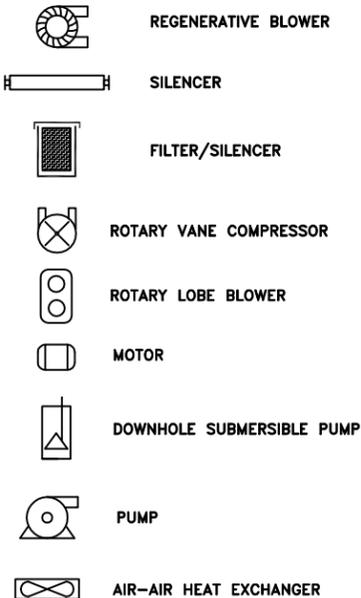
**INSTRUMENT IDENTIFICATION MATRIX**

1st LETTER (MEASURED OR INITIATING VARIABLE)	SUCCEEDING LETTERS (FUNCTION)																			
	INDICATOR	RECORDER	CONTROL	INDICATING CONT.	RECORDING CONT.	TRANSMITTER	ELEMENT	SWITCH	SWITCH LOW	SWITCH LOW-LOW	SWITCH HIGH	SWITCH HIGH-HIGH	ALARM LOW	ALARM LOW-LOW	ALARM HIGH	ALARM HIGH-HIGH	TOTALIZE	ALARM	OVERLOAD	
	I	R	C	IC	RC	T	E	S	SL	SLL	SH	SHH	AL	ALL	AH	AHH	Q	A	O	
LEVEL	L																			
PRESSURE	P																			
DIFF. PRESSURE	D																			
VACUUM	V																			
TEMPERATURE	T																			
FLOW	F																			
SPEED	S																			
VOLTAGE	E																			
CURRENT	I																			
TIME	K																			
% LEL	Y																			
MOTOR	M																			
CONTROL RELAY	C																			
AUXILIARY	A																			

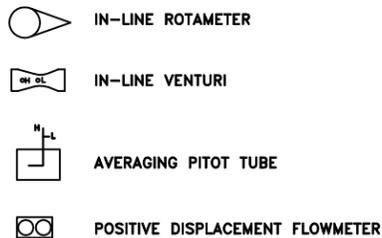
**VALVE & PIPING SYMBOLS**



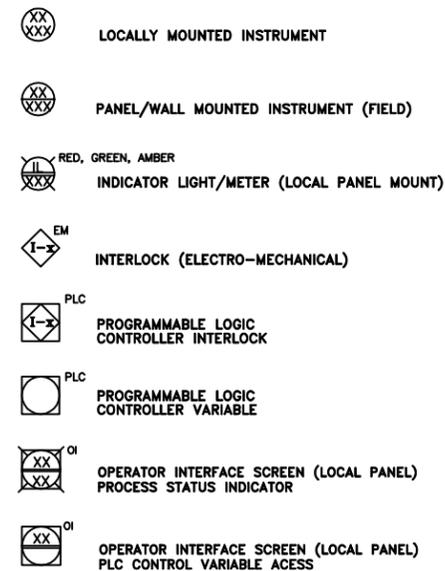
**PROCESS EQUIPMENT SYMBOLS**



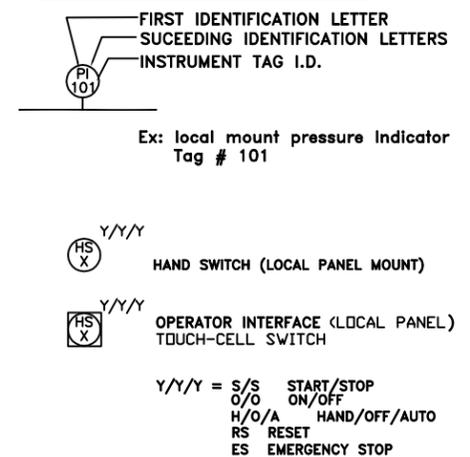
**FLOW METER SYMBOLS**



**CONTROL & PROCESS INSTRUMENT SYMBOLS**

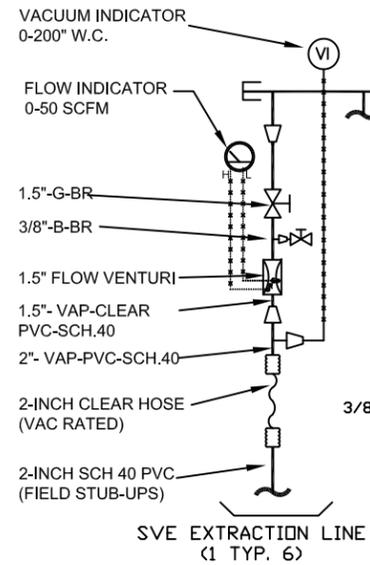


**INSTRUMENT IDENTIFICATION**



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CS	10/19/2015	SUBMITTAL		
ACAD file: Trihydro-Havre_MT_SYSLO.dwg			DWG NO.:	P1



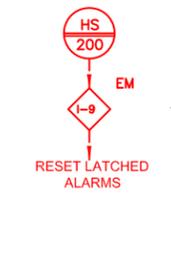
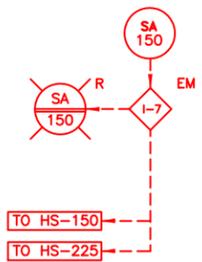
**GENERAL NOTES**

1. ALL CONTROL INTERLOCKS ARE INTERFACED WITH MOTOR CONTROLLER THROUGH AUTO SIDE OF H-O-A SWITCH UNLESS OTHERWISE SPECIFIED. ALL INTERLOCKS SHOWN CONNECTED TO H-O-A SWITCH ARE BYPASSED WITH WHEN H-O-A SWITCH PLACED IN THE HAND POSITION, UNLESS OTHERWISE NOTED IN MANUAL.

2. EXHAUST STACK MINIMUM 12' ABOVE GRADE. SUPPLY WITH RAIN CAP. PLACE HIGH TEMP WARNING LABELS ON BLOWER EXHAUST PIPING.

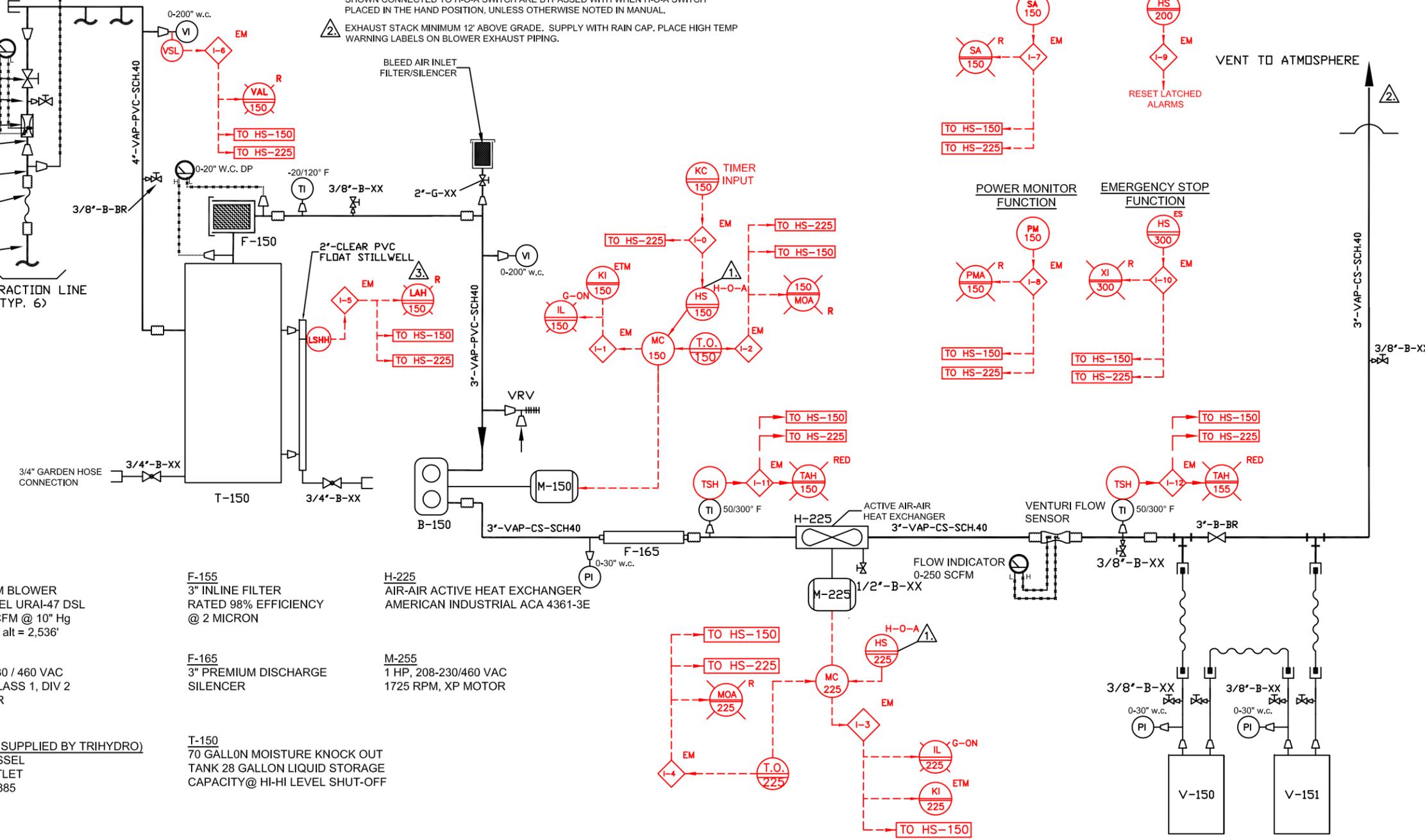
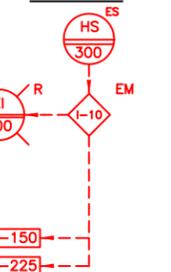
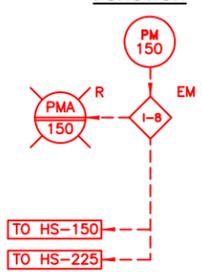
**SURGE ARRESTER FUNCTION**

**RESET BUTTON FUNCTION**



**POWER MONITOR FUNCTION**

**EMERGENCY STOP FUNCTION**



**B-150**  
SVE VACUUM BLOWER  
ROOTS MODEL URAI-47 DSL  
150 INLET SCFM @ 10" Hg  
VACUUM @ alt = 2,536'

**F-155**  
3" INLINE FILTER  
RATED 98% EFFICIENCY  
@ 2 MICRON

**H-225**  
AIR-AIR ACTIVE HEAT EXCHANGER  
AMERICAN INDUSTRIAL ACA 4361-3E

**M-150**  
15 HP, 208-230 / 460 VAC  
1800 RPM, CLASS 1, DIV 2  
TEFC MOTOR

**F-165**  
3" PREMIUM DISCHARGE  
SILENCER

**M-255**  
1 HP, 208-230/460 VAC  
1725 RPM, XP MOTOR

**V-150, 151 (\*\* SUPPLIED BY TRIHYDRO)**  
CARBON VESSEL  
4" INLET/OUTLET  
MODEL GPC385

**T-150**  
70 GALLON MOISTURE KNOCK OUT  
TANK 28 GALLON LIQUID STORAGE  
CAPACITY@ HI-HI LEVEL SHUT-OFF



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CS	10/14/2015	SUBMITTAL

Trihydro Corporation  
Turnkey SVE Remediation System  
Havre, MT

SVE PROCESS FLOW AND  
INSTRUMENTATION DIAGRAM

**TABLE 1 –SYSTEM INTERLOCKS**

<b>Interlock I.D.</b>	<b>Interlock Name</b>	<b>Interlock Description</b>
I-0	SVE Blower 24-hr. Timer Control	Provides ON/OFF timer control of SVE blower based on 24-hr. timer.
I-1	SVE Blower Run Status	Provides run status of SVE blower. Activates blower runtime counter and activates run light. Activates autodialer alarm #11.
I-2	SVE Blower Motor Thermal Overload/ Short Circuit Alarm	Deactivates SVE blower on motor thermal overload or short circuit condition. Activates SVE T.O/S.C. alarm and indicator. Latching alarm. Deactivates Heat Exchanger. Enabled in HAND. Activates autodialer alarm #2.
I-3	Heat Exchanger Run Status	Provides run status of heat exchanger. Activates heat exchanger runtime counter and activates run light. Activates autodialer alarm #10
I-4	Heat Exchanger Motor Thermal Overload/ Short Circuit Alarm	Deactivates heat exchanger on motor thermal overload or short circuit condition. Activates heat exchanger T.O/S.C. alarm and indicator. Latching alarm. Deactivates SVE Blower. Enabled in HAND. Activates autodialer alarm #3.
I-5	KO Tank High-High Level Alarm	Deactivates SVE blower and Heat exchanger on KO tank Hi-Hi level condition after specified time delay. Activates KO Tank High-High Level alarm indicator. Latching alarm. Activates autodialer alarm #4.
I-6	SVE Low Vacuum Alarm	Deactivates SVE blower on blower inlet low vacuum condition after specified time delay. Activates SVE Low Vacuum alarm indicator. Latching alarm. Activates autodialer alarm #5.
I-7	Surge Arrester Alarm	Deactivates SVE blower and heat exchanger motor. Activates Surge Arrester Alarm indicator. Non-latching alarm. Activates autodialer alarm #9.
I-8	Power Monitor	Deactivates SVE blower and heat exchanger motor. Activates Power Monitor Alarm indicator. Non-latching alarm. Activates autodialer alarm #8.
I-9	Reset Button	Resets all latched alarms once alarm conditions are cleared.
I-10	Emergency Stop	Deactivates SVE blower and heat exchanger motor. Activates Emergency Stop Alarm indicator. Latching alarm. Activates autodialer alarm #1.
I-11	SVE Discharge High Temp. Alarm	Deactivates SVE blower and heat exchanger on discharge hi temp condition. Activates High Temperature light. Latching alarm. Activates autodialer alarm #6.
I-12	H.E. Discharge High Temp. Alarm	Deactivates SVE blower and heat exchanger on discharge hi temp condition. Activates High Temperature light. Latching alarm. Activates autodialer alarm #7.

**Notes:**

1. Alarm interlocks enabled only when H-O-A switch in AUTO unless otherwise specified.
2. All alarm interlocks create a latched alarm condition, unless otherwise noted. To restart system after an alarm, the condition must be cleared and alarm reset button pressed on control panel.

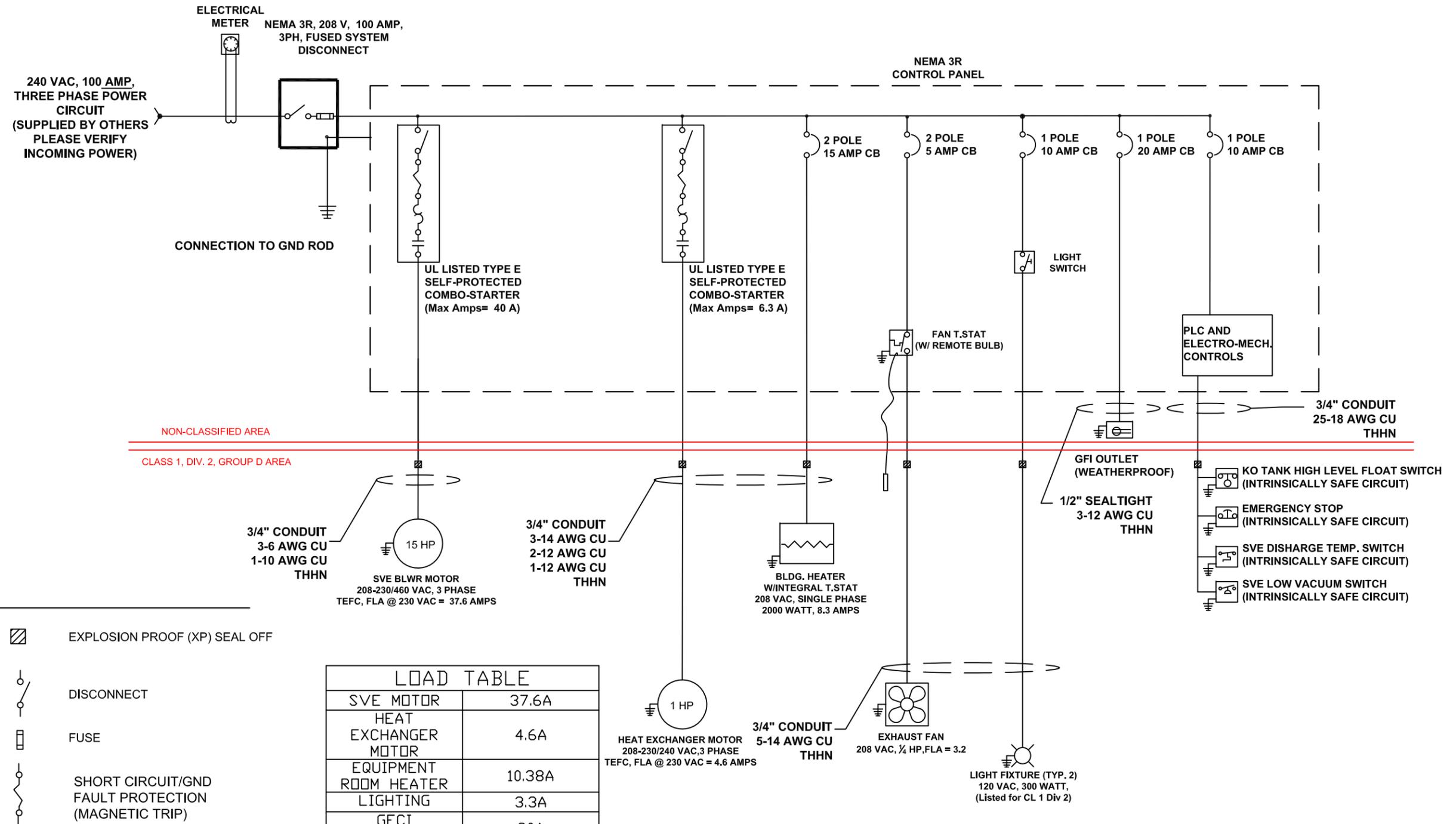


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DRAWN BY:	DATE:	DESCRIP:	Trihydro Corporation Turnkey SVE Remediation System Havre, MT	PROCESS FLOW AND INSTRUMENTATION DIAGRAM INTERLOCK DESCRIPTIONS
CS	10/19/2015	SUBMITTAL		
ACAD file: Trihydro-Havre_MT_SYSLO.dwg			DWG. NO.:	P3

## **BLUE DIVIDER SHEET**

**BLUE DIVIDER SHEET**



NON-CLASSIFIED AREA  
 CLASS 1, DIV. 2, GROUP D AREA

**LEGEND**

-  MOTOR CONTACTOR
-  THERMAL OVERLOAD
-  CIRCUIT BREAKER
- NOTES:
-  EXPLOSION PROOF (XP) SEAL OFF
-  DISCONNECT
-  FUSE
-  SHORT CIRCUIT/GND FAULT PROTECTION (MAGNETIC TRIP)

1. RUN INTRINSICALLY SAFE CIRCUITS IN SEPARATE CONDUIT.
2. ALL ELECTRICAL WORK INSIDE EQUIPMENT ENCLOSURE TO BE COMPLETED IN ACCORDANCE WITH NEC CODE FOR A CLASS I, DIV. II, GROUP D ENVIRONMENT.
3. SHORT CIRCUIT CALCULATIONS BASED ON POINT TO POINT LISTED IN BUSSMAN MANUFACTURING PUBLICATION SPD90.

LOAD TABLE	
SVE MOTOR	37.6A
HEAT EXCHANGER MOTOR	4.6A
EQUIPMENT ROOM HEATER	10.38A
LIGHTING	3.3A
GFCI RECEPTACLE	20A
CONTROL POWER	5A
+25% LARGEST MOTOR	9.4A
TOTAL	90.28

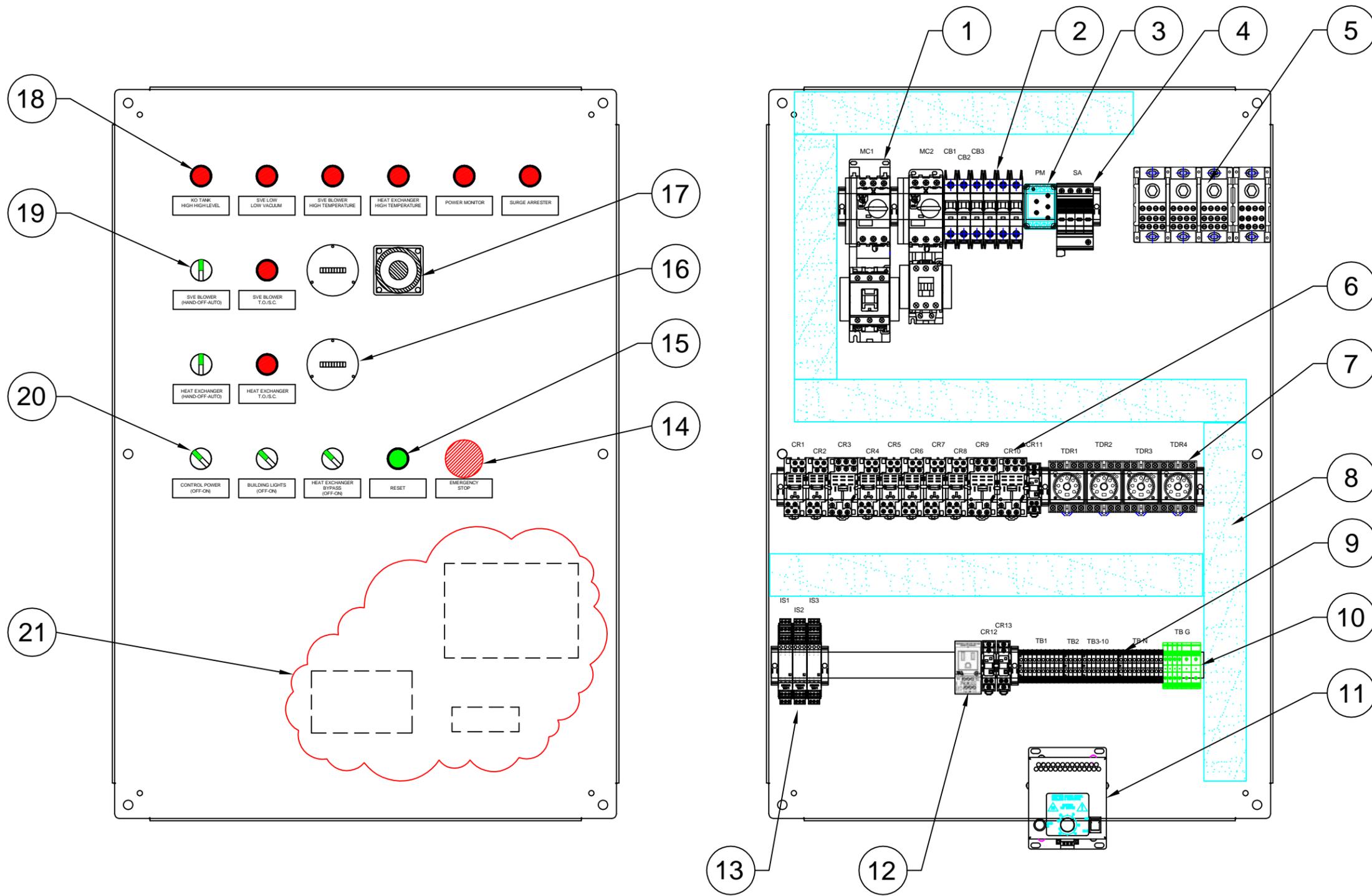


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Trihydro Corporation  
 Turnkey SVE Remediation System  
 Havre, MT

SINGLE LINE ELECTRICAL DIAGRAM	
ACAD file: Trihydro-Havre_MT_SLED. DWG	DWG. NO.: E1



**EQUIPMENT LIST**

- 1) TYPE E MOTOR CONTROLLER (1 TYP. 2)
- 2) UL-489 CIRCUIT BREAKERS (1 TYP. 5)
- 3) POWER MONITOR
- 4) SURGE ARRESTER
- 5) MAIN POWER AND NEUTRAL DISTRIBUTION BLOCKS
- 6) CONTROL RELAY (1 TYP. 13)
- 7) TIME DELAY RELAY (1 TYP. 4)
- 8) CABLE TRAY
- 9) TERMINAL BLOCKS
- 10) GROUND BLOCKS
- 11) PANEL HEATER
- 12) AUTO-DIALER OUTLET
- 13) INTRINSICALLY SAFE BARRIERS (1 TYP. 3)
- 14) EMERGENCY STOP BUTTON
- 15) RESET BUTTON
- 16) RUNTIME METER (1 TYP. 2)
- 17) SVE 24 HR TIMER CONTROL
- 18) RED LED ALARM LIGHT (1 TYP. 8)
- 19) THREE-POSITION H-O-A SWITCH (TYP. 8)
- 20) ON/OFF SWITCH (1 TYP. 3)
- 21) AUTODIALER/CELLULAR MODEM (MOUNTED ON BACK OF SWINGOUT DOOR)

MC = MOTOR CONTROLLER  
 CB = CIRCUIT BREAKER  
 CR = CONTROL RELAY  
 IS = INTRINSICALLY SAFE BARRIER  
 TB = TERMINAL BLOCK  
 FB = FUSED TERMINAL BLOCK  
 SA = SURGE ARRESTER  
 PM = POWER MONITOR  
 PS = POWER SUPPLY

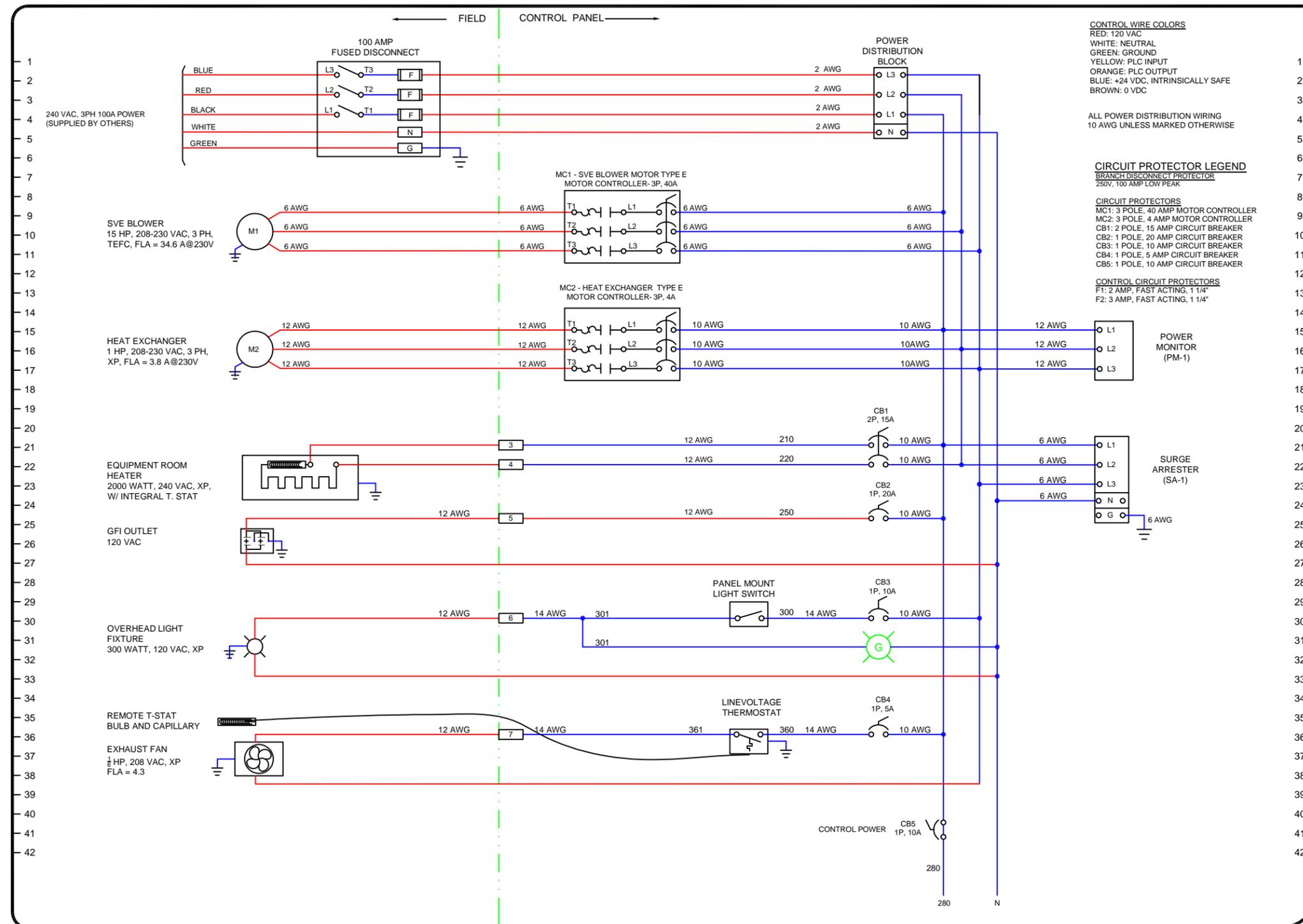


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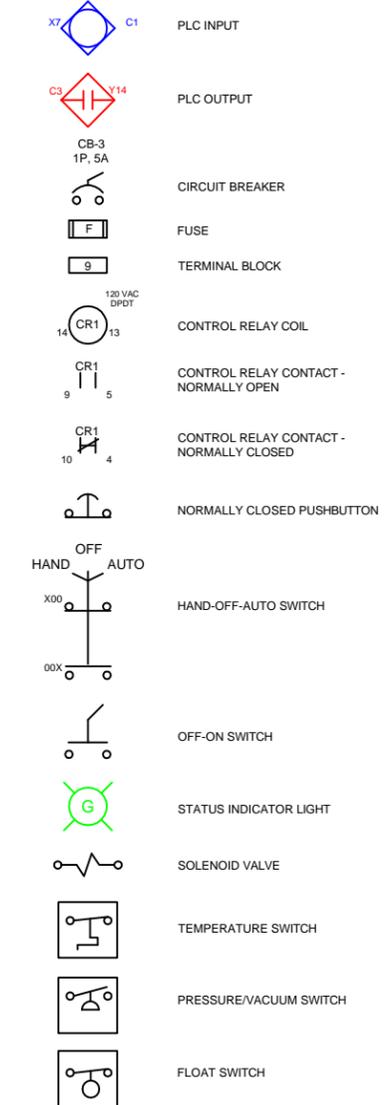
DRAWN BY:	DATE:	DESCRIP:
CS	11/16/2015	SUBMITTAL
TJS	1/7/2015	AS-BUILT

Trihydro Corporation  
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 Havre, MT

Control Panel Schematics  
 TRIHYDRO-HAVRE



**COMPONENT LEGEND**



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CS	1/8/2016	AS-BUILT

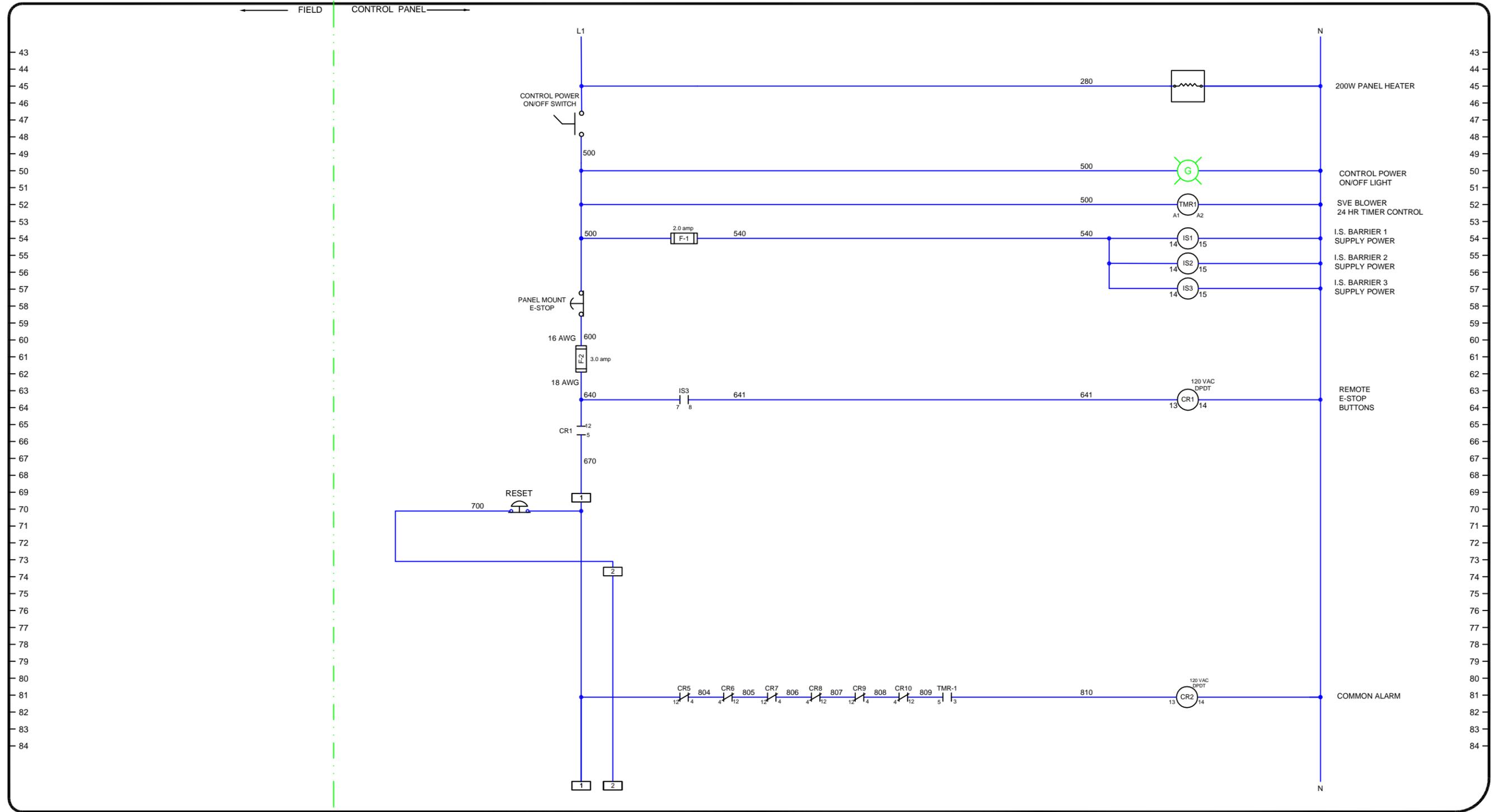
Trihydro Corporation  
 Turnkey SVE Remediation System  
 Havre, MT



Control Panel Schematics  
 TRIHYDRO-HAVRE

ACAD file:  
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DWG. NO.: CP2



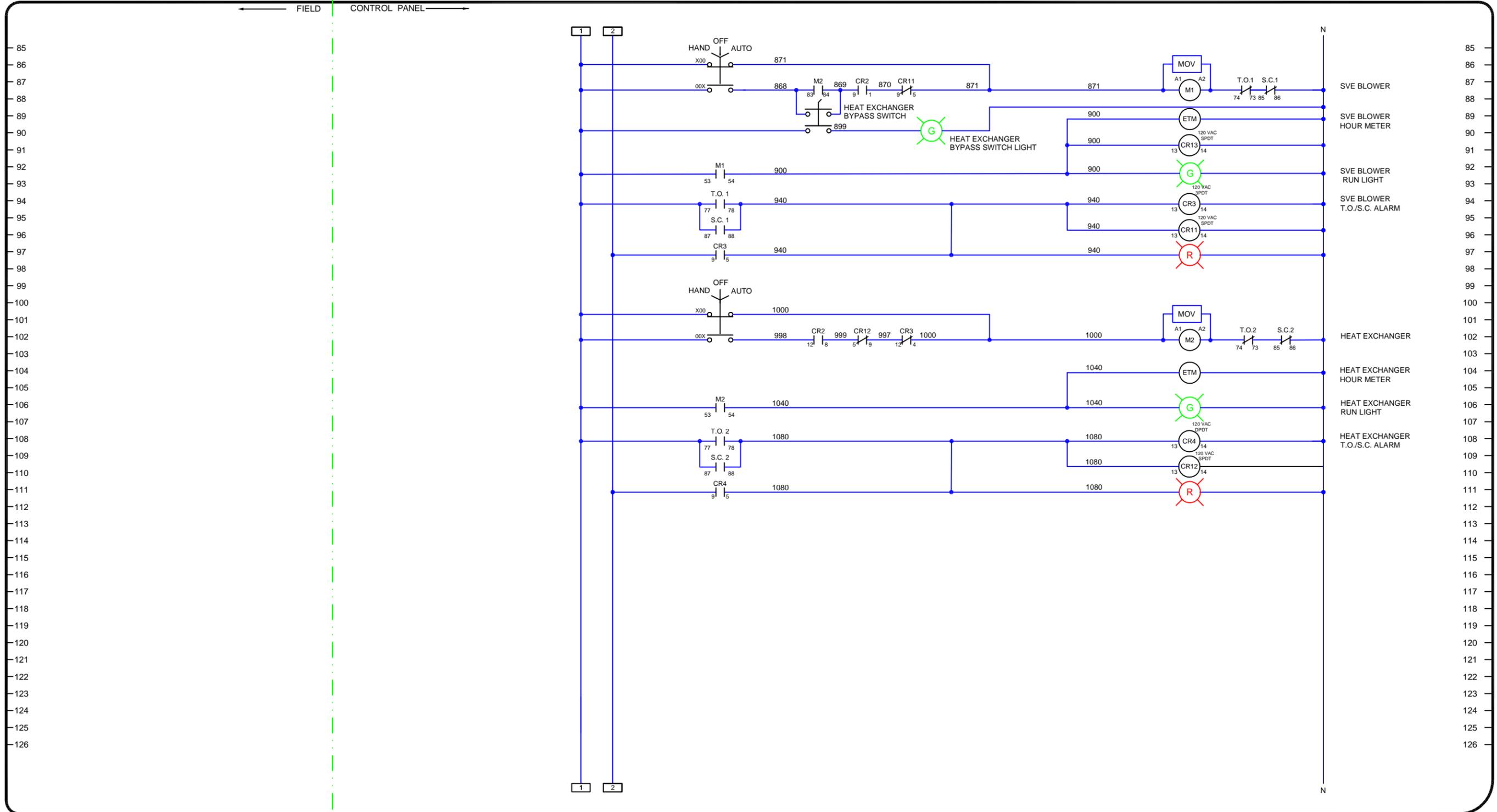
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CS	1/8/2016	AS-BUILT

Trihydro Corporation  
Turnkey SVE Remediation System  
Havre, MT

Control Panel Schematics  
TRIHYRO-HAVRE

ACAD file: **Trihydro-Havre\_MT\_CPLO.dwg**      DWG NO.: CP3



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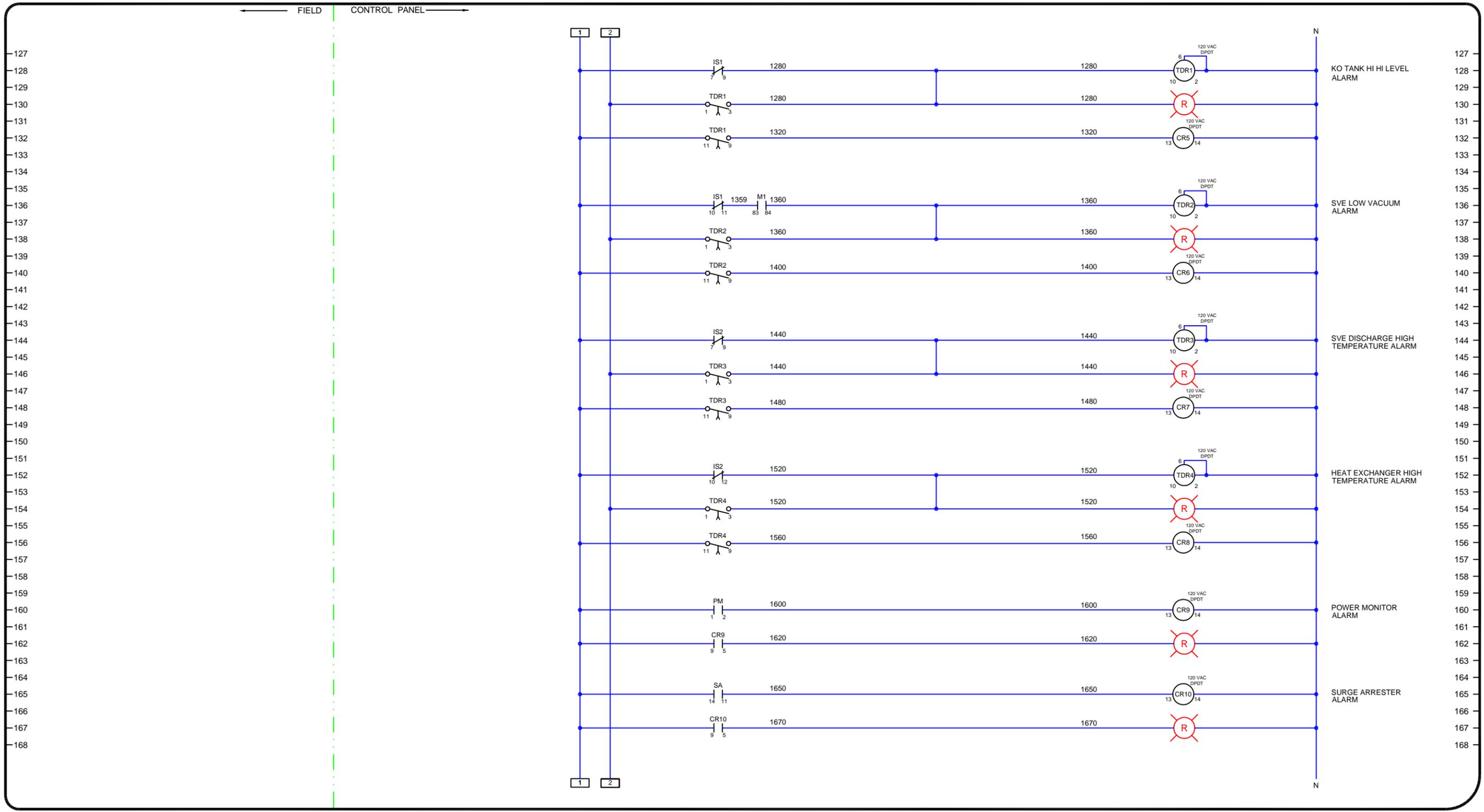
DRAWN BY:	DATE:	DESCRIP:
CS	11/9/2015	SUBMITTAL
CS	1/8/2016	AS-BUILT

Trihydro Corporation  
 Turnkey SVE Remediation System  
 Havre, MT

Control Panel Schematics  
 TRIHYDRO-HAVRE

ACAD file:  
 Trihydro-Havre\_MT\_CPLO.dwg

DWG. NO.: CP4

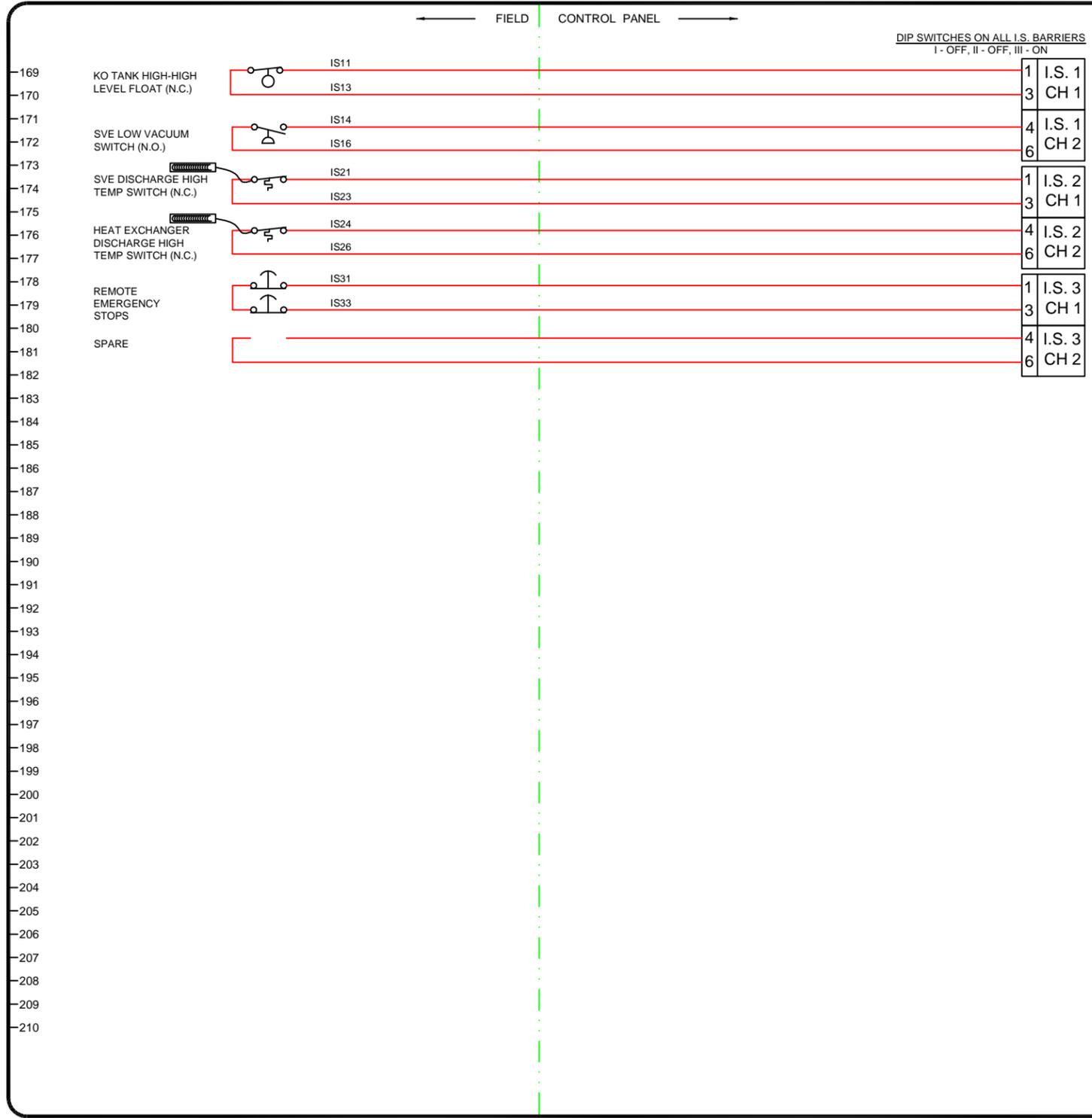


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Trihydro Corporation  
Turnkey SVE Remediation System  
Havre, MT

Control Panel Schematics TRIHYDRO-HAVRE	
ACAD file: Trihydro-Havre_MT_CPLO.dwg	DWG. NO.: CP5



**I.S. BARRIER INSTALLATION NOTES:**  
 - BARRIERS TO BE CONNECTED TO EQUIPMENT INSTALLED IN A CLASS I, DIV. II, GROUP A, B, C, OR D AREA.  
 - INSTALL IN ACCORDANCE WITH ARTICLE 504 OF THE NATIONAL ELECTRICAL CODE.  
 - CONNECT FIELD SWITCHES TO TERMINALS 1 & 3 FOR I.S. CHANNEL 1 RELAY, OR TERMINALS 4 & 6 FOR I.S. CHANNEL 2 RELAY.  
 - MAX. CABLE LENGTH: 168 FT.

**\*\*NOTES:**  
 1. CR1, 2, 3, 4, 5 SPECIFICATIONS:  
 - CONTACTS: 10A, 240VAC, RESISTIVE, 7A, 240VAC, GENERAL USE, 1/3HP, 240VAC, 1/6HP, 120VAC, 10A, 120VAC, RESISTIVE, 500K CYCLES  
 - COIL: 6-240VAC  
 - CONTROL RELAYS ARE USED TO CONTROL PROCESS SOLENOIDS AND SWITCHES.  
 - FIELD WIRING MUST BE SIZED TO ACCOMMODATE THE APPROPRIATE LOADS ASSOCIATED WITH THE SOLENOIDS AND RELAYS.  
 2. INSULATION ON ALL CONDUCTORS IN WIRE TRAY MUST BE SUITABLE FOR 240V. ROUTE CLASS 2 CONDUCTORS ON ENCLOSURE SIDES OUTSIDE OF WIRE TRAY.  
 3. MOV - METAL OXIDE VARISTOR FOR SURGE PROTECTION  
 4. TO RESET MOTOR CONTROLLERS IN THE EVENT OF A THERMAL OVERLOAD ALARM, FIRST TURN THE BLACK KNOB ON THE MOTOR CONTROLLER TO THE OFF POSITION, THEN TO THE ON POSITION, AND THEN PRESS THE RESET BUTTON LOCATED ON THE CONTROL PANEL.

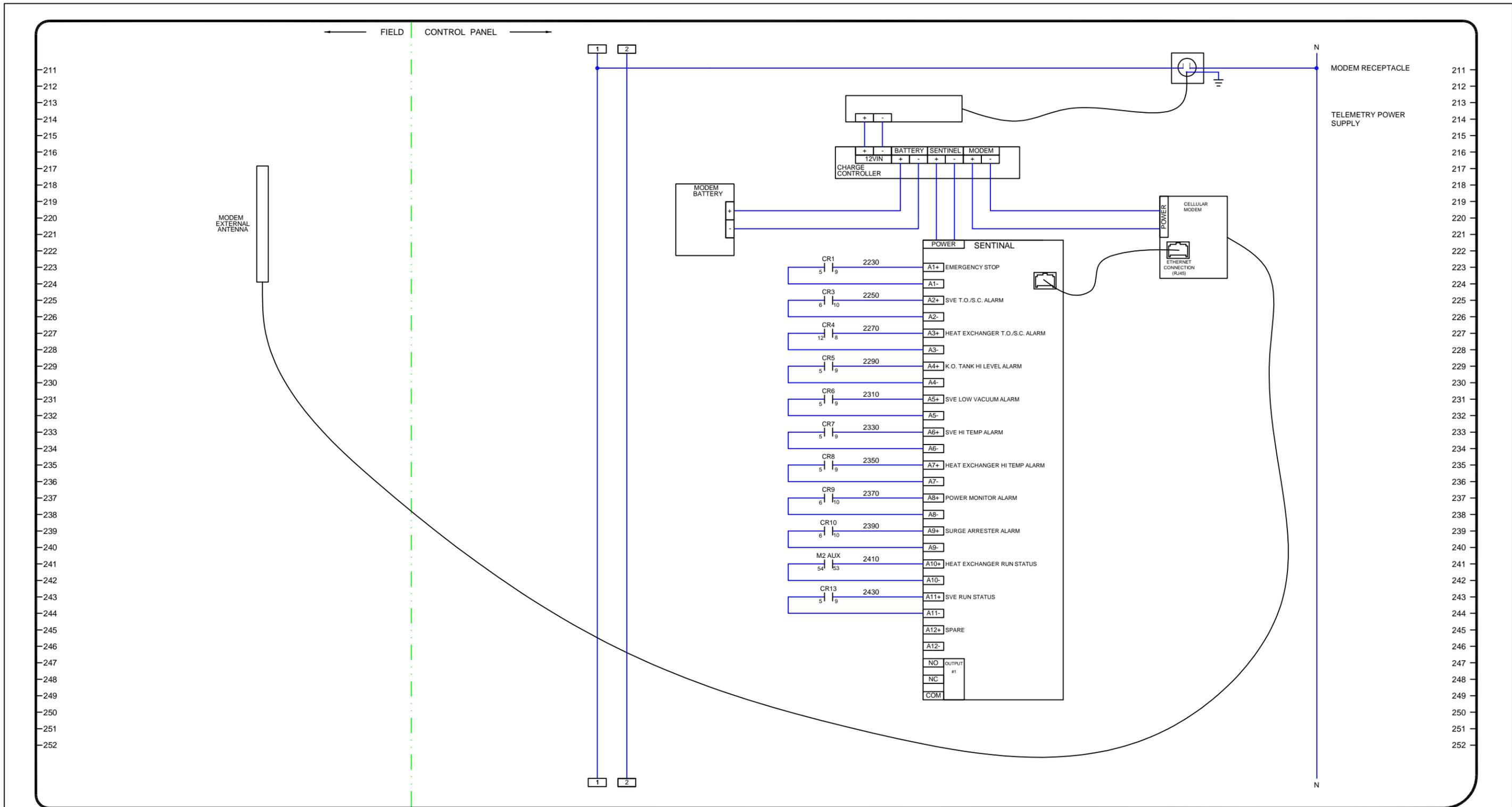


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Control Panel Schematics TRIHYDRO-HAVRE	
ACAD file: Trihydro-Havre_MT_CPLO.dwg	DWG. NO.: CP6



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Havre, MT

Control Panel Schematics  
TRIHYDRO-HAVRE

ACAD file:  
Trihydro-Havre\_MT\_CPLO.dwg

DWG. NO.: CP7

**CONTROL SYSTEM  
I/O MANUALS**

**BLANK SHEET**



# INSTALLATION INSTRUCTIONS PMP SERIES THREE-PHASE MONITOR RELAYS

April, 2014 (Replaces November, 2008)

901-0000-140

## DANGER!



Potentially hazardous voltages are present. Electrical shock can cause death or serious injury. Installation should be done by qualified personnel following all National, State & Local Codes.



**BE SURE TO REMOVE ALL POWER SUPPLYING THIS EQUIPMENT BEFORE CONNECTING OR DISCONNECTING WIRING. READ INSTRUCTIONS BEFORE INSTALLING OR OPERATING THIS DEVICE. KEEP FOR FUTURE REFERENCE.**

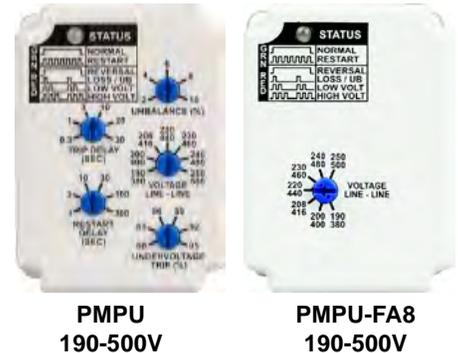


**IMPORTANT: READ THIS FIRST IF REPLACING A PMP SERIES PRODUCT WITH DATE CODE OF 1414 OR EARLIER**

Macromatic made several product design enhancements on all PMP Series products manufactured with Date Code of 1415 or later (2nd week of April 2014). These include a dial-in-dial line-line voltage scale on the PMPU with an increased 190-500V range, new LED fault codes & the ability to set the Line-Line Voltage with power applied. Basic functionality & protection has been retained. For more information, please visit [www.macromatic.com/new-pmp](http://www.macromatic.com/new-pmp).

### Installation and Wiring

- Mount the appropriate 8 pin octal socket in a suitable enclosure. **NOTE: a 600V-rated socket such as the Macromatic 70169-D or Custom Connector OT08-PC must be used with these products on applications greater than 300V. When making connections to the socket, make sure to match the terminal numbers on the socket to the ones shown on the wiring diagram (the wiring diagram on the relay is the view looking towards the bottom of the relay vs. the top of the socket).** Use one or two #12-22 solid or stranded copper or copper-clad aluminum conductors with terminals on the above Macromatic or Custom Connector sockets—a terminal tightening torque of 12 in-lbs should be used.
- Set the VOLTAGE LINE-LINE knob to the actual three-phase line-to-line voltage. The Voltage Line-Line knob on the PMPU & the PMPU-FA8 has two ranges (see right): 190-250V on the low voltage scale and 380-500V on the high voltage scale. The unit auto senses the three-phase line-line voltage when applied and automatically selects one of the two ranges. The PMP120 has a single adjustable range of 102-138V and the PMP575 has a single adjustable range of 460-600V.
- (For PMPU-FA8, skip to Step 4)* Set initial settings on the UNDERVOLTAGE TRIP, TRIP DELAY and RESTART DELAY knobs to minimum. Set initial setting on the UNBALANCE knob to maximum.
- Connect the three-phase line-line voltage to terminals 3, 4 and 5 (see Wiring Diagram on the side of the relay or on the back of this sheet). A connection to the neutral or ground is not required in Wye systems. **DO NOT** connect output wires to terminals 1, 2 and 8 until later (Step 13).
- RESET: As standard, the PMP Series relays are in the Automatic Reset mode, which means they will automatically reset once the fault has been corrected. However, they can be set up in the Manual Reset mode by connecting an external N.C. switch across terminals 6 and 7. Upon application of three-phase voltage, the PMP Series will go into Manual Reset mode if it recognizes a closure across terminals 6 and 7. After a fault clears, the relay will not reset until the N.C. switch is opened. **NOTE:** this unit can only be set back to Automatic Reset mode from Manual Reset mode by removing three-phase voltage, removing the N.C. switch across terminals 6 and 7, and reapplying the three-phase voltage.
- Plug the three-phase monitor relay into the socket, making sure the key on the center post is in the proper orientation before insertion. **If the relay must be removed from the socket, do NOT rock the relay back and forth excessively—the center post could be damaged.**
- Apply three-phase voltage. The LED indicator should initially flash GREEN if in the Automatic Reset mode while the relay goes through its start-up delay or waiting for an external switch to be operated if in the Manual Reset mode and then illuminate solid GREEN. If the LED turns RED solid or flashing, a fault condition exists and must be corrected. **Use the LED Status Table at right or the Troubleshooting Guide on back to determine exact cause of fault.** Make required corrections.



	LED STATUS	STATUS
GREEN	[Solid Line]	NORMAL / RELAY ON
	[Pulsing Line]	RESTART DELAY
RED	[Solid Line]	REVERSAL
	[Flashing Line]	LOSS / UNBALANCE
	[Pulsing Line]	UNDERVOLTAGE
	[Pulsing Line]	OVERVOLTAGE

### Settings

- REMOVE THREE-PHASE VOLTAGE for Steps 9-13. *(For PMPU-FA8, REMOVE THREE-PHASE VOLTAGE and skip to Step 13)*
- Set the RESTART DELAY knob. This setting should be the time period required after a fault has been cleared before the relay should automatically energize. **NOTE:** this value is ignored when in the Manual Reset mode (see Step 5).
- Set the UNDERVOLTAGE TRIP knob between 80 and 95% of the line-line voltage setting. This value should be the same as the minimum operating voltage for the equipment to be adequately protected.
- Set the TRIP DELAY knob. This is the maximum time period that an unbalance, undervoltage or overvoltage condition should be allowed to last. Too short a setting will cause nuisance tripping if there are momentary changes in the three-phase voltage. Too long a setting could cause damage to the equipment. Note that the setting should be at least slightly longer than the time a three-phase motor is drawing its inrush or startup current. This will avoid nuisance tripping caused by the starting current.
- Set the UNBALANCE knob. This setting should be the maximum allowable unbalance in phase voltage that the three-phase system can tolerate. Too low of a setting can cause nuisance tripping. Too high of a setting may not adequately protect the system.

(Continued on Back)



# INSTALLATION INSTRUCTIONS

## PMP SERIES

### 3-PHASE MONITOR RELAYS

#### Operation

13. Connect the output terminal wires to terminals 1, 2 and 8 (see Wiring Diagram on the side of the relay or below).
14. When all connections are made, apply three-phase line-line voltage. The LED indicator should initially flash GREEN while the relay goes through its restart delay or waiting for an external switch to be operated if in the Manual Reset mode and then illuminate solid GREEN when all voltage conditions are correct.
15. If the LED does not illuminate solid GREEN during regular operation, a fault condition has occurred. REMOVE THREE-PHASE VOLTAGE, and check for proper phase rotation, presence of all three phases, and low or high voltage conditions. **Use the LED Status Table on the first page or the Troubleshooting Guide below to determine exact cause of fault.** Correct if necessary. Re-energization is automatic upon correction of the fault condition unless using MANUAL RESET, which requires opening the N.C. switch across terminals 6 and 7 to reset the unit (see Step 5).

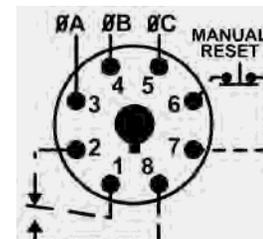
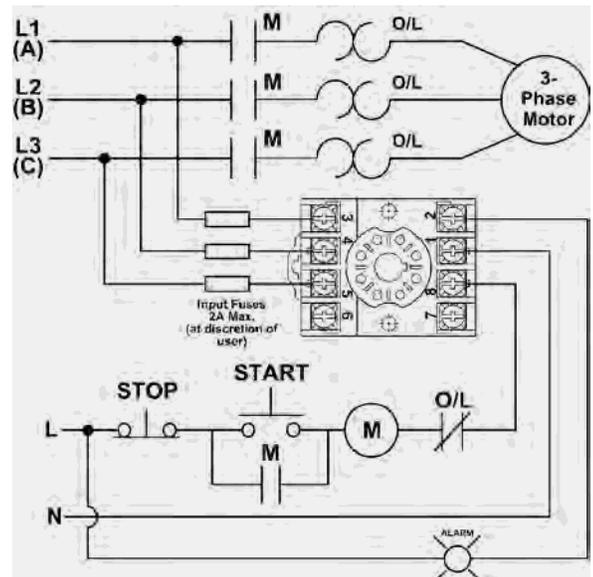
#### Troubleshooting

If the unit fails to operate properly, check that all connections are correct per the appropriate wiring diagram on the product. Check Troubleshooting table below. If problems continue, contact Macromatic at 800-238-7474 or e-mail [tech-support@macromatic.com](mailto:tech-support@macromatic.com) for assistance.

**Troubleshooting Guide**

LED STATUS	SITUATION	SOLUTION
GREEN 	Motor is not starting	Either (a) the relay is going through its POWER-UP/RESTART delay and will energize the output contacts when completed; or (b) the relay is in the Manual Reset mode and waiting for an external switch to be operated before energizing the output contacts.
GREEN 	Motor is not starting	The relay is in the run mode and working properly. Either another control device is preventing the motor from starting or all wiring should be checked.
NO INDICATION	Relay is not energized and/or motor is not running	Verify L1, L2 and L3 (A, B & C) are connected to terminals 3, 4 and 5. Measure the three line-to-line voltages. If any of the voltages are below the specified minimum operation voltage, the relay does not have enough power to operate. Check to see why operating voltage is low and correct.
RED 	On power-up or with motor running	The relay is sensing a phase reversal or phase out-of-sequence (rotation) condition. REMOVE THREE-PHASE VOLTAGE and switch any two of the three line connections to ensure the phase sequence (rotation) is correct.
RED 	Either a phase loss or voltage unbalance condition	Make sure all three phases are present. Check for a blown fuse or a loose or broken wire. Measure all three line-line voltages and calculate the percent unbalance—compare to UNBALANCE knob setting. Determine why unbalanced condition exists and correct it.
RED 	Low voltage	Measure the three line-to-line voltages. If the average of these three voltages is below the UNDERVOLTAGE TRIP knob setting, the relay has tripped due to a low voltage condition. Check for low voltage condition and correct it.
RED 	High voltage	Measure the three line-to-line voltages. If the average of these three voltages is > 10% of the VOLTAGE LINE-LINE knob setting, the relay has tripped due to a over voltage condition. Check for high voltage condition and correct it.

**Typical Connections**  
(For Load Side connection, contact Macromatic)



**Diagram 104**

#### Warranty

All catalog-listed PMP Series products manufactured by Macromatic are warranted to be free from defects in workmanship or material under normal service and use for a period of five (5) years from date of manufacture.

## **BLUE DIVIDER SHEET**

## **BLUE DIVIDER SHEET**



## OPERATING INSTRUCTIONS

# PROGRAMMABLE INDUSTRIAL TIME SWITCHES

MODELS TA4150 THRU TA4153

FORM 5S2826

03475

0591/188/10M

**READ CAREFULLY BEFORE ATTEMPTING TO ASSEMBLE, INSTALL, OPERATE OR MAINTAIN THE PRODUCT DESCRIBED. PROTECT YOURSELF AND OTHERS BY OBSERVING ALL SAFETY INFORMATION. FAILURE TO COMPLY WITH INSTRUCTIONS COULD RESULT IN PERSONAL INJURY AND/OR PROPERTY DAMAGE!**  
**RETAIN INSTRUCTIONS FOR FUTURE REFERENCE.**

### Description

Diehl programmable industrial time switches are for applications where it is required that electric circuits be switched on/off in periodically occurring cycles, e.g., electrical appliances, heating and ventilation systems, furnaces, annealing and drying ovens, automatic feeding machines, testing apparatus, laboratory equipment, protection and alarm systems.

Models are available with weekly or daily programs. Available with or without a rechargeable battery time reserve.

### ⚠ WARNING ⚠

**DO NOT USE THIS TIME SWITCH IN AN EXPLOSIVE ATMOSPHERE!**

#### ADDITIONAL TIME SWITCH FEATURES

- Models with battery time reserve driven by quartz controlled step motor.
- Program disc with non-detachable switch actuators.
- Easy and fast program setting.
- Display of switch-on time period by orange time section.
- Daily models have 96 switch actuators which give switching intervals of 15 minutes.
- Weekly models have 84 switch actuators which give switching intervals of 2 hours.
- Time reserve models have approximately a 90 hour reserve.
- The ambient temperature range for the time reserve models is -10°C to +55°C.
- The ambient temperature range for the standard models is -10°C to +85°C.

### Specifications & Dimensions

MODEL	PROGRAM	SWITCH	TIME RESERVE	MOTOR INPUT	HP	CONTACT RATINGS @ 120AC	
						TUNGSTEN WATTS	PILOT DUTY VA
TA4150	Daily	SPST	No	120vac	1/2	1000	470
TA4152	Daily	SPST	Yes	120vac	1/2	1000	470
TA4151	Weekly	SPST	No	120vac	1/2	1000	470
TA4153	Weekly	SPST	Yes	120vac	1/2	1000	470

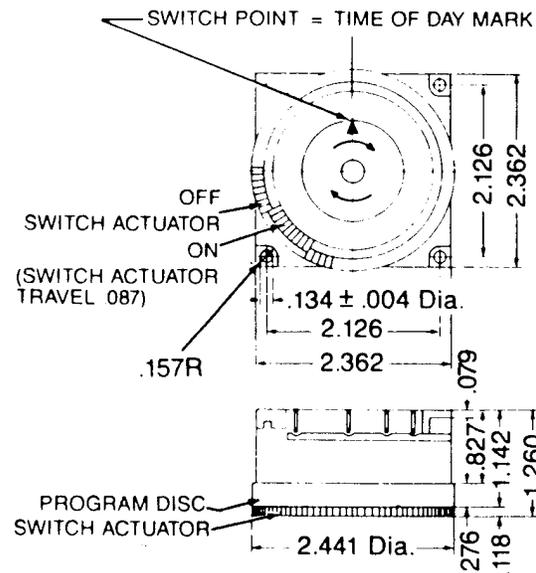


Figure 1 — Dimensions

### General Safety Information

### ⚠ WARNING ⚠

**DO NOT USE THIS TIME SWITCH IN AN EXPLOSIVE ATMOSPHERES!**

1. These devices should be used within their recognized ratings as shown on device.
2. These devices shall be mounted in a suitable enclosure complying with the requirements of the National Electrical Code and all local codes and ordinances.
3. The connections to the device are intended to be accomplished with the use of the proper quick disconnect terminals.
4. Wire should have a temperature rating of 105C minimum.
5. The suitability of the dial as part of the enclosure, should be determined in the application.
6. The overall temperature of the device shall not exceed 85°C (55°C for time reserve models).
7. Clock operated time switches have a finite life. Normal failure modes include contact sticking and improper operation. Installation where property damage, and/or personal injury might result due to a possibility of improper operation, requires the further installation of backup systems designed to prevent personal injury and/or property damage.

**Installation**

1. Crimp 1/4" quick disconnect terminals (not furnished) to wires.  
NOTE: All wiring should be done in accordance with the National Electrical Code and all local requirements.
2. Align template on mounting plate (not furnished) and center punch the center of the dial clearance hole and the centers of the three mounting holes. (See Figure 2)

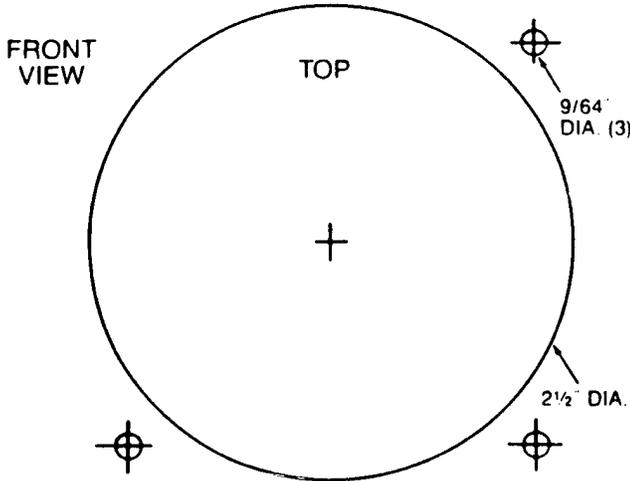


Figure 2 — Template (Actual Size)

3. Drill the three mounting holes 9/64" diameter. Punch out the center dial clearance hole 2 1/2" diameter (standard conduit punch may be used).
4. Mounting the unit onto the mounting plate, as shown, using the enclosed hardware. (See Figure 3).

**CAUTION**

The spacers must be used between the timer and the mounting plate to prevent the timer housing from cracking.

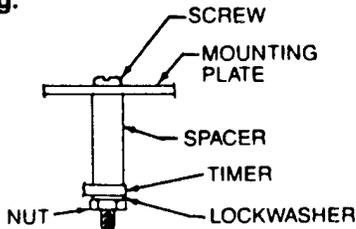


Figure 3 — Mounting Detail

5. Connect the previously prepared wires to the unit.

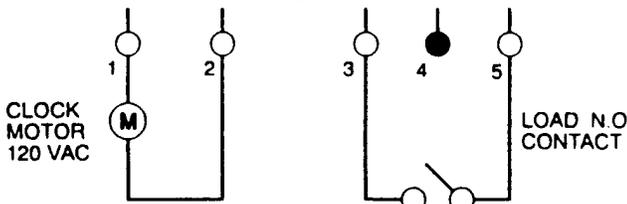


Figure 4 — Wiring Diagrams

6. Install the assembled timer and mounting plate into an NEMA approved enclosure, following all local electrical and safety codes, as well as the National Electrical Code (NEC) and the Occupational Safety and Health Act (OSHA).

**Operation**

1. Rotate the program disc, in the direction of the arrows, to align the correct time of day (the correct day of the week for weekly models) with the time of day mark.
2. Set the desired switching program by pushing the switch actuators toward the center of the time switch. Each actuator provides a 15 minute on time (2 hour on time for weekly models). The now visible orange area(s) indicate the switch on period.

**IMPORTANT: MODELS WITH BATTERY RESERVE**

These models utilize a nickel cadmium battery to provide power during power outages. This battery has a normal operating life of 6 to 8 years and it is not user replaceable.

For maximum battery life the unit should not be disconnected from the power source and stored for long periods of time (over two weeks) in a discharged condition. The maximum battery life is realized by maintaining a constant float charge in normal service operation. Normal power interruptions or disconnections of less than five days are considered to be normal service.

**Troubleshooting Chart**

SYMPTOM	POSSIBLE CAUSES	CORRECTIVE ACTION
Time switch does not run	Proper power not reaching unit	Check that time switch is connected to a live power line with good fuses, and that the voltage at the terminals is correct

**LIMITED WARRANTY**

Diehl ONE-YEAR LIMITED WARRANTY. Programmable industrial time switches. Models TA4150 Thru TA4153 are warranted by Diehl to the original user against defects in workmanship or materials under normal use for one year after date of purchase. Any part which is determined by Diehl to be defective in material or workmanship and returned to an authorized service location, as Diehl designates, shipping costs prepaid, will be, as the exclusive remedy, repaired or replaced at Diehl's option. For limited warranty claim procedures, see PROMPT DISPOSITION below. This limited warranty gives purchasers specific legal rights which vary from state to state.

LIMITATIONS OF LIABILITY. To the extent allowable under applicable law, Diehl's liability for consequential and incidental damages is expressly disclaimed. Diehl's liability in all events is limited to, and shall not exceed, the purchase price paid.

WARRANTY DISCLAIMER. Diehl has made a diligent effort to illustrate and describe the products in this literature accurately, however, such illustrations and descriptions are for the sole purpose of identification, and do not express or imply a warranty that the products are merchantable, or fit or fit for a particular purpose, or that the products will be necessarily conform to the illustrations or descriptions.

Except as provided below, no warranty or affirmation of fact, expressed or implied, other than as stated in "LIMITED WARRANTY" above is made or authorized by Diehl.

PRODUCT SUITABILITY. Many states and localities have codes and regulations governing sales, construction, installation, and/or use of products for certain purposes, which vary from those in neighboring areas. While Diehl attempts to assure that its products comply with such codes, it cannot guarantee compliance, and cannot be responsible for how the product is installed or used. Before purchase and use of a product, please review the product application, and national and local codes and regulations, and be sure that the product, installation, and use will comply with them.

Certain aspects of disclaimers are not applicable to consumer products; e.g., (a) some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you; (b) also, some states do not allow limitations on how long an implied warranty lasts, consequently the above limitation may not apply to you; and (c) by law, the period of this limited warranty, any implied warranties of merchantability or fitness for a particular purpose applicable to consumer products purchased by consumers, may not be excluded or otherwise disclaimed.

PROMPT DISPOSITION. Diehl will make a good faith effort for prompt correction or other adjustment with respect to any product which proves to be defective within limited warranty. For any product believed to be defective within limited warranty, first write or call dealer from whom product was purchased. Dealer will give additional directions. If unable to resolve satisfactorily, write to Diehl, giving dealer's name, address, date and number of dealer's invoice, and describing the nature of the defect. Title and risk of loss pass to buyer on delivery to common carrier. If product was damaged in transit to you, file a claim with carrier.

**BORG GENERAL CONTROLS, LLC**  
1386 JARVIS AVE., ELK GROVE VILLAGE, IL 60007

## **BLUE DIVIDER SHEET**

## **BLUE DIVIDER SHEET**



1-800-633-0405

Instruction Manual  
Fuji Timing Relay  
Type MS4SM, MS4SA, MS4SC

## SAFETY PRECAUTIONS

Before installation, wiring, operation, maintenance, and inspection of the device, be sure to read the operating instructions carefully to ensure proper operation. Care should be taken that the operating instructions will be furnished to the maintenance supervisors of final users.

**WARNING** : Incorrect handling of the device may result in death or serious injury.

- Turn off the power supply prior to installation, removal, wiring, maintenance or inspection to prevent electric shocks and burns due to short-circuit.

**CAUTION** : Incorrect handling of the device may result in minor injury or physical damage. Even some "Caution" items may also result in a serious accident.

- If the device defect may cause danger to life or damage to property, careful attention must be applied to ensure the operation. It may also be necessary to incorporate fail-safe measures if connected to a critical process or safety application.
- Do not use one found damaged or deformed when unpacked.
- Installation, electric work, maintenance and inspection of the device should be performed by qualified engineers having special knowledge.
- Do not install the device in a place of environment with high temperature, humidity, dust, corrosive gases, excessive vibration, etc. to prevent fire accidents and malfunction of the device.
- Use the device in a range of the rated voltage and current.
- Make connection on the power supply and load in a correct manner. Or, fire accident may be occur.
- Care should be taken to prevent entry of foreign objects such as dust, concrete chips, Iron powder, etc., or it may result in poor contacts, defective release unless it is permitted.
- Make sure that terminals are fully tightened periodically to prevent malfunction.
- Never disassemble, modify or repair the product.
- When the device is to be disposed of, it should be handled as an industrial waste.

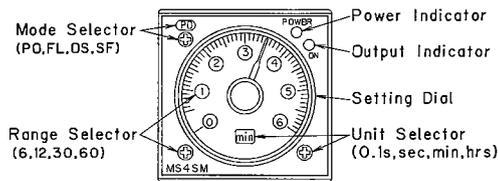
### ■ Specification

Type	MS4SM	MS4SA	MS4SC
Operation Mode	Multi-mode	On-delay	On-delay
Terminal Form	11-Pin	8-Pin	8-Pin
Timed Contact	DPDT	DPDT	SPDT
Instantaneous Contact	—	—	SPDT
Applicable Socket	TP411X	TP48X	TP48X

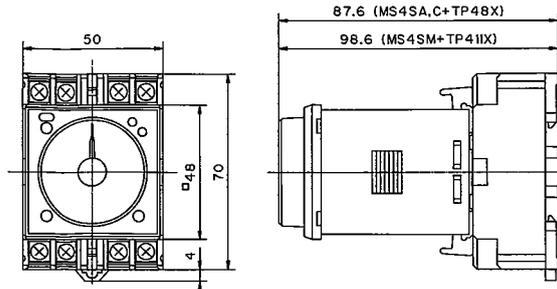
### ■ Timing Range Chart

Range Selection	Unit Selection			
	× 0.1s	sec	min	hrs
6	0.05-0.6s	0.5-6s	0.5-6min	0.5-6h
12	0.1-1.2s	1-12s	1-12min	1-12h
30	0.25-3s	2.5-30s	2.5-30min	2.5-30h
60	0.5-6s	5-60s	5-60min	5-60h

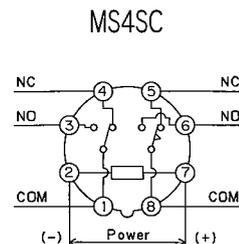
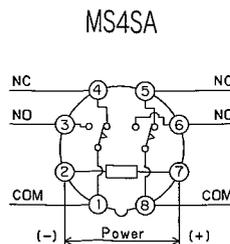
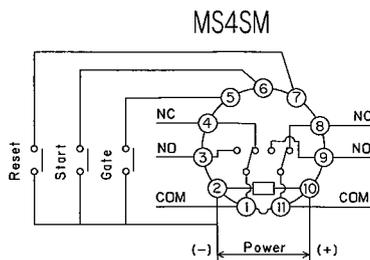
### ■ Nomenclature



### ■ Dimensions. mm



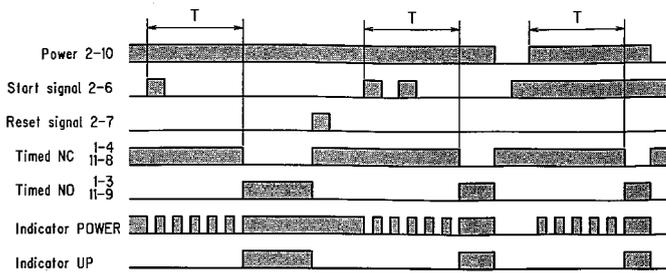
### ■ Wiring Diagrams



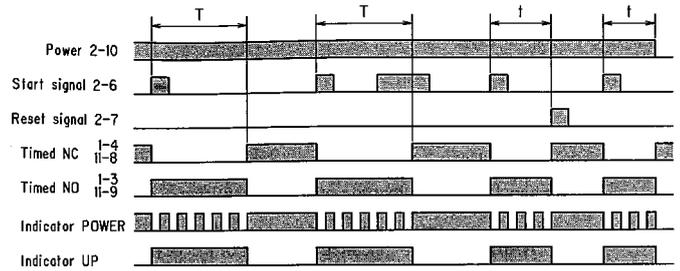
※ When the Gate is input, stops the time count.

## ■ Timing Diagrams (MS4SM)

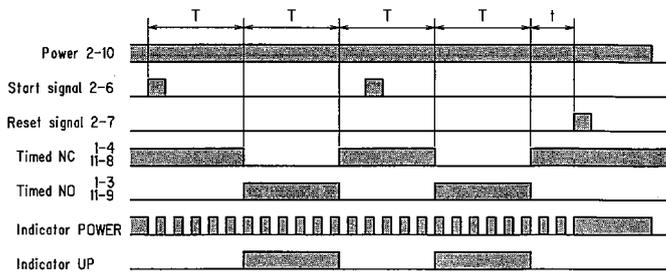
### On-delay (PO)



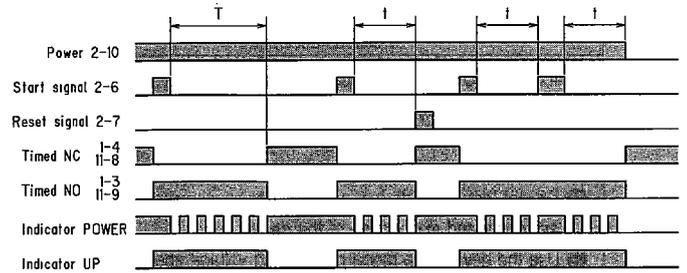
### One-shot (OS)



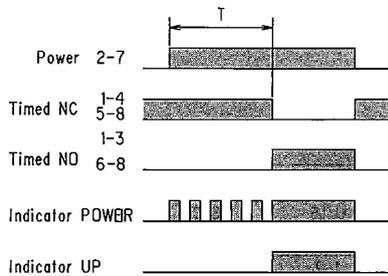
### Flicker (FL)



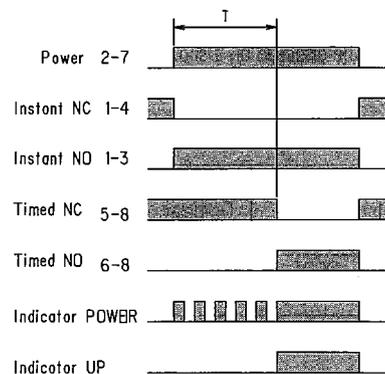
### Signal off-delay (SF)



## ■ Timing Diagrams (MS4SA)



## (MS4SC)



## ■ DC power supply

DC-operated timers are available for use with single-phase full-wave rectification DC power supplies.

## ■ Others

1. Set the time within the range of the timing scale divisions. To make a timer output a signal as soon as it is power ON, turn the dial fully counterclockwise.
2. The time setting dial can be turned while the timer is operating. However, the time for that operation will be incorrect.
3. Do not try to turn the time setting dial to outside the timing range. Turn it carefully, do not turn forcibly.
4. Do not remove the case of the timer, or operating characteristics will be changed.
5. Keep the timer away from corrosive gas, water, oil, dust, and direct sunlight. Do not use the timer in these circumstances.

6. Do not use the timer where it will be subjected to vibration or shock.

7. The case of the timer can be damaged by organic solvents such as thinner and benzene, and by corrosive substances such as strong acid or alkaloids. Keep the timer away from these substances.

8. The storage temperature must be between  $-25^{\circ}\text{C}$  and  $+60^{\circ}\text{C}$ .

If the timer has been left at  $-10^{\circ}\text{C}$  or below, leave it at room temperature for three hours or more before applying power.

## **BLUE DIVIDER SHEET**

## **BLUE DIVIDER SHEET**



# Magnetic Contactor

This manual should be given to the person who actually uses the products and is responsible for their maintenance.

Suffixes listed below may be attached to the above types at portions marked with [ \* ]. For details regarding specifications, see the catalog.  
[ \* 1 ] : RM

Type	SC-E02 [ * 1 ] , SC-E02 [ * 1 ] /G
	SC-E03 [ * 1 ] , SC-E03 [ * 1 ] /G
	SC-E04 [ * 1 ] , SC-E04 [ * 1 ] /G
	SC-E05 [ * 1 ] , SC-E05 [ * 1 ] /G

## Safety Precautions

To ensure proper use of the product, be sure to read this manual and the other attached documents carefully before starting installation, operation, maintenance and inspection. Within this instruction manual, safety precautions are ranked, in order of importance, as either "Warning" or "Caution".

**WARNING** An operator may be killed or seriously injured by a hazardous condition resulting from improper operation.

**CAUTION** An operator may suffer minor injuries and/or objects may be damaged by a hazardous condition resulting from improper operation.

Under certain conditions, improper operation may result in serious injury and/or damage even if it is labelled only as "Caution". Every item indicated by either "Warning" or "Caution" should be considered significant. Be sure to give particular care to those items.

**WARNING**

- Do not touch the product or approach it when power connected. Electric shock or burns may result.
- Turn off the power before starting maintenance or inspection. Failure to turn off power may result in Electric shock or burns.

**CAUTION**

- For wiring, select wire sizes suitable for the applied voltage and current. Tighten wires with the tightening torque specified in the instruction manual. Failure to do so may result in fire.
- Do not touch the product immediately after the power is turned off. As it may still be hot, burns may result.
- Do not use the product after removing its arc chamber. Electric shock or burns may result.
- Treat the product as industrial waste when discarding.

## 1. Unpacking

- Check that the type, coil voltage, and applicable capacity match the requested specifications.
- Make sure that no parts have been lost or damaged.

## 2. Storage

Store the unit in the packing box. Do not store the packing box in a location subject to high temperature, high humidity, corrosive gas, or direct sun light.

## 3. Mounting

- Mount in a dry, clean and stable location.
- Mounting on a vertical surface. The product must not incline more than 30° . (Fig.1)
- The rail mounting type can be attached on a standard 35mm IEC60715 mounting rail. Fuji type TH35-15AL mounting rail is recommended. Mounting of the rail on the panel (Fig.2) Attachment and removal (Fig.3)
- Even if the product is provided with four mounting holes, use any two mounting holes on a diagonal line. (Fig.4)

## 4. Mounting space

- Mount the products at a distance of at least that shown in the table below. (Fig.5, Fig.6)

A [mm]	0
B [mm]	10
C [mm]	0

- When units must be installed very closely, the temperature may rise in some conditions (i.e. the power is continuously supplied for a long time or units that frequently do switching are installed very closely), and it may shorten the life of the coil. Thus, when installing units very closely, it is recommended to install the units 5 mm or more apart.

## 5. Connection

Connectable wire size and proper tightening torque.

(1) Main terminals					
Types		SC-E02 SC-E02/G	SC-E03 SC-E03/G	SC-E04 SC-E04/G	SC-E05 SC-E05/G
Solid and stranded [Note 1] [Note 2]	X1	[mm <sup>2</sup> ]	0.75 to 6		
	X2	[mm <sup>2</sup> ]	"1 to 4" or "1.5 to 6"		
AWG conductor connection	X1		18 to 10		
	X2		"18 to 12" or "16 to 10"		
Stripped length		[mm]	11		
Terminal screw size	M4				
Kinds of screw [Note 3]	⊕ ⊖				
Tightening torque	[N · m]	[lb.in]	1.2 to 1.5 (11 to 13)		

(2) Coil terminals					
Types		SC-E02 SC-E02/G	SC-E03 SC-E03/G	SC-E04 SC-E04/G	SC-E05 SC-E05/G
Solid and stranded [Note 1] [Note 2]	X1	[mm <sup>2</sup> ]	0.75 to 6 (φ 1 to φ 1.6)		
	X2	[mm <sup>2</sup> ]	"0.75 to 1.5" or "1.5 to 2.5"		
AWG conductor connection	X1		18 to 14		
	X2		18 to 14		
Stripped length		[mm]	10		
Terminal screw size	M3.5				
Kinds of screw [Note 3]	⊕ ⊖				
Tightening torque	[N · m]	[lb.in]	0.8 to 1 (7 to 9)		

- [Note 1] Finely stranded wire without end sleeve is not applicable. Use finely stranded wire with end sleeve.  
 [Note 2] Stranded wire : Number of solids ≤ 7  
 Except above stranded wire : Finely stranded with sleeve.  
 [Note 3] ⊕ : Philips PH2 φ 6  
 ⊖ : Slotted-head screw I1 X5.5 type B  
 [Note 4] Tighten all terminal screws even if not used.  
 [Note 5] After alignment or bending back of connected leads, check the tightening torque of the clamping screws.

## 6. Operation indicator of contactor

Indicator shows contactor operates or not. (Fig.7)  
 Don't touch or push the indicator for continuity test, or it may result in Electric shock or burns.

## 7. Maintenance and Inspection

- Check that the operating circuit voltage is within the allowable voltage fluctuation range of the coil voltage.
- Check that all terminals are tightened with the proper torque periodically.
- In AC operation, check that operation power supply is sinusoidal waveform (50Hz and 60Hz) without distortion or cave-in etc.
- In combination of short circuit protection equipment (SCPD) type "2" of 8 clause, when slightly contacts weld occur, remove arc chamber and separate slightly welded contacts with a screwdriver, and products can be used in succession.
- After fastening terminal screw of middle phase, insert flat-bladed screwdriver between arc chamber and washer of terminal screw and lift the arc chamber, so arc chamber will be removed.
- Dark and rough contacts can still function. Do not refinish or grease them. If the contact facings are so badly eroded that the carrier material is visible, replace the product.

## 8. Short-circuit protective device (SCPD)

- Selection table according to IEC 60947-4-1

Type	Type "1"		Type "2"	
	Prospective Current Iq [kA]	Fuji Breakers Part No. Max. Rating [A]	Prospective Current Iq [kA]	IEC 60269-1 gG and gM Fuses Max. Rating [A]
SC-E02 SC-E02/G	10	SA103C/30 30	50	20
SC-E03 SC-E03/G		SA103C/30 30		25
SC-E04 SC-E04/G		SA103C/30 30		40
SC-E05 SC-E05/G		SA53RC/50 50		50

- Type "1" co-ordination requires that, under short-circuit conditions, the contactor or starter shall cause no danger to persons or installation and may not be suitable for further service without repair and replacement of parts.  
 Type "2" co-ordination requires that, under short-circuit conditions, the contactor or starter shall cause no danger to persons or installation and shall be suitable for further use. The risk of contact welding is recognized, in which case the manufacturer shall indicate the measures to be taken as regards the maintenance of the equipment.

- Short circuit protection according to UL508  
 Suitable for use on a circuit capable of delivering not more than 5,000 rms symmetrical amperes, 600V max. Maximum circuit breaker and fuse rating are described in the name plate.

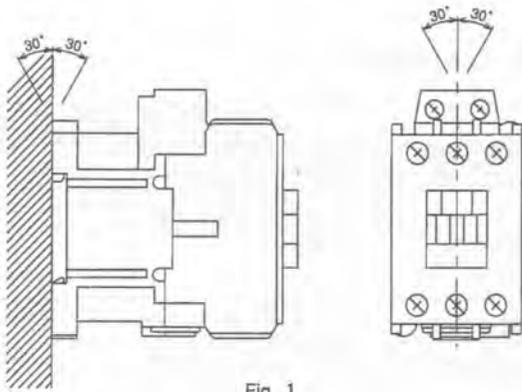


Fig. 1

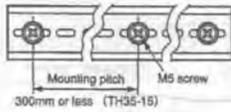


Fig. 2

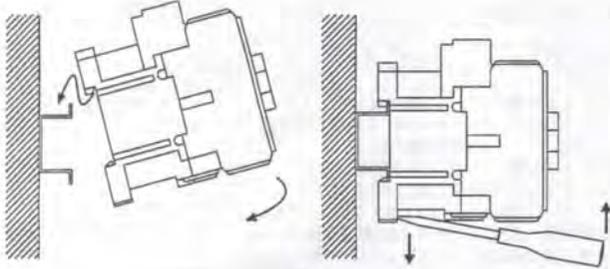


Fig. 3

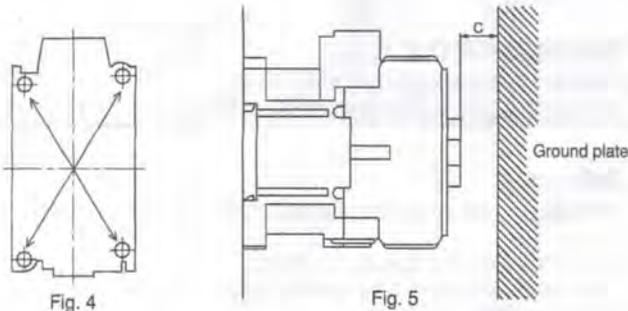


Fig. 4

Fig. 5

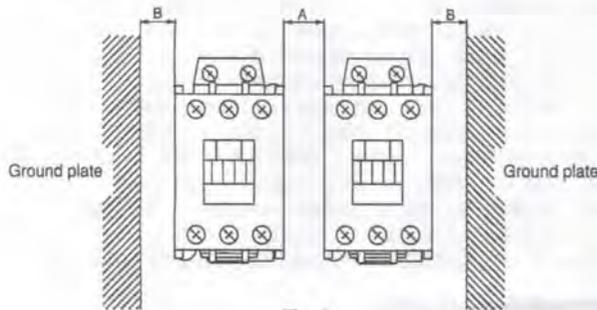


Fig. 6

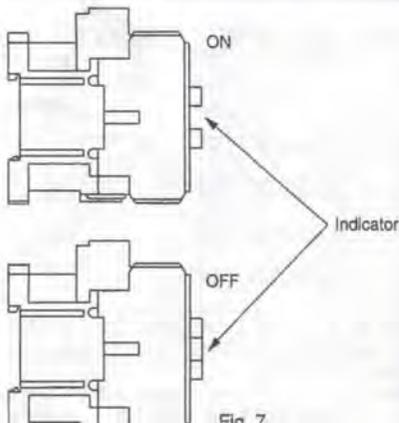


Fig. 7

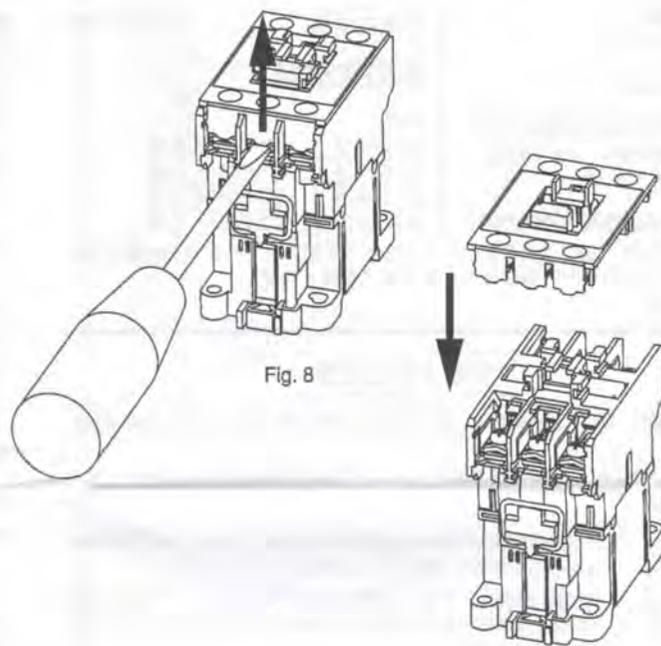


Fig. 8

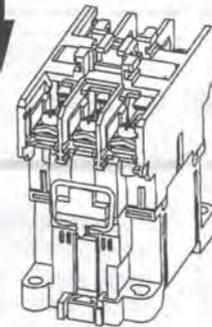
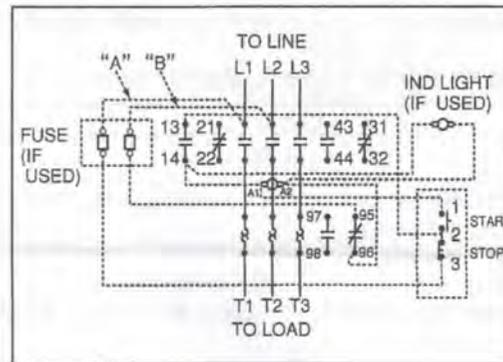


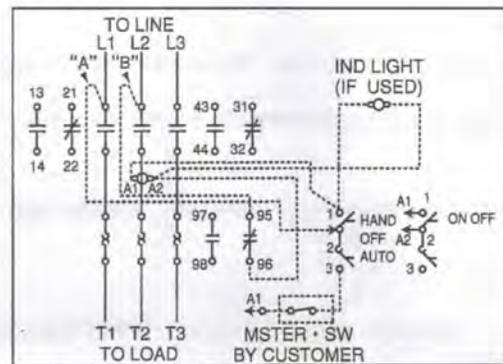
Fig. 9

### Wiring diagram for USA and Canada

(1) 3-wire control circuit



(2) 2-wire control circuit



In 2 wire control circuits, be careful of the following points when using thermal overload relay with setting reset button to auto reset mode. If over-current flows, which is not large enough to blow the fuse or to operate the circuit breaker, the magnetic contactor repeats make/break operations. It does this because the thermal overload relay repeats the resets and the trips automatically. This repeated make/break operations would damage the magnetic contactor and the thermal overload relay. Eventually, contact welding short-circuit (phase to phase) or grounding occur, and the fuse blow or circuit breaker operate. In this case, check the magnetic contactor and the thermal overload relay. Replace them if they have been damaged.

### Fuji Electric FA Components & Systems Co., Ltd.

Mitsui Sumitomo Bank Ningyo-cho Bldg., 5-7, Nihonbashi  
 Odemma-cho, Chuo-ku, Tokyo 103-0011, Japan  
 Phone : +81-3-5847-8060  
 Fax : +81-3-5847-8182  
 URL <http://www.fujielectric.co.jp/fcs/eng/>



TYPE:BM3RHB-□  
:BM3RHBK-□  
:BM3RHR-□  
:BM3RHRK-□

富士マニュアルモータスタータ  
MANUAL MOTOR STARTER  
DISJONCTEURS MOTEURS  
MOTORSCHUTZSCHALTER

INTERRUTTORE PROTETTORE  
INTERRUPTOR AUTOMATICO  
DISJUNTOR PARA MOTOR  
MOTORBEVEILINGSCHAKELAAR

安全上のご注意

取付け、運転、保守・点検の前に必ずこの取扱説明書とその他の付属書類をすべて熟読し、正しくお使いください。  
この取扱説明書では、安全注意事項のランクを「危険」「注意」として区分しております。

- 危険** : 取り扱いを誤った場合に、危険な状況が起こりえて、死亡または重傷を受ける可能性が想定される場合。
  - 注意** : 取り扱いを誤った場合に、危険な状況が起こりえて、中程度の傷害や軽傷を受ける可能性が想定される場合および物的損害だけの発生が想定される場合。
- なお、**注意**に記載した事項でも状況によっては重大な結果に結びつく可能性があります。いずれも重要な内容を記載していますので必ず守ってください。

危険(Warning)

- 通電中は製品のハンドル以外に触れたり近づいたりしないでください。感電、火傷のおそれがあります。
- 本体、付属品、端子カバー等の配線、取付、保守・点検は上位の電源を切って行ってください。感電のおそれがあります。

注意(Caution)

- 取付: ●電気工事、取付および保守点検は専門知識をもつ資格者が行ってください。  
●高温多湿、じんあい、腐食性ガス、過度の振動・衝撃などの異常な環境に設置しないでください。火災、誤動作のおそれがあります。  
●取付は取扱説明書に規定されたスペース以上を確保して行ってください。火傷、火災のおそれがあります。
- 接続: ●配線は通電電流に適した電線サイズを使用し、取扱説明書に規定された締付けトルクで締め付けてください。火災のおそれがあります。  
●端子ねじは付属の端子ねじを使用し、締付後、端子カバーをつけてください。(BM3RHR, BM3RHRK)
- 使用時: ●自動的に遮断した場合は、原因を取り除いてからハンドルを投入 (ON) してください。火災のおそれがあります。  
●直入れ開閉器として使用する場合はONエンドまで速やかに投入動作を行ってください。
- 保守・点検: ●端子は定期的にしめ締めしてください。火災のおそれがあります。  
●製品を廃棄する場合は、産業廃棄物として扱ってください。

Warning

**WARNING** : Do not touch the product or approach it except handle when power is connected. Electric shock or burn may result. Turn off the power before starting installation, maintenance, or inspection. Failure to turn off power may result in Electric shock or burn.

**ATTENTION** : Ne pas toucher un produit lorsque l'alimentation est branchée. Un électrochoc ou des brûlures pourraient en résulter. Débrancher l'alimentation avant l'installation, la maintenance ou l'inspection. Ne pas le faire expose l'utilisateur à des risques d'électrochoc ou de brûlures.

**WARNUNG** : Berühren sie das Produkt nicht und kommen Sie nicht zu nahe, wenn das Produkt unter Netzspannung steht. Es besteht die Gefahr eines elektrischen Schocks oder von Verbrennungen. Schalten Sie das Gerät ab, bevor Sie mit Installieren, Wartung, oder Inspektion beginnen. Anderenfalls besteht die Gefahr eines elektrischen Schocks oder von Verbrennungen.

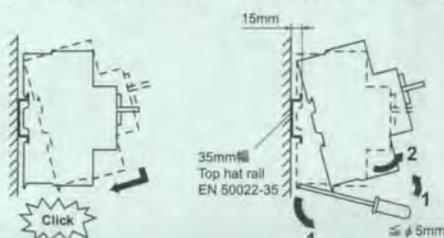
**ATTENZIONE** : Non toccare o operare su un prodotto quando è acceso. Potrebbe provocare scosse elettriche o ustioni. Spegnerne l'alimentazione prima di iniziare l'installazione, la manutenzione o il collaudo. L'alimentazione accesa può provocare scosse elettriche o ustioni.

**ATENCIÓN** : No toque ni se acerque a un producto cuando esté conectado a la red. Puede ocasionarle una descarga eléctrica o quemaduras. Desconecte la red eléctrica antes de iniciar la instalación, mantenimiento, o inspección. Si no la desconecta puede ocasionarle una descarga eléctrica.

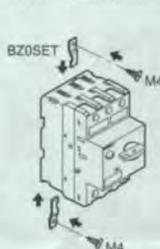
**ATENCAO** : Não toque nem se aproxime de nenhuma parte do produto além de sua alça quando o mesmo estiver ligado. Isso pode resultar num choque elétrico ou queimadura. Desligue o produto antes de iniciar a instalação, manutenção ou inspeção. Deixar de fazer isso pode resultar em choque elétrico ou queimadura.

**OPGELET** : Wanneer de stroom is ingeschakeld mag u een product uitsluitend aan de eigen handgreep vastpakken. Anders kunt u een elektrische schok of brandwonden oplopen. Schakel de stroom uit voor u begint aan installatie, onderhoud of inspectie. Doet u dit niet, dan kunt u een elektrische schok of brandwonden oplopen.

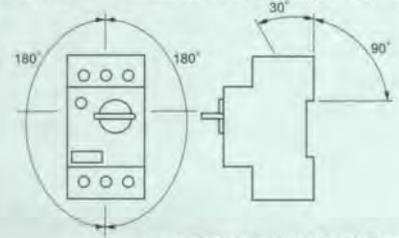
レール取付け Installation      レール取外し Removal



ねじ取付け Screw mounting



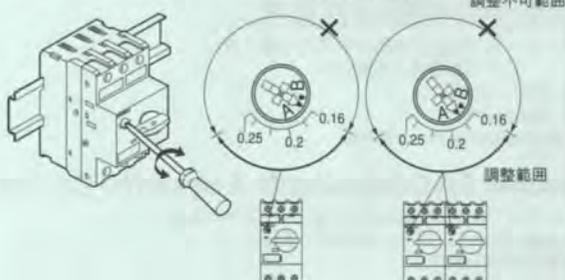
取付角度 Permissible operating position



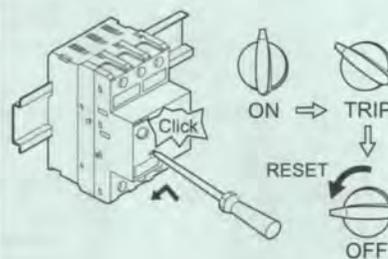
レール垂直での取付けは押え金具、富士電機テクニカ製 (LT9E-T1) をご使用ください。

電流設定 Current Adjustment (BM3RHB, BM3RHR)

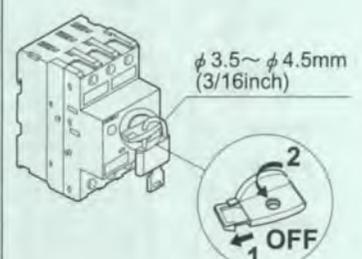
ex. Ie=0.16A



テストトリップ Test Trip



ハンドルロック Pad Lock

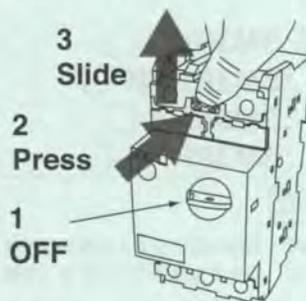


配線 Connection

配線はドライバを押しつけながら規定された締付トルクで締め付けてください。

TYPE		BM3RHB BM3RHBK	BM3RHR BM3RHRK	BZ0_
サイズ SIZE (ねじ頭形状)		M4 (PZ2)		M3.5 (PZ2)
10 	単線 Solid	$\phi 1.6 \sim \phi 2.6$		$\phi 1 \sim \phi 1.6$
	より線 Stranded	1x1...10 mm <sup>2</sup> 2x1...6 mm <sup>2</sup>		1x0.5...2.5 mm <sup>2</sup> 2x0.5...2.5 mm <sup>2</sup>
10 	スリーブ付より線 With end sleeve	1x1...6 mm <sup>2</sup> 2x1...6 mm <sup>2</sup>		—
AWG		1x18 to 8 AWG 2x18 to 10 AWG		1x18 to 14 AWG 2x18 to 14 AWG
圧着端子 Ring type terminal lug		—		2枚×R1.25-4 ~R8-4
締付トルク TORQUE		2.0 N·m 18 lb·in		0.8 N·m 7 lb·in

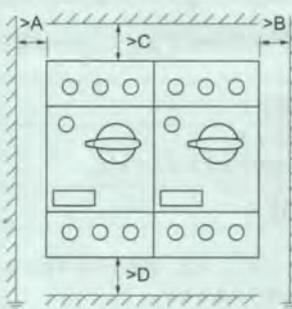
丸形圧着端子対応形  
Ring Terminal Connection Type  
(BM3RHR, BM3RHRK)



アークスペース (mm)

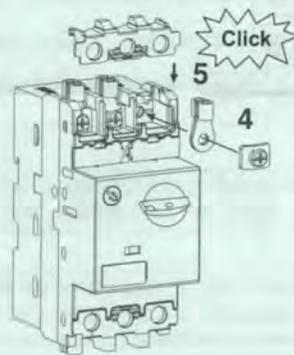
Ue(V)	A, B, C, D
~500V	15 30
~690V	40 50

「ブスバー」の選定はカタログをご参照ください。  
Please refer Catalog to select "Busbar"

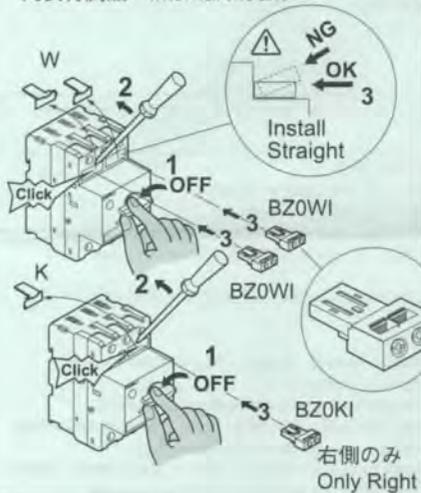


Suitable for motor group installation  
480V AC/50kA  
600V AC/10kA  
when protected by max.  
500A Fuse, CB.

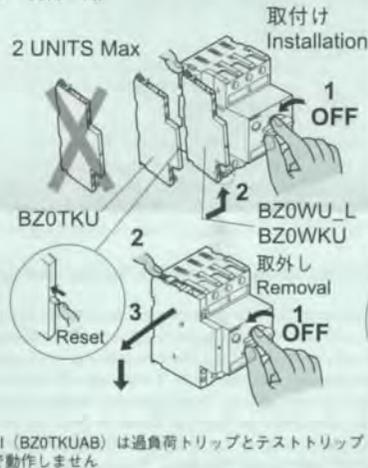
For manual self-protected  
COMB. CNTLR, use short  
circuit alarm (BZ0TKUAB)  
and terminal cover  
(BZ0TCRE or BZ0RTCRE).



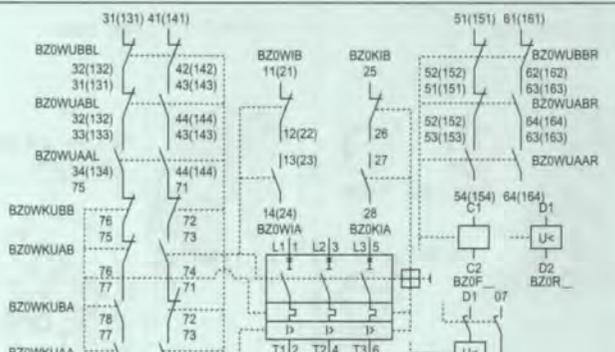
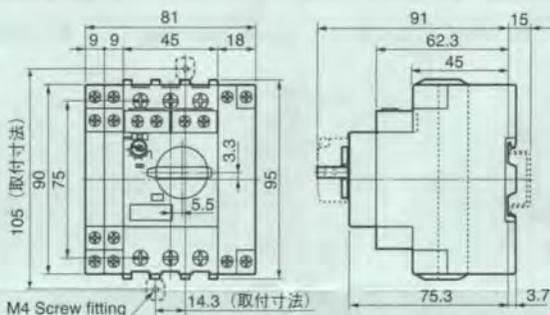
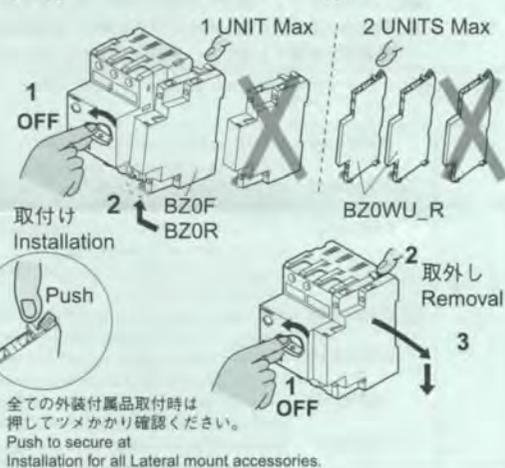
内装付属品 Internal mount



外装付属品 (左) Lateral mount (Left)  
W · WK · KI



外装付属品 (右) Lateral mount (Right)  
F · R



富士電機機器制御株式会社

〒103-0011 東京都中央区日本橋大伝馬町5番7号  
(三井住友銀行人形町ビル)

TEL (03) 5847-8060  
FAX (03) 5847-8182  
URL <http://www.fujielectric.co.jp/fcs/>

Fuji Electric FA Components & Systems Co., Ltd.

Mitsui Sumitomo Bank Ningyo-cho Bldg., 5-7, Nihonbashi  
Odemma-cho, Chuo-ku, Tokyo 103-0011, Japan  
Phone : +81-3-5847-8060

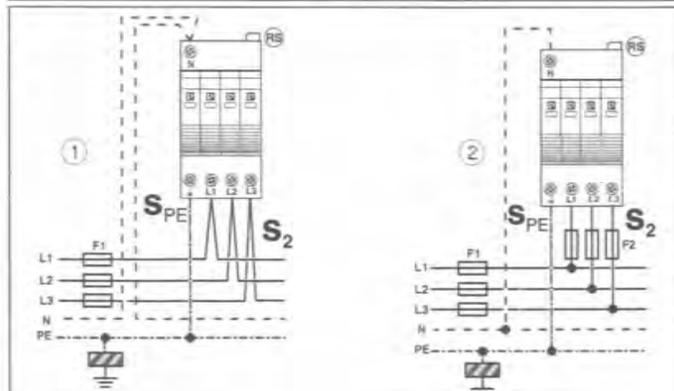
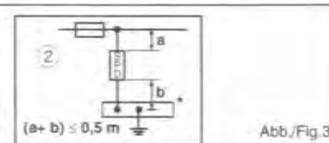
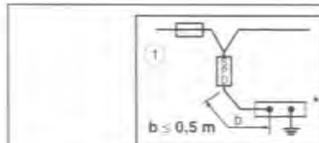
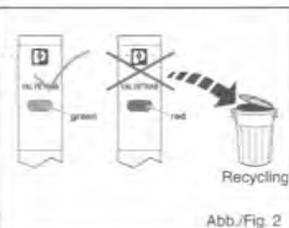
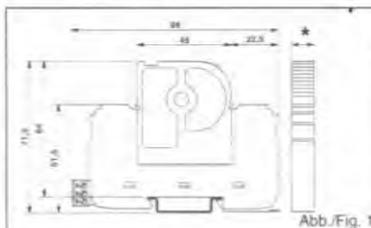
## **BLUE DIVIDER SHEET**

## **BLUE DIVIDER SHEET**



- DE Einbauanleitung für den Elektroinstallateur
- EN Installation instructions for the electrician
- FR Instruction d'installation pour l'électricien
- RU Инструкция по монтажу для электромонтажника
- ES Instrucciones de montaje para el

VAL-CP-3S-175	2859453
VAL-CP-2S-175	2859495
VAL-CP-1S-175	2859479



F1	S <sub>2</sub>	S <sub>PE</sub>
A g/L/gG	mm <sup>2</sup>	mm <sup>2</sup>
25	6	6
35	6	6
40	6	6
50	10	10
63	10	10

F1	F2	S <sub>2</sub>	S <sub>PE</sub>
A g/L/gG	A g/L/gG	mm <sup>2</sup>	mm <sup>2</sup>
25		6	6
35		6	6
40		6	6
50		6	6
63		10	10
80		10	10
100		16	16
125		16	16
> 125	125	16	16

Abb./Fig.4

## Surge protection for the power supply (SPD Class II, Type 2)

### 1. Description

- VAL-CP-3S-175 for 5-conductor networks (L1, L2, L3, N, PE)
- VAL-CP-2S-175 for 4-conductor networks (L1, L2, N, PE)
- VAL-CP-1S-175 for 3-conductor networks (L, N, PE)

### 2. Safety notes:

This device has to be installed by an authorized specialist for electronics only. Warranty claim against the supplier does not apply any longer in case of opening the device.

### 3. Installation

When installing, country-specific regulations and rules have to be observed. It is important that the max. operational voltage of the installation does not exceed the arrester rated voltage U<sub>C</sub>. Before assembly, the device must be checked for external damage. If the device is faulty, it must not be used anymore.

### 4. Insulation measurements

Unplug the protective plug before performing an insulation measurement in the system. Otherwise inaccurate measurements are possible. Re-insert the plug into the base element after the insulation measurement.

### 5. Dimensional drawing (Fig. 1)

- \* VAL-CP-3S-175 -> 49,2 mm
- \* VAL-CP-2S-175 -> 37,25 mm
- \* VAL-CP-1S-175 -> 25,3 mm

### 6. Error display Connector (Fig. 2)

- green -> ok
- red -> defect

### 7. Connection (Fig. 3)

- ① - kelvin wiring  
DIN-VDE 0100-534:2009-02  
b recommended ≤ 0,5 m;  
maximum 1 m  
IEC 60364-5-53:2002-06  
b maximal 0,5 m
- ② - stub wiring  
DIN-VDE 0100-534:2009-02  
(a-b) recommended ≤ 0,5 m;  
maximum 1 m  
IEC 60364-5-53:2002-06  
(a-b) maximum 0,5 m  
\* Equipotential bonding strip

### 8. Applications in the TN-S system (Fig.4)

- ① Kelvin wiring
- ② Stub wiring

### 9. Backup fuse (Fig.4)

Please refer to the information for the backup fuse in the corresponding applications.

## Überspannungsschutz für die Stromversorgung (SPD Class II, Typ 2)

### 1. Produktbeschreibung

- VAL-CP-3S-175 für 5-Leiter-Netze (L1, L2, L3, N, PE)
- VAL-CP-2S-175 für 4-Leiter-Netze (L1, L2, N, PE)
- VAL-CP-1S-175 für 3-Leiter-Netze (L, N, PE)

### 2. Sicherheitshinweise:

Die Installation dieses Gerätes darf nur von einer autorisierten Elektrofachkraft ausgeführt werden. Bei Öffnen des Gerätes erlischt der Gewährleistungsanspruch gegenüber dem Hersteller.

### 3. Installation

Bei der Installation sind landesspezifische Vorschriften und Gesetze einzuhalten. Insbesondere ist darauf zu achten, dass die max. Betriebsspannung der Anlage die Ableiterbemessungsspannung U<sub>C</sub> nicht übersteigt. Das Gerät ist vor der Installation auf äußere Beschädigungen zu prüfen. Ist das Gerät defekt, darf es nicht verwendet werden.

### 4. Isolationsmessungen

Ziehen Sie vor einer Isolationsmessung in der Anlage den Schutzstecker. Anderenfalls sind Fehlmessungen möglich. Setzen Sie den Stecker nach der Isolationsmessung wieder in das Basiselement ein.

### 5. Maßbild (Abb. 1)

- \* VAL-CP-3S-175 -> 49,2 mm
- \* VAL-CP-2S-175 -> 37,25 mm
- \* VAL-CP-1S-175 -> 25,3 mm

### 6. Defektanzeige Stecker (Abb. 2)

- grün -> ok
- rot -> defekt

### 7. Anschluss (Abb. 3)

- ① - V-förmige Verdrähtung  
DIN-VDE 0100-534:2009-02  
b bevorzugt ≤ 0,5 m; maximal 1m  
IEC 60364-5-53:2002-06  
b maximal 0,5 m
- ② - Stich-Verdrähtung  
DIN-VDE 0100-534:2009-02  
(a-b) bevorzugt ≤ 0,5 m; maximal 1m  
IEC 60364-5-53:2002-06  
(a-b) maximal 0,5 m  
\* Potenzialausgleichsschiene

### 8. Applikation im TN-S-System (Abb. 4)

- ① - V-förmige Verdrähtung
- ② - Stich-Verdrähtung

### 9. Vorsicherung (Abb. 4)

Die Angaben zur Vorsicherung in den entsprechenden Applikationen sind zu beachten.

## ENGLISH

### 10. Conductor connection (Fig. 5)

for Kelvin wiring

1 - Cable lug  $\Rightarrow$  6 mm<sup>2</sup> F1  $\leq$  40 A

2 - TWIN ferrule  $\Rightarrow$

2 x 10 mm<sup>2</sup> F1  $\leq$  63 A

### 11. Remove plug (Fig. 6)

Use a screwdriver to lift out the plug from the base element

### 12. Remote indicator contact

(RS) (Fig. 7)

## DEUTSCH

### 10. Leitungsanschluss (Abb. 5)

bei V-förmiger Verdrahtung

1 - Kabelschuh  $\Rightarrow$  6 mm<sup>2</sup> F1  $\leq$  40 A

2 - TWIN-Aderendhülse  $\Rightarrow$

2 x 10 mm<sup>2</sup> F1  $\leq$  63 A

### 11. Stecker ziehen (Abb. 6)

Stecker mit einem Schraubendreher aus dem Basiselement hebeln

### 12. Fernmeldekontakt (RS)

(Abb. 7)

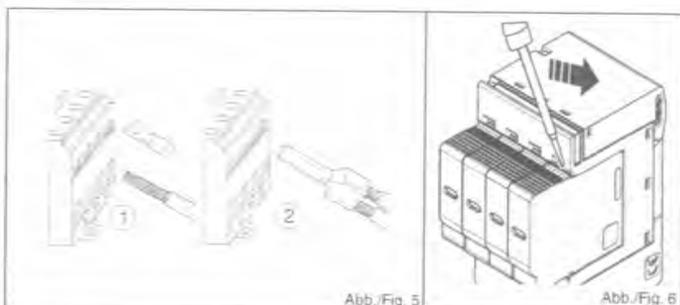


Abb./Fig. 5

Abb./Fig. 6

	<b>U<sub>max</sub> / I<sub>max</sub> AC:</b> 250 V / 1,0 A 125 V / 1,0 A (UL)
	<b>U<sub>max</sub> / I<sub>max</sub> DC:</b> 125 V / 0,2 A
0,14 mm <sup>2</sup> - 1,5 mm <sup>2</sup> AWG 26-16 (CSA) AWG 30-14 (UL)	

Abb./Fig. 7

## Technical Data

### Type / Order No.

Replacement connector	
System	
Network type	
IEC category	
Nominal voltage U <sub>N</sub>	
Highest continuous voltage U <sub>C</sub>	L-N/N-PE
U <sub>TOV</sub> (withstand, 5 s)	L-N
U <sub>TOV</sub> (withstand, 200 ms)	N-PE
Protection level U <sub>p</sub>	L-N/N-PE
Nominal discharge surge current I <sub>n</sub> (8/20)μs	L-N/N-PE
Max. discharge surge current I <sub>n,max</sub> (8/20)μs	L-N/N-PE
Short circuit resistance with max. backup fuse I <sub>p</sub>	
Back-up fuse max.	
Temperature range	
Degree of protection	
Test standards	
Connection data solid / stranded / AWG	
Screw thread	
Tightening torque	
Stripping length	

## Technische Daten

### Typ / Artikelnummer

Ersatzstecker	
System	
Netzform	
IEC-Prüfklasse	
Nennspannung U <sub>N</sub>	
Höchste Dauerspannung U <sub>C</sub>	L-N/N-PE
U <sub>TOV</sub> (withstand, 5 s)	L-N
U <sub>TOV</sub> (withstand, 200 ms)	N-PE
Schutzpegel U <sub>p</sub>	L-N/N-PE
Nennableitstoßstrom I <sub>n</sub> (8/20)μs	L-N/N-PE
max. Ableitstoßstrom I <sub>n,max</sub> (8/20)μs	L-N/N-PE
Kurzschlussfestigkeit bei max. Vorsicherung I <sub>p</sub>	
max. Vorsicherung	
Temperaturbereich	
Schutzart	
Prüfnormen	
Anschlussdaten starr / flexibel / AWG	
Schraubengewinde	
Ärztugsdrehmoment	
Abisolierlänge	

VAL-CP-3S-175 / 2859453 | VAL-CP-2S-175 / 2859495 | VAL-CP-1S-175 / 2859479

VAL-CP-175-ST / 2859628 // VAL-CP-N/PE-350-ST / 2859699

TN-S / TT		
L1, L2, L3, N, PE	L1, L2, N, PE	L1, N, PE
II / T2		
120 V AC		
175 V AC / 150 V AC		
208 V AC		
1200 V AC		
≤ 850 V / ≤ 950 V		
20 kA / 20 kA		
40 kA / 40 kA		
25 kA <sub>eff</sub>		
125 A gL/gG		
-40 °C ... +80 °C		
IP20		
IEC 61643-1:2005 / EN 61643-11:2002 + A11 / UL 1449 3rd edition		
2,5-25 mm <sup>2</sup> / 2,5-16 mm <sup>2</sup> / 12-4 (CSA), 14-4 (UL)		
M 5		
4,5 Nm (40 lbs-in)		
16 mm		

## **BLUE DIVIDER SHEET**

## **BLUE DIVIDER SHEET**

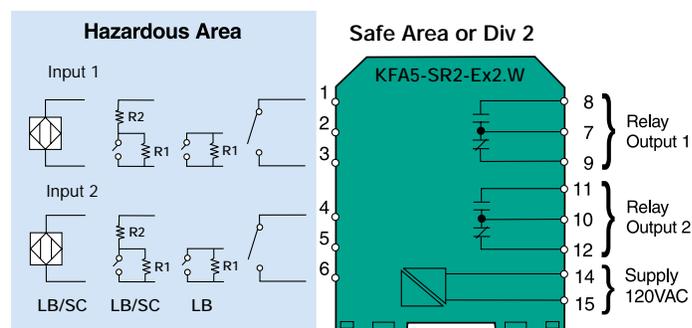
## Technical Data

<b>Power Supply</b>	Terminals 14, 15
Nominal voltage	103.5-126 VAC, 45-65 Hz
Power consumption	≤ 1.3 W
<b>Inputs 1, 2 (intrinsically safe)</b>	Terminals 1+, 2+, 3-; 4+, 5+, 6-
Nominal data	per NAMUR, ≈ 8 VDC / 8 mA
Input pulse length / interval	≥ 20 ms
Lead monitoring	Breakage < 0.1 mA / Short circuit > 6 mA
<b>Output (Not intrinsically safe)</b>	
Output 1 (SPDT contacts)	Terminals 7, 8, 9
Output 2 (SPDT contacts)	Terminals 10, 11, 12
Contact load	250VAC / 2A / $\cos\phi > 0.7$ ; 120VAC, 4A 40 VDC / 2 A resistive load
Mechanical life	≥ 10 <sup>7</sup> operations
Energizing / de-energizing delay	≈ 20 ms
<b>Transfer Characteristics</b>	
Switching frequency	≤ 10 Hz
<b>Entity Parameters</b>	Terminals 1+, 2+, 3-; 4+, 5+, 6-
FM control drawing no.	116-0035
Voltage $V_{oc}$	12.9 V
Current $I_{sc}$	19.8 mA
Explosion group	A & B    C & E    D, F & G
Max. external capacitance ( $C_a$ )	1.2 μF    3.8 μF    10.1 μF
Max. external inductance ( $L_a$ )	84.8 mH    254.4 mH    678.4 mH
<b>Mechanical</b>	
Housing	Type C (see page 387)
Dimensions (mm)	118 x 20 x 115
Weight	150 g (5.3 oz.)
<b>Ambient Temperature</b>	-20°C to +60°C (-4°F to +140°F)



## Connection Diagram

Class I, Div 1, Group A-G,  
Zone 0, IIC



## Switch Isolators Relay Output



**Model Number**  
**KFA5-SR2-Ex2.W**

- Dual-channel / 120 VAC supply
- 1 signal output with 1 form C relay per channel
- Optional lead breakage (LB)/short circuit (SC) monitoring
- Suitable for Division 2 mounting

This device is a dual-channel, galvanically isolated intrinsic safety barrier with a built-in amplifier that transfers discrete signals (NAMUR sensors/mechanical contacts) from a hazardous area to a safe area. Each proximity sensor or switch controls a form C relay contact for the safe area load. The barrier output changes state when the input signal changes state. The normal output state can be reversed through the mode of operation switches S1 and S2.

Lead breakage (LB) and short circuit (SC) monitoring can be selected or disabled by placing external resistors and by properly positioning switch S3 on the barrier. NAMUR proximity sensors, however, are designed with the LB and SC functions, making external resistors unnecessary. For a mechanical contact, LB monitoring can be selected by placing a 10 kΩ resistor across the mechanical contact in the field. In addition, SC monitoring is selected by placing a 400Ω - 2kΩ resistor in series with the mechanical contact and moving switch S3 to position 1 on the barrier. In case of a LB/SC fault, the signal output relay reverts to the de-energized state.

## Introduction

Switch isolators supply power to the proximity sensor in a hazardous area, to receive the path proportional current, to convert the input signals into digital output signals and to transfer the switching signal to a control device (DCS, PLC etc.). The intrinsically safe interface of the switch isolator is designed for Class I, Div. I ([Ex ia] IIC) areas.

Essentially, the isolator consists of three components: the power supply, the transistor switch amplifier and the output stage. The input and the output are separated from one another through galvanic isolation.

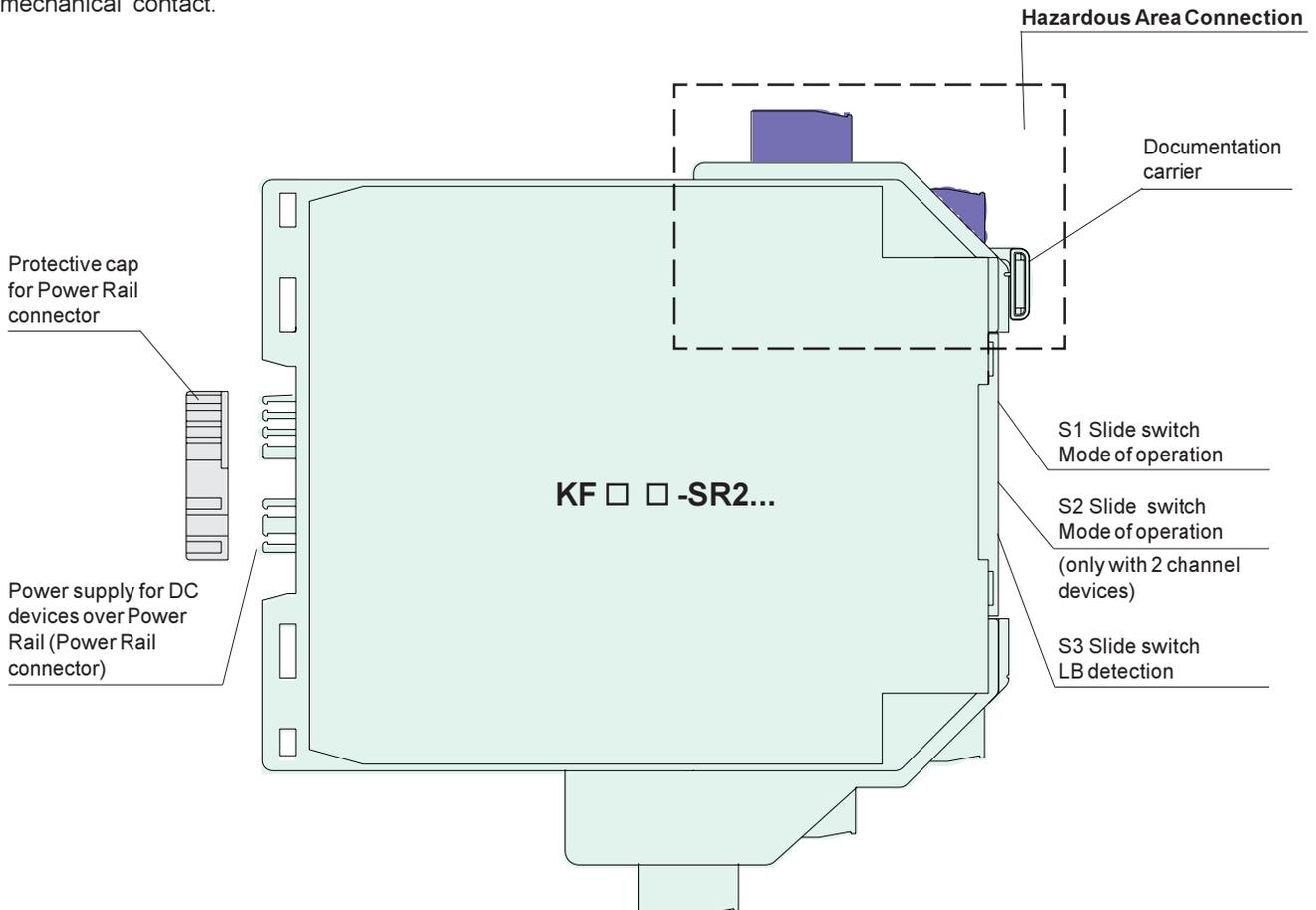
The isolator's input stage is achieved through a transistor switch amplifier which provides the intrinsically safe interface. This input stage is designed in accordance with DIN 19 234 (NAMUR). This means that the residual voltage in normal operation equals approximately 8 V DC and the short circuit current equals approximately 8 mA. The switch points are in a range between 1.2mA and 2.1mA and the hysteresis equals 0.2 mA. Typical values are 1.6mA and 1.8 mA.

The output stage of an isolator, depending on the application, can be set to monitor the presence or absence of a target. This flexibility is guaranteed through the mode of operation switch. It should also be noted that an inductive proximity sensor has the reversed characteristics of a switch. Capacitive, photoelectric and magnetic field sensors behave like a mechanical contact.

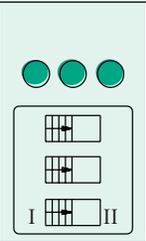
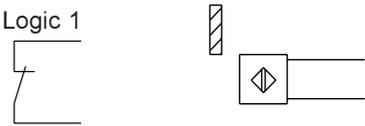
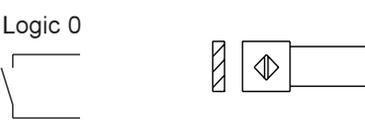
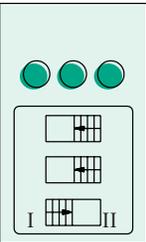
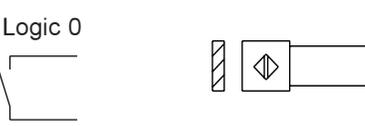
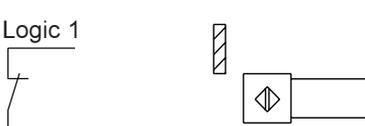
By using the reversible mode of operation, the same unit can be used in both cases. The mode of operation is selected with a slide switch on the barrier.

The hazardous area circuit is monitored for lead breakage. Some models also monitor for short circuit. A short circuit or lead breakage is signaled by a red LED and the output stage is changed to the de-energized state. A separate error output is available in certain models (i.e. KFD2-SR2-Ex1.W.LB). In the event of an error, this type of barrier has the ability to report its status to the controller, which would initiate the appropriate actions.

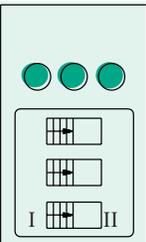
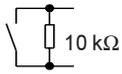
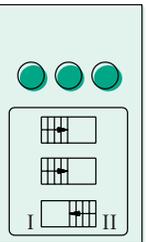
If lead breakage monitoring is bypassed, a 10Kohm resistor must be connected across the input circuit. This resistor is integrated in KFD2 and KFA□ modules and is activated by the S3, S1b or S2b slide switches depending on the barrier. Please refer to individual data sheets for further details.



Mode of Operation Table

Faceplate	Input	Relay Output	Transistor Output
	Logic 1 	energized	through switched
	Logic 0 	de-energized	open
	Logic 0 	energized	through switched
	Logic 1 	de-energized	open

Lead Breakage Monitoring Table

Faceplate	Input	
		with Lead Breakage Monitoring
		without Lead Breakage Monitoring

Relays, as well as active and passive transistor outputs are available.

For relay outputs, Form 'C' contacts (N.O./N.C) are available and can be reversed using the mode of operation switch. The contacts are rated 250VAC, 2A @  $\cos \phi > 0.7$  and 40VDC, 2A resistive. The energizing/de-energizing delay equals approximately 20ms and the maximum switching frequency is 10Hz.

The active transistor output delivers current up to 100mA. The leakage current for transistor outputs is  $\leq 10\text{mA}$ . The output voltage for the transistor is approximately 3.5V lower than the power supply voltage. The maximum switching frequency is 5kHz while the input pulse delay is 0.6ms.

The passive transistor outputs are potential free. The nominal voltage is between 10-30 V DC with a maximum current of 100 mA. The voltage drop across the outputs equals a maximum of 2.5 V. The leakage current is  $\leq 10 \mu\text{A}$ , the maximum switching frequency is 5kHz and the input pulse delay is  $\leq 0.6 \text{ ms}$ .

In order to connect different power sources, KFD and KHD variations are available for connecting to 24 V DC, while KFA and KHA variations are available for connecting to 120VAC or 240VAC.

**BLANK SHEET**

## **BLUE DIVIDER SHEET**

## **BLUE DIVIDER SHEET**



**INSTALLATION AND SETUP GUIDE**  
**VERSION 2.1**

**SENSAPHONE<sup>®</sup>**  
REMOTE MONITORING SOLUTIONS

## Sentinel Installation and Setup Guide

Every effort has been made to ensure that the information in this document is complete, accurate and up-to-date. Sensaphone assumes no responsibility for the results of errors beyond its control. Sensaphone also cannot guarantee that changes in equipment made by other manufacturers, and referred to in this manual, will not affect the applicability of the information in this manual.

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First Edition, version 2.1, April 2015

Written and produced by SENSAPHONE®.

Please address comments on this publication to:

SENSAPHONE®

901 Tryens Road

Aston, PA 19014

# Important Safety Instructions

Your Sentinel has been carefully designed to give you years of safe, reliable performance. As with all electrical equipment, however, there are a few basic precautions you should take to avoid hurting yourself or damaging the unit:

- Read the installation and operating instructions in this guide carefully. Be sure to save it for future reference.
- Read and follow all warning and instruction labels on the product itself.
- To protect the Sentinel from overheating, make sure all openings on the unit are not blocked. Do not place on or near a heat source, such as a radiator or heat register.
- Do not use your Sentinel near water, or spill liquid of any kind into it.
- Be certain that your power source matches the rating in the specifications of this manual. If you're not sure of the type of power supply to your facility, consult your dealer or local power company.
- Do not allow anything to rest on the power cord. Do not locate this product where the cord will be abused by persons walking on it.
- Do not overload wall outlets and extension cords, as this can result in the risk of fire or electric shock.
- Never push objects of any kind into this product through ventilation holes as they may touch dangerous voltage points or short out parts that could result in a risk of fire or electric shock.
- To reduce the risk of electric shock, do not disassemble this product, but return it to Sensaphone Customer Service, or another approved repair facility, when any service or repair work is required. Opening or removing covers may expose you to dangerous voltages or other risks. Incorrect reassembly can cause electric shock when the unit is subsequently used.
- If anything happens that indicates that your Sentinel is not working properly or has been damaged, unplug it immediately and follow the procedures in the manual for having it serviced. Return the unit for servicing under the following conditions:
  1. The power cord or plug is frayed or damaged.
  2. Liquid has been spilled into the product or it has been exposed to water.
  3. The unit has been dropped, or the enclosure is damaged.
  4. The unit doesn't function normally when you're following the operating instructions.
- To reduce the risk of fire or injury to persons, read and follow these instructions:
  1. Use only the specified type and size battery.
  2. Do not dispose of the battery in a fire. The cell may explode. Check with local codes for possible special disposal instructions.
  3. Do not open or mutilate batteries. Released electrolyte is corrosive and may cause damage to the eyes or skin. It may be toxic if swallowed.
  4. Exercise care in handling batteries in order not to short the battery with conducting materials such as rings, bracelets, and keys. The battery or conductor may overheat and cause burns.
  5. Remove main power connections before replacing the battery.

### **FCC Requirements**

Part 15: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

## 2 YEAR LIMITED WARRANTY

PLEASE READ THIS WARRANTY CAREFULLY BEFORE USING THE PRODUCT.

THIS LIMITED WARRANTY CONTAINS SENSAPHONE'S STANDARD TERMS AND CONDITIONS. WHERE PERMITTED BY THE APPLICABLE LAW, BY KEEPING YOUR SENSAPHONE PRODUCT BEYOND THIRTY (30) DAYS AFTER THE DATE OF DELIVERY, YOU FULLY ACCEPT THE TERMS AND CONDITIONS SET FORTH IN THIS LIMITED WARRANTY.

IN ADDITION, WHERE PERMITTED BY THE APPLICABLE LAW, YOUR INSTALLATION AND/OR USE OF THE PRODUCT CONSTITUTES FULL ACCEPTANCE OF THE TERMS AND CONDITIONS OF THIS LIMITED WARRANTY (HEREINAFTER REFERRED TO AS "LIMITED WARRANTY OR WARRANTY"). IF YOU DO NOT AGREE TO THE TERMS AND CONDITIONS THIS WARRANTY, INCLUDING ANY LIMITATIONS OF WARRANTY, INDEMNIFICATION TERMS OR LIMITATION OF LIABILITY, THEN YOU SHOULD NOT USE THE PRODUCT AND SHOULD RETURN IT TO THE SELLER FOR A REFUND OF THE PURCHASE PRICE. THE LAW MAY VARY BY JURISDICTION AS TO THE APPLICABILITY OF YOUR INSTALLATION OR USE ACTUALLY CONSTITUTING ACCEPTANCE OF THE TERMS AND CONDITIONS HEREIN AND AS TO THE APPLICABILITY OF ANY LIMITATION OF WARRANTY, INDEMNIFICATION TERMS OR LIMITATIONS OF LIABILITY.

- 1. WARRANTOR:** IN THIS WARRANTY, WARRANTOR SHALL MEAN "DEALER, DISTRIBUTOR, AND/OR MANUFACTURER."
- 2. ELEMENTS OF WARRANTY:** THIS PRODUCT IS WARRANTED TO BE FREE FROM DEFECTS IN MATERIALS AND CRAFTSMANSHIP WITH ONLY THE LIMITATIONS AND EXCLUSIONS SET OUT BELOW.
- 3. WARRANTY AND REMEDY:** TWO-YEAR WARRANTY — IN THE EVENT THAT THE PRODUCT DOES NOT CONFORM TO THIS WARRANTY AT ANY TIME DURING THE TIME OF TWO YEARS FROM ORIGINAL PURCHASE, WARRANTOR WILL REPAIR THE DEFECT AND RETURN IT TO YOU AT NO CHARGE.

THIS WARRANTY SHALL TERMINATE AND BE OF NO FURTHER EFFECT AT THE TIME THE PRODUCT IS: (1) DAMAGED BY EXTRANEOUS CAUSE SUCH AS FIRE, WATER, LIGHTNING, ETC. OR NOT MAINTAINED AS REASONABLE AND NECESSARY; OR (2) MODIFIED; OR (3) IMPROPERLY INSTALLED; OR (4) MISUSED; OR (5) REPAIRED OR SERVICED BY SOMEONE OTHER THAN WARRANTORS' AUTHORIZED PERSONNEL OR SOMEONE EXPRESSLY AUTHORIZED BY WARRANTOR'S TO MAKE SUCH SERVICE OR REPAIRS; (6) USED IN A MANNER OR PURPOSE FOR WHICH THE PRODUCT WAS NOT INTENDED; OR (7) SOLD BY ORIGINAL PURCHASER.

LIMITED WARRANTY, LIMITATION OF DAMAGES AND DISCLAIMER OF LIABILITY FOR DAMAGES: THE WARRANTOR'S OBLIGATION UNDER THIS WARRANTY IS LIMITED TO REPAIR OR REPLACEMENT OF THE PRODUCT, AT THE WARRANTOR'S OPTION AS TO REPAIR OR REPLACEMENT. IN NO EVENT SHALL WARRANTORS BE LIABLE OR RESPONSIBLE FOR PAYMENT OF ANY INCIDENTAL, CONSEQUENTIAL, SPECIAL AND/OR PUNITIVE DAMAGES OF ANY KIND, INCLUDING BUT NOT LIMITED TO ANY LABOR COSTS, PRODUCT COSTS, LOST REVENUE, BUSINESS INTERRUPTION LOSSES, LOST PROFITS, LOSS OF BUSINESS, LOSS OF DATA OR INFORMATION, OR FINANCIAL LOSS, FOR CLAIMS OF ANY NATURE, INCLUDING BUT NOT LIMITED TO CLAIMS IN CONTRACT, BREACH OF WARRANTY OR TORT, AND WHETHER OR NOT CAUSED BY WARRANTORS' NEGLIGENCE. IN THE EVENT THAT IT IS DETERMINED IN ANY ADJUDICATION THAT THE LIMITED WARRANTIES OF REPAIR OR REPLACEMENT ARE INAPPLICABLE, THEN THE PURCHASER'S SOLE REMEDY SHALL BE PAYMENT TO THE PURCHASER OF THE ORIGINAL COST OF THE PRODUCT, AND IN NO EVENT SHALL WARRANTORS BE LIABLE OR RESPONSIBLE FOR PAYMENT OF ANY INCIDENTAL, CONSEQUENTIAL, SPECIAL AND/OR PUNITIVE DAMAGES OF ANY KIND, INCLUDING BUT NOT LIMITED TO ANY LOST REVENUE, BUSINESS INTERRUPTION LOSSES, LOST PROFITS, LOSS OF BUSINESS, LOSS OF DATA OR INFORMATION, OR FINANCIAL LOSS, FOR CLAIMS OF ANY NATURE, INCLUDING BUT NOT LIMITED TO CLAIMS IN CONTRACT, BREACH OF WARRANTY OR TORT, AND WHETHER OR NOT CAUSED BY WARRANTORS' NEGLIGENCE.

WITHOUT WAIVING ANY PROVISION IN THIS LIMITED WARRANTY, IF A CIRCUMSTANCE ARISES WHERE WARRANTORS ARE FOUND TO BE LIABLE FOR ANY LOSS OR DAMAGE ARISING OUT OF MISTAKES, NEGLIGENCE, OMISSIONS, INTERRUPTIONS, DELAYS, ERRORS OR DEFECTS IN WARRANTORS' PRODUCTS OR SERVICES, SUCH LIABILITY SHALL NOT EXCEED THE TOTAL AMOUNT PAID BY THE CUSTOMER FOR WARRANTORS' PRODUCT AND SERVICES OR \$250.00, WHICHEVER IS GREATER. YOU HEREBY RELEASE WARRANTORS FROM ANY AND ALL OBLIGATIONS, LIABILITIES AND CLAIMS IN EXCESS OF THIS LIMITATION.

INDEMNIFICATION AND COVENANT NOT TO SUE: YOU WILL INDEMNIFY, DEFEND AND HOLD HARMLESS WARRANTORS, THEIR OWNERS, DIRECTORS, OFFICERS, EMPLOYEES, AGENTS, SUPPLIERS OR AFFILIATED COMPANIES, AGAINST ANY AND ALL CLAIMS, DEMANDS OR ACTIONS BASED UPON ANY LOSSES, LIABILITIES, DAMAGES OR COSTS, INCLUDING BUT NOT LIMITED TO DAMAGES THAT ARE DIRECT OR INDIRECT, INCIDENTAL, SPECIAL OR CONSEQUENTIAL, AND INCLUDING ATTORNEYS FEES AND LEGAL COSTS, THAT MAY RESULT FROM THE INSTALLATION, OPERATION, USE OF, OR INABILITY TO USE WARRANTORS' PRODUCTS AND SERVICES, OR FROM THE FAILURE OF THE WARRANTORS' SYSTEM TO REPORT A GIVEN EVENT OR CONDITION, WHETHER OR NOT CAUSED BY WARRANTORS' NEGLIGENCE.

YOU AGREE TO RELEASE, WAIVE, DISCHARGE AND COVENANT NOT TO SUE WARRANTORS, THEIR OWNERS, DIRECTORS, OFFICERS, EMPLOYEES, AGENTS, SUPPLIERS OR AFFILIATED COMPANIES, FOR ANY AND ALL LIABILITIES POTENTIALLY ARISING FROM ANY CLAIM, DEMAND OR ACTION BASED UPON ANY LOSSES, LIABILITIES, DAMAGES OR COSTS, INCLUDING BUT NOT LIMITED TO DAMAGES THAT ARE DIRECT OR INDIRECT, INCIDENTAL, SPECIAL OR CONSEQUENTIAL, AND INCLUDING ATTORNEYS FEES AND LEGAL COSTS, THAT MAY RESULT FROM THE INSTALLATION, OPERATION, USE OF, OR INABILITY TO USE WARRANTORS' PRODUCTS AND SERVICES, OR FROM THE FAILURE OF THE WARRANTORS' SYSTEM TO REPORT A GIVEN EVENT OR CONDITION, WHETHER OR NOT CAUSED BY WARRANTORS' NEGLIGENCE, EXCEPT AS NECESSARY TO ENFORCE THE EXPRESS TERMS OF THIS LIMITED WARRANTY.

EXCLUSIVE WARRANTY: THE LIMITED WARRANTY OR WARRANTIES DESCRIBED HEREIN CONSTITUTE THE SOLE WARRANTY OR WARRANTIES TO THE PURCHASER. ALL IMPLIED WARRANTIES ARE EXPRESSLY DISCLAIMED, INCLUDING: THE WARRANTY OF MERCHANTABILITY AND THE WARRANTY OF FITNESS FOR A PARTICULAR USE AND THE WARRANTY OF FITNESS FOR A

# Sentinel Installation and Setup Guide

PARTICULAR PURPOSE AND THE WARRANTY OF NON-INFRINGEMENT AND/OR ANY WARRANTY ARISING FROM A COURSE OF DEALING, USAGE, OR TRADE PRACTICE.

IT MUST BE CLEAR THAT THE WARRANTORS ARE NOT INSURING YOUR PREMISES OR BUSINESS OR GUARANTEEING THAT THERE WILL NOT BE DAMAGE TO YOUR PERSON OR PROPERTY OR BUSINESS IF YOU USE THIS PRODUCT. YOU SHOULD MAINTAIN INSURANCE COVERAGE SUFFICIENT TO PROVIDE COMPENSATION FOR ANY LOSS, DAMAGE, OR EXPENSE THAT MAY ARISE IN CONNECTION WITH THE USE OF PRODUCTS OR SERVICES, EVEN IF CAUSED BY WARRANTORS' NEGLIGENCE. THE WARRANTORS ASSUME NO LIABILITY FOR INSTALLATION OF THE PRODUCT AND/OR INTERRUPTIONS OF THE SERVICE DUE TO STRIKES, RIOTS, FLOODS, FIRE, AND/OR ANY CAUSE BEYOND SELLER'S CONTROL, FURTHER SUBJECT TO THE LIMITATIONS EXPRESSED IN ANY LICENSE AGREEMENT OR OTHER AGREEMENT PROVIDED BY WARRANTORS TO PURCHASER.

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**4. PROCEDURE FOR OBTAINING PERFORMANCE OF WARRANTY:** IN THE EVENT THAT THE PRODUCT DOES NOT CONFORM TO THIS WARRANTY, THE PRODUCT SHOULD BE SHIPPED OR DELIVERED FREIGHT PREPAID TO A WARRANTOR WITH EVIDENCE OF ORIGINAL PURCHASE.

**5. LEGAL REMEDIES AND DISCLAIMER:** SOME JURISDICTIONS MAY NOT ALLOW, OR MAY PLACE LIMITS UPON, THE EXCLUSION AND/OR LIMITATION OF IMPLIED WARRANTIES, INCIDENTAL DAMAGES AND/OR CONSEQUENTIAL DAMAGES FOR SOME TYPES OF GOODS OR PRODUCTS SOLD TO CONSUMERS AND/OR THE USE OF INDEMNIFICATION TERMS. THUS, THE EXCLUSIONS, INDEMNIFICATION TERMS AND LIMITATIONS SET OUT ABOVE MAY NOT APPLY, OR MAY BE LIMITED IN THEIR APPLICATION, TO YOU. IF THE IMPLIED WARRANTIES CAN NOT BE EXCLUDED, AND THE APPLICABLE LAW PERMITS LIMITING THE DURATION OF IMPLIED WARRANTIES, THEN THE IMPLIED WARRANTIES HEREIN ARE TO BE LIMITED TO THE SAME DURATION AS THE APPLICABLE WRITTEN WARRANTY OR WARRANTIES HEREIN. THE WARRANTY OR WARRANTIES HEREIN MAY GIVE YOU SPECIFIC LEGAL RIGHTS THAT WILL DEPEND UPON THE APPLICABLE LAW. YOU MAY ALSO HAVE OTHER LEGAL RIGHTS DEPENDING UPON THE LAW IN YOUR JURISDICTION.

**6. CHOICE OF FORUM AND CHOICE OF LAW:** IN THE EVENT THAT A DISPUTE ARISES OUT OF OR IN CONNECTION WITH THIS LIMITED WARRANTY, THEN ANY CLAIMS OR SUITS OF ANY KIND CONCERNING SUCH DISPUTES SHALL ONLY AND EXCLUSIVELY BE BROUGHT IN EITHER THE COURT OF COMMON PLEAS OF DELAWARE COUNTY, PENNSYLVANIA OR THE UNITED STATES DISTRICT COURT FOR THE EASTERN DISTRICT OF PENNSYLVANIA.

REGARDLESS OF THE PLACE OF CONTRACTING OR PERFORMANCE, THIS LIMITED WARRANTY AND ALL QUESTIONS RELATING TO ITS VALIDITY, INTERPRETATION, PERFORMANCE AND ENFORCEMENT SHALL BE GOVERNED BY AND CONSTRUED IN ACCORDANCE WITH THE LAWS OF THE STATE OF DELAWARE, WITHOUT REGARD TO THE PRINCIPLES OF CONFLICTS OF LAW.

Effective date 02/25/2015

PHONETICS, INC. d.b.a. SENSAPHONE

901 Tryens Road

Aston, PA 19014

Phone: 610.558.2700 Fax: 610.558.0222

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

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# CHAPTER 1: INSTALLATION

## INTRODUCTION

Congratulations on your purchase of the Sentinel Monitoring System. The system is designed to be an easy, cost-effective, cloud-based monitoring and data logging system to notify you when equipment or conditions go awry. The internet browser-based programming makes the device easy to use from any computer or tablet. Monitored conditions can include temperature, humidity levels, pressure, flow, leak detection, UPS systems, and more. The system allows multiple users to be notified immediately of any detected problems. Notification can occur via voice call, e-mail or SMS (text message), however voice calls and text messages require a premium subscription plan. The internal battery backup system insures the unit will continue to run if main power fails.

## FEATURES

The Sentinel includes the following key features:

- Twelve sensor inputs to monitor environmental conditions and/or alarm contacts from other equipment.
- 10/100BASE-T Ethernet port.
- Battery backup for uninterrupted performance.
- Compact design allows wall-mount or weatherproof installation in a suitable enclosure.
- Notification via e-mail, text message (optional) and voice call (optional).
- Relay output capable of automatic or manual control.
- Cloud-based user interface for programming, data storage, and alarm delivery.

## TECHNICAL SUPPORT

If any questions arise upon installation or operation of the Sentinel, please contact the Sensaphone Technical Service Department at 610.558.2700 and have the following information available:

- Date of purchase \_\_\_\_\_
- Serial number \_\_\_\_\_

Technical support is available from 8:00 AM to 5:00 PM, M-F, eastern time.

## ABOUT THIS MANUAL

This manual comprises the instructions necessary to install and setup the Sentinel. You should thoroughly read this manual to establish a basic understanding of the system and keep it as a reference.

# INSTALLATION AND CONFIGURATION

## PHYSICAL DESCRIPTION

The Sentinel is housed in a 5.5” x 5.5” x 1.5” enclosure, which can be easily wall mounted.

## LAYOUT

The Sentinel has connections for twelve sensor inputs, an ethernet port, and 12VDC power. See figure below:



Figure 1: Front Panel Layout of the Sentinel

- |                                |                                |
|--------------------------------|--------------------------------|
| 1) Acknowledge/Standby Button  | 5) Power Jack                  |
| 2) On/Off Switch               | 6) Ethernet Jack               |
| 3) Power, Online, Standby LEDs | 7) Sensor Input Terminal Strip |
| 4) Alarm LEDs                  | 8) Relay Output Input          |

## RJ-45 10/100BASE-T ETHERNET PORT

This jack is for connecting to your network so that the device can communicate with the Sentinel servers. Two LEDs indicate when the Sentinel has a valid link (green) and transmitted/received data (yellow).

## SENSOR INPUTS

The sensor inputs labeled zones 1-12 are designed to interface with normally open/normally closed devices, 2.8K or 10K temperature sensors and 4-20mA transducers.

## POWER ON LED (GREEN)

This light indicates that the Sentinel unit is powered and operational.

## ALARM LEDS (RED)

The Alarm LEDs indicate if an alarm exists.

## ONLINE LED (GREEN)

This light indicates that the Sentinel unit is communicating with the Sentinel servers.

## STANDBY LED (YELLOW)

This light indicates that the Sentinel unit is in standby mode.

## **ACKNOWLEDGE/ STANDBY BUTTON**

When an unacknowledged alarm exists (as indicated by a blinking red alarm LED), briefly press the button and the alarm LED will stop blinking, indicating that the alarm is acknowledged. To enter Standby mode, press and hold the button for at least 5 seconds until the Standby LED lights up, then release. To exit from Standby mode, hold the button down for 5 seconds until the Standby LED turns off.

## **INSTALLATION**

This section provides information on:

- Operating environment
- Installation
- Connecting sensors
- Network Configuration

### **PARTS REQUIRED**

- Screwdriver and #8 screws
- Network Hub, Switch, or Router that supports 10 or 100 BASE-T
- Computer w/Internet Connection

## **OPERATING ENVIRONMENT**

Before you install the Sentinel be sure that your operating environment meets the physical requirements of the equipment.

Operating Temperature:	32° – 122° Fahrenheit (0° – 50° C)
Humidity:	5 – 90 %RH, non-condensing
Power:	115VAC 50/60 Hz outlet within 6'

## **POWER**

Connect the included AC power supply to the power jack on the Sentinel. Plug the power adapter into a 115V AC power outlet.

## **NETWORK CONFIGURATION**

Using the included network cable, connect the Sentinel into your network hub, switch or router. If your network supports DHCP the ONLINE green LED should light up within a few minutes indicating that the device has connected to the sensaphone.net servers.

If your network requires the device to have a static IP address, please contact Sensaphone technical support for availability of this feature.

## WALL MOUNT INSTALLATION

The Sentinel can be wall mounted using dry wall anchors and (4) #6 screws. Follow the steps below:

- 1) Install four drywall anchors (if necessary). Attach the Sentinel using four #6 tapping screws. See Figure 2 for dimensions.
- 2) Attach sensors to the zone terminals.
- 3) Plug the power adaptor into a 115VAC 50/60Hz outlet.
- 4) Connect a CAT5 cable to the Ethernet port and connect to a 10/100 network hub, switch or router.

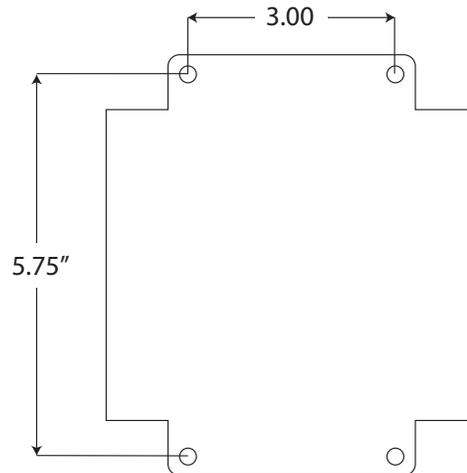


Figure 2: Sentinel mounting dimensions

## CONNECTING SENSORS

The Sentinel is compatible with a wide variety of sensors including normally open/normally closed contacts, 2.8K and 10K temperature sensors, and 4–20mA current sources. Compatible sensors and accessories are shown on the Sentinel website. Sensors may be connected while the device is powered on or off. A proper size screwdriver is provided for your convenience. Contact Sensaphone or your Sensaphone reseller for assistance in selecting sensors for your monitoring requirements. A list of sensors and accessories is shown in Appendix B. Follow the instructions below to properly wire and configure the inputs for each type of electrical signal.

**Warning:** The inputs are designed to work with low voltage signals. DO NOT connect voltages greater than 3.3V to the inputs. DO NOT connect 120VAC to the inputs.

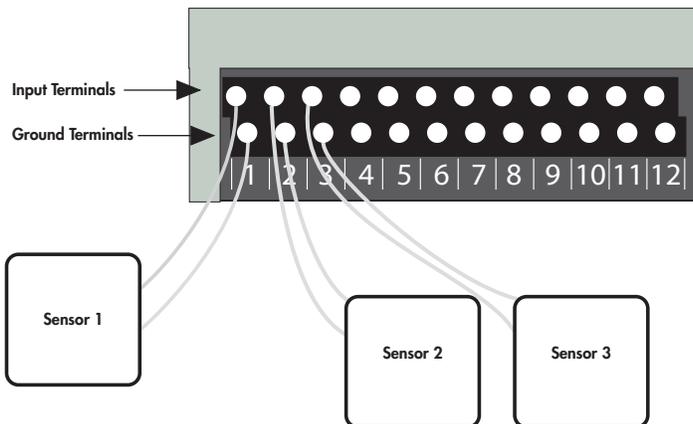
## GENERAL WIRING CONSIDERATIONS

Most dry contact sensors can be connected to the Sentinel using inexpensive 2-conductor twisted-pair cable as small as #24 AWG. For temperature and 4–20mA sensors, use the wire chart below as a reference for selecting the appropriate wire gauge. Note that if the sensor is located far from the unit or if you are running cable in an electrically noisy environment, you should seriously consider using shielded cable. This will shield the signal from electrical interference, thereby preventing false readings and/or damage to the unit. For your convenience, Sensaphone has 22 gauge shielded cable available in 50' lengths (part number FGD-0010). To minimize electrical noise coupling between sensor wires and other wiring, follow the guidelines listed below:

- Route the power supply and network cables to the unit by a separate path than the wiring to the sensor inputs. Where paths must cross, their intersection should be perpendicular.
- Do not run sensor wiring and AC power in the same conduit.
- Segregate wiring by signal type. Bundle wiring with similar electrical characteristics together.
- If shielded cable is used, tie the shield to the input ground terminal.

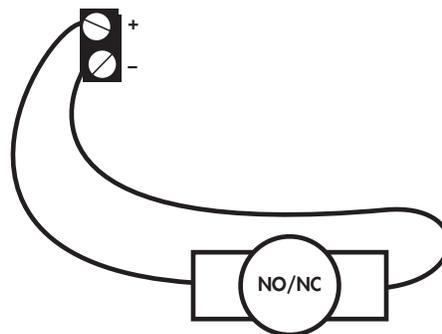
<u>Wiring Distance</u>	<u>Minimum Wire Gauge</u>
700'	#24 AWG
1500'	#22 AWG
2500'	#20 AWG

The zone terminal strip has an upper and lower level for connecting up to 12 sensors. The lower level terminals are all “ground” and are electrically connected together. The upper terminal strip is the positive connection for each sensor. See illustration below.



## NORMALLY OPEN / NORMALLY CLOSED DRY CONTACTS

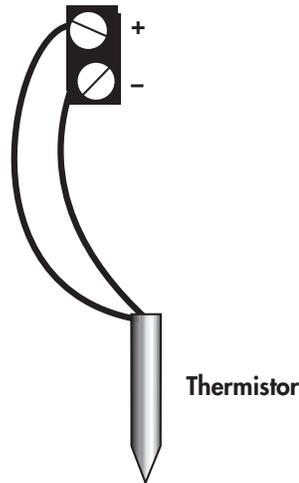
Dry contact sources consist of alarm relays or switches that are isolated and have no external voltage applied. These devices can be connected directly to the zone terminals without regard for polarity. Choose a zone and connect the wires to the corresponding screw terminals for that zone. The following figure shows how to connect a dry contact sensor:



Wiring a Dry Contact Sensor

## 2.8K/10K TEMPERATURE SENSORS

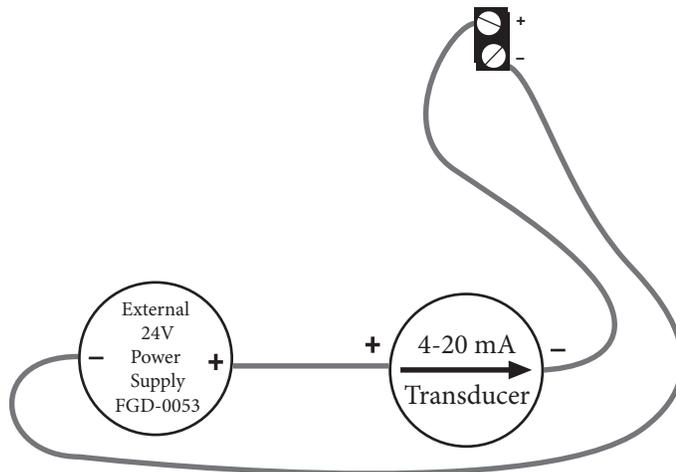
The Sentinel is compatible with 2.8K/10K temperature sensors that match the curve data listed in the tables in Appendix F. The monitoring temperature range of the 2.8K thermistor is -109 to 115°F (-85° to 57°C) and the 10K thermistor is -87° to 168°F (-66° to 76°C). Temperature sensors can be connected directly to the zone terminals without regard for polarity. Choose an alarm input and connect the wires to the corresponding screw terminals for that zone. 2.8K and 10K temperature sensors are available from Sensaphone. See Appendix C for part numbers. The figure below shows how to connect a temperature sensor:



Wiring a Temperature Sensor

## 4-20mA CURRENT LOOP TRANSDUCERS

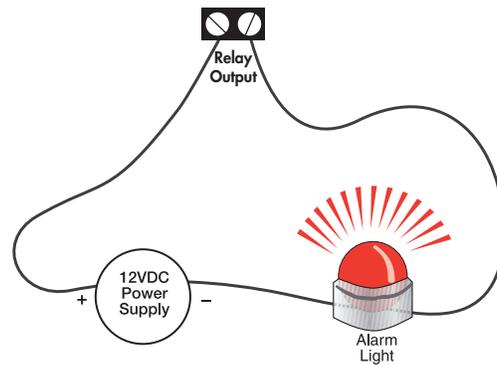
The inputs on the Sentinel are compatible with transducers that produce an analog output current of 4 to 20mA. Such transducers are available to measure tank and well levels, extreme temperatures, air pressure, water pressure, flow, voltage, current, rotational speed, etc. Contact our technical support department for assistance regarding your monitoring requirements (877-373-2700 or support@sensaphone.com). Follow the wiring diagrams below for connecting a 4-20mA device:



Wiring a 4-20mA device using an external 24 VDC supply.

## RELAY OUTPUT WIRING

The Sentinel includes an relay output (switch) that can be used to turn on a light, siren, or other device whenever an alarm occurs. The output is a normally–open (i.e. off) dry contact that can be used for low voltage switching. The relay is rated for up to 30VAC/VDC 1 Amp. A sample wiring diagram is shown below:



The relay can be programmed to turn on whenever an input is above or below the programmed alarm limits and the programmed recognition time has been met. It will release as soon as the input returns to a normal condition.

## BATTERY BACKUP

The Sentinel has an internal rechargeable battery backup pack (part #FGD-0032) which will provide up to 8 hours of backup time in the event of a power failure. The unit will charge the battery and monitor its charge level. The percent charge can be viewed on the website. The Sentinel contains circuitry to protect the battery from deep discharge damage and will disconnect the battery when all of its available energy has been expended. The battery backup module should last 4 to 5 years.



## RESETTING THE SENTINEL TO FACTORY DEFAULT SETTINGS

In the event that you can no longer connect to your Sentinel, you can reset the unit to factory defaults. On the bottom of the unit is a small hole. Beneath the hole is a push button. Insert a paper clip or similar item into the hole and push the button for 5 seconds while the device is powered on. The Sentinel will erase all of its programming and then reboot automatically.

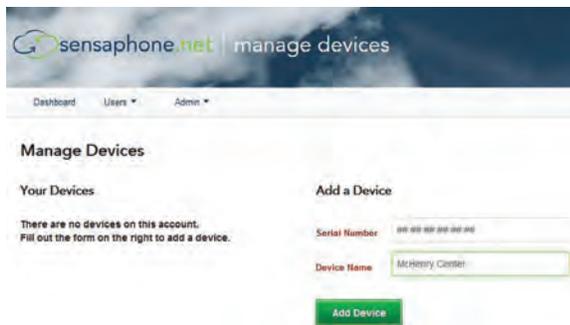
# CHAPTER 2: SET UP

When your Sentinel “Online” LED is lit you can continue with the following website section.

1. Open an internet browser and go to [www.sensaphone.net](http://www.sensaphone.net).
2. Fill in the form to create a new account.



3. Once you are logged in, click *Admin*, then *Manage Devices*. In the “Add a Device” section, enter the Serial Number of your Sentinel and enter a device name. Click the *Add Device* button when finished.



Your Sentinel is now online with the Sensaphone.net website. Read the section below to learn how to view status and program your device.

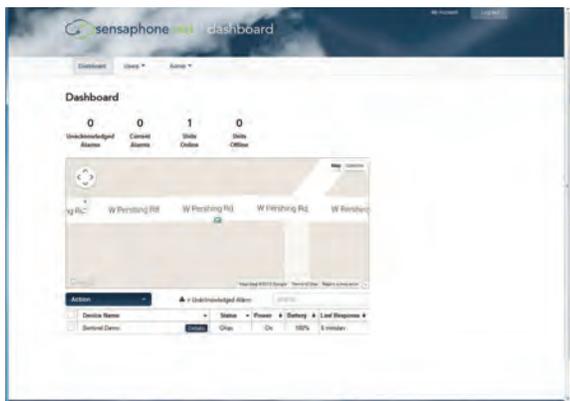
## DESCRIPTION OF WEB PAGES

### DASHBOARD

The dashboard will list all of the devices on your account. This page is automatically updated with the most current information available.

The numbers at the top will show how many Unacknowledged Alarms, Current Alarms, Units Online, and Units Offline that currently exist for all devices on your account.

The map will show the location of any device on your account that has an address or GPS location listed. You can hover over the icon to see the device name and status. If the icon for the device is green, your device status is OK. If it is red, your device has alarms. You can click on the icon to show the zones for the selected device.



The device table will display all devices on your account. Click on the *Details* button to display and configure the zones for that device. You can also use the search box above the table to search through the table, or click on the table column headers to sort the data.

**Device Name** – The name of the device

**Status** – The current status of the device (Okay, Alarms, Offline, or Standby) If the device has any unacknowledged alarms, a symbol will be displayed in this column

**Power** – Displays if the device is On or Off (--- will display if the device is offline)

**Battery** – The current percentage of the device battery (--- will display if the device is offline)

**Last Response** – The time that the device last connected to the server

### Alarm Acknowledgment

Alarms can be acknowledged from the dashboard page by selecting a device using the checkboxes next to each device, and then clicking the “Action” drop-down at the top of the screen. You can acknowledge both Device Offline alarms or Zone alarms. Devices with ‘Unacknowledged’ alarms are identified with an exclamation point within a triangle. Once the alarm is acknowledged this symbol will disappear. You can acknowledge multiple alarms on multiple devices at the same time. Alarms can also be acknowledged during telephone calls by entering 555 when prompted to enter the acknowledgment code, or by simply replying to alarm messages sent via email.

### Standby Mode

Standby mode puts the Sentinel in a temporary state such that no alarms will be detected, allowing onsite personnel to perform maintenance or other tasks that may have triggered an alarm otherwise. Standby mode can be entered using the Action drop down on the Dashboard page or via the pushbutton on the front of the unit. Standby mode will persist for the duration of time entered on the Device Configure screen and will automatically exit once the time expires. When using the pushbutton you must depress the button for 5 seconds. The Standby LED will light up to indicate that the device is in Standby mode. You can also exit Standby mode using the same methods.

**Standby** – Allows you to put the selected devices into Standby mode

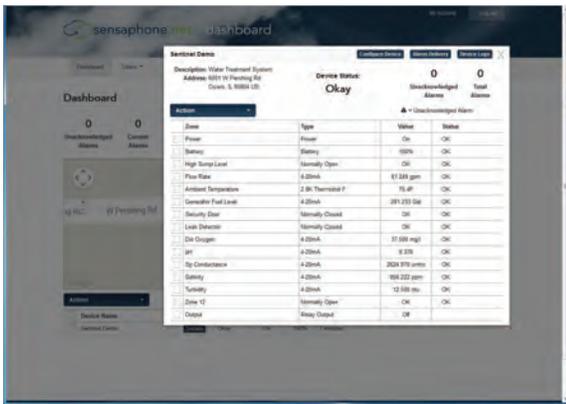
**Enter** – Put the Sentinel in Standby mode for the length of time that is set on the Device Configure page

**Enter (Untimed)** – Put the Sentinel in Standby mode until you disable it

**Exit** – Take the device out of Standby mode

## DEVICE DETAILS

The device details page displays the sensor values for your Sentinel. This page is automatically updated with the most current information available. At the top of the page are buttons to access the *Configuration*, *Alarm Delivery* and *Logs*.



At the top of the page, you will see the device name, description, address and alarm status.

You will also see all of the zones for your device in the table.

Zone – The name of the zone

Value – The current value of the zone

Status – The current status of the zone

If the device has any unacknowledged alarms, a symbol will be displayed in this column

Type – The type of sensor that the zone is set to monitor

The Action dropdown menu provides options that allow you to interact with your device.

Acknowledge Alarms – Allows you to acknowledge alarms for the selected zones (you can have multiple zones selected)

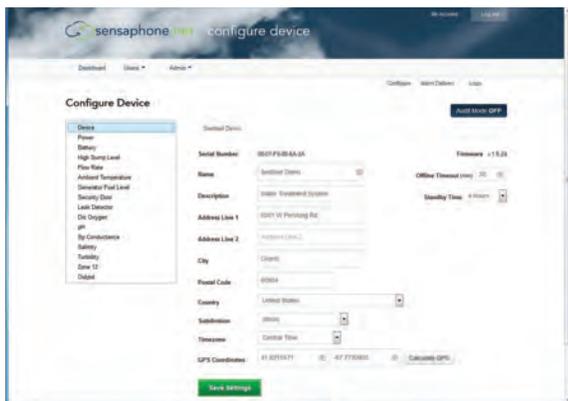
## CONFIGURE DEVICE

At the top of the dashboard, click *Configure Device* to go to the device and zone programming screens.

The box on the left will display all of your configureable zones, as well as Device (for general device settings), Power, Battery and Relay Output. As you select an option, the form on the right will change to display the appropriate data. Complete the address so that the Sentinel icon will be displayed at the appropriate location on the dashboard map.

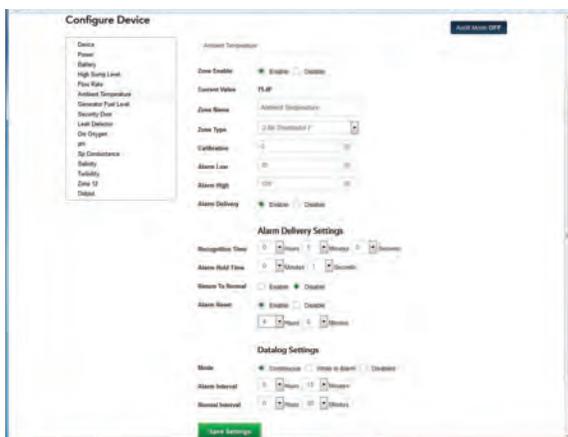
This page also contains settings for the *Device Offline* alarm and for *Standby Mode*. The *Device Offline* alarm will notify you if your devices stops communicating with the sensaphone.net servers for the programmed time duration.

Once you have completed your programming, click on the *Save Settings* button at the bottom of the page.



## Zone Programming

Select the zone you would like to configure from the box from the left. A sample screen for a temperature sensor is shown below.



## ZONE PARAMETER DEFINITIONS

**Enable/Disable:** This setting determines if the Zone is being used (Enabled) or not (Disabled). Selecting Disabled will remove the gauge from the Summary screen.

**Name:** Enter a name for the sensor you are monitoring which describes its purpose and/or location. The name will appear on the Device Details screen as well as on alarm messages.

**Type:** Choose the type of sensor you are connecting to the Zone input. For temperature sensors choose either degrees F or C.

**Units:** The Units field is used to describe the units of measure for the value being monitored. When Temperature is selected the Units field will automatically display F (Fahrenheit) or C (Celsius). When a 4-20mA type is selected you can enter the appropriate text for the monitored condition (e.g. %RH, PSI, GPM, RPM,...). When you select Normally Open (NO) or Normally Closed (NC) you can choose from several preset descriptions for the Open and Closed state of the input. The first word always describes the Open state of the contact and the second the Closed state. If you choose Custom you can enter your own text for the Open and Closed states. To do this simply type the words into the lower Units field and separate them with a slash (/). For example, “Slow/Fast”, “Safe/Danger”, “Dry/Wet”.

**Calibration:** This field can be used to offset the Zone value either positive or negative if there is some error in the reading.

**Alarm Low:** This is used to determine the low level at which a temperature or 4–20mA Zone has reached the alarm threshold. The value must fall below the Alarm Limit to trip an alarm.

## Sentinel Installation and Setup Guide

**Alarm High:** This is used to determine the high level at which a temperature or 4–20mA Zone has reached the alarm threshold. The value must exceed the Alarm Limit to trip an alarm.

**Table Low:** The Table Low value is used to define the lower range (4mA) of your 4-20mA sensor.

**Table High:** The Table High value is used to define the upper range (20mA) of your 4-20mA sensor.

**Alarm Delivery Enable/Disable:** When Enabled, alarm messages will be delivered, if set to Disabled alarm messages will not be delivered.

**Recognition Time:** This is the length of time that an alarm condition must be present before a valid alarm exists and message delivery is started.

**Alarm Hold Time:** When an alarm occurs, the *Alarm Hold Time* will latch the alarm condition for the programmed time period, thus preventing redundant alarms from sending additional notification messages. This is useful for alarms that are likely to trip several times within a short time period, such as motion detectors.

**Return to Normal Enable/Disable:** This feature instructs the Sentinel to send a message when a zone input has changed from an alarm condition back to a normal condition. Anyone who received the original alarm message will also be sent the Return-to-Normal message.

**Alarm Reset Enable/Disable:** This setting enables or disables the Alarm Reset Feature. The Alarm Reset feature is used to re-send alarm messages in the event that a fault condition is not corrected in a timely fashion. If an alarm continues to exist for the duration of the programmed Reset Time (see below) the alarm will reset (reactivate) and the alarm message delivery process will begin all over again. This is an optional feature.

**Alarm Reset Time:** This is the time allowed for an alarm's fault condition to be corrected before the Sentinel resets (reactivates) the alarm and begins the message delivery process all over again. It is recommended that this be set to no lower than 30 minutes to prevent numerous messages from being sent.

**Datalogging Mode:** The Sentinel has two modes of data logging for each zone: Continuous or While In Alarm. In Continuous mode the unit will log the value of the input on a fixed time interval all the time. The Normal Interval sets the logging rate while the value is within the normal range. The Alarm Interval sets the logging rate while the value is an alarm condition. By choosing the While In Alarm mode you can choose to have the unit only log values when it exceeds the alarm limits.

**Alarm Datalog Interval:** This is the interval that data will be logged while the input is beyond the programmed alarm limits. (Note: this is regardless of the programmed Alarm Recognition Time).

**Normal Datalog Interval:** This is the interval that data will be logged while the input is within the programmed alarm limits. To maximize the available memory for datalogging, set the Datalog Interval for each zone to multiples of each other. For example, Zone 1 can be set to 30 seconds, Zone 2 to 1 minute, Zone 3 to 5 minutes, etc...

## MANAGE USERS

The sensaphone.net website allows you to set up users that will be linked to your account. Each user can be configured to have their own login for website access and/or be contacted for alarms. In addition, you can choose to give alarm acknowledgement capability to each user.

There are several levels of site access that can be assigned to each user. You can also enter contact information for alarm delivery purposes. From the main menu, select *Users*, then *Manage Users*. To add a new user, click on the *Add User* button. The example below shows a user setup as an administrator with four contact destinations.

**User Details**

**New User**

User Enabled

Site Access: Administrator | Alarm Delivery: Allow Acknowledgement

Name\*: Joe McHenry  
 Email\*: jmchenry@mycompany.com  
 Password\*:   
 Address Line 1: 100 Oak Rd  
 Address Line 2:   
 City: Los Angeles  
 Postal Code: 90001  
 Country: United States  
 Subdivision: California

**Contact Details**

Alarm Delivery Enabled

Description	Type	Destination	Enable	Remove
Joe's Office	Phone	888-555-1234	<input checked="" type="checkbox"/> Enable	X
Joe's Cell	SMS	333-777-2222	<input checked="" type="checkbox"/> Enable	X
Joe's Home	Phone	111-888-4444	<input checked="" type="checkbox"/> Enable	X
Joe's Work Email	Email	jmchenry@mycompany.com	<input checked="" type="checkbox"/> Enable	X

\* = Required

The following defines the various site access levels:

**Administrator** – Full site access, all devices on your account

**Supervisor** – Gives the user access to the Dashboard, device-specific pages (for example, Device Details), Manage Users, and Manage User Groups, but for only the devices you choose for them (chosen under the Device Groups section of the form). Supervisors will have the ability to create new users, but they can only give the users Supervisor access or lower.

**User** – Gives the user access to the Dashboard, but only shows the devices you choose for them (chosen under the Device Groups section of the form)

**None** – No access to the website

**Alarm Delivery** – Choose whether you would like the user to be able to receive alarm notifications or not. There are three options (listed below):

**Disabled** – No alarm delivery

**Inform Only** – User is notified about the alarm, but cannot acknowledge it

**Allow Acknowledgement** – User is notified about the alarm and is able to acknowledge it

Click on *Save Changes* once you are finished editing, or *Cancel* to abandon all changes.

You can search the table for a particular user. Click on a user name to view some quick information about them. Click on the green edit icon to edit the user, or the red X to remove the user from your account.

### **MANAGE USER GROUPS**

Allows you to set up groups of users that can be used on other site pages.

Select the group you wish to edit from the dropdown menu, or select *Create New Group* to make a new group.

Make sure to give each group a unique, descriptive name so they can be easily referenced.

Click on the plus icon to add users to the group. A pop up modal window will show that will list all the alarm users you have added to your account from the Manage Users page (see that page description for more information).

You can select an entire user (all destinations listed under that user at the time of the alarm will be notified) or individual destinations of the user.

Click on the red X icon to remove that user from the group.

Once you are finished adding and removing users, click on the *Save Group* button at the bottom of the page.

### **ALARM DELIVERY**

The Alarm Delivery section is where you program the people that will be contacted when an alarm occurs. You can select from the users and destinations you have already configured, or you can insert individual destinations directly. There are two different scheduling methods to choose from: Custom or Advanced. You can also choose to have no alarms sent out by selecting the “default” option. The sections below explain how to configure each type of schedule. These are the users that will be notified when an alarm occurs. To get to the Alarm Delivery programming section, click the *Details* button from the Dashboard for the device you would like to configure, then click the *Alarm Delivery* button.

#### **Default**

No alarm notifications are sent

#### **Custom**

Allows you to quickly personalize your alarm delivery schedule

All alarm notifications will be delivered to the users listed on this page immediately after an alarm occurs.

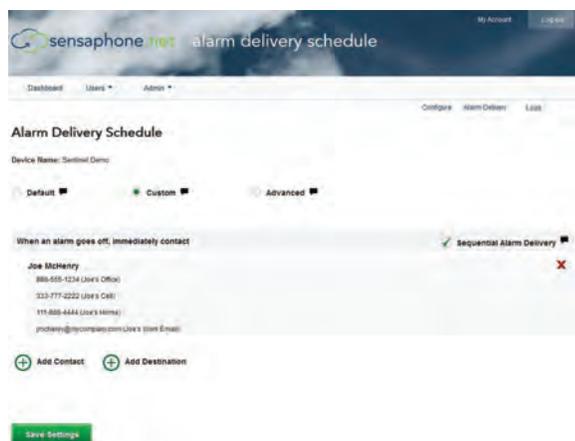
Sequential Alarm Delivery, if checked, allows the notifications to be delivered one at a time (per user) instead of all at once to the users listed.

Click on *Add Contact* to select a user to add to your schedule. These users are the Alarm Users that are set up on the Manage Users page (see page description for more information).

You can select an entire user (all destinations listed under that user at the time of the alarm will be notified) or individual destinations of the user.

Click on *Add Destination* to add a quick destination that will just be used for this schedule.

You can drag and drop the users that are listed to reorder them.



### Advanced – Allows advanced settings for your alarm delivery schedule

In addition to everything listed under Custom, this will allow you to set custom time frames for the schedule, and allow you to have multiple tiers of users that can be notified.

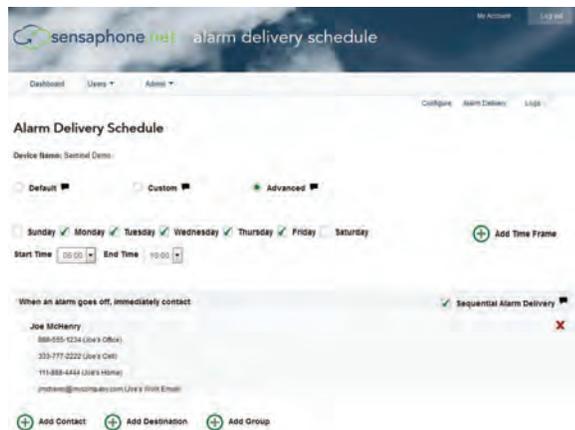
The checkboxes and dropdown menus at the top of the form dictate when exactly the schedule will be active – for example, Monday – Friday 8:00 am to 5:00 pm. You can have multiple time frames.

Click on *Add Group* to add a preset group of users to the schedule (see Manage User Groups for more information).

Click on *Add New Tier* to add another group of users that will be notified after a set time delay – for example, after 30 minutes – if the alarm is not yet acknowledged.

When you are finished setting up your schedule, click on the Save Settings button on the bottom of the form.

When an alarm on your device occurs, this schedule will continue to process in the order you have listed until the alarm is acknowledged.



### DEVICE LOGS

The Sentinel includes an Alarm Log and Data Log. The Alarm Log lists all alarm activity for the selected device. You can narrow down the messages by individual zones or you can select multiple zones. The Data Log contains the recorded values for each zone based on the parameters you set up on the Zone Configuration screens. You can display the values on the screen as well as graph them. There is also an option to Save the data to a file. To get to the Device Logs section, click the Details button from the Dashboard for the device you would like to view, then click the Device Logs button.

**Alarm Log** – Shows the history of all alarm notifications that were sent for the device

**Data Log** – Show the history of all logged zone values and statuses for the device

You can sort the data, search the data, show/hide more table rows, print the entire table, or save the entire table as a CSV, Excel, or PDF document.

### MANAGE DEVICES

Allows you to add, modify, and remove devices from your account.

To add a new device to your account:

Fill out the form on the right, under Add a Device.

You must enter the Device ID, as well as a name and a description of the device. The ID will be located on the bottom of the device in the format 00-11-22-33-44-55.

The name and description can be any text you would like, but it will help you identify the device by a descriptive name. For example, you can use “North Farm” as the name, and “Main Entrance” as the description.

You can also give the address and/or GPS coordinates of the device if you would like to have them shown on the map on the Dashboard page, but these fields are optional.

Once finished with the form, click on *Add Device*.

To modify or remove a device from your account:

Click on the checkbox next to the device(s) you wish to modify from the list on the left, under Your Devices.

Choose the option you would like to do from the dropdown menu.

Click on the *Submit* button at the bottom of the page on the left.

### DEVICE GROUPS

Allows you to set up groups of devices that can be used on other site pages.

In the main window, you will see a list of all your devices, and any groups you may have already created.

Devices are shown with a green device icon, and groups are shown with a black users icon.

You can have multiple groups within a groups, empty groups, and devices not listed in any group.

If a device icon is lined up on the left-most side of the window, they are not in a group.

The blue number shown on the groups icon shows how many devices and/or groups are within that group.

To add a new group, click on the *Add Group* button on the bottom of the page.

You can rename a group by right clicking on the group and selecting *Rename*.

To remove a group, right click on the group and select *Delete*.

Any devices and/or groups in that group will be moved up one level.

For example, if a group that had two devices was deleted, the two devices would be shifted to the left and would no longer be in any group. No device will be deleted.

To move a device or a group into a group, click on the device and drag it into the group you would like it.

You can click and drag a device or group to reorder them.

To search through your devices click on *Filters*. You can choose to hide any device or group that does not match your search, and you can choose to only search through your devices and not your groups.

Once you are finished editing your groups, click on the *Save Groups* button at the bottom of the page.

## **ALARM ACKNOWLEDGEMENT**

When receiving voice calls, the alarm can be acknowledged by pressing 555 on a touch-tone telephone when prompted. Alarms can also be acknowledged by simply replying to alarm messages sent via email, or you can login to the website and acknowledge alarms right on the Dashboard.

# APPENDIX A: WEEKLY TESTING PROCEDURE

We recommend that you test your Sensaphone weekly to be sure it is functioning properly. This will ensure that when a problem arises the Sensaphone will be ready to alert the appropriate personnel.

There are several tests that can be performed:

1.) Create an alarm on each zone by tripping all connected sensors.

**Temperature sensors:** Heat or cool the sensor.

**Motion sensors:** Have someone walk in front of the sensor.

**Door/window sensors:** open the door/window.

**Water sensors:** Apply a small amount of water beneath the sensor or use a wet towel and touch it to the sensor probes.

**Humidity sensors:** Raise the humidity around the sensor by holding a cup of very hot water beneath the sensor.

2.) Allow the unit to contact all programmed users. This will make sure that the Sensaphone is programmed properly. It will also prepare personnel to respond appropriately when they receive a message from the Sensaphone.

3.) Test the battery (if installed) by unplugging the AC adapter and making sure that the Sensaphone continues to function. Keep the AC adapter unplugged so that a Power Failure alarm occurs. Plug in the AC adapter after the unit has finished.

4.) Keep a log of your tests, noting the date and whether the Sentinel passed in each category tested. An example of such a log is shown below. (See “Test Log” at the end of this manual.)

WEB600 Test Log							
Date	Inputs		Alarm		Battery		
	Pass	Fail	Pass	Fail	Pass	Fail	
07/19/09	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Bob H
08/20/09	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Alex G.
09/19/09	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Bob H.
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

If you require assistance, call Sensaphone Technical Support at 610-558-2700.

# APPENDIX B: ACCESSORIES

The sensors listed below are available from Sensaphone, and represent the most commonly used zone devices. Other dry contact sensors, designed for more specialized applications, may also be used. Commercial or industrial electrical supply houses can provide devices to monitor virtually any condition. For further information, contact Sensaphone Customer Service at 610-558-2700.

## PART # . . . . . SENSOR / SWITCH

BAT-0032 . . . . .	Sentinel Battery
FGD-0006 . . . . .	Magnetic Reed Switch
FGD-0007 . . . . .	Passive Infra-Red Detector
FGD-0010 . . . . .	50' two-conductor #22AWG shielded Cable
FGD-0013 . . . . .	Spot Water Detector
FGD-0022 . . . . .	Temp° Alert
FGD-0027 . . . . .	Humidistat
FGD-0049 . . . . .	Smoke Detector with Built-in Relay
FGD-0052 . . . . .	Humidity 4-20mA Transmitter
FGD-0053 . . . . .	24VDC Power Supply
FGD-0054 . . . . .	Power-Out Alert™
FGD-0056 . . . . .	Zone Water Detector w/Water Rope
FGD-0063 . . . . .	Additional 10' Water Rope for FGD-0056
FGD-0065 . . . . .	Carbon Monoxide Sensor
FGD-0066 . . . . .	Air Quality Sensor
FGD-0067 . . . . .	Surge Suppressor
FGD-0100 . . . . .	2.8k Remote Temperature Sensor
FGD-0101 . . . . .	2.8k Weatherproof Temperature Probe
FGD-0102 . . . . .	10k Weatherproof Temperature Probe
FGD-0103 . . . . .	10k Indoor Decorator
FGD-0104 . . . . .	10k Outdoor Air Weatherproof
FGD-0205 . . . . .	Multi-Point Wireless I/O System

# **APPENDIX C: SPECIFICATIONS**

## **ALERT ZONES**

Number of Zones: 12

Zone Connector: terminal block

Zone Types: N.O./N.C. contact, 2.8K Thermistor ( -109° to 115°F, -85° to 57°C ) And 10K Thermistor (-87° to 168°F; -66° to 76°C), and 4-20mA (-80,000.0 to 80,000.0

Zone Characteristics: 28.7K $\Omega$  to 3.3V (temperature/contact) or 250 Ohms to ground (4-20mA)

A/D Converter Resolution: 12 bits  $\pm$ 2 LSB

Zone Protection: 5.5VDC Metal Oxide Varistor with fast acting diode clamps.

## **RELAY OUTPUT**

Rated for 1A 30VAC/ 1A 30VDC Maximum

## **DATA LOGGING**

1 minute to 1 month sampling rate

User programmable channel selection

Zones 1 – 12

Battery

Input Power

## **LED INDICATORS**

Power: On steady when the unit is powered on.

Alarm: Off when no alarm exists.

Ethernet Link and Activity LEDs

Online

Standby

## **COMMUNICATION TYPE:**

10/100 BASE-T Ethernet with SSL encryption

## **POWER SUPPLY**

Power Supply: 120VAC/12VDC 50/60Hz 6W wall plug-in transformer w/6' cord.

Power Consumption: 2 Watts

Power Protection: Metal Oxide Varistor

Battery Backup: Internal 8 hr battery backup module (Part #BAT-0032).

## **ENVIRONMENTAL**

Operating Temperature: 32–122° F (0–50° C)

Operating Humidity: 0–90% RH non-condensing

Storage Temperature: 32°–140° F (0–60° C)

## **PHYSICAL**

Dimensions: 5.5” x 5.5” x 1.5” (14 cm x 14 cm x 3.8 cm)

Weight: 1.5 lbs. (680 grams)

Enclosure: Powder-coated aluminum enclosure with tabs for wall or panel mounting

# **APPENDIX D: THERMISTORS**

## **2.8K THERMISTOR DATA**

Degrees Celsius	Resistance (Ohms)
-50	187,625
-40	94,206
-30	49,549
-20	27,180
-10	15,491
0	9,142
10	5,572
20	3,498
30	2,256
40	1,491
50	1,009
60	697
70	490
80	351

## **10K THERMISTOR DATA**

Degrees Celsius	Resistance (Ohms)
-50	441.3K
-40	239.8K
-30	135.2K
-20	78.91K
-10	47.54K
0	29.49K
10	18.79K
20	12.25K
30	8,194K
40	5,592
50	3,893
60	2,760
70	1,990
80	1,458
90	1,084
100	816.8
120	481.8
130	376.4
140	297.2
150	237.0

# **APPENDIX E: RETURNING THE UNIT FOR REPAIR**

In the event that the Sentinel does not function properly, we suggest that you do the following:

- 1) Record your observations regarding the Sentinel's malfunction.
- 2) Call the Technical Service Department at 610-558-2700 prior to sending the unit to Sensaphone for repair.

If the unit must be sent to Sensaphone for Servicing, please do the following:

- 1) Unplug the AC power supply from the wall outlet and disconnect all sensors from the alert zones.
- 2) Carefully pack the unit to avoid damage in transit. Use the original container (if available) or a sturdy shipping box.
- 3) You must include the following information to avoid shipping delays:
  - a) Your name, address and telephone number.
  - b) A note explaining the problem.

- 4) Ship your package to the address below:

SERVICE DEPARTMENT  
SENSAPHONE  
901 Tryens Road  
Aston, PA 19014

- 5) Ship prepaid and insured via UPS or US Mail to ensure a traceable shipment with recourse for damage or replacement.





**BLANK SHEET**

## **BLUE DIVIDER SHEET**

## **BLUE DIVIDER SHEET**

# CloudGate



User guide

## CloudGate Setup Guide

Last updated on 19/06/2015

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# CloudGate Setup Guide

When the CloudGate is connected to a laptop through an Ethernet cable, you can configure the device locally using the on-device web interface.

The CloudGate does automatically recognize the presence of an expansion card. The web interface is updated accordingly: it shows one or multiple additional tabs that allow the user to configure the parameters of the inserted expansion card(s).

The following subsections explain:

- how to configure the base unit
- how to configure the expansion cards

The web interface allows you to configure one device at a time.

## Setup and configure the Base Unit

When the CloudGate is connected to a laptop through an Ethernet cable, you can configure the device locally using the on-device web interface. The web interface allows you to configure one device at a time.

TIP: To provision a number of CloudGates at once, use the web interface to create a configuration file and use the CloudGate Universe to download the file to multiple devices. The procedure how to do this is explained in the CloudGate Universe Guide.

In the Logging On section you can learn how to log on to the on-device web interface.

The web interface displays a number of tabs based on the expansion cards installed. For the CloudGate base unit with no expansion cards, the following default tabs are available: Home, Interfaces, Firewall, Connection Persistence, Provisioning, System and VPN. In the Interfaces tab you can select between Main Ethernet and 3G Connection.



Click this tab	To do these tasks
Home	<ul style="list-style-type: none"> <li>- Verifying the Internet Connection</li> <li>- Checking the Firmware Version</li> </ul>
Interfaces, then select Main Ethernet	<ul style="list-style-type: none"> <li>- Disabling the WAN/LAN Switchover Feature</li> <li>- Managing IP Configuration Settings</li> </ul>
Interfaces, then select 3G Connection <sup>1</sup>	<ul style="list-style-type: none"> <li>- Configuring the WWAN Interface</li> <li>- Choosing a Wireless Operator</li> <li>- Setting Up SIM Parameters</li> <li>- Setting Up WWAN Connection Parameters</li> <li>- Choosing PIN Code Settings</li> <li>- Setting up Verizon Wireless or Sprint wireless operators</li> </ul>
Firewall	<ul style="list-style-type: none"> <li>- Setting Default Firewall settings</li> </ul>

Click this tab	To do these tasks
	<ul style="list-style-type: none"> <li>- Setting Up the DMZ</li> <li>- Setting Up Inbound Port Forwarding</li> <li>- Setting Up Outbound Port Filtering</li> <li>- Setting Up Outbound Trusted IPs</li> <li>- Setting Up Static Routing</li> </ul>
Connection Persistence	<ul style="list-style-type: none"> <li>- Configuring the Connection Watchdog</li> <li>- Configuring the Automatic Timed Reset</li> </ul>
Provisioning	<ul style="list-style-type: none"> <li>- Setting up Automatic updates</li> </ul>
System	<ul style="list-style-type: none"> <li>- Setting up the Time Zone</li> <li>- Setting up Remote Access to the CloudGate</li> <li>- Setting up a Dynamic DNS Service</li> <li>- Changing the Username and Password <ul style="list-style-type: none"> <li>- Creating Log Files</li> </ul> </li> <li>- Download a configuration file</li> <li>- Manually Resetting the CloudGate</li> </ul>
VPN	<ul style="list-style-type: none"> <li>- Setting up Tunnel Management</li> </ul>

Note1:

The CloudGate Ethernet (CG0102) will not show a "3G connection" tab as it has no WWAN module.

## 1.1.1. Logging On to the Base Unit

To log on to the on-device web interface:

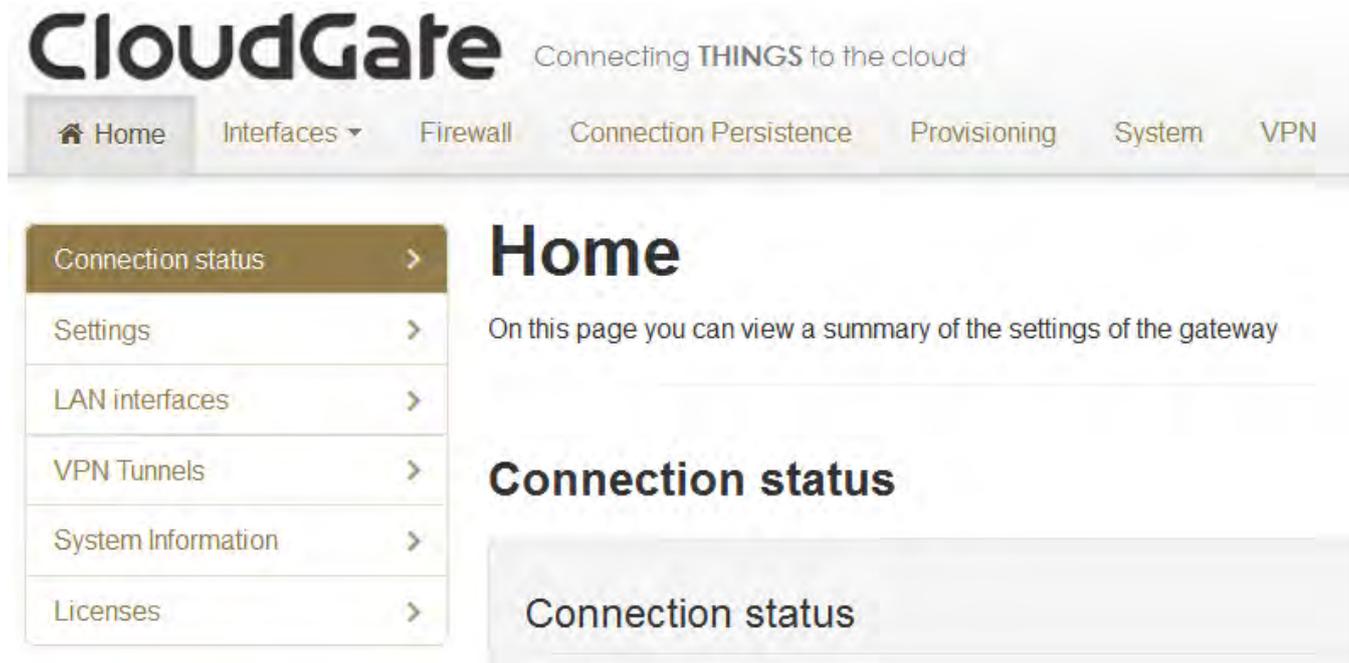
1. In a web browser, go to the URL: 192.168.1.1.
  2. Enter the username and password, and then click "Login".
- Use the default username "admin" and password "admin". Via the System Tab you can change the default username and password later if necessary.



The screenshot shows a web interface for logging in. At the top left, the text "Please login" is displayed. Below this, there are two input fields: "Username" and "Password". Underneath the password field, the text "default username/password: admin/admin" is shown. In the bottom right corner, there is a green button labeled "Login".

## 1.1.2. Home Tab

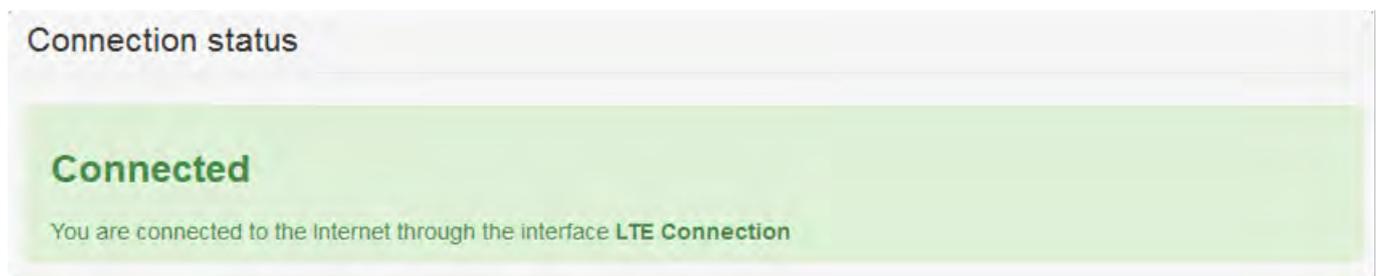
The Home tab displays the CloudGate connection status, the connection settings, the different available LAN interfaces, the VPN tunnels and the system information, like firmware and software versions installed.



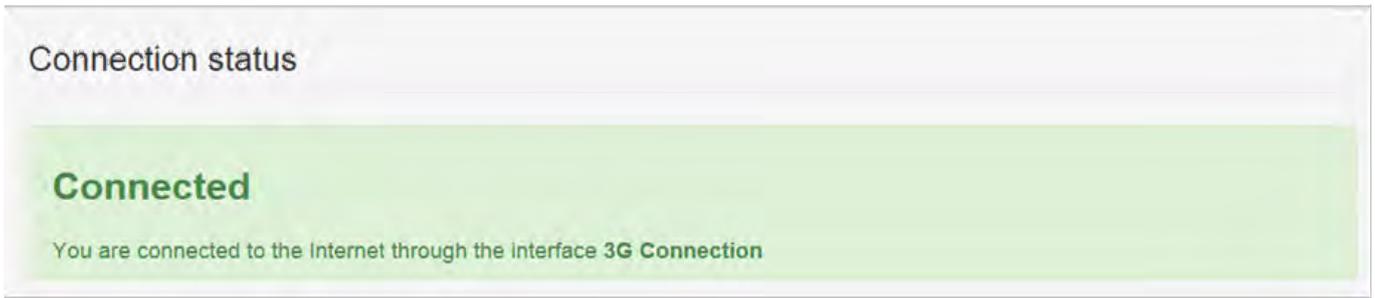
## Connection status

Displays the type of Internet connection and reports if the unit is connected or not connected.

In case of a CloudGate LTE that is connected to the LTE network, the screen looks as follows:

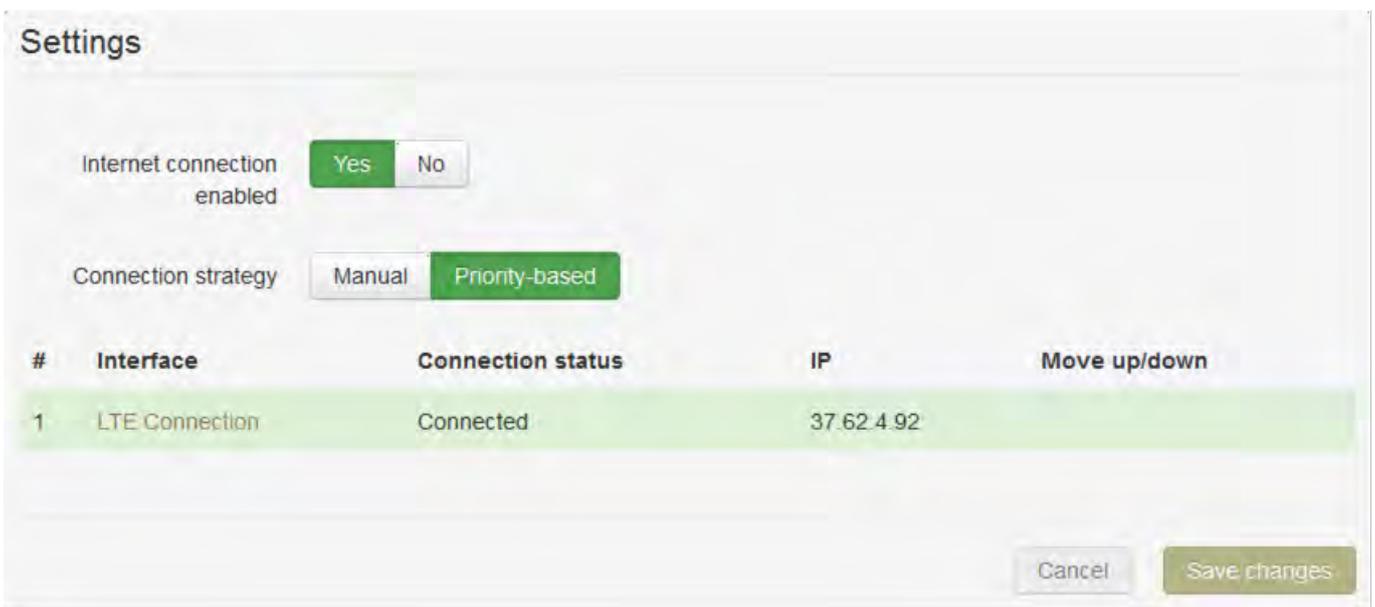


In case of a CloudGate 3G that is connected to the 3G network, the screen looks as follows:



## Connection settings

In case of a CloudGate LTE that is connected to the LTE network, the screen looks as follows:



For a CloudGate 3G the screen looks as follows:

**Settings**

Internet connection enabled  Yes  No

Connection strategy  Manual  Priority-based

#	Interface	Connection status	IP	Use for internet connection
1	3G Connection	Connected	92.48.145.253	<input checked="" type="checkbox"/>
2	WLAN Client			<input type="checkbox"/> Use this

Note: the WLAN client settings are not present if there is no WLAN expansion card (CG2101) inserted.

Internet connection enabled:

This parameter enables (yes) or disables (No) the WAN interface.

- default = Yes

Connections strategy:

This parameter defines which interface should be chosen to connect to the internet (WAN interface) in case multiple solutions are possible. Two possible solutions are available: "Manual" and "Priority based".

- Manual
  - In manual mode, the interface with a blue background will be the one and only interface to the internet (WAN interface).
  - In order to change the interface press on the "use this" button behind the interface you would like to be the WAN interface.
- Priority based
  - In priority based mode the CloudGate will first try to make a WAN connection with the interface on the top row of the table.
  - When the first interface is unable to make a connection to the internet the second interface will be taken
  - When the second interface fails the next line will be taken.
  - In order to change the priorities, press on the arrows behind the interface

you would like to change.

- default = Priority based

Important:

The CloudGate decides that he's not connected anymore when:

- For the Ethernet connection the cable is removed.
- For the 3G connection when a disconnect message of the network is received
- For the WLAN connection when out of range.

This functionality can be extended when used together with the connection persistence feature.

## LAN interfaces

This is a list of the available LAN interfaces and their IP address.

LAN interfaces			
#	Interface	Enabled	IP
1	Main Ethernet	✓	192.168.1.1
2	WLAN Access Point 1	✓	192.168.2.1
3	WLAN Access Point 2		192.168.3.1

Note: the WLAN interfaces are not present if there is no WLAN expansion card (CG2101) inserted.

## VPN Tunnels

This is a list of the active VPN tunnels.

VPN Tunnels			
#	Interface	Connection status	Type

## System information

## System Information

Device serial number: **MX19D3C0JN**

There are no updates available on the CloudGate Universe server.

Firmware version: **Option Firmware - 1.43.0**

Image version: **No application - not set**

Configuration version: **Option Default Configs - empty**

### Device serial number

- This shows the serial number of the CloudGate

### Firmware version

- This is the version of the Option firmware. Every CloudGate needs an Option firmware!

### Image version

- This is the version of the developers image. This image is only required in case you need features which are not part of the Option firmware.

### Configuration version

- This is the version of the configuration file.
- A configuration file is not mandatory, it's a way to provision CloudGate settings to multiple units. More information can be found in the CloudGate Universe Guide.

## 1.1.3. Interfaces Tab

The interfaces menu groups the settings of all connection technologies.

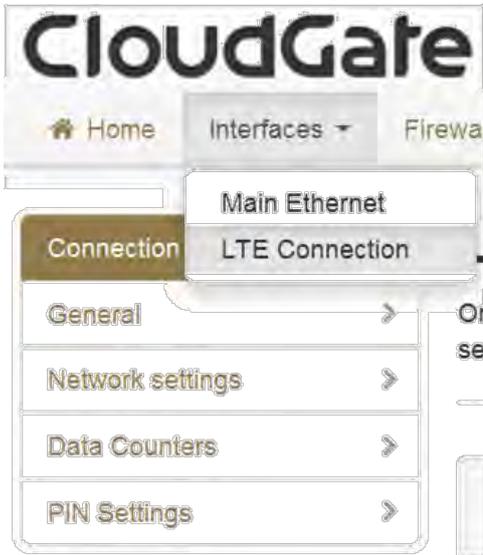
The content of this menu depends on the CloudGate model and on the expansion cards that are inserted.

### CloudGate LTE WW

In case of a CloudGate LTE WW base unit the Interfaces Tab looks as follows:

- Main Ethernet
- LTE Connection

Note: the base unit is the CloudGate without expansion cards inserted.

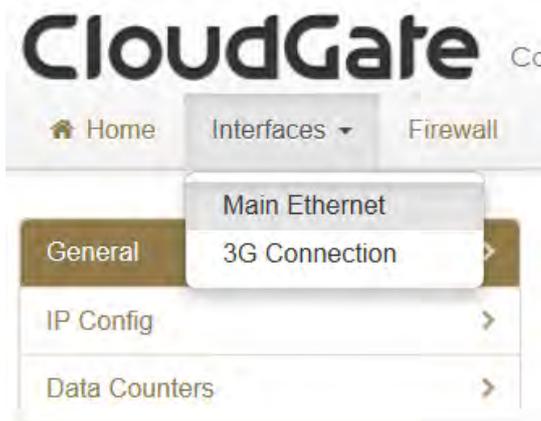


### CloudGate 3G

For a CloudGate 3G base unit the Interface Tab shows the following list:

- Main Ethernet
- 3G Connection

Note: the base unit is the CloudGate without expansion cards inserted.



Depending upon the presence of expansion cards, the list can be expanded with one or more interfaces.

In case a WLAN expansion card (CG2101) is inserted in the CloudGate, the following interfaces are visible in the web interface:

- Main Ethernet
- 3G Connection
- WLAN Client
- WLAN Access point

The explanation about the WLAN Client and WLAN Access Point Tab settings can be found in the corresponding subsection of the "Setup Expansion Cards" chapter.



In case an Ethernet Switch (CG1103, CG1104 or CG1109) and a WLAN expansion card (CG2101) are inserted in the CloudGate, the following interfaces are visible in the web interface:

- Main Ethernet
- Ethernet Switch

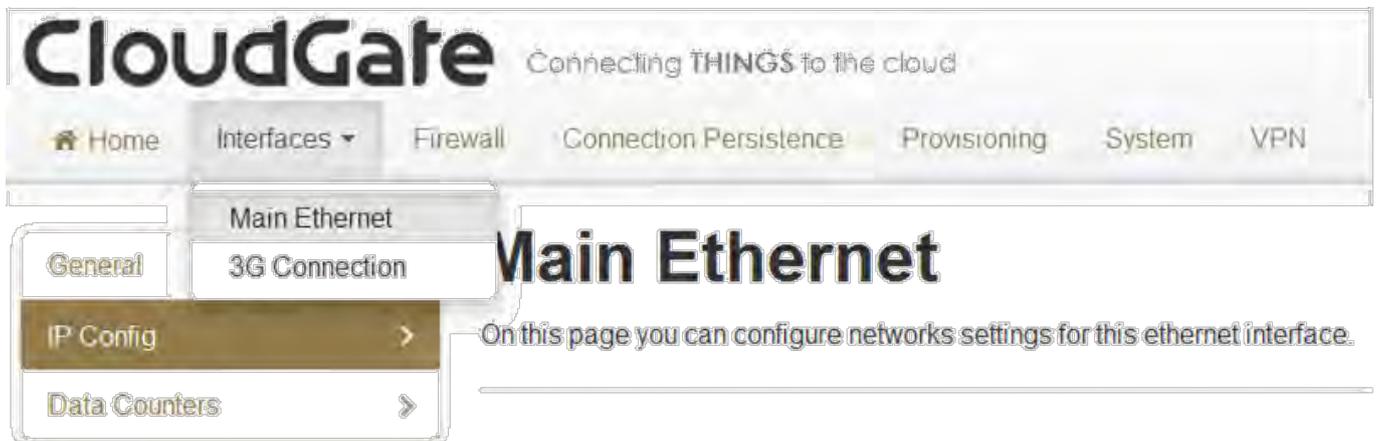
- 3G Connection
- WLAN Client
- WLAN Access point

The explanation about the Ethernet Switch Tab settings can be found in the corresponding subsection of the "Setup Expansion Cards" chapter.



### 1.1.3.1. Main Ethernet Tab

The Main Ethernet tab configures the behavior of the Ethernet port of the base unit at startup and manages IP network settings.



It includes the following sections:

- General
- IP Config
- Data Counters

## General

Enabled  Yes  No

Mode  LAN  WAN  PPPoE

WAN/LAN Switchover  Yes  No

MTU

---

## IP Config

IP address   
ex: 192.168.2.1

Netmask   
ex: 255.255.255.0

Enable DHCP server  Yes  No

DHCP range  to

Lease time

DNS 1

DNS 2

## General

### Enabled

- Enables (Yes) or disables (No) the Ethernet interface on the main board of the CloudGate
- default = Yes

### Mode

- The Mode setting will define the state of the Ethernet interface in case the WAN/LAN Switchover feature is disabled.
- In case the WAN/LAN switchover feature is enabled the state of the Ethernet

interface will be as in the table below.

- PPPoE: Point to Point Protocol over Ethernet

### WAN/LAN Switchover

- This setting enables or disables the WAN/LAN switchover feature
- By default, WAN/LAN switchover is enabled.
- If set to Yes the Cloudgate tries to connect to the internet through the Ethernet connection, such as an ADSL or cable modem.
- If a connection is found, then the port switches to WAN mode and acts as a WAN interface.
- If there is no connection available, then the port switches to LAN mode and acts as a LAN interface.
- Set to No to power on the Ethernet port as defined in the "Mode" parameter.

### Combination of Mode and WAN/LAN Switchover

Result of WAN/LAN switchover feature	State of "Mode"	End result
WAN	LAN	WAN
WAN	WAN	WAN
LAN	LAN	LAN
LAN	WAN	WAN

A more detailed explanation of the WAN/LAN switchover feature, together with a flowchart, can be found below.

## IP Config

### IP address

- Sets the IP address of the CloudGate. By default the IP address is 192.168.1.1 you can change this to any value you want.

### Netmask

- Sets the netmask of the CloudGate. By default the netmask is set to 255.255.255.0 you can change this to any value you want.

### Enable DHCP server

- Enables the DHCP server. By default the DHCP server is enabled. (When the Ethernet port is in LAN state.) In case you want to use static IP addresses in your network you can disable the DHCP server.

## DHCP range

- Sets the DHCP range for the DHCP server.
- Default range is 100 to 250

## Lease time

- Sets the lease time of the connection
- Default lease time is 12 hours

## DNS 1 and DNS 2

- When the Ethernet interface is in LAN mode the DNS fields will be empty by default. As a result the CloudGate itself will act as a DNS server. All the connected Ethernet devices will receive an DNS address which is equal to the CloudGates IP address (by default 192.168.1.1). When the DNS server inside the Cloudgate can't resolve the DNS request it will forward the request to the DNS server of the WAN connection.
- When the Ethernet interface is in WAN mode the DNS address will be defined by the DHCP server of the internet provider. When the DNS fields are changed to another value then the other IP address will be used for the DNS server.

## Reserved leases

- Lists the DHCP leases which are assigned to a certain MAC address.
- Click "Add" to assign another lease and link a MAC address to an IP address.

## Active leases

- Lists the active DHCP leases of the devices connected to the CloudGate.
- Click "Reserve" to add the lease to the "Reserve leases" list.

**Reserved leases**

Hostname	MAC	Lease time	IP	Active	Actions
Option-Canada	00:15:b7:6d:f1:67	1d	192.168.1.237	✘	 
Option-US	00:23:32:da:de:52	1d	192.168.1.122	✔	 

**Active leases**

Hostname	MAC	IP	Actions
Option-US	00:23:32:da:de:52	192.168.1.122	<input type="button" value="+ Reserve"/>

## WAN/LAN Switchover Feature

The Ethernet port can be in two states:

- WAN state: the Ethernet interface acts as a WAN interface. In this state the Ethernet port can be connected to the Internet, e.g. via an ADSL or a cable modem
- LAN state: the Ethernet interface acts as a LAN interface. In this state e.g. a PC can locally be connected to the Ethernet port and the CloudGate will act as DHCP server on this connection

The Cloudgate has a built in mechanism to maximize the internet connectivity via the Ethernet port. There are two elements in this mechanism:

- An automatic WAN/LAN switchover feature that determines the state of the port after power on
- A manual setting "Mode" by which the user can determine the state if the WAN/LAN switchover is disabled or can force the state to WAN even if the switchover mechanism determined the power-on state to be LAN

## WAN/LAN detection at power up

The WAN/LAN switchover feature defines the state of the Ethernet port at power-on. By default, this feature is enabled. See above how to disable WAN/LAN Switchover.

If the feature is enabled then the following will happen each time the CloudGate is

powered on:

- CloudGate will check if he can reach the internet via the Ethernet port by sending a DHCP discover message over the Ethernet interface.
- When it receives a DHCP offer it proceeds with the DHCP protocol and the Ethernet interface remains in WAN state.
- When it does not receive a DHCP offer it resends the DHCP discover message. If no DHCP offer is received after five tries, the CloudGate starts running a DHCP server on the Ethernet interface and act as a LAN interface.

TIP: WAN/LAN detection only happens during power on. The Ethernet connection remains in the same state (WAN or LAN) until a power cycle or reset has happened.

## Manual selection of the Mode

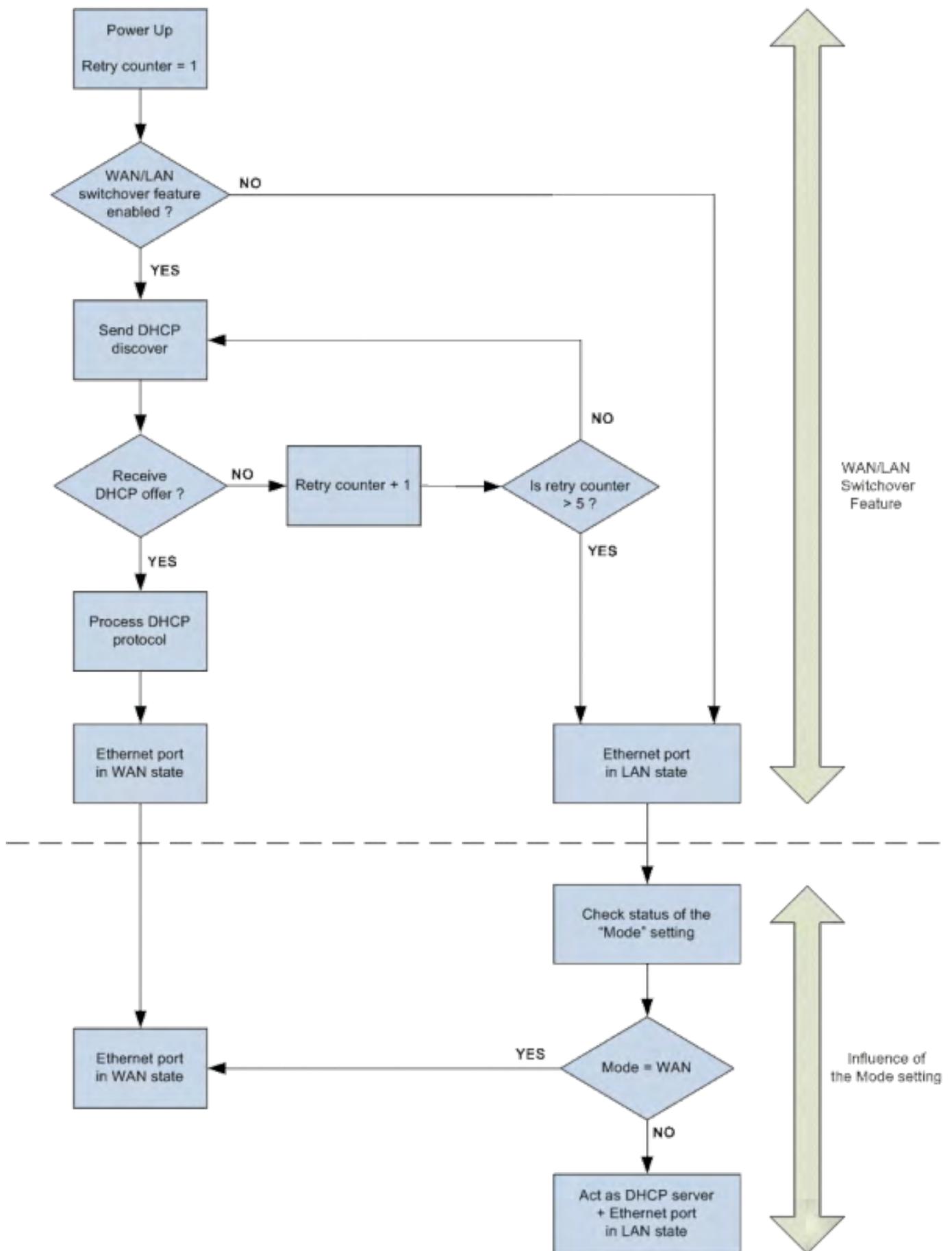
By setting the Mode parameter the user has the possibility to select the preferred state of the Ethernet port (LAN or WAN). By default the Mode is set to LAN. See above how to change the Mode setting.

If the WAN/LAN switchover feature is disabled, then the state of the Ethernet port is determined by the Mode setting.

If the WAN/LAN switchover feature is enabled, then the state is determined by this feature, unless the user has set the Mode to WAN. In that case the result of the switchover feature is overruled by the Mode setting.

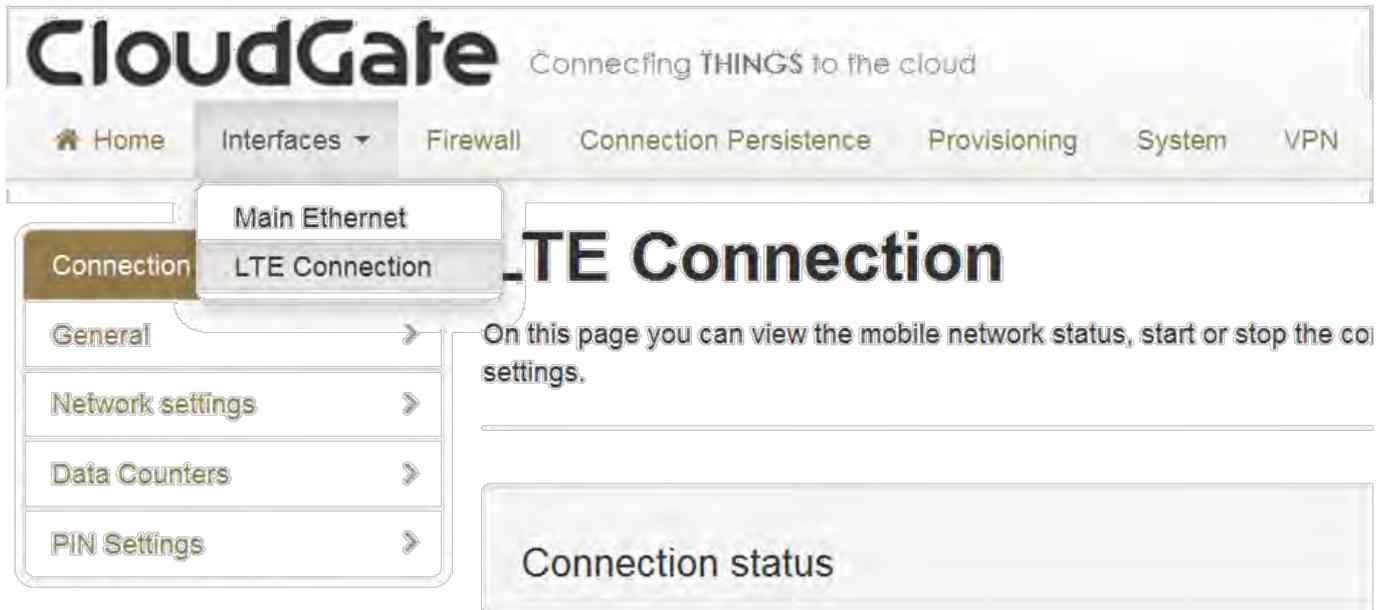
## Final state of the Ethernet port

Following flow diagram shows how the WAN/LAN switchover feature works and what the influence is of the Mode setting.



## 1.1.3.2. LTE Connection Tab

The LTE Connection tab configures the CloudGate WWAN interface, as well as LTE network settings.



It includes the following sections:

- Connection Status
- General
- Network Settings
- Data counters
- PIN Settings

### Connection Status

The Connection status section provides information about the LTE wireless WWAN network.

## Connection status

### Connected

The gateway is connected to the mobile network

Operator BEL PROXIMUS

Signal strength -99 dBm

Technology LTE

Voice number

## IP configuration

<b>IP</b>	46.178.17.142
<b>Netmask</b>	255.255.255.0
<b>Gateway</b>	46.178.17.1
<b>DNS 1</b>	80.201.237.239
<b>DNS 2</b>	80.201.237.238

### Operator Name

- Displays the name of the wireless operator the CloudGate is connected to.

### Signal Strength

- Displays the received signal strength.

### Technology

- Displays the technology used by the wireless operator.

### Voice number

- Displays the voice number linked to the SIM card for LTE wireless operators.

# General

The General section configures the LTE WWAN interface on the CloudGate.

General

Enabled  Yes  No

Only upon traffic  Yes  No

Connect while on international roaming  Yes  No

WWAN Passthrough mode  Yes  No

Allow ICMP  Yes  No

Radio firmware selection  AT&T LTE  Generic LTE\*  Verizon LTE

Cancel Save changes

## Enabled

- Enables and disables the WWAN (LTE) interface,
- Set to Yes (default) to enable the WWAN interface.
- Set to No to disable the the WWAN interface.

**IMPORTANT:** the fact that the LTE interface is enabled, does not necessarily mean that a connection will be set up via this LTE interface. The CloudGate will select one of the available interfaces, depending upon the "Manual" or "Priority-based" settings as described in the Home Tab

## Only upon traffic

- By default, the device is always connected to the network and can send and receive data in both directions: Internet to CloudGate, and CloudGate to Internet. To protect the device from unauthorized access and ensure you only pay for the data you want to send, you can configure the device to connect only when it has data to transmit.
- Set to Yes to connect the device to the WWAN when it has data to send and

disconnect it afterwards. Note that when the device is disconnected, it is also unable to receive data. Option recommends enabling this feature only if you are interested in one way, CloudGate-to-Internet data flow.

- Set to No (default) to disable sending data only upon traffic.

IMPORTANT: Remote login to the CloudGate does not work when "Only upon traffic" is enabled.

### Connect while on international roaming

- Manages international roaming settings for a device installed in a vehicle.
- If set to Yes, international roaming is enabled.
- If set to No (default), international roaming is disabled. Option recommends disabling this feature to prevent high roaming costs.

IMPORTANT: National roaming is always allowed on the CloudGate. The "Connect while on international roaming" feature only has an impact on international roaming behaviour.

### WWAN Passthrough Mode

- By default, the Passthrough Mode is disabled (set to No).
- If set to Yes, the connected laptop receives an IP address from the wireless operator through the CloudGate.

### Radio firmware selection

- Different network operators require a different firmware. With the radio buttons you can select a network operator and then the corresponding firmware will be selected automatically.
- AT&T LTE
- Generic LTE
- Verizon LTE

## Network Settings

**Network settings**

APN:

Authentication method:  Automatic  PAP  CHAP  None

Username:

Password:

Network selection method:  Automatic  Manual

Cancel Save changes

You can configure the following network settings.

#### APN

- Sets the APN value automatically based on the SIM card installed.

**IMPORTANT:** When the APN which is set automatically, is not the correct one, you can change it manually. When the APN is manually changed, the CloudGate will remember this and will use this APN every time it detects this individual SIM card. When a different SIM card is inserted the CloudGate will again choose the APN automatically.

#### Authentication method

- Selects the authentication method:
  - Automatic: (default). Uses PAP authentication for connecting to the network, followed by CHAP authentication.
  - PAP: Uses PAP authentication protocol for connecting to the network.
  - CHAP: Uses CHAP authentication protocol for connecting to the network.
  - NONE: No authentication protocol used.

#### Username

- Defines a user name if required by the wireless network subscription.

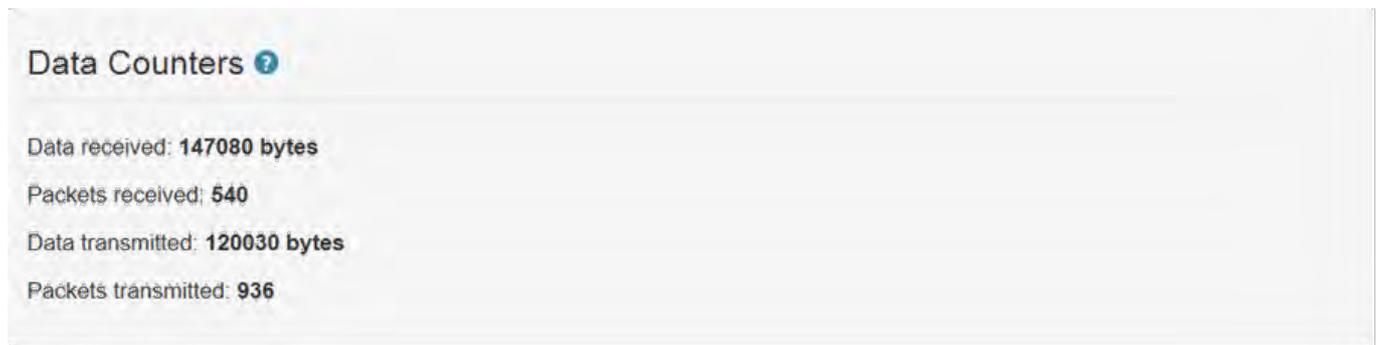
#### Password

- Defines a password if required by the wireless network subscription.

## Network selection method

- Sets the network selection method when roaming:
  - Automatic (default): registers the device to the network corresponding to the SIM card installed. When roaming, the device connects to the roaming partner designated by the wireless operator.
  - Manual: scans for networks and then lets you select a network manually.

## Data counters



The screenshot shows a settings page titled "Data Counters" with a help icon. It displays four statistics: Data received (147080 bytes), Packets received (540), Data transmitted (120030 bytes), and Packets transmitted (936).

**Data Counters** ?

---

Data received: **147080 bytes**

Packets received: **540**

Data transmitted: **120030 bytes**

Packets transmitted: **936**

## PIN Settings



The screenshot shows a settings page titled "Change PIN". It contains three input fields for "Enter current PIN", "Choose new PIN", and "Confirm new PIN". A "Submit" button is located at the bottom right.

**Change PIN**

---

Enter current PIN

Choose new PIN

Confirm new PIN

---

**Submit**

The image shows a web form with two sections: "Enable PIN" and "Save PIN".

**Enable PIN**

Enabled  Yes  No

Enter PIN

**Save PIN**

Enabled  Yes  No

#### Enable PIN

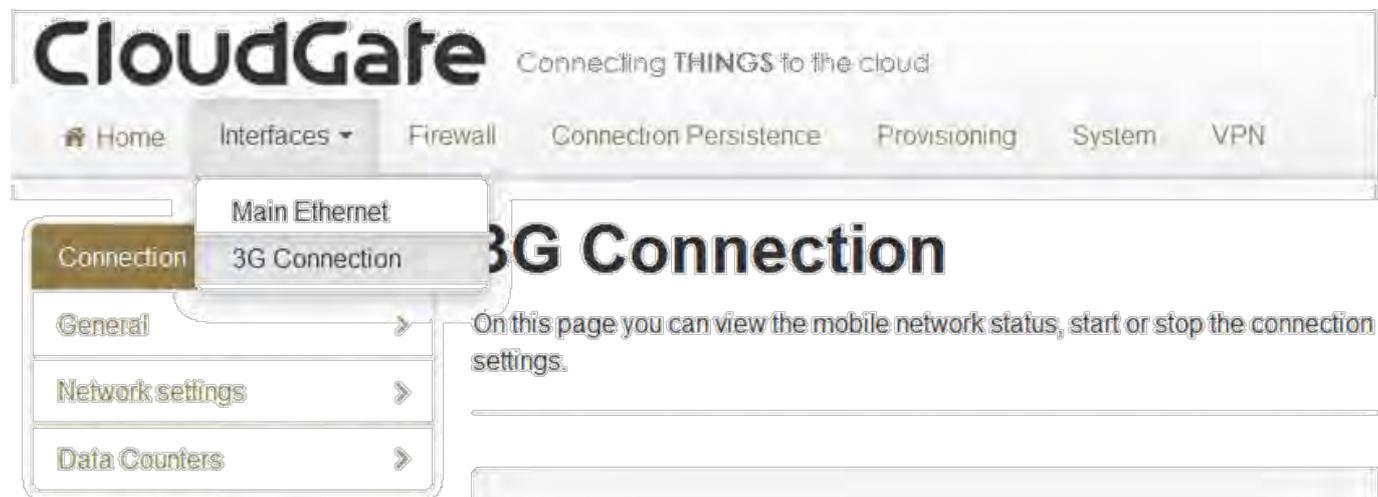
- Enables the PIN code and displays a field for entering the value.

#### Save PIN

- Automatically saves the PIN code.

### 1.1.3.3. 3G Connection Tab

The 3G Connection tab configures the CloudGate WWAN interface, as well as 3G and CDMA network settings.



It includes the following sections:

- Connection Status
- General
- Network Settings
- Data counters
- PIN Settings
- CDMA

### Connection Status

The Connection status section provides information about the 3G wireless WWAN network.

## Connection status

### Connected

CloudGate is connected to the mobile network.

Operator BEL PROXIMUS

Signal strength -65 dBm

ECIO -4 dB

Technology HSDPA & HSUPA

Voice number

## IP configuration

<b>IP</b>	109.140.77.230
<b>Netmask</b>	255.255.0.0
<b>Gateway</b>	109.140.77.229
<b>DNS 1</b>	80.201.237.239
<b>DNS 2</b>	80.201.237.238

### Operator Name

- Displays the name of the wireless operator the CloudGate is connected to.

### Signal Strength

- Displays the received signal strength.

### ECIO

- Displays the energy per chip over the interference. This is a typical way to indicate the quality of 3G networks.

### Technology

- Displays the technology used by the wireless operator.

Voice number

- Displays the voice number linked to the SIM card for 3G wireless operators.

## General

The General section configures the WWAN interface on the CloudGate.

The list of parameters depends on the CloudGate model. For the CloudGate 3G Americas the settings are indicated in the screenshot below:

The screenshot shows the 'General' configuration page for the WWAN interface. It includes several toggle switches and a dropdown menu. The 'Enabled' switch is set to 'Yes'. Other switches include 'Only upon traffic', 'Connect while on international roaming', 'WWAN Div antenna present', 'WWAN Passthrough mode', and 'Allow ICMP', all set to 'No'. The 'Limit Wireless Mode' is set to 'No limit' and the 'MTU' is set to '1500'. A note at the bottom states: 'Note: when using an AT&T SIM card select "AT&T", for all other wireless operators using SIM cards select "UMTS generic"'. The 'Radio firmware selection' section has radio buttons for 'Sprint', 'Verizon Wireless', 'UMTS Generic' (selected), and 'AT&T' (with a red warning message: 'A SIM requiring different radio firmware was detected.'). The 'Connection hunting' switch is set to 'No'. At the bottom right, there are 'Cancel' and 'Save changes' buttons.

General

Enabled  Yes  No

Only upon traffic  Yes  No

Connect while on international roaming  Yes  No

WWAN Div antenna present  Yes  No

WWAN Passthrough mode  Yes  No

Allow ICMP  Yes  No

Limit Wireless Mode

MTU

Note: when using an AT&T SIM card select "AT&T", for all other wireless operators using SIM cards select "UMTS generic".

Radio firmware selection  Sprint  Verizon Wireless  UMTS Generic  AT&T A SIM requiring different radio firmware was detected.

Connection hunting  Yes  No

Cancel Save changes

For the CloudGate 3G EMEA the settings are indicated in the screenshot below:

The screenshot shows the 'General' settings page for CloudGate 3G EMEA. The settings are as follows:

Setting	Value
Enabled	Yes
Only upon traffic	No
Connect while on international roaming	No
WWAN Div antenna present	No
WWAN Passthrough mode	No
Allow ICMP	No
Limit Wireless Mode	No limit
MTU	1500

Buttons: Cancel, Save changes

For the CloudGate 3G JP/APAC the settings are indicated in the screenshot below:

## General

Enabled  Yes  No

Only upon traffic  Yes  No

Connect while on international roaming  Yes  No

WWAN Div antenna present  Yes  No

Allow ICMP  Yes  No

MTU

### Enabled

- Enables and disables the WWAN (3G) interface,
- Set to Yes (default) to enable the WWAN interface.
- Set to No to disable the the WWAN interface.

**IMPORTANT:** the fact that the 3G interface is enabled, does not necessarily mean that a connection will be set up via this 3G interface. The CloudGate will select one of the available interfaces, depending upon the "Manual" or "Priority-based" settings as described in the Home Tab

### Only upon traffic

- By default, the device is always connected to the network and can send and receive data in both directions: Internet to CloudGate, and CloudGate to Internet. To protect the device from unauthorized access and ensure you only pay for the data you want to send, you can configure the device to connect only when it has data to transmit.
- Set to Yes to connect the device to the WWAN when it has data to send and

disconnect it afterwards. Note that when the device is disconnected, it is also unable to receive data. Option recommends enabling this feature only if you are interested in one way, CloudGate-to-Internet data flow.

- Set to No (default) to disable sending data only upon traffic.

**IMPORTANT:** Remote login to the CloudGate does not work when "Only upon traffic" is enabled.

#### Connect while on international roaming

- Manages international roaming settings for a device installed in a vehicle.
- If set to Yes, international roaming is enabled.
- If set to No (default), international roaming is disabled. Option recommends disabling this feature to prevent high roaming costs.

**IMPORTANT:** National roaming is always allowed on the CloudGate. The "Connect while on international roaming" feature only has an impact on international roaming behaviour.

#### WWAN Div Antenna present

- Enables antenna diversity.
- The base unit supports two antenna interfaces: WWAN with Diversity/GPS and WWAN Main. Using both antennas ensures better reception in low coverage areas and increased throughput.
- If set to Yes, antenna diversity is enabled and both physical antennas must be installed.
- If set to No (default), then the RX diversity is disabled.

**IMPORTANT:** Installing one antenna with diversity enabled (set to Yes), results in poor or unstable performance. Make sure that diversity is disabled when there is only one antenna installed.

#### WWAN Passthrough Mode

- By default, Passthrough Mode is disabled (set to No).
- If set to Yes, the connected laptop receives an IP address from the wireless operator through the CloudGate.

**IMPORTANT:** When passthrough is active, data send to port 80 will always redirect to the WebGui of the CloudGate!

#### Limit Wireless Mode

- This parameter allows to limit the unit to register (and connect) on 2G or 3G networks

- Possible settings are: "2G only", "3G only" and "No limit"
- Default setting is "No limit"

#### Image configuration (Radio firmware selection)

- These settings are applicable for the CloudGate 3G Americas
- Different network operators require a different firmware. With the radio buttons you can select a network operator and then the corresponding firmware will be selected automatically.
- If Verizon Wireless or Sprint is selected, the web interface jumps to the CDMA section. Click "Update profile" to provision the unit for CDMA.
- If UMTS Generic is selected for T-Mobile or any operator not listed, you may be required to enter a PIN code. In the PIN code section, enter the appropriate settings and click "Save changes" to provision the unit for UMTS 3G.
- If AT&T is selected, you may be required to enter a PIN code. In the Pin Code section, enter the settings and click "Save changes" to provision the unit for AT&T 3G.
- In case a non-AT&T SIM is inserted, a warning message "A SIM requiring different radio firmware was detected" next to the AT&T radio button and the AT&T firmware cannot be selected

**IMPORTANT:** When using the CloudGate 3G EMEA (CG0112) base unit, you don't have to select the wireless operator. The device uses the UMTS Generic setting.

#### Connection Hunting

Connection hunting is a feature developed by Option that allows the CloudGate to actively search for another network in case the primary network is not available.

When enabled a new section of the menu will appear allowing the user to select which other networks the CloudGate should try to connect to in case the primary connection cannot be established.

The fallback time field allows to select the period during which the CloudGate will try to a network from the list before trying the next network.

Connection hunting  Yes  No

### Connection hunting

Connection hunting configuration

- Verizon Wireless
- UMTS Generic
- Sprint
- AT&T
- Aeris

Fallback time  minutes

IMPORTANT: The connection hunting feature is only available on CloudGate 3G Americas (CG0192).

## Network Settings

### Network settings

APN

Authentication method  Automatic  PAP  CHAP  None

Username

Password

Network selection method  Automatic  Manual

If AT&T or UMTS Generic is the chosen wireless operator firmware, you can configure a number of 3G network settings.

### APN

- Sets the APN value automatically based on the SIM card installed.

IMPORTANT: When the APN which is set automatically, is not the correct one, you can

change it manually. When the APN is manually changed, the CloudGate will remember this and will use this APN every time it detects this individual SIM card. When a different SIM card is inserted the CloudGate will again choose the APN automatically.

### Authentication method

- Selects the authentication method:
  - Automatic: (default). Uses PAP authentication for connecting to the network, followed by CHAP authentication.
  - PAP: Uses PAP authentication protocol for connecting to the network.
  - CHAP: Uses CHAP authentication protocol for connecting to the network.
  - NONE: No authentication protocol used.

### Username

- Defines a user name if required by the wireless network subscription.

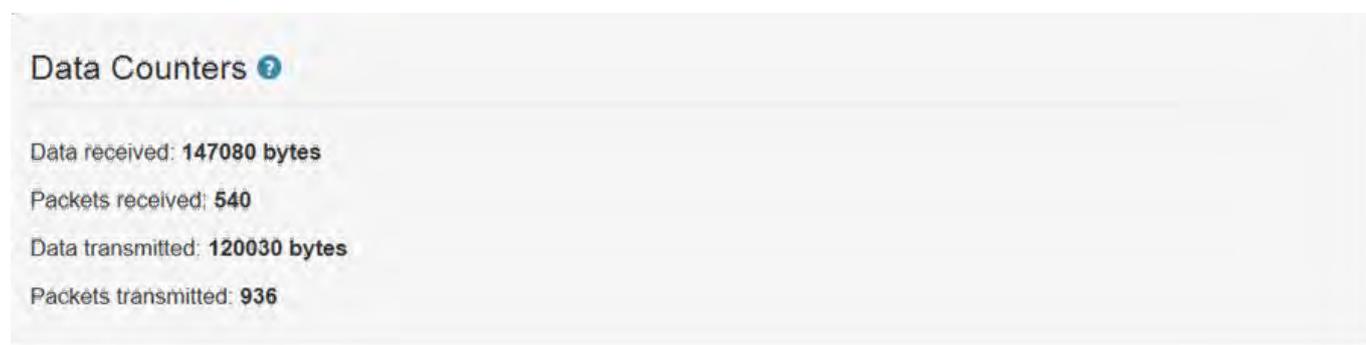
### Password

- Defines a password if required by the wireless network subscription.

### Network selection method

- Sets the network selection method when roaming:
  - Automatic (default): registers the device to the network corresponding to the SIM card installed. When roaming, the device connects to the roaming partner designated by the wireless operator.
  - Manual: scans for networks and then lets you select a network manually.

## Data counters



## PIN Settings

### Change PIN

Enter current PIN

Choose new PIN

Confirm new PIN

When you select AT&T or UMTS Generic as the wireless operator, you may have to enter a PIN code.

### Enable PIN

Enabled  Yes  No

Enter PIN

### Save PIN

Enabled  Yes  No

#### Enable PIN

- Enables the PIN code and displays a field for entering the value.

#### Save PIN

- Automatically saves the PIN code.

## CDMA

This paragraph is only applicable for CloudGate 3G Americas.

If Verizon Wireless or Sprint is the chosen wireless operator, click Update profile to provision the CloudGate.

### CDMA

Programming in progress

[PRL Update](#) [Update profile](#)

## 1.1.4. Firewall Tab



The Firewall tab controls how data passes from one type of interface to another. There are three different sources or destinations for CloudGate data:

- A WAN interface, which is a connection to the Internet
- A LAN connection, which is a connection to a laptop or other computer on the same network interface
- The CloudGate itself, called the Local network

TIP: When the device is powered on, the Main Ethernet interface (this is the Ethernet interface of the base unit) behaves as a WAN or LAN depending on the mode configured through the WAN/LAN Switchover feature, as described in section about the Main Ethernet tab.

The firewall tab includes the following sections:

- Default Policies
- DMZ
- Inbound Port Forwarding
- Outbound Port Forwarding
- Outbound Trusted IPs
- Static Routing

### Default Policies

The Default Policies section sets the basic firewall rules.

## Default policies

LAN -> WAN	Accept
LAN -> LAN	Accept
LAN -> Local	Accept
WAN -> Local	Drop

In order for the changes to take effect, please reboot your gateway after saving.

- Sets the default firewall rules to accept or reject data flow between the following interfaces:
  - LAN to WAN
  - LAN to LAN
  - LAN to Local
  - WAN to Local
- Sets the action for each rule:
  - Accepted: the data is allowed to pass from one interface type to the other interface type.
  - Rejected: the data is not allowed to pass from one interface type to the other interface type; the CloudGate drops the data packets and sends a reject message to the source of the packets.
  - Dropped: the data is not allowed to pass from one interface type to the other interface type; the CloudGate drops these data packets without sending a reject message.

Note: The WAN to Local traffic is by default "Dropped". This makes sure that no incoming traffic from the internet can enter the CloudGate.

## DMZ

The DMZ section configures the demilitarized zone.

This feature forward all incoming data to a specific IP address.

### Enabled

- Enables the DMZ.
- The default status is No

### WAN Interface

- Selects the WAN interface the data will be coming from for forwarding.

### IP Address

- Sets the IP address for forwarding all data coming from a WAN interface.

## Inbound Port Forwarding

The Inbound Port Forwarding section forwards data from a WAN interface to a designated IP address and port.

Protocol	Inbound interface	Source IP	Dest. port	Target IP : port	Actions
<input type="button" value="⊕ Add"/>					

**Note:** Inbound port forwarding is priority based. The first line has the highest priority.

- Lists the inbound forwarding rules, up to a maximum of 40.
- These rules allow you to forward data from a WAN interface to the IP address set in the destination field.
- The port forwarding rules have a higher priority than the DMZ rule!

- Click "Add" to create a forwarding rule. Enter the port information and target IP address in the dialog box and click "Save".

## Edit inbound port forwarding rule

Protocol

Inbound interface

Source IP  Any  
 Specific:

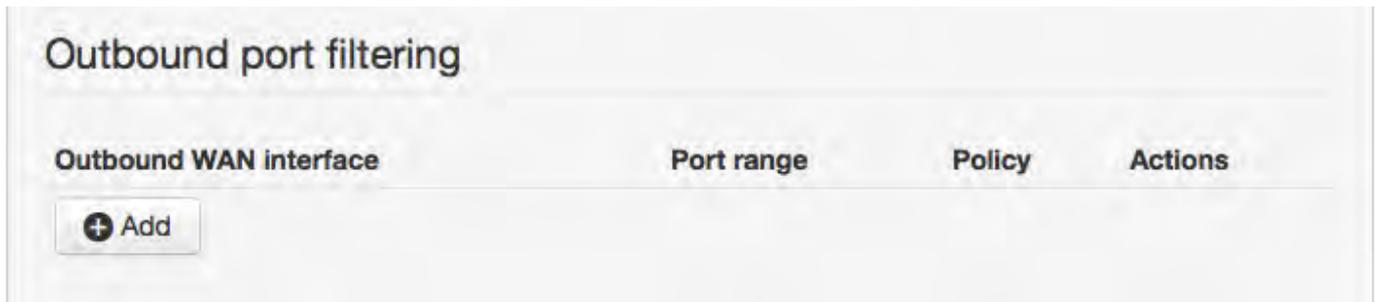
Destination port  Required

Target IP address  Required

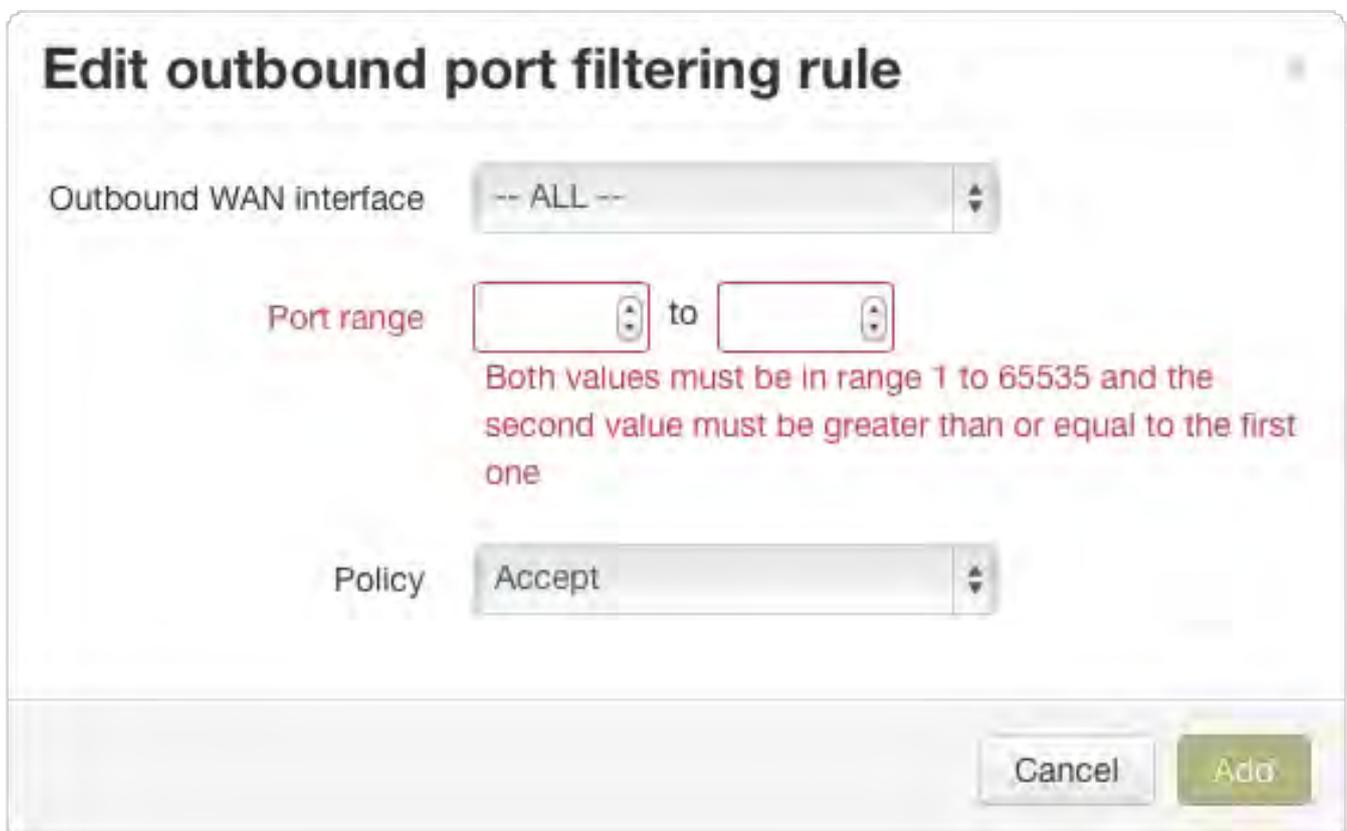
Target destination port  Required

## Outbound Port Filtering

The Outbound Port Filtering section defines the data allowed to pass from the Local or LAN interface to the WAN interface.



- Lists the outbound port filtering rules, up to a maximum of 20.
- By default, all data can be sent to a WAN interface. When an outbound port filtering rule is added, the data sent over the chosen port will be allowed, rejected or dropped.
- Click "Add" to create a filtering rule. Enter the port range and select whether to Allow, Reject or Drop the data sent over the chosen port and click "Save".



## Outbound Trusted IPs

The Outbound Trusted IP list is disabled when "LAN -> WAN" policy is set to "Accept" (this is the factory default setting).

## Outbound trusted IPs

The outbound trusted IP list is disabled when LAN -> WAN Policy is set to 'accept'  
You may click on the button below to change it

Change LAN -> WAN Policy to 'reject'

Cancel

Save changes

When the "LAN -> WAN" policy is set to "reject", you can give a list of Outbound trusted IP's. These IP addresses that can be contacted even when LAN-to-WAN traffic is not allowed.

## Outbound trusted IPs

new IP

Add

Cancel

Save changes

- When the LAN to WAN traffic is rejected or dropped based on the default firewall policies, no data can be transmitted from the LAN to the WAN network.
- The outbound trusted IP list defines the IP addresses that can be contacted even when LAN-to-WAN traffic is not allowed.
- Enter an IP address and click "Add".

## Static Routing

## Static routing

Interface	Target	Netmask	Gateway	Actions
<input type="button" value="⊕ Add"/>				
<input type="button" value="Cancel"/> <input type="button" value="Save changes"/>				

Static routing allows you to define a specific gateway for an IP address

- Interface: specify on which interface you would like to have the static routing
- Target: specify the destination IP address.
- Netmask: specify the netmask of the destination IP address
- Gateway: specify the gateway which has to be used to send packets to the target IP address.

When clicking the "Add" button the following window pops up. Fill out the required fields and tap "Add" to confirm.

## Edit static routing ✕

---

Interface

Target  Required

Netmask  Required

Gateway  Required

# Priority scheme of the different firewall rules

Inbound Rules WAN -> LAN/LOCAL

-  
Next is a list of the PORT FORWARDING rules by priority from high to low:

- 
- 1. HTTPS (port determined in the >SYSTEM tab
- 2. Port forwarding rules
- 3. DMZ

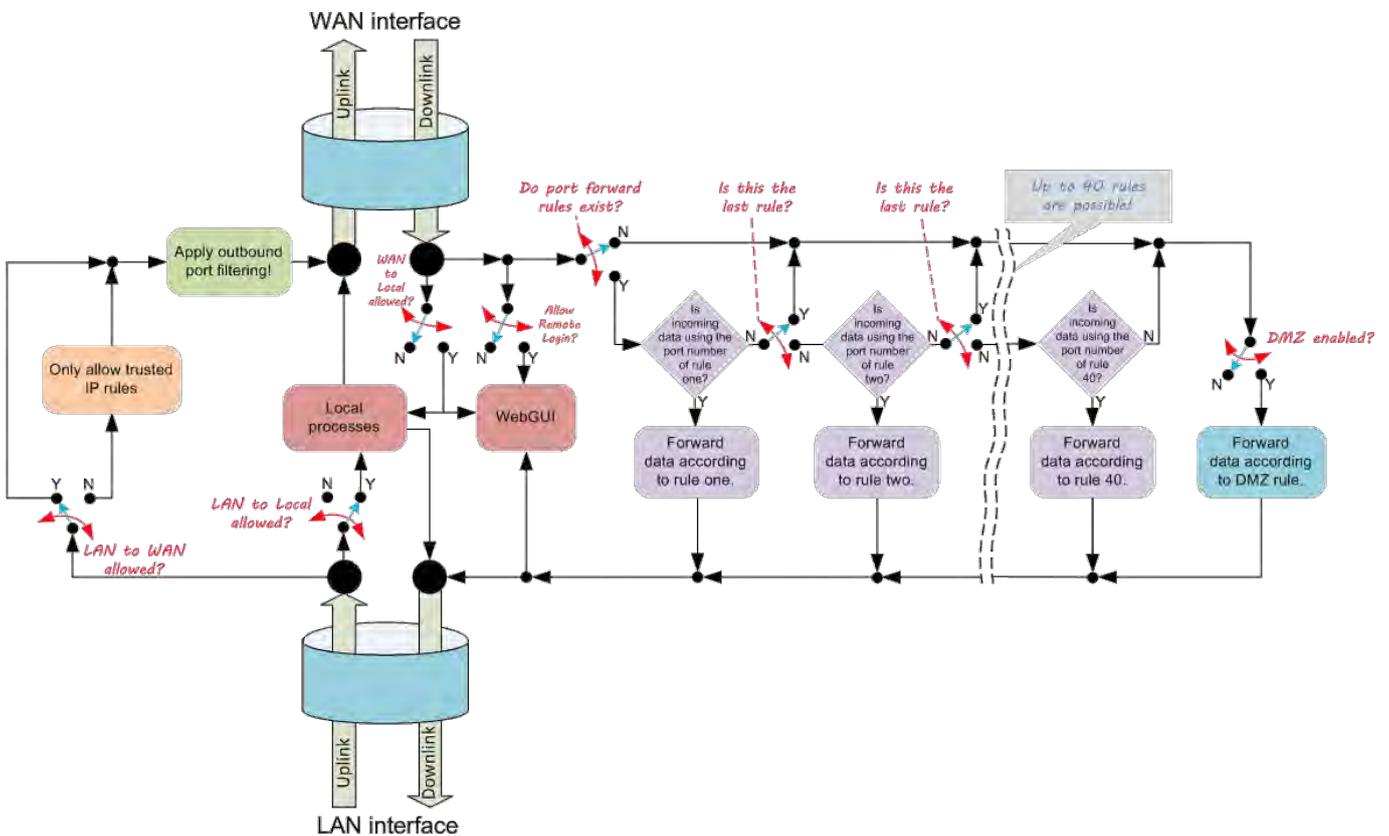
Priority example: If you enable HTTPS and DMZ, you can still use the HTTPS because those port forwarding's are processed before the DMZ redirect.

Outbound Rules LAN -> WAN

-  
Outbound rules in order of priority:

- 
- 1. Port filter rules (only used when trusted IP is disabled).
- 2. Trusted IP rules (if enabled forces general LAN -> WAN rules to Reject/Drop)
- 3. General LAN -> WAN rule (in case of trusted IP always Reject or Drop)

The following scheme (also attached as PDF) gives the overview:



## Connection Persistence Tab



The Connection Persistence tab configures the watchdogs that monitor CloudGate operation and performance.

The following actions can be configured to make sure the CloudGate works properly.

Connection watchdog:

- This watchdog action is based on a connection persistence algorithm that tests if the active WAN interface is able to connect to the internet. If not it will trigger the next WAN interface in the priority list. When it detects that the 3G interface is not able to contact the internet it will trigger the next WAN interface in the priority list and it will reset or reconnect the WWAN module.
- The priority list can be found and configured in the Home Tab under "Connection Settings".

Timed reset:

- This feature will reset the CloudGate after a period of time.

## Connection Watchdog

Algorithm:

- The connection persistence algorithm will regularly check whether it still has internet access. If no data is received after a certain period of time the algorithm will try to lookup a list of up to 5 URLs and/or IP addresses at regular intervals.
- For each URL in the list a DNS request will be sent to verify whether the URL can be resolved. Optionally also a PING request can be sent to that URL.
- For each IP address in the list a PING request will be sent.
- The algorithm will run through the list 3 times.
- If all the above checks fail, the conclusion will be that there is no internet

connection any more and the watchdog action will be executed: the next WAN interface in the priority list will be taken and if the current WAN interface was the 3G interface, then the 3G module will be either reset or just re-connected

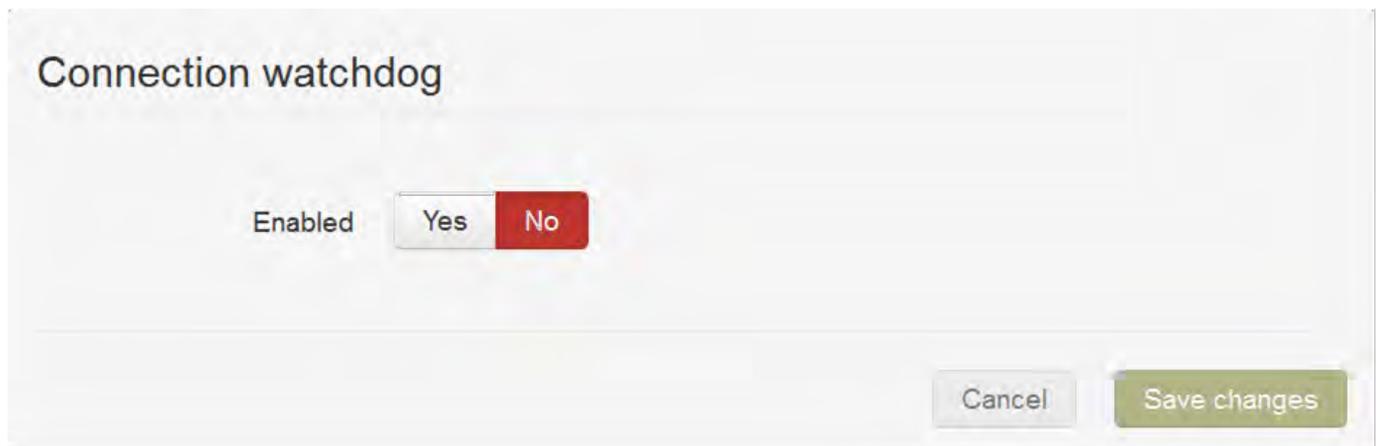
- A flow chart of the connection persistence algorithm can be found below

Notes:

- in the current SW versions the connection persistence algorithm will start to lookup the URL/IP addresses when no data is received during a certain period of time (being the checking interval)
- in future SW versions the algorithm will monitor the internet access continuously, this means independent whether data is received or not. The URL/IP lookup will be checked periodically, after the checking interval

Watchdog configuration

- After factory reset the watchdog is disabled and the screen looks as follows:



Enabled

- Set to No (= default status) to disable the watchdog
- Set to Yes to enable the connection watchdog and to monitor the active WAN interface for data received.

If set to "Yes" the following screenshot appears:

## Connection watchdog

Enabled  Yes  No

Addresses to check No addresses defined

Use PING in addition to DNS  Yes  No

Checking interval    seconds

Watchdog action  Reset interface  Re-establish connection

### Addresses to check

- Specifies the IP addresses or URL's to send a DNS request or PING to if the connection watchdog is enabled
- A maximum of 5 IP addresses or URL's can be specified. .

**IMPORTANT:** The URL's in the table must be the URL name, not the used protocol.

For example:

www.google.com will be accepted.

http://www.google.com will not work

### Use PING in addition to DNS

- If set to No (= default status), then the URL/IP lookup feature will just send a DNS request for each URL
- If set to Yes, then the URL/IP lookup feature will send a DNS request plus a PING
- Note: this parameter has only impact for the URL addresses. For the IP addresses in the list, there will always be a PING sent

### Checking interval

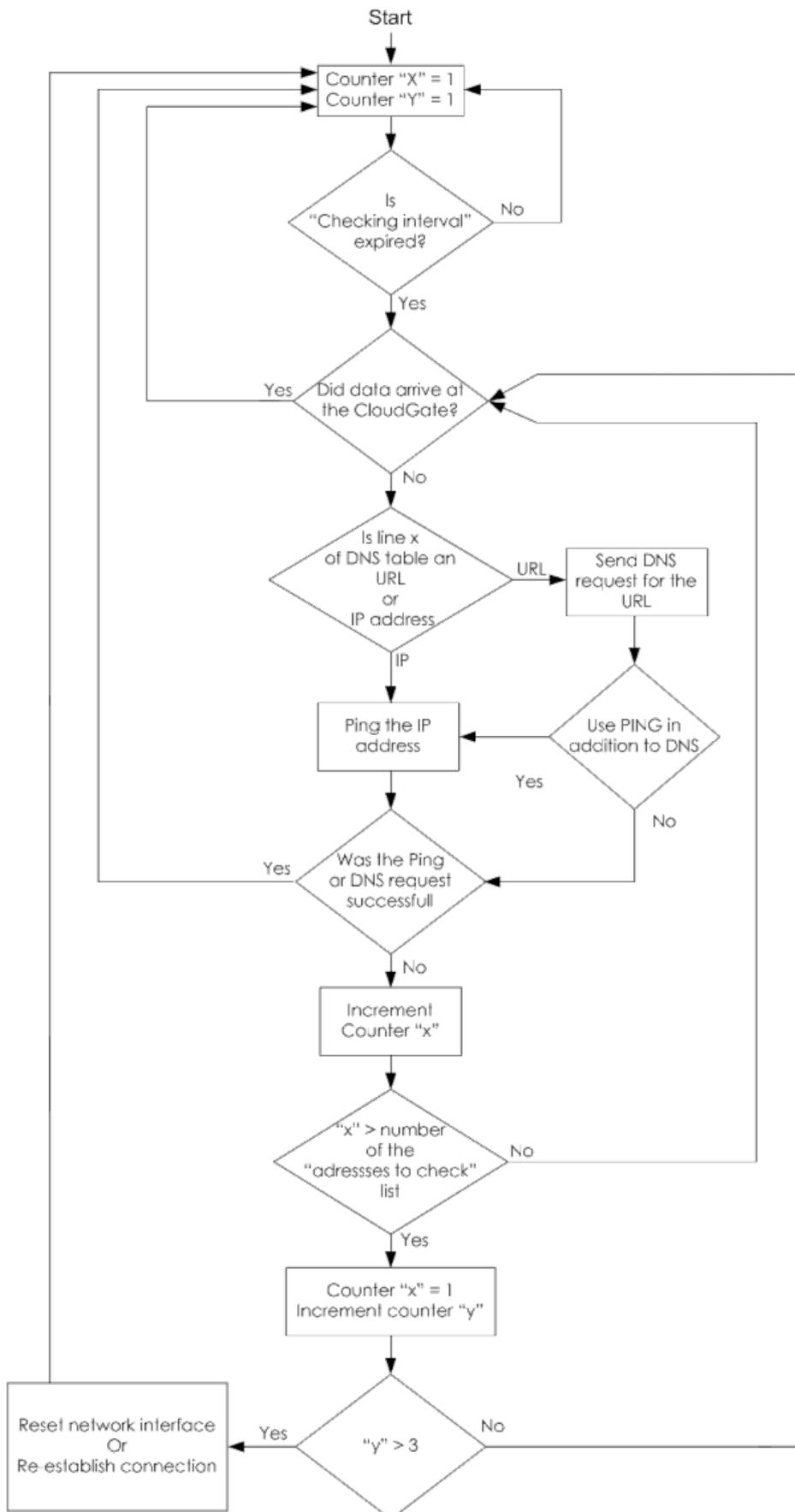
- If no data is received during a time equal to the "checking interval" the connection persistence algorithm will start the URL/IP lookup feature.
- The factory default checking interval is 30 seconds

#### Watchdog action

- If set to "Reset interface" (= default status) then the watchdog will reset the WWAN module.  
Resetting the WWAN module can take about 2 minutes
- If set to "Re-establish connection" then the watchdog will just try to re-establish the connection to the wireless network.  
Reconnecting to the wireless network will take about 20 seconds.

#### Flowchart of the connection persistence algorithm

# Connection persistence watchdog

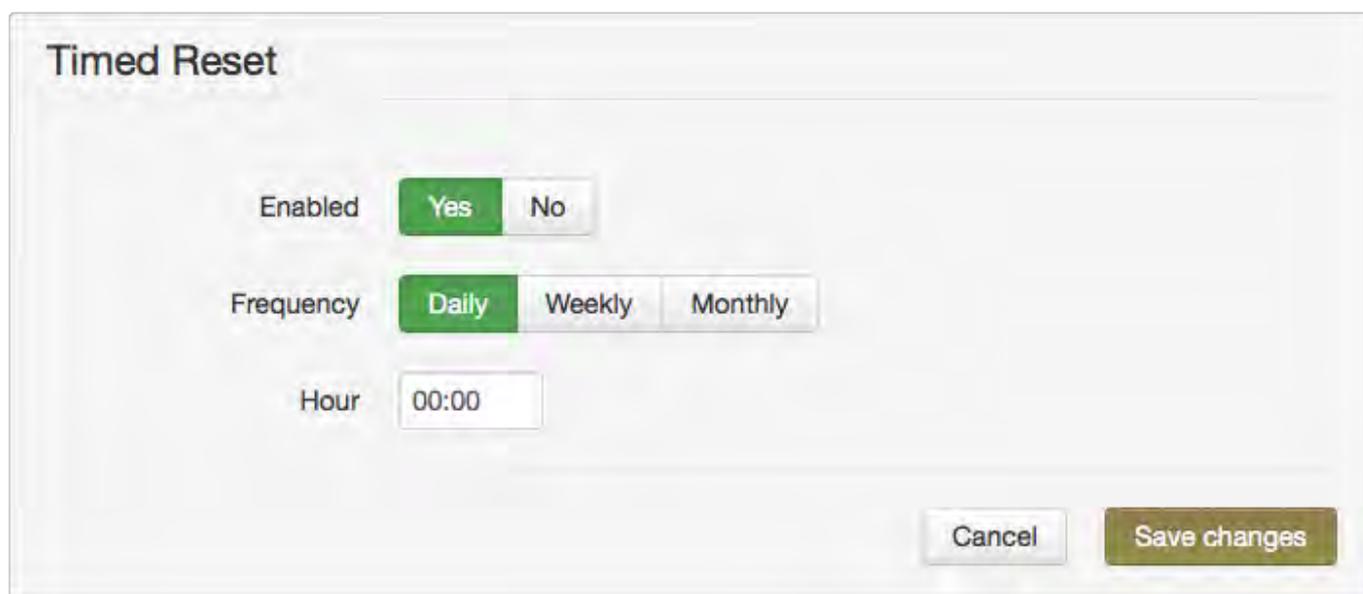


## Timed Reset

The Timed Reset section sets up the CloudGate to reset on a daily, weekly or monthly basis.

The default status after factory reset is "No".

When clicking "Yes" the following screenshot appears.



The screenshot shows a configuration window titled "Timed Reset". It contains three main settings:

- Enabled:** A toggle switch with "Yes" selected (highlighted in green) and "No" unselected.
- Frequency:** Three radio buttons: "Daily" (selected and highlighted in green), "Weekly", and "Monthly".
- Hour:** A text input field containing "00:00".

At the bottom right of the window, there are two buttons: "Cancel" and "Save changes".

### Enabled

- Default status is No
- Set to Yes to enable the Timed Reset watchdog. The CloudGate will reset at the specified time interval.

### Frequency

- Set to Daily and select the time of the day at which you want to perform the reset.
- Set to Weekly and select the days of the week you want to perform the reset. Also select the time of the day. Selected days are green.

## Timed Reset

Enabled  Yes  No

Frequency  Daily  Weekly  Monthly

**Weekdays**  Monday  Tuesday  Wednesday  Thursday  Friday  
 Saturday  Sunday

Please select at least one weekday

Hour

Cancel

Save changes

- Set to Monthly and enter the day of the month and the time of the day.

## Timed Reset

Enabled  Yes  No

Frequency  Daily  Weekly  Monthly

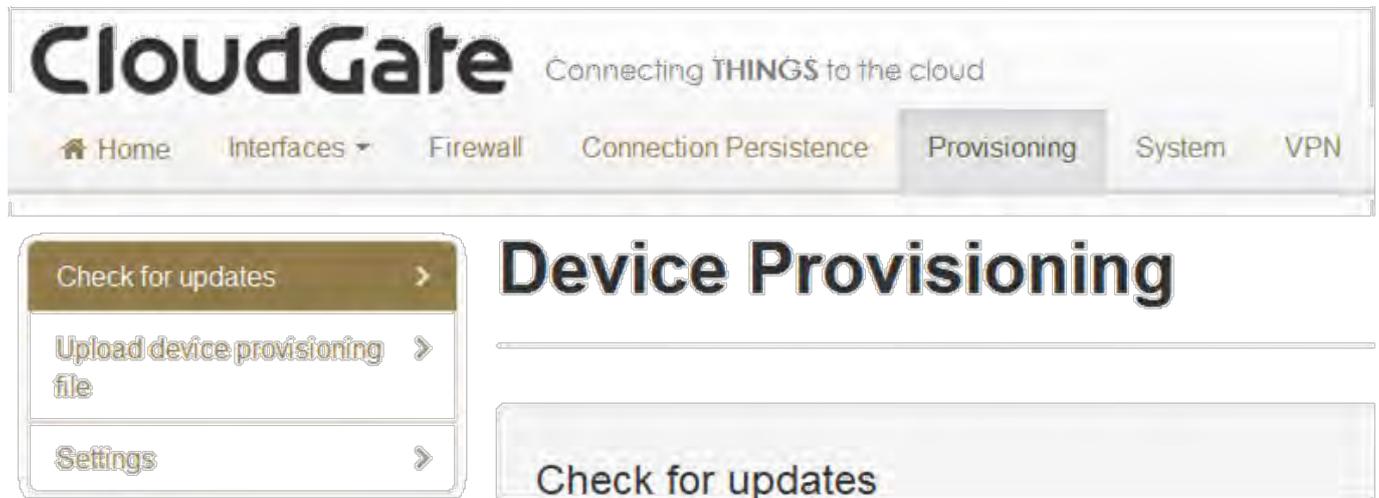
Day of the month

Hour

Cancel

Save changes

## Provisioning Tab



The Provisioning tab configures how and when the CloudGate checks for image updates from the CloudGate Universe server (also called "Provisioning server"), and explains how an image can be uploaded locally.

A CloudGate image contains the following files:

- the firmware provided by Option,
- the radio firmware for the radio module, also provided by Option,
- the configuration file,
- the application software.

The upgrade with a new image can happen:

- either locally from a PC directly connected to the CloudGate via a network cable,
- or remotely over the WAN interface.

Upgrades can be triggered manually or will be driven automatically. The following cases are possible:

- via the WAN interface after CloudGate power on,
- via the WAN interface at regular and configurable time intervals,
- via the WAN interface, but triggered manually via the local web interface,
- locally from a PC connected to CloudGate via a network cable.

The Provisioning Tab explains the configuration screens that are available via the web interface of the device.

The section "Check-in frequency" in the CloudGate Universe Guide explains how to configure the check in frequency for periodic upgrade checks.

## At CloudGate power on

- By default, the CloudGate base unit connects to the CloudGate Universe server each time the device is powered on, and checks for an updated image. The device downloads and installs the update over the WAN interface.

## Check for Updates



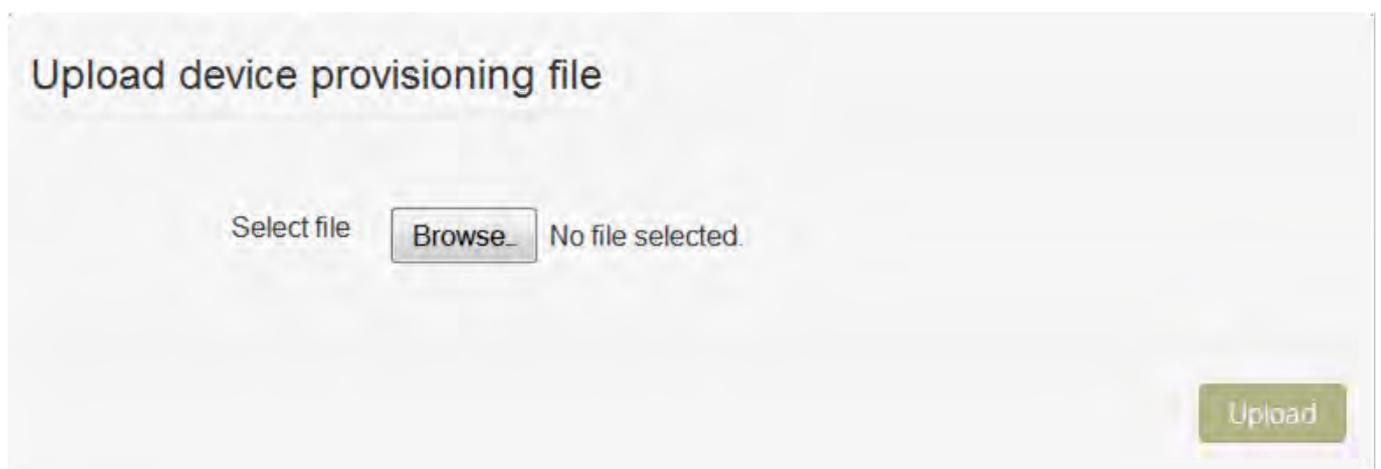
Check for updates

**Note:** this will automatically install updates to the gateway, even when automatic provisioning has been disabled. "Check for updates" can cause data traffic on your wireless operator subscription.

Check for updates

- By this method the user can trigger the CloudGate to check the CloudGate Universe server for firmware, developer image, and configuration file updates
- Click the "Check for Updates" button to check for updates even if "Enable automatic provisioning" (see below) is disabled.

## Upload Option Provisioning File



Upload device provisioning file

Select file  No file selected.

Upload

- This allows the user to upgrade the unit with an image from a PC that is locally connected via a network cable.
- Click "Browse" to select the file and then click "Upload".

# Settings



The screenshot shows a settings window titled "Settings". At the top, there is a light blue note box that reads: "Note: activate 'Enable automatic provisioning' can cause data traffic on your wireless operator subscription." Below the note, the setting "Enable automatic provisioning" is displayed. It has two buttons: "Yes" (highlighted in green) and "No" (grey). At the bottom right of the dialog, there are two buttons: "Cancel" (grey) and "Save changes" (green).

- This setting controls automatic updates from the CloudGate Universe.
- Default value of this parameter (= after factory reset) is "Yes".
- Set to Yes to automatically check for updates. This happens:
  - each time the unit is powered on,
  - depending on the "check in frequency" parameter on the CloudGate Universe. For more details on how to configure this parameter, please refer to the "Check-in frequency" section in the CloudGate Universe Guide
- Set to No to disable automatic provisioning.
  - In this case the CloudGate will not check for updates any more, neither at periodic intervals, nor at power up,
  - But nevertheless the user can connect his PC locally to the CloudGate and manually trigger an upgrade check via the "Check for updates" button (see above).

## Related topics

- Check-in frequency section in the CloudGate Universe Guide
- Managing software section in the CloudGate Universe Guide

## 1.1.7. System Tab

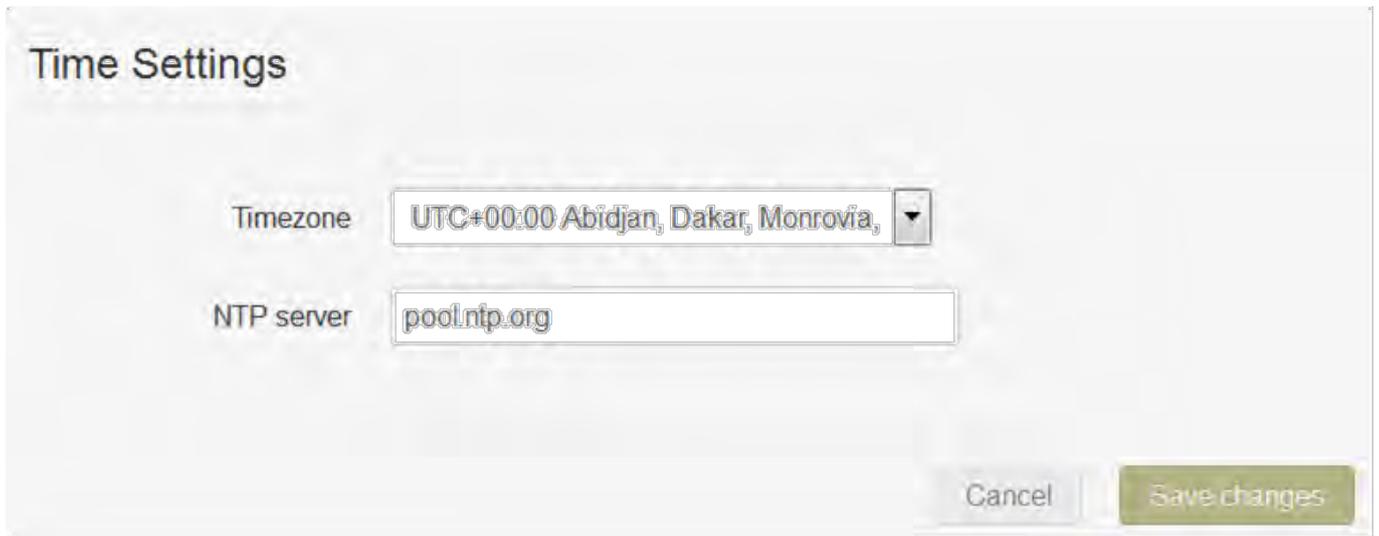
The screenshot shows the CloudGate web interface. At the top, the logo 'CloudGate' is displayed with the tagline 'Connecting THINGS to the cloud'. Below the logo is a navigation menu with items: Home, Interfaces, Firewall, Connection Persistence, Provisioning, System (highlighted), and VPN. The main content area is titled 'System' and includes a sub-header: 'On this page you can configure general settings, remote access etc.' On the left side, there is a vertical sidebar menu with the following items: Time Settings (highlighted), Power Savings, Data Counters, Remote Access, Static DNS, Dynamic DNS, Username & Password, Logging, Config export, System reboot, and Factory reset. The main content area displays the 'Time Settings' configuration page, which includes two input fields: 'Timezone' set to 'UTC+00:00 Abidjan, Dakar, Monrovia,' and 'NTP server' set to 'pool.ntp.org'.

The System tab configures remote access settings, log file parameters, and manual reset settings.

It includes the following sections:

- Time Settings
- Power Savings
- Data Counters
- Remote Access
- Static DNS
- Dynamic DNS
- Username and Password
- Logging
- Config Export
- System Reboot
- Factory Reset

## Time Settings



Time Settings

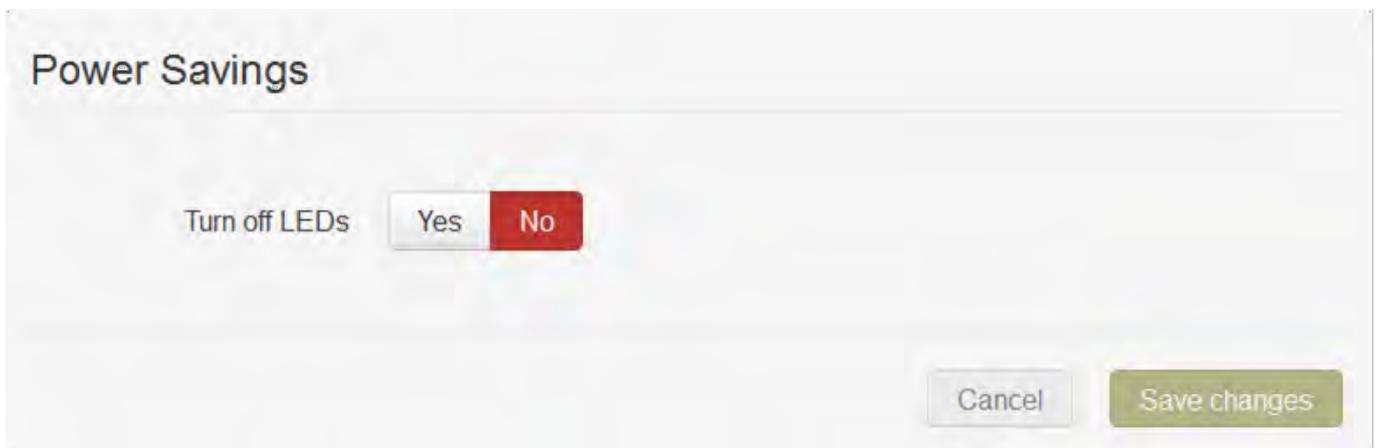
Timezone

NTP server

Cancel Save changes

Sets the timezone used by the unit for the "Timed Reset" watchdog. The description of the "Timed Reset" feature is given in the Connection Persistence Tab.

## Power Savings



Power Savings

Turn off LEDs

Cancel Save changes

### Turn off LEDs

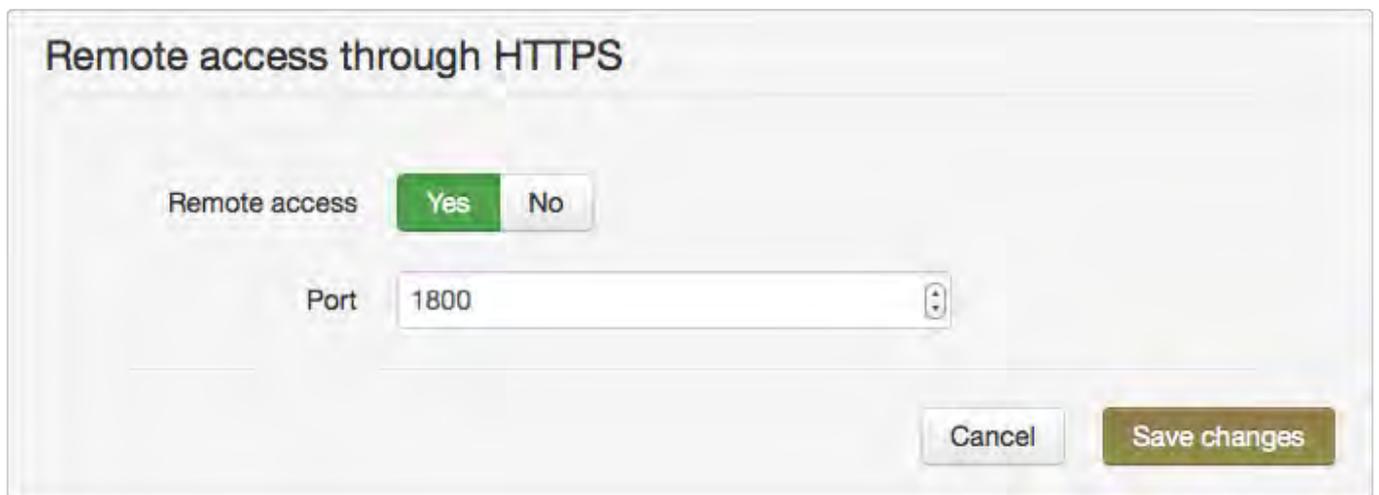
- Default status is "No", which means the LEDs indicate the status of the CloudGate
- Select "Yes" and "Save changes" to turn off all the LEDs

## Data Counters



## Remote Access through HTTPS

The Remote Access section configures a port on the CloudGate for remote access. With remote access, you can log on to the on-device web interface from a remote PC or laptop.



Default status after factory reset is "No".

To set up remote login:

1. Click the "3G connection" tab and make a note of the IP address of the WAN connection displayed in IP Configuration.
2. Click the "System" tab.
3. Set the "Remote access through HTTPS" field to "Yes".
4. Enter the port number (default is 1800) for which remote login is allowed.
5. Click "Save changes".

To log in to the CloudGate remotely:

1. On a remote laptop, go to the URL: `https://IPaddress:portnumber`.
2. Enter the user name and password.

Warning: the default port number is 1800. You may change this but make sure that you

take a port number that does not conflict with any rules or limitations that are imposed by the mobile operator.

## Static DNS

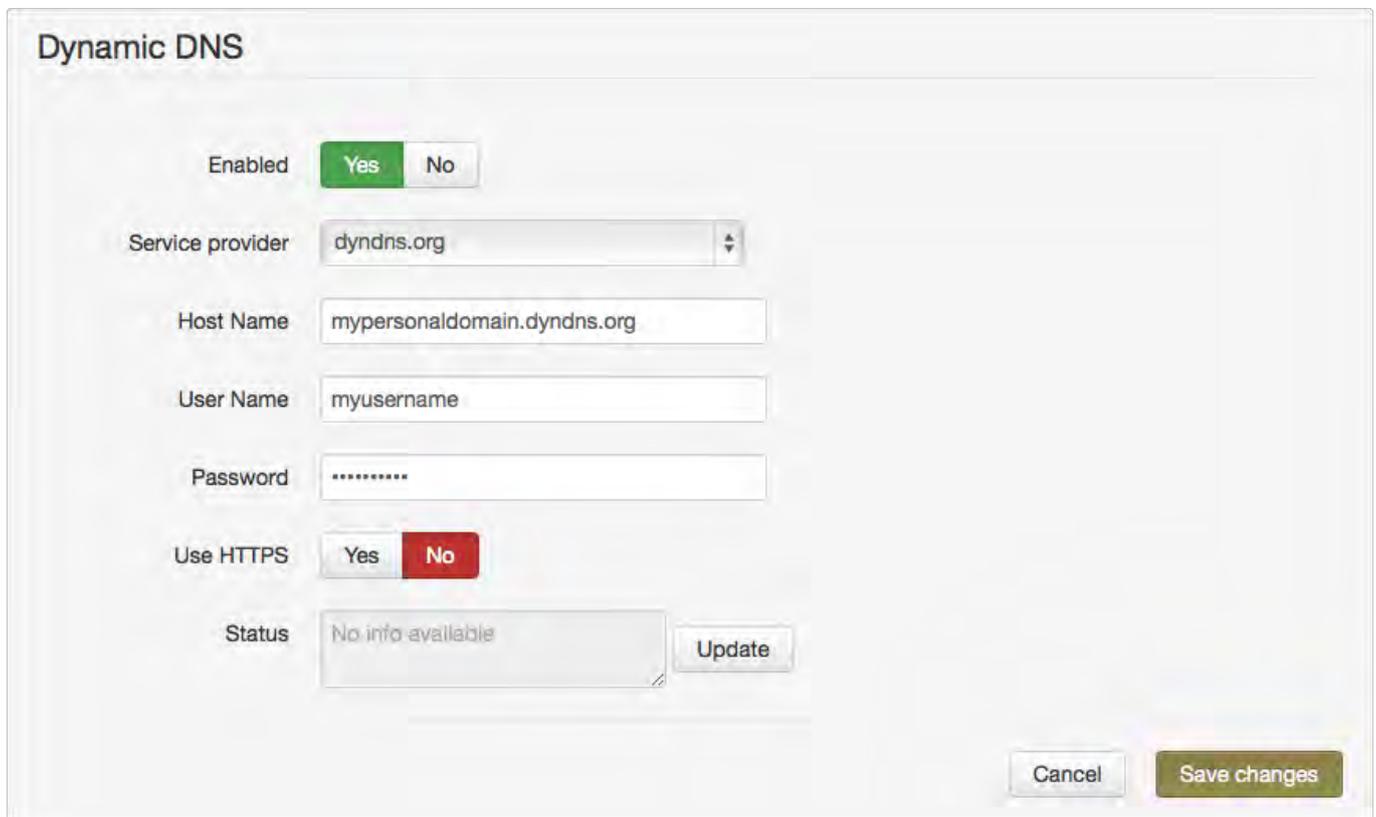


Static DNS settings

Nameserver 1

Nameserver 2

## Dynamic DNS



Dynamic DNS

Enabled  Yes  No

Service provider

Host Name

User Name

Password

Use HTTPS  Yes  No

Status

Enabled

- Default status is "No"
- Set to Yes to enable Dynamic DNS.

#### Service Provider

- Selects the dynamic DNS service provider.

#### Host name

- Defines the host name for the DNS service provider account.

#### User name

- Defines the user name you have set up with the DNS service provider.

#### Password

- Defines the password you have set up with the DNS service provider.

#### Use HTTPS

- Set to "Yes" to enable HTTPS login.

#### Status

- Displays status information.
- Click "Update" to refresh the status.

## Username and Password

The image shows a web interface with two main sections: 'Username' and 'Password'. The 'Username' section contains a text input field with the value 'admin' and two buttons: 'Cancel' and 'Save changes'. The 'Password' section contains three text input fields labeled 'Old password', 'New password', and 'Confirm password', and two buttons: 'Cancel' and 'Save changes'.

## Username

- Sets a new username for logging on to the on-device web interface.

## Password

- Resets the password.

## Logging

Option customer support may request logfiles to diagnose a problem.



To create a log file:

1. Click "Yes" to enable logging.
2. Set additional logging parameters according to Option Customer Support recommendations.
3. Click "Save changes".
4. Reproduce the CloudGate problem.
5. Download the log file by clicking "Download log file".

Enable logging

- If set to "Yes", the unit logs all CloudGate activity.

Maximum log file size

- Sets the maximum log file size. Option recommends 2048 kB.

Select log levels

- Sets the log levels. In order of severity the levels are: Info, Warning, Error, Debug

Download log file

- Downloads the file to a hard drive or USB stick.

Clear log file

- Removes the log file from the unit's memory.

## Config Export



- Click "Download config" to save the device configuration to a file on a laptop. The configuration file can then be uploaded to the CloudGate Universe and used for provisioning multiple devices.

## System Reboot and Factory Reset

Two different manual resets are possible on the CloudGate: system reboot and factory reset.

TIP:

Automatic resets of the WWAN interface are managed by the connection watchdog feature.

Automatic resets of the CloudGate are managed by the timed reset feature.

System reboot



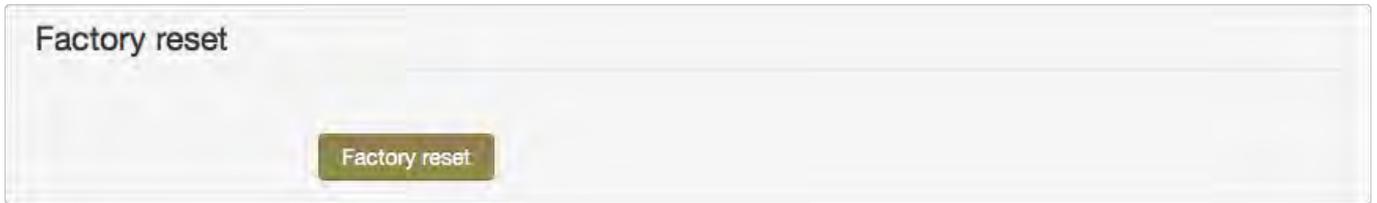
To reboot the CloudGate:

1. Click "System reboot".
2. In the confirmation dialog box, click "System reboot" to confirm.

During the reboot there is a "Rebooting" count down timer window visible which goes back to the login page when the CloudGate is operational again.

Note: This is the same as pressing the hardware reset button on the back of the CloudGate for one second.

## Factory reset



To reset the CloudGate to the factory default configuration settings and overwrite all custom configuration changes:

1. Click "Factory Reset"
2. In the confirmation dialog click "Factory reset" to confirm, in order to restart the device with the original configuration settings version from the factory.

During the factory reset there is a "Resetting" count down timer window visible which goes back to the login page when the CloudGate is operational again.

TIP: This is the same as pressing the hardware reset button on the back of the CloudGate for more than five seconds.

## Hardware Reset Button

The hardware reset button is located on the unit back panel. Using a pen or small screwdriver, press and hold:

- Hold for one second to perform a normal reset.
- Hold for five seconds or more to perform a factory reset.



When the user performs a factory reset by pushing the reset button for more than 5 seconds, he will get visual feedback via a specific LED sequence as follows:

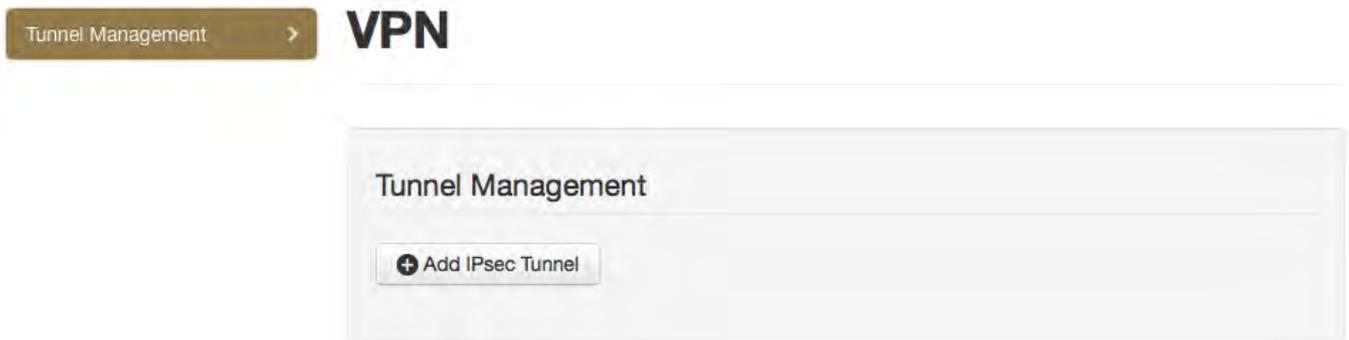
- the LEDs will quickly turn on red one by one (from the left to the right) until all LEDs are red

- then all LEDs will quickly turn on green
- finally all LEDs will quickly turn on orange and will remain orange for a while, until the CloudGate is ready to boot up again

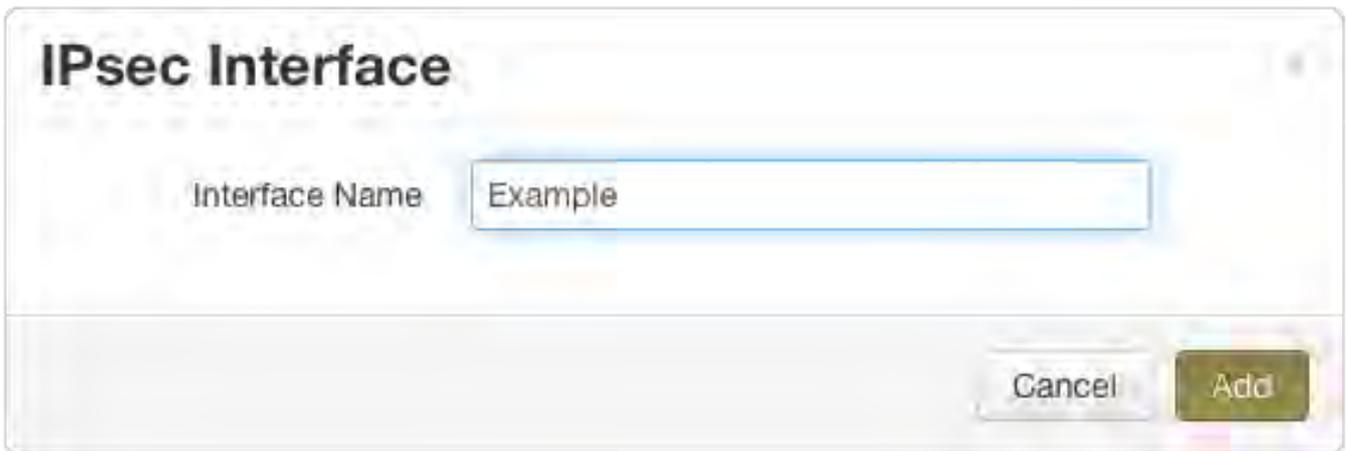
## 1.1.8. VPN Tab



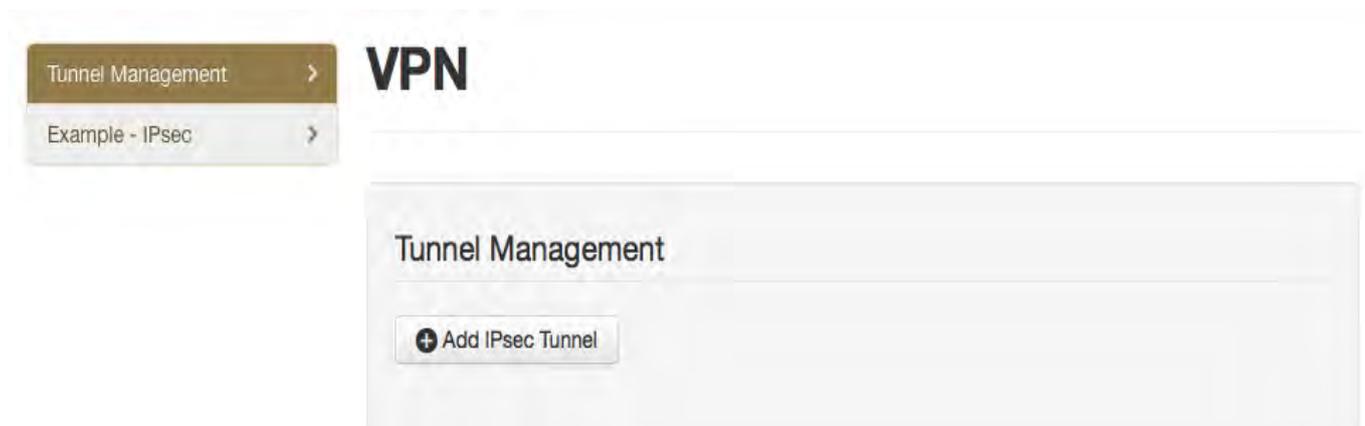
The VPN tab allows adding and configuring IPsec tunnels. By default the CloudGate has no IPsec tunnels preconfigured.



A tunnel can easily be added by clicking the "+ add IPsec Tunnel" button, a window will prompt for the user to enter a name for the new tunnel.



When the tunnel is successfully added a new field in the VPN tab will appear for each tunnel that is added.



Tunnels can be removed in the bottom right corner of the field of each tunnel using the “Delete Tunnel” button.

## Configuring a Tunnel

3 elements can be configured for each tunnel:

- Identity
- IKE Settings
- IPsec Settings

All fields must be configured for the tunnel to become active.

### Identity

There are two modes.

Client Mode:

## Identity

Mode

Server

Client

Authentication Method

PSK

Pre-shared Key

WAN Interface

Remote Host

Remote Peer Identity

Local Peer Identity

Local Subnet

ex: 192.168.1.1/24

Remote Subnet

ex: 192.168.1.1/24

Server mode:

## Identity

Mode  Server  Client

Authentication Method

Pre-shared Key

WAN Interface

Remote Peer Identity

Local Peer Identity

Local Subnet   
ex: 192.168.1.1/24

Remote Subnet   
ex: 192.168.1.1/24

The identity section provides the ability to configure:

- Authentication Method: currently only PSK is available,
- Pre-shared Key,
- WAN Interface: the interface on which the tunnel should be used. Here the user can select if the tunnel can only be used on a specific connection type or all connection types
- Remote Host:
- Remote & Local identity: These are optional fields that can be used in case the other tunnel endpoint has configured a local identity. This field may contain an IP or a FQDN (fully qualified domain name)
- Local and Remote subnet. These are optional fields that can be used to define the subnet on your local and remote setup.

## IKE Settings

The Internet Key Exchange is a protocol used to set-up the security associations in the IPsec protocol suit.

## IKE Settings

IKE Version  V1  V2

Negotiation Mode  Main  Aggressive

IKE Encryption

IKE Authentication

IKE Key Group

IKE SA Lifetime  seconds

## IKE Settings

IKE Version  V1  V2

IKE Encryption

IKE Authentication

IKE Key Group

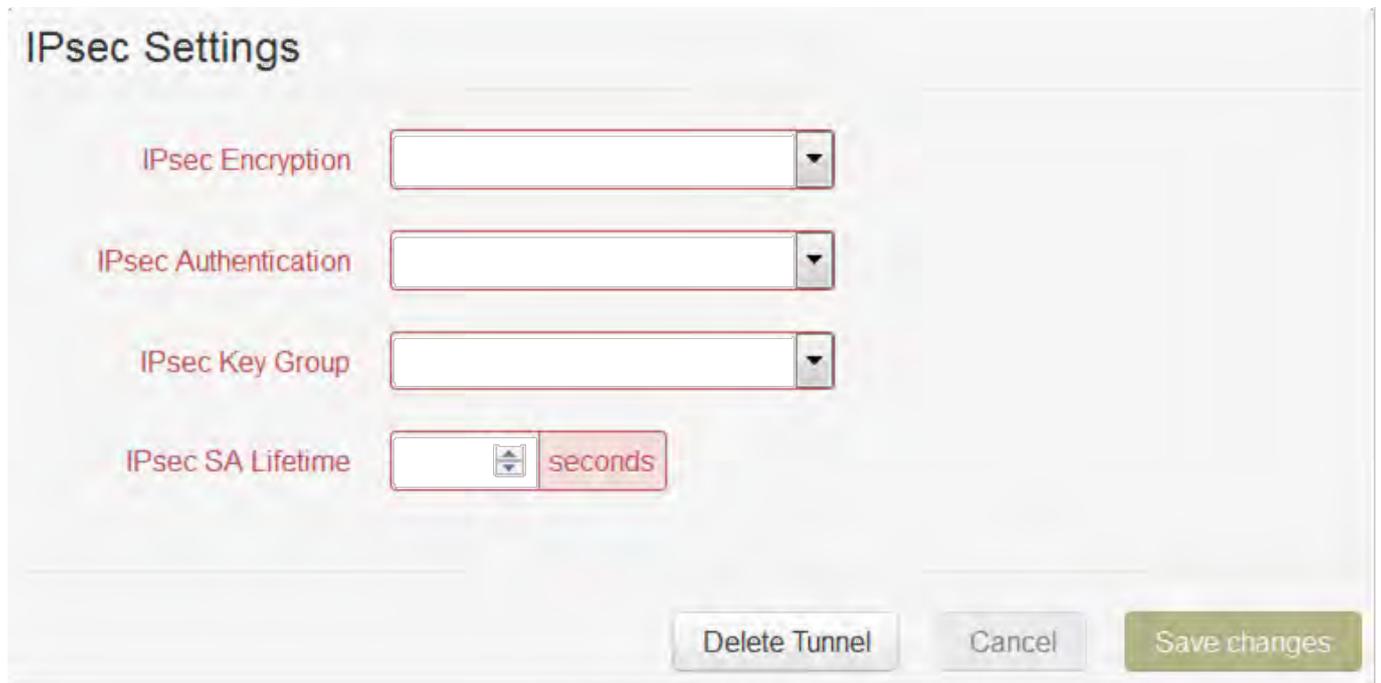
IKE SA Lifetime  seconds

- IKE Version: V1, V2
- Negotiation Mode (only for IKE V1): Main & Aggressive
- IKE Encryption: 3DES, AES128, AES256
- IKE Authentication: MD5, SHA1, SHA256
- IKE Key Group: DH1, DH2, DH5, DH14
- IKE SA Lifetime: must be a value between 60 - 86400

Wikipedia: Internet Key Exchange

## IPsec Settings

These fields are used to configure the IPsec tunnel's encryption details.



The image shows a configuration window titled "IPsec Settings". It contains four fields for configuration:

- IPsec Encryption:** A dropdown menu.
- IPsec Authentication:** A dropdown menu.
- IPsec Key Group:** A dropdown menu.
- IPsec SA Lifetime:** A numeric input field followed by a unit selector set to "seconds".

At the bottom right of the window, there are three buttons: "Delete Tunnel", "Cancel", and "Save changes".

- IPsec Encryption: NULL, 3DES, AES128, AES256
- IPsec Authentication: MD5, SHA1, SHA256
- IPsec Key Group: DH1, DH2, DH5, DH14
- IPsec SA Lifetime: must be a value between 60 - 86400

## Setup and configure Expansion Cards

If the CloudGate contains an Option expansion card, the device automatically detects and identifies the card and displays the appropriate configuration tab(s) in the Interfaces Tab.

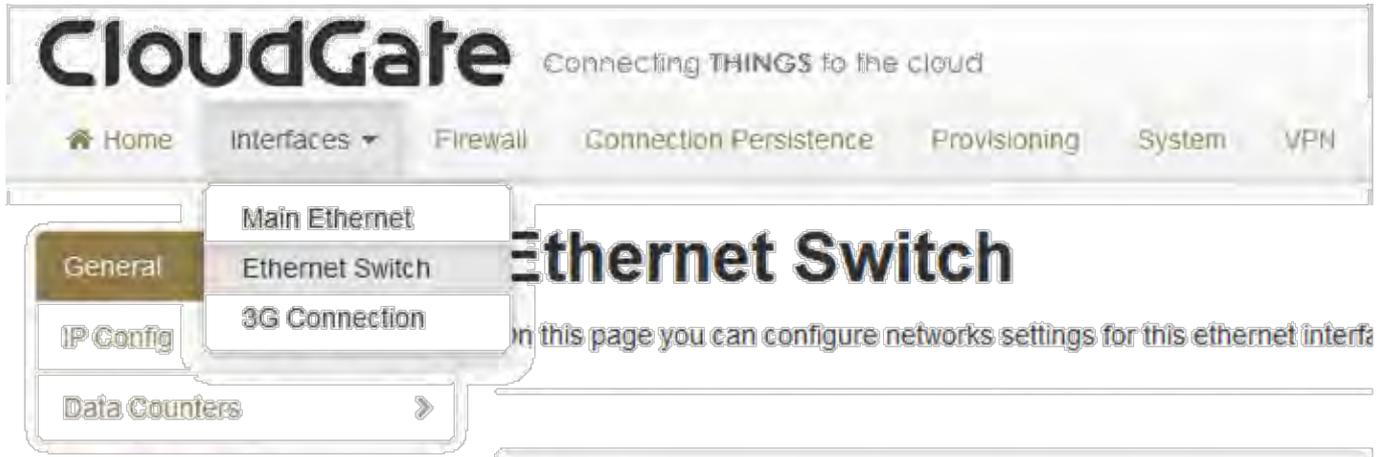
The additional configuration tabs are:

Click this tab	To do these tasks
Ethernet Switch	<ul style="list-style-type: none"><li>• Enable the Ethernet Switch</li><li>• Set the MTU</li><li>• Configure the IP parameters</li></ul>
WLAN Client	<ul style="list-style-type: none"><li>• Enable the WLAN client</li><li>• Connect the device to a WLAN network</li><li>• Disconnect the device from a WLAN network</li></ul>
WLAN Access Point	<ul style="list-style-type: none"><li>• Enable the WLAN access point</li><li>• Configure the SSID of the WLAN access point</li><li>• Configure WLAN card IP address information</li></ul>

## 1.2.1. Ethernet Switch Tab

When the Ethernet expansion card is inserted into the CloudGate an additional item "Ethernet Switch" will be visible in the Interfaces tab.

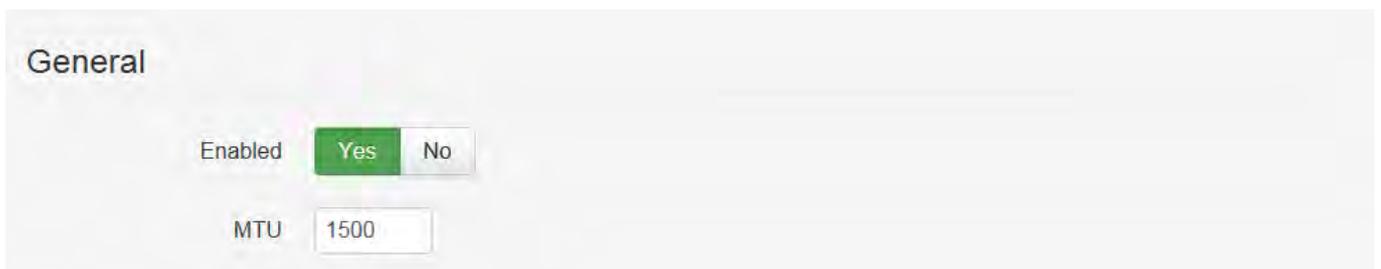
The Ethernet expansion card can only provide LAN functionality, no WAN functionality.



3 fields are available in this tab:

- General
- IP Config
- Data Counters

### General



In the general section of the Ethernet Switch Tab the following settings can be selected :

- Enabled: Yes / No  
Default status is "Yes"
- The MTU packet size: value range 68 to 1500  
Default value is 1500

# IP Config

The screenshot shows the 'IP Config' web interface. It includes the following fields and sections:

- IP address:** Input field with '192.168.4.1' and example text 'ex: 192.168.2.1'.
- Netmask:** Input field with '255.255.255.0' and example text 'ex: 255.255.255.0'.
- Enable DHCP server:** Radio buttons for 'Yes' (selected) and 'No'.
- DHCP range:** Input fields for '100' and '250' with 'to' between them.
- Lease time:** Input field for '12' and a dropdown menu for 'Hour(s)'.
- DNS 1:** Empty input field.
- DNS 2:** Empty input field.
- Reserved leases:** A table with columns: Hostname, MAC, Lease time, IP, Active, Actions. Below the table is a '+ Add' button.
- Active leases:** A table with columns: Hostname, MAC, IP, Actions.
- Buttons:** 'Cancel' and 'Save changes' at the bottom right.

The IP configuration field allows to set:

- IP address: this is the IP address on which the CloudGate will be reachable from the Ethernet expansion card network

By default the CloudGate uses subnet 4 on the Ethernet expansion card. Subnet 1 is reserved for the Main Ethernet interface, Subnet 2 & 3 for the WLAN SSID1 & SSID2 interfaces.

- Net mask: allows to configure a specific netmask, default 255.255.255.0

- Enable DHCP Server: when enabled the DHCP service of the CloudGate will be available to all devices connected through the Ethernet expansion card. When enabled the address range can be selected
- DNS 1 & 2: these fields allow specification of custom primary and secondary DNS servers using their IP address

## Reserved and active leases

The reserved and active leases table allow to manage the devices able to connect to ports of the Ethernet expansion card. To add a device manually to the list click the "Add" button. Host name, MAC & IP address are required. A specific lease time can be selected.

### Edit DHCP Reservation




---

Host name	<input type="text"/>	Required
MAC Address	<input type="text"/>	Required
IP Address	<input type="text"/>	Required
Lease time	<input type="text" value="1"/> <input type="button" value="↓"/> <input type="text" value="Day(s)"/> <input type="button" value="▼"/>	

## Data counters

Data counters will trace the incoming & outgoing traffic of the Ethernet expansion card outputs since last start.

## Data Counters [?](#)

Data received: **4540027 bytes**

Packets received: **34910**

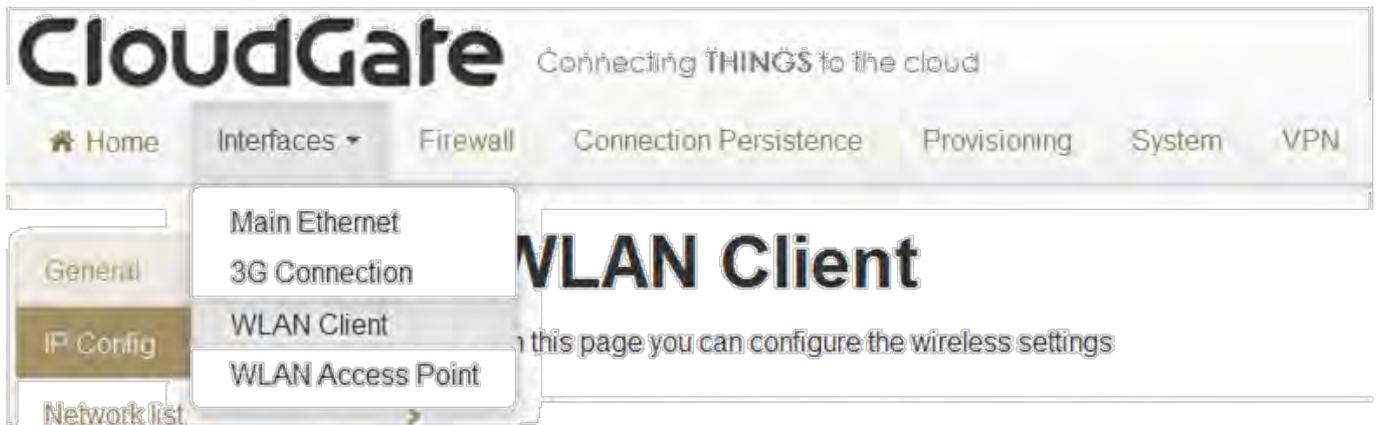
Data transmitted: **18199127 bytes**

Packets transmitted: **26729**

## 1.2.2. WLAN Client Tab

The WLAN expansion card (CG2101) acts as both a WLAN client and WLAN access point. The WLAN access point allows the CloudGate to connect other wireless devices to a wired or 3G network. The WLAN client allows the CloudGate to send and receive data over a WLAN network.

When this card is inserted into the CloudGate, then two additional items "WLAN Client Tab" and "WLAN Access Point Tab" will be visible in the interfaces tab.



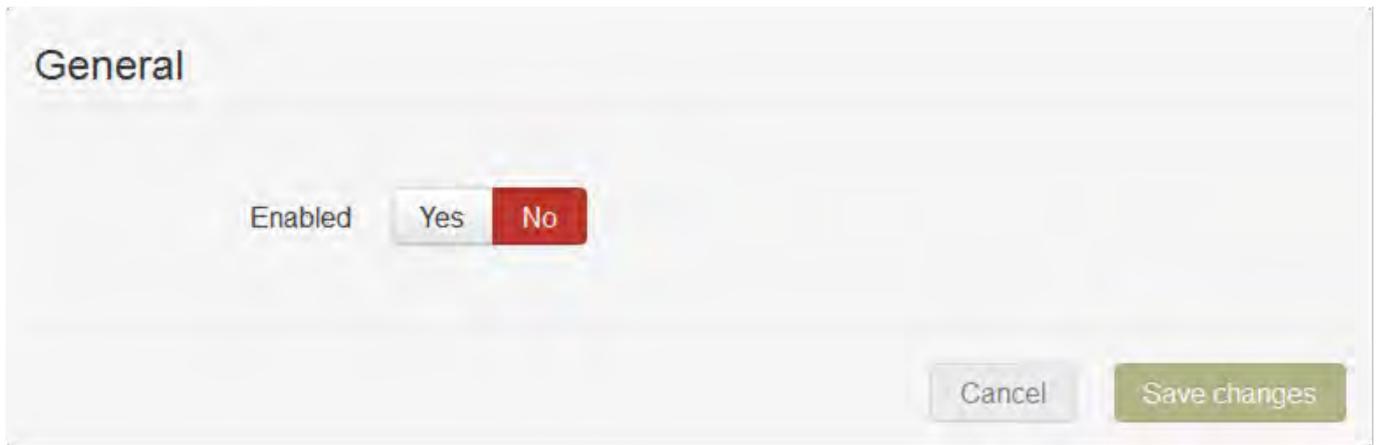
The WLAN Client tab allows the device to send and receive data over a WLAN network.

Using this tab you can:

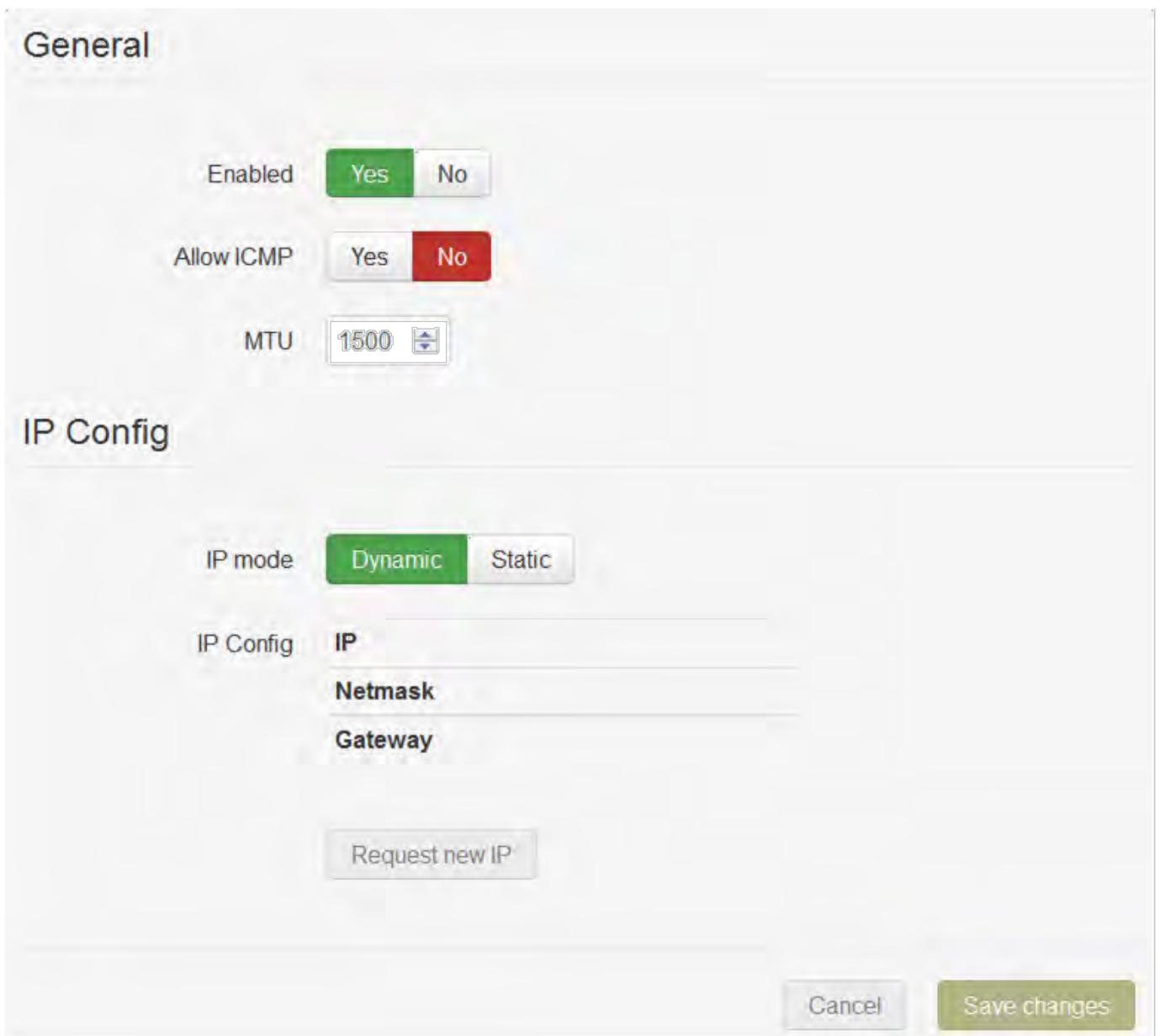
- Enable the WLAN client
- Connect to a WLAN network
- Manually Connect to a WLAN network
- Disconnect from a WLAN network

### General

By default and after factory reset the WLAN Client is disabled.



To enable the client mode, set the "Enabled" parameter to "Yes" and tap "Save changes". Then the screen will look as follows:



Enabled

- Click "Yes" to enable the WLAN client, and then click "Save changes".

## IP Config

IP Mode

- Click "Dynamic" to use IP addresses provided by the DHCP server
- Click "Static" to use a fixed IP address. Enter the IP address, netmask and DNS information.
- Default value is "Dynamic"

IP Config

- Displays the IP, netmask and gateway addresses of the connected WLAN network.

IP Config

IP mode

IP address  Required

Netmask  Required  
ex: 255.255.255.0

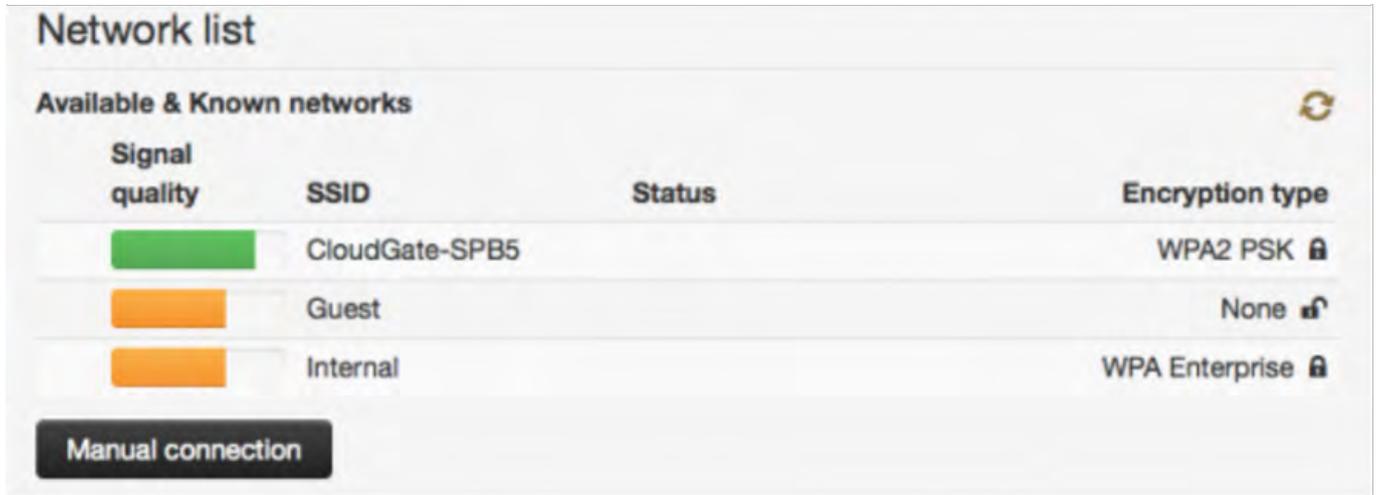
Gateway

DNS 1  Required

DNS 2

Network list

- Lists the WLAN networks within range and displays the signal quality, SSID, status, and encryption method of each.
- Click the Refresh icon  to refresh the network list.



Connecting to a WLAN Network

To connect to a WLAN network:

1. Click the network name.

**CloudGate-SPB5** 

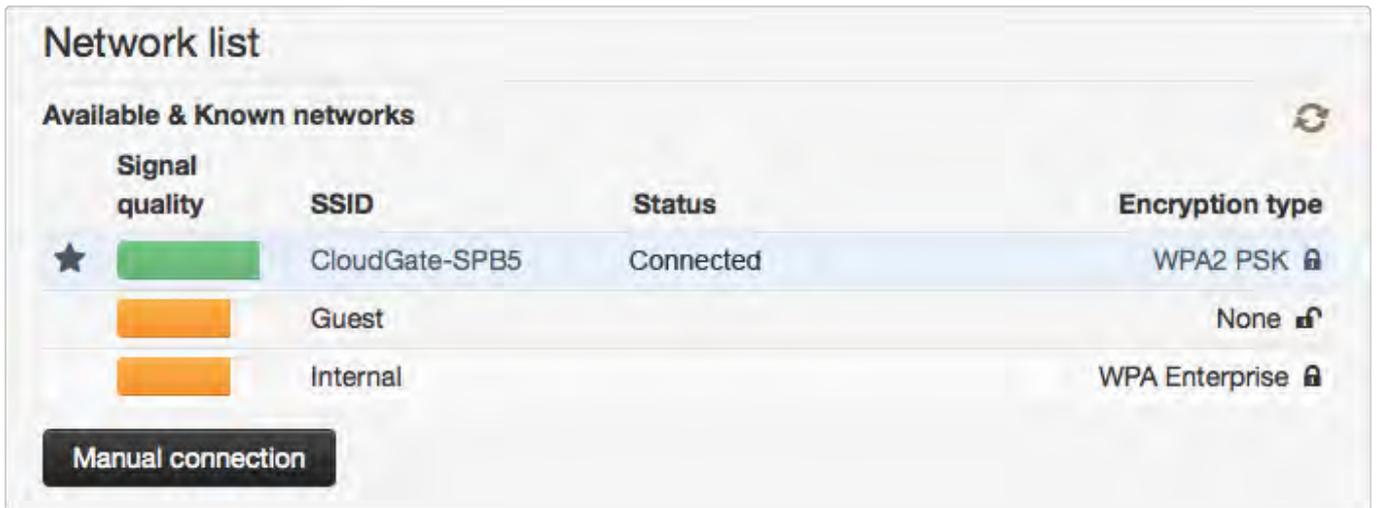
Password

Required



2. Enter the network password and click "Connect".

3. Note the status change to "Connected" in the Available & Known Networks list.



## Creating a Manual Connection to a WLAN Network

If the WLAN network you want to use is not in the list of known networks, you can create a manual connection.

1. Click "Manual connection".

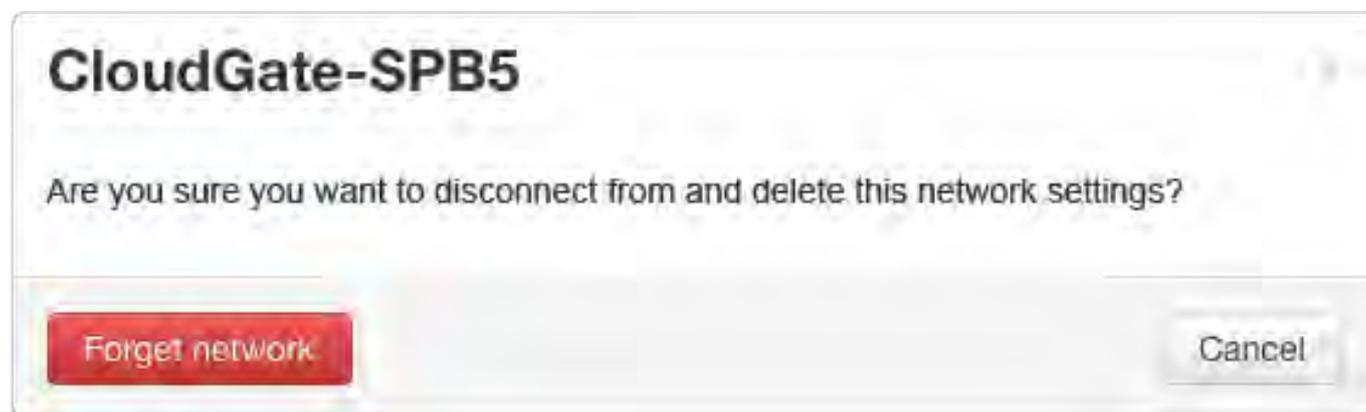
The screenshot shows a configuration form for a manual connection. It has three main sections: 'SSID' with a text input field and a 'Required' label; 'Encryption type' with a dropdown menu currently set to 'WPA PSK'; and 'Password' with a text input field and a 'Required' label. At the bottom right, there are two buttons: 'Cancel' and 'Save'.

2. Enter the network SSID, select an encryption type and enter the network password.

3. Click "Save".

Disconnecting from a WLAN Network

1. Click the WLAN network to disconnect.



2. Click "Forget network".

Data counters

## 1.2.3. WLAN Access Point Tab

The WLAN access point allows the CloudGate to connect other wireless devices to a wired or 3G network. The WLAN client allows the CloudGate to send and receive data over a WLAN network.

The WLAN Access Point Tab looks slightly different, depending on which type of WLAN card is inserted in the CloudGate.

The WLAN expansion card (CG2101) acts both as a WLAN client and as a WLAN access point.

When this card is inserted into the CloudGate, then two additional items will be visible in the interfaces tab:

- WLAN Client Tab
- WLAN Access Point Tab

The WLAN Access Point Card (CG2102) will only act as a WLAN access point, it has no WLAN client functionality.

When this card is inserted into the CloudGate, the following additional item will be visible in the interfaces tab:

- WLAN Access Point Tab

# WLAN Access Point Tab for WLAN Expansion Card CG2101

The WLAN expansion card (CG2101) acts as both a WLAN client and WLAN access point. The WLAN access point allows the CloudGate to connect other wireless devices to a wired or 3G network. The WLAN client allows the CloudGate to send and receive data over a WLAN network.

When this card is inserted into the CloudGate, then two additional items "WLAN Client Tab" and "WLAN Access Point Tab" will be visible in the interfaces tab.

This section explains how the WLAN Access Point Tab looks like when the WLAN Expansion Card (CG2101) is inserted in the CloudGate.



The WLAN Access Point tab lets you to manage the broadcast settings of the wireless access point.

## General



## Enabled

- Enables the WLAN access point
- Default value after factory reset is "Yes"

## WLAN Mode

- Selects a 2.4Ghz or 5GHz access point

Warning: the 5GHz band is currently not supported

## Channel

- Selects the WLAN channel on which the access point has to work.
- Default setting after factory reset is "auto"

Information: The WLAN channel can only be selected when the WLAN client is disabled. In case the WLAN client is active, the access point will use the channel used by the WLAN client!

## Enable second SSID

- Activates a second SSID
- Default setting is "No"

## SSID 1

## General

**General**

Network name (SSID)   
 ex: MyNetwork

Broadcast SSID  Yes  No

Encryption

Password

MTU

### Network name (SSID)

- The WLAN expansion card is shipped from the factory with a pre-defined, random SSID, which is different for each WLAN card. The pre-defined SSID is visible on the label that was delivered together with the expansion card
- The user can change this pre-defined SSID

### Broadcast SSID

- If set to Yes, the SSID will be broadcasted.
- Default setting is "Yes"

### Encryption

- Allows you to choose the type of encryption.  
Possible choices are: "None", "WPA PSK", "WPA PSK2" and "Mixed PSK"
- Default setting is "Mixed PSK"

### Password

- The WLAN expansion card is shipped from the factory with a pre-defined, random password, which is different for each WLAN card. The pre-defined password is visible on the label that was delivered together with the expansion card
- The user can change the password.

### MTU

- the MTU packet size: value range from 68 to 1500
- default setting is 1500

## IP Config

The screenshot shows the 'IP Config' configuration page. It includes the following fields and options:

- IP address:** A text input field containing '192.168.2.1' with a subtext 'ex: 192.168.2.1'.
- Netmask:** A text input field containing '255.255.255.0' with a subtext 'ex: 255.255.255.0'.
- Enable DHCP server:** A toggle switch currently set to 'Yes'.
- DHCP range:** Two spinners showing '100' and '250' with a 'to' label between them.
- Lease time:** A spinner showing '12' and a dropdown menu set to 'Hour(s)'.
- DNS 1:** An empty text input field.
- DNS 2:** An empty text input field.

### IP address

- Sets the IP address of the WLAN access point.
- Default IP address is 192.168.2.1

### Netmask

- Sets the netmask of the WLAN access point.
- Default setting is 255.255.255.0

### Enable DHCP server

- Enables the DHCP server.
- Default setting is "Yes"

### DHCP range

- Sets the DHCP range for the DHCP server.
- Default range is 100 to 250

### Lease time

- Sets the lease time
- Default setting is 12 hours

### DNS 1 and DNS 2

When the CloudGate is in LAN mode the DNS fields will be empty by default. As a result the CloudGate itself will act as a DNS server. All the connected ethernet devices will receive an DNS address which is equal to the CloudGates IP address (by default 192.168.1.1) When the DNS server inside the Cloudgate can't resolve the DNS request it will forward the request to the DNS server of the WAN connection.

When the CloudGate is in WAN mode the DNS address will be defined by the DHCP server of the internet provider. When the DNS fields are changed to another value then the other IP address will be used for the DNS server.

### Reserved leases

Reserved leases					
Hostname	MAC	Lease time	IP	Active	Actions
<input type="button" value="+ Add"/>					

- Lists the DHCP leases which are assigned to a MAC address.
- Click "Add" to assign another lease and link a MAC address to an IP address.

### Active leases

Active leases			
Hostname	MAC	IP	Actions

- Lists the active DHCP leases of the devices connected to the WLAN access point.
- Click "Reserve" to add the lease to the Reserved leases list.

## Data counters



The screenshot shows a 'Data Counters' section with a help icon. It displays four statistics: Data received (88971 bytes), Packets received (703), Data transmitted (146630 bytes), and Packets transmitted (378).

Category	Value
Data received	88971 bytes
Packets received	703
Data transmitted	146630 bytes
Packets transmitted	378

## SSID2

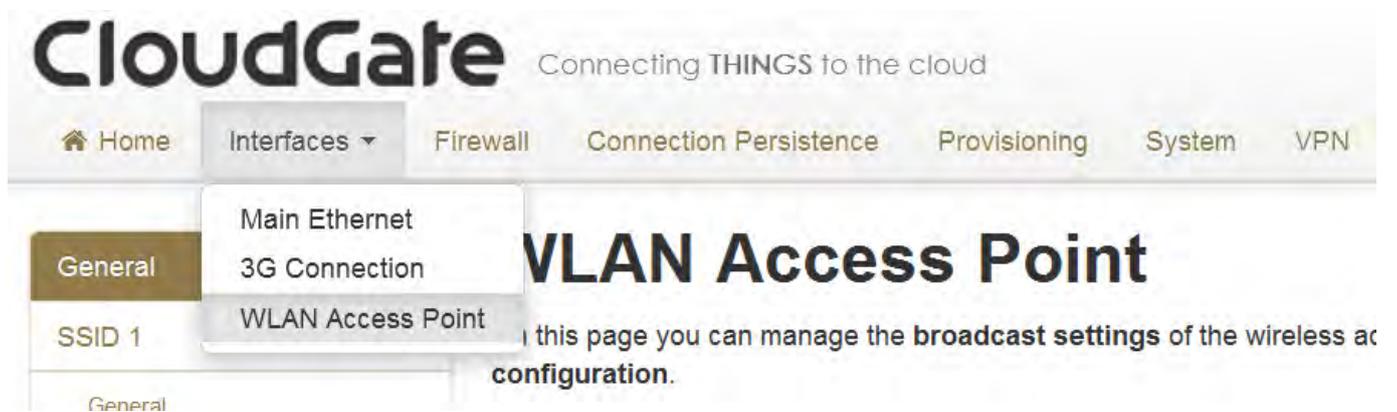
The SSID2 tab allows you to set or change some parameters for the second SSID. These parameters are identical as the parameters for the first SSID.

# WLAN Access Point Tab for WLAN Access Point Card CG2102

The WLAN Access Point Card (CG2102) acts as a WLAN access point only. The WLAN access point allows the CloudGate to connect other wireless devices to a wired or 3G network.

When this card is inserted into the CloudGate, then an "WLAN Access Point Tab" will be visible in the interfaces tab.

This section explains how the WLAN Access Point Tab looks like when the WLAN Access Point Card (CG2102) is inserted in the CloudGate.



The WLAN Access Point tab lets you to manage the broadcast settings of the wireless access point.

## General

General

Enabled  Yes  No

WLAN Mode

Channel

Cancel Save changes

### Enabled

- Enables the WLAN access point
- Default value after factory reset is "Yes"

### WLAN Mode

- Selects a 2.4Ghz or 5GHz access point

### Channel

- Selects the WLAN channel on which the access point has to work.
- Default setting after factory reset is "auto"

## SSID 1

### General

## General

Network name (SSID)   
ex: MyNetwork

Broadcast SSID  Yes  No

Encryption

Password

MTU

### Network name (SSID)

- The WLAN Access Point Card is shipped from the factory with a pre-defined, random SSID, which is different for each WLAN card. The pre-defined SSID is visible on the label that was delivered together with the expansion card
- The user can change this pre-defined SSID

### Broadcast SSID

- If set to Yes, the SSID will be broadcasted.
- Default setting is "Yes"

### Encryption

- Allows you to choose the type of encryption.  
Possible choices are: "None", "WPA PSK2" and "Mixed PSK"
- Default setting is "Mixed PSK"

### Password

- The WLAN Access Point Card is shipped from the factory with a pre-defined, random password, which is different for each WLAN card. The pre-defined password is visible on the label that was delivered together with the expansion card
- The user can change the password.

### MTU

- the MTU packet size: value range from 68 to 1500
- default setting is 1500

## IP Config

The screenshot shows a web interface titled "IP Config". It contains several configuration fields:

- IP address:** A text input field containing "192.168.2.1" with a small example text "ex: 192.168.2.1" below it.
- Netmask:** A text input field containing "255.255.255.0" with a small example text "ex: 255.255.255.0" below it.
- Enable DHCP server:** A toggle control with two buttons: "Yes" (highlighted in green) and "No".
- DHCP range:** Two spinners for the range, with "100" on the left and "250" on the right, separated by the word "to".
- Lease time:** A spinner containing "12" followed by a dropdown menu currently set to "Hour(s)".
- DNS 1:** An empty text input field.
- DNS 2:** An empty text input field.

### IP address

- Sets the IP address of the WLAN access point.
- Default IP address is 192.168.2.1

### Netmask

- Sets the netmask of the WLAN access point.
- Default setting is 255.255.255.0

### Enable DHCP server

- Enables the DHCP server.
- Default setting is "Yes"

### DHCP range

- Sets the DHCP range for the DHCP server.
- Default range is 100 to 250

### Lease time

- Sets the lease time
- Default setting is 12 hours

### DNS 1 and DNS 2

When the CloudGate is in LAN mode the DNS fields will be empty by default. As a result the CloudGate itself will act as a DNS server. All the connected ethernet devices will receive an DNS address which is equal to the CloudGates IP address (by default 192.168.1.1) When the DNS server inside the Cloudgate can't resolve the DNS request it will forward the request to the DNS server of the WAN connection.

When the CloudGate is in WAN mode the DNS address will be defined by the DHCP server of the internet provider. When the DNS fields are changed to another value then the other IP address will be used for the DNS server.

### Reserved leases

Reserved leases						
Hostname	MAC	Lease time	IP	Active	Actions	
<div style="border: 1px solid #ccc; border-radius: 5px; padding: 5px; display: inline-block;"> <span style="font-size: 1.2em;">+</span> Add         </div>						

- Lists the DHCP leases which are assigned to a MAC address.
- Click "Add" to assign another lease and link a MAC address to an IP address.

### Active leases

Active leases			
Hostname	MAC	IP	Actions

- Lists the active DHCP leases of the devices connected to the WLAN access point.
- Click "Reserve" to add the lease to the Reserved leases list.

## Data counters

### Data Counters

---

Data received: **0 bytes**

Packets received: **0**

Data transmitted: **0 bytes**

Packets transmitted: **0**



**P T I O N**

WIRELESS TECHNOLOGY

**SVE SYSTEM  
I/O MANUALS**



**Process Technology  
Support, LLC**

*Serving The Environmental Remediation Industry*

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**BLANK SHEET**

Company: Process Technology Support, LLC  
Address: 14274 Mead Street, Longmont, CO 80504  
Ph: 970-535-0913/970-535-9583

SVE PERFORMANCE CALC.

Contact: Terry Sprouse

ROOTS BLOWER PERFORMANCE REPORT : Program Version 6.30 Release Date 4/26/2012

Program Mode: SELECTION Run Date: 09/24/2015

AMBIENT CONDITIONS:

Gas	AIR	
Relative Humidity	36%	
Molecular Weight	28.806	
k-Value	1.395	
Specific Gravity	.994	
Ambient Temperature	90	deg F
Ambient Pressure	13.39	PSIA

STANDARD CONDITIONS:

Pressure	14.7	PSIA
Temperature	68	deg F
Relative Humidity	36	%

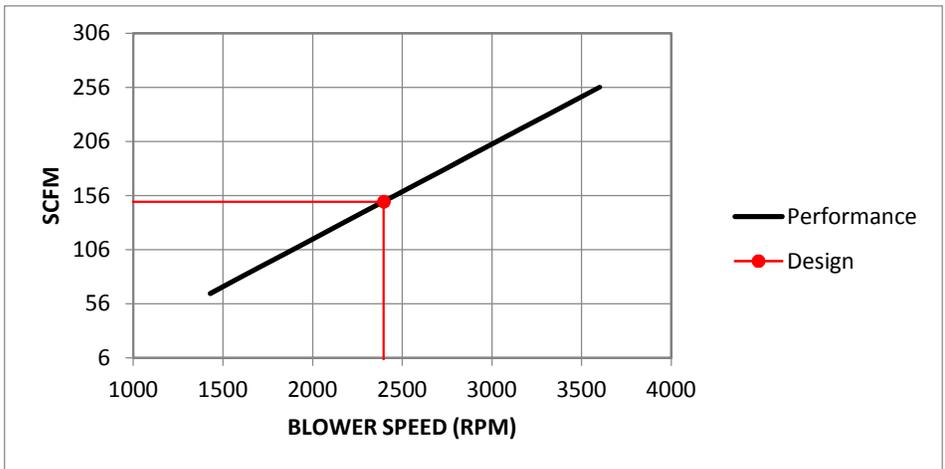
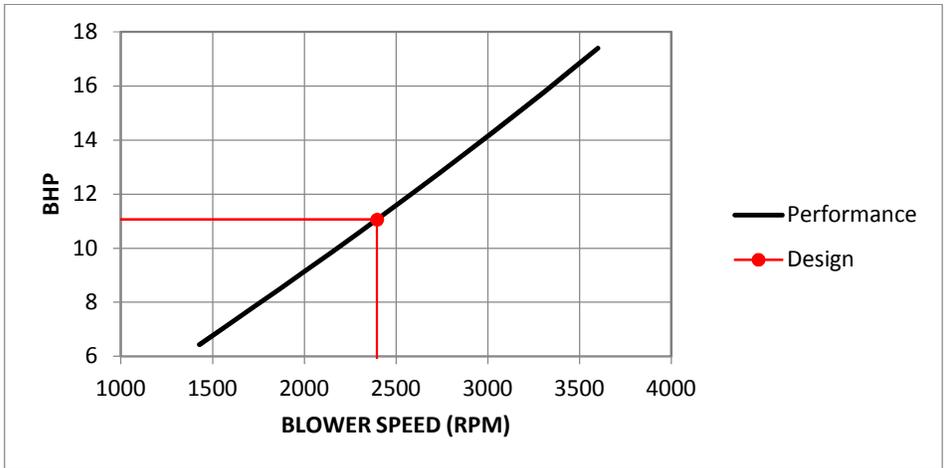
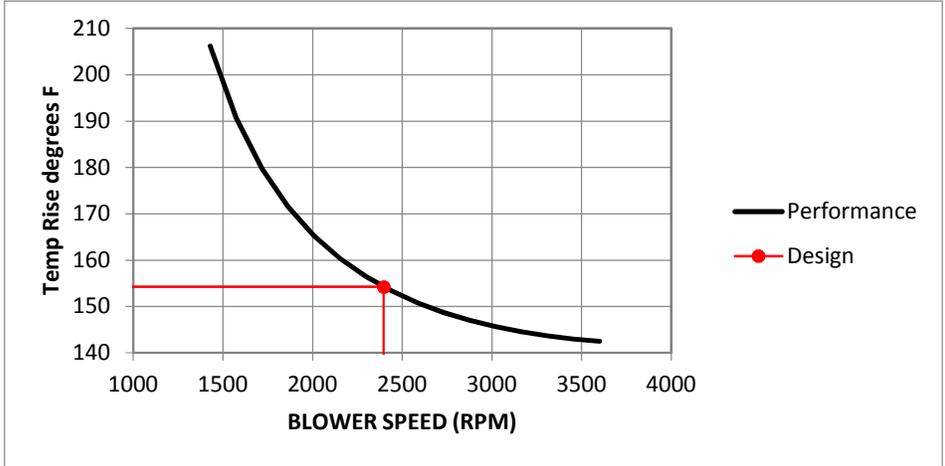
SELECTED UNIT DETAIL: Model 47 URAI-DSL

	Design	Des/Max
Speed, RPM	2396	66.6%
System Inlet Volume, ICFM	260	
Actual Blower Inlet Volume, ICFM	273	+/-5 %
Standard Volume, SCFM	150	
Mass/Weight Flow, #/min	11.24	+/-5 %
System Inlet Temperature, deg F	68.0	
System Inlet Pressure, in Hg Vac	10.000	
Inlet Pressure Loss, PSI	0.400	
Blower Inlet Pressure, in Hg Vac	10.818	
Blower Discharge Pressure, PSIA	14.490	
Discharge Press. Loss, PSI	1.100	
System Discharge Pressure, PSIA	13.390	
Blower Diff. Press., PSI	6.390	87.1%
Power, BHP	11.06	+/-4%
Temperature Rise, deg F	154.2	68.5%
Discharge Temperature, deg F	222.2	
System Discharge Volume, ACFM	197	
Relief Valve Setting	NO RELIEF VALVE SPECIFIED	
V-Belt: Est. B10 Brg Life, hours	1644807	
Coupling: Est. B10 Brg Life, hours	1644807	
Est. Free Field Noise, dBa	85.8	

Measured as sound press. level per ISO 2151:2004E with +/-3 dBA tol.



# Dresser Roots 47 URAI-DSL: Variable Speed Performance



Customer :

Project :

INLET CONDITIONS: AIR

RH = 36.00%, MW = 28.806, k = 1.395, Tin = 68 deg F

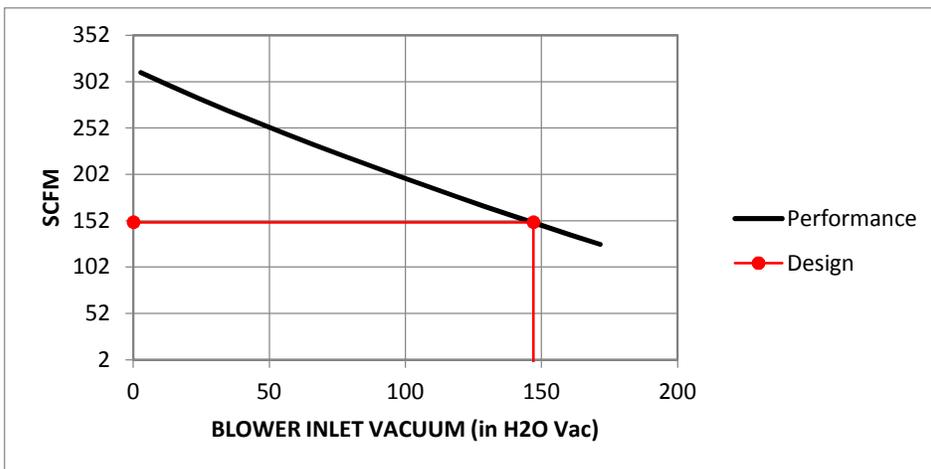
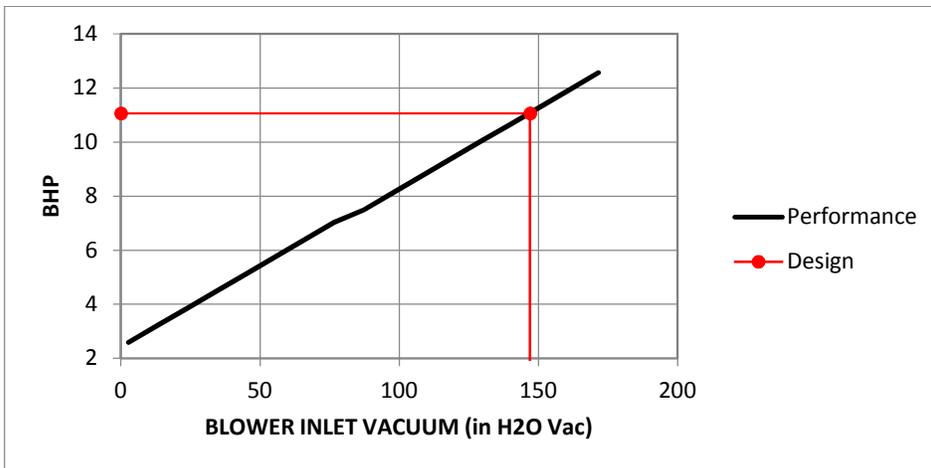
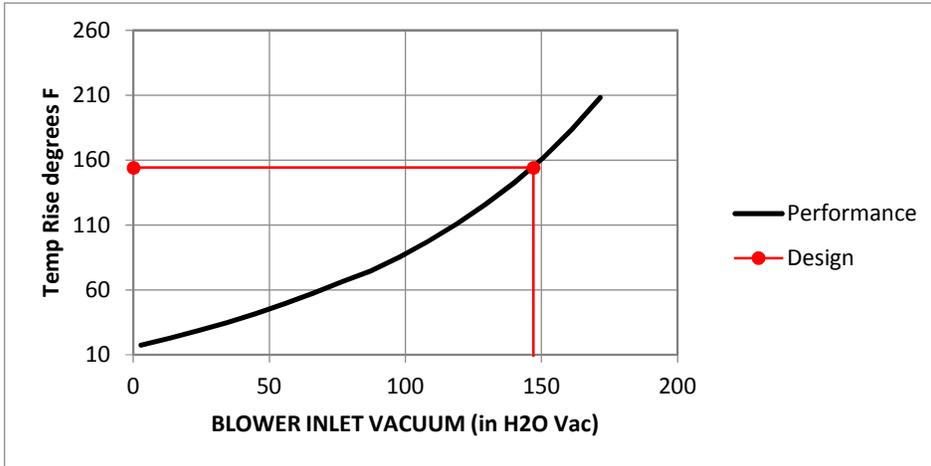
DESIGN: Speed = 2396 RPM

System Inlet P = 10 in Hg Vac, Inlet P Loss = 0.4 PSI

System Disch P = 13.39 PSIA, Disch P Loss = 1.1 PSI



# Dresser Roots 47 URAI-DSL: Variable Pressure Performance



Customer :

Project :

INLET CONDITIONS: AIR

RH = 36.00%, MW = 28.806, k = 1.395, Tin = 68 deg F

DESIGN: Speed = 2396 RPM

System Inlet P = 10 in Hg Vac, Inlet P Loss = 0.4 PSI

System Disch P = 13.39 PSIA, Disch P Loss = 1.1 PSI

**BLANK SHEET**

# ROOTS

Blowers Compressors Exhausters

US \$3.00, Canada \$4.50

## Universal RAI<sup>®</sup>, URAI-J<sup>™</sup>, URAI DSL, URAI-J<sup>™</sup> DSL, URAI-G<sup>™</sup> and Metric Series Blowers

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### Do These Things To Get The Most From Your ROOTS<sup>™</sup> blower

- Check shipment for damage. If found, file claim with carrier and notify Roots.
- Unpack shipment carefully, and check contents against Packing List. Notify Roots if a shortage appears.
- Store in a clean, dry location until ready for installation. Lift by methods discussed under INSTALLATION to avoid straining or distorting the equipment. Keep covers on all openings. Protect against weather and corrosion if outdoor storage is necessary.
- Read OPERATING LIMITATIONS and INSTALLATION sections in this manual and plan the complete installation.
- Provide for adequate safeguards against accidents to persons working on or near the equipment during both installation and operation. See SAFETY PRECAUTIONS.
- Install all equipment correctly. Foundation design must be adequate and piping carefully done. Use recommended accessories for operating protection.
- Make sure both driving and driven equipment is correctly lubricated before start-up. See LUBRICATION.**
- Read starting check points under OPERATION. Run equipment briefly to check for installation errors and make corrections. Follow with a trial run under normal operating conditions.
- In event of trouble during installation or operation, do not attempt repairs of Roots furnished equipment. Notify Roots, giving all nameplate information plus an outline of operating conditions and a description of the trouble. Unauthorized attempts at equipment repair may void Roots warranty.
- Units out of warranty may be repaired or adjusted by the owner. Good inspection and maintenance practices should reduce the need for repairs.

**NOTE:** Information in this manual is correct as of the date of publication. Roots reserves the right to make design or material changes without notice, and without obligation to make similar changes on equipment of prior manufacture.

For your nearest Roots Office, dial our Customer Service Hot Line toll free; 1 877 363 ROOT(S) (7668) or direct 832-590-2600.



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**ROOTS™ products are sold subject to the  
current General Terms of Sale, GTS-5001  
and Warranty Policy WP-5020. Copies are  
available upon request.**

**Contact your local Roots Office  
or Roots Customer Service**

**Hot Line 1-877-363-ROOT(S) (7668) or  
direct 832-590-2600.**

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## Safety Precautions

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It is important that all personnel observe safety precautions to minimize the chances of injury. Among many considerations, the following should be particularly noted:

- Blower casing and associated piping or accessories may become hot enough to cause major skin burns on contact.
- Internal and external rotating parts of the blower and driving equipment can produce serious physical injuries. Do not reach into any opening in the blower while it is operating, or while subject to accidental starting. Protect external moving parts with adequate guards.
- Disconnect power before doing any work, and avoid bypassing or rendering inoperative any safety or protective devices.
- If blower is operated with piping disconnected, place a strong coarse screen over the inlet and avoid standing in the discharge air stream. **CAUTION: Never cover the blower inlet with your hand or other part of body.**
- Stay clear of the blast from pressure relief valves and the suction area of vacuum relief valves.
- Use proper care and good procedures in handling, lifting, installing, operating and maintaining the equipment.
- Casing pressure must not exceed 25 PSI (1725 mbar) gauge. Do not pressurize vented cavities from an external source, nor restrict the vents without first consulting Roots.
- Do not use air blowers on explosive or hazardous gases.
- Other potential hazards to safety may also be associated with operation of this equipment. All personnel working in or passing through the area should be trained to exercise adequate general safety precautions.

## Operating Limitations

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A ROOTS blower or exhauster must be operated within certain approved limiting conditions to enable continued satisfactory performance. Warranty is contingent on such operation.

Maximum limits for pressure, temperature and speed are specified in TABLE 1 for various models & sizes of blowers & exhausters. These limits apply to all units of normal construction, when operated under standard atmospheric conditions. Be sure to arrange connections or taps for instruments, thermometers and pressure or vacuum gauges at or near the inlet and discharge connections of the unit. These, along with a tachometer, will enable periodic checks of operating conditions.

**PRESSURE** – The pressure rise, between inlet and discharge, must not exceed the figure listed for the specific unit frame size concerned. Also, in any system where the unit inlet is at a positive pressure above atmosphere a maximum case rating of 25 PSI gauge (1725 mbar) should not be exceeded without first consulting Roots. Never should the maximum allowable differential pressure be exceeded.

On vacuum service, with the discharge to atmospheric pressure, the inlet suction or vacuum must not be greater than values listed for the specific frame size.

**TEMPERATURE** – Blower & exhauster frame sizes are approved only for installations where the following temperature limitations can be maintained in service:

- Measured temperature rise must not exceed listed values when the inlet is at ambient temperature. Ambient is considered as the general temperature of the space around the unit. This is not outdoor temperature unless the unit is installed outdoors.
- If inlet temperature is higher than ambient, the listed allowable temperature rise values must be reduced by 2/3 of the difference between the actual measured inlet temperature and the ambient temperature.
- The average of the inlet and discharge temperature must not exceed 250°F. (121°C).
- The ambient temperature of the space the blower/motor is installed in should not be higher than 120°F (48.8°C).

**SPEED** – These blowers & exhausters may be operated at speeds up to the maximum listed for the various frame sizes. They may be direct coupled to suitable constant speed drivers if pressure/temperature conditions are also within limits. At low speeds, excessive temperature rise may be a limiting factor.

**Special Note:** The listed maximum allowable temperature rise for any particular blower & exhauster may occur well before its maximum pressure or vacuum rating is reached. This may occur at high altitude, low vacuum or at very low speed. The units' operating limit is always determined by the maximum rating reached first. It can be any one of the three: Pressure, Temperature or Speed.

## Installation

ROOTS blowers & exhausters are treated after factory assembly to protect against normal atmospheric corrosion. The maximum period of internal protection is considered to be one year under average conditions, if shipping plugs & seals are not removed. Protection against chemical or salt water atmosphere is not provided. Avoid opening the unit until ready to start installation, as corrosion protection will be quickly lost due to evaporation.

If there is to be an extended period between installation and start up, the following steps should be taken to ensure corrosion protection.

- Coat internals of cylinder, gearbox and drive end bearing reservoir with Nox-Rust VCI-10 or equivalent. Repeat once a year or as conditions may require. Nox-Rust VCI-10 is petroleum soluble and does not have to be removed before lubricating. It may be obtained from Daubert Chemical Co., 2000 Spring Rd., Oak Brook, Ill. 60521.
- Paint shaft extension, inlet and discharge flanges, and all other exposed surfaces with Nox-Rust X-110 or equivalent.
- Seal inlet, discharge, and vent openings. It is not recommended that the unit be set in place, piped to the system, and allowed to remain idle for extended periods. If any part is left open to the atmosphere, the Nox-Rust VCI-10 vapor will escape and lose its effectiveness.
- Protect units from excessive vibration during storage.
- Rotate shaft three or four revolutions every two weeks.
- Prior to start up, remove flange covers on both inlet and discharge and inspect internals to insure absence of rust. Check all internal clearances. Also, at this time, remove gearbox and drive end bearing cover and inspect gear teeth and bearings for rust.

Because of the completely enclosed unit design, location of the installation is generally not a critical matter. A clean, dry and protected indoor location is preferred. However, an outdoor location will normally give satisfactory service. Important requirements are that the correct grade of lubricating oil be provided for expected operating temperatures, and that the unit be located so that routine checking and servicing can be performed conveniently. Proper care in locating driver and accessory equipment must also be considered.

Supervision of the installation by a Roots Service Engineer is not usually required for these units. Workmen with experience in installing light to medium weight machinery should be able to produce satisfactory results. Handling of the equipment needs to be accomplished with care, and in compliance with safe practices. Unit mounting must be solid, without strain or twist, and air piping must be clean, accurately aligned and properly connected.

**Bare-shaft Units:** Two methods are used to handle a unit without base. One is to use lifting lugs bolted into the top of the unit headplates. Test them first for tightness and frac-

tures by tapping with a hammer. In lifting, keep the direction of cable pull on these bolts as nearly vertical as possible. If lifting lugs are not available, lifting slings may be passed under the cylinder adjacent to the headplates. Either method prevents strain on the extended drive shaft.

**Packaged Units:** When the unit is furnished mounted on a baseplate, with or without a driver, use of lifting slings passing under the base flanges is required. Arrange these slings so that no strains are placed on the unit casing or mounting feet, or on any mounted accessory equipment. **DO NOT** use the lifting lugs in the top of the unit headplates.

Before starting the installation, remove plugs, covers or seals from unit inlet and discharge connections and inspect the interior completely for foreign material. If cleaning is required, finish by washing the cylinder, headplates and impeller thoroughly with an appropriate solvent. Turn the drive shaft by hand to make sure that the impellers turn freely at all points. Anti-rust compound on the connection flanges and drive shaft extension may also be removed at this time with the same solvent. Cover the flanges until ready to connect piping.

### Mounting

Care will pay dividends when arranging the unit mounting. This is especially true when the unit is a "bare-shaft" unit furnished without a baseplate. The convenient procedure may be to mount such a unit directly on a floor or small concrete pad, but this generally produces the least satisfactory results. It definitely causes the most problems in leveling and alignment and may result in a "Soft Foot" condition. Correct soft foot before operation to avoid unnecessary loading on the casing and bearings. Direct use of building structural framing members is not recommended.

For blowers without a base, it is recommended that a well anchored and carefully leveled steel or cast iron mounting plate be provided. The plate should be at least 1 inch (25 mm) thick, with its top surface machined flat, and large enough to provide leveling areas at one side and one end after the unit is mounted. It should have properly sized studs or tapped holes located to match the unit foot drilling. Proper use of a high quality machinist's level is necessary for adequate installation.

With the mounting plate in place and leveled, set the unit on it without bolting and check for rocking. If it is not solid, determine the total thickness of shims required under one foot to stop rocking. Place half of this under each of the diagonally-opposite short feet, and tighten the mounting studs or screws. Rotate the drive shaft to make sure the impellers turn freely. If the unit is to be direct coupled to a driving motor, consider the height of the motor shaft and the necessity for it to be aligned very accurately with the unit shaft. Best unit arrangement is directly bolted to the mounting plate while the driver is on shims of at least 1/8 inch (3mm) thickness. This allows adjustment of motor position in final shaft alignment by varying the shim thickness.

### Aligning

When unit and driver are factory mounted on a common baseplate, the assembly will have been properly aligned and is to be treated as a unit for leveling purposes. Satisfactory

installation can be obtained by setting the baseplate on a concrete slab that is rigid and free of vibration, and leveling the top of the base carefully in two directions so that it is free of twist. The slab must be provided with suitable anchor bolts. The use of grouting under and partly inside the leveled and shimmed base is recommended.

It is possible for a base-mounted assembly to become twisted during shipment, thus disturbing the original alignment. For this reason, make the following checks after the base has been leveled and bolted down. Disconnect the drive and rotate the unit shaft by hand. It should turn freely at all points. Loosen the unit foot hold-down screws and determine whether all feet are evenly in contact with the base. If not, insert shims as required and again check for free impeller rotation. Finally, if unit is direct coupled to the driver, check shaft and coupling alignment carefully and make any necessary corrections.

In planning the installation, and before setting the unit, consider how piping arrangements are dictated by the unit design and assembly. Drive shaft rotation must be established accordingly and is indicated by an arrow near the shaft.

Typical arrangement on vertical units has the drive shaft at the top with counterclockwise rotation and discharge to the left. Horizontal units are typically arranged with the drive shaft at the left with counterclockwise rotation and discharge down. See Figure 4 for other various unit arrangements and possible conversions.

When a unit is DIRECT COUPLED to its driver, the driver RPM must be selected or governed so as not to exceed the maximum speed rating of the unit. Refer to Table 1 for allowable speeds of various unit sizes.

A flexible type coupling should always be used to connect the driver and unit shafts.

When direct coupling a motor or engine to a blower you must ensure there is sufficient gap between the coupling halves and the element to prevent thrust loading the blower bearings. When a motor, engine or blower is operated the shafts may expand axially. If the coupling is installed in such a manner that there is not enough room for expansion the blower shaft can be forced back into the blower and cause the impeller to contact the gear end headplate resulting in damage to the blower. The two shafts must be in as near perfect alignment in all directions as possible, and the gap must be established with the motor armature on its electrical center if end-play exists. Coupling manufacturer's recommendations for maximum misalignment, although acceptable for the coupling, are normally too large to achieve smooth operation and maximum life of the blower.

The following requirements of a good installation are recommended. When selecting a coupling to be fitted to the blower shaft Roots recommends a taper lock style coupling to ensure proper contact with the blower shaft. If the coupling must have a straight bore the coupling halves must be fitted to the two shafts with a line to line thru .001" interference fit. Coupling halves must be warmed up per coupling manufacturer's recommendations. Maximum deviation in offset alignment of the shafts should not exceed .005" (.13 mm) total indicator reading, taken on the two coupling hubs. Maximum deviation from parallel of the inside coupling faces should not exceed .001" (.03 mm) when checked at six points around

the coupling.

When a unit is BELT DRIVEN, the proper selection of sheave diameters will result in the required unit speed. When selecting a sheave to be fitted to the blower shaft Roots recommends a taper lock style sheave to insure proper contact with the blower shaft. This flexibility can lead to operating temperature problems caused by unit speed being too low. Make sure the drive speed selected is within the allowable range for the specific unit size, as specified under Table 1.

Belt drive arrangements usually employ two or more V-belts running in grooved sheaves. Installation of the driver is less critical than for direct coupling, but its shaft must be level and parallel with the unit shaft. **The driver should be mounted on the inlet side of a vertical unit (horizontal piping) and on the side nearest to the shaft on a horizontal unit. SEE PAGE 6 - Acceptable Blower Drive Arrangement Options.** The driver must also be mounted on an adjustable base to permit installing, adjusting and removing the V-belts. To position the driver correctly, both sheaves need to be mounted on their shafts and the nominal shaft center distance known for the belt lengths to be used.

**CAUTION:** Drive couplings and sheaves (pulleys) should have an interference fit to the shaft of the blower (set screw types of attachment generally do not provide reliable service.) It is recommended that the drive coupling or sheave used have a taper lock style bushing which is properly sized to provide the correct interference fit required. Drive couplings, that require heating to fit on the blower shaft, should be installed per coupling manufacturer recommendations. A drive coupling or sheave should not be forced on to the shaft of the blower as this could affect internal clearances resulting in damage to the blower.

**Engine drive applications often require special consideration to drive coupling selection to avoid harmful torsional vibrations. These vibrations may lead to blower damage if not dampened adequately. It is often necessary to install a flywheel and/or a torsionally soft elastic element coupling based on the engine manufacturer recommendations.**

The driver sheave should also be mounted as close to its bearing as possible, and again should fit the shaft correctly. Position the driver on its adjustable base so that 2/3 of the total movement is available in the direction away from the unit, and mount the assembly so that the face of the sheave is accurately in line with the unit sheave. This position minimizes belt wear, and allows sufficient adjustment for both installing and tightening the belts. After belts are installed, adjust their tension in accordance with the manufacturer's instructions. However, only enough tension should be applied to prevent slippage when the unit is operating under load. Excessive tightening can lead to early bearing concerns or shaft breakage.

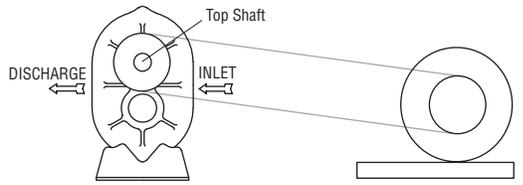
Before operating the drive under power to check initial belt tension, first remove covers from the unit connections. Make sure the interior is still clean, then rotate the shaft by hand. Place a coarse screen over the inlet connection to prevent anything being drawn into the unit while it is operating, and avoid standing in line with the discharge opening. Put oil in the sumps per instructions under **LUBRICATION**.

## Piping

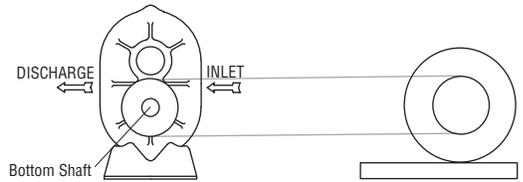
Before connecting piping, remove any remaining anti-rust compound from unit connections. Clean pipe should be no

## Acceptable Blower Drive Arrangement Options

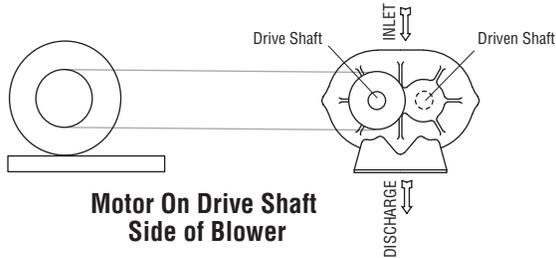
### ACCEPTABLE



**Motor On Inlet Side of Blower (Top Shaft)**

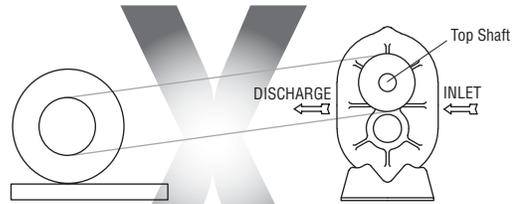


**Motor On Inlet Side of Blower (Bottom Shaft)**



**Motor On Drive Shaft Side of Blower**

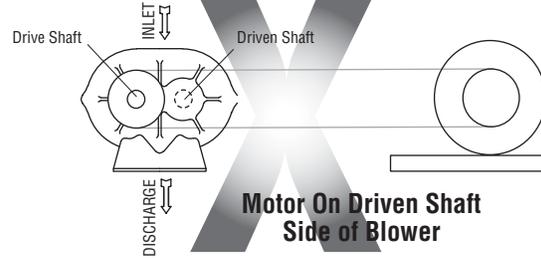
### UNACCEPTABLE



**Motor On Discharge Side of Blower (Top Shaft)**



**Motor On Discharge Side of Blower (Bottom Shaft)**



**Motor on Driven Shaft Side of Blower**

smaller than unit connections. In addition, make sure it is free of scale, cuttings, weld beads, or foreign material of any kind. To further guard against damage to the unit, especially when an inlet filter is not used, install a substantial screen of 16 mesh backed with hardware cloth at or near the inlet connections. Make provisions to clean this screen of collected debris after a few hours of operation. It should be removed when its usefulness has ended, as the wire will eventually deteriorate and small pieces going into the unit may cause serious damage.

Pipe flanges or male threads must meet the unit connections accurately and squarely. DO NOT attempt to correct misalignment by springing or cramping the pipe. In most cases this will distort the unit casing and cause impeller rubbing. In severe cases it can prevent operation or result in a broken drive shaft. For similar reasons, piping should be supported near the unit to eliminate dead weight strains. Also, if pipe expansion is likely to occur from temperature change, installation of flexible connectors or expansion joints is advisable.

Figure 3 represents an installation with all accessory items that might be required under various operating conditions. Inlet piping should be completely free of valves or other restrictions. When a shut-off valve can not be avoided, make sure a full size vacuum relief is installed nearest the unit inlet. This will protect against unit overload caused by accidental closing of the shut-off valve.

Need for an inlet silencer will depend on unit speed and pressure, as well as sound-level requirements in the general surroundings. An inlet filter is recommended, especially in dusty

or sandy locations. A discharge silencer is also normally suggested, even though Whispair units operate at generally lower noise levels than conventional rotary blowers. Specific recommendations on silencing can be obtained from your local Roots distributor.

Discharge piping requires a pressure relief valve, and should include a manual unloading valve to permit starting the unit under no-load conditions. Reliable pressure/vacuum gauges and good thermometers at both inlet and discharge are recommended to allow making the important checks on unit operating conditions. The back-pressure regulator shown in Figure 3 is useful mainly when volume demands vary while the unit operates at constant output. If demand is constant, but somewhat lower than the unit output, excess may be blown off through the manual unloading valve.

In multiple unit installations where two or more units operate with a common header, use of check valves is mandatory. These should be of a direct acting or free swinging type, with one valve located in each line between the unit and header. Properly installed, they will protect against damage from reverse rotation caused by air and material back-flow through an idle unit.

After piping is completed, and before applying power, rotate the drive shaft by hand again. If it does not move with uniform freedom, look for uneven mounting, piping strain, excessive belt tension or coupling misalignment.

**DO NOT** operate the unit at this time unless it has been lubricated per instructions.

## Technical Supplement for Universal RAI-G™ Gas Blowers

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### Technical Supplement for 32, 33, 36, 42, 45, 47, 53, 56, 59, 65, 68, 615 Universal RAI-G blowers

ROOTS Universal RAI-G rotary positive gas blowers are a design extension of the basic Universal RAI blower model. URAI-G blower uses (4) mechanical seals in place of the standard inboard lip seals to minimize gas leakage into the atmosphere. The seal chambers are piped to plugged connections. These should be opened periodically to confirm that there is no build-up of oil due to leakage by the mechanical seal. Special traps may be required for vacuum operation. These units are intended for gases which are compatible with cast iron case material, steel shafts, 300/400 series stainless steel and carbon seal components, viton o-rings and the oil/grease lubricants. If there are any questions regarding application or operation of this gas blower, please contact factory.

**Precaution: URAI-G blowers: Care must be used when opening the head plate seal vent chamber plugs (43) as some gas will escape—if it is a pressure system, or the atmospheric air will leak in-if the system is under vacuum. There is a possibility of some gas leakage through the mechanical seals. This leakage on the gear end will escape through the gear box vent, and on the drive end, through the grease release fittings. If the gas leakage is undesirable, each seal chamber must be purged with an inert gas through one purge gas hole (43) per seal . There are two**

**plugged purge gas holes(1/8 NPT) provided per seal. The purge gas pressure must be maintained one psi above the discharge gas pressure. Also, there exists a possibility of gear end oil and drive end grease leakage into the gas stream.**

The lubricants selected must be compatible with the gas.

### URAI GAS Blower Oil and Grease Specifications

The specified oil should be Roots synthetic P/N 813-106- of the proper viscosity.

When servicing drive end bearings of a Gas blower, use the specified NLGI #2 premium grade aluminum complex\* grease, Roots P/N T20019001, with 300°F (149°C) service temperature and moisture resistance and good mechanical stability.

\*ROOTS Synthetic Oil & Grease is superior in performance to petroleum based products. It has high oxidation stability, excellent corrosion protection, extremely high film strength and low coefficient of friction. Typical oil change intervals are increased 2-3 times over petroleum based lubricants. Also, ROOTS Synthetic Oil is 100% compatible with petroleum based oils. Simply drain the oil in the blower and refill the reservoirs with ROOTS Synthetic Oil to maintain optimum performance of your ROOTS blower.

## Lubrication

Due to sludge build-up and seal leakage problems, Roots recommendation is **DO NOT USE** Mobil SHC synthetic lubricants in ROOTS blowers.

### For Units with a Grease Lubricated Drive End

A simple but very effective lubrication system is employed on the drive shaft end bearings. Hydraulic pressure relief fittings are provided to vent any excess grease, preventing pressure build-up on the seals. A restriction plug and metering orifice prevent loss of lubricant from initial surges in lubricant pressure but permit venting excess lubricant under steadily rising pressures.

For grease lubricated drive end blowers see page 16, table 4, regarding specified greasing intervals.

When servicing drive end bearings of Non Gas blower, use the specified NLGI #2 premium grade microgel grease with 250°F (121°C) service temperature and moisture resistance and good mechanical stability. ROOTS specifies Shell Darina EP NLGI Grade 2. Product Code 71522 or Shell Darina SD 2 product code 506762B.

### URAI GAS Blower Oil and Grease Specifications

The specified oil should be Roots synthetic P/N 813-106- of the proper viscosity.

When servicing drive end bearings of a Gas blower, use the specified NLGI #2 premium grade aluminum complex\* grease, Roots P/N T20019001, with 300°F (149°C) service temperature and moisture resistance and good mechanical stability.

**NOTE: Lithium based greases are not compatible with the ROOTS Synthetic grease used when assembling a Gas blower or the non-soap base grease used when assembling a standard URAI blower. Lithium based grease is not approved for any ROOTS blowers.**

Using a pressure gun, slowly force new lubricant into each drive end bearing housing until traces of clean grease comes out of the relief fitting. The use of an electric or pneumatic grease gun could force the grease in too rapidly and thus invert the seals and should not be used.

To fill the gearbox, remove the breather plug (25) and the oil overflow plug (21) - see page 14. Fill the reservoir up to the overflow hole. Place the breather and the overflow plug back into their respective holes.

After a long shutdown, it is recommended that the grease fittings be removed, the old grease flushed out with kerosene or #10 lubricating oil, drained thoroughly, and bearings refilled with new grease. Be sure grease relief fittings are reinstalled. Grease should be added using a hand operated grease gun to the drive end bearings at varying time intervals depending on duty cycle and RPM. Table 4 has been prepared as a general greasing schedule guide based on average operating conditions. More frequent intervals may be necessary depending on the grease operating temperature and unusual circumstances.

### For Units with Splash Lubrication on Both Ends

Bearings and oil seals are lubricated by the action of the timing gears or oil slingers which dip into the main oil sumps

causing oil to splash directly on gears and into bearings and seals. A drain port is provided below each bearing to prevent an excessive amount of oil in the bearings. Seals located inboard of the bearings in each headplate effectively retain oil within the sumps. Any small leakage that may occur should the seals wear passes into a cavity in each vented headplate and is drained downward.

Oil sumps on each end of the blower are filled by removing top vent plugs, Item (25), and filling until oil reaches the middle of the oil level sight gauge when the unit is not operating, Item (45 or 53), **DO NOT FILL PAST THE MIDDLE OF THE SIGHT GLASS.**

Initial filling of the sumps should be accomplished with the blower not operating, in order to obtain the correct oil level. Approximate oil quantities required for blowers of the various models and configurations are listed in Table 3. Use a good grade of industrial type non-detergent, rust inhibiting, anti-foaming oil and of correct viscosity per Table 2. **\*ROOTS synthetic oil (Roots P/N 813-106-) is specified and recommended.** Roots does not recommend automotive type lubricants, as they are not formulated with the properties mentioned above.

The oil level may rise or fall on the gauge during operation, to an extent depending somewhat on oil temperature and blower speed.

Proper lubrication is usually the most important single consideration in obtaining maximum service life and satisfactory operation from the unit. Unless operating conditions are quite severe, a weekly check of oil level and necessary addition of lubricant should be sufficient. During the first week of operation, check the oil levels in the oil sumps about once a day, and watch for leaks. Replenish as necessary. Thereafter, an occasional check should be sufficient. It is recommended that the oil be changed after initial 100 hours of operation. Frequent oil changing is not necessary unless the blower is operated in a very dusty location.

Normal life expectancy of petroleum based oils is about 2000 hours with an oil temperature of about 180°F (82°C). As the oil temperature increases by increments of 15-18°F (8°C - 10°C), the life is reduced by half. Example: Oil temperatures of 210-216°F (99°C - 102°C) will produce life expectancy of 1/4 or 500 hours. Therefore, it is considered normal to have oil change periods of 500 hours with petroleum based oils.

Normal life expectancy of ROOTS™ Synthetic Oil is about 4000 to 8000 hours with an oil temperature of about 180°F (82°C). As the oil temperature increases by increments of 15-18°F (8°C - 10°C), the life is reduced by half. Example: Oil temperatures of 210-216°F (99°C - 102°C) will produce life expectancy of 1/4 or 1000 to 2000 hours.

**NOTE:** To estimate oil temperature, multiply the discharge temperature of the blower by 0.80. Example: if the discharge air temperature of the blower is 200° F, it is estimated that the oil temperature is 160° F.

\*ROOTS™ Synthetic Oil & Grease is superior in performance to petroleum based products. It has high oxidation stability, excellent corrosion protection, extremely high film strength and low coefficient of friction. Typical oil change intervals are increased 2-3 times over petroleum based lubricants. Also, ROOTS™ Synthetic Oil is 100% compatible with petroleum based oils. Simply drain the oil in the blower and refill the reservoirs with ROOTS™ Synthetic Oil to maintain optimum performance of your ROOTS™ blower.

## Operation

Before operating a blower under power for the first time, recheck the unit and the installation thoroughly to reduce the likelihood of avoidable troubles. Use the following procedure check list as a guide, but consider any other special conditions in the installation.

- Be certain that no bolts, tools, rags, or debris have been left in the blower air chamber or piping.
- If an outdoor intake without filter is used, be sure the opening is located so it cannot pick up dirt and is protected by a strong screen or grille. Use of the temporary protective screen as described under INSTALLATION is strongly recommended.
- Recheck blower leveling, drive alignment and tightness of all mounting bolts if installation is not recent. If belt drive is used, adjust belt tension correctly.
- Turn drive shaft by hand to make sure impellers still rotate without bumping or rubbing at any point.
- Ensure oil levels in the main oil sumps are correct.
- Check lubrication of driver. If it is an electric motor, be sure that power is available and that electrical overload devices are installed and workable.
- Open the manual unloading valve in the discharge air line. If a valve is in the inlet piping, be sure it is open.
- Bump blower a few revolutions with driver to check that direction of rotation agrees with arrow near blower shaft, and that both coast freely to a stop.

After the preceding points are cleared, blower is ready for trial operation under “no-load” conditions. The following procedure is suggested to cover this initial operation test period.

- a. Start blower, let it accelerate to full speed, then shut off. Listen for knocking sounds, both with power on and as speed slows down.
- b. After blower comes to a complete stop, repeat above, but let blower run 2 or 3 minutes. Check for noises, such as knocking sounds.
- c. After blower comes to a complete stop, operate blower for about 10 minutes unloaded. Check oil levels. Observe cylinder and headplate surfaces for development of hot spots such as burned paint, indicating impeller rubs. Be aware of any noticeable increase in vibration.

Assuming that all trials have been satisfactory, or that necessary corrections have been made, the blower should now have a final check run of at least one hour under normal operating conditions. After blower is restarted, gradually

close the discharge unloading valve to apply working pressure. At this point it is recommended that a pressure gauge or manometer be connected into the discharge line if not already provided, and that thermometers be in both inlet and discharge lines. Readings from these instruments will show whether pressure or temperature ratings of the blower are being exceeded.

During the final run, check operating conditions frequently and observe the oil levels at reasonable intervals. If excessive noise or local heating develops, shut down immediately and determine the cause. If either pressure rise or temperature rise across the blower exceeds the limit specified in this manual, shut down and investigate conditions in the piping system. Refer to the TROUBLESHOOTING CHECKLIST for suggestions on various problems that may appear.

The blower should now be ready for continuous duty operation at full load. During the first few days make periodic checks to determine whether all conditions remain steady, or at least acceptable. This may be particularly important if the blower is supplying air to a process system where conditions can vary. At the first opportunity, stop the blower and clean the temporary inlet protective screen. If no appreciable amount of debris has collected, the screen may be removed. See comments under INSTALLATION. At this same time, verify leveling, coupling alignment or belt tension, and mounting bolt tightness.

Should operating experience prove that blower capacity is a little too high for the actual air requirements, a small excess may be blown off continuously through the manual unloading or vent valve. Never rely on the pressure relief valve as an automatic vent. Such use may cause the discharge pressure to become excessive, and can also result in failure of the valve itself. If blower capacity appears to be too low, refer to the TROUBLESHOOTING CHECKLIST.

### Vibration Assessment Criteria

With measurements taken at the bearing locations on the housings, see chart below for an appropriate assessment guide for rotary lobe blowers rigidly mounted on stiff foundations.

In general, blower vibration levels should be monitored on a regular basis and the vibration trend observed for progressive or sudden change in level. If such a change occurs, the cause should be determined through spectral analysis.

As shown on the chart below, the level of all pass vibration will determine the need to measure discrete frequency vibration levels and the action required.

All Pass Vibration (in/sec)	Discrete Frequency Vibration (in/sec)	Action
0.45 or less	N/R	Acceptable
Greater than 0.45 but 1.0 or less	0.45 or less @ any frequency	Acceptable
	Greater than 0.45 @ any frequency	Investigate
Greater than 1.0	Less than 1.0	Investigate
	Greater than 1.0	Investigate

## Troubleshooting Checklist

Trouble	Item	Possible Cause	Remedy
No flow	1	Speed too low	Check by tachometer and compare with published performance
	2	Wrong rotation	Compare actual rotation with Figure 1 Change driver if wrong
	3	Obstruction in piping	Check piping, valves, silencer to assure open flow path
Low capacity	4	Speed too low	See item 1, If belt drive, check for slippage and readjust tension
	5	Excessive pressure rise	Check inlet vacuum and discharge pressure and compare with Published performance
	6	Obstruction in piping	See item 3
	7	Excessive slip	Check inside of casing for worn or eroded surfaces causing excessive clearances
Excessive power	8	Speed too high	Check speed and compare with published performance
	9	Excessive pressure rise	See Item 5
	10	Impeller rubbing	Inspect outside of cylinder for high temperature areas, then check for impeller contact at these points. Correct blower mounting, drive alignment
	11	Scale, sludge, rust or product build up	Clean blower appropriately
Damage to bearings or gears	12	Inadequate lubrication	Check oil sump levels in gear and drive end headplates
	13	Excessive lubrication	Check oil levels. If correct, drain and refill with clean oil of recommended grade
	14	Excessive pressure rise	See Item 5
	15	Coupling misalignment	Check carefully. Realign if questionable
Vibration	16	Excessive belt tension	Readjust for correct tension
	17	Misalignment	See Item 15
	18	Impellers rubbing	See Item 10
	19	Worn bearings/gears	Check gear backlash and condition of bearings, and replace as indicated
	20	Unbalanced or rubbing impeller	Scale or process material may build up on casing and impellers, or inside impellers. Remove build-up to restore original clearances and impeller balance
	21	Driver or blower loose	Tighten mounting bolts securely
	22	Piping resonances	Determine whether standing wave pressure pulsations are present in the piping
	23	Scale/sludge build-ups	Clean out interior of impeller lobes to restore dynamic balance
Driver stops, or will not start	24	Casing strain	Re-work piping alignment to remove excess strain
	25	Impeller stuck	Check for excessive hot spot on headplate or cylinder. See item 10. Look for defective shaft bearing and/or gear teeth
	26	Scale, sludge, rust or product build-up	Clean blower appropriately
Excessive breather	27	Broken seal	Replace seals
Blow-by or excessive oil leakage to vent area	28	Defective O-ring	Replace seals and O-ring
Excessive oil leakage in vent area	29	Defective/plugged breather	Replace breather and monitor oil leakage
	30	Oil level too high	Check sump levels in gear and drive headplates.
	31	Oil type or viscosity incorrect	Check oil to insure it meets recommendations. Drain then fill with clean oil of recommended grade.
	32	Blower running hot	Check blower operating conditions to ensure they are within the operating limitations defined in this manual.

## Inspection & Maintenance: Universal RAI® series blowers

A good program of consistent inspection and maintenance is the most reliable method of minimizing repairs to a blower. A simple record of services and dates will help keep this work on a regular schedule. Basic service needs are:

- Lubrication
- Checking for hot spots
- Checking for increases or changes in vibration and noise
- Recording of operating pressures and temperatures

Above all, a blower must be operated within its specified rating limits, to obtain satisfactory service life.

A newly installed blower should be checked often during the first month of full-time operation. Attention there after may be less frequent assuming satisfactory performance. Lubrication is normally the most important consideration and weekly checks of lubricant levels in the gearbox and bearing reservoirs should be customary. Complete oil change schedules are discussed under **LUBRICATION**.

Driver lubrication practices should be in accordance with the manufacturer's instructions. If direct connected to the blower through a lubricated type coupling, the coupling should be checked and greased each time blower oil is changed. This will help reduce wear and prevent unnecessary vibration. In a belted drive system, check belt tension periodically and inspect for frayed or cracked belts.

In a new, and properly installed, unit there is no contact between the two impellers, or between the impellers and cylinder or headplates. Wear is confined to the bearings (which support and locate the shafts) the oil seals, and the timing gears. All are lubricated and wear should be minimal if clean oil of the correct grade is always used. Seals are subject to deterioration as well as wear, and may require replacement at varying periods.

Shaft bearings are designed for optimum life under average conditions with proper lubrication and are critical to the service life of the blower. Gradual bearing wear may allow a shaft position to change slightly, until rubbing develops between impeller and casing. This will cause spot heating, which can be detected by observing these surfaces. Sudden bearing failure is usually more serious. Since the shaft and impeller are no longer supported and properly located, extensive general damage to the blower casing and gears is likely to occur.

Oil seals should be considered expendable items, to be replaced whenever drainage from the headplate vent cavity becomes excessive or when the blower is disassembled for

any reason. Some oil seal leakage may occur since an oil film under the lip is required for proper operation. Periodically leaked oil should be wiped off from surfaces. Minor seal leakage should not be considered as indicating seal replacement.

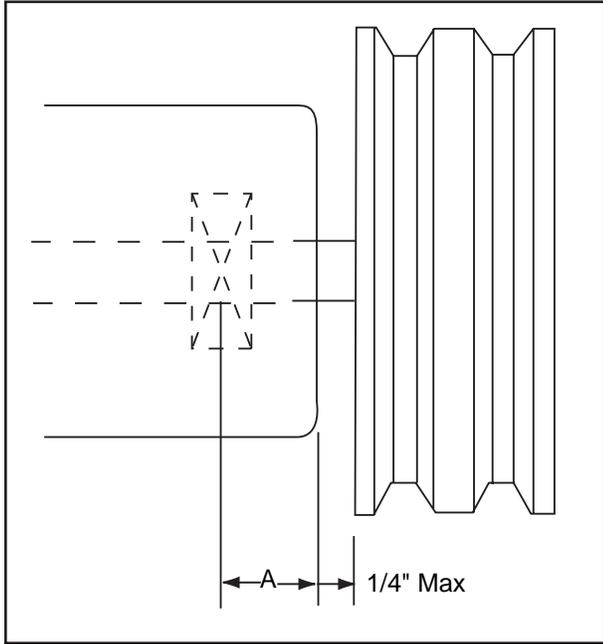
Timing gear wear, when correct lubrication is maintained, should be negligible. Gear teeth are cut to provide the correct amount of backlash, and gears correctly mounted on the shafts will accommodate a normal amount of tooth wear without permitting contact between lobes of the two impellers. However, too high an oil level will cause churning and excessive heating. This is indicated by unusually high temperature at the bottom of the gear housing. Consequent heating of the gears will result in loss of tooth-clearance, backlash and rapid wear of the gear teeth usually will develop. Continuation of this tooth wear will eventually produce impeller contacts (knocking), and from this point serious damage will be unavoidable if blower operation is continued. A similar situation can be produced suddenly by gear tooth fracture, which is usually brought on by sustained overloading or momentary shock loads.

Problems may also develop from causes other than internal parts failure. Operating clearances within a blower are only a few thousandths of an inch. This makes it possible for impeller interference or casing rubs to result from shifts in the blower mounting, or from changes in piping support. If this type of trouble is experienced, and the blower is found to be clean, try removing mounting strains. Loosen blower mounting bolts and reset the leveling and drive alignment. Then tighten mounting again, and make sure that all piping meets blower connections accurately and squarely. Foreign materials in the blower will also cause trouble, which can only be cured by disconnecting the piping and thoroughly cleaning the blower interior.

A wide range of causes & solutions for operating troubles are covered in the **TROUBLE SHOOTING CHECKLIST**. The remedies suggested should be performed by qualified mechanics with a good background. Major repairs generally are to be considered beyond the scope of maintenance, and should be referred to an authorized Roots distributor.

Warranty failures should not be repaired at all, unless specific approval has been obtained through Roots before starting work. Unauthorized disassembly within the warranty period may void the warranty.

Figure 2 - Allowable Overhung Loads for V-Belt Drives Universal RAI®/URAI®-J Units



$$\text{Belt Pull lbs} = \frac{252100 \cdot \text{Motor HP}}{\text{Blower RPM} \cdot \text{Sheave Diameter}}$$

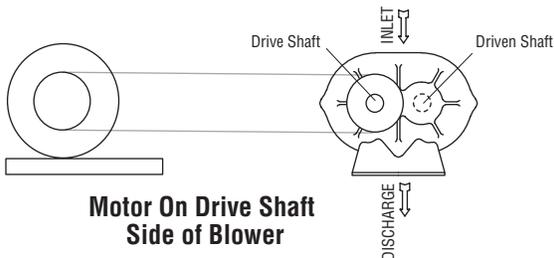
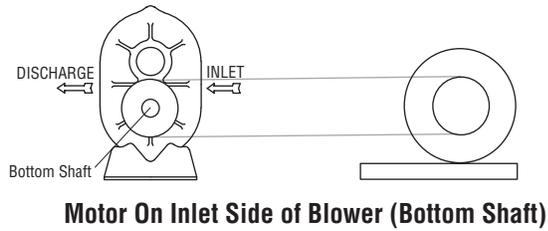
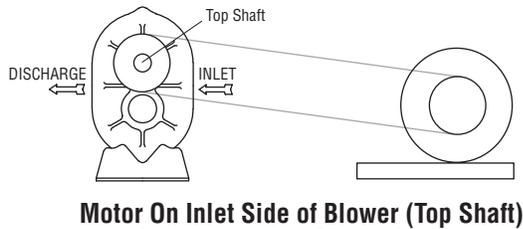
$$\text{Shaft Load (lb.in)} = \text{Belt Pull} \cdot \left( A + \frac{1}{4} + \frac{\text{Sheave Width}}{2} \right)$$

Frame Size	Dimension "A"	Max Allowable Shaft Load (lb-in.)	Min Sheave Diameter
22, 24	0.61	150	4.00
32, 33, 36	0.80	400	5.00
42, 45, 47	1.02	650	5.00
53, 56, 59	1.13	1,325	6.00
65, 68, 615	1.36	2,250	8.00
76, 711, 718	1.16	2,300	9.50

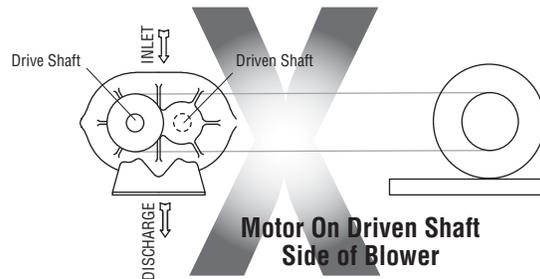
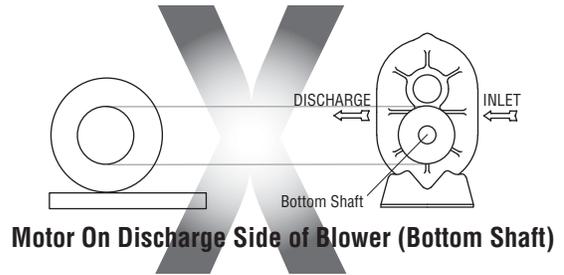
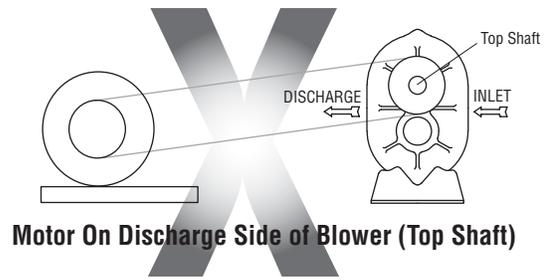
**NOTE:**  
 Arc of sheave belt contact on the smaller sheave not to be less than 170°  
 Driver to be installed on the inlet side for vertical units, and on the drive shaft side for horizontal units.  
 Roots recommends the use of two or more 3V, 5V or 8V matched set or banded belts and sheaves.

**Acceptable Blower Drive Arrangement Options**

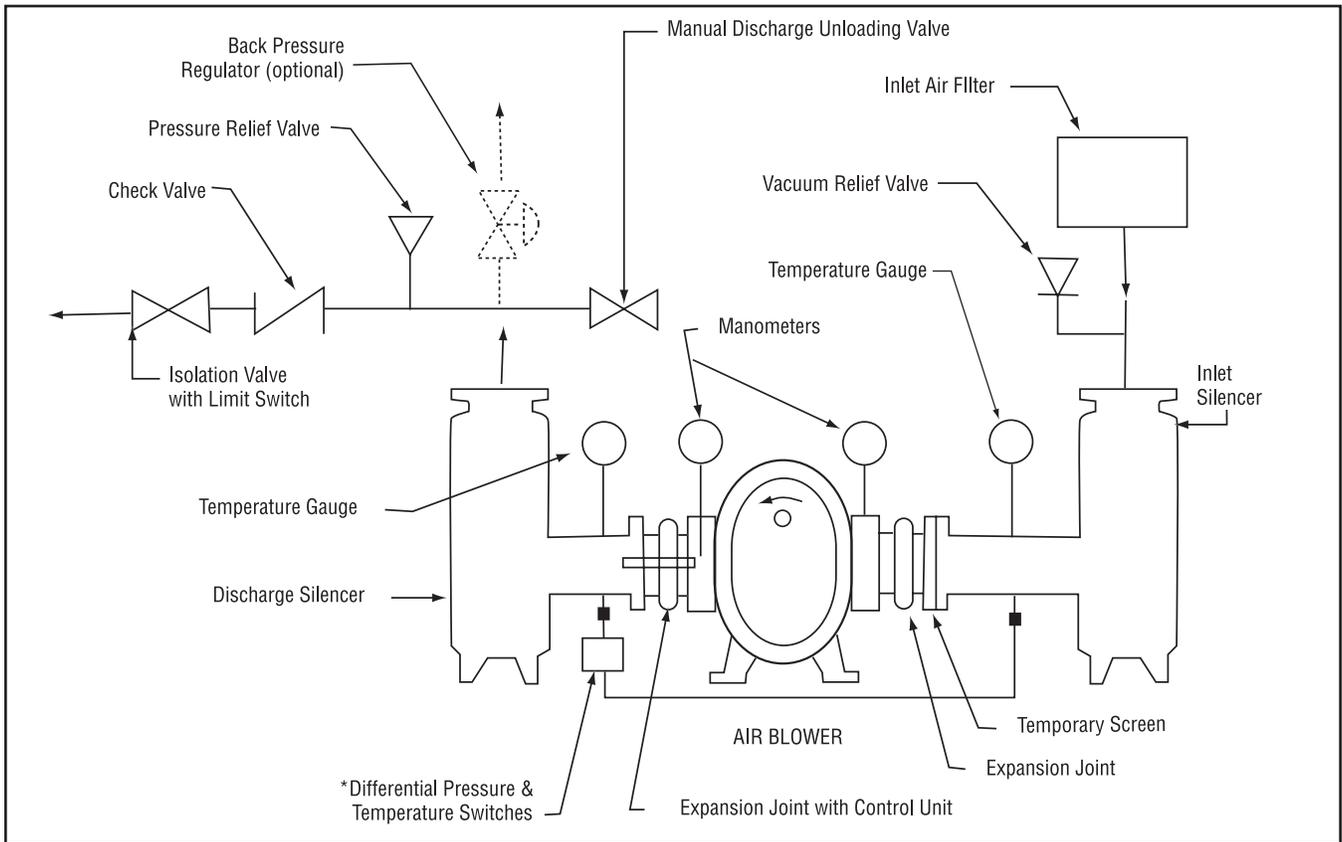
**ACCEPTABLE**



**UNACCEPTABLE**

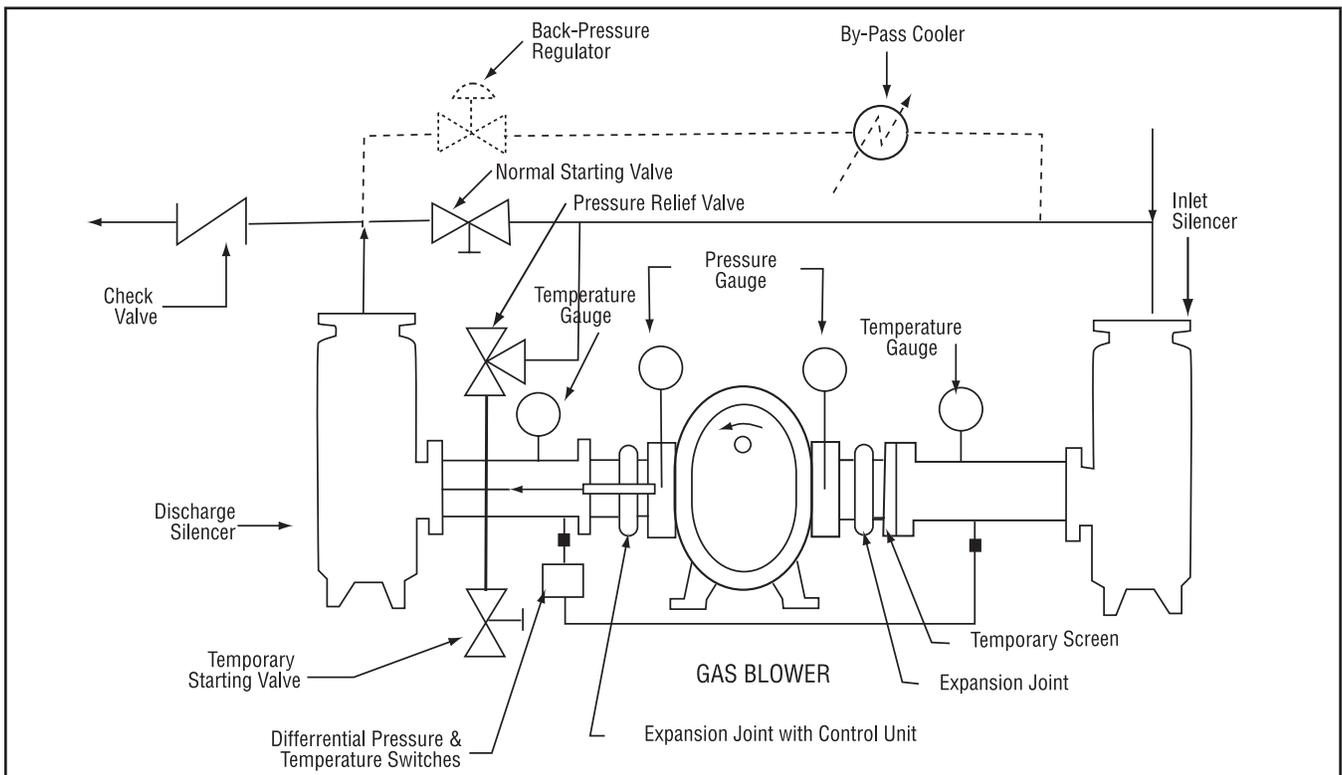


**Figure 3a - Air Blower Installation with Accessories**



Above are suggested locations for available accessories.

**Figure 3b - Gas Blower Installation with Accessories**



Above are suggested locations for available accessories.

Figure 4

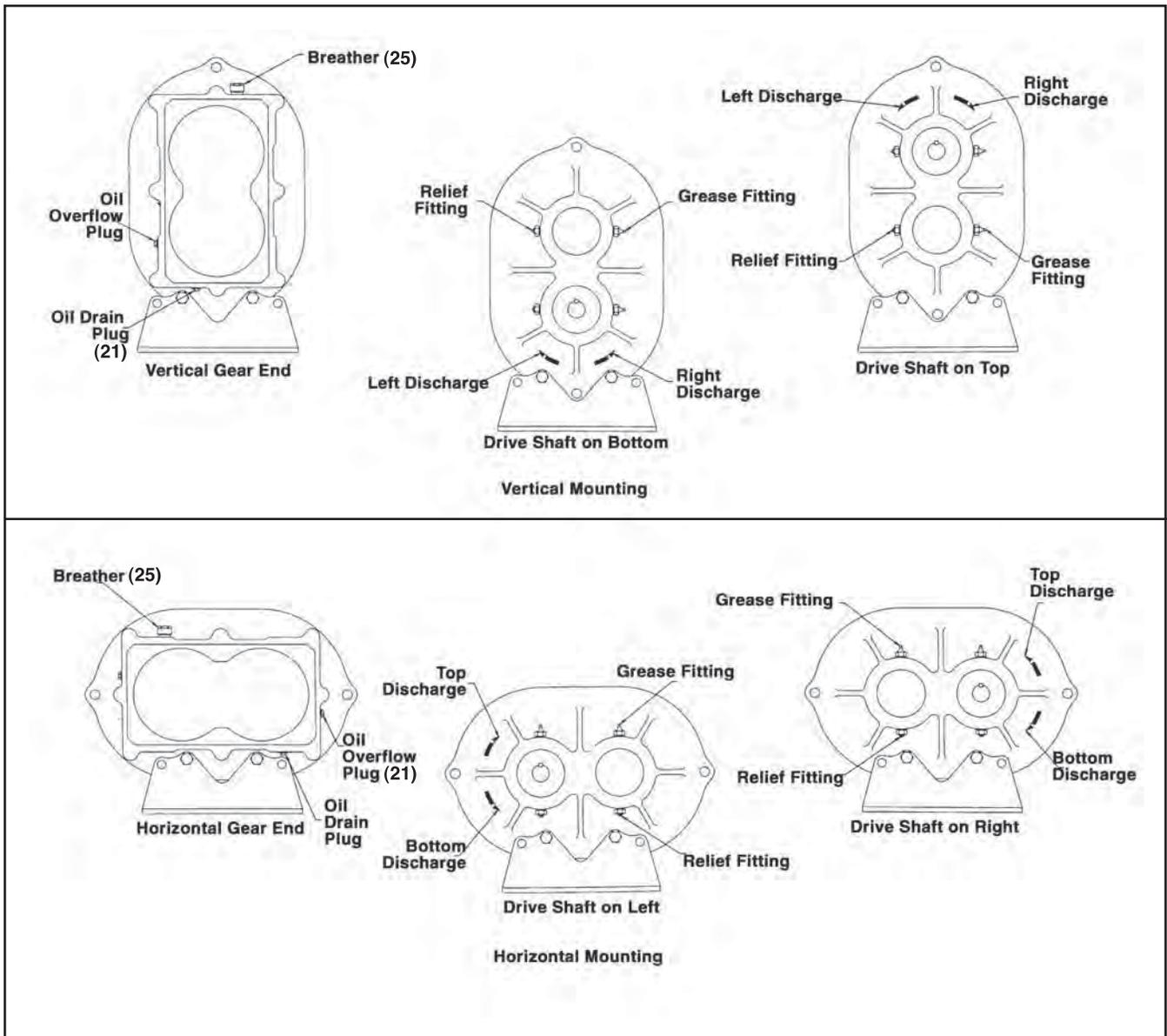
Blower Orientation Conversion

Model	Reversible Rotation	Whispair™ Design
URAI	yes	no
URAI-J Whispair™	no	yes
URAI-G	yes	no

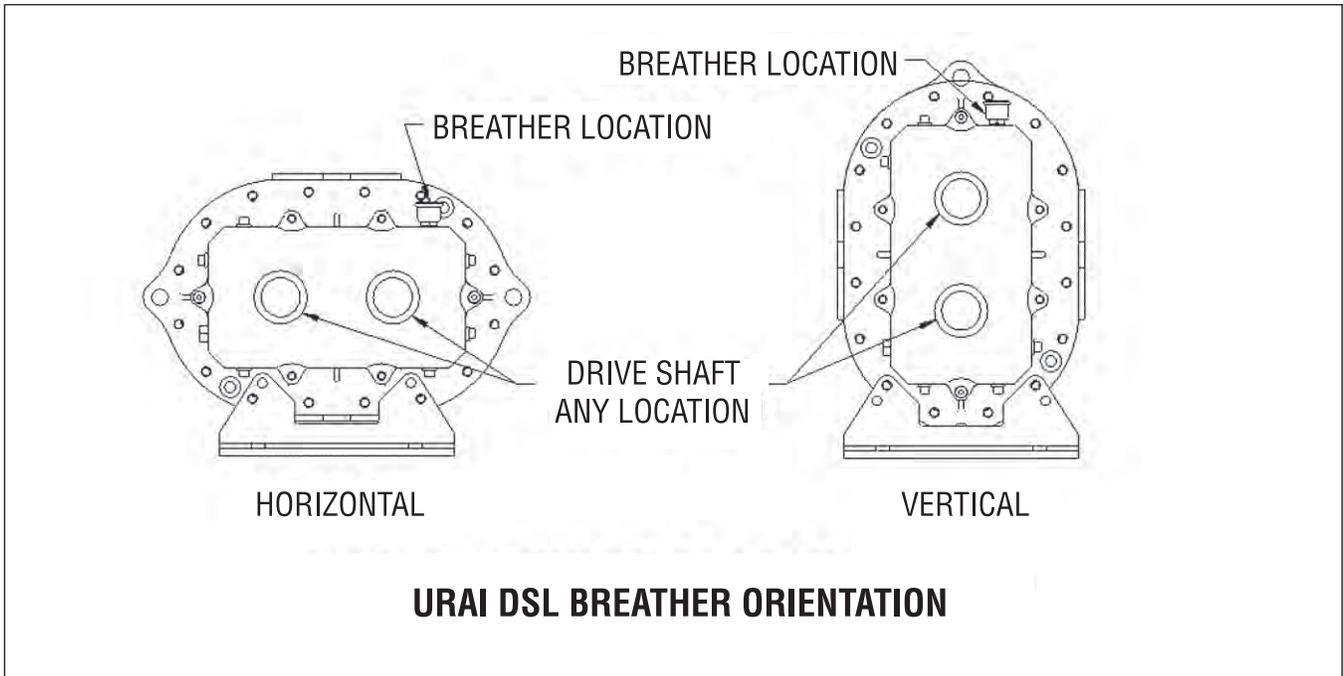
**Special Note:** WHISPAIR™ models are designed to operate with only one shaft rotation direction to take full advantage of the Whispair feature. Therefore, a WHISPAIR™ blower may be operated in the following combinations.

- CCW Rotation: Bottom Shaft; Right side discharge or a Left Shaft; Bottom discharge
  - CCW Rotation: Top Shaft; Left side discharge or a Right Shaft; Top discharge
- or
- CW Rotation: Bottom Shaft; Left side discharge or a Right Shaft Bottom discharge
  - CW Rotation: Top Shaft; Right side discharge or a Left Shaft Top discharge

Blower Orientation and Lubrication Points: Grease Lubricated Drive End  
URAI & URAI-G Blowers



**Drive End Breather Orientation for URAI DSL blowers with Oil Lube**



**Table 1 - URAI, URAI DSL & URAI-G blowers,  
Maximum Allowable Operating Conditions**

Frame Size	Gear Diameter (Inch)	Speed RPM	Temp. Rise		Delta Pressure		Inlet Vacuum	
			F°	(C°)	PSI	(mbar)	INHG	(mbar)
22	2.5	5275	225	(125)	12	(827)	15	(500)
24	2.5	5275	210	(117)	7	(483)	15	(500)
32	3.5	3600	240	(133)	15	1034	16	(539)
33	3.5	3600	225	(125)	12	(827)	15	(500)
36	3.5	3600	225	(125)	7	(483)	15	(500)
42	4.0	3600	240	(133)	15	(1034)	16	(539)
45	4.0	3600	225	(125)	10	(690)	16	(539)
47	4.0	3600	225	(125)	7	(483)	15	(500)
53	5.0	2850	225	(125)	15	(1034)	16	(539)
56	5.0	2850	225	(125)	13	(896)	16	(539)
59	5.0	2850	225	(125)	7	(483)	15	(500)
65	6.0	2350	250	(130)	15	(1034)	16	(539)
68	6.0	2350	240	(133)	14	(965)	16	(539)
615	6.0	2350	130	(72)	7	(483)	14	(472)
76	7.0	2050	250	(139)	15	(1034)	16	(539)
711	7.0	2050	225	(125)	10	(690)	16	(539)
718	7.0	2050	130	(72)	6	(414)	12	(405)

**Table 2 - Recommended Oil Grades**

Ambient Temperature °F (°C)	ISO Viscosity No.
Above 90° (32°)	320
32° to 90° (0° to 32°)	220
0° to 32° (-18° to 0°)	150
Below 0° (-18°)	100

Ambient temperature is defined as the temperature of the space in which the blower and drive are located.

**URAI-G Blower Oil and Grease Specifications**

The specified oil is Roots synthetic P/N 813-106- of the proper viscosity based on the ambient temperature of the space in which the blower and drive are located.

**Table 3 - Approximate Oil Sump Capacities**

These capacities are provided to assist in stocking the correct amount of oil. Exact sump capacities may differ slightly. See "Lubrication" section for proper filling instructions.

**URAI, URAI-J, and URAI-G Blowers**

Frame Size	Gear End Capacity Fl. Oz. (Liters)	
	Vertical	Horizontal
22	3.4 (.1)	6.1 (.18)
24	3.4 (.1)	6.1 (.18)
32	8.5 (.25)	16.0 (.47)
33	8.5 (.25)	16.0 (.47)
36	8.5 (.25)	16.0 (.47)
42	12.7 (.37)	22.8 (.67)
45	12.7 (.37)	22.8 (.67)
47	12.7 (.37)	22.8 (.67)
53	16.0 (.47)	27.6 (.82)
56	16.0 (.47)	27.6 (.82)
59	16.0 (.47)	27.6 (.82)
65	28.3 (.84)	52.1 (1.54)
68	28.3 (.84)	52.1 (1.54)
615	28.3 (.84)	52.1 (1.54)
76	32.3 (.96)	59.5 (1.76)
711	32.3 (.96)	59.5 (1.76)
718	32.3 (.96)	59.5 (1.76)

See page 14 and 15 for illustration of vertical and horizontal configurations.

**URAI DSL Splash Lubricated Drive End Blowers**

Note that the gear end sump capacity is provided on the adjacent table.

Frame Size	Drive End Capacity Fl. Oz. (Liters)	
	Vertical	Horizontal
32	4.0 (.12)	6.5 (.19)
33	4.0 (.12)	6.5 (.19)
36	4.0 (.12)	6.5 (.19)
42	5.5 (.16)	10.8 (.32)
45	5.5 (.16)	10.8 (.32)
47	5.5 (.16)	10.8 (.32)
53	7.5 (.22)	14.8 (.44)
56	7.5 (.22)	14.8 (.44)
59	7.5 (.22)	14.8 (.44)
65	16 (0.47)	31 (0.91)
68	16 (0.47)	31 (0.91)
615	16 (0.47)	31 (0.91)

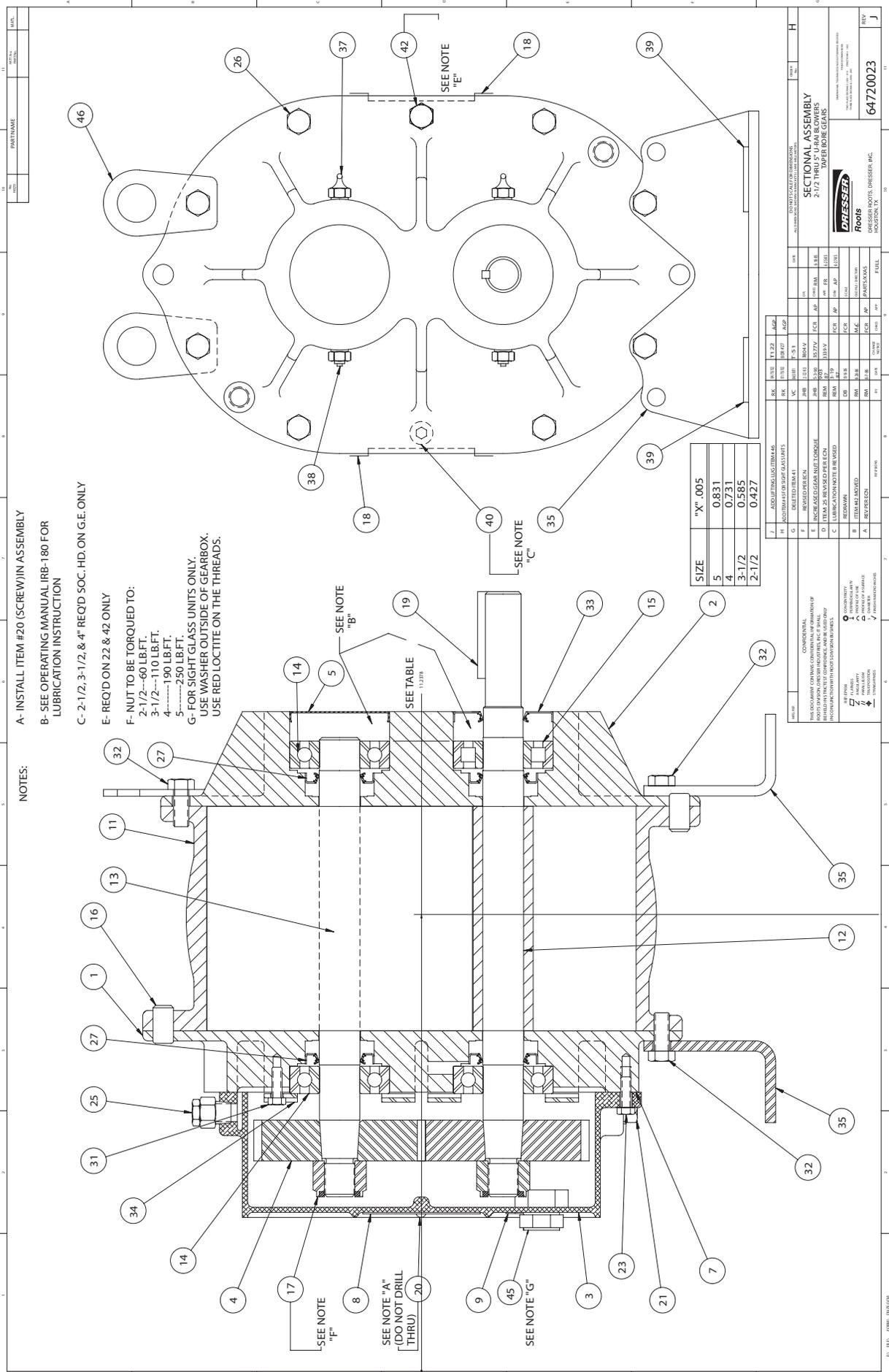
**Table 4 - URAI Blowers with Grease Lubricated Drive End: Specified Bearing Greasing Intervals**

Speed In RPM	Operating Hours Per Day		
	8	16	24
	Greasing Intervals in Weeks		
750-1000	7	4	2
1000-1500	5	2	1
1500-2000	4	2	1
2000-2500	3	1	1
2500-3000	2	1	1
3000 and up	1	1	1

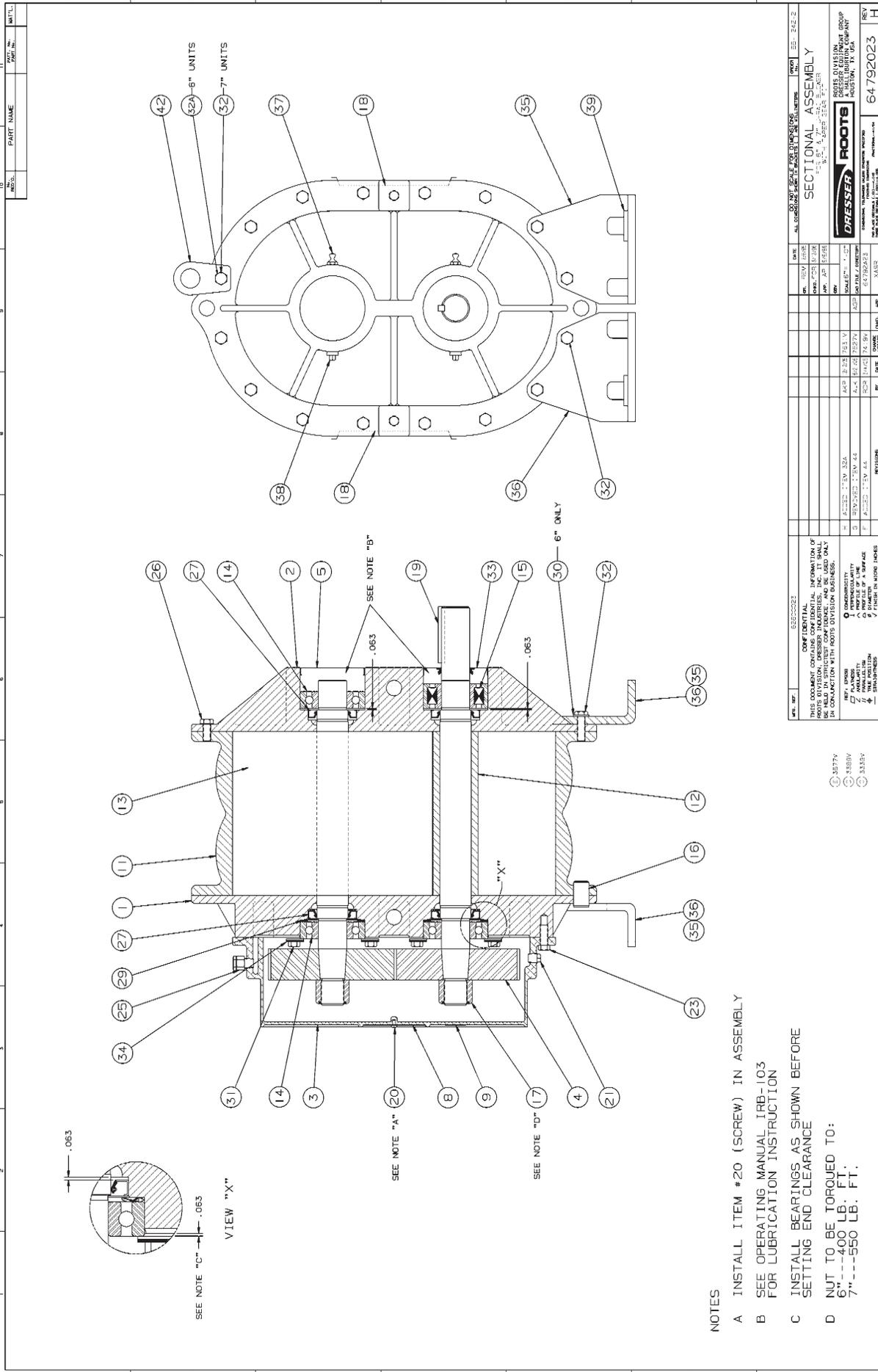
The specified grease for servicing drive end bearings of a Gas blower, use a NLGI #2 premium grade aluminum complex\* grease, Roots P/N T20019001 with 300°F (149°C) service temperature and moisture resistance and good mechanical stability.

When servicing drive end bearings of Non Gas blower, use a NLGI #2 premium grade microgel grease with 250°F (121°C) service temperature and moisture resistance and good mechanical stability. Roots specifies Shell Darina EP NLGI Grade 2. Product Code 71522.

NOTE: Lithium based greases are not compatible with the ROOTS Synthetic grease used when assembling a Gas blower or the non-soap base grease used when assembling a standard URAI blower. Lithium based grease is not approved for any ROOTS blowers.

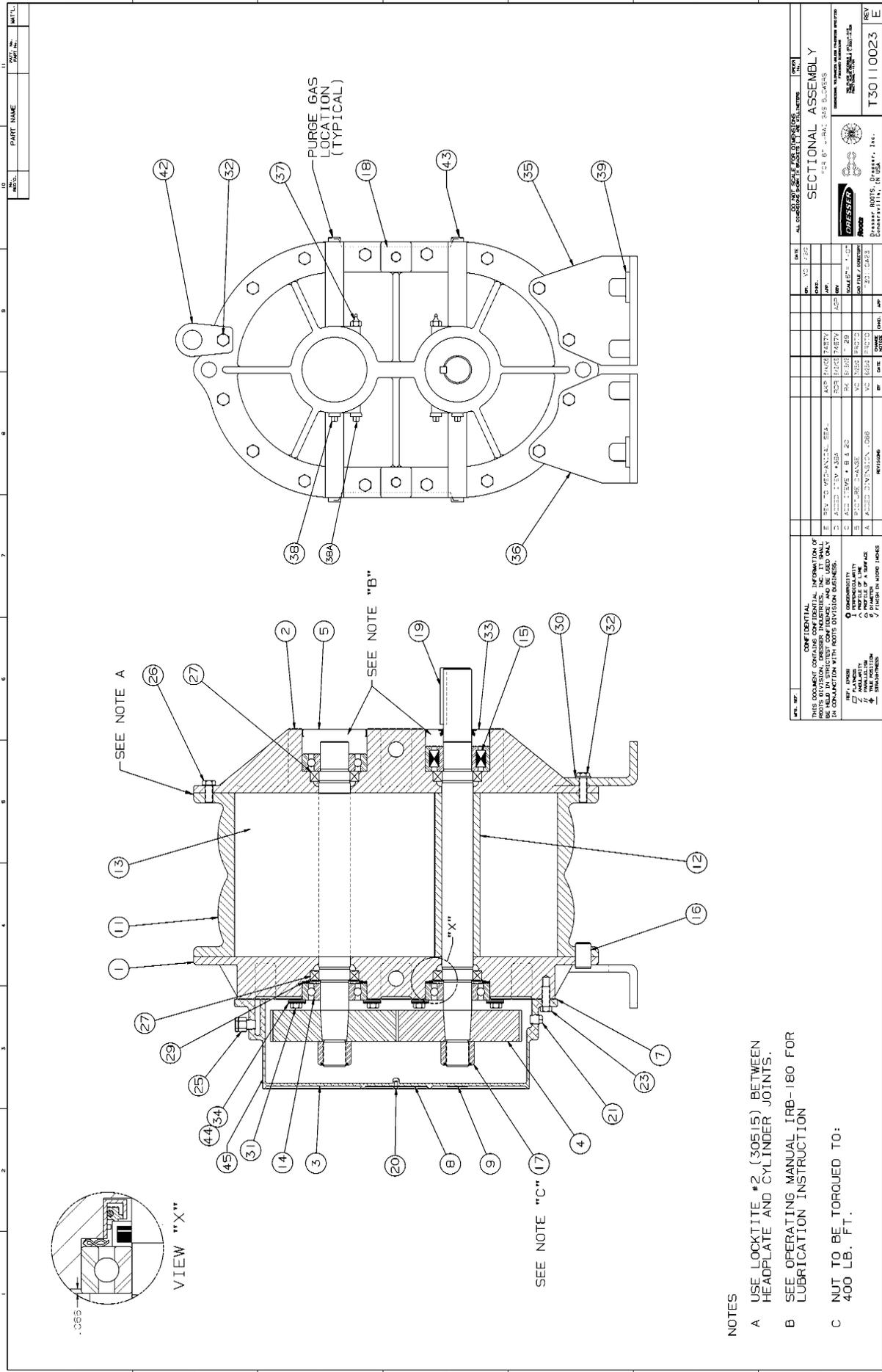


Assembly of URAI Blowers, 2-1/2" Through 5" Gear Diameter



Assembly of URAI Blowers, 6" and 7" Diameter





- NOTES**
- A USE LOCKTITE #2 (30515) BETWEEN HEADPLATE AND CYLINDER JOINTS.
  - B SEE OPERATING MANUAL IRB-180 FOR LUBRICATION INSTRUCTION
  - C NUT TO BE TORQUED TO: 400 LB. FT.

REV.	DATE	BY	CHKD.	DESCRIPTION
1	10/15/02			ISSUED FOR PRODUCTION
2	10/15/02			ISSUED FOR PRODUCTION
3	10/15/02			ISSUED FOR PRODUCTION
4	10/15/02			ISSUED FOR PRODUCTION
5	10/15/02			ISSUED FOR PRODUCTION
6	10/15/02			ISSUED FOR PRODUCTION
7	10/15/02			ISSUED FOR PRODUCTION
8	10/15/02			ISSUED FOR PRODUCTION
9	10/15/02			ISSUED FOR PRODUCTION
10	10/15/02			ISSUED FOR PRODUCTION
11	10/15/02			ISSUED FOR PRODUCTION
12	10/15/02			ISSUED FOR PRODUCTION
13	10/15/02			ISSUED FOR PRODUCTION
14	10/15/02			ISSUED FOR PRODUCTION
15	10/15/02			ISSUED FOR PRODUCTION
16	10/15/02			ISSUED FOR PRODUCTION
17	10/15/02			ISSUED FOR PRODUCTION
18	10/15/02			ISSUED FOR PRODUCTION
19	10/15/02			ISSUED FOR PRODUCTION
20	10/15/02			ISSUED FOR PRODUCTION
21	10/15/02			ISSUED FOR PRODUCTION
22	10/15/02			ISSUED FOR PRODUCTION
23	10/15/02			ISSUED FOR PRODUCTION
24	10/15/02			ISSUED FOR PRODUCTION
25	10/15/02			ISSUED FOR PRODUCTION
26	10/15/02			ISSUED FOR PRODUCTION
27	10/15/02			ISSUED FOR PRODUCTION
28	10/15/02			ISSUED FOR PRODUCTION
29	10/15/02			ISSUED FOR PRODUCTION
30	10/15/02			ISSUED FOR PRODUCTION
31	10/15/02			ISSUED FOR PRODUCTION
32	10/15/02			ISSUED FOR PRODUCTION
33	10/15/02			ISSUED FOR PRODUCTION
34	10/15/02			ISSUED FOR PRODUCTION
35	10/15/02			ISSUED FOR PRODUCTION
36	10/15/02			ISSUED FOR PRODUCTION
37	10/15/02			ISSUED FOR PRODUCTION
38	10/15/02			ISSUED FOR PRODUCTION
39	10/15/02			ISSUED FOR PRODUCTION
40	10/15/02			ISSUED FOR PRODUCTION
41	10/15/02			ISSUED FOR PRODUCTION
42	10/15/02			ISSUED FOR PRODUCTION

**Assembly of URAI-G Blowers, 6" Gear Diameter**

**SECTIONAL ASSEMBLY**

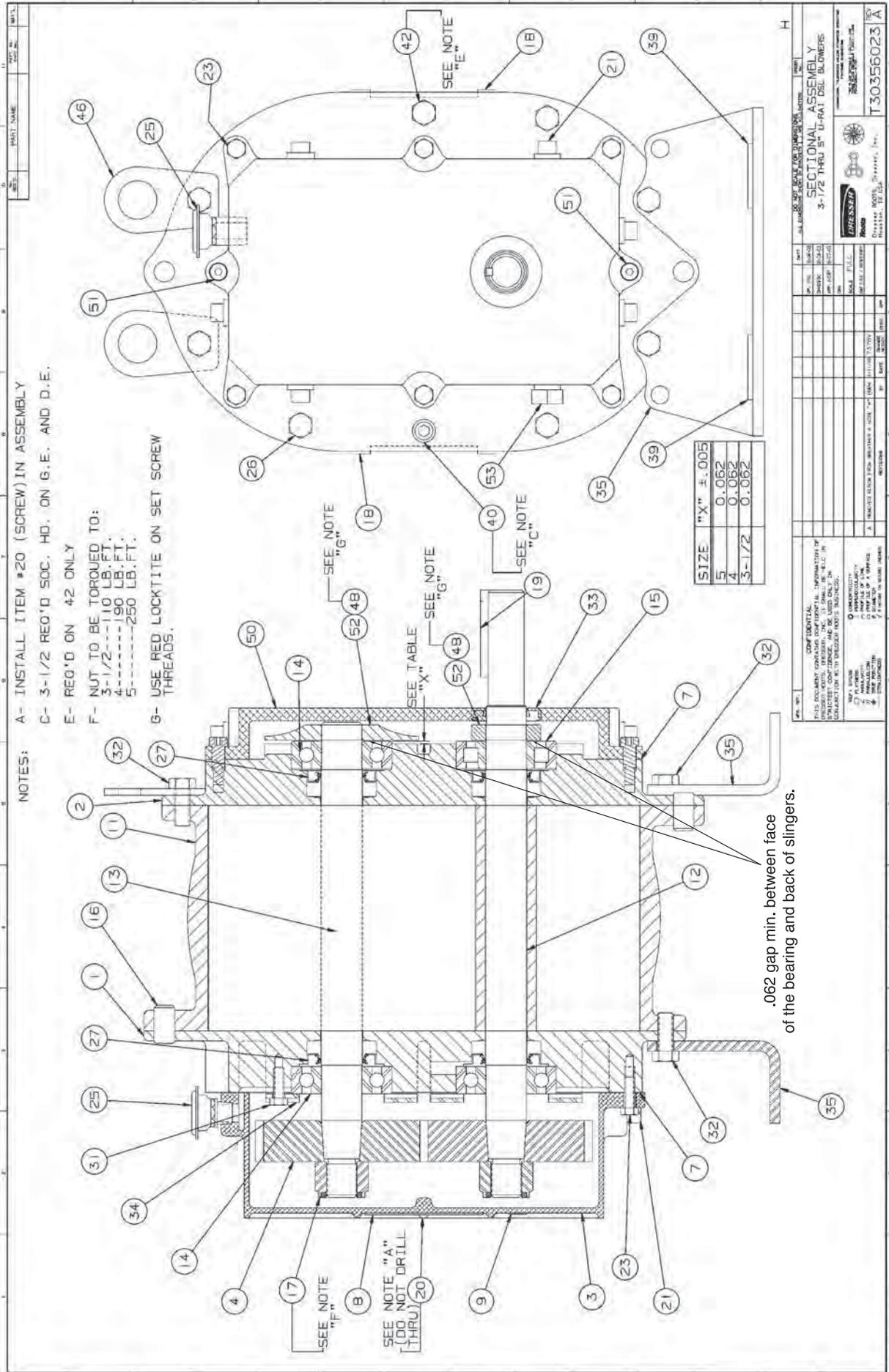
6" URAI-G Blowers

**DRESSER**

Blowers, Roots, Pumps, Inc.

T30110023

REV E



Assembly of URAI DSL Blowers with Splash Lubricated Drive End 3-5" Gear Diameter



**URAI Blowers Parts List**  
**2-1/2" – 5" Gear Diameter**

(Refer to drawing #64720023)

**URAI Blowers Parts List**  
**6" & 7" Gear Diameter**

(Refer to drawing #64792023)

**URAI Blowers Parts List**  
**3-1/2" – 5" Gear Diameter**

(Refer to drawing #T30356023)

Item #	Part Name	Qty.
1	Headplate Gear End	1
2	Headplate Drive End	1
3	Gearbox	1
4	Timing Gears	2
5	Cover-Blind (Plug Opening)	1
7	Gasket, Gear Box	1
11	Cylinder	1
12	Impeller & Shaft Drive	1
13	Impeller & Shaft Driven	1
14	Bearing, Ball	3
15	Bearing, Roller	1
16	Pin, Dowel	4
17	Gear Nut	2
19	Key	1
21	Plug, Pipe	3
23	Screw Hex	6
25	Breather (Plug Vent)	1
26	Screw, Hex	*
27	Seal, Lip Bearing	4
31	Screw, Hex, Nylock	4
32	Screw, Hex	6
33	Seal Lip-Drive	1
34	Clamp Plate	2
35	Foot	2
37	Fitting, Grease	2
38	Fitting, Relief	2
39	Washer Mounting	4
40	Screw Socket	2
42	Screw Hex	2

Item #	Part Name	Qty.
1	Headplate Gear End	1
2	Headplate Drive End	1
3	Gearbox	1
4	Timing Gears	2
5	Cover-Blind (Plug Opening)	1
7	Gasket, Gear Box	1
11	Cylinder	1
12	Impeller & Shaft Drive	1
13	Impeller & Shaft Driven	1
14	Bearing, Ball	3
15	Bearing, Roller	1
16	Pin, Dowel	4
17	Gear Nut	2
19	Key	1
21	Plug, Pipe	3
23	Screw Hex Nylock	8
25	Breather (Plug Vent)	1
26	Screw, Hex	*
27	Seal, Lip Bearing	4
29	Washer, Spring Wavy	2
31	Screw, Hex, Nylock	4
32	Screw, Hex	10
33	Seal Lip-Drive	1
34	Clamp Plate	2
35	Foot	2
37	Fitting, Grease	2
38	Fitting, Relief	2
39	Washer Mounting	4

\*Quantities vary by blower.

Item #	Part Name	Qty.
1	Headplate Gear End	1
2	Headplate Drive End	1
3	Gearbox	1
4	Timing Gears	2
7	Gasket, Gear Box, DE Cover	1
11	Cylinder	1
12	Impeller & Shaft Drive	1
13	Impeller & Shaft Driven	1
14	Bearing, Ball	3
15	Bearing, Roller	1
16	Pin, Dowel	4
17	Gear Nut	2
19	Key	1
21	Plug, Pipe	3
23	Screw Hex	6
25	Breather (Plug Vent)	1
26	Screw, Hex	*
27	Seal, Lip Bearing	4
31	Screw, Hex, Nylock	4
32	Screw, Hex	6
33	Seal Lip-Drive	1
34	Clamp Plate	2
35	Foot	2
39	Washer Mounting	4
40	Screw Socket	2
42	Screw Hex	2
48	DE Oil Slinger Set Screw	4
50	Drive End Cover	1
52	Drive End Oil Slinger	2
53	Oil Sight Glass	2

\*Quantities vary by blower.

\*Quantities vary by blower.

**URAI DSL Blowers Parts List 6" Gear Diameter**

(Refer to drawing #T30382023)

Item #	Part Name	Qty.
1	Headplate Gear End	1
2	Headplate Drive End	1
3	Gearbox	1
4	Timing Gears	2
7	Gasket, Gear Box	1
11	Cylinder	1
12	Impeller & Shaft Drive	1
13	Impeller & Shaft Driven	1
14	Bearing, Ball	3
15	Bearing, Roller	1
16	Pin, Dowel	4
17	Gear Nut	2
19	Key	1
21	Plug, Pipe	3

\*Quantities vary by blower.

Item #	Part Name	Qty.
23	Screw Hex Nylock	8
25	Breather (Plug Vent)	1
26	Screw, Hex	*
27	Seal, Lip Bearing	4
31	Screw, Hex, Nylock	4
32	Screw, Hex	10
33	Seal Lip-Drive	1
34	Clamp Plate	2
35	Foot	2
39	Washer Mounting	4
48	DE Oil Slinger Set Screw	4
50	Drive End Cover	1
52	Drive End Oil Slinger	2
53	Oil Sight Glass	2
7.1	Gasket, DE Cover	1

**URAI-G Blowers Parts List**  
**3-1/2" & 5" Gear Diameter**

(Refer to drawing #T30099023)

Item #	Part Name	Qty.
1	Headplate Gear End	1
2	Headplate Drive End	1
3	Gearbox	1
4	Timing Gears	2
5	Cover-Blind (Plug Opening)	1
7	Gasket, Gear Box	1
11	Cylinder	1
12	Impeller & Shaft Drive	1
13	Impeller & Shaft Driven	1
14	Bearing, Ball	3
15	Bearing, Roller	1
16	Pin, Dowel	4
17	Gear Nut	2
19	Key	1
21	Plug, Pipe	3
23	Screw Hex	8
25	Breather (Plug Vent)	1
26	Screw, Hex	14*
27	Seal, Bearing	4
31	Screw, Hex	4
32	Screw, Hex	4
33	Seal Lip-Drive	1
34	Clamp Plate	2
35	Foot	2
37	Fitting, Grease	2
38	Fitting, Relief	2
39	Washer Mounting	4
40	Screw Socket	2
42	Screw Hex	2

\*Quantities vary by blower.

**URAI-G Blowers Parts List**  
**6" Gear Diameter**

(Refer to drawing #T3011023)

Item #	Part Name	Qty.
1	Headplate Gear End	1
2	Headplate Drive End	1
3	Gearbox	1
4	Timing Gears	2
5	Cover-Blind (Plug Opening)	1
7	Gasket, Gear Box	1
7*	Gasket DE Cover	1
11	Cylinder	1
12	Impeller & Shaft Drive	1
13	Impeller & Shaft Driven	1
14	Bearing, Ball	3
15	Bearing, Roller	1
16	Pin, Dowel	4
17	Gear Nut	2
19	Key	1
21	Plug, Pipe	3
23	Screw Hex Nylock	8
25	Breather (Plug Vent)	1
26	Screw, Hex	14**
27	Seal, Bearing	4
31	Screw, Hex	4
32	Screw, Hex	10
33	Seal Lip-Drive	1
34	Clamp Plate	2
35	Foot	2
37	Fitting, Grease	2
38	Fitting, Relief	2
39	Washer Mounting	4
40	Screw Socket	2
42	Screw Hex	2
43	Plug	8
51	Shoulder Bolt	2
53	Oil Sight Glass	2

\*DE cover gasket is not the same as the gasket used on the GE. You must specify the gasket required when ordering.

\*\*Quantities vary by blower.

**Specified Lubricants**

**ROOTS Synthetic Oil: ISO-VG-320 Grade**

	Part Number
Quart	13106004
Gallon	13106005
Case (12 qts)	13106007

**ROOTS Synthetic Oil: ISO-VG-220 Grade**

	Part Number
Quart	13106001
Gallon	13106002
Case (12 qts)	13106008

**ROOTS Synthetic Oil: ISO-VG-150 Grade**

	Part Number
Quart	13106020
Gallon	13106021
Case (12 qts)	13106023

5 Gallon Pail	13106022
55 Gallon Drum	13106025

**ROOTS Synthetic Oil: ISO-VG-100 Grade**

	Part Number
Quart	13106011
Gallon	13106012
Case (12 qts)	13106014

5 Gallon Pail	13106013
55 Gallon Drum	13106016

**ROOTS Synthetic Grease: NLGI #2**

	Part Number
14.5 oz. Tube	T200019-001
5 Gallon Pail	T200019-003
Case (30 tubes)	T200019-002

## Basic Connection & Drive Shaft Information

### UNIVERSAL RAI (URAI) AIR BLOWERS

#### URAI AIR BLOWERS (with Grease Lubricated Drive End)

BOM # *	FRAME SIZE	INLET/DISCH CONN.	SHAFT DIAMETER	BARE WEIGHT
65102020	22	1" NPT	0.625"	32
65103020	24	2" NPT	0.625"	43
71048020	32	1.25" NPT	0.750"	69
65105020	33	2" NPT	0.750"	74
65106020	36	2.5" NPT	0.750"	102
65108020	42	1.5" NPT	0.875"	88
65109020	45	2.5" NPT	0.875"	109
65110020	47	3" NPT	0.875"	128
65112020	53	2.5" NPT	1.125"	143
65113020	56	4" NPT	1.125"	170
65114020	59	4" NPT	1.125"	204
65116020	65	3" NPT	1.375"	245
65117020	68	5" NPT	1.375"	285
65118020	615	6" Flange	1.375"	425
65120020	76	4" NPT	1.562"	400
65121020	711	6" Flange	1.562"	530
65122020	718	8" Flange	1.562"	650

Refer to Specification Sheet S-12K84

#### URAI DSL AIR BLOWERS (with Dual Splash Lubrication DSL)

BOM # *	FRAME SIZE	INLET/DISCH CONN.	SHAFT DIAMETER	BARE WEIGHT
T30378020	32	1.25" NPT	0.750"	72
T30379020	33	2" NPT	0.750"	77
T30380020	36	2.5" NPT	0.750"	105
T30352020	42	1.5" NPT	0.875"	92
T30353020	45	2.5" NPT	0.875"	113
T30354020	47	3" NPT	0.875"	132
T30359020	53	2.5" NPT	1.125"	148
T30360020	56	4" NPT	1.125"	175
T30361020	59	4" NPT	1.125"	209
T30384020	65	3" NPT	1.375"	250
T30385020	68	5" NPT	1.375"	290
T30386020	615	6" Flange	1.375"	430

Refer to Specification Sheet S-27S03

**Universal RAI** air blowers include detachable mounting feet which permit vertical or horizontal installation. The units are center timed for rotation in either direction. The bearings on the URAI are grease lubricated on the drive end and splash lubricated on the gear end. The URAI-DSL is splash lubricated on BOTH ends.

### UNIVERSAL RAI (URAI) GAS BLOWERS

#### URAI-G™ GAS BLOWERS (with Grease Lubricated Drive End)

BOM # *	FRAME SIZE	INLET/DISCH CONN.	SHAFT DIAMETER	BARE WEIGHT
710480G0	32	1.25" NPT	0.750"	69
651050G0	33	2" NPT	0.750"	74
651060G0	36	2.5" NPT	0.750"	102
651080G0	42	1.5" NPT	0.875"	88
651090G0	45	2.5" NPT	0.875"	109
651100G0	47	3" NPT	0.875"	128
651120G0	53	2.5" NPT	1.125"	143
651130G0	56	4" NPT	1.125"	170
651140G0	59	4" NPT	1.125"	204
651160G0	65	3" NPT	1.375"	245
651170G0	68	5" NPT	1.375"	285
651180G0	615	6" NPT	1.375"	425

Refer to Specification Sheet S-60A01

**Universal RAI-G™** gas blowers include detachable mounting feet which permit vertical or horizontal installation. **Feet are different for vertical and horizontal mounting.**

The units are center timed for rotation in either direction. The bearings on the Universal RAI-GTM are grease lubricated on the drive end and splash lubricated on the gear end. ROOTS Synthetic lubricant is recommended.

**Basic Connection & Drive Shaft Information**

**UNIVERSAL RAI (URAI-J) WHISPAIR AIR BLOWERS**

**URAI-J WHISPAIR AIR BLOWERS (with Grease Lubed Drive End)**

<b>BOM # *</b>	<b>FRAME SIZE</b>	<b>INLET/DISCH CONN.</b>	<b>SHAFT DIAMETER</b>	<b>BARE WEIGHT</b>
74065020	33J	2" NPT	0.750"	84
74086020	36J	2.5" NPT	0.750	112
74066020	45J	2.5" NPT	0.875"	119
74087020	47J	3" NPT	0.875	138
74067020	56J	4" NPT	1.125"	180

Refer to Specification Sheet S-33A93

**URAI-J-DSL WHISPAIR AIR BLOWERS (with Dual Splash Lubrication DSL)**

<b>BOM # *</b>	<b>FRAME SIZE</b>	<b>INLET/DISCH CONN.</b>	<b>SHAFT DIAMETER</b>	<b>BARE WEIGHT</b>
T30417020	33J	2" NPT	0.750"	87
T30418020	36J	2.5" NPT	0.750	115
T30410020	45J	2.5" NPT	0.875"	122
T30412020	47J	3" NPT	0.875	141
T30415020	56J	4" NPT	1.125"	185

Refer to Specification Sheet S-30S03

**URAI-J METRIC WHISPAIR AIR BLOWERS (with Grease Lubed Drive End)**

<b>BOM # *</b>	<b>FRAME SIZE</b>	<b>INLET/DISCH CONN.</b>	<b>SHAFT DIAMETER</b>	<b>BARE WEIGHT</b>
TBD	33J	2" BSP	19 mm	84
740860M0	36J	2.5" BSP	19 mm	112
TBD	45J	2.5" BSP	24 mm	119
TBD	47J	3" BSP	24 mm	138
TBD	56J	4" BSP	28 mm	180

**URAI-J-DSL METRIC WHISPAIR AIR BLOWERS (with Dual Splash Lubrication DSL)**

<b>BOM # *</b>	<b>FRAME SIZE</b>	<b>INLET/DISCH CONN.</b>	<b>SHAFT DIAMETER</b>	<b>BARE WEIGHT</b>
TBD	33J	2" BSP	19 mm	87
T304660M0	36J	2.5" BSP	19 mm	115
TBD	45J	2.5" BSP	24 mm	122
T304550M0	47J	3" BSP	24 mm	141
TBD	56J	4" BSP	28 mm	185

Universal RAI-J air blowers incorporate the patented Whispair™ design in addition to the same features as the original URAI blowers. The URAI-J's are center timed, however the Whispair™ benefits can only be realized when the jet is located in the discharge position.

## Basic Connection & Drive Shaft Information

### UNIVERSAL RAI METRIC (URAI-M) AIR BLOWERS

*NOTE: METRIC URAI product has metric shaft diameter and connection sizes*

#### URAI-METRIC AIR BLOWERS (with Grease Lubricated Drive End)

BOM # *	FRAME SIZE	INLET/DISCH CONN.	SHAFT DIAMETER	BARE WEIGHT
651020M0	22	1" BSP	16 mm	32
651030M0	24	2" BSP	16 mm	43
710480M0	32	1 1/4" BSP	19 mm	69
651050M0	33	2" BSP	19 mm	74
651060M0	36	2 1/2" BSP	19 mm	102
651080M0	42	1 1/2" BSP	24 mm	88
651090M0	45	2 1/2" BSP	24 mm	109
651100M0	47	3" BSP	24 mm	128
651120M0	53	2 1/2" BSP	28 mm	143
651130M0	56	4" BSP	28 mm	170
651140M0	59	4" BSP	28 mm	204
T30392060	65	3" BSP	32 mm	245
T30394060	68	5" BSP	32 mm	285
T30390060	615	150 NP10	32 mm	425
T30396060	76	4" BSP	38 mm	400
T30398060	711	150 NP10	38 mm	530
T30400060	718	200 NP10	38 mm	650

#### URAI-DSL-METRIC AIR BLOWERS (with Dual Splash Lubrication DSL)

BOM # *	FRAME SIZE	INLET/DISCH CONN.	SHAFT DIAMETER	BARE WEIGHT
T30463060	32	1 1/4" BSP	19 mm	72
T30464060	33	2" BSP	19 mm	77
T30465060	36	2 1/2" BSP	19 mm	105
T30451060	42	1 1/2" BSP	24 mm	92
T30452060	45	2 1/2" BSP	24 mm	113
T30453060	47	3" BSP	24 mm	132
T30459060	53	2 1/2" BSP	28 mm	148
T30460060	56	4" BSP	28 mm	175
T30461060	59	4" BSP	28 mm	209
T30472060	65	3" BSP	32 mm	250
T30473060	68	5" BSP	32 mm	290
T30474060	615	150 NP 10	32 mm	430

**Universal RAI** air blowers include detachable mounting feet which permit vertical or horizontal installation. The units are center timed for rotation in either direction. The bearings on the URAI are grease lubricated on the drive end and splash lubricated on the gear end. The URAI-DSL is splash lubricated on BOTH ends.



**Roots**

ISRB-2002 rev.0907

**www.rootsblower.com** Visit "Contact Us" page for your nearest location  
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**United Kingdom Operations** • Phone: +44 (0) 1695 52600  
**USA/Canada Sales** • Phone: 773-444-3360  
**Houston, Texas Factory Service** • Phone: 713-896-4810  
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## **BLUE DIVIDER SHEET**

## **BLUE DIVIDER SHEET**



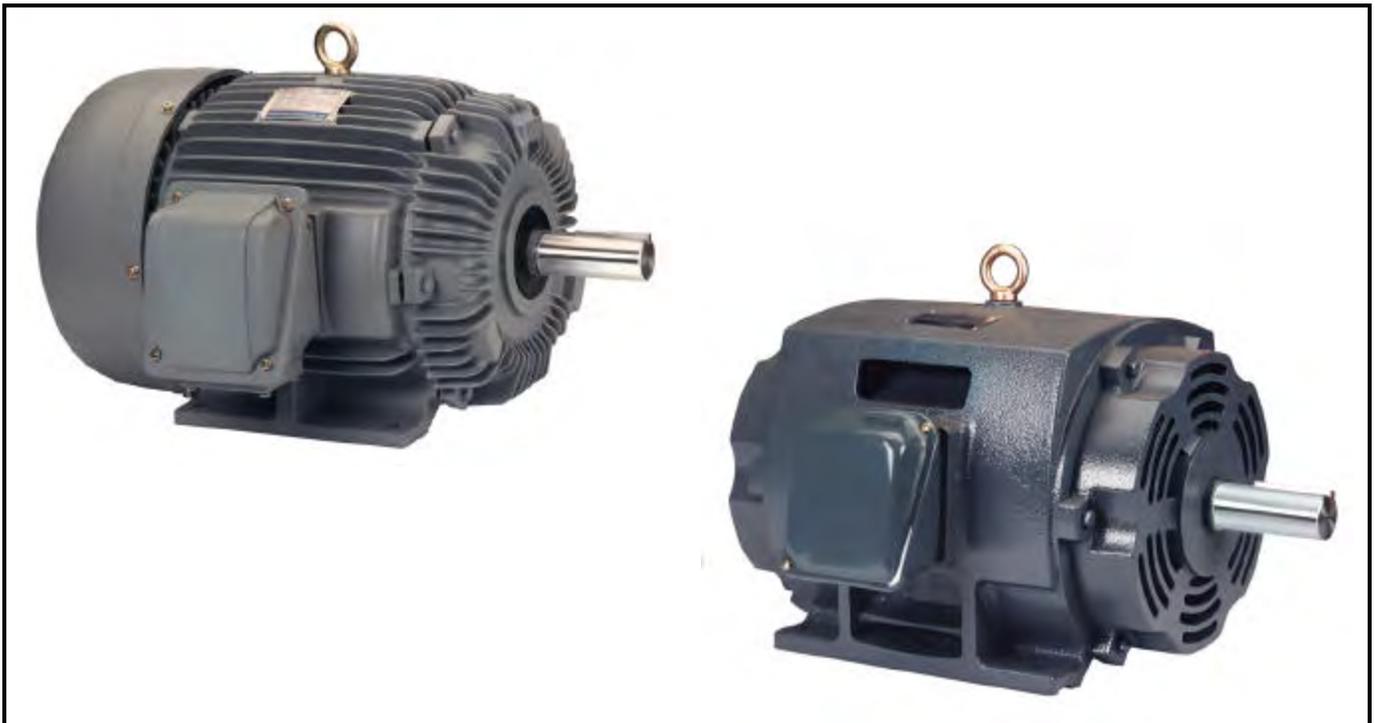
**TECO-Westinghouse**



M O T O R C O M P A N Y

# INSTALLATION AND MAINTENANCE INSTRUCTIONS FOR THREE PHASE INDUCTION MOTORS

Frames 143T - 449TZ



5100 North IH 35 Round Rock, Texas 78681  
Phone: 800-451-8798 512-255-4141 Fax: 512-244-5512

## RECEIVING

1. Check nameplate data.
2. Check whether any damage has occurred during transportation.
3. After removal of shaft clamp, turn shaft by hand to check that it turns freely.
4. If motor is to be reshipped (alone or installed to another piece of equipment) the shaft must again be clamped to prevent axial movement.

Note: Remove the bearing clamp before turning the shaft on 284T-449TZ frame motors.

## WARNING

### THE FOLLOWING SAFETY PRECAUTIONS MUST BE OBSERVED:

1. Electric rotating machinery and high voltage can cause serious or fatal injury if improperly installed, operated or maintained. Responsible personnel should be familiarized with NEMA MG2; Safety Standards for Construction and Guide Selection. Installation and Use of Electric Motors and Generators; National Electric Code and all local safety requirements.
2. When servicing, all power sources to the motor and to the accessory devices should be de-energized and disconnected and all rotating parts should be at standstill.
3. Lifting means, when supplied, are intended for lifting the motor only. When two lifting devices are supplied with the motor a dual chain must be used.
4. Suitable protection must be used when working near machinery with high noise levels.
5. Safeguard or protective devices must not be by-passed or rendered inoperative.
6. The frame of this machine must be grounded in accordance with the National Electric Code and applicable local codes.
7. A suitable enclosure should be provided to prevent access to the motor by other than authorized personnel. Extra caution should be observed around motors that are automatically or have automatic re-setting relays as they may restart unexpectedly.
8. Shaft key must be fully captive or removed before motor is started.
9. Provide proper safeguards for personnel against possible failure of motor-mounted brake, particularly on applications involving overhauling loads.
10. Explosion proof motors are constructed to comply with the label service procedure manual, repair of these motors must be made by TECO-Westinghouse Motor Company or U/L listed service center in order to maintain U/L listing.

## LOCATION

1. Drip-proof motors are intended for use where atmosphere is relatively clean, dry, well ventilated and non-corrosive.
2. Totally enclosed motors may be installed where dirt, moisture, or dust are present and in outdoor locations.
3. Explosion-proof motors are built for use in hazardous locations as indicated by Underwriters' label on the motor.
4. Chemical duty enclosed motors are designed for installation in high corrosion or excessive moisture locations.

**Note: in all cases, no surrounding structure should obstruct normal flow or ventilating air through or over the motor.**

## MOUNTING

1. Mount motor securely on a firm, flat base. All ball bearing normal thrust motors up to and including 256T frame size may be side-wall or ceiling mounted; all others check nearest TECO-Westinghouse office for mounting recommendations.
2. Align motor accurately, using a flexible coupling if possible. For drive recommendations, consult with drive or equipment manufacturer, or TECO-Westinghouse.
3. Mounting bolts must be carefully tightened to prevent changes in alignment and possible damage to the equipment. The recommended tightening torque's for medium carbon steel bolts, identified by three radial lines at 120 degrees on the head, are:

Bolt Size	Recommended Torque (Ft-lb.)	
	Minimum	Maximum
2/8	25	37
1/2	60	90
5/8	120	180
3/4	210	320

4. V-belts Sheave Pitch Diameters should not be less than those shown in Table 1 (NEMA recommended values)
5. Tighten belts only enough to prevent slippage. Belt speed should not exceed 5000 ft. per min.

**TABLE 1. V-Belt Sheave Pitch Diameters (MG1-14.42)**

Frame Number					V-Belt Sheave			
					Conventional A, B, C, D AND E		Narrow 3V, 5V, AND 8V	
	Horsepower at				Minimum Pitch Diameter Inches	*Maximum Width Inches	Minimum Outside Diameter Inches	**Maximum Width Inches
	Synchronous Speed, RPM							
3600	1800	1200	900					
143T	1.5	1	.75	.5	2.2	4.25	2.2	2.25
145T	2-3	1.5-2	1	.75	2.4	4.25	2.4	2.25
182T	3	3	1.5	1	2.4	5.25	2.4	2.75
182T	5	...	...	...	2.6	5.25	2.4	2.75
184T	...	...	2	1.5	2.4	5.25	2.4	2.75
184T	5	...	...	...	2.6	5.25	2.4	2.75
184T	7.5	5	...	...	3.0	5.25	3.0	2.75
213T	7.5-10	7.5	3	2	3.0	6.5	3.0	3.375
215T	10	...	5	3	3.0	6.5	3.0	3.375
215T	15	10	...	...	3.8	6.5	3.8	3.375
254T	15	...	7.5	5	3.8	7.75	3.8	4
254T	20	15	...	...	4.4	7.75	4.4	4
256T	20-25	...	10	7.5	4.4	7.75	4.4	4
256T	...	20	...	...	4.6	7.75	4.4	4
284T	...	...	15	10	4.6	9	4.4	4.625
284T	...	25	...	...	5.0	9	4.4	4.625
286T	...	30	20	15	5.4	9	5.2	4.625

**TABLE 1. V-Belt Sheave Pitch Diameters (MG1-14.42)**

Frame Number					V-Belt Sheave			
					Conventional A, B, C, D AND E		Narrow 3V, 5V, AND 8V	
	Horsepower at				Minimum Pitch Diameter Inches	*Maximum Width Inches	Minimum Outside Diameter Inches	**Maximum Width Inches
	Synchronous Speed, RPM							
3600	1800	1200	900					
324T	...	40	25	20	6.0	10.25	6.0	5.25
326T	...	50	30	25	6.8	10.25	6.8	5.25
364T	...	...	40	30	6.8	11.5	6.8	5
364T	...	60	...	...	7.4	11.5	7.4	5.785
365T	...	...	50	40	8.2	11.5	8.2	5.785
365T	...	75	...	...	9.0	11.5	8.6	5.785
404T	...	...	60	...	9.0	14.25	8.0	7.25
404T	...	...	...	50	9.0	14.25	8.4	7.25
404T	...	100	...	...	10.0	14.25	8.6	7.25
405T	...	...	75	60	10.0	14.25	10.0	7.25
405T	...	100	...	...	10.0	14.25	8.6	7.25
405T	...	125	...	...	11.5	14.25	10.5	7.25
444T	...	...	100	...	11.0	16.75	10.0	8.5
444T	...	...	...	75	10.5	16.75	9.5	8.5
444T	...	125	...	...	11.0	16.75	9.5	8.5
444T	...	150	...	...	...	16.75	10.5	8.5
445T	...	...	125	...	12.5	16.75	12.0	8.5
445T	...	...	...	100	12.5	16.75	12.0	8.5
445T	...	150	...	...	...	16.75	10.5	8.5

\*Max. Sheave width =  $2(N-W) - .25$

\*\*Max Sheave width =  $N-W$

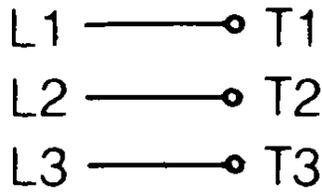
\*\*\*Sheave ratios greater than 5:1 and center-to-center distance less than the diameter of the large sheave should be referred to TECO-Westinghouse.

## POWER SUPPLY & CONNECTIONS

1. Wiring of motor and control, overload protection and grounding should be in accordance with National Electrical Code and all local safety requirements.
2. Nameplate voltage and frequency should agree with power supply. Motor will operate satisfactorily on line voltage within  $\pm 10\%$  of nameplate voltage; or frequency with  $\pm 5\%$  and with a combined variation not to exceed  $\pm 10\%$ . 230-volt motors can be used on 208-volt network systems, but with slightly modified performance characteristics as shown on the nameplate.
3. Dual voltage and single voltage motors can be connected for the desired voltage by following connection diagram shown on the nameplate or inside of the conduit box.
4. All Explosion Proof motors have Temperature Limiting Devices in the motor enclosure to prevent excessive external surface temperature of the motor in accordance with U/L standards. Terminals of thermal protectors (P1 & P2) should be connected to the motor control equipment, according to the connection diagram inside of the conduit box.
5. Standard connection diagram for three phase, not thermally protected, dual rotation motors are shown in diagrams A through E.

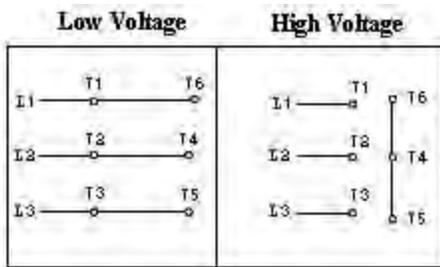
**(Note: To change rotation, Interchange any two line leads)**

**A. 3 Lead, Single Voltage**

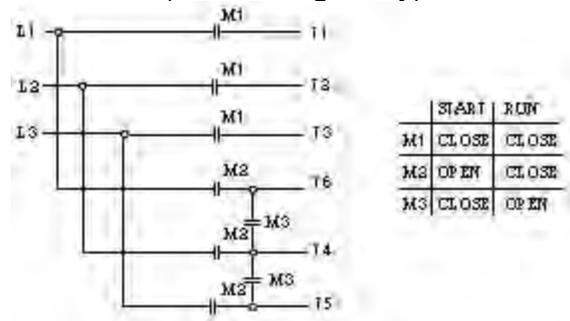


**B. 6 Lead, Dual Voltage & Voltage Ratio 1 to 3**

B-1 Across the Line Start & Run

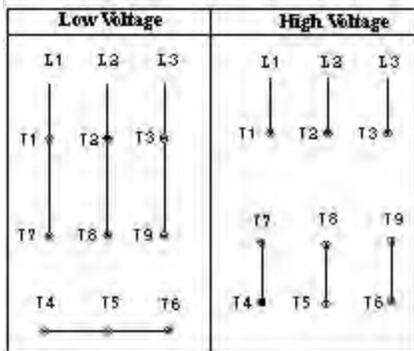


B-2 Wye Start & Delta Run  
(Low Voltage only)

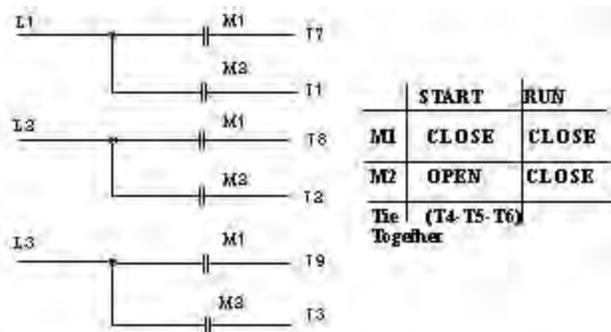


**C. 9 Leads; Dual Voltage & Voltage Ratio 1 to 2, Wye Connected**

C-1 Across the Line Start & Run

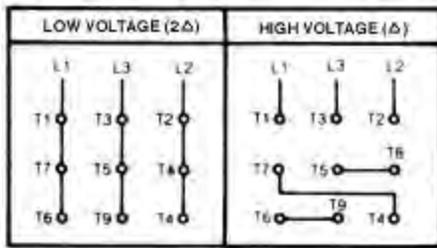


C-2 Part Winding Start  
(Low Voltage only)

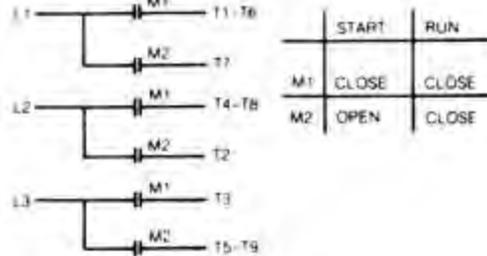


### D. 9 Leads; Dual Voltage & Voltage Ratio 1 to 2, Delta Connected

D-1 Across the Line Start & Run

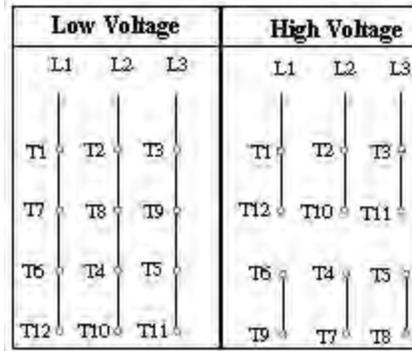


D-2 Part Winding Start (Low Voltage only)

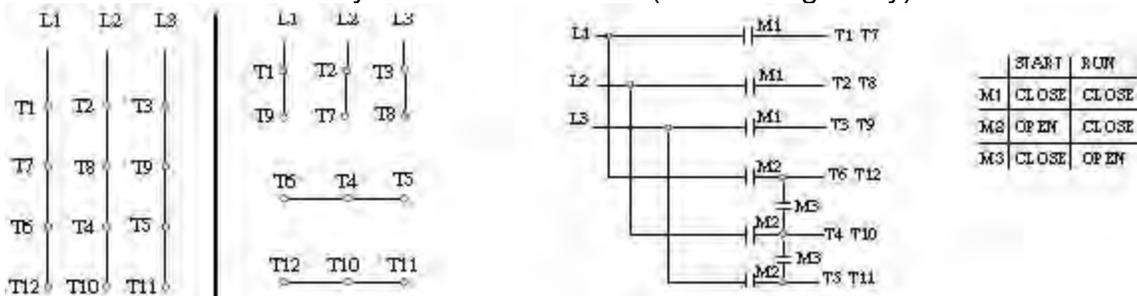


### E. 12 Leads, Dual Voltage

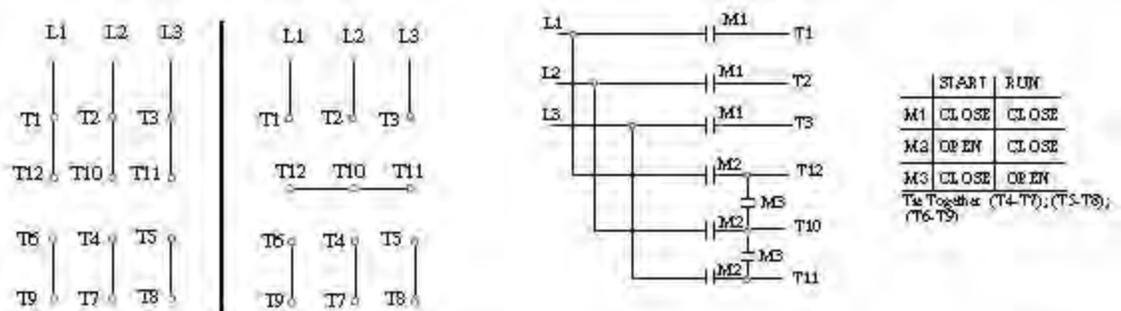
E-1 Across the Line Start & Run



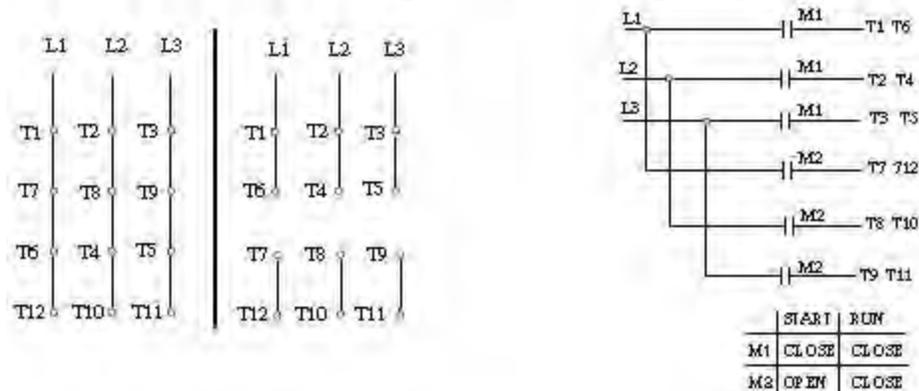
E-2-1 Wye Start & Delta Run (Low Voltage only)



E-2-2 Wye Start & Delta Run (High Voltage only)



### E-3 Part Winding Start (Low Voltage only)



\*Important: For Part Winding Start, M2 contactor should be closed within two (2) seconds after M1 contactor is closed.  
Only 4 pole and above (e.g., 6P, 8P...) motors are satisfactory for Part Winding Start at low voltage.

### START UP

1. Disconnect load and start motor. Check direction of rotation. If rotation must be changed, ALLOW THE MOTOR TO STOP COMPLETELY. Interchange any two leads of a three-phase motor.
2. Connect load. The motor should start quickly and run smoothly. If no, shut power off at once. Recheck the assembly including all connections before restarting.
3. If excessive vibration is noted, check for loose mounting bolts too flexible motor support structure or transmitted vibration from adjacent machinery. Periodic vibration checks should be made; foundations often settle.
4. Operate under load for short period of time and check operating current against nameplate.

### TESTING

If the motor has been in storage for an extensive period or has been subjected to adverse moisture conditions, it is best to check the insulation resistance of the stator winding with a megohmmeter. Depending on the length and conditions of storage it may be necessary to regrease or change rusted bearings.

If the resistance is lower than one megohm the windings should be dried in one of the following two ways:

1. Bake in oven at temperatures not exceeding 194°F until insulation resistance becomes constant.
2. With rotor locked, apply low voltage and gradually increase the current through windings until temperature measured with a thermometer reaches 194°F. Do not exceed this temperature.

# MAINTENANCE

## INSPECTION

Inspect motor at regular intervals. Keep motor clean and ventilation openings clear.

## LUBRICATION

1. Frame 143T-256T: Double shielded and pre-lubricated ball-bearing motors without grease fittings and don't need relubrication, except on MAX-E1<sup>®</sup> and MAX-E2<sup>®</sup> products which have regreasable features.
2. Frames 280TS, 320-449TZ(TS): Motors having grease fittings and grease discharge devices at brackets. Motors are shipped with grease for initial running. It is necessary to relubricate anti-friction bearing motors periodically, depending on size and type of service. See Table 2 to provide maximum bearing life. Excessive or too frequent lubrication may damage the motor.

**TABLE 2**

Horsepower	Standard Conditions	Severe Conditions	Extreme Conditions
1 Thru 30 Hp, 1800 rpm and below	7 years	3 years	180 days
40 Thru 75 Hp, 1800 rpm and below	210 days	70 days	30 days
100 Thru 150 Hp, 1800 rpm and below	90 days	30 days	15 days
1 Thru 20 Hp, 3600 rpm	5 years	2 years	90 days
25 Thru 75 Hp, 3600 rpm	180 days	60 days	30 days
100 Thru 150 Hp, 3600 rpm	90 days	30 days	15 days

**Note:**

- A. Standard conditions: 8 hours operation per day, normal or light loading, clear and 40°C ambient conditions.
  - B. Severe conditions: 24-hour operation per day or light shock loading, vibration or in dirty or dusty conditions.
  - C. Extreme conditions: With heavy shock loading or vibration or dusty conditions.
  - D. For double shielded bearings, above data (lubrication frequency) means that the bearing must be replaced.
3. Be sure fittings are clean and free from dirt. Using a low-pressure grease gun, pump in the recommended grease until new grease appears at grease discharge hole.
  4. Use the ALVANIA R3 grease or equivalent lithium based grease unless special grease is specified on the nameplate.
  5. If relubrication is to be performed with the motor running, stay clear of rotating parts. After regreasing, allow the motor to run for ten to thirty minutes.

## **RENEWAL PARTS**

1. Use only genuine TECO-Westinghouse renewal parts or as recommended by TECO-Westinghouse Motor Company.
2. When you order renewal parts please specify complete information to TECO-Westinghouse office/agent such as type, frame no., poles, horsepower, voltage, series no., quantity, etc.

## **FOR FURTHER INFORMATION PLEASE CONTACT TECO-WESTINGHOUSE MOTOR COMPANY**

<b>SALES OFFICE:</b>	<b>Allentown, PA</b>	<b>800-926-6867</b>
	<b>Los Angeles, CA</b>	<b>800-825-8326</b>
	<b>Portland, OR</b>	<b>800-289-8332</b>
	<b>Round Rock, TX</b>	<b>800-873-8326</b>
	<b>Spartanburg, SC</b>	<b>800-873-2343</b>

**BLANK SHEET**

## **BLUE DIVIDER SHEET**

## **BLUE DIVIDER SHEET**



# Industrial Belt Design - Drive Detail Report

## Design Flex® Pro by the Gates Corporation

**Designed For:** Terry Sprouse  
 Process Technology Support, LLC  
 14274 Mead Street  
 Longmont, Colorado 80504  
 United States  
 tsprouse@processtechsup.com  
 970-535-0913 Phone  
 970-535-9583 Fax

**Provided By:** Greg Bussey  
 Western Belting Company  
 3037 East 42nd Avenue  
 Denver, Colorado 80216  
 United States  
 gbussey@westernbelting.com  
 303-322-3500 Phone

Application: **Trihydro-Havre, MT Project**

### INPUT

#### Drive Information

Speed Ratio: 1.36 Up  
 Input Load: 15 hp, Efficiency: 91.00 %  
 Service Factor: 1.3  
 Design Power: 19.5 hp  
 Center Distance: 21.15 to 25.85 in  
 Motor Standards: NEMA Electric Motor, NEMA 254T frame

	DriveR	DriveN
RPM:	1765.0	2400.0 +/-4%
Shaft Diameter:	1.625 in	0.875 in
Bushings Checked:	QD, No MPB	
Belts Checked:	Tri-Power	
	Single Belts, PowerBand	

### SELECTED DRIVE

Belt Type: **Tri-Power - BX**

	Belt	DriveR	DriveN
Total # of Strands/Ribs:	2		
Speed Ratio: <b>1.35 Up</b>	Part No: 2-BX65	QD2A7.0/B7.4	QD2A5.0/B5.4
dN RPM: <b>2378.6</b>	Product No: 9013-2065	7831-2070	7831-2050
Rated Load: <b>20.84 hp</b>	Top Width: --	1.75 in	1.75 in
ODR: <b>1.07</b>	Weight: 1.2 lb	13 lb	5.9 lb
Belt Pull: <b>211 lbf</b>	Rim/Belt Speed: 3580 ft/min	3547 ft/min	3539 ft/min
Center Distance: 23.33 in	RPM: 643.2	1765.0	2378.6
Install/Take-Up Range: 22.08 in to 25.33 in	Bushing Part No: --	SK 1 5/8	SDS 7/8
	Bushing Product No: --	7838-4110	7838-2014
	Bore: --	1.625 in	0.875 in
	Bolt Torque: --	180 lb-in	108 lb-in
	Pitch Diameter: --	7.75 in	5.75 in

### TENSION

	New Belt	Used Belt
Static Tension (per rib/strand):	79 to 85 lbf	68 to 73 lbf
Static Belt Pull (total pull):	316 to 339 lbf	271 to 293 lbf
Rib/Strand Deflection Distance:	0.36 in	0.36 in
Rib/Strand Deflection Force:	5.4 to 5.8 lbf	4.7 to 5.0 lbf
Sonic Tension Meter:	352 to 377 N	302 to 327 N
Belt Frequency:	43 to 44 Hz	40 to 41 Hz
507C/508C Model STM Settings:	Mass 135.93g/m, Width: 1 mm/#R, Span: 592 mm	
Powerband Multiplier:	1.0033 to 1.0035	1.0028 to 1.0031

### NOTES

- Pricing Scheme Used: Default
- This report: (1) only applies to Gates' products; (2) contains confidential information; (3) may only be disclosed to support the sale or maintenance of our products; and (4) is not a guarantee of performance.
- Gates products are not designed, manufactured, or tested for use on aircraft applications, including aircraft propeller or rotor drive systems, and all manned or unmanned airborne applications of any type. Lift and Braking systems have special considerations. Buyer has sole responsibility for the selection and testing of products for any intended use.

**SVE BELT DRIVE  
DESIGN INFO**

# How to Tension V-Belt Drives

## General Method

Tension of the belts on a V-belt is usually not critical. A few simple rules about tensioning will satisfy most of your requirements:

1. The best tension for a V-belt drive is the lowest tension at which the belts will not slip under the highest load condition.
2. Check the tension on a new drive frequently during the first day of operation.

3. Check the drive tension periodically, thereafter.
4. Too much tension shortens belt and bearing life.
5. Keep belts and sheaves free from any foreign material which may cause slip.
6. If a V-belt slips, **tighten it**.

**NOTE:** For quarter-turn drives, follow the tensioning instructions on Page 253.

## Numerical Method

While designing a drive, it is well to specify data for use in tensioning the drive. Many users of V-belt drives rely on their experience and the above general rules for tensioning drives, but it has become common practice to actually measure the tension in a drive. Numerical methods for measuring tension have several advantages. For example, they prevent inexperienced personnel from drastically overtensioning or undertensioning a drive, thus preventing possible bearing or belt damage. Even with experienced personnel, it helps the individual get a feel for the tension needed in a particular drive. This is especially important with modern drives, where each V-belt is rated for higher horsepower than were previous belts. If a belt is to carry more

horsepower, it must be installed proportionally tighter. Experience with older drives may lead to undertensioning of modern drives unless tension is measured at least once to help get the feel for correct tension.

The procedure in numerically tensioning a drive is:

1. Determine the correct tension for the stopped drive, called static tension, so that the tension will be correct when the drive is operating.
2. Measure the static tension so that it can be set at the correct value.

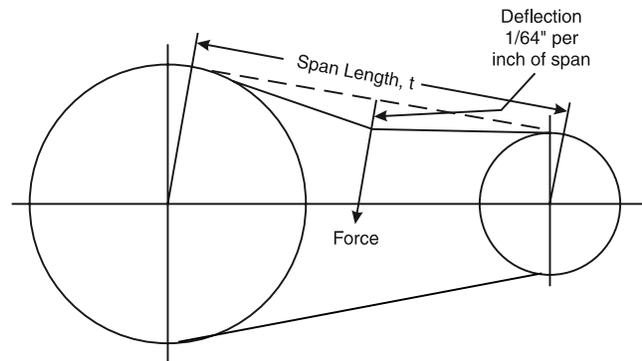
**NOTE:** Do not use this section if your drive uses a spring-loaded idler or other means of automatic drive tensioning. See your local Gates representative.

## Tension Tester Method

1. Measure the span length (t).
2. Position the lower of the two "O" Rings using **either** of these methods:
  - a. On the scale reading "Deflection inches", set the "O" Ring(s) to show a deflection equal to  $\frac{1}{64}$ " per inch of span length (t).
  - b. On the scale reading "Inches of Span Length", set the "O" Ring(s) to show a deflection equal to the inches of measured span length (t).
3. At the center of the span (t), apply force with the Gates Tension Tester perpendicular to the span, large enough to deflect one belt of a multiple belt set on the drive until the bottom edge of the lower "O" Ring(s) is even with the tops of the remaining belts. For drives with only one belt, a straight edge across the pulleys will assure accuracy of positioning.
4. Find the amount of deflection **force** on the upper scale of the Tension Tester. The Sliding Rubber "O" Ring(s) slides up the scale as the tool compresses — and stays up for accurate reading of pounds force. Read at the bottom edge of the ring(s) (Slide ring down before reusing).
5. Compare the deflection force with the range of forces recommended. If **less** than **minimum** recommended deflection force, belts should be tightened. If **more** than **maximum** recommended deflection force, drive is tighter than necessary.

**NOTE:** There normally will be a rapid drop in tension during the "run-in period" for V-belt drives. Check tension frequently during the first day of operation.

**Fig. No. 1**  
Tension Measurement By Deflection



# How to Tension V-Belt Drives (continued)

## Tension Tester Method (continued)

### Table No. 54

Recommended Deflection Force Per Belt For Super HC® V-Belts, Super HC PowerBand® Belts, Super HC Molded Notch V-Belts or Super HC Molded Notch PowerBand Belts\*

V-Belt Cross Section	Small Sheave Diameter Range (In.)	Small Sheave RPM Range	Speed Ratio Range	Recommended Deflection Force (Lbs.)	
				Minimum	Maximum
3V	2.65 - 2.80	1200-3600	2.00	3.0	4.3
	3.00 - 3.15	1200-3600		3.3	4.8
	3.35 - 3.65	1200-3600	to	3.7	5.4
	4.12 - 5.00	900-3600	4.00	4.4	6.4
	5.30 - 6.90	900-3600		4.8	7.1
3VX	2.20	1200-3600	2.00	2.8	4.1
	2.35 - 2.50	1200-3600		3.2	4.7
	2.65 - 2.80	1200-3600	to	3.5	5.1
	3.00 - 3.15	1200-3600	4.00	3.8	5.5
	3.35 - 3.65	1200-3600		4.1	6.0
	4.12 - 5.00	900-3600		4.8	7.1
5VX	5.30 - 6.90	900-3600		5.8	8.6
	4.40 - 4.65	1200-3600	2.00	9.0	13.0
	4.90 - 5.50	1200-3600		10.0	15.0
	5.90 - 6.70	1200-3600	to	11.0	17.0
	7.10 - 8.00	600-1800	4.00	13.0	19.0
8.50 - 10.90	600-1800		14.0	20.0	
5V	11.80 - 16.00	400-1200		15.0	23.0
	7.10 - 8.00	600-1800	2.00	11.0	16.0
	8.50 - 10.90	600-1800		to	13.0
8V	11.80 - 16.00	400-1200	4.00	14.0	21.0
	12.50 - 17.00	600-1200	2.00	28.0	41.0
8V	18.00 - 24.00	400- 900		to	
			4.00	32.0	48.0

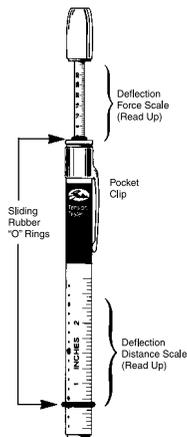
### Table No. 55

Recommended Deflection Force Per Belt For Hi-Power II™ V-Belts, Hi Power II PowerBand Belts or Tri-Power® Molded Notch V-Belts\*

V-Belt Cross Section	Small Sheave Diameter Range (In.)	Small Sheave RPM Range	Speed Ratio Range	Recommended Deflection Force (Lbs.)			
				Hi-Power II		Tri-Power Molded Notch	
				Minimum	Maximum	Minimum	Maximum
A AX	3.0	1750	2.00	2.7	3.8	3.8	5.4
	3.2			2.9	4.2	3.9	5.6
	3.4 - 3.6	to	to	3.3	4.8	4.1	5.9
	3.8 - 4.2	3600	4.00	3.8	5.5	4.3	6.3
B BX	4.6	1160	2.00	5.1	7.4	7.1	10.0
	5.0 - 5.2			5.8	8.5	7.3	11.0
	5.4 - 5.6	to	to	6.2	9.1	7.4	11.0
	6.0 - 6.8	1800	4.00	7.1	10.0	7.7	11.0
C CX	7.4 - 9.4			8.1	12.0	7.9	12.0
	7.0	870	2.00	9.1	13.0	12.0	18.0
	7.5			9.7	14.0	12.0	18.0
	8.0 - 8.5	to	to	11.0	16.0	13.0	18.0
9.0 - 10.5	1800	4.00	12.0	18.0	13.0	19.0	
D	11.0 - 16.0			14.0	21.0	13.0	19.0
	12.0 - 13.0	690	2.00	19.0	27.0	19.0	28.0
	13.5 - 15.5			21.0	30.0	21.0	31.0
	16.0 - 22.0	1200	4.00	24.0	36.0	25.0	36.0

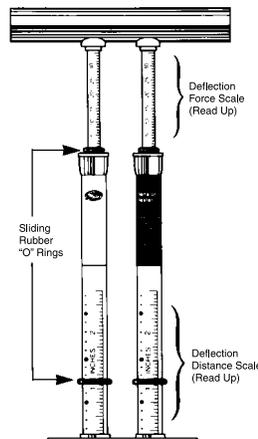
\*Note: This information is for Horsepower Ratings which are mentioned in this manual only. Use with older drives could result in overtensioning.

— up to 30 lbs.

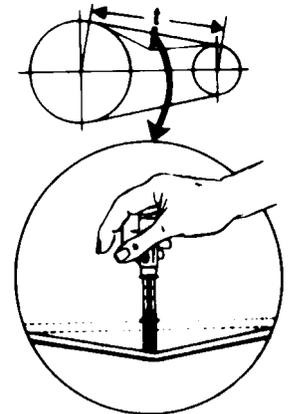


Read the scales at the bottom edge of the "O" Ring. Leave the upper "O" Ring in maximum "down" position

— up to 66 lbs.



Read the scales at the bottom edge of the "O" Ring. Leave the upper "O" Ring in maximum "down" position



<b>Part No.</b>	<b>Force Limitation</b>
7401-0076	Up to 30 Lbs.
7401-0075*	Up to 66 Lbs.

\*Dual Tensioner

**NOTE:** Lay a steel bar or a narrow block of wood across the PowerBand® belt and apply the deflection force to the bar so that all of the individual strands in the band are deflected the same amount. If more than one PowerBand Belt is used on the drive, the neighboring band can be used as a reference for measuring the deflection, just as is done with individual V-belts. If only one band is used, lay a straightedge or stretch a string from sheave-to-sheave to use as a reference for measuring deflection. Lay the straightedge or string across the back of the PowerBand Belt on the sheaves.

In tensioning Gates PowerBand Belts, multiply the pounds of deflection forces by the number of belts in the band. The tension tester can be applied as indicated above to deflect the entire PowerBand Belt, providing a small board or metal plate is placed on top of the band so that all belts in the band are deflected a uniform amount. A straight-edge can be laid across the sheaves to use as a reference for measuring deflection.

# How to Tension V-Belt Drives—continued

## Regular V-Belt Tensioning Method

### Step 1 Find the Required Tension Per Strand of Belt (Static Tension)

A. The static tension per strand ( $T_{st}$ ) is given by this formula:

#### Formula No. 6

$$T_{st} = 15 \left( \frac{2.5^* - K\phi}{K\phi} \right) \left( \frac{\text{Design HP} (10^3)}{(N)(V)} \right) + \frac{MV^2}{10^6}$$

Where:  $K\phi$  = arc correction factor from Table No. 48 on Page 205 or Table No. 89 on Page 251 for V-Flat drives.

$N$  = Number of belts.  
(This is the number of strands in the case of PowerBand® Belts.)

$V$  = Belt speed, ft./min.

$M$  = Constant from Table No. 56.

\*2.67 for Micro-V® Belts.

### Table No. 56

#### Factor M and Factor Y

Cross Section	M	Y	Cross Section	M	Y
Super HC® Molded Notch			Hi-Power II PowerBand		
3VX	0.29	4	A	0.66	7
5VX	0.78	13	B	1.0	9
Super HC® Molded Notch PowerBand®			C	1.8	18
3VX	0.39	4	D	3.4	28
5VX	0.98	13	Tri-Power® Molded Notch		
Super HC			AX	0.47	7
5V	1.0	11	BX	0.76	8
8V	2.6	22	CX	1.31	15
Super HC PowerBand			Micro-V® Belt		
3V	0.46	4	J*	0.035	0.56
5V	1.2	11	L	0.130	1.90
5VP	1.2	39	M	0.520	6.30
8V	3.0	22	Polyflex® JB®		
Hi-Power® II			5M**	0.05	1.2
A	0.51	7	7M	0.14	4.6
B	0.80	8	11M	0.31	8.5
C	1.5	18			
D	3.0	27			

\*If the calculated  $T_{st}$  value is less than 2.81 lbs for a J cross section Micro-V belt, use 2.81 lbs to calculate upper and lower deflection forces in step 2.

\*\*If the calculated  $T_{st}$  value is less than 7.87 lbs for a 5M cross section Polyflex belt, use 7.87 to calculate upper and lower deflection forces in step 2.

These minimum  $T_{st}$  values must be used on lightly loaded drives due to belt stiffness so the belt will properly conform to the sheave.

### Step 2 Determine the Lower and Upper Recommended Forces to Deflect One Belt 1/64" Per Inch of Span Length

A. Measure the **span length** ( $t$ ) of your drive (or see Formula No. 35 on Page 261 to calculate span length).

B. If your drive uses **two or more** PowerBand Belts or individual belts, calculate the lower and upper recommended deflection forces by these formulas:

#### Formula No. 7

$$\text{Lower Recommended Force} = \frac{T_{st} + Y}{16}$$

#### Formula No. 8

$$\text{Upper Recommended Force} = \frac{1.5 T_{st} + Y}{16}$$

Where:  $T_{st}$  = tension per strand from Step 1.

$Y$  = constant from Table No. 56.

C. If your drive has only **one** PowerBand Belt (See D top right) or individual belt, calculate the lower and upper recommended deflection forces by these formulas:

#### Formula No. 9

$$\text{Lower Recommended Force} = \frac{T_{st} + \left(\frac{t}{L}\right) Y}{16}$$

#### Formula No. 10

$$\text{Upper Recommended Force} = \frac{1.5 T_{st} + \left(\frac{t}{L}\right) Y}{16}$$

Where:  $T_{st}$  = tension per strand from Step 1.

$Y$  = constant from Table No. 56.

$t$  = span length (see Figure No. 1 on Page 212).

$L$  = belt length

D. The deflection forces calculated in Step 2B or 2C are for an individual belt. Multiply these forces by the number of individual strands in a band to get the lower and upper recommended forces for a PowerBand Belt. (If your drive uses 2 or more PowerBand Belts, use the band with the fewest number of strands.)

### Step 3 Determine If the Belts are Properly Tensioned

A. At the center of the span( $t$ ) **measure the force** required to deflect one belt on the drive 1/64" per inch of span length from its normal position. Be sure to apply the force perpendicular to the belt. See Figure No. 1 on Page 212. If your drive is a single belt drive or uses only one PowerBand Belt, be sure that at least one sheave is free to rotate. For PowerBand, see Step 1C of the Simplified Method for instructions on how to apply the measuring force and how to measure deflection.

B. If the measured force is less than the lower recommended force, the belts should be tightened. If it is more than the upper recommended force, the drive is tighter than it needs to be.

### Gates PowerBand Belt Tensioning Information

When the cross section and number of strands in a Gates PowerBand Belt become so large that the deflection force is greater than can reasonably be imposed on the belt, a method of measuring tension other than the deflection method may be used.

The alternate method of checking PowerBand Belt tension is the Elongation Method. The principle is simple. A known amount of tension elongates a belt a known amount. Therefore the elongation of a PowerBand Belt as it is installed on a drive and tensioned is a measure of the static tension in the belt.

### Elongation Method for Tensioning PowerBand Belts

#### Step 1 Find the Required Tension Per Strand of Belt (Static Tension)

A. Find the **required static tension**,  $T_{st}$ , using Formula No. 6 in Step 1A of the Regular V-Belt Tensioning Method.

B. Find a range or recommended tensions.

$$\text{Low Tension} = T_{st}$$

$$\text{Upper Tension} = 1.5 \times T_{st}$$

#### Step 2 Find the Amount to Elongate the Belt (On the Drive) to Obtain the Above Tension

A. Measure the **outside circumference** of the belt at no tension. This can be done with the belt either on or off the drive.

**NOTE:** If you are retensioning a used drive, slack off on the drive until there is no tension, then tape the outside circumference of the belt while it is still on the drive.

B. Find the correct **belt length multiplier** from Table No. 57 on Page 215 for each of the static tensions you calculated above.

C. Multiply the taped outside circumference of the PowerBand Belt of each of the belt length multipliers. This gives the **elongated outside circumference** of the PowerBand Belt corresponding to each of the calculated tensions.

#### Step 3 Tension the Drive

A. With the PowerBand Belt installed on the drive, tighten it until the taped outside circumference falls between the elongated outside circumferences calculated above.

## Table No. 57

### Belt Length Multipliers for Tensioning PowerBand® Belts

Tst Per Strand (Lbs.)	Super HC® Molded Notch PowerBand Belts & Super HC PowerBand Belts					Hi-Power® II PowerBand Belts					
						Cross Section					
						A*		B		C	
	3V	3VX	5VX	5V	8V	Equal To or Less Than 210" Length	Equal To or Less Than 210" Length	Over 210" Length	Equal To or Less Than 210" Length	Over 210" Length	
10	1.00122	1.00091	1.00033	1.00053	1.00029	1.00048	1.00042	1.00050	1.00025	1.00033	1.00017
12	1.00146	1.00109	1.00040	1.00063	1.00034	1.00057	1.00050	1.00060	1.00030	1.00040	1.00021
14	1.00171	1.00127	1.00047	1.00074	1.00040	1.00067	1.00058	1.00070	1.00035	1.00047	1.00024
16	1.00195	1.00145	1.00053	1.00084	1.00046	1.00076	1.00067	1.00080	1.00040	1.00053	1.00028
18	1.00220	1.00164	1.00060	1.00095	1.00051	1.00086	1.00075	1.00090	1.00045	1.00060	1.00031
20	1.00244	1.00182	1.00067	1.00105	1.00057	1.00095	1.00083	1.00100	1.00050	1.00067	1.00034
24	1.00293	1.00218	1.00080	1.00126	1.00069	1.00114	1.00100	1.00120	1.00060	1.00080	1.00041
28	1.00341	1.00255	1.00093	1.00147	1.00080	1.00133	1.00117	1.00140	1.00070	1.00093	1.00048
32	1.00390	1.00291	1.00107	1.00168	1.00091	1.00152	1.00133	1.00160	1.00080	1.00107	1.00055
36	1.00439	1.00327	1.00120	1.00189	1.00103	1.00171	1.00150	1.00180	1.00090	1.00120	1.00062
40	1.00488	1.00364	1.00133	1.00211	1.00114	1.00190	1.00167	1.00200	1.00100	1.00133	1.00069
45	1.00549	1.00409	1.00150	1.00237	1.00129	1.00214	1.00187	1.00225	1.00112	1.00150	1.00078
50	1.00610	1.00455	1.00167	1.00263	1.00143	1.00238	1.00208	1.00250	1.00125	1.00167	1.00086
55	1.00671	1.00500	1.00183	1.00289	1.00157	1.00262	1.00229	1.00275	1.00137	1.00183	1.00095
60	1.00732	1.00545	1.00200	1.00316	1.00171	1.00286	1.00250	1.00300	1.00150	1.00200	1.00103
65	1.00793	1.00591	1.00217	1.00342	1.00186	1.00309	1.00271	1.00325	1.00162	1.00217	1.00112
70	1.00854	1.00636	1.00233	1.00368	1.00200	1.00333	1.00292	1.00350	1.00175	1.00233	1.00121
75	1.00915	1.00682	1.00250	1.00395	1.00214	1.00357	1.00312	1.00375	1.00187	1.00250	1.00129
80	1.00976	1.00727	1.00267	1.00421	1.00229	1.00381	1.00333	1.00400	1.00200	1.00267	1.00138
85	1.01037	1.00773	1.00283	1.00447	1.00243	1.00405	1.00354	1.00425	1.00212	1.00283	1.00146
90	1.01098	1.00818	1.00300	1.00474	1.00257	1.00428	1.00375	1.00450	1.00225	1.00300	1.00155
95	1.01159	1.00864	1.00317	1.00500	1.00271	1.00452	1.00396	1.00475	1.00237	1.00317	1.00164
100	1.01220	1.00909	1.00333	1.00526	1.00286	1.00476	1.00417	1.00500	1.00250	1.00333	1.00172
120	1.01463	1.01091	1.00400	1.00632	1.00343	1.00571	1.00500	1.00600	1.00300	1.00400	1.00207
140	1.01707	1.01273	1.00467	1.00737	1.00400	1.00667	1.00583	1.00700	1.00350	1.00467	1.00241
160	1.01951	1.01455	1.00533	1.00842	1.00457	1.00762	1.00667	1.00800	1.00400	1.00533	1.00276
180	1.02195	1.01636	1.00600	1.00947	1.00514	1.00857	1.00750	1.00900	1.00450	1.00600	1.00310
200	1.02439	1.01818	1.00667	1.01053	1.00571	1.00952	1.00833	1.01000	1.00500	1.00667	1.00345
240	1.02927	1.02182	1.00800	1.01263	1.00686	1.01143	1.01000	1.01200	1.00600	1.00800	1.00414
280	1.03415	1.02545	1.00933	1.01474	1.00800	1.01333	1.01167	1.01400	1.00700	1.00933	1.00483
320	1.03902	1.02909	1.01067	1.01684	1.00914	1.01524	1.01333	1.01600	1.00800	1.01067	1.00552
360	1.04390	1.03273	1.01200	1.01895	1.01029	1.01714	1.01500	1.01800	1.00900	1.01200	1.00621
400	1.04878	1.03636	1.01333	1.02105	1.01143	1.01905	1.01667	1.02000	1.01000	1.01333	1.00690
450	1.05488	1.04091	1.01500	1.02368	1.01286	1.02143	1.01875	1.02250	1.01125	1.01500	1.00776
500	1.06098	1.04545	1.01667	1.02632	1.01429	1.02381	1.02083	1.02500	1.01250	1.01667	1.00862
550	1.06707	1.05000	1.01833	1.02895	1.01571	1.02619	1.02292	1.02750	1.01375	1.01833	1.00948
600	1.07317	1.05455	1.02000	1.03158	1.01714	1.02857	1.02500	1.03000	1.01500	1.02000	1.01034
650	1.07927	1.05909	1.02167	1.03421	1.01857	1.03095	1.02708	1.03250	1.01625	1.02167	1.01121
700	1.08537	1.06364	1.02333	1.03684	1.02000	1.03333	1.02917	1.03500	1.01750	1.02333	1.01207
750	1.09146	1.06818	1.02500	1.03947	1.02143	1.03571	1.03125	1.03750	1.01875	1.02500	1.01293
800	1.09756	1.07273	1.02667	1.04211	1.02286	1.03809	1.03333	1.04000	1.02000	1.02667	1.01379
850	1.10366	1.07727	1.02833	1.04474	1.02429	1.04048	1.03542	1.04250	1.02125	1.02833	1.01466
900	1.10976	1.08182	1.03000	1.04737	1.02571	1.04286	1.03750	1.04500	1.02250	1.03000	1.01552
950	1.11585	1.08636	1.03167	1.05000	1.02714	1.04524	1.03958	1.04750	1.02375	1.03167	1.01638
1000	1.12195	1.09091	1.03333	1.05263	1.02857	1.04762	1.04167	1.05000	1.02500	1.03333	1.01724

\* A Section PowerBand Belts are not a standard. For availability, check with your local Gates representative.



# Tensioning Example Using Super HC<sup>®</sup> V-Belts

**Given:**

## Existing Drive

Design Horsepower = 90  
DriveR = 6 grooves 5V 11.8" O.D.  
DriveR RPM = 870  
DriveN = 6 grooves 5V 46.0" O.D.  
V-Belts = 5VX1800  
Center Distance = 41.0"  
Belt Speed = 2665 ft./min.  
Factor  $K\phi = 0.86$

This drive meets all the requirements for the Simplified Tensioning Method except it uses one more belt than the number recommended, so simplified tensioning would put more tension in the drive than needed. Use the regular V-belt tensioning method shown below.

## Step 1 Find the Required Tension Per Strand of Belt, Using Formula No. 6 on Page 214.

$$\begin{aligned} T_{st} &= 15 \left( \frac{2.5 - 0.86}{0.86} \right) \left[ \frac{(90)(1000)}{(6)(2665)} \right] + \frac{(1.0)(2665)^2}{10^6} \\ &= (15)(1.91)(5.63) + 7.10 \\ &= 161.3 + 7.10 = 168.4 \text{ or } 168 \text{ Lbs.} \end{aligned}$$

## Step 2 Lower and Upper Forces for Deflection of One Belt.

A. Span length can be calculated from Formula No. 35 of Page 261.

$$\begin{aligned} t &= 41.0 [1 - 0.125 (0.83)^2] \\ &= 41.0 (1 - 0.0861) \\ &= 37.5" \end{aligned}$$

The deflection should be  $38\frac{3}{64}"$  or  $19\frac{1}{32}"$

B. Lower recommended force =  $\frac{168 + 13}{16} = 11.3$  Lbs.

Upper recommended force =  $\frac{(1.5)(168) + 13}{16} = 16.6$  Lbs.

## **BLUE DIVIDER SHEET**

## **BLUE DIVIDER SHEET**



## COMPACT "L" STYLE INLET VACUUM AIR FILTERS "CSL" Series 3/8" - 3" FPT

### APPLICATIONS

- ❑ Blowers-Side Channel
- ❑ Medical
- ❑ Vacuum Lifters
- ❑ Woodworking
- ❑ Factory Automation
- ❑ Printing Industry
- ❑ Vacuum Packaging
- ❑ Leak Detection
- ❑ Soil Venting/Remediation
- ❑ Vacuum Pumps & Systems

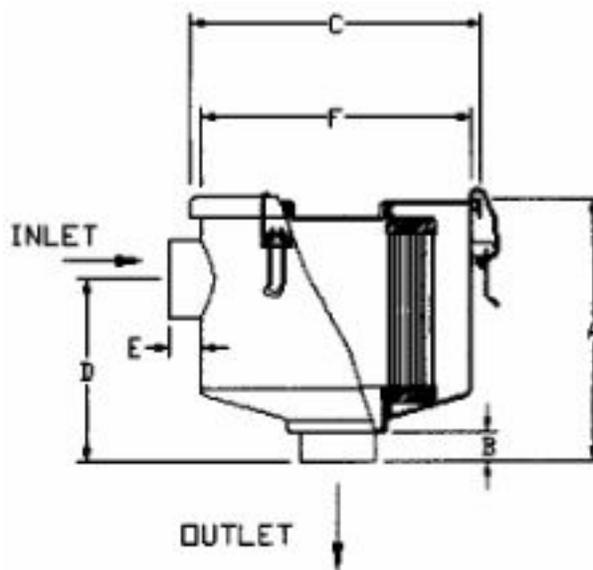
### FEATURES & SPECIFICATIONS

- ❑ ;99%+ removal efficiency std: Paper=2 micron, Polyester=5 micron
- ❑ Filter change out differential: 10"-15" in. H<sub>2</sub>O above initial delta P
- ❑ Positive sealing O-ring seal system
- ❑ Rugged all steel construction with baked enamel finish
- ❑ Stainless steel torsion clips for durability
- ❑ Vacuum level: Typically 1x10<sup>-3</sup> mmHg (1.3x10<sup>-3</sup> mbar)
- ❑ Brazed fittings for high vacuum duty
- ❑ Low pressure drop
- ❑ Pressure drop graphs available upon request
- ❑ Seamless drawn housings
- ❑ Temp (continuous): min -15° F ( -26° C) max 220° F (104° C)

### OPTIONS

- ❑ Activated carbon prefilter to reduce odor
- ❑ Epoxy coated housings
- ❑ Special connections
- ❑ Various elements available
- ❑ Alternate Top-to-canister fastening system for low pressure or pulsating systems
- ❑ Extra tap fittings for vacuum gauge
- ❑ Support brackets
- ❑ Available in *Stainless Steel*
- ❑ Larger sizes available
- ❑ Vacuum gauge available

### Line Drawing



\*All measurements are shown in standards.

Typical Lead Times:		Normally in stock
	1 - 2 weeks	 Normally in stock
	3 - 4 weeks	 5 - 7 weeks
		 8 + weeks

Add To Order	Model Number	Element Type	Inlet in. NPT or FLG	Outlet in. NPT or FLG	Connection Style	Dim A in.	Dim B in.	Dim C in.	Dim D in.	Dim E in.	Dim F in.	Dim G in.	Parent Flow SCFM	Element Parent Flow SCFM	Approx. Weight lbs.
	CSL-825-039HC	Polyester	0.375	0.375	FPT	3.63	0.56	3.66	1.88	0.56	3.5	3	18	25	0.88
	CSL-825-050HC	Polyester	0.5	0.5	FPT	3.63	0.56	3.66	1.88	0.56	3.5	3	18	25	0.88
	CSL-843-050HC	Polyester	0.5	0.5	FPT	4.38	0.56	5.88	2.5	0.56	5	3.25	20	55	3
	CSL-825-075HC	Polyester	0.75	0.75	FPT	3.75	0.56	3.66	1.88	0.56	3.5	3	24	25	0.88
	CSL-843-075HC	Polyester	0.75	0.75	FPT	4.38	0.56	5.88	2.5	0.56	5	3.25	25	55	3
	CSL-843-100HC	Polyester	1	1	FPT	4.38	0.75	5.88	2.62	0.75	5	3.25	35	55	3
	CSL-849-100HC	Polyester	1	1	FPT	6.75	0.75	7.33	4.5	0.75	6.8	5.25	40	115	5
	CSL-843-125HC	Polyester	1.25	1.25	FPT	4.38	0.75	5.88	2.62	0.75	5	3.25	55	55	3
	CSL-849-125HC	Polyester	1.25	1.25	FPT	6.75	0.75	7.33	4.5	0.75	6.8	5.25	60	115	5
	CSL-849-150HC	Polyester	1.5	1.5	FPT	6.75	0.75	7.33	4.5	0.75	6.8	5.25	80	115	5
	CSL-851-200HC	Polyester	2	2	FPT	10.25	0.75	8.75	5	0.75	7.62	9.25	175	290	15
	CSL-851-250HC	Polyester	2.5	2.5	FPT	10.5	1.25	8.75	5.5	1.25	7.62	9.25	210	290	15
	CSL-239-300C	Polyester	3	3	FPT	15.75	2.88	13.25	8.75	2.88	12	11	300	750	33
	CSL-824-039HC	Paper	0.375	0.375	FPT	3.63	0.56	3.66	1.88	0.56	3.5	3	18	25	0.88
	CSL-824-050HC	Paper	0.5	0.5	FPT	3.63	0.56	3.66	1.88	0.56	3.5	3	18	25	0.88
	CSL-842-050HC	Paper	0.5	0.5	FPT	4.38	0.56	5.88	2.5	0.56	5	3.25	20	55	3
	CSL-824-075HC	Paper	0.75	0.75	FPT	3.75	0.56	3.66	1.88	0.56	3.5	3	24	25	0.88
	CSL-842-075HC	Paper	0.75	0.75	FPT	4.38	0.56	5.88	2.5	0.56	5	3.25	25	55	3
	CSL-842-100HC	Paper	1	1	FPT	4.38	0.75	5.88	2.62	0.75	5	3.25	35	55	3
	CSL-848-100HC	Paper	1	1	FPT	6.75	0.75	7.33	4.5	0.75	6.8	5.25	40	115	5
	CSL-842-125HC	Paper	1.25	1.25	FPT	4.38	0.75	5.88	2.62	0.75	5	3.25	55	55	3
	CSL-848-125HC	Paper	1.25	1.25	FPT	6.75	0.75	7.33	4.5	0.75	6.8	5.25	60	115	5
	CSL-848-150HC	Paper	1.5	1.5	FPT	6.75	0.75	7.33	4.5	0.75	6.8	5.25	80	115	5
	CSL-850-200HC	Paper	2	2	FPT	10.25	0.75	8.75	5	0.75	7.62	9.25	175	290	15
	CSL-850-250HC	Paper	2.5	2.5	FPT	10.5	1.25	8.75	5.5	1.25	7.62	9.25	210	290	15
	CSL-238-300C	Paper	3	3	FPT	15.75	2.88	13.25	8.75	2.88	12	11	300	750	33

**Solberg Mfg.**

1151 W. Ardmore Ave. Itasca, IL 60143 (630)773-1363 Fax: (630)773-0727

# Section D

## MAINTENANCE RECOMMENDATIONS

1. Pressure drop readings are recommended to have an effective air filter. Always document initial pressure drop during start-up when element is clean. Replacement cartridge is needed when system experiences 10" to 15" / 250-380mm H<sub>2</sub>O higher pressure drop above the initial reading. Refer to page 4 for instructions.
2. Always check replacement cartridge gaskets to insure they are adhered uniformly along the end caps during handling. If not, contact Solberg Manufacturing, Inc. immediately. Do not modify or change from Solberg specified parts!
3. Always check inlets/outlets, element base and its components when replacing element to insure cleanliness. Wipe clean if necessary.
4. Operate only when a proper seal exists.
5. VS/VL: Never operate without absolute assurance that V-clamp is secured correctly along entire diameter of canisters. Check along V-clamp for wear. Replace if any distortion occurs due to handling and usage.

### SPARE PARTS LIST:

#### CSL/CT/VS/VL Series

Parent Model Model-Element-Connection	Prefilter Model	Housing						Element		
		Top Model No.	O-Ring Model No.	Gasket(s)/ Adapter Model No.	Wingnut(s) Model No.	Washer(s) Model No.	Clips/ Bolts Model No.	Top Plate Model No.	Wingnuts/ Bolt Model No.	Washer(s) Model No.
CSL-825/824-xxx	N/A	T824	OR337	BG224	N/A	N/A	CPWF	N/A	N/A	N/A
CSL-843/842-xxx	PF842	T842	OR550	BG268	N/A	N/A	CPWF	N/A	N/A	N/A
CSL-849/848-xxx	PF848	T848	OR675	BG281	N/A	N/A	CPWF	N/A	N/A	N/A
CSL-851/850-xxx	PF850	T850	OR750	BG412	N/A	N/A	CPWF	N/A	N/A	N/A
CSL-239/238-xxx	PF238	TD238	OR1250	N/A	N/A	N/A	CPWF	N/A	WN38X16	WR38X16
CSL-235/234-xxx	PF234	TC1400	OR1200	N/A	WN38X16	WR38X16	BT38163	T8000437	WN38X16	WR38X16
CSL-335/334-xxx	PF334	TC1400	OR1200	ADEX300	WN38X16	WR38X16	BT38163	T8000437	WN38X16	WR38X16
CSL-245/244-xxx	PF244	TC1850	OR1600	N/A	WN38X16	WR38X16	BT38163	T1000437	WN38X16	WR38X16
CSL-345/344-xxx	PF344	TC1850	OR1600	ADEX300	WN38X16	WR38X16	BT38163	T1000437	WN38X16	WR38X16
CSL-275/274-xxx	PF274	TC1850	OR1600	N/A	WN38X16	WR38X16	BT38163	T12000437	WN38X16	WR38X16
CSL-375/374-xxx	PF374	TC1850	OR1600	ADEX300	WN38X16	WR38X16	BT38163	T12000437	WN38X16	WR38X16
CSL-377/376-xxx	PF376	TC2250	OR2000	N/A	WN38X16	WR38X16	BT38163	T14750625	HN50X13	WR50X13
CSL-384(2)-xxx	PF384(2)	N/A	OR2400	N/A	WN38X16	WR38X16	BT38163	T19750625	HN50X13	WR50X13
CSL-685-xxx	PF684	N/A	OR2400	N/A	WN38X16	WR38X16	BT38163	T19750625	HN50X13	WR50X13
CSL-485(2)/484(2)-xxx	PF484(2)	N/A	OR2400	N/A	WN38X16	WR38X16	BT38163	T19750625	HN50X13	WR50X13
CT-851/850-xxx	PF850	N/A	OR725	BG412	N/A	N/A	CPWF	N/A	N/A	N/A
CT-235/234-xxx	PF234	N/A	GCT1100	ADCT234	N/A	N/A	CPWF	T8000437	BH38X16	WR38X88
CT-275/274-xxx	PF274	N/A	OR386	ADCT234	N/A	N/A	KITCT274	T12000437	BH38450	WR38X16
VS-275/274-xxx	PF274	N/A	OR386	N/A	N/A	N/A	N/A	T12000437	WN38X16	WR38X16
VL-275/274-xxx	PF274	N/A	OR386	N/A	N/A	N/A	N/A	T12000437	WN38X16	WR38X16

\*Note: Spare parts are for standard products. See page 4 for replacement element.



**BLANK SHEET**

## **BLUE DIVIDER SHEET**

## **BLUE DIVIDER SHEET**



## SMALL COMPACT FILTER SILENCERS WITH STANDARD FILTER DESIGN "FS" Series 1/2" - 3" MPT

### APPLICATIONS

- ☐ Blowers-PD Type
- ☐ Blowers-Side Channel
- ☐ Compressor-Screw
- ☐ Construction\Contractor Industry
- ☐ Engines
- ☐ Hydraulic Breathers - fine filtration
- ☐ Medical
- ☐ Pneumatic Conveying Systems
- ☐ Waste Water Aeration
- ☐ Workshop
- ☐ Compressor-Piston
- ☐ Dental
- ☐ Industrial & Severe Duty
- ☐ Sparging

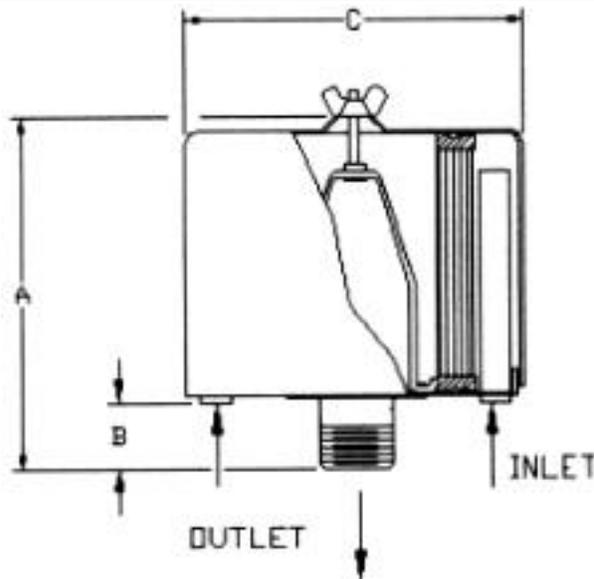
### FEATURES & SPECIFICATIONS

- ☐ ;99%+ removal efficiency std: Paper=2 micron, Polyester=5 micron
- ☐ Filter change out differential: 10"-15" in. H<sub>2</sub>O above initial delta P
- ☐ Interchangeable elements: Polyester, Paper, HEPA
- ☐ Pressure drop graphs available upon request
- ☐ Tubular silencing design - tube is positioned to maximize attenuation and air flow while minimizing pressure drop
- ☐ Durable carbon steel construction with powder coated finish or galvanized steel
- ☐ Fully drawn weatherhood - no welds to rust or vibrate apart
- ☐ Low pressure drop center bracket and outlet pipe design
- ☐ Temp (continuous): min -15° F ( -26° C) max 220° F (104° C)
- ☐ Typical noise attenuation up to 15 dB's (due to the wide range of applications and machines these units are used on, a single graph is insufficient. Please inquire for your specific requirement)

### OPTIONS

- ☐ 1/8" tap holes for differential pressure gauges
- ☐ Available in *Stainless Steel*
- ☐ Epoxy coated housings
- ☐ Hot dipped galvanized housings
- ☐ Special connections, BSPT/Metric
- ☐ Various elements available

### Line Drawing



\*All measurements are shown in standards.

## Typical Lead Times:

 1 - 2 weeks

 3 - 4 weeks


Normally in stock



5 - 7 weeks



8 + weeks

Add To Order	Model Number	Element Type	Outlet in. NPT or FLG	Connection Style	Dim A in.	Dim B in.	Dim C in.	Rated Flow Piston SCFM	Rated Flow Screw Blower Fan SCFM	Element Parent Flow SCFM	Tube Count	Approx. Weight lbs.
	FS-15-050	Polyester	0.5	MPT	4	1.5	6	10	10	35	1	1.8
	FS-15-075	Polyester	0.75	MPT	4	1.5	6	20	25	35	2	2
	FS-15-100	Polyester	1	MPT	4	1.5	6	25	35	35	3	2.1
	FS-19P-100	Polyester	1	MPT	6.63	1.5	6	35	55	100	3	3
	FS-19P-125	Polyester	1.25	MPT	6.63	1.63	6.1	55	70	100	5	3.3
	FS-19P-150	Polyester	1.5	MPT	6.63	1.5	6	70	85	100	5	3.5
	FS-231P-200	Polyester	2	MPT	12.25	2.25	10	135	135	300	5	14
	FS-31P-200	Polyester	2	MPT	7.25	2.25	10	85	135	195	5	7.8
	FS-231P-250	Polyester	2.5	MPT	12.5	2.5	10	195	195	300	9	14.5
	FS-31P-250	Polyester	2.5	MPT	7.5	2.5	10	100	195	195	5	8.2
	FS-231P-300	Polyester	3	MPT	13	3	10	200	300	300	9	15
	FS-14-050	Paper	0.5	MPT	4	1.5	6	10	10	35	1	1.8
	FS-14-075	Paper	0.75	MPT	4	1.5	6	20	25	35	2	2
	FS-14-100	Paper	1	MPT	4	1.5	6	25	35	35	3	2.1
	FS-18P-100	Paper	1	MPT	6.63	1.5	6	35	55	100	3	3
	FS-18P-125	Paper	1.25	MPT	6.63	1.63	6.1	55	70	100	5	3.3
	FS-18P-150	Paper	1.5	MPT	6.63	1.5	6	70	85	100	5	3.5
	FS-230P-200	Paper	2	MPT	12.25	2.25	10	135	135	300	5	14
	FS-30P-200	Paper	2	MPT	7.25	2.25	10	85	135	195	5	8.2
	FS-230P-250	Paper	2.5	MPT	12.5	2.5	10	195	195	300	9	14.5
	FS-30P-250	Paper	2.5	MPT	7.5	2.5	10	100	195	195	5	8.2
	FS-230P-300	Paper	3	MPT	13	3	10	200	300	300	9	15

**Solberg Mfg.**

1151 W. Ardmore Ave.·Itasca, IL 60143·(630)773-1363· Fax: (630)773-0727

SFS\_2-2

## **BLUE DIVIDER SHEET**

## **BLUE DIVIDER SHEET**



# Chamber-Absorption Silencers



Stoddard Silencers, Inc.  
 1017 Progress Drive • Grayslake, Illinois 60030  
 Telephone (847) 223-8636 • FAX (847) 223-8638  
 E-Mail - info @ stoddardsilencersinc.com  
 Web page - www.stoddardsilencersinc.com

## Application

Blower Discharge Silencer for maximum silencing at blower speeds above transition speed.

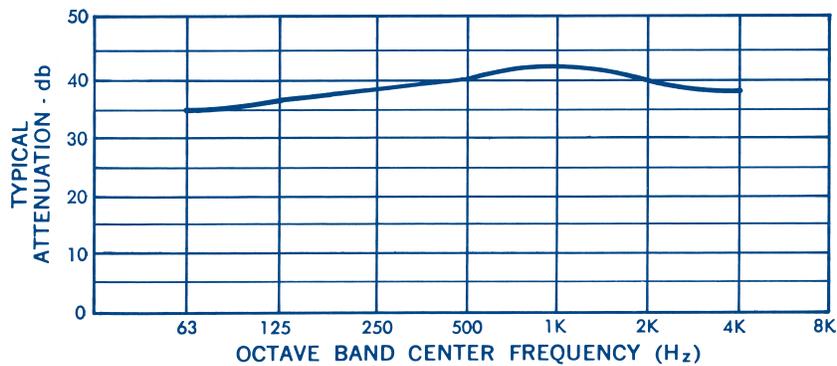
## Design

A multi-chamber silencer containing a high frequency absorption device in addition to a special arrangement of volumes and air passageways to effectively reduce both pulsation and excessive high frequencies through the process of converting noise energy into heat. D33 and D33H Silencers may be installed horizontally or vertically. Design parameters permit nozzle orientation to suit installation requirements.

## Construction

All welded steel sheet and plate construction for long service life. Acoustic absorption material temperature limits far exceed application temperatures. Exterior surfaces are prime coated. Flanges are drilled to match 125 lb. American Standard Flanges. Inspection openings, mounting brackets, relief valve nozzles or special paint are available at extra charge.

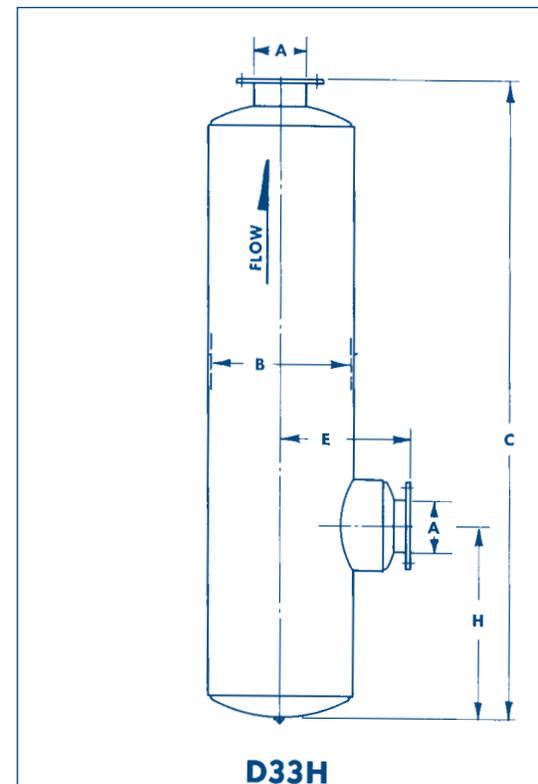
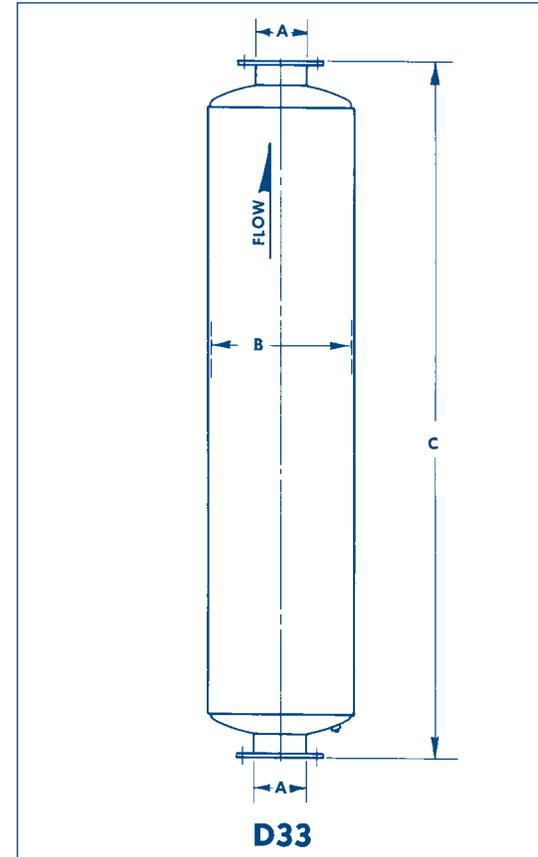
## Typical Attenuation Curve



Model	A	B	C	Wt.
D33- 2	2*	8	33	25
D33- 2½	2½*	10	33	53
D33- 3	3*	10	51	75
D33- 4	4**	14	53	139
D33- 5	5**	16	65	200
D33- 6	6**	18	72	281
D33- 8	8	22	98	715
D33-10	10	26	123	958
D33-12	12	30	136	1353
D33-14	14	36	168	1826
D33-16	16	42	182	2906
D33-18	18	48	189	4175
D33-20	20	48	201	4525
D33-22	22	54	214	5337
D33-24	24	54	232	6560

\*NPT Connection  
 \*\*Available in NPT or Flange Connections

Model	A	B	C	E	H		Wt.
					Min.	Max.	
D33H- 2	2*	8	30	9	6	10	30
D33H- 2½	2½*	10	31	10	7	11	40
D33H- 3	3*	10	49	12	7	11	50
D33H- 4	4**	14	50	14	8	17	120
D33H- 5	5	16	62	15	9	20	165
D33H- 6	6	18	69	17	10	24	215
D33H- 8	8	22	95	26	12	26	715
D33H-10	10	26	120	34	14	36	958
D33H-12	12	30	133	40	16	40	1353
D33H-14	14	36	165	48	17	40	1826
D33H-16	16	42	179	54	19	44	2906
D33H-18	18	48	186	60	21	46	4175
D33H-20	20	48	198	66	22	47	4525
D33H-22	22	54	211	72	24	48	5337
D33H-24	24	54	229	72	26	54	6560



**BLANK SHEET**

## **BLUE DIVIDER SHEET**

## **BLUE DIVIDER SHEET**

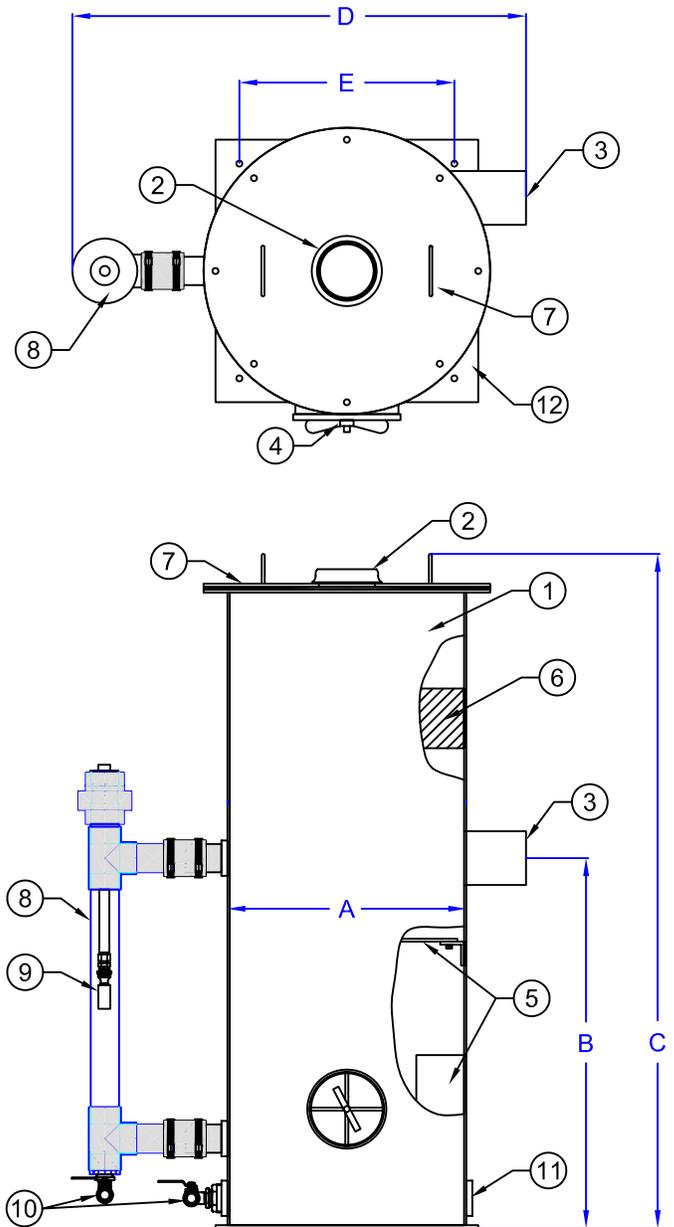
**MOISTURE SEPARATOR KNOCK OUT TANK**

Model	Total Tank Capacity (US Gallons)	Liquid Capacity at High-High Level (US Gallons)	Tank Dimensions (Inches)				
			"A"	"B"	"C"	"D"	"E"
70 Gallon Tank	70	28	20	31	56.5	38	18
110 Gallon Tank	110	44	24	31	64	40	22
170 Gallon Tank	170	68	28	38	71	44	26

The moisture separator knockout tank provides gross moisture removal for the SVE system. The chart below lists the components and options that are available with the knockout tank.

Part #	Part Name	Options
1	Custom Welded 3/16" Carbon Steel Tank	
2	Outlet Connection	4" or 6" pipe, FNPT connection
3	Tangential Inlet Connection	4" or 6" pipe, slip or groove connection, left or right inlet
4	Cleanout/Access Port	Expansion Plug or groove connection
5	Interior Tank Baffle	
6	Removable/Washable 4" SS 304 Demister Pad	
7	Removable Steel Lid with Handles and Buna-N Gasket	
8	2" Clear PVC Stillwell	Left or right side installation
9	Removable Float Switch	Single Point or 3 point level switches
10	3/4" Hose Bib Drain Ports	
11	2" FNPT transfer pump connection	
12	1/4" Steel Base with (4) 1/2" dia. mounting holes	

Note: Industrial gray polyurethane paint or powder coat applied to tank exterior. Tank internals not painted. Epoxy coating of KO tank internals available as an option.



**BLANK SHEET**

## **BLUE DIVIDER SHEET**

## **BLUE DIVIDER SHEET**

# American Industrial Heat Transfer Inc.®

Manufacturer of Quality Heat Exchangers



## ACA SERIES



**AIR COOLED**

## **AFTERCoolERS**

*For Compressed Gas or Vapor*

- Computer Selection.
- Low pressure drop available.
- Standard ports NPT, optional ANSI flange.
- Operating temperature of 400° F & pressure of 150PSI.
- Custom designs to fit your needs.
- Cools: Air, Compressors, Blowers, Steam vapors, Pneumatic systems, Vapor recovery systems etc...

note: AIHTI reserves the right to make reasonable design changes without notice.

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3905 Route 173 Zion, IL 60099

tel: 1 (847) 731-1000

fax: 1 (847) 731-1010

www.aihti.com

# ACA Series *construction*

ACA - 3181 through ACA - 4362



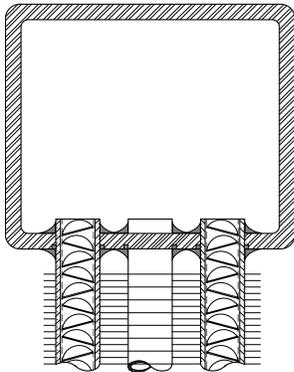
*Brazed Core Construction*

Air coolers are an essential part of any compressed air system, by cooling the air, and condensing water vapor into a liquid state for removal. When air is compressed, the compression induces heat into both the air and the water entrained in the air.

The American Industrial ACA series heat exchanger cools air with air, making it a simple inexpensive way to cool when compared to other water-cooled or refrigerant cooled systems. The unique compact brazed fin/tube design provides efficient cooling and low maintenance under the warmest environmental conditions. By using an ACA series air-cooled after cooler, machine tools will receive cooler dryer air, provide longer trouble free life, experience less down time, and be cost effective to operate on a continuous basis.

## *SUPERIOR COOLING FINNS*

Copper tubes are mechanically bonded to highly efficient aluminum cooling fins. Die-formed fin collars provide a durable precision fit for maximum heat transfer. Custom fin design forces air to become turbulent and carry heat away more efficiently than old flat fin designs.



## *TANKS*

State-of-the-art high temperature brazing method insures permanent bond and positive contact of tube to manifold, eliminating leaks and providing maximum service life.

## **CONSTRUCTION MATERIALS & RATINGS**

Standard Construction Materials		Standard Unit Ratings	
Tubes	Copper	Operating Pressure	150 psig
Fins	Aluminum	Operating Temperature	400 °F
Cabinet & Pipes	Steel	Consult factory for optional materials and ratings.	
Fan Guard	Zinc Plated Steel		
Manifolds	Steel		

note: AIHTI reserves the right to make reasonable design changes without notice.

ACA - 6301 through ACA 6602



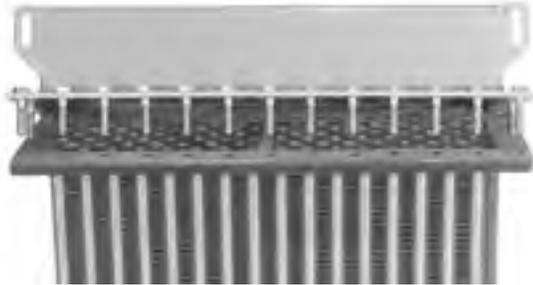
*Serviceable Core® Construction*

Air coolers are an essential part of any compressed air system, by cooling the air, and condensing water vapor into a liquid state for removal. When air is compressed, the compression induces heat into both the air and the water entrained in the air.

The American Industrial ACA series heat exchanger cools air with air, making it a simple inexpensive way to cool when compared to other water-cooled or refrigerant cooled systems. The unique compact *serviceable core®* design provides efficient cooling and low maintenance under the warmest environmental conditions. By using an ACA series air-cooled after cooler, machine tools will receive cooler dryer air, provide longer trouble free life, experience less down time, and be cost effective to operate on a continuous basis.

**SERVICEABLE CORE®**

Core covers disassemble for easy access and cleaning. Repairable design for applications that require limited down time or in the event of a mishap requiring repair. Roller expanded tube to tube-sheet joint. 100% mechanical bond. Positive gasket seal is field replaceable for field maintenance or repair.



**SUPERIOR COOLING FINNS**

Copper tubes are mechanically bonded to highly efficient aluminum cooling fins. Die-formed fin collars provide a durable precision fit for maximum heat transfer. Custom fin design forces air to become turbulent and carry heat away more efficiently than old flat fin designs.

**CONSTRUCTION MATERIALS & RATINGS**

Standard Construction Materials		Standard Unit Ratings	
Tubes	Copper	Operating Pressure	150 psig
Fins	Aluminum	Operating Temperature	400 °F
Cabinet & Pipes	Steel	Consult factory for optional materials and ratings.	
Fan Guard	Zinc Plated Steel		
Manifolds	Steel		

note: AIHTI reserves the right to make reasonable design changes without notice.

# ACA Series selection

## Compressed Air

Normally air compressors have airflow rates based upon the horsepower. Rotary Screw compressors normally discharge air at 180 °f - 200 °f, prior to after-cooling. Reciprocating compressors normally discharge air at 250 °f - 275 °f, prior to after-cooling. Compressors are rated in CFM or cubic feet per minute of free air at inlet conditions. For practical purpose we will use sea level at 68 °f and 36% relative humidity as a norm. Altitude, differing ambient conditions with respect to temperature and humidity will all affect heat exchanger performance to a degree. Moisture content in air actually increases the Btu/hr load requirement for cooling air by adding an additional condensing load to the gas load requirement. As air rapidly cools, moisture in the compressed air stream will condense and separate into droplets, the more humidity present the more condensation will occur.

## Sizing

The performance curves provided are for air. However, gases other than air may be applied to this cooler with respect to compatibility by applying a correction factor. Please take time to check the operating specifications thoroughly for material compatibility, pressure, and size before applying an American Industrial heat exchanger into your system.

## Terms

**Approach Temperature** is the desired outlet temperature of the compressed gas minus the inlet ambient air temperature of the external air flowing over the coil.

**SCFM** (Standard Cubic Feet per Minute)

A cubic foot of air at 68 °f, 14.696 psia, & 36% relative humidity, per minute.

**CFM** (Cubic Feet per Minute)

Air at inlet atmospheric conditions.

**ACFM** (Actual Cubic Feet per Minute)

Air at current pressure, temperature, & humidity conditions without reference to a standard.

## To Determine the Heat Load

If the heat load (Btu/hr) is unknown a value can be calculated based upon system operational requirements. To properly calculate the heat load (Btu/hr) to be rejected, several items must be known with certainty (see below).

- Flow rate SCFM (standard cubic feet pr minute)
- Type of gas and its makeup.
- System inlet pressure to the heat exchanger.
- Ambient temperature where the heat exchanger will be located (hottest condition).
- Temperature of the gas at the heat exchanger inlet.
- Temperature of the gas desired at heat exchanger outlet.
- Maximum acceptable pressure loss or cooled gas.

## Using The Chart

American Industrial has created a quick reference chart for selecting ACA heat exchangers for Rotary Screw compressors (see page 214) [This chart offers basic information based upon compressor horsepower and average airflow rates. To properly use the chart, select the compressor horsepower at the left or the air flow rate. Next select the approach to ambient that is desired. Where the two columns intersect is shown the proper ACA model number.]

## Using The Graphs

American Industrial provides performance graphs for ease of model selection. The following calculation examples (page 213), illustrate formulas to determine model selection sizes. It should be noted that there are some assumptions made when applying the basic principles for calculation in the formula. Altitude, humidity, materials, pressures, etc... all contribute to the final selection. Contact American Industrial for more detailed calculation.

## Selection

The selection process is important, many considerations should be made when selecting a heat exchanger. Once the proper Fs requirement is calculated, it is time to apply the data to the graph and make a selection.

1) Find the Flow rate in SCFM located at the bottom of the graph. Follow the graph line up until it matches the calculated Fs from your calculations. If the point falls just above one of the model graphed lines, select the next larger size. If the point is on a line select it as your choice.

2) Check carefully the pressure differential. Units with operating pressures from 70+ psig will have no greater than 2.0 psid within the published flow range. For lower inlet pressure see the pressure drop curves for more detail.

3) Calculate a Nozzle size using the nozzle size calculation to verify your selection has the proper port sizes for your required inlet pressure.

## Formula: Nozzle Calculation

$$\text{Nozzle Size} = \sqrt{\frac{(\text{SCFM} \times 4.512) \times 144}{(270,000 \times d) \cdot .7854}}$$

All numbers in equation are constants except for SCFM and (d) "density".

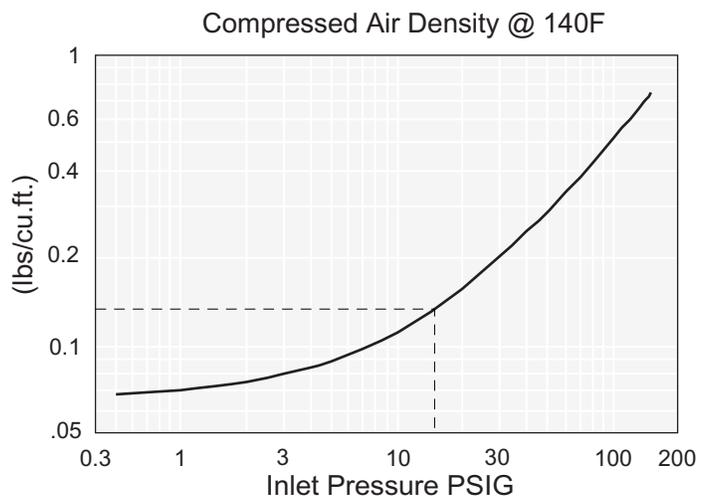
Example:

Flow rate = 200 SCFM

Pressure = 15 psig

Density = (d) from Compressed Air Density Graph

$$\sqrt{\frac{(200 \times 4.512) \times 144}{(270,000 \times .14) \cdot .7854}} = 2.09" \text{ or } (2" \text{ Nozzle})$$



**Examples:** (Note: All air flow rates must be converted to SCFM)

### Application 1 Air Rotary Screw Compressor

Determine the heat load "Q" =Btu/hr

$$Q = [\text{SCFM} \times \text{CF} \times (T_1 - T_2)] \text{ or } [350 \times 1.13 \times 105^\circ] = 41,528 \text{ Btu/hr}$$

T<sub>1</sub> = Inlet gas temperature: 200°F

T<sub>2</sub> = Outlet gas temperature: Ambient + 10°F = (95°F)

T<sub>a</sub> = Ambient temperature: 85°F

Airflow rate: 350 SCFM

PSIG = Operating Pressure 100 psig

CF = Correction factor: 1.13

S = Specific gravity with air being 1.0

C = Specific heat (Btu/Lb °f): .25

Model Selection - ACA-4362

Determine the Fs =  $\frac{\text{Btu/hr}}{T_2 - T_a}$  or  $\frac{41,528}{10} =$

**4,153 Fs** Refer to graph example on page 215

$$\text{CF} = (.0753 \times S \times C \times 60) \text{ or } (.0753 \times 1.0 \times .25 \times 60) = 1.13$$

$$\sqrt{\frac{[(350 \times 4.512) \times 144]}{(270,000 \times .50)}} = 1.46" \text{ or } (1.5" \text{ minimum nozzle})$$

### Application 2 Methane Gas

Determine the heat load "Q" = Btu/hr

$$Q = [\text{SCFM} \times \text{CF} \times (T_1 - T_2)] \text{ or } [500 \times 1.428 \times 210^\circ] = 149,940 \text{ Btu/hr}$$

T<sub>1</sub> = Inlet gas temperature: 300°F

T<sub>2</sub> = Outlet gas temperature: 90°F

T<sub>a</sub> = Ambient temperature: 60°F

Gas flow rate: 500 SCFM

PSIG = Operating pressure: 150 psig

CF = Correction factor: 1.428

S = Specific gravity with air being 1.0: .55

C = Specific heat (Btu/Lb °f)

Model Selection - ACA-6421

Determine the Fs =  $\frac{\text{Btu/hr}}{T_2 - T_a}$  or  $\frac{149,940}{30} =$

**4,998 Fs** Refer to graph example on page 215

$$\text{CF} = (.0753 \times S \times C \times 60) \text{ or } (.0753 \times .55 \times .575 \times 60) = 1.428$$

$$\sqrt{\frac{[(500 \times 4.512) \times 144]}{(270,000 \times .74)}} = 1.44" \text{ or } (1.5" \text{ minimum nozzle})$$

### Application 3 Low Pressure Blower

Determine the heat load "Q" = Btu/hr

$$Q = [\text{SCFM} \times \text{CF} \times (T_1 - T_2)] \text{ or } [76 \times 1.13 \times 150^\circ] = 12,882 \text{ Btu/hr}$$

T<sub>1</sub> = Inlet gas temperature: 250°F

T<sub>2</sub> = Outlet gas temperature: 100°F

T<sub>a</sub> = Ambient temperature: 90°F

CF = Correction Factor: 1.13

PSIG = Operating pressure: 2 psig

Airflow rate: 90 ACFM

S = Specific gravity with air being 1.0

C = Specific heat (Btu/lb °f): .25

ΔP = 5" water column or less (example pg. 220)

Model Selection - ACA-3302

Determine the Fs =  $\frac{\text{Btu/hr}}{T_2 - T_a}$  or  $\frac{12,882}{10} =$

**1,288 Fs** Refer to graph example on page 215

To Convert

$$\text{ACFM to SCFM} = \frac{\text{ACFM} \times (\text{PSIG} + 14.7) \times 528}{(T_1 + 460) \times 14.7} = \frac{90 \times 16.7 \times 528}{710 \times 14.7} = 76 \text{ SCFM}$$

$$\sqrt{\frac{[(76 \times 4.512) \times 144]}{(270,000 \times .075)}} = 1.76" \text{ or } (2.0" \text{ minimum nozzle})$$

**Pressure Drop** (see page 220 for graphs)

Since gas is compressible the density of the gas changes from one temperature or pressure to the next. While the mass flow rate may not change, the pressure differential across the heat exchanger will change dramatically from high (70-125 psig) to low (1-5 psig) pressure. A low pressure condition requires larger carrying lines to move flow than does the same gas rate under a higher pressure. At lower pressures the differential pressure across the heat exchanger can be quite high compared to the same flow rate at a higher pressure. For that reason it is suggested that the pressure differential graphs on page 220 be consulted prior to making your final selection.

The ACA series heat exchanger is designed to be easily modified to accept larger port sizes in the event your system pressure requires larger nozzles. Consult our engineering department for more exacting information regarding pressure differential issues.

# ACA Series selection

## ROTARY SCREW COMPRESSORS (200°F @ 125 PSI & 36% relative humidity)

Compressor Horse Power (HP)	Average Air Discharge Cubic feet per minute (SCFM)	Model Size Selection			
		*Approach Temperature °F ( $T_2 - T_a$ )			
		5°F	10°F	15°F	20°F
15	60	ACA - 3302	ACA - 3242	ACA - 3242	ACA - 3182
20	80	ACA - 3302	ACA - 3242	ACA - 3242	ACA - 3182
30	130	ACA - 3362	ACA - 3302	ACA - 3242	ACA - 3242
40	165	ACA - 3362	ACA - 3302	ACA - 3302	ACA - 3242
60	250	ACA - 4362	ACA - 3362	ACA - 3302	ACA - 3302
75	350	ACA - 6362	ACA - 4362	ACA - 3362	ACA - 3302
100	470	ACA - 6362	ACA - 6362	ACA - 3362	ACA - 3362
125	590	ACA - 6422	ACA - 6362	ACA - 4362	ACA - 3362
150	710	ACA - 6422	ACA - 6362	ACA - 6362	ACA - 4362
200	945	ACA - 6482	ACA - 6422	ACA - 6362	ACA - 6362
250	1160	ACA - 6482	ACA - 6422	ACA - 6362	ACA - 6362
300	1450	ACA - 6542	ACA - 6482	ACA - 6422	ACA - 6362
350	1630	ACA - 6542	ACA - 6482	ACA - 6422	ACA - 6362
400	1830	ACA - 6602	ACA - 6482	ACA - 6422	ACA - 6422
500	2150	ACA - 6602	ACA - 6542	ACA - 6482	ACA - 6422

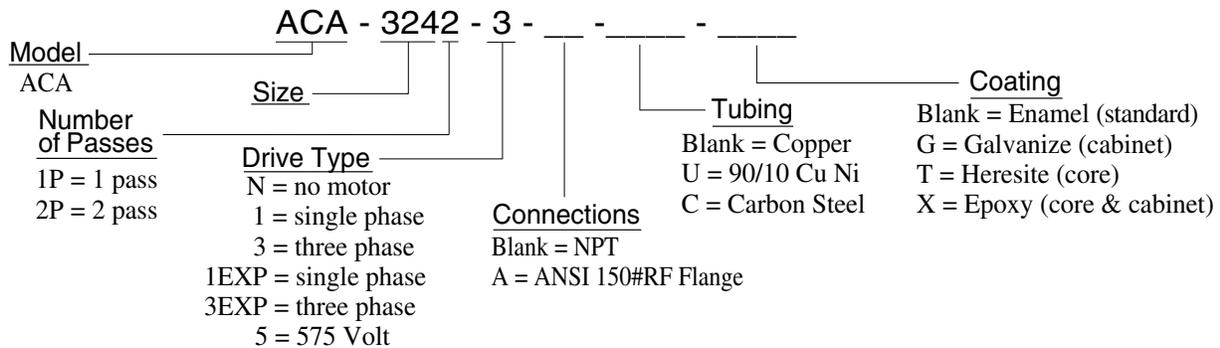
### \*Approach Temperature

the desired outlet temperature of the compressed gas minus the inlet ambient air temperature of the external air flowing over the coil.

$T_2$  - Outlet gas temperature

$T_a$  - Ambient temperature

### Example of a model:



Using the performance graphs (page 215)

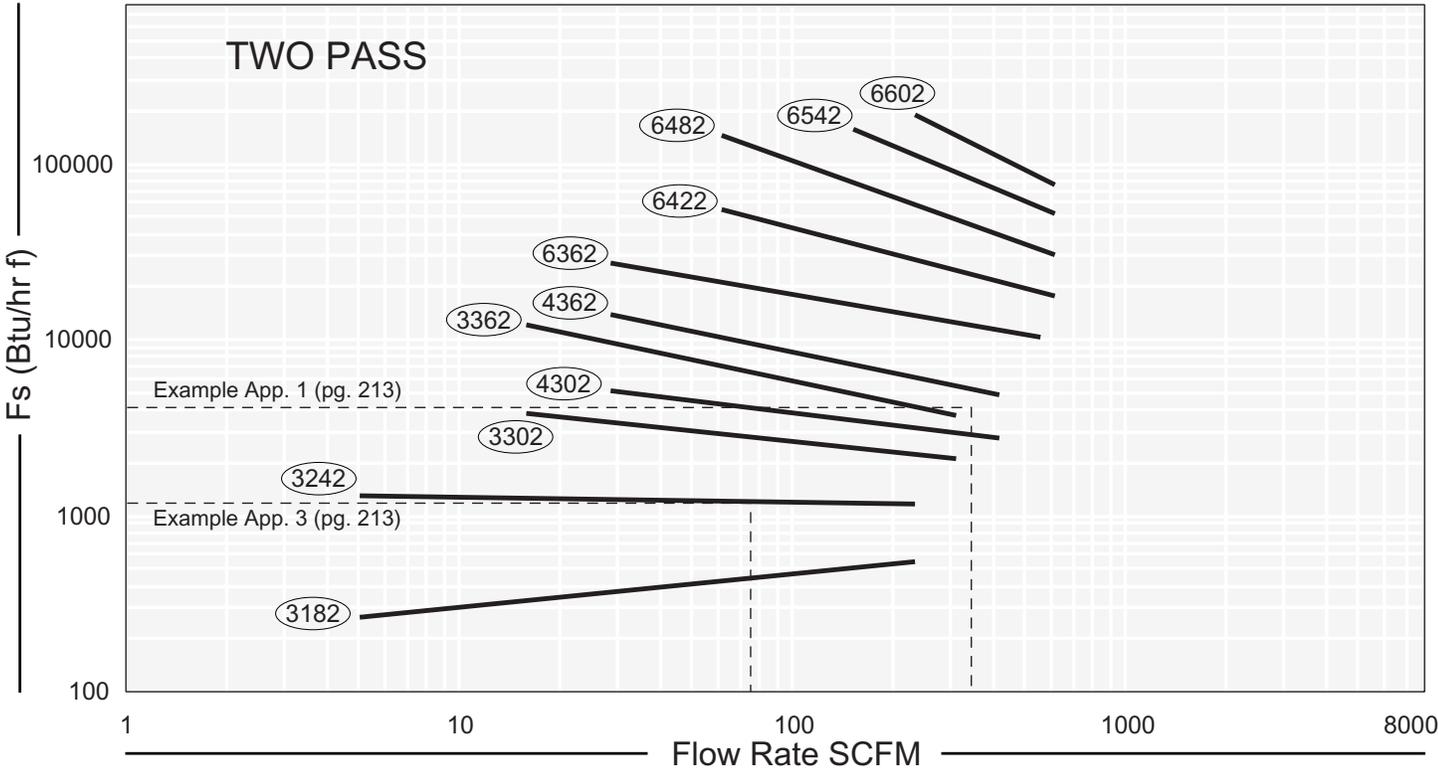
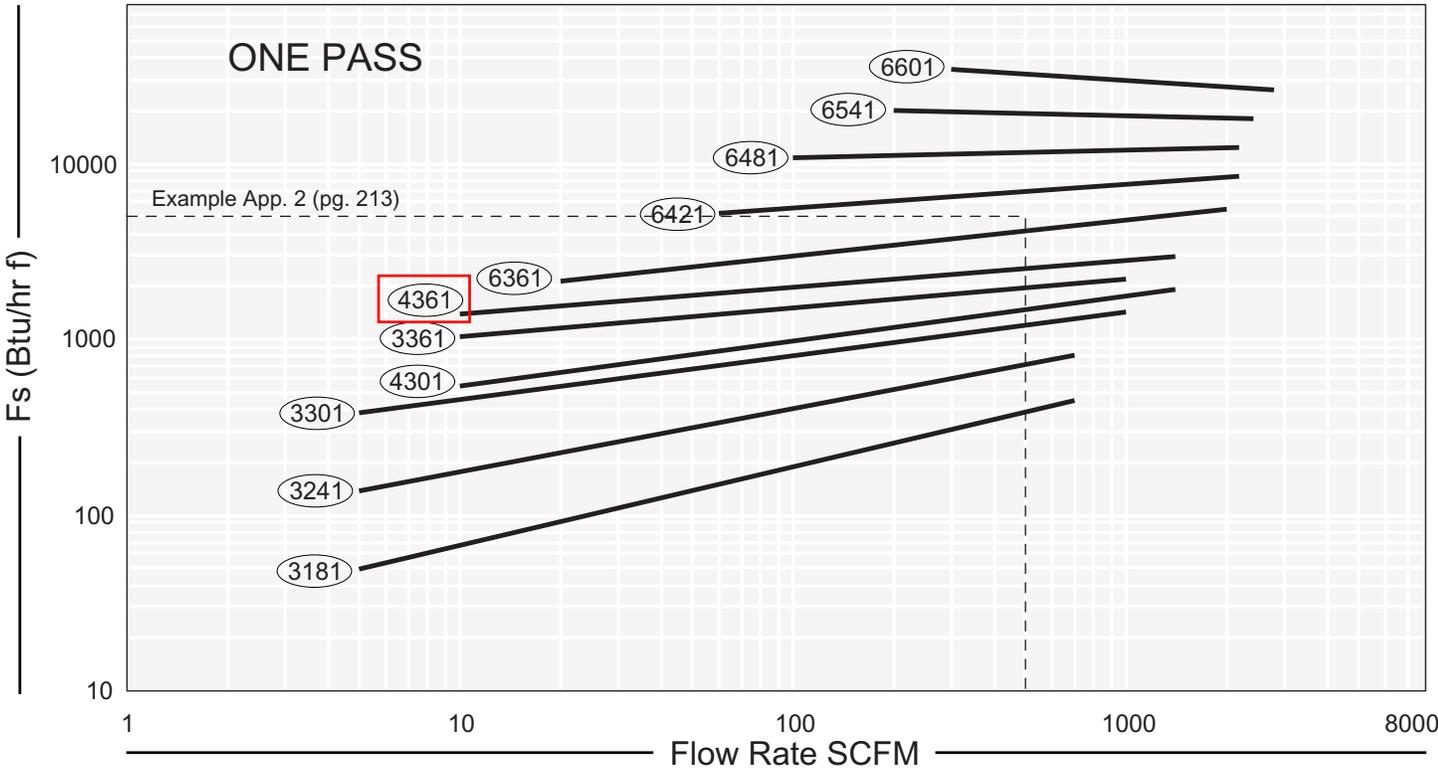
The Flow vs.  $F_s$  graph is calculated based upon SCFM units.

To convert volumetric Actual Cubic Feet per Minute (ACFM) into Standard Cubic Feet per Minute (SCFM) see page 213 application 3.

To select a model, locate the flow rate in SCFM located at the bottom of the graph. Proceed upward on the graph until the SCFM flow rate intersects with the calculated

$F_s$ . The curve closest, on or above the intersection point is the proper selection.

Using the one pass graph or two-pass graph depends upon pressure differential, flow, and performance requirements. The actual surface area for one or two pass units is the same. However, the airflow velocity in the tubes increases with the number of passes giving slightly higher pressure differentials and better cooling performance.



**Example**

Application #3 (p.5)

SCFM = 76

ΔPSI required = 5" H<sub>2</sub>O

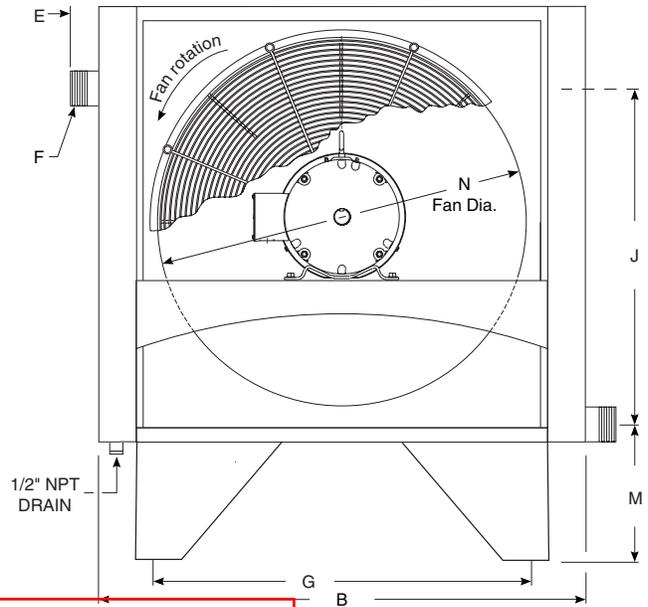
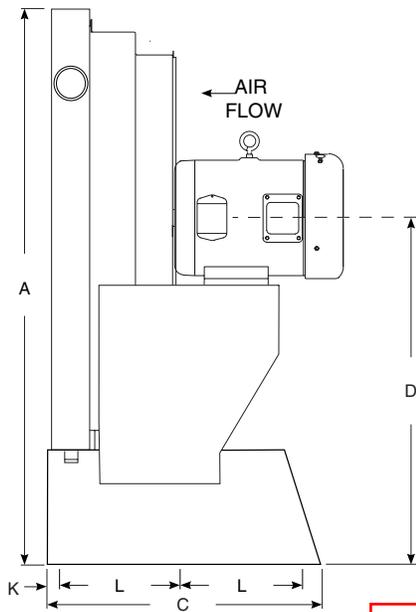
Model selection = ACA-6421-3

$F_s$  = 1,288 Nozzle check (p.4) = 3.10 or 3"NPT

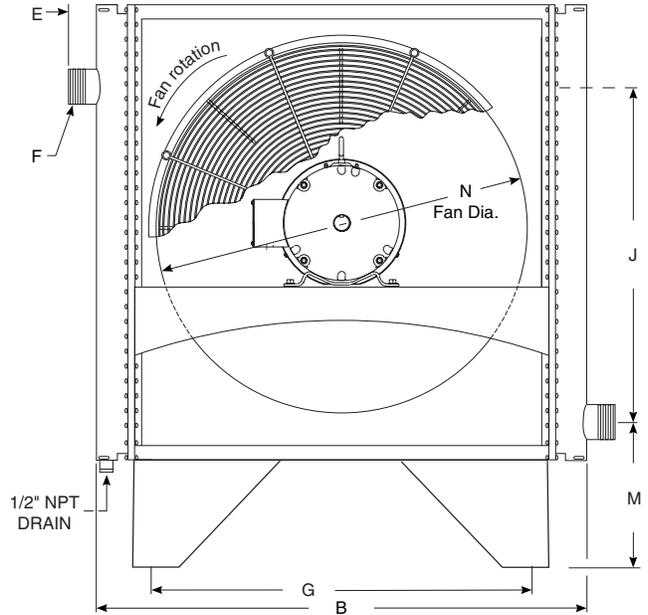
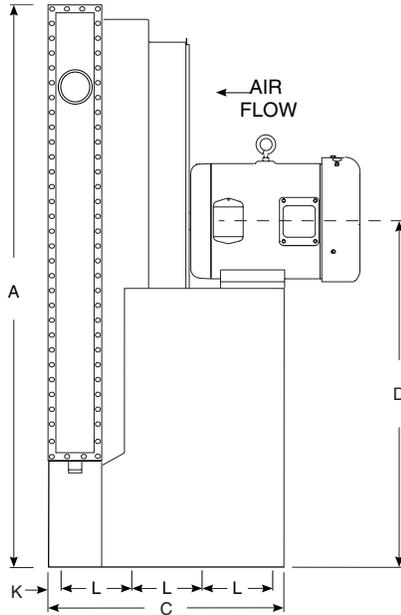
$$F_s = \frac{\text{Heat Load (Btu/hr)}}{\text{Process exiting temperature } (T_2) - \text{Ambient air entering the cooler } (T_a) \text{ from cooler}}$$

note: AIHTI reserves the right to make reasonable design changes without notice.

# ACA Series *dimensions*



ACA - 3181 through ACA - 4361

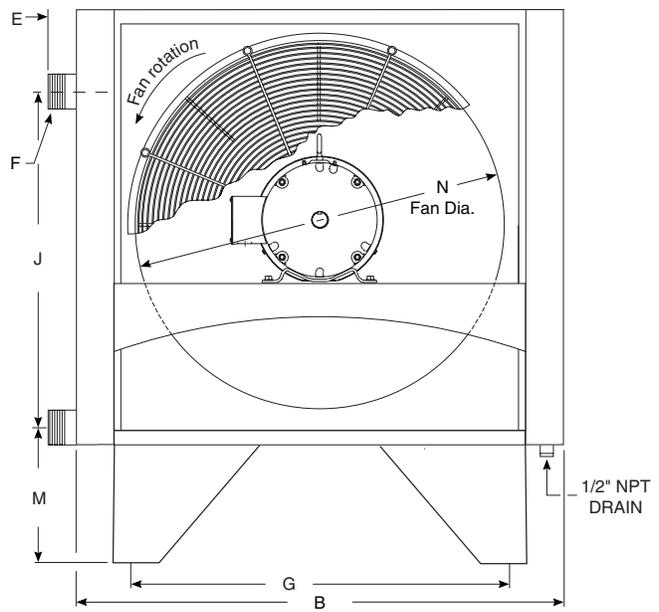
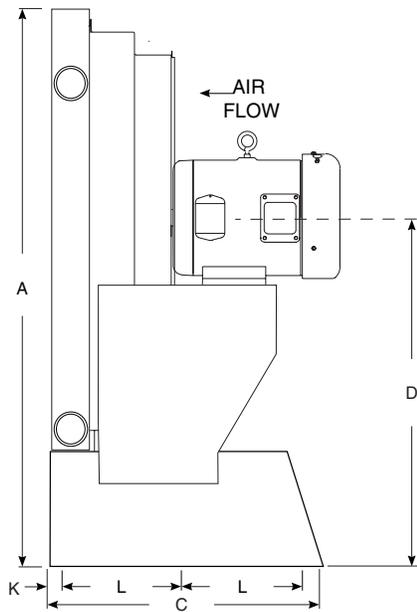


ACA - 6301 through ACA - 6601

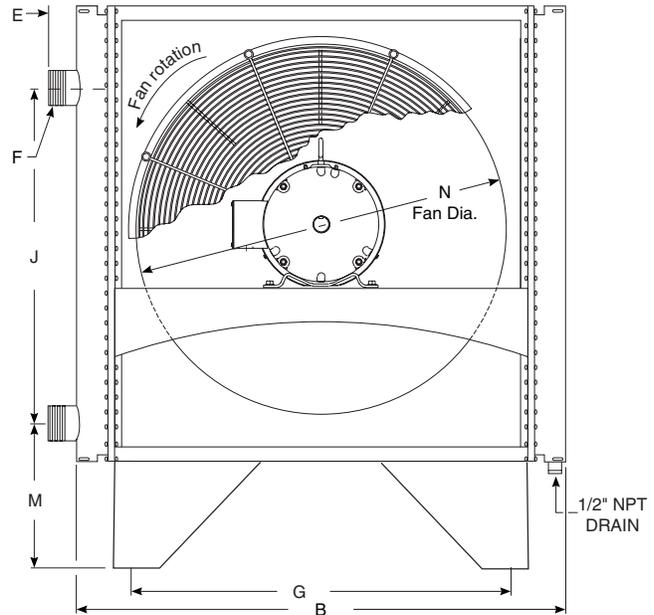
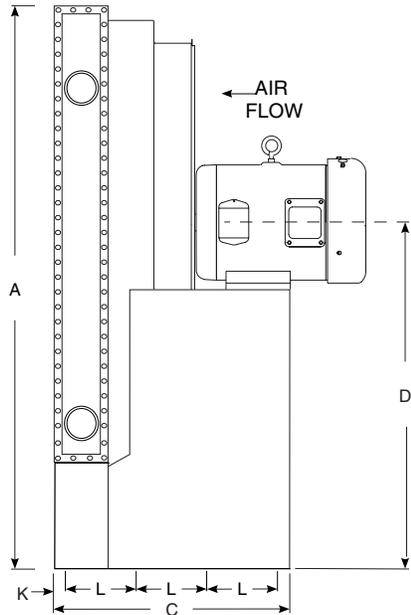
DIMENSIONS (inches)												
Model	A	B	C	D	E	F NPT	G	J	K	L	M	N
ACA - 3181	30.6	23.0	19.8	20.25	2.5	1.5	16.3	12.98	1.5	8.38	11.93	14.0
ACA - 3241	36.6	29.0	19.8	23.25	2.5	1.5	22.3	17.48	1.5	8.38	11.93	22.0
ACA - 3301	42.6	35.0	19.8	26.25	2.5	2.0	28.3	21.75	1.5	8.38	12.15	28.0
ACA - 4301	42.6	36.0	19.8	26.25	2.5	2.5	28.3	21.55	1.5	8.38	12.35	28.0
ACA - 6301	42.6	38.8	19.8	26.25	2.5	3.0	28.3	21.07	1.5	8.38	12.98	28.0
ACA - 3361	48.6	41.0	19.8	29.25	2.5	2.0	34.3	26.25	1.5	8.38	12.15	32.0
ACA - 4361	48.6	42.0	19.8	29.25	2.5	2.5	34.4	26.05	1.5	8.38	12.35	32.0
ACA - 6361	48.5	43.9	19.8	29.25	2.5	3.0	34.3	26.0	1.5	8.38	12.7	32.0
ACA - 6421	54.5	50.8	27.36	32.25	2.5	4.0	40.3	29.4	2.0	6.75	13.3	36.0
ACA - 6481	60.6	56.8	27.36	35.25	2.5	4.0	46.3	34.1	2.0	6.75	13.3	42.0
ACA - 6541	66.6	62.8	28.83	38.25	2.5	4.0	52.3	38.6	2.0	6.75	13.3	48.0
ACA - 6601	72.4	67.9	30.6	41.25	2.5	4.0	58.3	43.05	2.0	6.75	13.3	48.0

note: AIHTI reserves the right to make reasonable design changes without notice.

# ACA Series dimensions



ACA - 3182 through ACA - 4362



ACA - 6302 through ACA - 6602

DIMENSIONS (inches)												
Model	A	B	C	D	E	F NPT	G	J	K	L	M	N
ACA - 3182	30.6	23.0	19.8	20.25	2.5	1.5	16.3	12.98	1.5	8.38	11.93	14.0
ACA - 3242	36.6	29.0	19.8	23.25	2.5	1.5	22.3	17.48	1.5	8.38	11.93	22.0
ACA - 3302	42.6	35.0	19.8	26.25	2.5	2.0	28.3	21.75	1.5	8.38	12.15	28.0
ACA - 4302	42.6	36.0	19.8	26.25	2.5	2.5	28.3	21.55	1.5	8.38	12.35	28.0
ACA - 6302	42.6	38.8	19.8	26.25	2.5	3.0	28.3	21.07	1.5	8.38	12.98	28.0
ACA - 3362	48.6	41.0	19.8	29.25	2.5	2.0	34.3	26.25	1.5	8.38	12.15	32.0
ACA - 4362	48.6	42.0	19.8	29.25	2.5	2.5	34.4	26.05	1.5	8.38	12.35	32.0
ACA - 6362	48.5	43.9	19.8	29.25	2.5	3.0	34.3	26.0	1.5	8.38	12.7	32.0
ACA - 6422	54.5	50.8	27.36	32.25	2.5	4.0	40.3	29.4	2.0	6.75	13.3	36.0
ACA - 6482	60.6	56.8	27.36	35.25	2.5	4.0	46.3	34.1	2.0	6.75	13.3	42.0
ACA - 6542	66.6	62.8	28.83	38.25	2.5	4.0	52.3	38.6	2.0	6.75	13.3	48.0
ACA - 6602	72.4	67.9	30.6	41.25	2.5	4.0	58.3	43.05	2.0	6.75	13.3	48.0

note: AIHTI reserves the right to make reasonable design changes without notice.

# ACA Series motor data

## ELECTRIC MOTOR DATA

Model	Horse Power	Phase	Hz	Volts	RPM	NEMA Frame	Enclosure Type	Full Load Amperes	Service Factor	Thermal Overload
ACA- 3181/2- 1	.25	1	60-50	115/230 - 90/190	1725-1440	48	TEFC	3.2/1.6/2.8-1.4	1.15	NO
ACA- 3181/2 -3	.25	3	60-50	208 - 230/460 - 190/380	1725-1440	48	TEFC	1.3/.65/1.1-.55	1.15	NO
ACA- 3241/2 -1	.25	1	60-50	115/230 - 90/190	1140-950	56	TEFC	6.8/3.1-3.4	1.15	NO
ACA- 3241/2 -3	.25	3	60-50	208 - 230/460 - 190/380	1140-950	56	TEFC	1.7/2.0/1.0	1.15	NO
ACA- 3301/2 -1	.5	1	60-50	115/230 - 90/190	1140-950	56	TEFC	9.6/4.7-4.8/10.4/5.2	1.15	NO
ACA- 3301/2 -3	.5	3	60-50	208 - 230/460 - 190/380	1140-950	56	TEFC	2.4-2.7/1.35-2.5/1.25	1.15	NO
ACA- 4301/2 -1	.5	1	60-50	115/230 - 90/190	1140-950	56	TEFC	9.6/4.7-4.8/10.4/5.2	1.15	NO
ACA- 4301/2 -3	.5	3	60-50	208 - 230/460 - 190/380	1140-950	56	TEFC	2.4-2.7/1.35-2.5/1.25	1.15	NO
ACA- 6301/2 -3	1.0	3	60-50	208 - 230/460 - 190/380	1140-950	56	TEFC	4/2-3.7/1.85	1.15	NO
ACA- 3361/2 -3	1.0	3	60-50	208 - 230/460 - 190/380	1140-950	56	TEFC	4/2-3.7/1.85	1.15	NO
ACA- 4361/2- 3	1.0	3	60-50	208 - 230/460 - 190/380	1140-950	56	TEFC	4/2-3.7/1.85	1.15	NO
ACA- 6361/2 -3	3.0	3	60-50	208 - 230/460 - 190/380	1725-1440	182T	TEFC	8.4-6.8/3.4	1.15	NO
ACA- 6421/2 -3	5.0	3	60-50	208 - 230/460 - 190/380	1140-950	213T	TEFC	8.2-7.6/3.8	1.15	NO
ACA- 6481/2 -3	5.0	3	60-50	208 - 230/460 - 190/380	1140-950	213T	TEFC	14.0/7.0	1.15	NO
ACA- 6541/2 -3	7.5	3	60-50	208 - 230/460 - 190/380	1140-950	254T	TEFC	20.4/10.2	1.15	NO
ACA- 6601/2 -3	10	3	60-50	208 - 230/460 - 190/380	1140-950	256T	TEFC	28.0/14.0	1.15	NO

### ELECTRIC MOTOR NOTES:

- 1) Motor electrical ratings are an approximate guide and may vary between motor manufacturers. Consult ratings on motor data plate prior to installation and operation.
- 2) Explosion proof, high temperature, severe duty, chemical, IEC, Canadian Standards Association, and Underwriters Laboratory recognized motors are available upon request.
- 3) American Industrial reserves the right to enact changes to motor brand, type and ratings regarding horsepower, RPM,FLA,and service factor for standard products without notice. All specific requirements will be honored without change.
- 4) Fan rotation is clockwise when facing the motor shaft.
- 5) The above motors contain factory lubricated shielded ball bearings (no additional lubrication is required).
- 6) **Abbreviation Index**  
 TEFC.....Totally Enclosed, Fan Cooled  
 EXP.....Explosion Proof

### CLASS I, DIV.1, GROUP D or CLASS II, DIV.2, GROUP F & G EXPLOSION PROOF MOTOR DATA

Model	Horse Power	Phase	Hz	Volts	RPM	NEMA Frame	Enclosure Type	Full Load Amperes	Service Factor	Thermal Overload
ACA- 3181/2 -1	.25	1	60	115/230	1725	48	EXP	5.8/2.8	1.0	YES
ACA- 3181/2 -3	.25	3	60	208-230/460	1725	48	EXP	1.4-1.3/.65	1.0	YES
ACA- 3241/2 -3	.33	1	60	115/230	1140	56	EXP	7.8/3.5	1.0	YES
ACA- 3241/2 -1	.33	3	60	208-230/460	1140	56	EXP	1.18-1.6/8	1.0	YES
ACA- 3301/2 -3	.75	1	60	115/230	1140	56	EXP	9.4/4.8	1.0	YES
ACA- 3301/2 -1	.75	3	60	208-230/460	1140	56	EXP	2.5-2.4/1.2	1.0	YES
ACA- 4301/2 -3	.75	1	60	115/230	1140	56	EXP	9.4/4.8	1.0	YES
ACA- 4301/2 -1	.75	3	60	208-230/460	1140	56	EXP	2.5-2.4/1.2	1.0	YES
ACA- 6301/2 -1	1.0	3	60	230/460	1140	56	EXP	3.8/1.9	1.0	YES
ACA- 3361/2 -3	1.0	3	60	230/460	1140	56	EXP	3.8/1.9	1.0	YES
ACA- 4361/2 -3	1.0	3	60	230/460	1140	56	EXP	3.8/1.9	1.15	YES
ACA- 6361/2 -3	3	3	60	230/460	1725	182	EXP	8.8/4.4	1.15	YES
ACA- 6421/2 -3	5	3	60	230/460	1160	215	EXP	15.0-13.8/6.9	1.15	YES
ACA- 6481/2 -3	5	3	60	230/460	1160	215	EXP	15.0-13.8/6.9	1.15	YES
ACA- 6541/2 -3	7.5	3	60	230/460	1160	256	EXP	21.6-20.4/10.2	1.15	YES
ACA- 6601/2 -3	10	3	60	230/460	1160	256	EXP	29-26/13	1.15	YES

NOTE: Basic electric drive units are supplied with one of the corresponding above listed motors.

## 575 VOLT ELECTRIC MOTOR DATA

Model	Horse Power	Phase	Hz	Volts	RPM	NEMA Frame	Enclosure Type	Full Load Amperes	Service Factor	Thermal Overload
ACA-3181/2 -5	1/3	3	60	575	1725	56	TEFC	.52 .56	1.15	NO
ACA-3241/2 -5	1/3	3	60	575	1140	56	TEFC	.52 .56	1.15	NO
ACA-3301/2 -5	1/2	3	60	575	1140	56	TEFC	1.08	1.15	NO
ACA-4301/2 -5	1/2	3	60	575	1140	56	TEFC	1.08	1.15	NO
ACA-6301/2 -5	1	3	60	575	1140	56	TEFC	1.6	1.15	NO
ACA-3361/2 -5	1	3	60	575	1140	56	TEFC	1.6	1.15	NO
ACA-4361/2 -5	1	3	60	575	1140	56	TEFC	1.6	1.15	NO
ACA-6361/2 -5	3	3	60	575	1725	182T	TEFC	3.3	1.15	NO
ACA-6421/2 -5	5	3	60	575	1140	213T	TEFC	5.9	1.15	NO
ACA-6481/2 -5	5	3	60	575	1140	213T	TEFC	5.9	1.15	NO
ACA-6541/2 -5	7.5	3	60	575	1140	254T	TEFC	8.0	1.15	NO
ACA-6601/2 -5	10	3	60	575	1140	256T	TEFC	10.5	1.15	NO

## COMMON DATA

Model	Air Flow		Sound Level dB(A) @ 7ft	Weight		Serviceable Core
	CFM	m³/s		w/ motor	w/o motor	
ACA-3181/2	1550	0.731	72	131	111	NO
ACA-3241/2	2900	1.36	76	154	134	NO
ACA-3301/2	4450	2.10	76	184	160	NO
ACA-4301/2	4450	2.10	76	211	187	NO
ACA-6301/2	4450	2.10	76	343	305	YES
ACA-3361/2	6350	2.99	79	243	205	NO
ACA-4361/2	6350	2.99	79	289	251	NO
ACA-6361/2	10500	4.95	91	402	342	YES
ACA-6421/2	14300	6.75	87	636	443	YES
ACA-6481/2	18700	8.82	88	753	560	YES
ACA-6541/2	23350	11.02	91	938	691	YES
ACA-6601/2	29300	13.83	91	1104	835	YES

### NOTES:

TEFC = Totally Enclosed, Fan Cooled

To estimate the sound level at distances other than 7 feet (2.1 meters) from the cooler, add 6 db for each halving of distance, or subtract 6 db for each doubling of the distance.

### Example:

The Sound Level of the ACA-3181/2 is 72 dB at 7ft. At 3.5ft (7ft x 0.5 = 3.5ft) the sound level is 66 dB (72dB - 6dB = 66dB). At 14ft (7ft x 2 = 14ft) the sound level is 78dB (72dB + 6dB = 78dB).

### Pressure Drop Graphs (see page 220)

Each graph represents a specific pressure drop at differing flow rates and inlet pressures. The four graphs for each model series size represents the more popular milestone pressure differentials commonly applied.

To use the graphs for selection purposes follow the steps below.

- 1) Locate the operating pressure at the bottom of the desired pressure drop chart.
- 2) Locate the flow rate in SCFM at the left end of the chart.
- 3) Follow the "Pressure" line vertically and the "Flow" line horizontally until they cross, note the location.
- 4) The curve on, or closest above will be exact or less pressure drop than requested and suitable for the application.
- 5) There may be several units shown above the intersection point, all of which will produce less than the desired pressure drop at the required flow.

### Example: Application 3 Low Pressure Blower

Flow = 76 SCFM

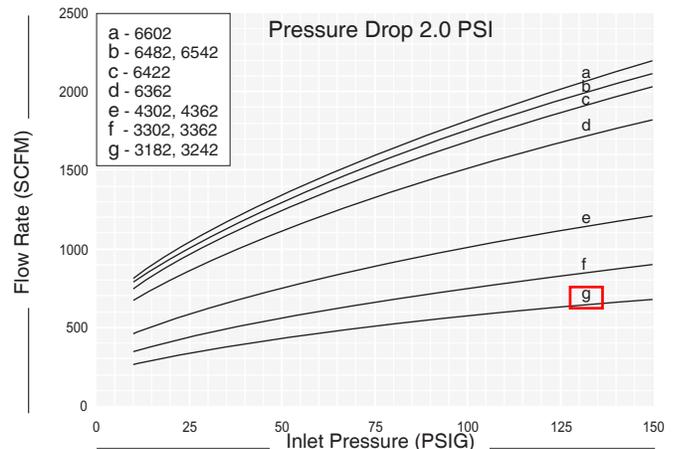
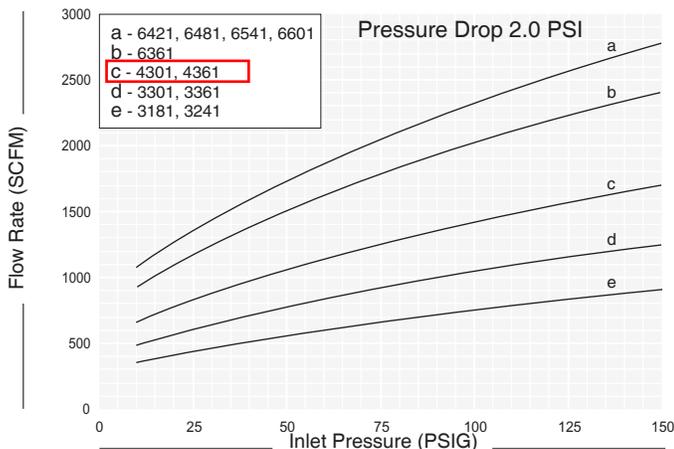
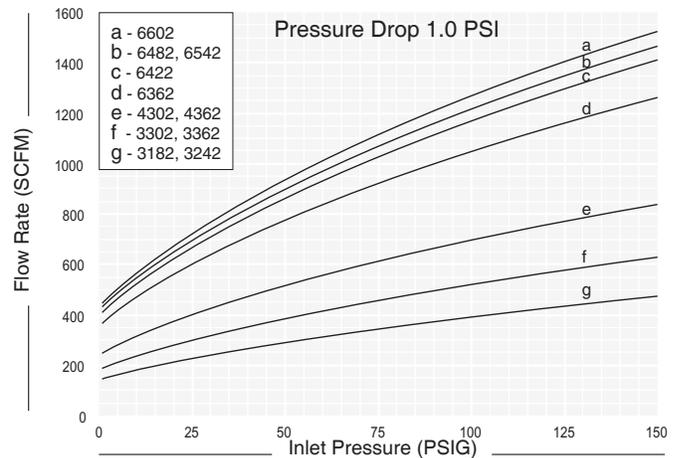
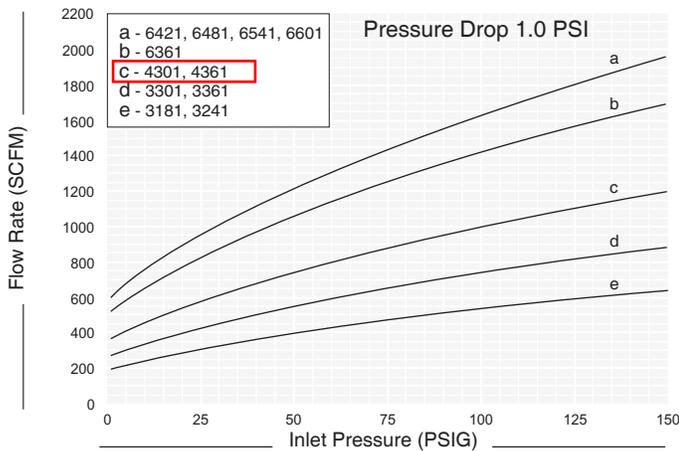
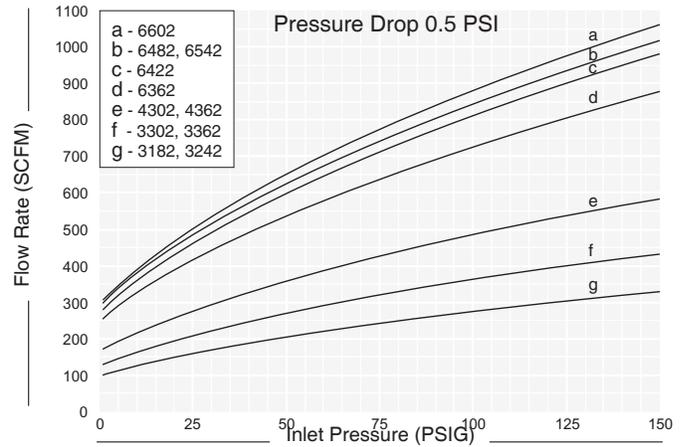
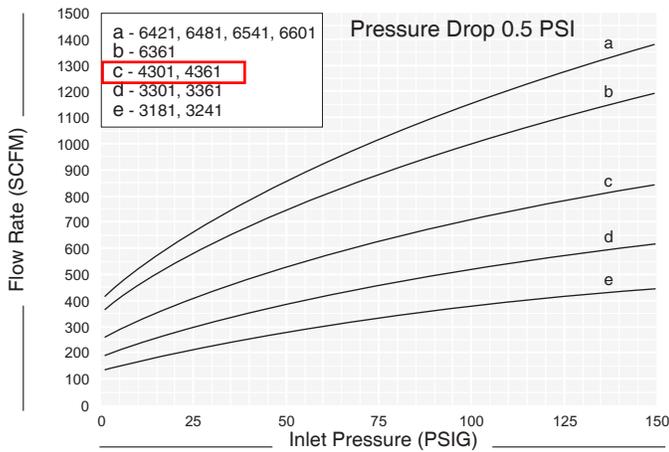
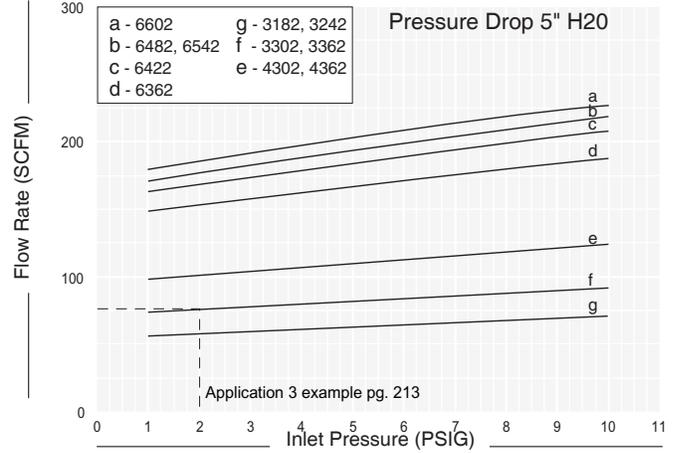
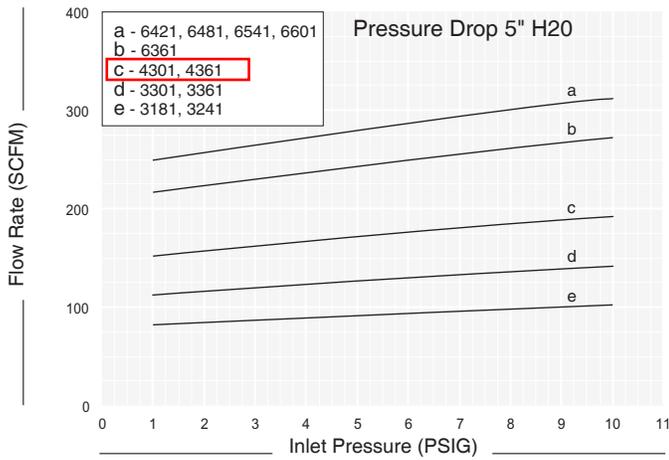
Operating pressure = 2 PSIG

Initial selection from graph page 215 = ACA-3302

Desired pressure drop = 5" H2O or less. (USE the "Pressure Drop 5" H2O" curves page 220)

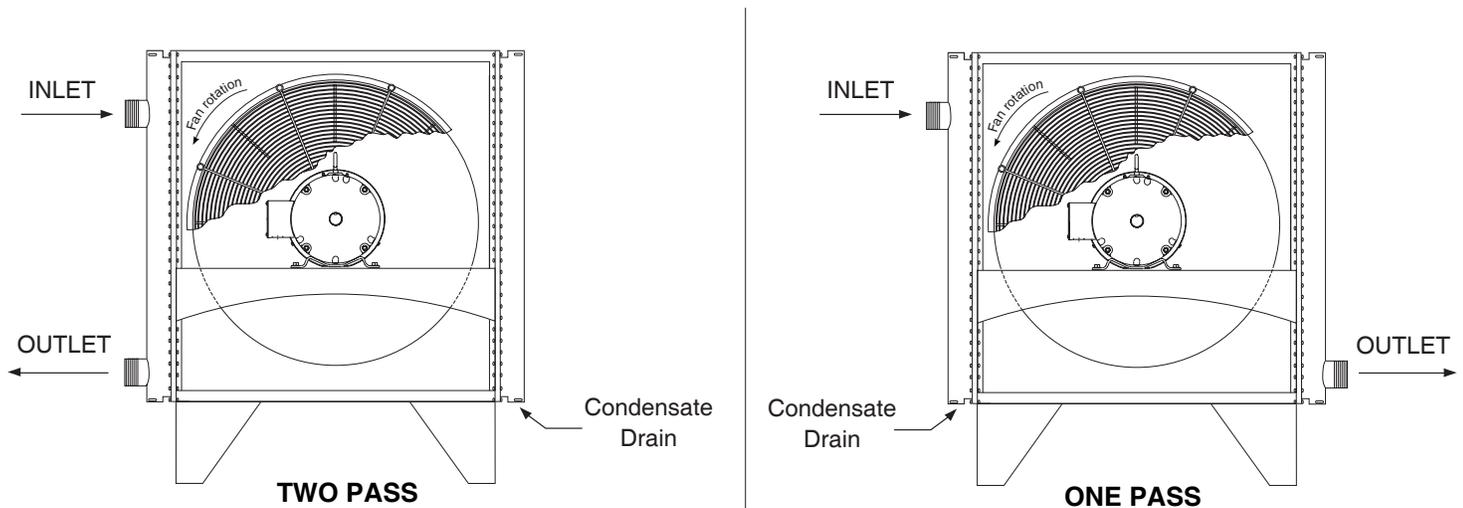
From the pressure drop graph, page 220. Acceptable choice - ACA-3302 is on the line, ACA-3242 is well below the line. The ACA-3302 meets the pressure drop requirement, but exceeds the capacity requirement. However, even though the ACA-3242 exceeds 5" of water pressure drop, other considerations should be made prior to selection such as unit physical size, cost, availability, and port size.

# ACA Series pressure drop graphs



note: AIHTI reserves the right to make reasonable design changes without notice.

## PIPING HOOK UP



### Receiving:

a) Inspect unit for any shipping damage before uncrating. Indicate all damages to the trucking firms' delivery person and mark it on the receiving bill before accepting the freight. Make sure that the core and fan are not damaged. Rotate the fan blade to make sure that it moves freely. The published weight information located in this brochure is approximate. True shipment weights are determined at the time of shipping and may vary. Approximate weight information published herein is for engineering approximation purposes and should not be used for exact shipping weight. *Since the warranty is based upon the unit date code located on the model identification tag, removal or manipulation of the identification tag will void the manufacturers warranty.*

b) When handling the ACA heat exchanger, special care should be taken to avoid damage to the core and fan. All units are shipped with wood skids for easy forklift handling

c) Standard Enamel Coating: American Industrial provides its standard products with a normal base coat of oil base air cure enamel paint. The enamel paint is applied as a temporary protective and esthetic coating prior to shipment. While the standard enamel coating is durable, American Industrial does not warrant it as a long-term finish coating. It is strongly suggested that a more durable final coating be applied after installation or prior to long-term storage in a corrosive environment to cover any accidental scratches, enhance esthetics, and further prevent corrosion. It is the responsibility of the customer to provide regular maintenance against chips, scratches, etc... and regular touch up maintenance must be provided for long-term benefits and corrosion prevention.

### Installation:

a) American Industrial recommends that the equipment supplied should be installed by qualified personal who have solid understanding of system design, pressure and temperature ratings, and piping assembly. Verify the service conditions of the system prior to applying any ACA series cooler. If the system pressure or temperature does not fall within the parameters on ACA rat-

ing tag located on the heat exchanger, contact our factory prior to installation or operation.

b) In order for the heat exchanger to properly function, installation should be made with minimum airflow obstruction distance of not less than twenty (20) inches on both fan intake and exiting side of the heat exchanger.

c) Process piping should be as indicated above with the process flow entering into the upper port and exiting out the lower port (see illustration). This configuration will allow for condensate moisture to drain completely from the equipment. It is recommended that an air separator or automatic drip leg be applied to the outlet side of the heat exchanger to trap any moisture that develops.

d) Flow line sizes should be sized to handle the appropriate flow to meet the system pressure drop requirements. If the nozzle size of the heat exchanger is smaller than the process line size an increased pressure differential at the heat exchanger may occur.

e) ACA series coolers are produced with both brazed ACA-3181 through ACA-4362, and serviceable core® ACA-6301 through ACA-6602 style coils. A brazed construction coil does not allow internal tube access. A serviceable core® will allow full accessibility to the internal tubes for cleaning and maintenance. ACA series coolers are rated for 150 PSIG working pressure, and a 400°f working temperature.

f) Special Coatings: American Industrial offers as customer options, Air-Dry Epoxy, and Heresite (Air-Dry Phenolic) coatings at additional cost. American Industrial offers special coatings upon request, however American Industrial does not warrant coatings to be a permanent solution for any equipment against corrosion. It is the responsibility of the customer to provide regular maintenance against chips, scratches, etc... and regular touch up maintenance must be provided for long-term benefits and corrosion prevention.

# ACA Series *installation & maintenance*

g) Electric motors should be connected only to supply source of the same characteristics as indicated on the electric motor information plate. Prior to starting, verify that the motor and fan spin freely without obstruction. Check carefully that the fan turns in the correct rotation direction normally counter clockwise from the motor side (fan direction arrow). Failure to operate the fan in the proper direction could reduce performance or cause serious damage to the heat exchanger or other components. Fan blades should be rechecked for tightness after the first 100 hours of operation.

## Maintenance

Regular maintenance intervals based upon the surrounding and operational conditions should be maintained to verify equipment performance and to prevent premature component failure. Since some of the components such as, motors, fans, load adapters, etc... are not manufactured by American Industrial maintenance requirements provided by the manufacture must be followed.

a) Inspect the entire heat exchanger and motor/fan assembly for loosened bolts, loose connections, broken components, rust spots, corrosion, fin/coil clogging, or external leakage. Make immediate repairs to all affected areas prior to restarting and operating the heat exchanger or its components.

b) Heat exchangers operating in oily or dusty environments will often need to have the coil cooling fins cleaned. Oily or clogged fins should be cleaned by carefully brushing the fins and tubes with water or a non-aggressive degreasing agent mixture (Note: Cleaning agents that are not compatible with copper, brass, aluminum, steel or stainless steel should not be used). A compressed air or a water stream can be used to dislodge dirt and clean the coil further. Any external dirt or oil on the electric motor and fan assembly should be removed. Caution: Be sure to disconnect the electric motor from its power source prior to doing any maintenance.

c) In most cases it is not necessary to internally flush the coil. In circumstances where the coil has become plugged or has a substantial buildup of material, flushing the coil with water or a solvent may be done. Flushing solvents should be non-aggressive suitable for the materials of construction. Serviceable Core® models can be disassembled and inspected or cleaned if required.

d) Most low horsepower electric motors do not require any additional lubrication. However, larger motors must be lubricated with good quality grease as specified by the manufacture at least once every 6-9 months or as directed by the manufacture. T.E.F.C. air ventilation slots should be inspected and cleaned regularly to prevent clogging and starving the motor of cooling air. To maintain the electric motor properly see the manufactures requirements and specifications.

e) Fan blades should be cleaned and inspected for tightness during the regular maintenance schedule when handling a fan blade care must be given to avoid bending or striking any of the blades. Fan blades are factory balanced and will not operate properly if damaged or unbalanced. Damaged fan blades can cause excessive vibration and severe damage to the heat exchanger or drive motor.

Replace any damaged fan with an American industrial suggested replacement.

f) ACA heat exchanger cabinets are constructed using 7ga. through 18ga. steel that may be bent back into position if damaged. Parts that are not repairable can be purchased through American Industrial.

g) Coil fins that become flattened can be combed back into position. This process may require removal of the coil from the cabinet.

h) It is not advisable to attempt repairs to brazed joints of a brazed construction coil unless it will be done by an expert in silver solder brazing. Brazed coils are heated uniformly during the original manufacturing process to prevent weak zones from occurring. Uncontrolled reheating of the coil may result in weakening of the tube joints surrounding the repair area. In many instances brazed units that are repaired will not hold up as well to the rigors of the system as will a new coil. American Industrial will not warranty or be responsible for any repairs done by unauthorized sources. Manipulation in any way other than normal application will void the manufactures warranty.

i) Units containing a Serviceable Core® have bolted manifold covers that can be removed for cleaning or repair purposes.

## Service Sequence

American Industrial has gone to great lengths to provide components that are repairable. If the ACA unit requires internal cleaning or attention the following steps will explain what must be done to access the internal tubes. Be sure to order gasket kits or repair parts prior to removal and disassembly to minimize down time.

a) To clean the internal tubes first remove all connection pipes from the unit.

b) Be sure the unit is drained of all water etc...

c) Place the ACA unit in an area that it can be accessed from all sides.

d) Remove the manifold cover bolts and hardware and place them into a secure place.

e) The manifold covers are tightly compressed and may need some prying to separate them from the gasket, physically remove the cover assemblies from both sides.

f) The tubes are now accessible for cleaning. We suggest a mild water-soluble degreaser be used with a brush. Tubing I.D. is .325 a plastic bristle brush on a rod will work best for cleaning the tubes. Steel brushes should be avoided since the steel is harder than the copper tubing and may heavily score the tubes if used.

g) If there are any leaking tubes you may plug them by forcing a soft metal plug into the hole and tapping it tight. You may in some cases weld the leaking tube shut however, care should be taken since excessive heat may cause surrounding tube joints to loosen and leak.

**PROCESS INSTRUMENTATION  
I/O MANUALS**



**Process Technology  
Support, LLC**

*Serving The Environmental Remediation Industry*

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**BLANK SHEET**

Capacity curves are for water at +70°F. Most other media can be converted to equivalent GPM water at +70°F by the use of an appropriate formula with the following constants:

### Constants:

1.0 GPM water at +70°F is approximately equal to:

Air ( $C_a$ ) = 3.8 SCFM AT 0 PSIG & +70°F.

Steam ( $C_s$ ) = 12.25 PPH at 0 PSIG saturated (+212°F).

Gas ( $C_g$ ) =  $\frac{3.8}{\sqrt{S_g}}$  SCFM at 0 PSIG & +70°F.

### Legend:

$Q_1$  = given quantity of fluid.

$Q_2$  = sizing quantity equivalent GPM +70°F water.

$F_{pa}$  = pressure correction factor for air.

$F_{ta}$  = temperature correction factor for air.

$F_{ps}$  = pressure correction factor for steam.

SCFM = a cubic foot of air at 14.7 PSIA and +70°F.

PPH = pounds per hour.

$S_g$  = specific gravity of gas relative to air.

### 1. Water

Read directly from capacity curves which are designed to read GPM water at +70°F. For other temperatures see correction factors sheet 606.

### 2. Air

To find the equivalent GPM water at +70°F use the following formula:

$$Q_2 = \frac{Q_1}{C_a} \times F_{pa} \times F_{ta}$$

Example: 500 SCFM Air at 100 psig and +150°F.

$$Q_2 = \frac{500}{3.8} \times .36 \times 1.07 = 50.7 \text{ GPM}$$

Solution: Use 2"-685 to read 12.5" Δ P.

### 3. Saturated Steam

Use the following formula:

$$Q_2 = \frac{Q_1}{C_s} \times F_{ps}$$

Example: 5000 PPH at 100 psig

$$Q_2 = \frac{5000}{12.25} \times .38 = 155 \text{ GPM}$$

Solution: Use 4"-555 to read 23" Δ P.

### 4. Other Liquids

Use the following formula:

$$Q_2 = Q_1 \sqrt{S_g}$$

Example:

100 GPM, Specific gravity 1.21, viscosity 1.0 Centistokes

$$Q_2 = Q_1 \sqrt{S_g}$$

$$Q_2 = 100 \times 1.1 = 110 \text{ GPM}$$

Solution: Use 3"-623 to read 33" Δ P.

Note: For viscous fluids, consult factory.

### 5. Gas

Use the following formula:

$$Q_2 = \frac{Q_1}{C_g} \times F_{pa} \times F_{ta}$$

Example: 24,000 SCFM natural gas with specific gravity of 0.6 and measured at 15 psig and +70°F.

$$Q_2 = 24,000 \div \frac{3.8}{\sqrt{0.6}} \times .70 \times 1.0 = 3424 \text{ GPM}$$

Solution: Use 16"-721 to read 24" Δ P.

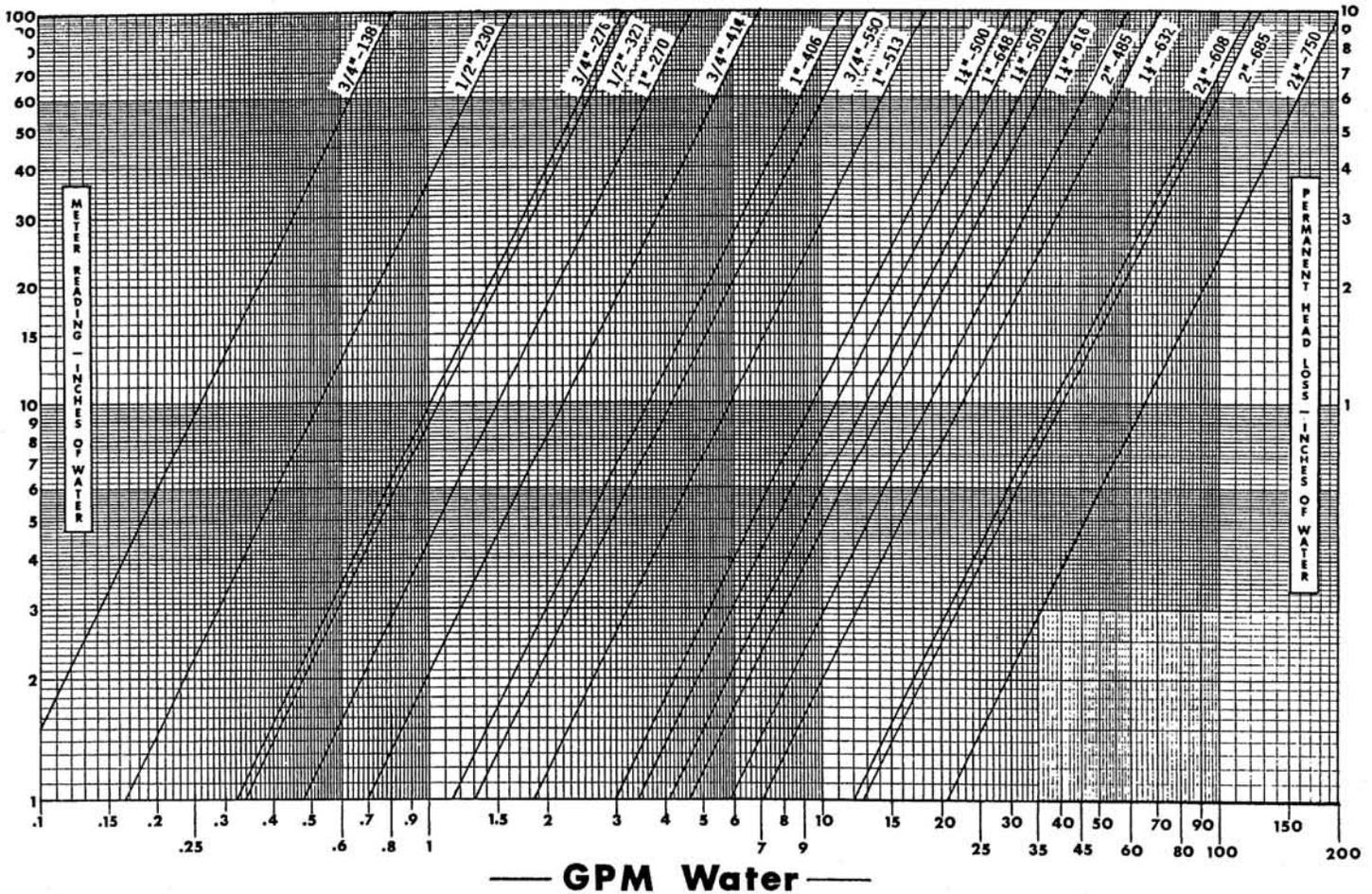
SVE FLOW  
VENTURI I/O

Temperature		Pressure		
Deg. F	Air/Gas Temp. $F_{ta}$	PSIG	Air/Gas Press. $F_{pa}$	Sat. Steam Press. $F_{ps}$
0	0.932	0	1.000	1.000
2	0.933	2	.938	.934
4	0.936	4	.886	.887
6	0.938	6	.843	.846
8	0.940	8	.805	.811
10	0.942	10	.771	.780
12	0.944	12	.742	.752
14	0.946	14	.716	.727
16	0.948	16	.692	.705
18	0.950	18	.670	.685
20	0.952	20	.651	.666
25	0.956	25	.608	.626
30	0.961	30	.573	.592
35	0.966	35	.544	.564
40	0.971	40	.518	.539
50	0.981	50	.477	.498
60	0.990	60	.443	.466
70	1.000	70	.416	.439
80	1.009	80	.394	.416
90	1.019	90	.375	.397
100	1.028	100	.358	.380
120	1.046	120	.330	.352
140	1.064	140	.308	.331
160	1.081	160	.290	.312
180	1.099	180	.275	.296
200	1.116	200	.261	.282
225	1.137	225	.247	.267
250	1.157	250	.235	.255
275	1.177	275	.225	.244
300	1.197	300	.216	.234
325	1.217	325	.208	.226
350	1.236	350	.201	.218
375	1.255	375	.194	.211
400	1.274	400	.188	.204
425	1.292	425	.183	.198
450	1.310	450	.178	.193
475	1.328	475	.173	.188
500	1.346	500	.169	.183

## GERAND ENGINEERING CO.

4903 SOUTH CEDAR LAKE ROAD • MINNEAPOLIS, MN 55416 USA • PHONE: (612) 374-1320 FAX: (612) 374-1758

# GERAND VENTURIS 1/2" thru 2 1/2" Threaded



**INSTALLATION INSTRUCTIONS**

\*MINIMUM PIPE DIAMETERS FROM FITTING OR VALVE

**STYLE VS**

Brass - Screwed - 1/2" - 2"; Steel - Screwed - 2 1/2"  
Accuracy - ±1%

SIZE	A	SIZE	A
1/2"-230	2 3/4"	1 1/4"-500	4"
1/2"-327	2 3/4"	1 1/4"-616	3 3/4"
3/4"-138	3"	1 1/2"-505	4 1/4"
3/4"-276	3"	1 1/2"-632	4"
3/4"-414	3"	2"-485	5"
3/4"-550	3"	2"-685	4 1/4"
1"-270	3 3/4"	2 1/2"-608	5 1/2"
1"-406	3 3/4"	2 1/2"-750	5 1/4"
1"-513	3 3/4"		
1"-648	3 3/4"		

**STANDARD RATING OF SYSTEM**  
250 PSI AND 250°F WATER.

**SPECIAL OPTIONS AVAILABLE**

ALL SIZES AVAILABLE IN THE FOLLOWING MATERIALS  
 STEEL • STAINLESS STEEL • ALUMINUM • PVC  
 TEFLON • NYLON • MONEL • INCONEL

CONSULT FACTORY FOR HIGH TEMPERATURE & HIGH PRESSURE UNITS

## **BLUE DIVIDER SHEET**

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## SVE Leg Venturi Conversions

### Venturi Data

Model 505  
 connections 1.5" fnpt  
 fullscale dp(" w.c.) 100  
 fullscale flow(gpm) 41

### Magnehelic Flow Indicator Calibration

**@ fullscale DP = 10.3" w.c., flowrate = 50 scfm**

**Note: Scale calibration based on std. conditions**

**P = 14.73 psia: T = 70 deg F**

### Assumed Standard Conditions

P std (psia) 14.73  
 T std ( deg F) 70

### Assumed Atmospheric Pressure

P atm  
 @ 5,880 ft (psia) 11.82

Equiv. Flow (gpm)	Diff. Press. ("w.c.)	Operating Parameters & Conversion Factors	SCFM (uncorr.)	SCFM (corrected for actual P & T)						
				0	-20	-40	-60	-80	-100	-120
		P act(" w.c.g)	0	0	-20	-40	-60	-80	-100	-120
		Pact (psia)	14.73	11.82	11.10	10.38	9.66	8.94	8.21	7.49
		T act (deg F)	70	60	60	60	60	60	60	60
		Fpa	1.0	1.116	1.152	1.191	1.235	1.284	1.339	1.402
		Fta	1.0	0.991	0.991	0.991	0.991	0.991	0.991	0.991
0.0	0.0		0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.3	0.1		5	4.5	4.4	4.2	4.1	3.9	3.8	3.6
2.6	0.4		10	9.0	8.8	8.5	8.2	7.9	7.5	7.2
3.9	0.9		15	13.6	13.1	12.7	12.3	11.8	11.3	10.8
5.3	1.6		20	18.1	17.5	16.9	16.3	15.7	15.1	14.4
6.6	2.6		25	22.6	21.9	21.2	20.4	19.7	18.8	18.0
7.9	3.7		30	27.1	26.3	25.4	24.5	23.6	22.6	21.6
9.2	5.0		35	31.7	30.7	29.7	28.6	27.5	26.4	25.2
10.5	6.6		40	36.2	35.1	33.9	32.7	31.5	30.2	28.8
11.8	8.3		45	40.7	39.4	38.1	36.8	35.4	33.9	32.4
13.2	10.3		50	45.2	43.8	42.4	40.9	39.3	37.7	36.0
14.5	12.5		55	49.7	48.2	46.6	45.0	43.2	41.5	39.6

### Notes:

1. SCFM value based on 14.73 pisa and 70 deg F.
2. SCFM must be corrected for actual conditions as follows:  
 $SCFM (corrected) = SCFM(uncorrected) \times equiv\ flow(gpm) \times [Cg / (Fta \times Fpa)]$

### Where:

Cg (gas conversion constant) = 3.8  
 Fta (flowing temp factor) =  $\sqrt{Tact / Tstd}$   
 Fpa (flowing pressure factor) =  $\sqrt{Pstd/Pact}$

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## SVE TOTAL FLOW VENTURI CONVERSIONS

### Venturi Data

Model 745  
 connections 3"  
 fullscale dp(" w.c.) 100  
 fullscale flow(gpm) 310

### Magnehelic Flow Indicator Calibration

**@ fullscale DP = 2.9 w.c., flowrate =200 scfm**

**Note: Scale calibration based on std. conditions**

**P = 14.73 psia: T = 70 deg F**

### Assumed Standard Conditions

P std (psia) 14.73  
 T std ( deg F) 70

### Assumed Atmospheric Pressure

P atm

@5200 ft (psia) 12.13

Equiv. Flow (gpm)	Diff. Press. ("w.c.)	Operating Parameters & Conversion Factors	SCFM (uncorr.)	SCFM (corrected for actual P & T)				
		P act(" w.c.g)	0	0	3	6	9	12
		Pact (psia)	14.73	12.13	15.13	18.13	21.13	24.13
		T act (deg F)	70	60	60	60	60	60
		Fpa	1.0	1.102	0.987	0.901	0.835	0.781
		Fta	1.0	0.991	0.991	0.991	0.991	0.991
0.0	0.0		0	0	0	0	0	0
6.6	0.0		25	23	26	28	30	32
13.2	0.2		50	46	51	56	60	65
19.7	0.4		75	69	77	84	91	97
26.3	0.7		100	92	102	112	121	129
32.9	1.1		125	115	128	140	151	162
39.5	1.6		150	137	153	168	181	194
46.1	2.2		175	160	179	196	212	226
52.6	2.9		200	183	205	224	242	258
59.2	3.6		225	206	230	252	272	291
65.8	4.5		250	229	256	280	302	323
72.4	5.4		275	252	281	308	333	355
78.9	6.5		300	275	307	336	363	388
85.5	7.6		325	298	333	364	393	420

### Notes:

1. SCFM value based on 14.73 pisa and 70 deg F.
2. SCFM must be corrected for actual conditions as follows:  
 SCFM (corrected) = SCFM(uncorrected) X equiv flow(gpm) X [Cg / (Fta X Fpa)]

### Where:

Cg (gas conversion constant) = 3.8  
 Fta (flowing temp factor) = sqrt (Tact / Tstd)  
 Fpa (flowing pressure factor) = sqrt ( Pstd/Pact)

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## **BLUE DIVIDER SHEET**

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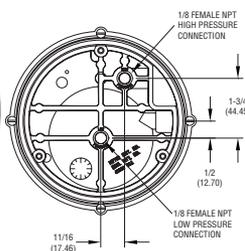
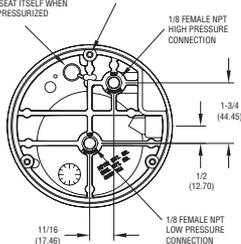


# Magnehelic® Differential Pressure Gauge

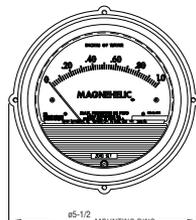
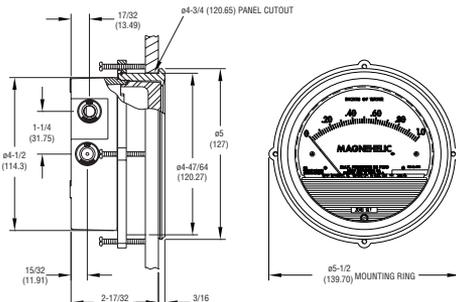
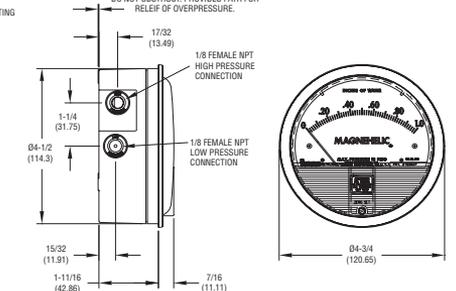


\* RUBBER PRESSURE RELIEF PLUG WILL UNSEAT ITSELF WHEN GAGE IS OVERPRESSURIZED

(3) 6-32 X 3/16 (4.76) DEEP HOLES EQUALLY SPACED ON A Ø4-1/8 (104.78) BOLT CIRCLE FOR PANEL MOUNTING



.025 (64) SPACE CREATED BY 3 SPACER PADS WHEN SURFACE MOUNTED. DO NOT OBSTRUCT. PROVIDES PATH FOR RELIEF OF OVERPRESSURE.



The Magnehelic® Differential Pressure Gauge consists of two pressure-tight compartments separated by a molded flexible diaphragm.

The interior of the gauge case serves as the "high" pressure compartment and a sealed chamber behind the diaphragm serves as the "low" pressure compartment.

Differences in pressure between the "high" and "low" sides of the diaphragm cause the diaphragm to assume a balanced position between the two pressures. The front support plate of the diaphragm is linked to a leaf spring which is anchored at one end. The spring provides calibrated resistance to the diaphragm motion. Motion of the spring is transmitted through an exclusive magnetic linkage to the pointer.

The Magnehelic® Differential Pressure Gauge requires no maintenance. The only field adjustment required is occasional zero setting of the pointer which is done by opening the plastic vent valves and turning the adjustment of the gage.

**STANDARD GAGE ACCESSORIES:** Two 1/8" NPT plugs for duplicate pressure taps, two 1/8" pipe thread to rubber tubing adapters and three flush mounting adapters with screws.

**MP AND HP GAGE ACCESSORIES:** Mounting ring and snap ring retainer substituted for 3 adaptors, 1/4" compression fittings replace 1/8" pipe thread to rubber tubing adaptors.

\*The blowout plug is not used on models above 180 inches of water pressure, medium or high pressure models, or on gages which require an elastomer other than silicone for the diaphragm.

## SPECIFICATIONS

**Service:** Air and non-combustible, compatible gases. (Natural Gas option available.)

**Wetted Materials:** Consult factory.

**Housing:** Die cast aluminum case and bezel, with acrylic cover. (MP model has polycarbonate cover).

**Accuracy:** ±2% of full scale (±3% on -0, -100 Pa, -125 Pa, 10MM and ±4% on -00, -00N, -60 Pa, -6MM ranges), throughout range at 70°F (21.1°C).

**Pressure Limits:** -20" Hg to 15 psig † (-0.677 bar to 1.034 bar); MP option: 35 psig (2.41 bar), HP option: 80 psig (5.52 bar).

**Overpressure:** Relief plug opens at approximately 25 psig (1.72 bar), standard gages only. The blowout plug is not used on models above 180 inches of water pressure, medium or high pressure models, or on gages which require an elastomer other than silicone for the diaphragm.

**Temperature Limits:** 20 to 140°F (-6.67 to 60°C).

\*Low temperature models available as special option. Size: 4" (101.6 mm) diameter dial face.

**Mounting Orientation:** Diaphragm in vertical position. Consult factory for other position orientations.

**Process Connections:** 1/8" female NPT duplicate high and low pressure taps - one pair side and one pair back.

**Weight:** 1 lb 2 oz (510 g), MP & HP 2 lb 2 oz (963 g).

†For applications with high cycle rate within gage total pressure rating, next higher rating is recommended. See Medium and High pressure options.

**Note:** May be used with hydrogen when ordering Buna-N diaphragm. Pressure must be less than 35 psi.

# MAGNEHELIC® INSTALLATION

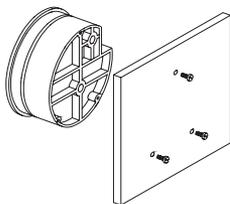
**OVERPRESSURE PROTECTION:** Standard Magnehelic® Differential Pressure Gages are rated for a maximum pressure of 15 psig and should not be used where that limit could be exceeded. Models employ a rubber plug on the rear which functions as a relief valve by unseating and venting the gage interior when over pressure reaches approximately 25 psig (excludes MP and HP models). To provide a free path for pressure relief, there are four spacer pads which maintain .023" clearance when gage is surface mounted. Do not obstruct the gap created by these pads.

## INSTALLATION

Select a location free from excessive vibration and where the ambient temperature will not exceed 140°F (60°C). Also, avoid direct sunlight which accelerates discoloration of the clear plastic cover. Sensing lines may be run any necessary distance. Long tubing lengths will not affect accuracy but will increase response time slightly. Do not restrict lines. If pulsating pressures or vibration cause excessive pointer oscillation, consult the factory for ways to provide additional damping.

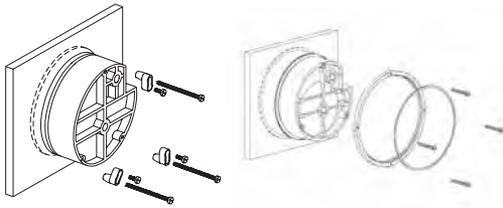
All standard Magnehelic® Differential Pressure Gages are calibrated with the diaphragm vertical and should be used in that position for maximum accuracy. If gages are to be used in other than vertical position, this should be specified on the order. Many higher range gages will perform within tolerance in other positions with only rezeroing. Low range models of 0.5" w.c. plus 0.25" w.c. and metric equivalents must be used in the vertical position only.

## SURFACE MOUNTING



Locate mounting holes, 120° apart on a 4-1/8" dia. circle. Use No. 6-32 machine screws of appropriate length.

## FLUSH MOUNTING



Provide a 4-9/16" dia. (116 mm) opening in panel. Provide a 4-3/4" dia. (120 mm) opening for MP and HP models. Insert gage and secure in place with No. 6-32 machine screws of appropriate length, with adapters, firmly secured in place.

## PIPE MOUNTING

To mount gage on 1-1/4" - 2" pipe, order optional A-610 pipe mounting kit.

## TO ZERO GAGE AFTER INSTALLATION

Set the indicating pointer exactly on the zero mark, using the external zero adjust screw on the cover at the bottom. Note that the zero check or adjustment can only be made with the high and low pressure taps both open to atmosphere.

## OPERATION

**Positive Pressure:** Connect tubing from source of pressure to either of the two high pressure ports. Plug the port not used. Vent one or both low pressure ports to atmosphere.

**Negative Pressure:** Connect tubing from source of vacuum or negative pressure to either of the two low pressure ports. Plug the port not used. Vent one or both high pressure ports to atmosphere.

**Differential Pressure:** Connect tubing from the greater of two pressure sources to either high pressure port and the lower to either low pressure port. Plug both unused ports.

When one side of the gage is vented in dirty, dusty atmosphere, we suggest an A-331 Filter Vent Plug be installed in the open port to keep inside of gage clean.

**A.** For portable use of temporary installation use 1/8" pipe thread to rubber tubing adapter and connect to source of pressure with flexible rubber or vinyl tubing.

**B.** For permanent installation, 1/4" O.D., or larger, copper or aluminum tubing is recommended.

# MAINTENANCE

## MAINTENANCE

No lubrication or periodic servicing is required. Keep case exterior and cover clean. Occasionally disconnect pressure lines to vent both sides of gage to atmosphere and re-zero. Optional vent valves should be used in permanent installations.

## WARNING

Attempted field repair may void your warranty. Recalibration or repair by the user is not recommended.

## TROUBLE SHOOTING TIPS

### Gage won't indicate or is sluggish.

1. Duplicate pressure port not plugged.
2. Diaphragm ruptured due to overpressure.
3. Fittings or sensing lines blocked, pinched, or leaking.
4. Cover loose or "O"ring damaged, missing.
5. Pressure sensor, (static tips, Pitot tube, etc.) improperly located.
6. Ambient temperature too low. For operation below 20°F (-7°C), order gage with low temperature, (LT) option.

### Pointer stuck-gage can't be zeroed.

1. Scale touching pointer.
2. Spring/magnet assembly shifted and touching helix.
3. Metallic particles clinging to magnet and interfering with helix movement.
4. Cover zero adjust shaft broken or not properly engaged in adjusting screw.

## ORDERING INSTRUCTIONS

The Series 2000 is not field serviceable and should be returned if repair is needed (field repair should not be attempted and may void warranty). Be sure to include a brief description of the problem plus any relevant application notes. Contact customer service to receive a return goods authorization number before shipping.

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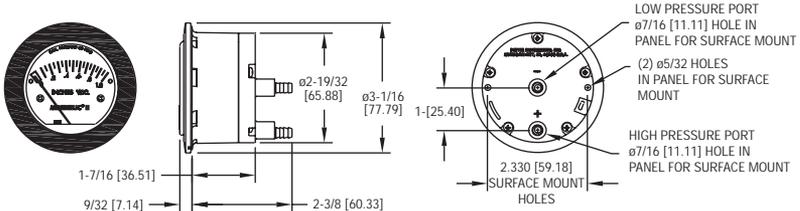
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## **BLUE DIVIDER SHEET**



# Series 2-5000 Minihelic® II Differential Pressure Gauge

Specifications: Installation & Operating Instructions



**Series 2-5000 Minihelic® II Differential Pressure Gauges** have clean design, small size, low cost and sufficient accuracy for all but the most demanding applications. With housing molded from mineral- and glass-filled nylon and a lens molded from polycarbonate, this gauge will withstand rough use and exposure, as well as high total pressure up to 30 psig [2.067 bar]. Over-pressure is accommodated by a blow-out membrane molded in conjunction with the diaphragm.

### INSTALLATION

1. Select a location free from excessive vibration and where ambient temperature will be between 20 to 120°F (-6.7 to 49°C). Sensing lines may be any length necessary without affecting accuracy. However, long runs of tubing will dampen readings slightly and cause a minor increase in response time. If pulsing pressure or vibration cause excessive pointer oscillation, please contact factory for ways to provide additional damping.
2. This gauge is calibrated and zeroed in the vertical position at the factory. If the gauge is used in any other position, it must be re-zeroed each time the position is changed. Gauges with ranges under 5" w.c. (1.24 kPa), or the equivalent, should be used only in the vertical position unless special calibration was specified when ordering.

### SPECIFICATIONS

- Service:** Air and compatible gases.
- Wetted Materials:** Consult factory.
- Housing:** Glass filled nylon; polycarbonate lens.
- Accuracy:** ±5% of full scale at 70°F (21.1°C).
- Pressure Limits:** 30 psig (2.067 bar) continuous to either pressure connection.
- Temperature Limits:** 20 to 120°F (-6.67 to 48.9°C).
- Size:** 2-1/16" (52.39 mm) diameter dial face.
- Mounting Orientation:** Diaphragm in vertical position. Consult factory for other position orientations.
- Process Connections:** Barbed, for 3/16" I.D. tubing (standard); 1/8" male NPT (optional).
- Weight:** 6 oz (170.1g).

**CAUTION: FOR USE ONLY WITH AIR OR COMPATIBLE GASES.**

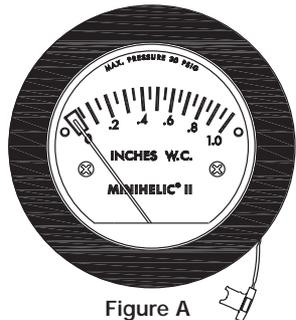
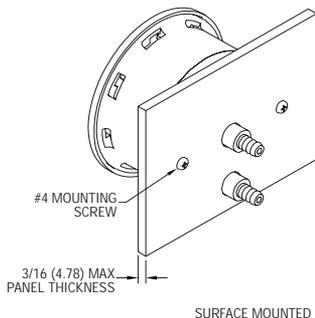
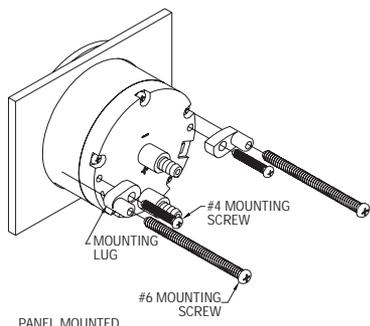


Figure A



## PANEL MOUNTED INSTALLATION

3. To surface-mount the gage in a 3/16 (4.78 mm) max panel thickness, drill two 5/32" (3.97 mm) holes on a horizontal line, 2.330" (59.18 mm) apart for mounting screws. Next, drill two 7/16" (11.11 mm) holes 1.000" (25.4 mm) apart on a vertical line for pressure connections. Secure the gage with two #4 mounting screws. Be careful not to block the slotted hole near the right-hand mounting hole, this provides a path for pressure relief in the event of over-pressurization.

4. To panel-mount the gage, cut a 2-5/8" (66.68 mm) diameter hole. Install mounting lugs to the back of the gage with two #4 mounting screws, thread two #6 mounting screws through mounting lugs and tighten.

5. Before installation, the Minihelic® II Differential Pressure Gage may need to be zeroed before placing into operation. If zeroing is required, you must first remove the locking clip located near the bottom face of the gage (refer to Fig A). Use a small blade screwdriver or the allen wrench supplied with the Minihelic® II Differential Pressure Gage to remove the clip. The clip is attached with a hinge design so it will not get lost after removal. After removing the clip, firmly hold the case with one hand and rotate the front cover in the counterclockwise direction with the palm of the other hand. The Minihelic® II Differential Pressure Gage utilizes a bayonet locking design. The cover will rotate approximately 9 degrees then stop and can be removed. **Caution:** When removing the cover be careful to slowly pull the cover straight off the gage housing. Damage can occur to the scale if the cover is pulled off on an angle. If difficult to loosen cover, place a small sheet of rubber between the cover and the palm of the hand. The zero adjust screw is located below the pointer. Use the hex allen wrench supplied and adjust until the pointer is on zero. This must be done with both pressure connections vented to atmosphere and the gage oriented in the final mounting position. Replace cover.

6. To measure positive pressure, connect tubing to port marked "HI" and vent "LO" port to atmosphere. For negative pressure (vacuum), connect to port marked "LO" and vent "HI" port to atmosphere. For differential pressure, connect higher pressure to port marked "HI" and lower to "LO" port. If gage is supplied with 1/8" NPT connections, be careful not to over-tighten fittings to avoid damage to the gage.

## CALIBRATION CHECK

Select a second gage or manometer of known accuracy and in an appropriate range. Use short lengths of rubber or vinyl tubing to connect the high-pressure side of the gage and the test gage to two legs of a tee. Very slowly, apply pressure through the third leg. Allow enough time for pressure to equalize throughout the system and for fluid to drain. If a manometer is being used. Compare readings. If the gage being tested exceeds rated accuracy, it should be returned to the factory for recalibration.

## MAINTENANCE

No lubrication or periodic servicing is required. Keep case exterior and cover clean. Occasionally, disconnect pressure lines to vent both sides of the gage to atmosphere and re-zero per installation paragraph 5.

Upon final installation of the Series 2-5000 Minihelic® II Differential Pressure Gage, no routine maintenance is required. A periodic check of the system calibration is recommended. The Series 2-5000 is not field serviceable and should be returned if repair is needed (field repair should not be attempted and may void warranty). Be sure to include a brief description of the problem plus any relevant application notes. Contact customer service to receive a return goods authorization number before shipping.

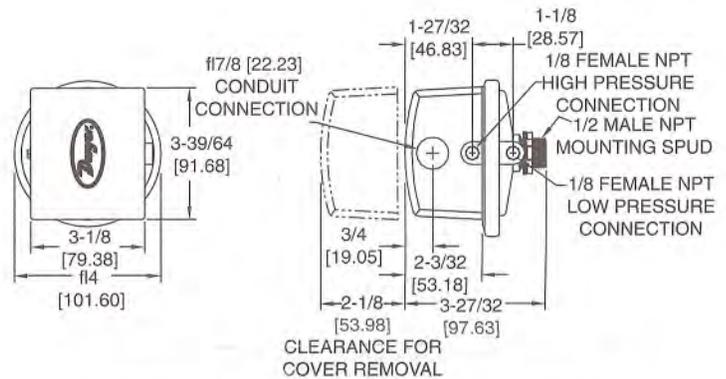
## **BLUE DIVIDER SHEET**

## **BLUE DIVIDER SHEET**

**Series Low Differential Pressure Switches  
1800 for General Industrial Service**



**Specifications – Installation and Operating Instructions**



Construction and dimensions. Series 1823 pressure switches.

Model 1823 pressure switch. UL and CSA Listed, FM approved.

Series 1823 pressure switch. Conduit enclosure removed to show electric switch.

One of our most popular pressure switches. Combines small size and low price with 2% repeatability for enough accuracy for all but the most demanding applications. Set point adjustment inside the mounting switch on one side of a wall or panel with adjustment easily accessible on the opposite side.

\*Model 1823 shown; (1823 replaces 1820, 1821 and 1822 which are similar).

**Environmental (MIL) Switch**

Unlisted Model 1820 can be furnished with special snap switch sealed against the environment for high humidity and/or for government applications. Similar to standard Model 1823 except dead band is slightly greater. Specify Model 1820 (Range No.) "MIL" in ordering.

**SERIES 1823 SWITCHES – OPERATING RANGES & DEADBANDS**

Model Number	Operating Range, Inches W.C.	Approximate Dead Band	
		At Min. Set Point	At Max. Set Point
1823-00	0.07 to 0.22	0.05	0.05
1823-0	0.15 to 0.5	0.06	0.06
1823-1	0.3 to 1.0	0.08	0.08
1823-2	0.5 to 2.0	0.10	0.12
1823-5	1.5 to 5.0	0.14	0.28
1823-10	2.0 to 10	0.18	0.45
1823-20	3 to 22	0.35	0.70
1823-40	5 to 44	0.56	1.10
1823-80	9 to 85	1.30	3.0

**SPECIFICATIONS**

**Service:** Air and non-combustible, compatible gases.

**Wetted Materials:** Consult Factory.

**Temperature Limits:** -30 to 180°F (-34 to 82.2°C). 1823-00, -20 to 180°F (-28.9 to 82.2°C).

**Pressure Limits:** 10 psig (68.95 kPa) continuous, 25 psig (172.4 kPa) surge.

**Switch Type:** Single-pole double-throw (SPDT).

**Repeatability:** ±2%.

**Electrical Rating:** 15 A @ 120-480 VAC, 60 Hz. Resistive 1/8 HP @125 VAC, 1/4 HP @ 250 VAC, 60 Hz. De-rate to 10 A for operation at high cycle rates.

**Electrical Connections:** 3 screw type, common, normally open and normally closed.

**Process Connections:** 1/8" female NPT.

**Mounting Orientation:** Diaphragm in vertical position. Consult factory for other position orientations.

**Set Point Adjustment:** Screw type inside mounting spud.

**Weight:** 1 lb, 5 oz (595 g).

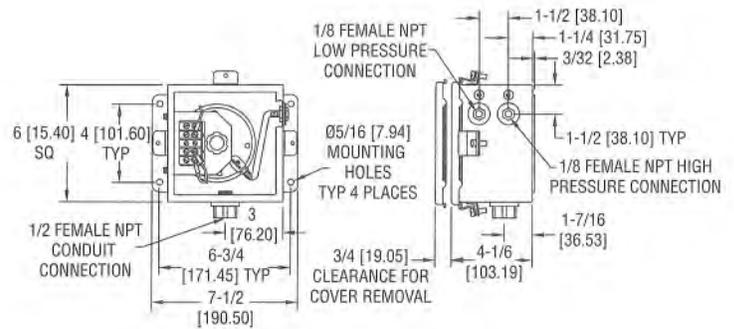
**Agency Approvals:** CE, UL, CSA, FM.

## INSTALLATION

1. Select a location free from excessive vibration and where oil or water will not drip upon the switch. See special housings for unusual conditions.
2. **While not required, positioning the pressure connections down is recommended.** Mount the switch with the diaphragm in a vertical plane. Switch with the diaphragm in a vertical plane. Switch must be recalibrated for each change in operating position.
3. Connect switch to source of pressure differential. Metal tubing with 1/4" O.D. is recommended but any tubing system which will not restrict the air flow is satisfactory. Note that the low pressure connection may be made to the 1/2" spud at the back of the switch if desired. If so connected, drill 1/16" diameter holes in the Spring Retainer flange and the head of Adjustment Screw to provide opening to the switch interior and plug the other low pressure connection.
4. Electrical connections to the standard single pole, double throw snap switch are provided by means of screw terminals marked "common", "norm open", and "norm closed". The normally open contacts close and the normally closed contact open when pressure increases beyond the set point.
5. Switch loads should not exceed the maximum specified current rating of 15 amps resistive. Switch capabilities decrease with high load inductance or rapid cycle rates. Whenever and application involves one or more of these factors, the user may find it desirable to limit the switched current to 10 amps or less in the interest of prolonged switch life.

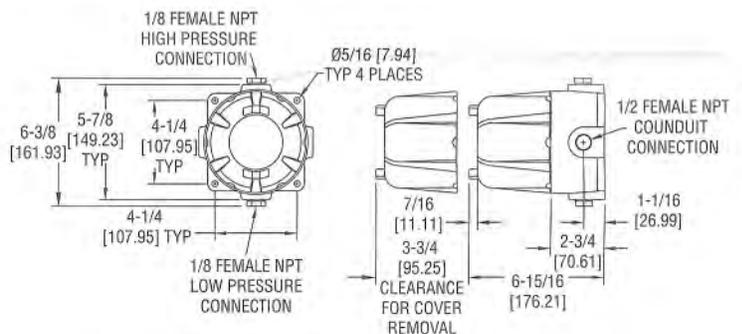
## ADJUSTMENT

1. If the switch has been factory preset, check the set-point before placing in service to assure it has not shifted in transit.
2. If switching has not been preset or it is desired to change the point, observe the following procedure:
  - a. To adjust the set point turn the slotted Adjustment Screw clockwise to increase the set point and counterclockwise to decrease the set point.
  - b. The following is a recommended procedure for calibrating or checking calibration: Use a "T" assembly with three rubber tubing leads, all as short as possible and the entire assembly offering minimum flow restriction. Run one lead to the pressure switch, another to a manometer of known accuracy and appropriate range, and apply pressure through the third tube. Make final approach to the set point slowly. Note the manometer and pressure switch will have different response characteristics due to different internal volumes, lengths of tubing, oil drainage, etc. Be certain switch is checked in position it will assume in use, i.e. vertical, horizontal, etc.



## Weatherproof Enclosure

16 ga. steel enclosure for unusually wet or oily conditions. Withstands 200 hour salt spray test. Gasketed cover. Weight 5-1/2 lb (2.5 kg). Switch must be installed at factory. Specify "WP" in addition to switch catalog number.



## Explosion-Proof Housing

Cast iron base and aluminum dome cover. Approximate weight 7-1/2 lb (3.4 kg). Specify "EXPL" in addition to switch catalog number.

## **BLUE DIVIDER SHEET**

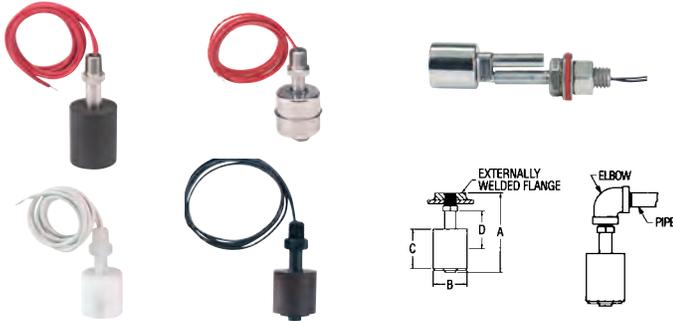
## **BLUE DIVIDER SHEET**



## SERIES F7 LIQUID LEVEL SWITCHES

**KO TANK HIGH LEVEL FLOAT**

### Specifications – Installation and Operating Instructions



Series F7 Level Switches provide simple, inexpensive control of liquid level within tanks or similar vessels. Switch ratings are suitable for many solid state control systems and monitors or alarms. Simple relay interfaces can be used for higher current applications. Two basic styles offer a choice of vertical or horizontal mounting. Hermetically sealed reed switches are actuated by magnets permanently bonded inside the float and can be easily adapted to open or close a circuit on rising or falling levels.

#### SWITCH ACTION (Normally open/Normally closed)

##### Vertical Models

Vertical mount models are shipped with normally open switch contacts which close as the float rises toward the mounting threads. Reverse switch action by removing the float, rotating it end-for-end and replacing it on the stem.

##### Horizontal Models

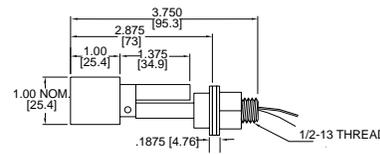
Horizontal models are in the normally open position when the indicating arrow points up (float is down), and normally closed when the arrow points down (float is up).

#### INSTALLATION

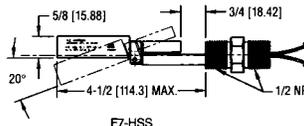
Choose a location away from fill pipes, drains, or other areas where turbulence or wave motion might occur. Turbulence will cause false actuation and shorten contact life. Excess contaminants in fluid may inhibit float operation and occasional wipe-down may be necessary. Care should be taken that switches are always operated within electrical ratings. Read and understand all safety precautions on back of this sheet before installing.

#### MOUNTING

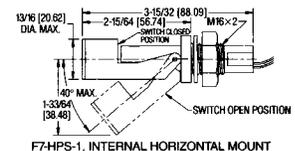
Install vertical mount models in an appropriate 1/8" NPT fitting. Vertical models mount internally, oriented within 30° of vertical, or select optional fittings for external mounting. Models F7-HPS-1 and F7-MHS must be mounted internally, which means the switch must be secured to the wall of the tank or vessel from the inside. Install horizontal model F7-HPS-1 in a 5/8" (16 mm) hole or model F7-MHS in a 1/2" (12.7 mm) hole. Secure into place with the nut provided. Tank wall should not exceed 1/8" (3 mm). Model F7-HPS-2 requires a horizontal 1/2" NPT female fitting and can be fitted to the tank or vessel from the outside. Model F7-HSS requires a horizontal 1/2" NPT female fitting and can be mounted from the inside or outside (internally or externally) of the tank or vessel.



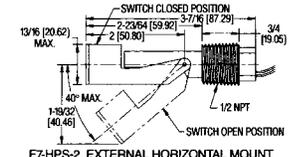
F7-MHS, INTERNAL HORIZONTAL MOUNT



F7-HSS



F7-HPS-1, INTERNAL HORIZONTAL MOUNT



F7-HPS-2, EXTERNAL HORIZONTAL MOUNT

#### SPECIFICATIONS

##### Electrical Rating (Maximum):

F7-SB, -SS2 AC: 25VA, 1.0A, 200 V DC: 10W, 1.0A, 200V

F7-PP, -BT, -HSS, -MHS

AC: 25VA, 1.0A, 200 V DC: 10W, 1.0A, 200V

F7-HPS-1, -2 AC: 25VA, 1.0A, 200 V DC: 10W, 1.0A, 200V

(F7-HSS is rated explosion-proof for Class I, Groups A, B, C, D;

Class II, Groups E, F, G; Class III).

**Mounting Connection:** 1/8" NPTM (all vertical mount), 1/2" NPTM (F7-HPS-2, F7-HSS), M16 x 2 (F7-HPS-1), 1/2" x 13 thread (F7-MHS)

**Wire leads:** 22 AWG x 18" (46 cm), vertical mount models; 22 AWG x 39" (1 m), models F7-HPS-1, -2; 22 AWG x 24" (61 cm), models F7-HSS, -MHS.

**Magnet:** Alnico (F7-SB, -PP, -BT, -HPS), ceramic (F7-SS2, -HSS, -MHS).

**Weight:** 2 oz. (58 g), F7-SB; 1.2 oz. (34g), F7-SS2; 0.8 oz. (23 g), F7-PP; 0.7 oz. (20 g), F7-BT; 1.5 oz. (43 g), F7-HPS-1; 2 oz. (57 g), F7-HPS-2 and -MHS; 3 oz. (94 g), F7-HSS.

#### DIMENSIONS, INCHES (MM) - Vertical Mount

Model Number	(A) Stem Length	(B) Float Diameter	(C) Float Height	(D) Actuation from HEX*
F7-SB	2.75 (70)	1.13 (29)	1.38 (35)	1.2 (31)
F7-SS2	2.06 (52)	1.0 (25)	1.0 (25)	0.73 (19)
F7-PP	2.18 (55)	1.18 (30)	1.0 (25)	0.69 (18)
F7-BT	2.18 (55)	1.18 (30)	1.0 (25)	0.69 (18)

\*Distance between HEX and liquid (S.G. = 1) level @ actuation pt. will vary with specific gravity changes.

#### PHYSICAL DATA

Model Number	Material Float/Stem	Max. Temp.	Max. Press.	Min. S.G.	Approx. Deadband
<b>Vertical Mount</b>					
F7-SB	Buna-N & Epoxy/ 316SS	220°F 105°C	150 psig 10 bar	0.60	1/16" 2 mm
F7-SS2	316/SS (CYC)/ 316SS	300°F 149°C	450 psig 31 bar	0.75	1/16" 2 mm
F7-PP	Polypropylene & Epoxy/ Polypropylene	220°F 105°C	100 psig 6.89 bar	0.60	1/8" 4 mm
F7-BT	Buna-N & Epoxy/ PBT*	220°F 105°F	150 psig 10 bar	0.45	1/8" 4 mm
<b>Horizontal Mount</b>					
F7-HPS -1, -2	Polysulfone/ Polysulfone	185°F 85°C	150 psig 10 bar	0.85	3/16" 5 mm
F7-HSS	316SS/316SS	392°F 200°C	300 psig 20.7 bar	0.60	1/8" 4 mm
F7-MHS	316 SS/316SS	392°F 200°C	100 psig 6.89 bar	0.70	3/16" 5 mm

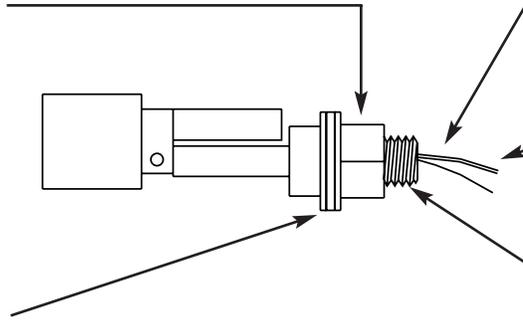
\* PBT - Polybutylene Terephthalate

**Installation Notes-**

Do not subject reed switch controls to excessive shock or vibration or any of the following:

- Bending or placing force loads on reed switch housing.
- Over-torquing fittings on reed switch housing.
- Placing pull-out force on lead wires.

Do not exceed 1.5 pounds/foot (2 N/m) tightening torque. Excessive torque may cause premature switch element or housing failure.



Gasket seal for internal mounting units should be pre-assembled before insertion through tank wall. Wall thickness should not exceed 1/8"(3mm).

Avoid installations where wiring entering the device is submerged or exposed to excessive amounts of liquid or humidity condensate.

When preparing wires for termination, avoid pulling against the resin seal or end plug of the float switch.

Units with tapered pipe threads should be treated with Teflon® based thread compound or tape before insertion in fitting. Sufficient torque is achieved at hand-tight plus one half turn.

**CIRCUIT INFORMATION FOR REED SWITCH PROTECTION**

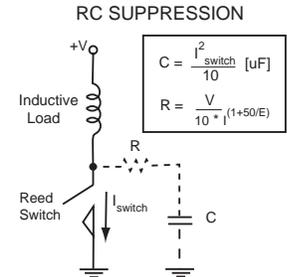
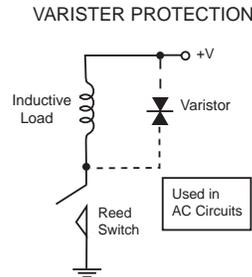
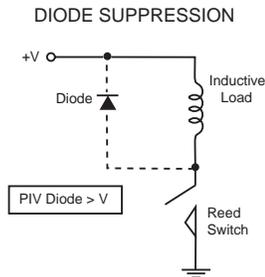
**READ INFORMATION BELOW BEFORE INSTALLING YOUR NEW REED SWITCH CONTROL!**

Exceeding the current capacity of this Reed Switch control may cause **FAULTY OPERATION!** Be aware of the inductive and capacitive or lamp loads you may be placing on your Reed Switch Control. The circuits below outline possible solutions to preventing overloads due to inrush or surge currents exceeding maximum or when the switch current and product of the inductive back EMF exceed the switch's power rating. Also, the circuit for prevention of overload when switching filament lamps (low "cold" resistance) is outlined below. Failure to follow these measures to protect Reed Switch Contacts may cause the contacts to weld together or result in premature wear.

**Possible Circuit Solutions Indicated by Dashed Lines**

**Inductive Loads**

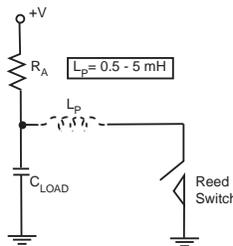
*Possible causes-*  
An electromagnetic relay, electro-magnetic solenoid, electromagnetic counter with inductive component as circuit load.



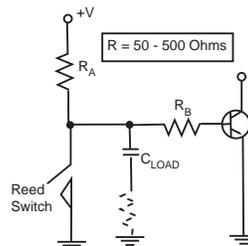
**Capacitive Loads**

*Possible causes-*  
A capacitor connected in series or parallel with Reed Switch Control. In a closed circuit, a cable length (usually greater than 50m [162.5 ft]) used to connect reed switch may also introduce static capacitance.

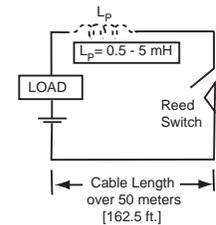
**SURGE LIMITER FOR CAPACITANCE IN SERIES**



**RESISTOR PROTECTION FOR CAPACITIVE LOAD**



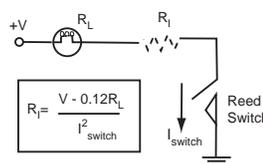
**INDUCTIVE PROTECTION FOR CABLE LENGTH CAPACITANCE**



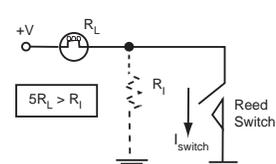
**Lamp Loads**

*Possible causes-*  
A tungsten filament lamp load.

**CURRENT LIMITING RESISTOR IN SERIES**



**CURRENT LIMITING RESISTOR IN PARALLEL**



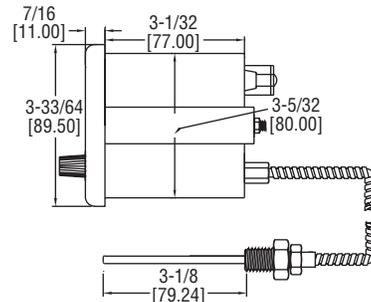
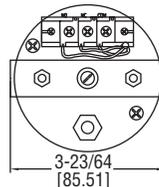
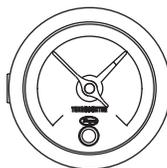
## **BLUE DIVIDER SHEET**

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# Series RRT3 Remote Reading Thermometer with Switch

## Specifications - Installation and Operating Instructions



The Series RRT3 Remote Reading Thermometer with Switch combines an easy to read 3-1/4" dual scale dial thermometer and a SPDT relay. Color coordinated pointers display the current process temperature and set point. In order to change the set point, a front adjustment knob controls the red set point pointer. The design of the internal mechanical switch movement prevents the set point pointer from sticking to the process indicating pointer. A 10.5 ft (3.2 m) stainless steel flex hose capillary prevents kinking and leaking of the measuring fluid when bending the capillary. For quick installation, electrical connections can be made to male quick connects or to the finger-safe screw terminals. Thermometer includes a u-clamp mounting bracket for panel mounting.

### SPECIFICATIONS

**Wetted Materials:** Brass.

**Accuracy:** ±3% FS.

**Housing Material:** 304 SS.

**Temperature Limit:** -4 to 158°F (-20 to 70°C).

**Switch Type:** SPDT, 3 A @ 250 VAC, .2 A @ 250 VDC.

**Electrical Connections:** Normally open (NO), normally closed (NC), and common (COM).

**Process Connection:** 1/2" (12.7 mm) male NPT.

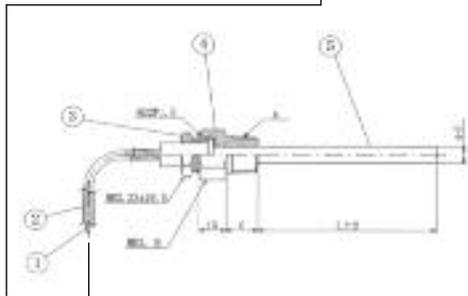
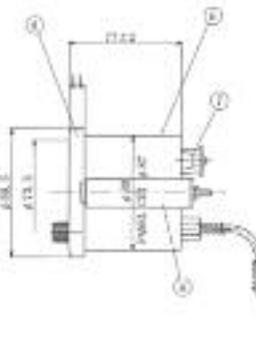
**Dial Size:** 3-1/2" (90 mm).

**Capillary Length:** 10.5' (3.2 m).

**Bulb Length:** 3" (76 mm).

**Weight:** 2 lb (900 g).

### OPERATING INSTRUCTIONS



- 9 Setting Knob
- 8 Setting Pointer
- 7 Terminal
- 6 Bracket
- 5 Case
- 4 Cover
- 3 Glass Disk
- 2 Scale Plate
- 1 Pointer

**SVE/HEAT EXCHANGER  
HI TEMP SWITCH**

### Mechanical Installation

1. For mounting, select a clean, dry location, free from extreme temperatures.
2. Cut a 3-7/32" (82 mm) diameter hole in the panel for the thermometer.
3. Prior to inserting the thermometer into the panel, remove the mounting bracket.
4. Insert the thermometer into the panel cutout from the front.
5. Place the U-bracket on the back of the thermometer (make sure the screws are aligned with the holes in the mounting bracket).
6. Secure the bracket into place by tightening the nuts until the bracket is tight against the panel.

#### NOTICE

If panel thickness exceeds 13/64" (5 mm), the bracket must be shortened accordingly.

7. The probe should be mounted so the bulb is fully immersed in the media and where the media temperature will be evenly distributed.

#### NOTICE

Since temperature effects along the capillary are compensated for, the capillary should not be located close to other temperature sources. Take care in arranging the steel capillary to avoid sharp bends that might kink internal capillary tube.

### Electrical Connections

#### CAUTION

Do not exceed the specified electrical ratings shown on the unit. Permanent damage, not covered by the warranty, will result.

1. Connections for the switch are made by three connections. The quick connect terminals are labeled N.O., N.C., and COM. N.O. is the normally open terminal, COM is the common terminal, and N.C. is the normally closed terminal.
2. For NC (normally closed) operation, make switch connections using terminals COM and N.C.
3. For NO (normally open) operation, make switch connections using terminals COM and N.O.



C : COMMON  
NO : NORMAL OPEN  
NC : NORMAL CLOSE

### Set Point Operation

The switch set point is fully adjustable across the entire range of the unit. The unit is equipped with internal stops at the minimum and maximum values of a specified range.

Adjust the set point by rotating the black knob on the front of the dial case to the desired temperature setting.

### MAINTENANCE/REPAIR

Upon final installation of the Series RRT3, no routine maintenance is required. The Series RRT3 is not field serviceable and should be returned if repair is needed. Field repair should not be attempted and may void warranty.

### WARRANTY/RETURN

Refer to "Terms and Conditions of Sales" in our catalog and on our website. Contact customer service to receive a Return Goods Authorization number before shipping the product back for repair. Be sure to include a brief description of the problem plus any additional application notes.

**MISCELLANEOUS  
I/O MANUALS**



**Process Technology  
Support, LLC**

*Serving The Environmental Remediation Industry*

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**BLANK SHEET**

**Please read and save these instructions.** Read carefully before attempting to assemble, install, operate or maintain the product described. Protect yourself and others by observing all safety information. Failure to comply with instructions could result in personal injury and/or property damage! Retain instructions for future reference.

# Dayton® Hazardous Location Direct-Drive Exhaust Fans

**BLDG EXHAUST FAN**

## Description

Dayton hazardous location exhaust fans are designed for ventilating spaces containing flammable or explosive vapors, gases, or dusts as defined under Article 500 of the National Electrical Code (NEC). Mount in vertical or horizontal position. Construction includes galvanized steel frame, pre-punched mounting holes, hazardous location ball bearings, and spark-resistant aluminum propeller. Motor is explosion-proof, fan-cooled enclosure with Class B insulation (if marked on motor). All fans have a maximum ambient temperature of 104°F (if marked on motor) and are UL/cUL Listed Standard 1203, NEC Class I, Groups C and D; NEC Class II, Groups F and G (Model 10E020 Groups E, F and G).



Dayton Electric Mfg. Co. certifies that the fans shown herein are licensed to bear the AMCA seal. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 211 and AMCA Publication 311 and comply with the requirements of the AMCA Certified Ratings Program.



## Unpacking

1. Inspect for any damage that may have occurred during transit.
2. Shipping damage claim must be filed with carrier.
3. Check all bolts, screws, set-screws, etc. for looseness that may have occurred during transit. Retighten as required. Rotate propeller by hand to be sure it turns freely.

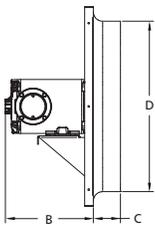


Figure 1 — Panel Fan Dimensions

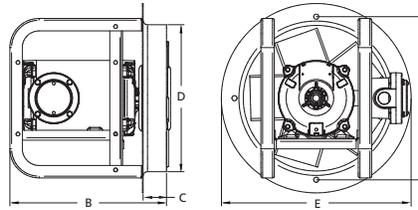
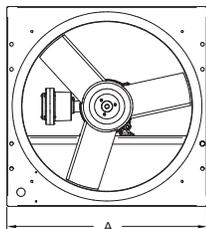


Figure 2 — Ring Fan Dimensions

## Dimensions and Specifications

Model	Prop. Dia.	Shaft Dia.	A	B	C	D	E	Blades	Recommended Wall Opening		
									Direct to Wall	Wall Collar, Wall Collar & Guard, or Wall Housing	
<b>PANEL FANS (See Figure 1)</b>											
10D995, 10D996	12"	5/8"	16"	9 1/2"	3"	12 1/4"	—	5	14 1/2" x 14 1/2"	17 1/4" x 17 1/4"	
10D997, 10D998	16	5/8	20	9 1/2	3 1/4	16 1/2	—	3	18 1/2" x 18 1/2"	21 1/4" x 21 1/4"	
10D999	18	5/8	22	9 1/2	3 3/8	18 1/2	—	3	20 1/2" x 20 1/2"	23 3/4" x 23 3/4"	
10E001	18	5/8	22	11	3 1/8	18 1/2	—	3	20 1/2" x 20 1/2"	23 3/4" x 23 3/4"	
10E002, 10E003	20	5/8	24	11 1/2	3 3/4	20 1/2	—	3	22 1/2" x 22 1/2"	25 5/8" x 25 5/8"	
10E004, 10E005, 10E006	24	5/8	28	11 1/2	3 3/8	24 1/2	—	3	26 1/2" x 26 1/2"	29 5/8" x 29 5/8"	
10E007	24	5/8	28	12	3 7/8	24 1/2	—	3	26 1/2" x 26 1/2"	29 5/8" x 29 5/8"	
<b>RING FANS (See Figure 2)</b>											
10E008, 10E009	12"	5/8	14 5/8"	13 1/2"	2"	12 1/2"	16 1/4"	5	13 1/2" Dia.	—	
10E010, 10E011	16	5/8	18 5/8"	13 1/2"	2"	16 1/2"	20 1/4"	3	17 1/2"	—	
10E012, 10E013	18	5/8	20 5/8"	13 1/2"	2"	18 1/2"	22 1/4"	3	19 1/2"	—	
10E014, 10E015	20	5/8	23"	13 1/2"	2"	20 1/2"	24 1/4"	3	21 1/2"	—	
10E016, 10E017, 10E018, 10E019	24	5/8	26 5/8"	13 1/2"	2"	24 1/2"	28 1/4"	3	25 1/2"	—	
10E020	30	5/8	32"	17 1/2"	2"	30 1/2"	34 1/4"	3	31 1/2"	—	

ENGLISH

ESPAÑOL

FRANÇAIS

# Dayton® Hazardous Location Direct-Drive Exhaust Fans

## Performance

Model		Prop. Dia.	HP	Motor RPM	Sones @ 0.000" SP @ 5ft.	CFM Air Delivery @ Static Pressure Shown				
1-PHASE 115/208-230	3-PHASE 208-230/460					0.000"	0.125"	0.250"	0.375"	0.500"
<b>PANEL FANS</b>										
<b>10D995</b>	<b>10D996</b>	12"	1/4	1750	13.4	1347	1262	1142	947	604
<b>10D997</b>	<b>10D998</b>	16	1/4	1750	14.1	2476	2288	2061	1769	1350
<b>10D999</b>	<b>10E001</b>	18	1/3	1750	19.1	3168	2912	2612	2219	1599
<b>10E002</b>	<b>10E003</b>	20	1/2	1750	23	4557	4254	3919	3542	3101
<b>10E004</b>	<b>10E006</b>	24	1/2	1750	26	5669	4946	4010	2963	1906
<b>10E005</b>	<b>10E007</b>	24	3/4	1750	28	6317	5851	5314	4729	4117
<b>RING FANS</b>										
<b>10E008</b>	<b>10E009</b>	12"	1/4	1725	13.6	1147	999	803	682	—
<b>10E010</b>	<b>10E011</b>	16	1/4	1750	17.0	2153	1943	1713	1366	1125
<b>10E012</b>	<b>10E013</b>	18	1/4	1750	21	2371	2089	1756	1423	1088
<b>10E014</b>	<b>10E015</b>	20	1/4	1750	23	2429	2074	1744	1341	1098
<b>10E016</b>	<b>10E018</b>	24	1/3	1750	30	3837	3305	2637	1970	—
<b>10E017</b>	<b>10E019</b>	24	1/2	1750	26	5669	4946	4010	2963	1906
<b>10E020</b>	—	30	3/4	1140	28	8153	7515	6804	5957	4956

Performance certified is for installation type A: Free inlet, Free outlet. Performance ratings do not include the effects of appurtenances (accessories). Speed (RPM) shown is nominal. Performance is based on actual speed of test. The sound ratings shown are loudness values in fan sones at 5 ft. (1.5 m) in a hemispherical free field calculated per AMCA Standard 301. Values shown are for installation type A: Free inlet hemispherical sone levels.

## General Safety Information

**⚠ DANGER** Do not depend on any switch as the sole means of disconnecting power when installing or servicing the fan. Always disconnect, lock and tag power source before installing or servicing. Failure to disconnect power source can result in fire, shock or serious injury. Units with thermally protected motors, motor will restart without warning after thermal protector trips. Do not touch operating motor, it may be hot enough to cause injury.

**⚠ DANGER** Do not place any body parts or objects in fan, motor openings or drives while motor is connected to power source.

1. Read and follow all instructions and cautionary markings. Make sure electrical power source conforms to

requirements of equipment and local codes.

- Fans should be assembled, installed and serviced by a qualified technician. Have all electrical work performed by a qualified electrician.
- Follow all local electrical and safety codes in the United States and Canada, as well as the National Electrical Code (NEC) and the Occupational Safety and Health Act (OSHA) in the United States. Ground motor in accordance with NEC Article 250 (grounding). Follow the Canadian Electric Code (CEC) in Canada.

4. All moving parts should be guarded.

**⚠ CAUTION** To reduce the risk of injury to persons, observe the following:

**OSHA requires OSHA complying guards when fan is installed within 7 feet of floor or working level.**

**UL/cUL Standards require OSHA complying guards when fan is installed within 8 feet of floor or working level.**

5. Make certain that the power source conforms to the requirements for the equipment.

## Installation

**⚠ WARNING** Installation, troubleshooting and parts replacement is to be performed only by qualified personnel.

**⚠ CAUTION** If gases, other than clean air, are to be exhausted using the fan, then the user bears the responsibility of determining that the fan is appropriate and safe for the application.

# Models 10D995 thru 10D999, 10E001 thru 10E020

E  
N  
G  
L  
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S  
H

## Installation (Continued)

**▲ WARNING** *Not for use where paint residue can accumulate on motor.*

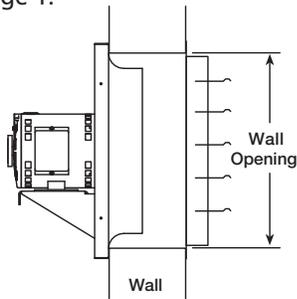
**▲ CAUTION** *To reduce the risk of ignition of hazardous atmospheres, disconnect the fan from the supply circuit before opening. Keep the motor tightly closed with in operation.*

### WALL MOUNTING

1. Move fan to the desired location and determine the method by which the fan is to be mounted.

**NOTE:** Wall opening size and propeller-to-shutter distance are two important dimensions for fan installation.

2. Cut an appropriate sized hole in the wall using the Dimensions table on page 1.



**Figure 3 — Direct to Wall Installation**

**NOTE:** Panel fans mounted to the wall require a different opening size than those mounted in collars or housings.

3. The fan should be securely mounted within a rigid framework to prevent flexing or movement of the fan frame during operation. The fan frame should be equally supported on all sides within the framework and caution should be taken to avoid twisting of the fan frame during installation.

**NOTE:** Allowing the fan frame to flex or move during operation will create harmful vibrations which may damage the unit.

4. Fans should be mounted in opening with 1/4" clearance around perimeter. Framing should be secured to building structure utilizing corrosion resistant fasteners (by others). Fasteners should be used in all pre-punched mounting holes.
5. Install remaining components (shutter, intake guard, etc.).
6. Check all fasteners and set screws for tightness.
7. Rotation direction of the propeller should be checked by momentarily turning the unit on. Rotation should be in the same direction as the rotation decal affixed to the unit. For 3-phase installations, fan rotation can be reversed by interchanging any two of the three electrical leads. For single phase installations follow the wiring diagram located on the motor.

### ELECTRICAL CONNECTION

**NOTE:** Refer to motor nameplate for wiring procedures. Refer to switch manufacturer for installation and wiring procedures.

1. Motor and fan must be securely grounded (bare metal) to a suitable electric ground, such as a grounded water pipe or ground wire system.

**▲ WARNING** *Comply with all local and national safety codes including the National Electrical Code (NEC) and National Fire Protection Act (NFPA).*

**NOTE:** Motor and switch must be classified as hazardous for fan to

be suitable for use in hazardous environments. Installation must be performed by a qualified personnel with suitable motor and disconnect for application.

2. Wire motor for desired voltage per wiring diagram on motor.
3. Wire control switches at ground level.
4. Before activating fan, inspect to be sure that there are no obstructions or debris that would interfere with the propeller.

### Operation

1. Before starting up or operating your new Dayton fan, check all fasteners for tightness. In particular, check set screws in propeller hub.

While in the OFF position, or before connecting the fan to power, turn the fan propeller by hand to be sure it is not striking the orifice or any obstacle.

2. Start the fan up and shut it off immediately to check rotation of the propeller with directional arrow in the motor compartment.
3. When the fan is started, observe the operation and check for any unusual noises.
4. Motor amperage should be checked to avoid overloading of the motor. With the system in full operation measure current input to the motor and compare with the nameplate rating to determine if the BHP is operating under safe load conditions. See performance on page 2.
5. Keep inlets and approaches to fan clean and free from obstruction.

# Dayton® Hazardous Location Direct-Drive Exhaust Fans

## Maintenance

**▲ WARNING** Always disconnect, lock and tag power source before installing or servicing. Failure to disconnect power source can result in fire, shock or serious injury.

**▲ CAUTION** Uneven cleaning of the propeller will

produce an out of balance condition that will cause vibration in the fan.

1. Depending on the usage and severity of the contaminated air, a regularly scheduled inspection for cleaning the fan propeller, housing and surrounding areas should be established.

2. Check for unusual noises when fan is running.

3. Periodically inspect and tighten set-screws.

4. Follow motor manufacturer's instructions for motor lubrication.

## Troubleshooting Chart

Symptom	Possible Cause(s)	Corrective Action
Fan inoperative	1. Blown fuse or breaker 2. Incorrectly wired 3. Electricity turned off	1. Replace or repair 2. Shut power OFF and check wiring for proper connections 3. Contact local power company
Airflow - Reversed air Airflow - Too much air	1. Propeller rotation reversed 2. Insufficient static pressure	1. Reverse motor rotation, rewire motor 2. Check static pressure calculation
Excessive noise or vibration	1. Foreign material inside bearing 2. Loose propeller 3. Fan not securely anchored	1. Replace bearing 2. Tighten set screws or taper bushing screws 3. Secure properly
Motor overloads or overheats	1. Incorrect propeller rotation 2. Over/Under line voltage	1. Check motor wiring 2. Contact Power Company

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Manufactured for Dayton Electric Mfg. Co.

**Dayton®**

## **BLUE DIVIDER SHEET**

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Johnson Controls, Inc.  
Systems Products Division

507 East Michigan Street  
P.O. Box 423  
Milwaukee, WI 53201

## Series A19 Temperature Controls—Single-Pole, Single-Throw and Single-Pole, Double-Throw Models with NEMA 1 Enclosure

### Application

These controls are designed to cover a broad range of general purpose operating temperature control applications in the refrigeration, air conditioning and heating field with a minimum number of models. Typical applications are: frozen food cases, display cases, beverage coolers, milk coolers, etc. Various control ranges are available.

Controls are supplied with an adjustable range (except models with factory sealed settings) and adjustable or nonadjustable differential.

All Series A19 temperature controls are designed for use only as operating controls. Where an operating control failure would result in personal injury and/or loss of property, it is the responsibility of the installer to add devices (safety, limit controls) or systems (alarm, supervisory systems) that protect against, or warn of, control failure.

### Installation

Follow equipment manufacturer's instructions if provided. If instructions are not provided proceed as follows:

#### Mounting

Controls are normally mounted to a surface through holes in back of case.

**CAUTION:** On rough mounting surfaces use the top two mounting holes only. When these controls are mounted on an uneven surface using screws in all four holes, the case can be twisted enough to affect the control's calibration and operation.

For closed tank applications without well assembly Part No.

FTG13A-600R packing nut assembly may be supplied. See Fig. 3 for sequence of installation. Put parts over support tube section of element, placing bulb into tank. Tighten 1/2" NPT adapter. Screw packing nut into adapter with the retaining washers and packing in place as shown.

To install models supplied with bulb well, first install bulb well into tank. Remove bushing from bulb well and slide bushing over capillary. Replace bushing into bulb well. Push bulb into position in bottom of well. Tighten set screw in end of adapter to hold bulb in position. See Fig. 4 for bulb well illustration.

**CAUTION:** Do not dent or deform the sensitive bulb of this control. A dent or deformation will change the calibration and cause the control to cycle at a temperature lower than the dial setting. When the bulb mounting clip is used to mount the bulb near the refrigerant tubing, be sure the sheet metal screw does not pierce the tubing.

### Adjustments

The A19 temperature controls may be supplied with an external range adjustment and screwdriver slot as shown in Fig. 1, range adjustment knob or solid cover as shown in Fig. 7. Solid cover models with calibrated dial are adjusted by removing the cover and moving dial so the desired setting is in line with the dial pointer on the stop bracket. (See Fig. 8.) Convertible adjustment models can be field converted from concealed screwdriver slot adjustment to knob adjustment or external screwdriver slot adjustment. They are supplied with a snap-in plug in the cover to provide

### EXHAUST FAN T-STAT

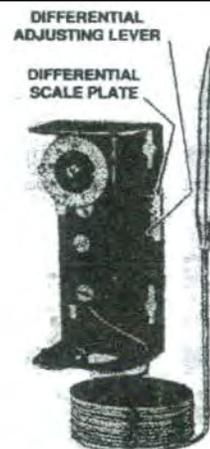


Fig. 1 — An A19 with external range adjustment and screwdriver slot.

concealed screwdriver slot adjustment. For knob adjustment remove the snap-in plug and press the knob onto the slotted shaft. For external screwdriver slot adjustment remove the snap-in plug. The convertible adjustment models with remote bulb include a bulb mounting clip.

Dial settings normally indicate the cutout setting unless otherwise specified by the equipment manufacturer. Models with SPDT



Fig. 2 — The Space Thermostats with convertible adjustment have a snap-in plug in the cover, built-in screwdriver slot and a knob for field installation.

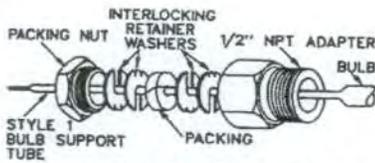


Fig. 3 — Part No. FTG13A-600R packing nut assembly. (Used with swaged bulb with support tube for direct immersion application.)

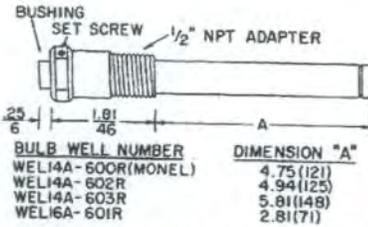


Fig. 4 — Bulb well for liquid immersion applications where a temperature bulb may be removed without draining tank.

contacts are normally set so the red (common) to yellow contacts open at the dial setting.

Models with adjustable differential and ranges of 20/80° F (-5/28° C), -30/50° F (-35/10° C) and -30/100° F (-35/40° C) have a differential scale plate showing differential in degrees. Other ranges have a scale plate (see Fig. 1) with a multiplier shown. For example when "MIN" differential is 5F° (2.8C°) then x2 is 10F° (5.6C°), x3 is 15F° (8.3C°), etc. The controls are supplied with adjusting lever at minimum differential stamped on the control. To adjust move the lever to the differential required.

Low cutout or high cutout stop supplied on certain models (specified by the equipment manufacturer).

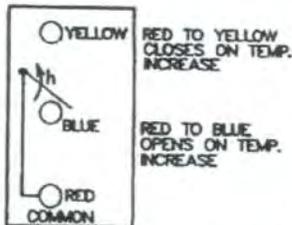


Fig. 5 — Terminal arrangement of SPDT models.

If high or low cutout stop adjustment is required proceed as follows:

1. Set dial to temperature at which stop is desired.
2. Remove cover of the control.
3. Loosen the cutout stop screw, slide the screw to the front of the temperature control against the plastic step behind the dial and tighten the screw. (See Fig. 8.) Sometimes an exact stop setting is not possible and stop must be set to the closest step corresponding to dial setting required.
4. Replace cover.

### Wiring

**CAUTION:** Disconnect power supply before wiring connections are made to avoid possible electrical shock or damage to equipment.

All wiring should conform to the National Electrical Code and local codes. Single-pole, double-throw models should be wired as shown in terminal drawing. Use copper conductor only. (See Fig. 5.)

**CAUTION:** Use terminal screws furnished (8-32 x 1/4" binder head). Substitution of other screws may cause problems in making proper connections.

### Checkout Procedure

Before applying power, make sure installation and wiring connections are according to job specifications. After the necessary mechanical adjustment and electrical connections have been made, an operational checkout is recommended.

Adjust the control set point to put the system in operation and observe at least three complete operating cycles to be sure that all components are functioning correctly.



Fig. 6 — The A19 with remote bulb and convertible adjustment has a snap-in plug in the cover, a knob for field installation and a bulb mounting clip.

If the system fails to operate, recheck the wiring and components.

### Repairs and Replacement

Field repairs must not be made. For a replacement control contact the nearest Johnson Controls wholesaler.



Fig. 7 — An A19 with solid cover and concealed adjustment.

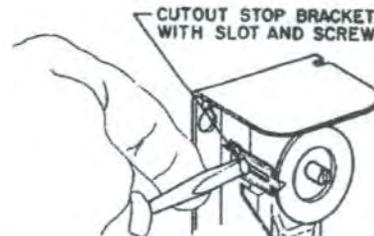


Fig. 8 — All models have a screw type cutout stop. The stop screw must be loosened and moved to the stop setting desired. Tighten screw after setting is made.

## **BLUE DIVIDER SHEET**

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**INSTALLATION, OPERATION, MAINTENANCE INSTRUCTIONS & SPARE PARTS LIST  
FOR NORSEMAN™ XB EXPLOSION-PROOF CONVECTION HEATER**

**1.0 PRE-INSTALLATION**

- 1.1 Initially, inspect the heater for possible damage due to shipping and handling. Claims for shipping damages shall be placed with the carrier.
- 1.2 Check the heater nameplate to ensure that the heater area classification and temperature code are suitable for the hazardous area classification.
- 1.3 Check to ensure that the heater voltage is the same as the supply voltage.

**2.0 INSTALLATION**

The heater must be installed by qualified personnel in strict compliance with the electrical code.

**2.1 GENERAL**

- 2.1.1 Norseman™ XB heaters are approved for wall or floor mounting with the terminal housing at the bottom. Ensure that is the wall sufficiently strong to support the heater which, depending on the model, could weigh up to 100 lbs. Otherwise use the brackets supplied to stand the heater on the floor.
- 2.1.2 Do not recess the Norseman™ XB heater into the wall. Use of the brackets supplied will ensure that the minimum spacing from the wall of 95mm (3.75 in.) is maintained.
- 2.1.3 If more than one heater is being installed, maintain at least 76mm (3 in.) between adjacent heater extrusions. **NEVER INSTALL ONE HEATER ABOVE THE OTHER.**
- 2.1.4 The Norseman™ XB heater relies on natural convection and "black heat" radiation to transfer heat to the surroundings. Try to maintain a 300 mm (12 in.) clearance and **NEVER LESS THAN 150 mm (6 in.)** clearance in front of and at the sides of the heater.
- 2.1.5 Use guard rails in front of the heater if there is a possibility that moving equipment could come in contact with the heater.

**2.2 REFLECTOR BAFFLES (T2D units only)**

Refer to Figure 1 when installing reflector baffles.

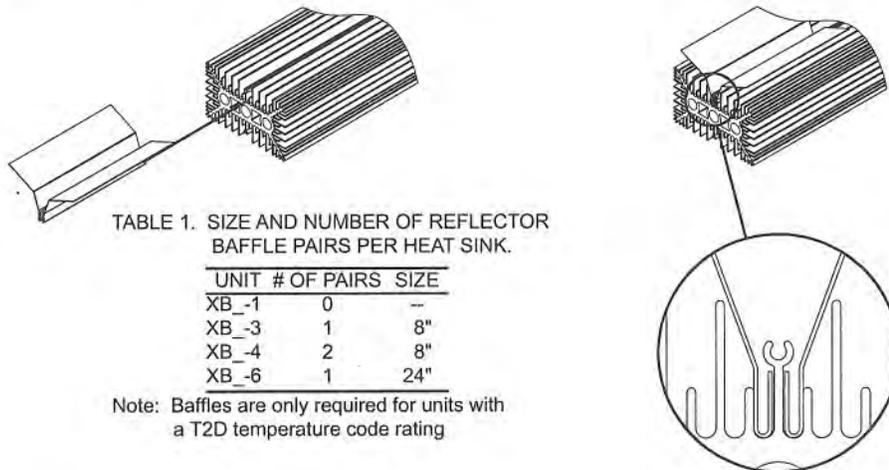


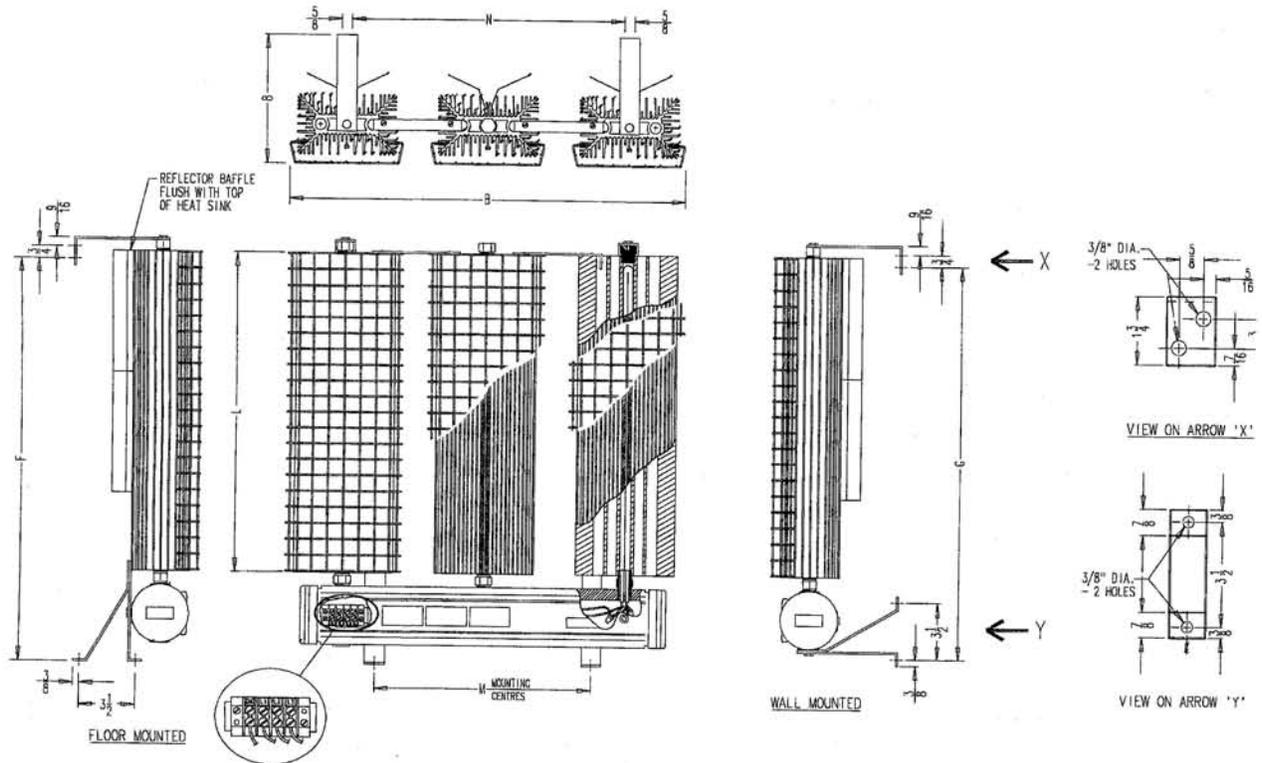
TABLE 1. SIZE AND NUMBER OF REFLECTOR BAFFLE PAIRS PER HEAT SINK.

UNIT	# OF PAIRS	SIZE
XB_-1	0	—
XB_-3	1	8"
XB_-4	2	8"
XB_-6	1	24"

Note: Baffles are only required for units with a T2D temperature code rating

**FIGURE 1. INSTALLATION OF REFLECTOR BAFFLES**

- 2.2.1 Position heater front face down on a flat surface.
- 2.2.2 With the fold in the baffle positioned between the keyhole fin and the adjacent short fin, slide reflector baffles onto back of heat sink.
- 2.2.3 Ensure reflector baffles are secure in place and flush with the top of the heat sink. If reflector baffles move freely, open the fold with a screw driver to improve the friction fit and reinstall baffles.



**FIGURE 2. NORSEMAN™ XB HEATER DIMENSIONS AND MOUNTING DETAILS**

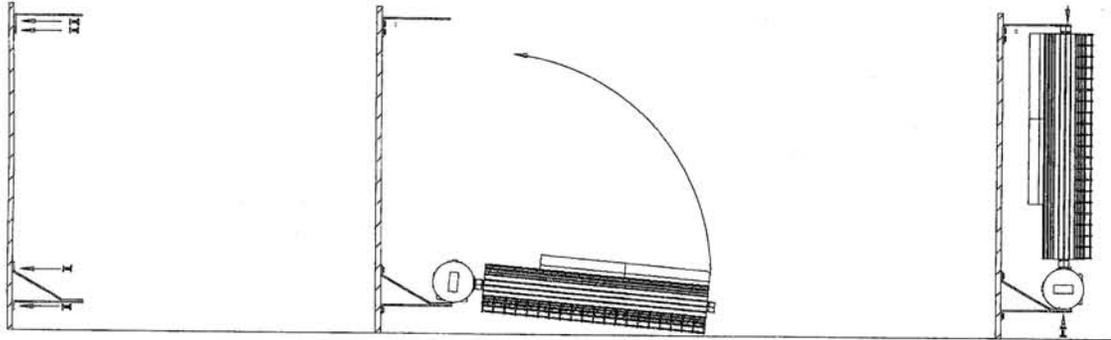
**TABLE 2. NORSEMAN™ XB HEATER DIMENSIONS**

UNIT	B	F	G	M	N
XB1-1		10 <sup>1</sup> / <sub>4</sub>	9 <sup>5</sup> / <sub>8</sub>		
XB1-3	7 <sup>1</sup> / <sub>4</sub>	17	16 <sup>3</sup> / <sub>8</sub>	--	--
XB1-4		23 <sup>5</sup> / <sub>8</sub>	23		
XB1-6		30 <sup>3</sup> / <sub>8</sub>	29 <sup>3</sup> / <sub>4</sub>		
XB2-1		10 <sup>1</sup> / <sub>4</sub>	9 <sup>5</sup> / <sub>8</sub>		
XB2-3	16 <sup>1</sup> / <sub>8</sub>	17	16 <sup>3</sup> / <sub>8</sub>	7 <sup>1</sup> / <sub>8</sub>	8 <sup>1</sup> / <sub>4</sub>
XB2-4		23 <sup>5</sup> / <sub>8</sub>	23		
XB2-6		30 <sup>3</sup> / <sub>8</sub>	29 <sup>3</sup> / <sub>4</sub>		
XB3-1		10 <sup>1</sup> / <sub>4</sub>	9 <sup>5</sup> / <sub>8</sub>		
XB3-3	25	17	16 <sup>3</sup> / <sub>8</sub>	13 <sup>3</sup> / <sub>4</sub>	17 <sup>1</sup> / <sub>8</sub>
XB3-4		23 <sup>5</sup> / <sub>8</sub>	23		
XB3-6		30 <sup>3</sup> / <sub>8</sub>	29 <sup>3</sup> / <sub>4</sub>		
XB4-1		10 <sup>1</sup> / <sub>4</sub>	9 <sup>5</sup> / <sub>8</sub>		
XB4-3	33 <sup>7</sup> / <sub>8</sub>	17	16 <sup>3</sup> / <sub>8</sub>	22 <sup>5</sup> / <sub>8</sub>	26
XB4-4		23 <sup>5</sup> / <sub>8</sub>	23		
XB4-6		30 <sup>3</sup> / <sub>8</sub>	29 <sup>3</sup> / <sub>4</sub>		

## 2.0 INSTALLATION CONT'D

### 2.3 WALL MOUNTING

Refer to Figures 2 and 3 for wall mounting instructions.



Secure wall and stabilizing brackets to mounting surface.

Position heater face down on floor with terminal box towards mounting brackets.

Angle heater such that the terminal box rests on bottom of wall bracket

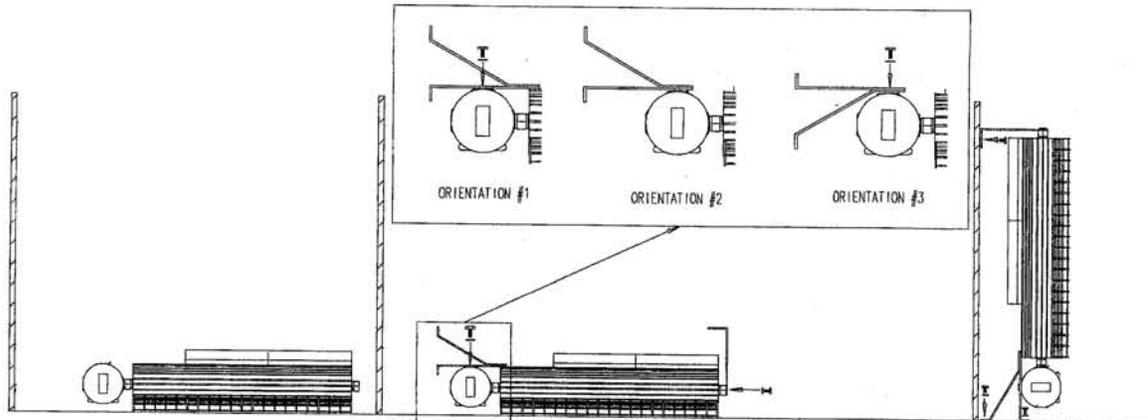
Lift top of heater and align with top stabilizing brackets. Secure with supplied 1/4"-20 hex bolts and lock washers

Secure bottom of heater to wall mounting brackets with supplied 1/4"-20 hex bolts and lock washers.

**FIGURE 3. WALL MOUNTING DIAGRAM**

### 2.4 FLOOR MOUNTING

Follow the instructions below referring to Figures 2 and 4.



Position heater face down on the floor with terminal box towards the wall.

Fasten top stabilizing bracket(s) and floor mounting bracket(s) to the unit. Floor mounting brackets may be mounted in one of three orientations.

Lift top of unit and position heater vertically against the wall. Secure stabilizing and floor mounting brackets to the mounting surfaces.

**FIGURE 4. FLOOR MOUNTING DIAGRAM**

### 2.5 INSTALLATION OF THERMOSTAT

#### 2.5.1 Factory Installed

For shipping purposes the thermostat well (located at back of unit) has not been installed.

Position thermostat bulb perpendicular to housing being careful not to kink the capillary. Slide well over bulb and screw into place. Make sure that a minimum 5 threads engagement is achieved.

#### 2.5.2 Field Installed Kit

Most Norseman™ XB units are suitable for field installation of a thermostat kit with the operator shaft hole on the front side of the unit and plugged with a socket head cap screw. If a thermostat is to be field installed, check to verify that you have been supplied with the correct thermostat kit. Single phase heaters use a single pole thermostat as supplied in kit number XTKW04481. Three phase heaters use a double pole thermostat as supplied in kit number XTKW04483. Follow the instructions supplied with the kit.

## 2.0 INSTALLATION CONT'D

### 2.6 WIRING

- 2.6.1 Whenever hazardous materials are present, ensure that the terminal housing covers are secure before powering the heater.
- 2.6.2 Use supply wires suitable for 105°C (221°F).
- 2.6.3 Use approved conduit and conduit seals as required by the code for hazardous locations.
- 2.6.4 To provide maximum protection each Norseman™ XB heater should be fused individually using the nearest standard fuse size which is not less than 120% of the expected line current.
- 2.6.5 All heaters come factory prewired and ready for direct connection to the power supply leads.
  - (a) Connect the power leads to terminals marked L1 and L2 for single phase and L1, L2 & L3 for three phase heaters as shown in Figure 5.
  - (b) Connect the ground wire to the ground connection located in the heater terminal housing.

### 3.0 START-UP

- 3.1 For heaters with a tamper-proof thermostat, to set temperature, disconnect the power and remove the socket head cap screw. Set the thermostat to the desired room temperature with a screw driver and replace cap screw.
  - 3.2 For heaters with an externally adjustable thermostat, set thermostat to desired temperature by adjusting the dial.
- NOTE:** The thermostat temperature range is -18°-40°C (0°-100°F) with an operating differential of 3-4°C(5-7°F). The room temperature setting should not exceed 24°C(77°F).
- 3.3 Install the terminal box cover and tighten securely.
  - 3.4 Check to ensure that all plugs, screws, and covers are securely in place.
  - 3.5 Check associated electrical equipment.
  - 3.6 Check that all wall/floor mounting bracket connections are tight.
  - 3.7 Turn on the supply power.

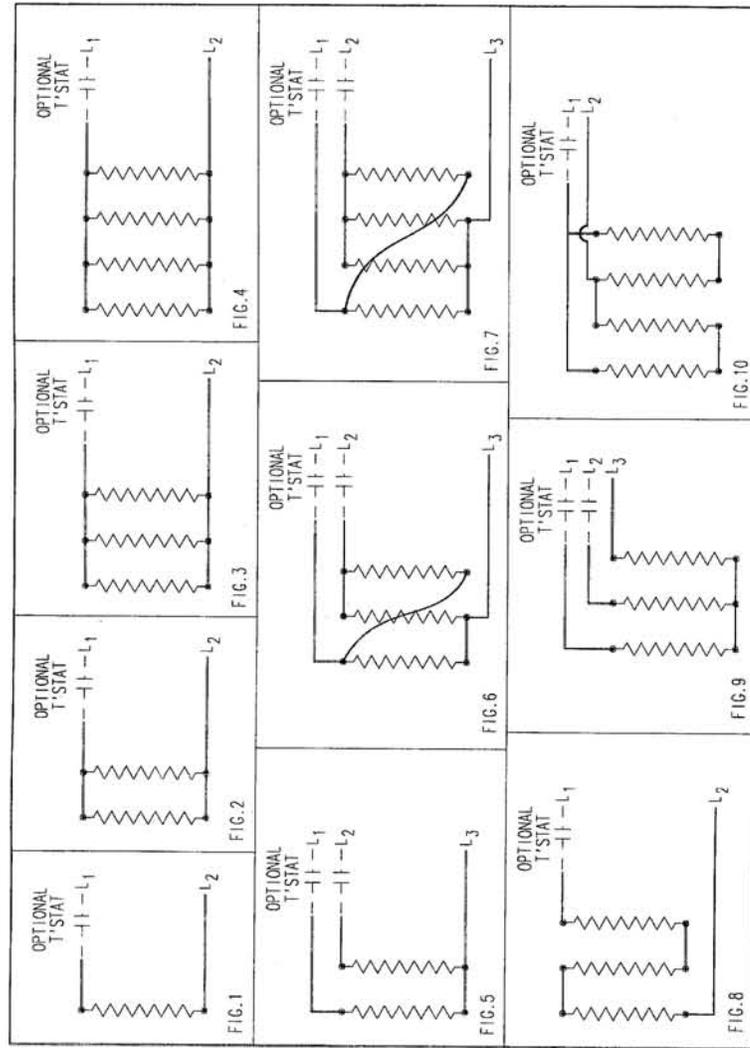
### 4.0 MAINTENANCE

- 4.1 Periodically inspect the heater installation to ensure that all connections, fittings, plugs, screws, covers, etc. are tight and free of corrosion.
- 4.2 Check that the reflector baffles (if required) have not moved upwards or downwards in relation to the heat sink.
- 4.3 Check the extrusions of the heater for dust and debris. A blast of compressed air is recommended for cleaning the fins. If air is not available, disconnect the power supply to the heater and when cool, wipe it down with a damp cloth or soft brush. Remove wire guards prior to cleaning.
- 4.4 The heat sink is anodized or painted black to ensure that the maximum area code temperature is not exceeded. After an extended period of use or in extremely harsh environments the anodization/paint may wear away leaving bare surfaces. For continued safe operation, these surfaces must be repainted. When repainting use only black high temperature resistant paint.
- 4.5 Except for thermostat replacement, field repair of the heater shall not be normally undertaken. In the event that the heater must be repaired, contact the factory for a return authorization number.

### 5.0 SPARE PARTS

#### 5.1 REPLACEMENT THERMOSTATS

VOLTAGE	THERMOSTAT PART NO.
ONE PHASE HEATERS	XTKW04481
THREE PHASE HEATERS	XTKW04483

**FIGURE 5. WIRING DIAGRAMS FOR NORSEMAN™ XB HEATERS**


XB4-6500T2D	FIG. 4 EXCEPT (XB4-6160T4A 600V & XB4-3250T2D 600V USE FIG. 10)	FIG. 7
XB4-6450T2D		
XB4-4375T2D		
XB4-6300T3B		
XB4-6300T3B	FIG. 3 EXCEPT (XB3-4150T3B 600V & XB3-6125T4A 600V USE FIG. 8)	FIG. 6 EXCEPT (XB3-4150T3B 600V & XB3-6125T4A 600V USE FIG. 9)
XB4-3250T2D		
XB4-4225T3B		
XB4-6160T4A		
XB4-1150T2D	FIG. 2	FIG. 5
XB4-6080T6		
XB3-6375T2D		
XB3-4300T2D		
XB3-6225T3B	FIG. 1	FIG. 1
XB3-3200T2D		
XB3-4150T3B		
XB3-6125T4A		
XB3-1125T2D	FIG. 1	FIG. 1
XB3-3100T3B		
XB3-1100T2D		
XB3-6060T6		
XB2-6250T2D	FIG. 1	FIG. 1
XB2-4200T2D		
XB2-6150T3B		
XB2-3150T2D		
XB2-4100T3B	FIG. 1	FIG. 1
XB2-6085T4A		
XB2-1075T2D		
XB2-6040T6		
XB1-6135T2D	FIG. 1	FIG. 1
XB1-6125T2D		
XB1-4100T2D		
XB1-3075T2D		
XB1-3047T3B	FIG. 1	FIG. 1
XB1-1047T2D		
XB1-6045T4A		
XB1-1030T3B		
XB1-6020T6	FIG. 1	FIG. 1
XB1-1017T4A		
XB1-1010T4A		
XB1-1005T6		
CAT. NO.	10	30
WIRING DIAGRAM		

**BLANK SHEET**

## **APPENDIX H**

### **SVE SYSTEM STARTUP**

## STEP TEST PROCEDURES

### SVE Test (Stage 1)

1. Start SVE system with dilution air 100% open.
2. Slowly close dilution valve until the SVE blower reaches maximum vacuum or dilution is 100% closed. Hold at this setting until vacuum reading stabilizes and document maximum well head vacuum.
3. Close ball valves on all wells except SVE03.
4. Open dilution air valve until the well head vacuum reaches 1/3 of the maximum from step 2.
5. Maintain wellhead vacuum setting by adjusting the dilution air. After 30 minutes, collect full round of system and well readings (see field form).
6. Repeat data collection every 30 minutes until readings stabilize or 2 hours of operation.
7. Collect vapor sample from discharge.
8. Increase wellhead vacuum to 2/3 of maximum from Step 2 and repeat Steps 5, 6 and 7.
9. Increase wellhead vacuum to maximum recorded during Step 4 and repeat Steps 5, 6 and 7.
10. Shut down SVE system and return wells SVE01 and SVE06 to operating configuration.

### SVE Test (Stage 2)

1. Start SVE system with dilution air 100% open.
2. Close ball valves on all wells except SVE04.
3. Open dilution air valve until the well head vacuum reaches 1/3 of the maximum from step 2 of **Stage 1**.
4. Maintain wellhead vacuum setting by adjusting the dilution air. After 30 minutes, collect full round of system and well readings (see field form).
5. Repeat data collection every 30 minutes until readings stabilize or 2 hours of operation.
6. Collect vapor sample from discharge.
7. Increase wellhead vacuum to 2/3 of maximum from Step 2 and repeat Steps 5, 6 and 7.
8. Increase wellhead vacuum to maximum recorded during Step 4 and repeat Steps 5, 6 and 7.
9. Shut down SVE system and return wells SVE01 and SVE06 to operating configuration.

			SVE01	SVE02	SVE03	SVE04	SVE05	SVE06	Vapor Probe	Soil Gas			SVE Blower Vacuum
1310	1/14/2016								0.05				83
1315	1/14/2016		48	45	49	44		46	48				
							Flow						
1345	1/14/2016		10	30	22	32		41	15	0.02	0.8		53

		DATE	TIME	DURATION	SVE WELL OPEN	SVE01	SVE06	Soil Probe	CARBON CANISTERS						SVE BLOWER VACUUM	
						Vacuum/Pressure	Vacuum/Pressure	Vacuum/Pressure	Soil Gas -Pre (PID ppm)	Air Flow	Air Temperature (F)	Soil Gas-Mid (PID ppm)	Soil Gas-Post (PID ppm)	Air Flow CFM)		Air Temperature (F)
S T A G E  1		1/14/2016		START	SVE03											
	0.16	1/14/2016	1410	0.5	SVE03	0	0	0	0.9	27	200	0	0	195	120	50
	0.16	1/14/2016	1440	1.0	SVE03	0	0	0	0.8	28	200	0	0	195	120	98
	0.16	1/14/2016	1510	1.5	SVE03	0	0	0	1	32	200	0	0	195	120	98
	0.16	1/14/2016	1540	2.0	SVE03											
	0.34	1/14/2016	1545	0.0	SVE03											
	0.34	1/14/2016	1615	0.5	SVE03	0.1	0	0.005	1	38	200	0	0	195	120	98
	0.34	1/14/2016	1645	1.0	SVE03	0.1	0	0.005	1.1	34	200	0	0	195	120	98
	0.34	1/14/2016	1715	1.5	SVE03	0.1	0	0.005	1.2	32	200	0	0	195	120	98
					2.0	SVE03										
	0.49	1/15/2016	815	0.0	SVE03											
	0.44	1/15/2016	845	0.5	SVE03	0.1	0	0.01	1.5	22	200	0	0	195	120	98
0.42	1/15/2016	915	1.0	SVE03	0.1	0	0.01	1.4	26	200	0	0	195	120	98	
0.49	1/15/2016	945	1.5	SVE03	0.1	0	0.01	1.4	26	200	0	0	195	120	98	
		1/15/2016		2.0	SVE03											
S T A G E  2	0.12	1/15/2016	955	0.0	SVE04											
	0.09	1/15/2016	1025	0.5	SVE04	0	0	0	0.1	34	200	0	0	160	120	150
	0.1	1/15/2016	1055	1.0	SVE04	0	0	0	0.1	38	200	0	0	160	120	150
	0.09	1/15/2016	1125	1.5	SVE04	0	0	0	0.1	43	200	0	0	160	120	150
	0.11	1/15/2016	1155	2.0	SVE04	0	0	0	0.1	42	200	0	0	160	120	147
	0.3	1/15/2016	1200	0.0	SVE04											
	0.19	1/15/2016	1230	0.5	SVE04	0	0	0	0.1	41	200	0	0	170	120	147
	0.14	1/15/2016	1300	1.0	SVE04	0	0	0	0.1	45	200	0	0	165	120	138
	0.18	1/15/2016	1330	1.5	SVE04	0	0	0	0.1	45	200	0	0	165	120	136
	0.16	1/15/2016	1510	2.0	SVE04	0.18	--	0	0.1	45	200	0	0	165	120	136
	0.16	1/15/2016	1610	0.0	SVE04											
	0.16	1/15/2016	1640	0.5	SVE04	0.18	0.22	0	0.1	23	200	0	0	165	120	138
0.16	1/15/2016	1710	1.0	SVE04	0.17	0.21	0	0.1	22	200	0	0	165	120	133	
				1.5	SVE04											
				2.0	SVE04											

Measured at SVE03  
Measured at SVE05

P8/13

CHECKLIST ITEM	REFERENCE <sup>1</sup>	RESPONSIBLE	INITIALS	TIME/DATE	COMMENTS
<b>DO NOT TURN ON THE MAIN SYSTEM POWER DISCONNECT UNTIL THE FOLLOWING PROCEDURE HAS BEEN COMPLETED. FAILURE TO FOLLOW THESE INSTRUCTIONS MAY RESULT IN SERIOUS DAMAGE TO THE SYSTEM.</b>					
Connect antenna to modem before powering up system	Section 3.1.8	Trihydro			
Remove the plug from the SVE stack coupling and install the stack completely before starting system.	Section 4.2	Trihydro	JR	1/13/16 @ 1005	
Install temperature sensor and flow sensor (if supplied) into the ports on the exhaust stack. Typically these components are removed from the stack and tied off at a location near to the SVE switch box prior to shipping.	Section 4.2		NA		
Flexible pipe couplers and 2-inch clear PVC hose was supplied to connect customers SVE line stub-ups to the SVE manifold. The clear PVC hose should be cut to length to fit between the pipe stub-up and the corresponding SVE manifold line. The flexible couplers are installed halfway over both ends of the hose and clamped. The other side of each flexible coupler is then clamped onto the pipe.	Section 4.2	Trihydro	JR	1/13/16 @ 0945	
If supplied, mount building anchor brackets to concrete slab using supplied concrete anchor bolts at locations shown on drawings and then attach to building 4x4 woods skids using supplied	Section 4.2	Trihydro	JR	12/22/15	
Make sure all circuit breakers inside the control panel are placed in the OFF position (switch handles down).	Section 4.3	Electrician	GA	1/13/16 @ 1020	
Make sure all motor controller devices located inside the control panel are placed in the OFF position (black knob handle turned to sideways (9:00) position)	Section 4.3	Electrician	GA	1/13/16 @ 1001	
Make sure all H-O-A switches and ON/OFF switches on the swing-out panel door are placed in the OFF position.	Section 4.3	Electrician	GA	1/13/16 @ 1001	
Locate the Surge Arrester inside the control panel and remove the four (4) Surge Arrester plug-in modules. <b>Make sure to note which module goes in which slot so they can be re-installed in the proper position at the end of this procedure. !!!Warning !!! Placement of the modules in the wrong position on a system with a wild leg will result in module failure.</b>	Section 4.3	Electrician	GA	1/13/16 @ 1003	
With the control panel door closed and latched, place the Main Service Disconnect switch in the ON position.	Section 4.3	Electrician	GA	1/13/16 @ 1003	
Open the control panel door and swing-out panel door and check voltages at the Main Power Distribution Block located inside the control panel. Measure voltage between all three phases and between each phase and the neutral block to verify proper voltage is being supplied to the system.	Section 4.3	Electrician	GA	1/13/16 @ 1005	

CHECKLIST ITEM	REFERENCE <sup>1</sup>	RESPONSIBLE	INITIALS	TIME/DATE	COMMENTS
If the supplied power is three phase and possibly contains a wild leg, it MUST be verified that the wild leg phase is connected to L2 at the control panel main power distribution block BEFORE any of the system circuit breakers, motor controllers, or equipment H-O-A switches are turned ON.	Section 4.3	Electrician	SR	11/13/16	1006
Check status of the LED located on the face of power monitor located inside control panel.	Section 4.3	Electrician	SR	11/13/16	Green
Once the Power Monitor LED is steady GREEN, and it has been verified that, if present, the wild leg is connected to L2 at the panel, the power being supplied to the system is acceptable.	Section 4.3	Electrician	SR	11/13/16	check
Turn OFF the Main Power Disconnect and re-install the surge arrester modules back into the proper slots on the surge arrester base module.	Section 4.3	Electrician	SR	11/13/16	1008
After surge arrester modules have been re-installed, turn the Main Power Disconnect switch back to the ON position.	Section 4.3	Electrician	SR	11/13/16	1005
Turn all circuit breakers and motor controller switches to the ON position.	Section 4.3	Electrician	SR	11/13/16	1010
Turn on the Control Power switch ON/OFF switch to the ON position. Leave all of the other H-O-A and ON/OFF switches in the OFF position.	Section 4.3	Electrician	SR	11/13/16	1010
Turn the Building Light switch to the ON position to activate the interior building light.	Section 4.4	Trihydro	SR	11/13/16	1010
Verify that the Equipment Heater is set to approximately 40 degrees Fahrenheit. The Building Heater Thermostat is located on the bottom front of the Building Heater.	Section 4.4	Trihydro	C	11/13/16	check
Verify that the Building Fan Thermostat, located in the control panel, is set to around 80-85 degrees Fahrenheit.	Section 4.4	Trihydro	SR	11/13/16	82°F
Open the SVE manual bleed air valve and each extraction line control valve to the full open position by turning CCW.	Section 4.5	Trihydro	SR	11/13/16	1013
check blower rotation, bump the motor by momentarily switching the H-O-A switch to the HAND position while another person monitors the equipment. Proper rotation of the SVE blower can be verified by checking for vacuum at an inlet sample port, seeing if the rain cap on the exhaust stack flips up or by checking to see if the motor fan rotation matches the rotation arrow marked on the blower (if marked).	Section 4.5	Trihydro Electrician	SR	11/13/16	1030
Set the 24 Hour Timer. Timer operation is described in Section 3.1.2.	Section 4.5	Trihydro	SR	11/13/16	check
Place the SVE blower (H-O-A) switch in AUTO position, then set the heat exchanger (H-O-A) switch in the AUTO position. Both the SVE blower and Heat Exchanger should activate along with their respective green run lights at this time.	Section 4.5	Trihydro	SR	11/13/16	1013

8/3/3

CHECKLIST ITEM	REFERENCE <sup>1</sup>	RESPONSIBLE	INITIALS	TIME/DATE	COMMENTS
With the SVE blower (H-O-A) switch in AUTO, gradually adjust bleed air valve and set flows at individual extraction lines to desired flow and vacuum values. If adjustments in individual extraction lines results in excessive high vacuum at the blower inlet, lower system vacuum by opening the bleed air valve.	Section 4.5	Trihyje		6/13/16 @ 1300	

NOTES: 1) Activities referenced in Section 4.3 are to be completed by Schine Electric

**APPENDIX I**

**INJECTION INFORMATION**

## ROXY CLEANERS ISB DESIGN

80 ft	treatment zone length, north to south
40 ft	treatment zone width, east to west
4 ft	vertical thickness of treatment zone
4,025 ft <sup>2</sup>	area of treatment zone accounting for ramp
16,100 ft <sup>3</sup>	volume of treatment zone
0.1 -	treatment zone effective porosity
0.6 -	fraction of effective pore volume injected
7,226 gal	total volume injected
17 -	number of injection locations
425 gal	volume injected per location
6.7 ft	cylindrical fluid radius of influence
4.0 gpm	possible injection flow rate
1.8 hours	duration of injection at possible flow rate
30.1 hours	total injection duration, exclusive of moving equipment, abandoning borings etc.
0.12 lb/ft <sup>3</sup>	EVO loading rate
1,932 lbs	total EVO injected
8.757 lb/gal	EVO density
221 gal	total EVO volume required
13.0 gal	EVO volume per location
3.1% by vol.	Concentration of EVO
5,138 g/L	approximate TOC concentration in treatment zone

# UULC - Montana

**Ticket No:** 16001532

2 FULL BUSINESS

DAYS

**Original Call Date:** 01/18/16 09:23 am  
**Work to Begin Date:** 01/21/16 12:00 am

### CALLER INFORMATION

**Company Name:** REMMINGTON TECHNOLOGIES

**Best Time:**

**Contact Name:** SUE HAREM  
**Alt. Contact:** CELL

**Phone:** 970-278-1646  
**Phone:** 970-488-0136  
**Fax Phone:**

**Email Address:** sharem@remmingontech.net

### DIG SITE INFORMATION

**Type of Work:** ENVIRONMENTAL REMEDIATION SOIL BORING  
**Work Being Done For:** TRIHYRDO CORP

### DIG SITE LOCATION

**State:** MT **County:** HILL  
**Place:** HAVRE **Address:** 417  
**Street:** 1ST ST  
**Intersecting Street:** 5TH AVE

**Location of Work:** EXCAVATION SITE IS ON THE N SIDE OF THE ROAD. ADD IS APX 200FT W OF INTER MARK ALL UTILITIES GOING INTO THE BUILDING FROM 1ST ST

**Remarks:** BEST INFORMATION AVAILABLE

**Caller Twp:** 32N **Rng:** 16E **Sect-Qtr:** 8-NE,5-SE

**Map Twp:** 32N **Rng:** 16E **Sect-Qtr:** 8-NE,5-SE

**Map Coord NW Lat:** 48.5542404 **Lon:** -109.6763208  
**SE Lat:** 48.5531269 **Lon:** -109.6752647

### MEMBERS NOTIFIED

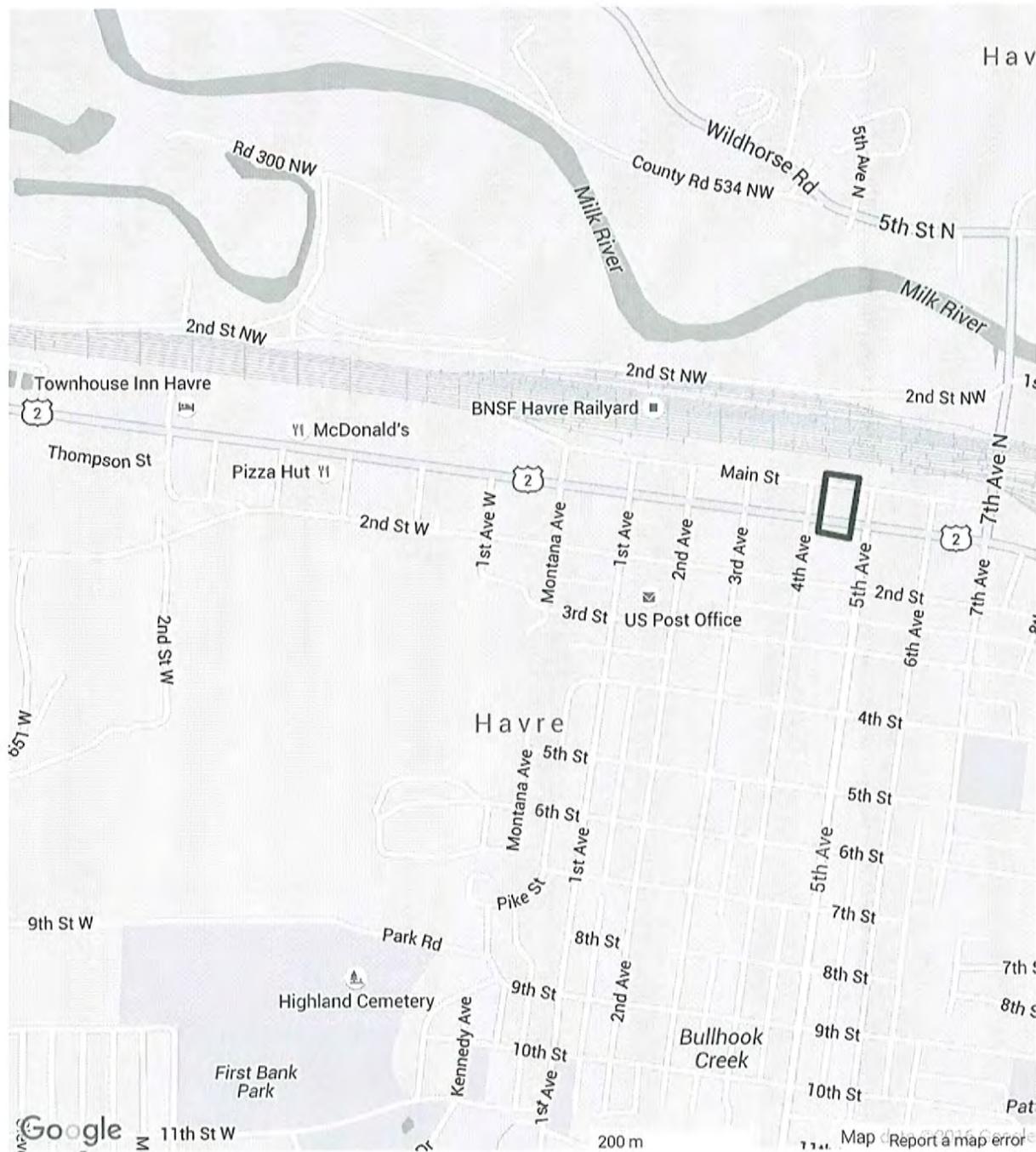
District	Company Name	Marking Concerns	Customer Service	Repair
ATTCBL19	CHARTER COMMUNICATIONS	406-431-0859	866-200-6216	866-200-6216
HAVRE02	CITY OF HAVRE	406-265-4941	406-265-4941	406-265-4941

District	Company Name	Marking Concerns	Customer Service	Repair
HILLRD01	HILL COUNTY ROAD DEPT	406-265-8507	406-265-8507	406-265-8507
MPC40	NORTHWESTERN ENERGY	888-467-2353	888-467-2669	888-467-2353
MTDOT13	MONTANA D.O.T. - HAVRE	406-262-5500	406-262-5500	406-262-5500
QLNMT25	CTLQL-CENTURYLINK		800-283-4237	800-573-1311

Legend:  Locate Polygon

48.553059

Lat/Lon -109.675612





# Remington

PROBLEM SOLVED

Soil and Groundwater Remediation  
8100 Arkins Court  
Loveland, CO 80538  
(970) 278-1646

---

James Gleason  
Trihydro Corporation  
1252 Commerce Drive  
Laramie, Wyoming 87107

February 2, 2016

Re: Remediation Injection Report  
Roxy's Cleaners  
417 1<sup>st</sup> Street, Havre, Montana  
Montana Department of Environmental Quality (DEQ) Interim Action

Dear Mr. Gleason,

Remington Technologies, LLC (Remington) personnel and equipment mobilized to 417 1<sup>st</sup> Street, Havre, Montana on January 17, 2016. The following morning, January 18, 2016, Remington representatives arrived onsite at 0730 hours to discuss the scope of work. After discussing the scope of work, an initial plan to perform tasks was communicated between the party representatives of Trihydro Corporation (Trihydro) and Remington Technologies (Remington).

Before work began, the job hazard analyses (JHAs), health and safety plan (HASP) and the emergency evacuation plans were discussed between Trihydro and Remington representatives. Documentation of the daily safety meetings remained in the company vehicle for inspection throughout the duration of the injection event.

The tasks completed throughout the injection event included:

- Conducted borehole clearance to ensure both injection areas were clear of any utility lines.
- Completed the waterworks paperwork to receive water during the duration of the injection event.
- Transported the Geoprobe® M540 to the basement of the facility to drill the 23 temporary injection points used for the remedial injection event.
- Injected 3.1 percent Emulsified Vegetable Oil (EVO) solution into the subsurface.
- Delivered 425 gallons of diluted EVO per injection point (Unless specified in Tables 1 through 5 below).
- Injected a total of 10,625 gallons of EVO solution throughout the duration of the injection event.

- Communicated all actions with Trihydro Corporation representative.
- Reported the Incident Report/Loss Time Prevention Observation (LTPO) to Remington management and the Trihydro Corporation client representative. (Report included in Attachment).
- Cleaned and restored all site conditions to alike or better conditions.

Details regarding daily injection parameters for each injection point, including job site location, total times, volumes, injection depths, flow rates and pressures, can be reviewed in Tables 1 through 5.

Work was completed on the 26<sup>th</sup> of January at 1830 hours. Figure 1 shows the location of the injection borings.

The proposed SOW was completed with the following deviations:

<b>Proposed SOW</b>	<b>Deviations from SOW</b>
Full scale injection event	NONE
3.1 percent EVO solution	NONE
17-25 temporary injection points	NONE (23 temporary injection points)
425 gallons of solution per injection point	Varied due to EVO volume purchased. Read Variations in Volume below.
220 - 325 gallons of EVO	318 gallons of EVO
2,425 – 3,585 pounds of EVO	3,506 pounds of EVO
10,625 gallons of EVO solution	NONE

### **Variations in Volume**

Minimal surfacing occurred whiling injecting the temporary injection points. As a result, one of the locations did not receive the intended amount of solution. The remaining locations that were capable of receiving additional solution were utilized to further degrade the chemicals of concern (COCs) remaining onsite.

### **Borehole Abandonment**

After the injections, each borehole was abandoned by placing sand from the bottom of the borehole to ground water surface. After sand was added, bentonite was poured and hydrated from groundwater surface to approximately 1.5 feet bgs. Sand was used to fill the void space from 1.5 feet bgs to 0.5 feet bgs. Concrete material was placed in the remaining portion of the borehole up to ground surface to match site conditions.

### **Waste Disposal**

During the injection event, no investigation-derived waste was generated. No future manifest or action will be required by Trihydro Corporation or Remington Technologies for the injection event.

**Summary**

In summary, the work proposed on November 16, 2015 was successful by completing the injection of a total of 10,625 gallons of EVO remedial material. A daily average injection summary for this event can be viewed in Table 6.

Influence from injecting remedial material was not immediately observed during the field study activities at the surrounding monitoring wells located outside the facility. Based on the full scale injection data, injection of remedial material is feasible, however, the effectiveness in reducing chlorinated solvents [tetrachloroethene (PCE), trichloroethene (TCE), vinyl chloride (VC) and cis/trans-1,2-dichloroethene] concentrations levels is unknown at this time.

Additional groundwater monitoring data is suggested to evaluate and confirm effectiveness of the full scale injection event and for future full scale injection event design.

If you have any questions or comments, please contact Grant Drennan or Sue Harem at (970) 278-1646.

Sincerely,

**Remington Technologies, LLC**

Grant Drennan  
Vice President of Operations  
[Gdrennan@RemingtonTech.Net](mailto:Gdrennan@RemingtonTech.Net)



Susan Harem  
Office Manager  
[SHarem@RemingtonTech.Net](mailto:SHarem@RemingtonTech.Net)

Table 1

		<b>DAILY INJECTION FIELD LOG SHEET</b>						
Client/Project:	Trihydro Corporation / Roxy's Cleaners				Client Representative:	Joel Riebli		
Technicians:	Eric Coonrad / Robby Orr / Josh Absalom				Time of Arrival:	0730		
Site Address:	417 1st Street, Havre, Montana							
Daily Tasks Completed:	3 injection locations / 975 gallons of EVO solution							
Boring ID No.	Date	Start Time	End Time	Total Time	Injection Interval	Average PSI	Average Flow Rate (gpm)	Total Injected @ interval (gal.)
A-2	1/20/16	12:19	12:49	30	7.5'-8'	1	14.17	425
A-5	1/20/16	12:55	13:15	20	7.5'-8'	1	5.00	100
A-8	1/20/16	15:00	15:30	30	7.5'-8'	1	15.00	450
Daily Injection Summary / Average		Injection Time (min.)		80		1.00	11.39	975

Table 2

 <b>Remington</b> PROBLEM SOLVED		<b>DAILY INJECTION FIELD LOG SHEET</b>						
<b>Client/Project:</b>	Trihydro Corporation / Roxy's Cleaners			<b>Client Representative:</b>	Joel Riebli			
<b>Technicians:</b>	Eric Coonrad / Robby Orr / Josh Absalom			<b>Time of Arrival:</b>	0730			
<b>Site Address:</b>	417 1st Street, Havre, Montana							
<b>Injection Scope of work:</b>		4 injection locations / 1,700 gallons of EVO solution						
Boring ID No.	Date	Start Time	End Time	Total Time	Injection Interval	Average PSI	Average Flow Rate (gpm)	Total Injected @ interval (gal.)
C-6	1/21/16	11:41	12:16	35	7.5'-8'	5	12.14	425
C-3	1/21/16	12:18	12:50	32	7.5'-8'	45	13.28	425
D-4	1/21/16	12:55	13:15	20	7.5'-8'	5	6.25	125
D-4	1/21/16	13:58	14:29	31	7.5'-8'	1	9.68	300
F-4	1/21/16	14:32	15:05	33	7.5'-8'	15	12.88	425
<b>Daily Injection Summary / Average</b>		<b>Injection Time (min.)</b>		<b>151</b>		<b>14.20</b>	<b>10.85</b>	<b>1700</b>

Table 3

 <b>Remington</b> PROBLEM SOLVED		<b>DAILY INJECTION FIELD LOG SHEET</b>						
<b>Client/Project:</b>	Trihydro Corporation / Roxy's Cleaners				<b>Client Representative:</b>	Joel Riebli		
<b>Technicians:</b>	Eric Coonrad / Robby Orr / Josh Absalom				<b>Time of Arrival:</b>	0730		
<b>Site Address:</b>	417 1st Street, Havre, Montana							
<b>Injection Scope of work:</b>		5 injection locations / 2,125 gallons of EVO solution						
Boring ID No.	Date	Start Time	End Time	Total Time	Injection Interval	Average PSI	Average Flow Rate (gpm)	Total Injected @ interval (gal.)
D-9	1/22/16	10:48	11:20	32	7.5'-8'	5	13.28	425
C-10	1/22/16	11:38	12:11	33	7.5'-8'	10	12.88	425
F-7	1/22/16	13:02	13:59	57	7.5'-8'	1	7.46	425
D-8	1/22/16	15:14	15:49	35	7.5'-8'	1	12.14	425
E-10	1/22/16	16:00	16:22	22	7.5'-8'	1	19.32	425
<b>Daily Injection Summary / Average</b>		<b>Injection Time (min.)</b>		<b>179</b>		<b>3.60</b>	<b>13.02</b>	<b>2125</b>

Table 4

		<b>DAILY INJECTION FIELD LOG SHEET</b>						
<b>Client/Project:</b>	Trihydro Corporation / Roxy's Cleaners				<b>Client Representative:</b>	Joel Riebli		
<b>Technicians:</b>	Eric Coonrad / Robby Orr / Josh Absalom				<b>Time of Arrival:</b>	0730		
<b>Site Address:</b>	417 1st Street, Havre, Montana							
<b>Injection Scope of work:</b>		5 injection locations / 2,125 gallons of EVO solution						
Boring ID No.	Date	Start Time	End Time	Total Time	Injection Interval	Average PSI	Average Flow Rate (gpm)	Total Injected @ interval (gal.)
D-2	1/23/16	9:59	10:53	54	7.5'-8'	10	7.87	425
H-1	1/23/16	11:14	11:58	44	7.5'-8'	1	9.66	425
H-5	1/23/16	14:11	15:16	65	7.5'-8'	1	6.54	425
H-8	1/23/16	16:03	17:02	59	7.5'-8'	1	7.20	425
G-9	1/23/16	18:00	19:00	60	7.5'-8'	1	7.08	425
<b>Daily Injection Summary / Average</b>		<b>Injection Time (min.)</b>		<b>282</b>		<b>2.80</b>	<b>7.67</b>	<b>2125</b>

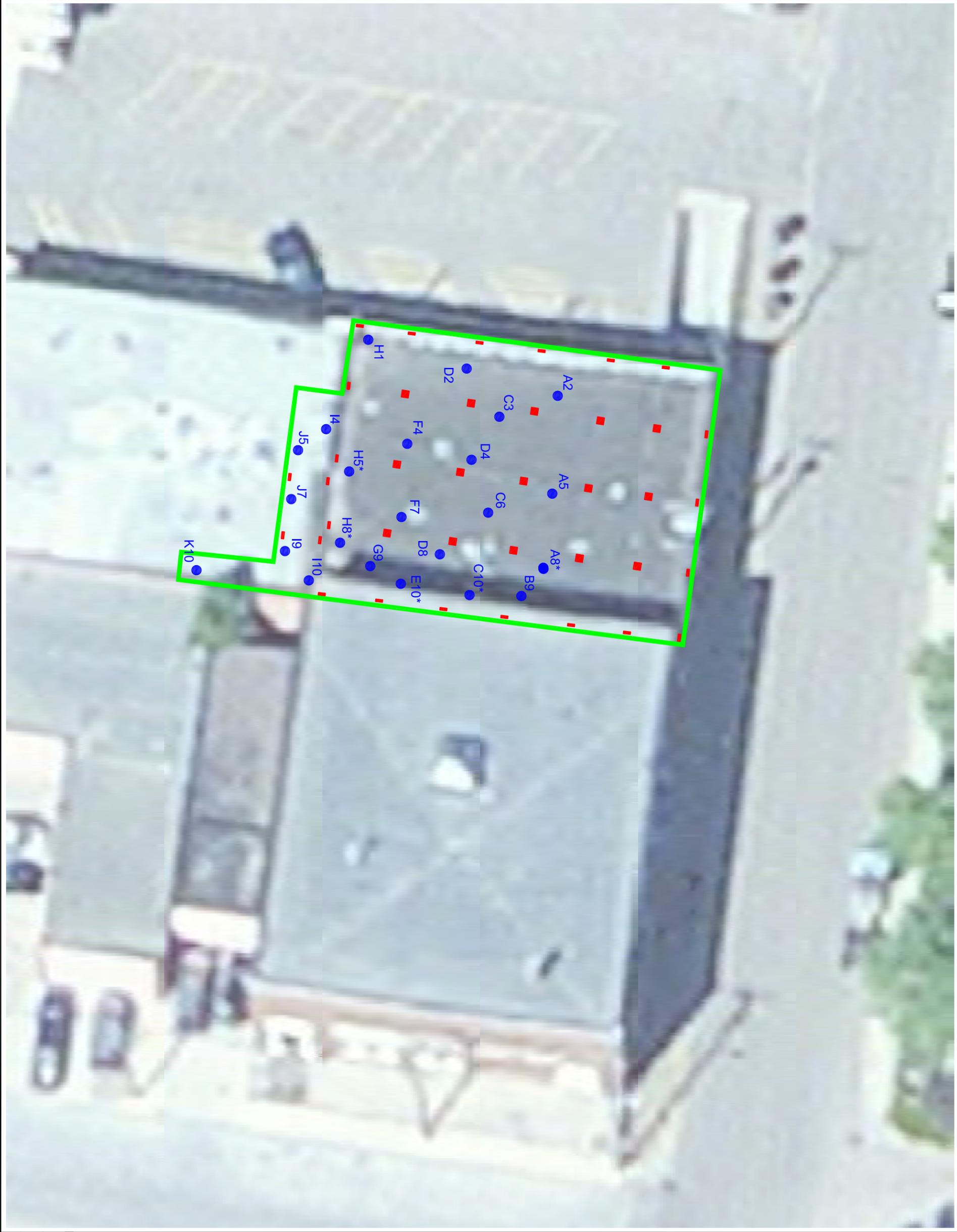
Table 5

 <b>Remington</b> PROBLEM SOLVED		<b>DAILY INJECTION FIELD LOG SHEET</b>						
<b>Client/Project:</b>	Trihydro Corporation / Roxy's Cleaners			<b>Client Representative:</b>	Joel Riebli			
<b>Technicians:</b>	Eric Coonrad / Robby Orr / Josh Absalom			<b>Time of Arrival:</b>	0730			
<b>Site Address:</b>	417 1st Street, Havre, Montana							
<b>Injection Scope of work:</b>		6 injection locations / 3,700 gallons of EVO solution						
Boring ID No.	Date	Start Time	End Time	Total Time	Injection Interval	Average PSI	Average Flow Rate (gpm)	Total Injected @ interval (gal.)
I-4	1/25/16	14:10	15:35	85	7.5'-8'	15	5.00	425
J-5	1/25/16	10:56	11:55	59	7.5'-8'	15	7.20	425
J-7	1/25/16	12:09	13:55	106	7.5'-8'	5	8.02	850
J-9	1/25/16	13:39	15:10	91	7.5'-8'	1	7.97	725
I-10	1/25/16	8:36	9:36	60	7.5'-8'	1	3.75	225
I-10	1/25/16	15:43	16:05	22	7.5'-8'	5	9.09	200
K-10	1/25/16	9:53	13:18	205	7.5'-8'	8	4.15	850
<b>Daily Injection Summary / Average</b>		<b>Injection Time (min.)</b>		<b>628</b>		<b>7.14</b>	<b>6.45</b>	<b>3700</b>

Table 6

		<b>Cumulative Injection Log</b>			
<b>Client/Project Name:</b>		<b>Trihydro Corporation / Roxy's Cleaners</b>			
Day	Date	Total Time (min.)	Average PSI	Average Flow Rate (gpm)	Total Injected (gal.)
Day 1	1/20/16	80	1.00	11.39	975
Day 2	1/21/16	151	14.20	10.85	1700
Day 3	1/22/16	179	3.60	13.02	2125
Day 4	1/23/16	282	2.80	7.67	2125
Day 5	1/25/16	628	7.14	6.45	3700
<b>Injection Summary Average</b>		<b>1320</b>	<b>6.24</b>	<b>9.48</b>	<b>10625</b>

### Injection Map



# LEGEND

- INJECTION POINT (\* INDICATES THAT THE INJECTION POINT COULD NOT BE COMPLETED BECAUSE OF FOUNDATION MATERIAL AND THE INJECTION POINT WAS MOVED)

- SUPPORT COLUMN



COORDINATE SYSTEM: STATE PLANE, MONTANA,  
NAD83, U.S. SURVEY FOOT



**Remington**

**PROBLEM SOLVED**  
8100 ARKINS COURT  
LOVELAND, CO 80538  
970-278-1646  
WWW.REMINGTONTECH.NET

**FIGURE 1**

AS-BUILT INJECTION POINTS  
ROXY'S CLEANERS  
417 1ST STREET  
HAVRE, MT

DRAWN BY: CAH CHECKED BY: GD

SCALE: 1" = 20'

DATE: 2/02/16

## Incident Report

**INCIDENT REPORT / LOSS TIME PREVENTION OBSERVATION (LTPO)**

**Incident Category:**

Incident: (Yes or No): No  
Near Miss: (Yes or No): Yes

**Incident Type (Yes or No)**

Property damage: No  
Injury: No                      First Aid Provided: No    Hospitalized: No  
Chemical release: No      Chemical Released (Name): N/A  
Automotive: No              Theft: No                      Equipment: Yes

**INCIDENT AND PROJECT SUMMARY**

Date of Incident: 01/20/2016                      Time: 1300 hours  
Date Reported to Management: 01/20/2016      Time: 1700 hours  
Client Name: Trihydro Corporation  
Project Site Name: Roxy's Cleaners                      Address: 417 1<sup>st</sup> Street, Havre, Montana

**Work Activity being conducted:** A Remington representative was about to begin core drilling activities.

**Name of Employee(s):** N/A

**Crew Leader of Project:** N/A

**Other Subcontractor Onsite (if Yes name):** N/A

**Client Contact Onsite:** N/A

**Other Witnesses:** N/A

**INCIDENT DETAILS**

**Conditions at Site:** Weather: Sunny 15 degrees                      **Lighting:** Work was being completed in the basement, lighting was fair.

**Detail of Incident (Who, What, When, Where and How):**

After team lifting the portable core drill from the back of the Dodge Ram 3500 to the basement of the Roxy's Cleaners project in Havre, Montana a Remington representative inspected the equipment and noticed one of the four hex bolts backed out of the machine. The four hex bolts secure the diamond core bit to the powered source to allow the bit to cut through the surface material. It was determined the bolt loosened due to vibration from previous field activities or the drive to the project site location.

**Employee Name Reporting:** N/A

**Signature:** N/A

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**Corrective Action Meeting Held: (Yes or No):** Yes

**Date:** 01/20/2016

**Personnel Attending Meeting:** All personnel onsite

**What Contributing Factors Led to the Incident?** As equipment begins to age bolt(s) typically begin to back out and servicing equipment is needed. The simplicity of this particular piece of equipment is easy to inspect and is done so before each use. In the opinion of the operator no safety incident would have occurred if the inspection was not made. The four inch all thread hex bolt was backed out 1/8 of an inch and remained mostly secure but not to manufacturer condition.

**Corrective Actions:** During the investigation and personnel discussions, a plan was set forth to inspect the bolts for unusual wear. Upon inspection the bolt were determined to still be in manufacturer condition. The bolts were then dipped into a Loctite® paste and secured to the power source of the machine. Before using the core drill unit the equipment was returned to manufacture specifications.

**Corrective Actions Assigned To:** Crew Leader on Site

**Date Due:** 01/20/2016

**Environmental Release (Yes or No):** No

**If yes, Product/Material Name Released:** N/A

**Person Notified of Release (Remington and/or Client):** N/A

**If yes, Product/Material Name Released:** N/A

**Amount Released:** N/A

**Amount Recovered:** N/A

**Corrective Actions Completed By:** N/A

**Title:** N/A

**Phone:** (970)278-1646

**Date:** 01/20/2016

JANUARY 2016 EVO INJECTIONS

MDEQ SRS ROXY CLEANERS, HAVRE, MT  
776-023-002

INJECTION ID	DATE	INJECTION DEPTH (FT BGS - Basement)	INJECTION DEPTH (FT BGS)	3.1% EVO INJECTION TOTAL (Gallons)	NOTES
A2	1/20/2016	7.5	14.5	425	
A5	1/20/2016	7.5	14.5	100	Injection fluids surfacing 3 1/2 feet from injection point
A8	1/20/2016	7.5	14.5	450	Injection fluids surfacing at rod; surfaceing sealed with case seal
B9	1/22/2016	7.5	14.5	425	
C3	1/21/2016	7.5	14.5	425	
C6	1/21/2016	7.5	14.5	425	
C10	1/22/2016	7.5	14.5	425	
D2	1/23/2016	7.5	14.5	425	
D4	1/21/2016	7.5	14.5	425	
D8	1/22/2016	4.5	11.5	425	
E10	1/22/2016	7.5	14.5	425	
F4	1/21/2016	7.5	14.5	425	
F7	1/22/2016	7.5	14.5	425	Injection fluids surfacing at rod; surfaceing sealed with case seal
G9	1/23/2016	7.5	14.5	425	
H1	1/23/2016	7.5	14.5	425	
H5	1/23/2016	7.5	14.5	425	
H8	1/23/2016	7.5	14.5	425	
I4	1/25/2016	7.5	14.5	425	
I10	1/25/2016	7.5	14.5	200	Injection fluids surfacing at rod; surfaceing sealed with case seal
	1/26/2016			225	
J5	1/25/2016	7.5	14.5	425	
J7	1/25/2016	7.5	14.5	850	
J9	1/26/2016	7.5	14.5	725	
K10	1/26/2016	7.5	14.5	850	Injection fluids surfacing at rod; surfaceing sealed with case seal

FT = feet  
BGS = below ground surface  
EVO = emulsified vegetable oil

**APPENDIX J**

**LABORATORY REPORTS AND DATA VALIDATION**



## Tier II Data Validation Report Summary

Client: Montana Department of Environmental Quality	Laboratory: Energy Laboratories, Inc.
Project Name: Roxy Cleaners Interim Action	Sample Matrix: Soil
Project Number: 776-023-002	Sample Start Date: 07/21/2016
Date Validated: 08/17/2016	Sample End Date: 07/21/2016
Parameters Included: <ul style="list-style-type: none"><li>Toxicity Characteristic Leaching Procedure (TCLP) Volatile Organic Compounds (VOC) by Test Methods for Evaluating Solid Waste (SW846) Method 8260B</li></ul>	
Laboratory Project ID: B16071730	
Data Validator: Kyle Power, Environmental Chemist	
Reviewer: Charles Ballek, Senior Chemist	

### DATA EVALUATION CRITERIA SUMMARY

A Tier II Data Validation was performed by Trihydro Corporation's Chemical Data Evaluation Services Group on the analytical data report package generated by Energy Laboratories, Inc. located in Helena, Montana evaluating samples from the MDEQ Roxy Cleaners site located in Havre, Montana.

Laboratory accuracy was established by reviewing the demonstrated percent recoveries (%R) of the following items to verify that data are not biased.

- Matrix spike (MS) samples
- Laboratory control sample (LCS)
- Organic system monitoring compounds (surrogates)

Method compliance was established by reviewing sample integrity, holding times, detection limits, surrogate recoveries, laboratory blanks, initial and continuing calibrations (where applicable), and the LCS percent recoveries against method-specific requirements.

Completeness was evaluated by determining the overall ratio of the number of samples and analyses planned versus the number of samples with valid analyses. Determination of completeness included a review of the chain-of-custody (CoC), laboratory analytical methods, and other laboratory and field documents associated with this analytical data set.

### SAMPLE NUMBERS TABLE

Client Sample ID	Laboratory Sample Number
RXY-SUE-Drum1	B16071730-001





## Tier II Data Validation Report Summary

The laboratory data were reviewed to evaluate compliance with the methods and the quality of the reported data. Assessment of CoC completeness is included in Item 3 of the Data Validation Checklist. A check mark (✓) indicates that the referenced validation criteria were deemed acceptable, whereas a crossed circle (⊗) indicates validation criteria for which the data have been qualified by the data validator. An empty circle (○) indicates that the specified criterion does not apply to the reviewed data. Details are noted in the tables below.

### Validation Criteria

- ✓ Data Completeness
- ✓ CoC Documentation (Item 3)
- ✓ Holding Times and Preservation (Items 6 and 7)
- Initial and Continuing Calibrations (Item 9)
- ✓ Laboratory Blanks (Item 11)
- ✓ MS (Item 13)
- ✓ LCS (Item 15)
- ✓ System Monitoring Compounds (i.e., Surrogates) (Item 17)
- Field, Equipment, and Trip Blanks (Item 18)
- Field Duplicates (Item 20)
- Laboratory Duplicates (Item 22)

### Guidance References

Chemical data validation was conducted in accordance with the United States Environmental Protection Agency (USEPA) Contract Laboratory Program (CLP) National Functional Guidelines for the analyses listed below, or by the appropriate method if not covered in the National Functional Guidelines.

- Data for organic analyses were evaluated according to validation criteria set forth in the USEPA CLP National Functional Guidelines for Superfund Organic Methods Data Review, document number EPA-540-R-014-002, August 2014 with additional reference to the USEPA CLP National Functional Guidelines for Organic Data Review, document number EPA 540/R-99/008, October 1999.
- Trihydro Data Validation Variance Documentation, February 2016.
- Project-specific Quality Assurance Project Plans (QAPP) data validation requirements, as applicable.





## Tier II Data Validation Report Summary

### OVERALL DATA PACKAGE ASSESSMENT

Based on a data validation review, the data are acceptable as delivered. Data qualified by the laboratory are discussed in Item 2 of the Data Validation Checklist.

The purpose of validating data and assigning qualifiers is to assist in proper data interpretation. Data that are not qualified meet the site data quality objectives.

Sample results were not qualified as a result of this data validation review.

### Data Completeness

The analyses were performed as requested on the CoC records. The associated samples were received by the laboratory and analyzed properly unless otherwise noted in the Criteria Checklist below. The complete data package consisted of 11 data points. No data points were rejected. The data completeness measure for this data package is calculated to be 100% and is acceptable.

<b>VALIDATION CRITERIA CHECKLIST</b>	
1. Was the report free of non-conformances identified by the laboratory? Comments: The laboratory did not identify non-conformances regarding the analytical data.	Yes
2. Were the data free of data qualification flags and/or notes used by the laboratory? If no, define. Comments: The laboratory did not use data qualification flags with this data set.	Yes
3. Were sample CoC forms and procedures complete? Comments: The CoC records from field to laboratory were complete and custody was maintained as evidenced by field and laboratory personnel signatures, dates, and times of receipt.	Yes
4. Were detection limits in accordance with the quality assurance project plan (QAPP), permit, or method, or indicated as acceptable? Comments: The detection limits appeared to be acceptable. A dilution of 100 times was applied for the TCLP VOC analyses of sample RXY-SUE-Drum1.	Yes
5. Were the reported analytical methods and constituents in compliance with the QAPP, permit, or CoC? Specify if any analytes reported by more than one method? Comments: The reported analytical methods were in compliance with the CoC and the laboratory reported the requested constituents in accordance with the CoC.	Yes
6. Were samples received in good condition within method-specified requirements? Comments: Samples were received on ice, in good condition, and with the cooler temperature outside the recommended temperature range of 4°C ± 2°C at 0.8°C as noted on the Work Order Receipt Checklist. The cooler temperature below 2°C was judged as acceptable since the samples were not reported to be frozen upon receipt at the laboratory and the sample containers were reported to be intact. The laboratory noted that the shipping containers were sealed and custody seals were present.	No
7. Were samples extracted/digested and analyzed within method-specified or technical holding times? Comments: The samples were analyzed within method-specific holding times.	Yes
8. Were reported units appropriate for the sample matrix/matrices and analytical method(s)? Specify if wet or dry units were used for soil. Comments: The results were reported in concentration units of milligrams per liter (mg/L), which was acceptable for the sample matrix and the analyses requested.	Yes
9. Did the laboratory provide any specific initial and/or continuing calibration results? Comments: Initial and continuing calibration data were not included as part of this data set.	No
10. If initial and/or continuing calibration results were provided, were the results within acceptable limits? Comments: Initial and continuing calibration data were not included as part of this data set.	N/A
11. Was the total number of laboratory blank samples prepared equal to at least 5% of the total number of samples or analyzed as required by the method? Comments: The total number of laboratory blank samples prepared was equal to at least 5% of the total number of samples.	Yes
12. Were target analytes reported as not detected in the laboratory blanks? Comments: Target analytes were reported as not detected in the laboratory blank.	Yes



**VALIDATION CRITERIA CHECKLIST**

13. Was the total number of MS samples prepared equal to at least 5% of the total number of samples or analyzed as required by the method?	Yes
Comments: The total number of matrix spike samples prepared was equal to at least 5% of the total number of samples. A matrix spike was prepared for Method 8260B batch 101123 from sample RXY-SUE-Drum1.	
14. For MS/MSDs prepared from project samples, were percent recoveries and RPDs within data validation or laboratory quality control (QC) limits?	Yes
Comments: The MS percent recoveries for project samples were within laboratory QC limits.	
15. Was the total number of LCSs analyzed equal to at least 5% of the total number of samples or analyzed as required by the method?	Yes
Comments: The total number of LCS samples analyzed was equal to at least 5% of the total number of samples.	
16. Were LCS/LCSD percent recoveries and LCS/LCSD RPDs within data validation or laboratory QC limits?	Yes
Comments: The LCS percent recoveries were within laboratory QC limits.	
17. Were surrogate recoveries within laboratory QC limits?	Yes
Comments: Surrogate recoveries were within laboratory QC limits.	
18. Were the number of trip blank, field blank, and/or equipment blank samples collected equal to at least 10% of the total number of samples or as required by the project guidelines, QAPP, SAP, or permit?	No
Comments: Trip, field, and equipment blank samples were not collected for this sample set.	
19. Were target analytes reported as not detected in the trip blank, field blank, and/or equipment blank samples?	N/A
Comments: Trip, field, and equipment blank samples were not collected for this sample set.	
20. Was the number of field duplicates collected equal to at least 10% of the total number of samples or as required by the project guidelines, QAPP, SAP, or permit?	No
Comments: Field duplicate samples were not collected as part of this sample set.	
21. Were field duplicate RPD values within data validation QC limits (soil 0-50%, water 0-30%, or air 0-25%)?	N/A
Comments: Field duplicate samples were not collected as part of this sample set.	
22. For laboratory duplicates prepared from project samples, were RPDs within laboratory QC limits?	N/A
Comments: Laboratory duplicate samples were not prepared for this sample set.	



## DATA QUALIFICATION SUMMARY

Data qualifiers were not applied as a result of this validation



## Tier II Data Validation Report

Client: Montana Department of Environmental Quality (MDEQ)	Laboratory: Energy Laboratories
Project Name: Roxy Cleaners Interim Action	Sample Matrix: Soil
Project Number: 776-023-002	Sample Start Date: 11/30/2015
Date Validated: 05/24/2017	Sample End Date: 11/30/2015
Parameters Included:	
<ul style="list-style-type: none"> <li>▪ Volatile Organic Compounds (VOC) – Trichloroethene (TCE) and Tetrachloroethene (PCE) – by Environmental Protection Agency (EPA) Test Methods for Evaluating Solid Waste (SW-846) Method 8260B</li> </ul>	
Laboratory Project ID: H15120023	
Data Validator: Charles Ballek, Senior Chemist	
Reviewer: Mike Phillips, Senior Chemist	

### DATA EVALUATION CRITERIA SUMMARY

A Tier II Data Validation was performed by Trihydro Corporation's Chemical Data Evaluation Services Group on the analytical data report package generated by Energy Laboratories, Inc. located in Helena, Montana evaluating samples from the MDEQ Roxy Cleaners site located in Havre, Montana.

Precision, accuracy, method compliance, and completeness of this data package were assessed during this data review. Precision was determined by evaluating the calculated relative percent difference (RPD) values from:

- Matrix spike (MS) and matrix spike duplicate (MSD) pairs

Laboratory accuracy was established by reviewing the demonstrated percent recoveries (%R) of the following items to verify that data are not biased.

- MS/MSD samples
- Laboratory control samples (LCS)
- Organic system monitoring compounds (surrogates)

Method compliance was established by reviewing sample integrity, holding times, detection limits, surrogate recoveries, laboratory blanks, initial and continuing calibrations (where applicable) percent recoveries, and LCS percent recoveries against method-specific requirements.

Completeness was evaluated by determining the overall ratio of the number of samples and analyses planned versus the number of samples with valid analyses. Determination of completeness included a review of the chain-of-custody (CoC), laboratory analytical methods, and other laboratory and field documents associated with this analytical data set.

### SAMPLE NUMBERS TABLE

Client Sample ID	Laboratory Sample Number
Soil Cutting	H15120023-001





## Tier II Data Validation Report

The laboratory data were reviewed to evaluate compliance with the methods and the quality of the reported data. Assessment of CoC completeness is included in Item 3 of the Data Validation Checklist. A check mark (✓) indicates that the referenced validation criteria were deemed acceptable, whereas a crossed circle (⊗) indicates validation criteria for which the data have been qualified by the data validator. An empty circle (○) indicates that the specified criterion does not apply to the reviewed data. Details are noted in the tables below.

### Validation Criteria

- ✓ Data Completeness
- ✓ CoC Documentation (Item 3)
- ✓ Holding Times and Preservation (Items 6 and 7)
- ✓ Initial and Continuing Calibrations (Items 9 and 10)
- ✓ Laboratory Blanks (Items 11 and 12)
- ⊗ MS/MSD (Items 13 and 14)
- ✓ LCS (Items 15 and 16)
- ✓ System Monitoring Compounds (i.e., Surrogates) (Item 17)
- Field, Equipment, and Trip Blanks (Items 18 and 19)
- Field Duplicates (Items 20 and 21)
- Laboratory Duplicates (Item 22)
- Data Relationships (Item 23)

### Guidance References

Chemical data validation was conducted in accordance with the United States Environmental Protection Agency (USEPA) Contract Laboratory Program (CLP) National Functional Guidelines for the analyses listed below, or by the appropriate method if not covered in the National Functional Guidelines.

- Data for organic analyses were evaluated according to validation criteria set forth in the USEPA CLP National Functional Guidelines for Superfund Organic Methods Data Review, document number EPA-540-R-2016-002, September 2016 with additional reference to the USEPA CLP National Functional Guidelines for Organic Data Review, document number EPA 540/R-99/008, October 1999.
- Project-specific Quality Assurance Project Plans (QAPP) data validation requirements, as applicable.
- Trihydro Data Validation Variance Documentation, February 2017.



## Tier II Data Validation Report

### OVERALL DATA PACKAGE ASSESSMENT

Based on a data validation review, the data are acceptable as delivered. Data qualified by the laboratory are discussed in Item 2 of the Validation Criteria Checklist.

The purpose of validating data and assigning qualifiers is to assist in proper data interpretation. Data that are not qualified meet the site data quality objectives. If values are assigned qualifiers other than an R (rejected, data not usable), the data may be used for site evaluation; however, consideration should be given to the reasons for qualification when interpreting sample concentrations. Data points that are assigned an R qualifier should not be used for site evaluation purposes.

Text identified in **bold font** in the Validation Criteria Checklist indicates that further action and/or qualification of the data were required. Data validation qualifiers were added for the items noted with crossed circles in the Validation Criteria section above. Please see the Data Qualification Summary table at the end of this report for a complete list of samples and analytes qualified.

Data qualifiers used during this validation are included in the following table.

<u>Qualifier</u>	<u>Definition</u>
J+	The result is an estimated concentration, but may be biased high

### Data Completeness

The analyses were performed as requested on the CoC records. The associated samples were received by the laboratory and analyzed properly unless otherwise noted in the Criteria Checklist below. The complete data package consisted of 2 data points. No data points were rejected. The data completeness measure for this data package is calculated to be 100% and is acceptable.



**VALIDATION CRITERIA CHECKLIST**

1. Was the report free of non-conformances identified by the laboratory?	Yes
Comments: The laboratory did not identify non-conformances related to this data set.	
2. Were the data free of data qualification flags and/or notes used by the laboratory? If no, define.	No
Comments: The laboratory applied the following data qualifiers or notes to results reported for this data set. S – Spike recovery outside of advisory limits.	
3. Were sample CoC forms and custody procedures complete?	Yes
Comments: The CoC record from field to laboratory was complete and custody was maintained as evidenced by field and laboratory personnel signatures, dates, and times of receipt. An inconsequential discrepancy between the sample identifications entered on the CoC and the sample label was noted. The sample ID defined on the CoC was used for reporting.  Custody seals were not present nor required since the samples were delivered to the laboratory by project personnel and custody was maintained at all times.	
4. Were detection limits in accordance with the quality assurance project plan (QAPP), permit, or method, or indicated as acceptable?	Yes
Comments: The detection limits appeared to be acceptable. Dilutions were not applied for the analysis of the submitted sample.  Final determination of the data quality based on detection limits will be established by the project team.	
5. Were the reported analytical methods and constituents in compliance with the QAPP, permit, or CoC?	Yes
Comments: The reported analytical methods were in compliance with the CoC and the laboratory reported the requested constituents in accordance with the CoC.	
6. Were samples received in good condition within method-specified requirements?	Yes
Comments: Samples were received on ice, in good condition, with the cooler temperature within the recommended temperature range of 4°C ± 2°C at 2.0°C as noted on the CoC and the <i>Work Order Receipt Checklist</i> .  The laboratory indicated that the sample containers were intact and sufficient sample mass was provided to complete the requested analyses.	
7. Were samples extracted/digested and analyzed within method-specified or technical holding times?	Yes
Comments: The samples were analyzed within method-specific holding times.	
8. Were reported units appropriate for the sample matrix/matrices and analytical method(s)? Specify if wet or dry units were used for soil.	Yes
Comments: The analytical results for the submitted sample were reported in concentration units of milligrams per kilogram (mg/kg). These units were acceptable for the sample matrix and the analysis requested. The results were reported on a wet weight basis (as received).	
9. Did the laboratory provide any specific initial and/or continuing calibration results?	Yes
Comments: A summary of the continuing calibration verification (CCV) for analytical batch R111514 was included in the laboratory report.	
10. If initial and/or continuing calibration results were provided, were the results within acceptable limits?	Yes
Comments: The reported CCV results for batch R111514 were within the listed acceptance limits.	



**VALIDATION CRITERIA CHECKLIST**

11. Was the total number of laboratory blank samples prepared equal to at least 5% of the total number of samples or analyzed as required by the method?	Yes
Comments: The total number of laboratory blank samples prepared was equal to at least 5% of the total number of samples.	
12. Were target analytes reported as not detected in the laboratory blanks?	Yes
Comments: Target analytes were not detected in the laboratory blank.	
13. Was the total number of MS samples prepared equal to at least 5% of the total number of samples or analyzed as required by the method?	Yes
Comments: The total number of matrix spike samples prepared was equal to at least 5% of the total number of samples. A matrix spike was prepared for Method 8260B batch 31375 from sample Soil Cutting.	
14. For MS/MSDs prepared from project samples, were percent recoveries and RPDs within data validation or laboratory quality control (QC) limits?	No
Comments: The MS and MSD recoveries and MS/MSD RPDs were within laboratory QC limits, with the following exception. <b>The reported recovery for tetrachloroethene in the MSD for Method 8260B batch 31375 was outside the stated acceptance limits of 84-108% at 124%. Tetrachloroethene was detected in the associated sample, Soil Cutting, and the result was assigned a J+ qualifier due to evidence of potential high bias.</b>	
15. Was the total number of LCSs analyzed equal to at least 5% of the total number of samples or analyzed as required by the method?	Yes
Comments: The total number of LCS samples analyzed was equal to at least 5% of the total number of samples.	
16. Were LCS/LCSD percent recoveries and LCS/LCSD RPDs within data validation or laboratory QC limits?	Yes
Comments: The LCS percent recoveries were within laboratory QC limits. The laboratory did not analyze an LCSD for the batch reported in this data set.	
17. Were surrogate recoveries within laboratory QC limits?	Yes
Comments: The surrogate recoveries were within laboratory QC limits.	
18. Were the number of trip blank, field blank, and/or equipment blank samples collected equal to at least 10% of the total number of samples or as required by the project guidelines, QAPP, SAP, or permit?	No
Comments: Trip, field, and equipment blank samples were not submitted for this sample set.	
19. Were target analytes reported as not detected in the trip blank, field blank, and/or equipment blank samples?	N/A
Comments: Trip, field, and equipment blank samples were not submitted for this sample set.	
20. Was the number of field duplicates collected equal to at least 10% of the total number of samples or as required by the project guidelines, QAPP, SAP, or permit?	No
Comments: Field duplicates were not collected as part of this sample set.	
21. Were field duplicate RPD values within data validation QC limits (soil 0-50%, water 0-30%, or air 0-25%)?	N/A
Comments: Field duplicates were not collected as part of this sample set.	



**VALIDATION CRITERIA CHECKLIST**

22. For laboratory duplicates prepared from project samples, were RPDs within laboratory QC limits? N/A

Comments: Laboratory duplicates were not prepared for the analyses reported in this data set.

23. Were the following data relationships realistic and acceptable?

- Target analytes were reported by more than one method (e.g., 8260/8270, EPH/8270) and the results were in agreement? N/A

Comments: The target analytes were not reported by more than one method.

- Both total and dissolved metals analyses were performed and the total metals results were greater than or equal to the dissolved metals results? N/A

Comments: Metals analyses were not performed as part of this data set.



### DATA QUALIFICATION SUMMARY

Abbreviation	Reason
HR-MS	The MS and/or MSD percent recovery was greater than the upper acceptable limit indicating possible matrix interference.

Analyte	Method	Field Sample ID	Lab Sample ID	Result	Limit	Units	Reviewer Qualifier	DV Flag Reasons
Tetrachloroethene	SW8260B	Soil Cutting	H15120023-001	0.46	0.2	mg/kg	J+	HR-MS





## Tier II Data Validation Report Summary

Client: Montana Department of Environmental Quality	Laboratory: Energy Laboratories, Inc.
Project Name: Roxy Cleaners Interim Action	Sample Matrix: Air
Project Number: 776-023-002	Sample Start Date: 02/10/2016
Date Validated: 04/28/2016	Sample End Date: 02/10/2016
Parameters Included: <ul style="list-style-type: none"><li>▪ Volatile Organic Compounds (VOC) by Test Methods for Evaluating Solid Waste (SW-846) Method 8260B</li><li>▪ Methane by SW-846 Method 8015M</li></ul>	
Laboratory Project ID: H16020197	
Data Validator: James Gianakon, Environmental Chemist	
Reviewer: Charles Ballek, Senior Chemist	

### DATA EVALUATION CRITERIA SUMMARY

A Tier II Data Validation was performed by Trihydro Corporation's Chemical Data Evaluation Services Group on the analytical data report package generated by Energy Laboratories, Inc. located in Helena, Montana with data from Billings, Montana evaluating samples from the MDEQ Roxy Cleaners site located in Havre, Montana.

Precision, accuracy, method compliance, and completeness of this data package were assessed during this data review. Precision was determined by evaluating the calculated relative percent difference (RPD) values from:

- Laboratory duplicate pairs

Laboratory accuracy was established by reviewing the demonstrated percent recoveries (%R) of the following items to verify that data are not biased.

- Laboratory control samples (LCS)
- Organic system monitoring compounds (surrogates)

Method compliance was established by reviewing sample integrity, holding times, detection limits, surrogate recoveries, laboratory blanks, initial and continuing calibrations (where applicable), and the LCS percent recoveries against method-specific requirements.

Completeness was evaluated by determining the overall ratio of the number of samples and analyses planned versus the number of samples with valid analyses. Determination of completeness included a review of the chain-of-custody (CoC), laboratory analytical methods, and other laboratory and field documents associated with this analytical data set.





## Tier II Data Validation Report Summary

### SAMPLE NUMBERS TABLE

Client Sample ID	Laboratory Sample Number
PRE-20160210	H16020197-001
Post #1-20160210	H16020197-002
SoilProbe-20160210	H16020197-003



## Tier II Data Validation Report Summary

The laboratory data were reviewed to evaluate compliance with the methods and the quality of the reported data. Assessment of CoC completeness is included in Item 3 of the Data Validation Checklist. A check mark (✓) indicates that the referenced validation criteria were deemed acceptable, whereas a crossed circle (⊗) indicates validation criteria for which the data have been qualified by the data validator. An empty circle (○) indicates that the specified criterion does not apply to the reviewed data. Details are noted in the tables below.

### Validation Criteria

- ⊗ Data Completeness
- ✓ CoC Documentation (Item 3)
- ⊗ Holding Times and Preservation (Items 6 and 7)
- Initial and Continuing Calibrations (Item 9)
- ✓ Laboratory Blanks (Item 11)
- MS/MSD (Item 13)
- ✓ LCS (Item 14)
- ✓ System Monitoring Compounds (i.e., Surrogates) (Item 17)
- Field, Equipment, and Trip Blanks (Item 18)
- ✓ Field Duplicates (Item 20)
- ✓ Laboratory Duplicates (Item 22)
- ⊗ Quality Control Frequency (Item 23)

### Guidance References

Chemical data validation was conducted in accordance with the United States Environmental Protection Agency (USEPA) Contract Laboratory Program (CLP) National Functional Guidelines for the analyses listed below, or by the appropriate method if not covered in the National Functional Guidelines.

- Data for organic analyses were evaluated according to validation criteria set forth in the USEPA CLP National Functional Guidelines for Superfund Organic Methods Data Review, document number EPA-540-R-014-002, August 2014 with additional reference to the USEPA CLP National Functional Guidelines for Organic Data Review, document number EPA 540/R-99/008, October 1999.
- Air and vapor data for samples collected in canisters and analyzed by EPA organics Method TO-15 were reviewed with reference to the USEPA Hazardous Waste Support Branch Validating Air Samples Volatile Organic Analysis of Ambient Air in Canister by Method TO-15, standard operating procedure number HW-31 revision 4, October 2006.
- Trihydro Data Validation Variance Documentation, February 2016.
- Project-specific Quality Assurance Project Plans (QAPP) data validation requirements, as applicable.





## Tier II Data Validation Report Summary

### OVERALL DATA PACKAGE ASSESSMENT

Based on a data validation review, the data are acceptable as delivered. Data qualified by the laboratory are discussed in Item 2 of the Validation Criteria Checklist.

The purpose of validating data and assigning qualifiers is to assist in proper data interpretation. Data that are not qualified meet the site data quality objectives. If values are assigned qualifiers other than an R (rejected, data not usable), the data may be used for site evaluation; however, consideration should be given to the reasons for qualification when interpreting sample concentrations. Data points that are assigned an R qualifier should not be used for site evaluation purposes.

Text identified in **bold font** in the Validation Criteria Checklist indicates that further action and/or qualification of the data were required. Data validation qualifiers were added for the items noted with crossed circles in the Validation Criteria section above. Please see the Data Qualification Summary table at the end of this report for a complete list of samples and analytes qualified.

Data that would be qualified with more than one flag were assigned one qualifier based on the severity; however, all reasons for qualification were retained. Data that would be qualified with both J+ and J- flags were evaluated based on validation criteria and assigned the appropriate flag. The hierarchy of qualifiers from the most to least severe is as follows:

- R > JB/U > NJ > J+/J- > J/UJ

Data qualifiers used during this validation are included in the following table.

<u>Qualifier</u>	<u>Definition</u>
R	Rejected, data not usable

### Data Completeness

The analyses were performed as requested on the CoC records. The associated samples were received by the laboratory and analyzed properly unless otherwise noted in the Criteria Checklist below. The complete data package consisted of 15 data points. 15 data points were rejected. The data completeness measure for this data package is calculated to be 0.0% and is not acceptable.

**VALIDATION CRITERIA CHECKLIST**

<p>1. Was the report free of non-conformances identified by the laboratory?</p> <p>Comments: The laboratory noted the following non-conformances as related to this data set.  <u>Method 8260B</u>: Sample SoilProbe-20160210 was analyzed 33 minutes past the 14 day hold time.</p>	No
<p>2. Were the data free of data qualification flags and/or notes used by the laboratory?                  If no, define.</p> <p>Comments: The data were free of data qualification flags or other notes used by the laboratory.</p>	Yes
<p>3. Were sample CoC forms and procedures complete?</p> <p>Comments: The CoC record from the field to the laboratory was complete and custody was maintained as evidenced by the field and laboratory personnel signatures, dates, and times of receipt.</p>	Yes
<p>4. Were detection limits in accordance with the quality assurance project plan (QAPP), permit, or method, or indicated as acceptable?</p> <p>Comments: The reporting limits for the data set were reviewed and appeared to be acceptable. Dilutions were not applied for the analyses of the project samples.</p>	Yes
<p>5. Were the reported analytical methods and constituents in compliance with the QAPP, permit, or CoC? Specify if any analytes were reported by more than one method.</p> <p>Comments: The reported analytical methods and constituents were found to be in compliance with the CoC. There were no analytes that were reported by more than one method.</p>	Yes
<p>6. Were samples received in good condition within method-specified requirements?</p> <p>Comments: Samples were received intact and in good condition.</p>	Yes
<p>7. Were samples extracted/digested and analyzed within method-specified or technical holding times?</p> <p>Comments: Samples were analyzed within method-specified holding times, with the following exceptions.  <b>Samples were analyzed by Method 8260B for VOCs approximately 11 days after expiration of the method-specified holding time of 3 days. The results were assigned R qualifiers due to gross holding time exceedances.</b>  <b>Samples were analyzed by Method 8015M for methane approximately 5 days after expiration of the method-specified holding time of 3 days. The results were assigned R qualifiers due to gross holding time exceedances.</b></p>	Yes
<p>8. Were reported units appropriate for the sample matrix/matrices and analytical method(s)? Specify if wet or dry units were used for soil.</p> <p>Comments: The results were reported in concentration units of milligrams per cubic meter (mg/m<sup>3</sup>) and parts per million (ppm), which were acceptable for the sample matrix and the analyses requested.</p>	Yes
<p>9. Did the laboratory provide any specific initial and/or continuing calibration results?</p> <p>Comments: Limited continuing calibration verification (CCV) data was included in the report.</p>	Yes
<p>10. If initial and/or continuing calibration results were provided, were the results within acceptable limits?</p> <p>Comments: The provided CCV results were within acceptance ranges.</p>	N/A



<b>VALIDATION CRITERIA CHECKLIST</b>		
11. Was the total number of laboratory blank samples prepared equal to at least 5% of the total number of samples or analyzed as required by the method?	Yes	
Comments: The total number of laboratory blank samples prepared was equal to at least 5% of the total number of samples.		
12. Were target analytes reported as not detected in the laboratory blanks?	Yes	
Comments: Target analytes were not detected above the MDL in the laboratory blank samples.		
13. Was the total number of MS samples prepared equal to at least 5% of the total number of samples or analyzed as required by the method?	No	
Comments: Matrix spikes were not prepared or analyzed as part of this data set.		
14. For MS/MSDs prepared from project samples, were percent recoveries and RPDs within data validation or laboratory quality control (QC) limits?	N/A	
Comments: Matrix spikes were not prepared or analyzed as part of this data set.		
15. Was the total number of LCSs analyzed equal to at least 5% of the total number of samples or analyzed as required by the method?	Yes	
Comments: The total number of LCS samples analyzed was equal to at least 5% of the total number of samples.		
16. Were LCS/LCSD percent recoveries and LCS/LCSD RPDs within data validation or laboratory QC limits?	Yes	
Comments: The LCS recoveries were within laboratory QC limits. LCSDs were not analyzed as part of this data set.		
17. Were surrogate recoveries within laboratory QC limits?	Yes	
Comments: Surrogate recoveries were within laboratory QC limits.		
18. Were the number of trip blank, field blank, and/or equipment blank samples collected equal to at least 10% of the total number of samples or as required by the project guidelines, QAPP, SAP, or permit?	No	
Comments: The number of trip, field, and equipment blanks collected was not equal to at least 10% of the total number of samples. Trip, field, and equipment blank samples were not collected as part of this sample set.		
19. Were target analytes reported as not detected in the trip blank, field blank, and/or equipment blank samples?	N/A	
Comments: Trip, field, and equipment blank samples were not collected as part of this sample set.		
20. Was the number of field duplicates collected equal to at least 10% of the total number of samples or as required by the project guidelines, QAPP, SAP, or permit?	No	
Comments: The number of field duplicates collected was not equal to at least 10% of the number of samples. Field duplicates were not collected as part of this sample set.		
21. Were field duplicate RPD values within data validation QC limits (soil 0-50%, water 0-30%, or air 0-25%)?	N/A	
Comments: Field duplicates were not collected as part of this sample set.		



**VALIDATION CRITERIA CHECKLIST**

22. For laboratory duplicates prepared from project samples, were RPDs within laboratory QC limits? Yes

Comments: A laboratory duplicate was prepared for Method 8015M batch SUB-B256744 from sample SoilProbe-20160210.

The RPDs for laboratory duplicates prepared from project samples were within laboratory acceptance limits.

General Comments: Quality control measures were not performed to measure the precision of Method 8260B. The non-detected sample results would have been assigned UJ qualifiers, but they had previously been assigned R qualifiers due to gross holding time exceedance. The tetrachloroethene result in sample SoilProbe-20160210 would have been assigned a J qualifier, but it had previously been assigned an R qualifier due to gross holding time exceedance.



### DATA QUALIFICATION SUMMARY

Abbreviation	Reason
HT-AN	Sample was analyzed outside of the method holding time.
HZ-QAQC	Analysis of QA/QC samples was not performed at the required frequency.

Analyte	Method	Field Sample ID	Lab Sample ID	Result	Limit	Units	Reviewer Qualifier	DV Flag Reasons
cis-1,2-Dichloroethene	SW8260B	PRE-20160210	H16020197-001	ND	1	mg/m3	R	HT-AN, HZ-QAQC
cis-1,2-Dichloroethene	SW8260B	Post #1-20160210	H16020197-002	ND	1	mg/m3	R	HT-AN, HZ-QAQC
cis-1,2-Dichloroethene	SW8260B	SoilProbe-20160210	H16020197-003	ND	1	mg/m3	R	HT-AN, HZ-QAQC
Methane	SW8015M	PRE-20160210	H16020197-001	3.3	2	ppm	R	HT-AN
Methane	SW8015M	Post #1-20160210	H16020197-002	3.7	2	ppm	R	HT-AN
Methane	SW8015M	SoilProbe-20160210	H16020197-003	4.1	2	ppm	R	HT-AN
Tetrachloroethene	SW8260B	PRE-20160210	H16020197-001	ND	1	mg/m3	R	HT-AN, HZ-QAQC
Tetrachloroethene	SW8260B	Post #1-20160210	H16020197-002	ND	1	mg/m3	R	HT-AN, HZ-QAQC
Tetrachloroethene	SW8260B	SoilProbe-20160210	H16020197-003	15	1	mg/m3	R	HT-AN, HZ-QAQC
Trichloroethene	SW8260B	PRE-20160210	H16020197-001	ND	1	mg/m3	R	HT-AN, HZ-QAQC
Trichloroethene	SW8260B	Post #1-20160210	H16020197-002	ND	1	mg/m3	R	HT-AN, HZ-QAQC
Trichloroethene	SW8260B	SoilProbe-20160210	H16020197-003	ND	1	mg/m3	R	HT-AN, HZ-QAQC
Vinyl Chloride	SW8260B	PRE-20160210	H16020197-001	ND	1	mg/m3	R	HT-AN, HZ-QAQC
Vinyl Chloride	SW8260B	Post #1-20160210	H16020197-002	ND	1	mg/m3	R	HT-AN, HZ-QAQC
Vinyl Chloride	SW8260B	SoilProbe-20160210	H16020197-003	ND	1	mg/m3	R	HT-AN, HZ-QAQC





## Tier II Data Validation Report Summary

Client: Montana Department of Environmental Quality	Laboratory: Energy Laboratories, Inc.
Project Name: Roxy Cleaners Interim Action	Sample Matrix: Water
Project Number: 776-023-002	Sample Start Date: 04/06/2016
Date Validated: 05/18/2016	Sample End Date: 04/06/2016
Parameters Included: <ul style="list-style-type: none"><li>▪ Volatile Organic Compounds (VOC) by Test Methods for Evaluating Solid Waste (SW-846) Method 8260B</li><li>▪ Arsenic by US Environmental Protection Agency (EPA) Method 200.8</li><li>▪ Total Organic Carbon (TOC) by Method A5310C</li><li>▪ Sulfide by Standard Methods for the Examination of Water and Wastewater (SM) Method A 4500-S F</li></ul>	
Laboratory Project ID: H16040119	
Data Validator: James Gianakon, Environmental Chemist	
Reviewer: Charles Ballek, Senior Chemist	

### DATA EVALUATION CRITERIA SUMMARY

A Tier II Data Validation was performed by Trihydro Corporation's Chemical Data Evaluation Services Group on the analytical data report package generated by Energy Laboratories, Inc. located in Helena, Montana with data from Billings, Montana and Casper, Wyoming evaluating samples from the MDEQ Roxy Cleaners site located in Havre, Montana.

Precision, accuracy, method compliance, and completeness of this data package were assessed during this data review. Precision was determined by evaluating the calculated relative percent difference (RPD) values from:

- Field duplicate pairs
- Matrix spike (MS) and matrix spike duplicate (MSD) pairs
- Laboratory control sample (LCS) and laboratory control sample duplicate (LCSD) pairs

Laboratory accuracy was established by reviewing the demonstrated percent recoveries (%R) of the following items to verify that data are not biased.

- MS/MSD samples
- LCS/LCSD samples
- Organic system monitoring compounds (surrogates)

Field accuracy was established by collecting and analyzing the following samples to monitor for possible ambient or cross contamination during sampling and transportation.

- Trip blanks
- Field blanks
- Equipment blanks





## Tier II Data Validation Report Summary

Method compliance was established by reviewing sample integrity, holding times, detection limits, surrogate recoveries, laboratory blanks, initial and continuing calibrations (where applicable), and the LCS/LCSD percent recoveries against method-specific requirements.

Completeness was evaluated by determining the overall ratio of the number of samples and analyses planned versus the number of samples with valid analyses. Determination of completeness included a review of the chain-of-custody (CoC), laboratory analytical methods, and other laboratory and field documents associated with this analytical data set.

### SAMPLE NUMBERS TABLE

Client Sample ID	Laboratory Sample Number
RSY-HV-43	H16040119-001
RXY-HV-41	H16040119-002
RXY-HV-62	H16040119-003
RXY-BD-1	H16040119-004
RXY-FB-1	H16040119-005
RXY-EB-1	H16040119-006
TB 5419	H16040119-007



## Tier II Data Validation Report Summary

The laboratory data were reviewed to evaluate compliance with the methods and the quality of the reported data. Assessment of CoC completeness is included in Item 3 of the Data Validation Checklist. A check mark (✓) indicates that the referenced validation criteria were deemed acceptable, whereas a crossed circle (⊗) indicates validation criteria for which the data have been qualified by the data validator. An empty circle (○) indicates that the specified criterion does not apply to the reviewed data. Details are noted in the tables below.

### Validation Criteria

- ✓ Data Completeness
- ✓ CoC Documentation (Item 3)
- ✓ Holding Times and Preservation (Items 6 and 7)
- ✓ Initial and Continuing Calibrations (Item 9)
- ✓ Laboratory Blanks (Item 11)
- ⊗ MS/MSD (Item 13)
- ✓ LCS/LCSD (Item 15)
- ✓ System Monitoring Compounds (i.e., Surrogates) (Item 17)
- ⊗ Field, Equipment, and Trip Blanks (Item 18)
- ⊗ Field Duplicates (Item 20)
- Laboratory Duplicates (Item 22)

### Guidance References

Chemical data validation was conducted in accordance with the United States Environmental Protection Agency (USEPA) Contract Laboratory Program (CLP) National Functional Guidelines for the analyses listed below, or by the appropriate method if not covered in the National Functional Guidelines.

- Data for organic analyses were evaluated according to validation criteria set forth in the USEPA CLP National Functional Guidelines for Superfund Organic Methods Data Review, document number EPA-540-R-014-002, August 2014 with additional reference to the USEPA CLP National Functional Guidelines for Organic Data Review, document number EPA 540/R-99/008, October 1999.
- Data for inorganic analyses were evaluated according to validation criteria set forth in the USEPA CLP National Functional Guidelines for Inorganic Superfund Data Review, document number EPA-540-R-013-001, August 2014 with additional reference to the USEPA CLP National Functional Guidelines for Inorganic Data Review, document number EPA 540-R-04-004, October 2004.
- Review of field duplicates was conducted according to the USEPA New England Environmental Data Review Supplement for Regional Data Review Elements and Superfund Specific Guidance/Procedures, EQADR-Supplement0, April 2013.
- Trihydro Data Validation Variance Documentation, February 2016.
- Project-specific Quality Assurance Project Plans (QAPP) data validation requirements, as applicable.



## Tier II Data Validation Report Summary

### OVERALL DATA PACKAGE ASSESSMENT

Based on a data validation review, the data are acceptable as delivered. Data qualified by the laboratory are discussed in Item 2 of the Validation Criteria Checklist.

The purpose of validating data and assigning qualifiers is to assist in proper data interpretation. Data that are not qualified meet the site data quality objectives. If values are assigned qualifiers other than an R (rejected, data not usable), the data may be used for site evaluation; however, consideration should be given to the reasons for qualification when interpreting sample concentrations. Data points that are assigned an R qualifier should not be used for site evaluation purposes.

Text identified in **bold font** in the Validation Criteria Checklist indicates that further action and/or qualification of the data were required. Data were qualified with J data flags by the laboratory if the result was greater than or equal to the method detection limit (MDL) but less than the reporting limit (RL). Laboratory J flags were preserved in the data and included in the Data Qualification Summary table at the end of this report. Data validation qualifiers were added for the items noted with crossed circles in the Validation Criteria section above. Please see the Data Qualification Summary table at the end of this report for a complete list of samples and analytes qualified.

Data that would be qualified with more than one flag were assigned one qualifier based on the severity; however, all reasons for qualification were retained. Data that would be qualified with both J+ and J- flags were evaluated based on validation criteria and assigned the appropriate flag. The hierarchy of qualifiers from the most to least severe is as follows:

- R > JB/U > NJ > J+/J- > J/UJ

Data qualifiers used during this validation are included in the following table.

<u>Qualifier</u>	<u>Definition</u>
J	Estimated concentration
J+	The result is an estimated concentration, but may be biased high
U	Evaluated to be undetected at the reporting limit
JB	Estimated concentration due to blank contamination

### Data Completeness

The analyses were performed as requested on the CoC records. The associated samples were received by the laboratory and analyzed properly unless otherwise noted in the Criteria Checklist below. The complete data package consisted of 208 data points excluding blank samples. No data points were rejected. The data completeness measure for this data package is calculated to be 100% and is acceptable.

**VALIDATION CRITERIA CHECKLIST**

<p>1. Was the report free of non-conformances identified by the laboratory? Comments: The laboratory did not report non-conformances related to this data set.</p>	Yes
<p>2. Were the data free of data qualification flags and/or notes used by the laboratory? If no, define. Comments: The laboratory used the following data qualification flags in the laboratory report. D – RL increased due to sample matrix. J – Estimated value. The analyte was present but less than the reporting limit. S – Spike recovery outside of advisory limits</p>	No
<p>3. Were sample CoC forms and procedures complete? Comments: The CoC record from the field to the laboratory was complete and custody was maintained as evidenced by the field and laboratory personnel signatures, dates, and times of receipt with the following exception. Specific metals were not identified on the CoC for dissolved metals analyses. Following discussion with project personnel and review of previous communications, the laboratory appropriately analyzed the samples for dissolved arsenic. No further action was required.</p>	Yes
<p>4. Were detection limits in accordance with the quality assurance project plan (QAPP), permit, or method, or indicated as acceptable? Comments: The reporting limits for the data set were reviewed and appeared to be acceptable. The following dilutions were applied to the project samples. <u>Method 8260B</u>: A dilution factor of 15 times was applied to the analysis of cis-1,2-dichloroethene and trans-1,2-dichloroethene in sample RSY-HV-43 and a dilution factor of 50 times was applied to the analysis of vinyl chloride in sample RXY-HV-62. <u>Method 200.8</u>: A dilution factor of 2 times was applied to the analysis of arsenic in samples RXY-HV-41 and RXY-HV-62. <u>Method A5310C</u>: A dilution factor of 40 times was applied to the analysis of TOC in sample RXY-HV-62.</p>	Yes
<p>5. Were the reported analytical methods and constituents in compliance with the QAPP, permit, or CoC? Specify if any analytes were reported by more than one method. Comments: The reported analytical methods and constituents were found to be in compliance with the CoC. There were no analytes that were reported by more than one method.</p>	Yes
<p>6. Were samples received in good condition within method-specified requirements? Comments: The samples were received in good condition, with the cooler temperature within the recommended temperature range of 4.0°C ± 2.0°C at a temperature of 2.9°C as noted on the CoC and the Work Order Receipt Checklist. Custody seals were not required since the samples were hand delivered to the laboratory by a member of the sampling team.</p>	Yes
<p>7. Were samples extracted/digested and analyzed within method-specified or technical holding times? Comments: The samples were digested and analyzed within method-specified holding times.</p>	Yes
<p>8. Were reported units appropriate for the sample matrix/matrices and analytical method(s)? Specify if wet or dry units were used for soil. Comments: The results were reported in concentration units of milligrams per liter (mg/L) and micrograms per liter (µg/L), which were acceptable for the sample matrix and the analyses requested.</p>	Yes



### VALIDATION CRITERIA CHECKLIST

9. Did the laboratory provide any specific initial and/or continuing calibration results? Yes

Comments: Limited initial calibration verification (ICV), continuing calibration verification (CCV), and Interference Check Sample data were included in the report.

10. If initial and/or continuing calibration results were provided, were the results within acceptable limits? Yes

Comments: The provided ICV, CCV, and Interference Check Sample results were within acceptance ranges.

11. Was the total number of laboratory blank samples prepared equal to at least 5% of the total number of samples or analyzed as required by the method? Yes

Comments: The total number of laboratory blank samples prepared was equal to at least 5% of the total number of samples.

12. Were target analytes reported as not detected in the laboratory blanks? No

Comments: Target analytes were not reported above the MDL in the laboratory blank samples, with the following exceptions.

TOC was detected in the laboratory blanks for Method A5310C batches C\_R210683 and C\_R120712 at concentrations of 0.06 mg/L and 0.08 mg/L, respectively. Associated detections were above the reporting limit and greater than ten times the blank concentrations and qualification of data was not required.

13. Was the total number of MS samples prepared equal to at least 5% of the total number of samples or analyzed as required by the method? Yes

Comments: The total number of matrix spike samples prepared was equal to at least 5% of the total number of samples. The matrix spike sample source for each analytical batch in this sample set has been indicated below.

<u>Method</u>	<u>Analytes</u>	<u>Batch</u>	<u>MS Sample Source</u>
A4500 S F	Sulfide	B_ttrsulfide 160412A	RSY-HV-43
A5310C	TOC	C_R210683	Not Associated
A5310C	TOC	C_R210712	RXY-EB-1
200.8	Arsenic	R114407	RXY-HV-43
200.8	Arsenic	R114469	RXY-FB-1
8260B	VOCs	R114390	RXY-FB-1
8260B	VOCs	R114420	Not Prepared

Not Associated – The MS sample source was not associated with this project.

Not Prepared – Matrix spikes were not prepared for this batch

14. For MS/MSDs prepared from project samples, were percent recoveries and RPDs within data validation or laboratory quality control (QC) limits? No

Comments: The MS/MSD percent recoveries and MS/MSD RPDs were within data validation and laboratory QC limits with the following exception.

**The recovery of arsenic in the MS for Method 200.8 batch R114407 was outside of the data validation limits of 75-125% at 131%. Detections of arsenic in the associated samples were assigned J+ qualifiers due to evidence of possible high bias.**

15. Was the total number of LCSs analyzed equal to at least 5% of the total number of samples or analyzed as required by the method? Yes

Comments: The total number of LCS samples analyzed was equal to at least 5% of the total number of samples.



### VALIDATION CRITERIA CHECKLIST

16. Were LCS/LCSD percent recoveries and LCS/LCSD RPDs within data validation or laboratory QC limits? Yes

Comments: The LCS/LCSD and laboratory fortified blank (LFB) percent recoveries and LCS/LCSD RPDs were within data validation and laboratory QC limits.

17. Were surrogate recoveries within laboratory QC limits? Yes

Comments: Surrogate recoveries were within laboratory QC limits.

18. Were the number of trip blank, field blank, and/or equipment blank samples collected equal to at least 10% of the total number of samples or as required by the project guidelines, QAPP, SAP, or permit? Yes

Comments: The number of trip and equipment blanks collected was equal to at least 10% of the number of samples. One trip blank sample, TB 5419, one field blank sample, RXY-FB-1, and one equipment blank sample, RXY-EB-1, were collected as part of this sample set.

19. Were target analytes reported as not detected in the trip blank, field blank, and/or equipment blank samples? No

Comments: Target analytes were not reported above the MDL in the trip, field, and equipment blank samples, with the following exceptions.

Blank Sample ID	Method	Analyte	Concentration (units)
RXY-FB-1	8260B	Bromodichloromethane	0.16 µg/L
RXY-FB-1	8260B	Chloroform	0.42 µg/L
RXY-FB-1	8260B	Toluene	0.14 µg/L
RXY-EB-1	8260B	Bromodichloromethane	0.15 µg/L
RXY-EB-1	8260B	Chloroform	0.40 µg/L
RXY-EB-1	A4500-S F	Sulfide	1 mg/L

**Detections of the identified analytes in associated samples that were equal to or below the reporting limit were assigned U qualifiers due to evidence of possible blank contamination. The sulfide detection in the associated sample, RXY-HV-62, was above the reporting limit but less than ten times the blank concentration and the result was assigned a JB qualifier due to evidence of possible blank contamination.** Associated non-detections did not require qualification.

**The equipment blank detections of bromodichloromethane and chloroform were assigned U qualifiers due to field blank contamination.**

20. Was the number of field duplicates collected equal to at least 10% of the total number of samples or as required by the project guidelines, QAPP, SAP, or permit? Yes

Comments: The number of field duplicates collected was equal to at least 10% of the total number of samples. Sample RXY-BD-1 was collected as a duplicate for sample RXY-HV-41.

21. Were field duplicate RPD values within data validation QC limits (soil 0-50%, water 0-30%, or air 0-25%)? No

Comments: As indicated in the Field Duplicate Summary Table at the end of this report, field duplicate RPD values were within the data validation QC limits of 0-30% for water samples, with the following exception.

**The RPD value for arsenic exceeded the data validation limit of 30% at 66.7%. The arsenic results in the parent and duplicate samples, RXY-HV-41 and RXY-BD-1, would have been assigned J qualifiers due to poor precision but had previously been assigned J+ qualifiers due to evidence of possible high bias.**

**VALIDATION CRITERIA CHECKLIST**

22. For laboratory duplicates prepared from project samples, were RPDs within laboratory QC limits?

N/A

Comments: Laboratory duplicates were not analyzed as part of this data set.

**FIELD DUPLICATE SUMMARY**

Client Sample ID: RXY-HV-41 Field Duplicate Sample ID: RXY-BD-1				
Method	Analyte	Laboratory Result (units)	Duplicate Result (units)	Relative Percent Difference (RPD)
8260B	o-Xylene	0.18 µg/L	0.18 µg/L	0.0% +/-RL
8260B	Toluene	0.16 µg/L	0.16 µg/L	0.0% +/-RL
8260B	Xylenes, Total	0.18 µg/L	0.18 µg/L	0.0% +/-RL
<b>200.8</b>	<b>Arsenic</b>	<b>0.004 mg/L</b>	<b>0.002 mg/L</b>	<b>66.7%</b>
A4500-S2 F	Sulfide	1 mg/L	1 mg/L	0.0% +/-RL
A5310C	TOC	5.3 mg/L	5.3 mg/L	0.0%
<p>Field duplicate RPD control limits are not to exceed 30% for water as established by USEPA New England Environmental Data Review Supplement for Regional Data Review Elements and Superfund Specific Guidance/Procedures, EQADR-Supplement0, April 2013.</p> <p>+/-RL – Indicates that the detections in both of the samples were within two times the reporting limit. Qualification of data was not required.</p> <p><b>The RPD value for arsenic exceeded the data validation limit of 30% at 66.7%. The arsenic results in the parent and duplicate samples, RXY-HV-41 and RXY-BD-1, were assigned J qualifiers due to poor precision.</b></p>				

### DATA QUALIFICATION SUMMARY

Abbreviation	Reason
HR-MS	The MS and/or MSD percent recovery was greater than the upper acceptable limit indicating possible matrix interference.
ERPD-FD	High field duplicate RPD.
FBD	Field blank detection
EBD	Equipment blank detection
MDLRL	Flagged by the laboratory: The result was greater than the MDL but less than the RL.

Analyte	Method	Field Sample ID	Lab Sample ID	Result	Limit	Units	Reviewer Qualifier	DV Flag Reasons
Arsenic, Dissolved	E200.8	RSY-HV-43	H16040119-001	0.005	0.001	mg/L	J+	HR-MS
Arsenic, Dissolved	E200.8	RXY-HV-41	H16040119-002	0.004	0.001	mg/L	J+	ERPD-FD, HR-MS
Arsenic, Dissolved	E200.8	RXY-HV-62	H16040119-003	0.024	0.001	mg/L	J+	HR-MS
Arsenic, Dissolved	E200.8	RXY-BD-1	H16040119-004	0.002	0.001	mg/L	J+	ERPD-FD, HR-MS
Bromodichloromethane	SW8260B	RXY-FB-1	H16040119-005	0.16	1	µg/L	J	MDLRL
Bromodichloromethane	SW8260B	RXY-EB-1	H16040119-006	0.15	1	µg/L	U	FBD, MDLRL
Chloroform	SW8260B	RXY-FB-1	H16040119-005	0.42	1	µg/L	J	MDLRL
Chloroform	SW8260B	RXY-EB-1	H16040119-006	0.4	1	µg/L	U	FBD, MDLRL
m,p-Xylene	SW8260B	RXY-HV-62	H16040119-003	0.28	1	µg/L	J	MDLRL
o-Xylene	SW8260B	RXY-HV-41	H16040119-002	0.18	1	µg/L	J	MDLRL
o-Xylene	SW8260B	RXY-BD-1	H16040119-004	0.18	1	µg/L	J	MDLRL
Sulfide, Total	A4500-S2 F	RSY-HV-43	H16040119-001	1	1	mg/L	U	EBD
Sulfide, Total	A4500-S2 F	RXY-HV-41	H16040119-002	1	1	mg/L	U	EBD
Sulfide, Total	A4500-S2 F	RXY-HV-62	H16040119-003	2	1	mg/L	JB	EBD
Sulfide, Total	A4500-S2 F	RXY-BD-1	H16040119-004	1	1	mg/L	U	EBD
Toluene	SW8260B	RSY-HV-43	H16040119-001	0.18	1	µg/L	U	FBD, MDLRL
Toluene	SW8260B	RXY-HV-41	H16040119-002	0.16	1	µg/L	U	FBD, MDLRL
Toluene	SW8260B	RXY-HV-62	H16040119-003	0.26	1	µg/L	U	FBD, MDLRL
Toluene	SW8260B	RXY-BD-1	H16040119-004	0.16	1	µg/L	U	FBD, MDLRL



Analyte	Method	Field Sample ID	Lab Sample ID	Result	Limit	Units	Reviewer Qualifier	DV Flag Reasons
Toluene	SW8260B	RXY-FB-1	H16040119-005	0.14	1	µg/L	J	MDLRL
Trichloroethene	SW8260B	RSY-HV-43	H16040119-001	0.9	1	µg/L	J	MDLRL
Trichloroethene	SW8260B	RXY-HV-62	H16040119-003	0.53	1	µg/L	J	MDLRL
Vinyl Chloride	SW8260B	RSY-HV-43	H16040119-001	0.19	1	µg/L	J	MDLRL
Xylenes, Total	SW8260B	RXY-HV-41	H16040119-002	0.18	1	µg/L	J	MDLRL
Xylenes, Total	SW8260B	RXY-BD-1	H16040119-004	0.18	1	µg/L	J	MDLRL



## Tier II Data Validation Report Summary

Client: Montana Department of Environmental Quality	Laboratory: Energy Laboratories, Inc.
Project Name: Roxy Cleaners Interim Action	Sample Matrix: Water
Project Number: 776-023-002	Sample Start Date: 06/24/2016
Date Validated: 07/12/2016	Sample End Date: 06/24/2016
Parameters Included: <ul style="list-style-type: none"><li>▪ Volatile Organic Compounds (VOC) by Test Methods for Evaluating Solid Waste (SW-846) Method 8260B</li><li>▪ Dissolved Arsenic by US Environmental Protection Agency (EPA) Method 200.8</li></ul>	
Laboratory Project ID: H16060477	
Data Validator: Charles Ballek, Senior Chemist	
Reviewer: Kyle Power, Environmental Chemist	

### DATA EVALUATION CRITERIA SUMMARY

A Tier II Data Validation was performed by Trihydro Corporation's Chemical Data Evaluation Services Group on the analytical data report package generated by Energy Laboratories, Inc. located in Helena, Montana evaluating samples from the MDEQ Roxy Cleaners site located in Havre, Montana.

Precision, accuracy, method compliance, and completeness of this data package were assessed during this data review. Precision was determined by evaluating the calculated relative percent difference (RPD) values from:

- Field duplicate pairs
- Matrix spike (MS) and matrix spike duplicate (MSD) pairs

Laboratory accuracy was established by reviewing the demonstrated percent recoveries (%R) of the following items to verify that data are not biased.

- MS/MSD samples
- Laboratory control samples (LCS) and laboratory fortified blanks (LFB)
- Organic system monitoring compounds (surrogates)

Field accuracy was established by collecting and analyzing the following samples to monitor for possible ambient or cross contamination during sampling and transportation.

- Trip blanks
- Equipment blanks

Method compliance was established by reviewing sample integrity, holding times, detection limits, surrogate recoveries, laboratory blanks, initial and continuing calibrations (where applicable), and the LCS/LFB percent recoveries against method-specific requirements.

Completeness was evaluated by determining the overall ratio of the number of samples and analyses planned versus the number of samples with valid analyses. Determination of completeness included a review of the chain-of-custody (CoC), laboratory analytical methods, and other laboratory and field documents associated with this analytical data set.





## Tier II Data Validation Report Summary

### SAMPLE NUMBERS TABLE

Client Sample ID	Laboratory Sample Number
RXY-HV-41	H16060477-001
RXY-HV-43	H16060477-002
RXY-HV-62	H16060477-003
EB-1	H16060477-004
BD-1	H16060477-005
TB 5598	H16060477-006



## Tier II Data Validation Report Summary

The laboratory data were reviewed to evaluate compliance with the methods and the quality of the reported data. Assessment of CoC completeness is included in Item 3 of the Data Validation Checklist. A check mark (✓) indicates that the referenced validation criteria were deemed acceptable, whereas a crossed circle (⊗) indicates validation criteria for which the data have been qualified by the data validator. An empty circle (○) indicates that the specified criterion does not apply to the reviewed data. Details are noted in the tables below.

### Validation Criteria

- ✓ Data Completeness
- ✓ CoC Documentation (Item 3)
- ✓ Holding Times and Preservation (Items 6 and 7)
- ✓ Initial and Continuing Calibrations (Item 9)
- ✓ Laboratory Blanks (Item 11)
- ⊗ MS/MSD (Item 13)
- ✓ LCS and LFB (Item 15)
- ✓ System Monitoring Compounds (i.e., Surrogates) (Item 17)
- ✓ Equipment and Trip Blanks (Item 18)
- ✓ Field Duplicates (Item 20)
- Laboratory Duplicates (Item 22)

### Guidance References

Chemical data validation was conducted in accordance with the United States Environmental Protection Agency (USEPA) Contract Laboratory Program (CLP) National Functional Guidelines for the analyses listed below, or by the appropriate method if not covered in the National Functional Guidelines.

- Data for organic analyses were evaluated according to validation criteria set forth in the USEPA CLP National Functional Guidelines for Superfund Organic Methods Data Review, document number EPA-540-R-014-002, August 2014 with additional reference to the USEPA CLP National Functional Guidelines for Organic Data Review, document number EPA 540/R-99/008, October 1999.
- Data for inorganic analyses were evaluated according to validation criteria set forth in the USEPA CLP National Functional Guidelines for Inorganic Superfund Data Review, document number EPA-540-R-013-001, August 2014 with additional reference to the USEPA CLP National Functional Guidelines for Inorganic Data Review, document number EPA 540-R-04-004, October 2004.
- Review of field duplicates was conducted according to the USEPA New England Environmental Data Review Supplement for Regional Data Review Elements and Superfund Specific Guidance/Procedures, EQADR-Supplement0, April 2013.
- Trihydro Data Validation Variance Documentation, February 2016.
- Project-specific Quality Assurance Project Plans (QAPP) data validation requirements, as applicable.





## Tier II Data Validation Report Summary

### OVERALL DATA PACKAGE ASSESSMENT

Based on a data validation review, the data are acceptable as delivered. Data qualified by the laboratory are discussed in Item 2 of the Validation Criteria Checklist.

The purpose of validating data and assigning qualifiers is to assist in proper data interpretation. Data that are not qualified meet the site data quality objectives. If values are assigned qualifiers other than an R (rejected, data not usable), the data may be used for site evaluation; however, consideration should be given to the reasons for qualification when interpreting sample concentrations. Data points that are assigned an R qualifier should not be used for site evaluation purposes.

Text identified in **bold font** in the Validation Criteria Checklist indicates that further action and/or qualification of the data were required. Data validation qualifiers were added for the items noted with crossed circles in the Validation Criteria section above. Please see the Data Qualification Summary table at the end of this report for a complete list of samples and analytes qualified.

Data qualifiers used during this validation are included in the following table.

<u>Qualifier</u>	<u>Definition</u>
J+	The result is an estimated concentration, but may be biased high

### Data Completeness

The analyses were performed as requested on the CoC records. The associated samples were received by the laboratory and analyzed properly unless otherwise noted in the Criteria Checklist below. The complete data package consisted of 200 data points excluding blank samples. No data points were rejected. The data completeness measure for this data package is calculated to be 100% and is acceptable.

### VALIDATION CRITERIA CHECKLIST

1. Was the report free of non-conformances identified by the laboratory? Yes

Comments: The laboratory did not identify non-conformances related to this data set.

2. Were the data free of data qualification flags and/or notes used by the laboratory? No  
If no, define.

Comments: The laboratory applied the following data qualification flags to data in the analytical report.

E – Estimated value. Result exceeds the instrument upper quantitation limit.

S – Spike recovery outside of advisory limits

3. Were sample CoC forms and procedures complete? Yes

Comments: The CoC record from the field to the laboratory was complete and custody was maintained as evidenced by the field and laboratory personnel signatures, dates, and times of receipt.

Custody seals were not present nor required since the samples were hand delivered to the laboratory by a member of the sampling team.

4. Were detection limits in accordance with the quality assurance project plan (QAPP), permit, or method, or indicated as acceptable? Yes

Comments: The reporting limits for the data set were reviewed and appeared to be acceptable. The following dilutions were applied to the project samples.

Method	Samples	Analytes	Dilution Factor
8260B	RXY-HV-62	VOCs	5x
8260B	RXY-HV-43 and BD-1	cis- and trans-1,2-Dichloroethene	10x
8260B	RXY-HV-62	trans-1,2-Dichloroethene	10x
8260B	RXY-HV-62	cis-1,2-Dichloroethene and vinyl chloride	100x

5. Were the reported analytical methods and constituents in compliance with the QAPP, permit, or CoC? Specify if any analytes were reported by more than one method. Yes

Comments: The reported analytical methods and constituents were found to be in compliance with the CoC. There were no analytes that were reported by more than one method.

6. Were samples received in good condition within method-specified requirements? Yes

Comments: The samples were received in good condition, with the cooler temperature within the recommended temperature range of 4.0°C ± 2.0°C at a temperature of 5.6°C as noted on the CoC and the Work Order Receipt Checklist.

7. Were samples extracted/digested and analyzed within method-specified or technical holding times? Yes

Comments: The samples were digested and analyzed within method-specified holding times.

8. Were reported units appropriate for the sample matrix/matrices and analytical method(s)? Specify if wet or dry units were used for soil. Yes

Comments: The results were reported in concentration units of milligrams per liter (mg/L) and micrograms per liter (µg/L), which were acceptable for the sample matrix and the analyses requested.



### VALIDATION CRITERIA CHECKLIST

9. Did the laboratory provide any specific initial and/or continuing calibration results? Yes

Comments: Limited initial calibration verification (ICV), continuing calibration verification (CCV), and Interference Check Sample data were included in the report.

10. If initial and/or continuing calibration results were provided, were the results within acceptable limits? Yes

Comments: The provided ICV, CCV, and Interference Check Sample results were within acceptance ranges.

11. Was the total number of laboratory blank samples prepared equal to at least 5% of the total number of samples or analyzed as required by the method? Yes

Comments: The total number of laboratory blank samples prepared was equal to at least 5% of the total number of samples.

12. Were target analytes reported as not detected in the laboratory blanks? Yes

Comments: Target analytes were not reported above the MDL in the laboratory blank samples.

13. Was the total number of MS samples prepared equal to at least 5% of the total number of samples or analyzed as required by the method? Yes

Comments: The total number of matrix spike samples prepared was equal to at least 5% of the total number of samples. The matrix spike sample source for each analytical batch in this sample set has been indicated below.

<u>Method</u>	<u>Analytes</u>	<u>Batch</u>	<u>MS Sample Source</u>
200.8	Arsenic	R116337	Not Associated
8260B	VOCs	R116415	RXY-HV-62
8260B	VOCs	R116462	Not Associated

Not Associated – The MS sample source was not associated with this project.

14. For MS/MSDs prepared from project samples, were percent recoveries and RPDs within data validation or laboratory quality control (QC) limits? No

Comments: The MS/MSD percent recoveries and MS/MSD RPDs were within laboratory QC limits with the following exceptions.

The recoveries of cis-1,2-dichloroethene in the MS and MSD for Method 8260B batch R116415 were outside the laboratory limits of 75-122% at 160% and 40%, respectively. However, the unspiked sample concentration was greater than 4 times the spike added and the acceptance criteria was not applicable and qualification of sample data was not required.

**In the same batch, vinyl chloride was recovered in the MS at 136%, outside the laboratory limits of 69-129%, indicating a potential high bias. Vinyl chloride was detected in the parent sample RXY-HV-62 and the result was assigned a J+ qualifier.** Vinyl chloride was not detected in the associated samples analyzed in batch R116415 and qualification of those results was not required.

15. Was the total number of LCSs analyzed equal to at least 5% of the total number of samples or analyzed as required by the method? Yes

Comments: The total number of LCS samples analyzed was equal to at least 5% of the total number of samples.

16. Were LCS/LCSD percent recoveries and LCS/LCSD RPDs within data validation or laboratory QC limits? Yes

Comments: The LCS and LFB percent recoveries were within data validation and laboratory QC limits.



<b>VALIDATION CRITERIA CHECKLIST</b>	
17. Were surrogate recoveries within laboratory QC limits?	Yes
Comments: Surrogate recoveries were within laboratory QC limits.	
18. Were the number of trip blank, field blank, and/or equipment blank samples collected equal to at least 10% of the total number of samples or as required by the project guidelines, QAPP, SAP, or permit?	Yes
Comments: The number of trip and equipment blanks collected was equal to at least 10% of the number of samples. One trip blank sample, TB 5598, and one equipment blank sample, EB-1, were collected as part of this sample set.	
19. Were target analytes reported as not detected in the trip blank, field blank, and/or equipment blank samples?	Yes
Comments: Target analytes were not reported above the MDL in the trip and equipment blank samples.	
20. Was the number of field duplicates collected equal to at least 10% of the total number of samples or as required by the project guidelines, QAPP, SAP, or permit?	Yes
Comments: The number of field duplicates collected was equal to at least 10% of the total number of samples. Sample BD-1 was collected as a duplicate for sample RXY-HV-43.	
21. Were field duplicate RPD values within data validation QC limits (soil 0-50%, water 0-30%, or air 0-25%)?	Yes
Comments: As indicated in the Field Duplicate Summary Table at the end of this report, field duplicate RPD values were within the data validation QC limits of 0-30% for water samples.	
22. For laboratory duplicates prepared from project samples, were RPDs within laboratory QC limits?	N/A
Comments: Laboratory duplicates were not analyzed as part of this data set.	

**FIELD DUPLICATE SUMMARY**

Client Sample ID: RXY-HV-43 Field Duplicate Sample ID: BD-1				
Method	Analyte	Laboratory Result	Duplicate Result	Relative Percent Difference (RPD)
8260B	cis-1,2-Dichloroethene	189 µg/L	181 µg/L	4.3%
8260B	trans-1,2-Dichloroethene	51 µg/L	50 µg/L	2.0%
8260B	Trichloroethene	1.1 µg/L	1.1 µg/L	0.0% +/-RL
200.8	Arsenic	0.004 mg/L	0.004 mg/L	0.0%
<p>Field duplicate RPD control limits are not to exceed 30% for water as established by USEPA New England Environmental Data Review Supplement for Regional Data Review Elements and Superfund Specific Guidance/Procedures, EQADR-Supplement0, April 2013.</p> <p>+/-RL – Indicates that the detections in both of the samples were within two times the reporting limit. Qualification of data was not required.</p>				



### DATA QUALIFICATION SUMMARY

Abbreviation	Reason
HR-MS	The MS and/or MSD percent recovery was greater than the upper acceptable limit indicating possible matrix interference.

Analyte	Method	Field Sample ID	Lab Sample ID	Result	Limit	Units	Reviewer Qualifier	DV Flag Reasons
Vinyl Chloride	SW8260B	RSY-HV-62	H16060477-003	392	25	µg/L	J+	HR-MS





## Tier II Data Validation Report Summary

Client: Montana Department of Environmental Quality (MDEQ)	Laboratory: Energy Laboratories
Project Name: Roxy Cleaners Interim Action	Sample Matrix: Soil
Project Number: 776-023-002	Sample Start Date: 10/25/2016
Date Validated: 03/27/2017	Sample End Date: 10/25/2016
Parameters Included:	
<ul style="list-style-type: none"> <li>▪ Toxicity Characteristic Leaching Procedure (TCLP) Volatile Organic Compounds (VOC) by Environmental Protection Agency (EPA) Test Methods for Evaluating Solid Waste (SW-846) Method 8260B and Method 1311</li> </ul>	
Laboratory Project ID: H16100494	
Data Validator: Charles Ballek, Senior Chemist	
Reviewer: Mike Phillips, Senior Chemist	

### DATA EVALUATION CRITERIA SUMMARY

A Tier II Data Validation was performed by Trihydro Corporation's Chemical Data Evaluation Services Group on the analytical data report package generated by Energy Laboratories, Inc. located in Helena, Montana evaluating samples from the MDEQ Roxy Cleaners site located in Havre, Montana.

Precision, accuracy, method compliance, and completeness of this data package were assessed during this data review.

Laboratory accuracy was established by reviewing the demonstrated percent recoveries (%R) of the following items to verify that data are not biased.

- Matrix spike (MS) samples
- Laboratory control samples (LCS)
- Organic system monitoring compounds (surrogates)

Method compliance was established by reviewing sample integrity, holding times, detection limits, surrogate recoveries, laboratory blanks, initial and continuing calibrations (where applicable) percent recoveries, and LCS percent recoveries against method-specific requirements.

Completeness was evaluated by determining the overall ratio of the number of samples and analyses planned versus the number of samples with valid analyses. Determination of completeness included a review of the chain-of-custody (CoC), laboratory analytical methods, and other laboratory and field documents associated with this analytical data set.

### SAMPLE NUMBERS TABLE

Client Sample ID	Laboratory Sample Number
RXY-Drum 2	H16100494-001





## Tier II Data Validation Report Summary

The laboratory data were reviewed to evaluate compliance with the methods and the quality of the reported data. Assessment of CoC completeness is included in Item 3 of the Data Validation Checklist. A check mark (✓) indicates that the referenced validation criteria were deemed acceptable, whereas a crossed circle (⊗) indicates validation criteria for which the data have been qualified by the data validator. An empty circle (○) indicates that the specified criterion does not apply to the reviewed data. Details are noted in the tables below.

### Validation Criteria

- ✓ Data Completeness
- ✓ CoC Documentation (Item 3)
- ⊗ Holding Times and Preservation (Items 6 and 7)
- Initial and Continuing Calibrations (Items 9 and 10)
- ✓ Laboratory Blanks (Items 11 and 12)
- ✓ MS (Items 13 and 14)
- ✓ LCS (Items 15 and 16)
- ✓ System Monitoring Compounds (i.e., Surrogates) (Item 17)
- Field, Equipment, and Trip Blanks (Items 18 and 19)
- Field Duplicates (Items 20 and 21)
- Laboratory Duplicates (Item 22)
- Data Relationships (Item 23)

### Guidance References

Chemical data validation was conducted in accordance with the United States Environmental Protection Agency (USEPA) Contract Laboratory Program (CLP) National Functional Guidelines for the analyses listed below, or by the appropriate method if not covered in the National Functional Guidelines.

- Data for organic analyses were evaluated according to validation criteria set forth in the USEPA CLP National Functional Guidelines for Superfund Organic Methods Data Review, document number EPA-540-R-2016-002, September 2016 with additional reference to the USEPA CLP National Functional Guidelines for Organic Data Review, document number EPA 540/R-99/008, October 1999.
- Project-specific Quality Assurance Project Plans (QAPP) data validation requirements, as applicable.
- Trihydro Data Validation Variance Documentation, February 2017.





## Tier II Data Validation Report Summary

### OVERALL DATA PACKAGE ASSESSMENT

Based on a data validation review, the data are acceptable as delivered. Data qualified by the laboratory are discussed in Item 2 of the Validation Criteria Checklist.

The purpose of validating data and assigning qualifiers is to assist in proper data interpretation. Data that are not qualified meet the site data quality objectives. If values are assigned qualifiers other than an R (rejected, data not usable), the data may be used for site evaluation; however, consideration should be given to the reasons for qualification when interpreting sample concentrations. Data points that are assigned an R qualifier should not be used for site evaluation purposes.

Text identified in **bold font** in the Validation Criteria Checklist indicates that further action and/or qualification of the data were required. Data validation qualifiers were added for the items noted with crossed circles in the Validation Criteria section above. Please see the Data Qualification Summary table at the end of this report for a complete list of samples and analytes qualified.

Data qualifiers used during this validation are included in the following table.

<u>Qualifier</u>	<u>Definition</u>
UJ	Estimated reporting limit

### Data Completeness

The analyses were performed as requested on the CoC records. The associated samples were received by the laboratory and analyzed properly unless otherwise noted in the Criteria Checklist below. The complete data package consisted of 11 data points. No data points were rejected. The data completeness measure for this data package is calculated to be 100% and is acceptable.



VALIDATION CRITERIA CHECKLIST	
1. Was the report free of non-conformances identified by the laboratory?	Yes
Comments: The laboratory did not report non-conformances related to this data set.	
2. Were the data free of data qualification flags and/or notes used by the laboratory? If no, define.	Yes
Comments: The laboratory did not apply data qualifier or notes to results reported for this data set.	
3. Were sample CoC forms and custody procedures complete?	Yes
Comments: The CoC record from field to laboratory was complete and custody was maintained as evidenced by field and laboratory personnel signatures, dates, and times of receipt.  Custody seals were not present nor required since the samples were delivered to the laboratory by project personnel and custody was maintained at all times.	
4. Were detection limits in accordance with the quality assurance project plan (QAPP), permit, or method, or indicated as acceptable?	Yes
Comments: The detection limits appeared to be acceptable.  Sample RXY-Drum 2 was diluted by a factor of 100 times for the analysis of TCLP VOCs.  Final determination of the data quality based on detection limits will be established by the project team.	
5. Were the reported analytical methods and constituents in compliance with the QAPP, permit, or CoC?	Yes
Comments: The reported analytical methods were in compliance with the CoC and the laboratory reported the requested constituents in accordance with the CoC.	
6. Were samples received in good condition within method-specified requirements?	No
Comments: Samples were received in good condition as noted on the Sample Receipt Checklist.  <b>Samples were received on ice, in good condition, with the sample temperature outside the recommended temperature range of 4°C ± 2°C at 7.2°C as noted on the CoC and the <i>Work Order Receipt Checklist</i>.</b>  <b>The sampler indicated that the sample had been on ice since collection but the temperature was still above 6°C. The target analytes were not detected in the submitted sample and the results were assigned UJ qualifiers due to the elevated temperature.</b>  The laboratory indicated that the sample containers were intact and sufficient sample mass was provided to complete the requested analyses.	
7. Were samples extracted/digested and analyzed within method-specified or technical holding times?	Yes
Comments: The samples were extracted and analyzed within method-specific holding times.	
8. Were reported units appropriate for the sample matrix/matrices and analytical method(s)? Specify if wet or dry units were used for soil.	Yes
Comments: The analytical results for the submitted sample were reported in concentration units of milligrams per liter (mg/L). These units were acceptable for the sample matrix and the analysis requested.	
9. Did the laboratory provide any specific initial and/or continuing calibration results?	No
Comments: Calibration data was not reported for this data set.	
10. If initial and/or continuing calibration results were provided, were the results within acceptable limits?	N/A
Comments: Calibration data was not reported for this data set.	



### VALIDATION CRITERIA CHECKLIST

<p>11. Was the total number of laboratory blank samples prepared equal to at least 5% of the total number of samples or analyzed as required by the method?</p> <p>Comments: The total number of laboratory blank samples prepared was equal to at least 5% of the total number of samples.</p>	<p>Yes</p>
<p>12. Were target analytes reported as not detected in the laboratory blanks?</p> <p>Comments: Target analytes were not detected in the laboratory blanks, with the following exception. Benzene was detected in the method blank for Method 8260B batch B_104150 at a concentration of 0.0370 mg/L. Benzene was not detected in the associated sample and qualification of the results was not required.</p>	<p>No</p>
<p>13. Was the total number of MS samples prepared equal to at least 5% of the total number of samples or analyzed as required by the method?</p> <p>Comments: The total number of matrix spike samples prepared was equal to at least 5% of the total number of samples. A matrix spike was prepared for Method 8260B batch B_104150 from sample RXY-Drum 2. The laboratory did not prepare an MSD for the batch reported in this data set.</p>	<p>Yes</p>
<p>14. For MS/MSDs prepared from project samples, were percent recoveries and RPDs within data validation or laboratory quality control (QC) limits?</p> <p>Comments: The recoveries for the MS prepared from the project sample were within laboratory QC limits. The laboratory did not analyze an MSD for the batch reported in this data set.</p>	<p>Yes</p>
<p>15. Was the total number of LCSs analyzed equal to at least 5% of the total number of samples or analyzed as required by the method?</p> <p>Comments: The total number of LCS samples analyzed was equal to at least 5% of the total number of samples.</p>	<p>Yes</p>
<p>16. Were LCS/LCSD percent recoveries and LCS/LCSD RPDs within data validation or laboratory QC limits?</p> <p>Comments: The LCS percent recoveries were within laboratory QC limits. The laboratory did not analyze an LCSD for the batch reported in this data set.</p>	<p>Yes</p>
<p>17. Were surrogate recoveries within laboratory QC limits?</p> <p>Comments: The surrogate recoveries were within laboratory QC limits.</p>	<p>Yes</p>
<p>18. Were the number of trip blank, field blank, and/or equipment blank samples collected equal to at least 10% of the total number of samples or as required by the project guidelines, QAPP, SAP, or permit?</p> <p>Comments: Trip, field, and equipment blank samples were not submitted for this sample set.</p>	<p>No</p>
<p>19. Were target analytes reported as not detected in the trip blank, field blank, and/or equipment blank samples?</p> <p>Comments: Trip, field, and equipment blank samples were not submitted for this sample set.</p>	<p>N/A</p>
<p>20. Was the number of field duplicates collected equal to at least 10% of the total number of samples or as required by the project guidelines, QAPP, SAP, or permit?</p> <p>Comments: Field duplicates were not collected as part of this sample set.</p>	<p>No</p>
<p>21. Were field duplicate RPD values within data validation QC limits (soil 0-50%, water 0-30%, or air 0-25%)?</p> <p>Comments: Field duplicates were not collected as part of this sample set.</p>	<p>N/A</p>



**VALIDATION CRITERIA CHECKLIST**

22. For laboratory duplicates prepared from project samples, were RPDs within laboratory QC limits? N/A

Comments: Laboratory duplicates were not prepared for the analyses reported in this data set.

23. Were the following data relationships realistic and acceptable?

- Target analytes were reported by more than one method (e.g., 8260/8270, EPH/8270) and the results were in agreement? N/A

Comments: Analytes were not reported by more than one method.

- Both total and dissolved metals analyses were performed and the total metals results were greater than or equal to the dissolved metals results? N/A

Comments: Metals analyses were not performed as part of this data set.



### DATA QUALIFICATION SUMMARY

Abbreviation	Reason
HTEM-PR	The temperature of the sample containers was greater than 6°C upon receipt at the laboratory.

Analyte	Method	Field Sample ID	Lab Sample ID	Result	Limit	Units	Reviewer Qualifier	DV Flag Reasons
1,1-Dichloroethene, TCLP	SW8260B	RXY-Drum 2	H16100494-001	ND	0.1	mg/L	UJ	HTEM-PR
1,2-Dichloroethane, TCLP	SW8260B	RXY-Drum 2	H16100494-001	ND	0.1	mg/L	UJ	HTEM-PR
1,4-Dichlorobenzene, TCLP	SW8260B	RXY-Drum 2	H16100494-001	ND	0.1	mg/L	UJ	HTEM-PR
2-Butanone, TCLP	SW8260B	RXY-Drum 2	H16100494-001	ND	2	mg/L	UJ	HTEM-PR
Benzene, TCLP	SW8260B	RXY-Drum 2	H16100494-001	ND	0.1	mg/L	UJ	HTEM-PR
Carbon Tetrachloride, TCLP	SW8260B	RXY-Drum 2	H16100494-001	ND	0.1	mg/L	UJ	HTEM-PR
Chlorobenzene, TCLP	SW8260B	RXY-Drum 2	H16100494-001	ND	0.1	mg/L	UJ	HTEM-PR
Chloroform, TCLP	SW8260B	RXY-Drum 2	H16100494-001	ND	0.1	mg/L	UJ	HTEM-PR
Tetrachloroethene, TCLP	SW8260B	RXY-Drum 2	H16100494-001	ND	0.1	mg/L	UJ	HTEM-PR
Trichloroethene, TCLP	SW8260B	RXY-Drum 2	H16100494-001	ND	0.1	mg/L	UJ	HTEM-PR
Vinyl Chloride, TCLP	SW8260B	RXY-Drum 2	H16100494-001	ND	0.1	mg/L	UJ	HTEM-PR





## Tier II Data Validation Report Summary

Client: Montana Department of Environmental Quality (MDEQ)	Laboratory: Energy Laboratories
Project Name: Roxy Cleaners Interim Action	Sample Matrix: Water
Project Number: 776-023-002	Sample Start Date: 03/21/2017
Date Validated: 04/17/2017	Sample End Date: 03/21/2017
Parameters Included: <ul style="list-style-type: none"><li>▪ Volatile Organic Compounds (VOC) by Environmental Protection Agency (EPA) Test Methods for Evaluating Solid Waste (SW-846) Method 8260B</li><li>▪ Dissolved and Total Arsenic by EPA Method 200.8</li></ul>	
Laboratory Project ID: H17030330	
Data Validator: Charles Ballek, Senior Chemist	
Reviewer: Mike Phillips, Senior Chemist	

### DATA EVALUATION CRITERIA SUMMARY

A Tier II Data Validation was performed by Trihydro Corporation's Chemical Data Evaluation Services Group on the analytical data report package generated by Energy Laboratories, Inc. located in Helena, Montana with additional data from Energy Laboratories in Billings, Montana evaluating samples from the MDEQ Roxy Cleaners site located in Havre, Montana.

Precision, accuracy, method compliance, and completeness of this data package were assessed during this data review. Precision was determined by evaluating the calculated relative percent difference (RPD) values from:

- Field duplicate pairs
- Matrix spike (MS) and matrix spike duplicate (MSD) pairs

Laboratory accuracy was established by reviewing the demonstrated percent recoveries (%R) of the following items to verify that data are not biased.

- MS/MSD samples
- Laboratory control samples (LCS) / laboratory fortified blanks (LFB)
- Organic system monitoring compounds (surrogates)

Field accuracy was established by collecting and analyzing the following samples to monitor for possible ambient or cross contamination during sampling and transportation.

- Field blanks
- Equipment blanks

Method compliance was established by reviewing sample integrity, holding times, detection limits, surrogate recoveries, laboratory blanks, initial and continuing calibrations (where applicable) percent recoveries, and LCS/LFB percent recoveries against method-specific requirements.

Completeness was evaluated by determining the overall ratio of the number of samples and analyses planned versus the number of samples with valid analyses. Determination of completeness included a review of the chain-of-custody (CoC), laboratory analytical methods, and other laboratory and field documents associated with this analytical data set.





## Tier II Data Validation Report Summary

### SAMPLE NUMBERS TABLE

Client Sample ID	Laboratory Sample Number
RXY-HV-43	H17030330-001
RXY-HV-41	H17030330-002
RXY-HV-62	H17030330-003
FB-1	H17030330-004
EB-1	H17030330-005
BD-1	H17030330-006



## Tier II Data Validation Report Summary

The laboratory data were reviewed to evaluate compliance with the methods and the quality of the reported data. Assessment of CoC completeness is included in Item 3 of the Data Validation Checklist. A check mark (✓) indicates that the referenced validation criteria were deemed acceptable, whereas a crossed circle (⊗) indicates validation criteria for which the data have been qualified by the data validator. An empty circle (○) indicates that the specified criterion does not apply to the reviewed data. Details are noted in the tables below.

### Validation Criteria

- ✓ Data Completeness
- ✓ CoC Documentation (Item 3)
- ⊗ Holding Times and Preservation (Items 6 and 7)
- ⊗ Initial and Continuing Calibrations (Items 9 and 10)
- ✓ Laboratory Blanks (Items 11 and 12)
- ✓ MS/MSD (Items 13 and 14)
- ✓ LCS/LFB (Items 15 and 16)
- ✓ System Monitoring Compounds (i.e., Surrogates) (Item 17)
- ✓ Field and Equipment Blanks (Items 18 and 19)
- ✓ Field Duplicates (Items 20 and 21)
- Laboratory Duplicates (Item 22)
- ✓ Data Relationships (Item 23)

### Guidance References

Chemical data validation was conducted in accordance with the United States Environmental Protection Agency (USEPA) Contract Laboratory Program (CLP) National Functional Guidelines for the analyses listed below, or by the appropriate method if not covered in the National Functional Guidelines.

- Data for organic analyses were evaluated according to validation criteria set forth in the USEPA CLP National Functional Guidelines for Superfund Organic Methods Data Review, document number EPA-540-R-2016-002, September 2016 with additional reference to the USEPA CLP National Functional Guidelines for Organic Data Review, document number EPA 540/R-99/008, October 1999.
- Data for inorganic analyses were evaluated according to validation criteria set forth in the USEPA CLP National Functional Guidelines for Inorganic Superfund Methods Data Review, document number EPA-540-R-2016-001, September 2016 with additional reference to the USEPA CLP National Functional Guidelines for Inorganic Data Review, document number EPA 540-R-04-004, October 2004.
- Review of field duplicates was conducted according to the USEPA New England Environmental Data Review Supplement for Regional Data Review Elements and Superfund Specific Guidance/Procedures, EQADR-Supplement0, April 2013.
- Project-specific Quality Assurance Project Plans (QAPP) data validation requirements, as applicable.
- Trihydro Data Validation Variance Documentation, February 2017.



## Tier II Data Validation Report Summary

### OVERALL DATA PACKAGE ASSESSMENT

Based on a data validation review, the data are acceptable as delivered. Data qualified by the laboratory are discussed in Item 2 of the Validation Criteria Checklist.

The purpose of validating data and assigning qualifiers is to assist in proper data interpretation. Data that are not qualified meet the site data quality objectives. If values are assigned qualifiers other than an R (rejected, data not usable), the data may be used for site evaluation; however, consideration should be given to the reasons for qualification when interpreting sample concentrations. Data points that are assigned an R qualifier should not be used for site evaluation purposes.

Text identified in **bold font** in the Validation Criteria Checklist indicates that further action and/or qualification of the data were required. Data validation qualifiers were added for the items noted with crossed circles in the Validation Criteria section above. Please see the Data Qualification Summary table at the end of this report for a complete list of samples and analytes qualified.

Data qualifiers used during this validation are included in the following table.

<u>Qualifier</u>	<u>Definition</u>
J-	The result is an estimated concentration, but may be biased low
UJ	Estimated reporting limit

### Data Completeness

The analyses were performed as requested on the CoC records. The associated samples were received by the laboratory and analyzed properly unless otherwise noted in the Criteria Checklist below. The complete data package consisted of 204 data points excluding blank samples. No data points were rejected. The data completeness measure for this data package is calculated to be 100% and is acceptable.

**VALIDATION CRITERIA CHECKLIST**

<p>1. Was the report free of non-conformances identified by the laboratory?</p> <p>Comments: The laboratory noted the following non-conformances related to this data set.  <u>Method 8260B</u>: Sample RXY-HV-62 was received in the laboratory with a pH &gt; 2. The pH was 7.</p>	<p align="right">No</p>
<p>2. Were the data free of data qualification flags and/or notes used by the laboratory?                  If no, define.</p> <p>Comments: The laboratory applied the following data qualifiers or notes to results reported for this data set.                  S – Spike recovery outside of advisory limits.                  R – RPD exceeds advisory limit.</p>	<p align="right">No</p>
<p>3. Were sample CoC forms and custody procedures complete?</p> <p>Comments: The CoC record from field to laboratory was complete and custody was maintained as evidenced by field and laboratory personnel signatures, dates, and times of receipt.                  Custody seals were not present nor required since the samples were delivered to the laboratory by project personnel and custody was maintained at all times.                  The laboratory noted that a collection time was not included on the CoC or the bottle label for sample BD-1. Collection times for field duplicates are routinely withheld to mask the relationship to the parent sample and ensure that the associations are not apparent.</p>	<p align="right">Yes</p>
<p>4. Were detection limits in accordance with the quality assurance project plan (QAPP), permit, or method, or indicated as acceptable?</p> <p>Comments: The detection limits appeared to be acceptable.  <u>Method 8260B</u>: Samples RXY-HV-41 and BD-1 were diluted by factors of 50 times for the analysis of cis-1,2-dichloroethene and trans-1,2-dichloroethene. A dilution of 100 times was applied to sample RXY-HV-62 for the analysis of cis-1,2-dichloroethene, trans-1,2-dichloroethene, and vinyl chloride  <u>Method 200.8</u>: Samples RXY-HV-41 and RXY-HV-62 were diluted by factors of 5 times for the analysis of dissolved arsenic.</p>	<p align="right">Yes</p>
<p>5. Were the reported analytical methods and constituents in compliance with the QAPP, permit, or CoC?</p> <p>Comments: The reported analytical methods were in compliance with the CoC and the laboratory reported the requested constituents in accordance with the CoC.                  The laboratory confirmed with project personnel that arsenic was included in the total metals list.</p>	<p align="right">Yes</p>
<p>6. Were samples received in good condition within method-specified requirements?</p> <p>Comments: Samples were received in good condition as noted on the Sample Receipt Checklist.                  Samples were received on ice, in good condition, with the sample temperature within the recommended temperature range of 4°C ± 2°C at 3.4°C as noted on the CoC and the <i>Work Order Receipt Checklist</i>. The laboratory indicated that the sample containers were intact and sufficient sample mass was provided to complete the requested analyses.                  The laboratory noted that the pH of the VOA vials designated for analysis by Method 8260B was &gt; 2 for sample RXY-HV-62. The pH of the sample at the time of analysis was 7. Following NFG defined actions, the holding time for the analysis of sample RXY-HV-62 by Method 8260B was reduced from 14 days to 7 days,</p>	<p align="right">No</p>



### VALIDATION CRITERIA CHECKLIST

7. Were samples extracted/digested and analyzed within method-specified or technical holding times? No

Comments: The samples were extracted and analyzed within method-specific holding times with the following exception.

**The Method 8260B analysis for sample RXY-HV-62 was performed approximately 3 to 6 days after expiration of the reduced holding time of 7 days. Detections of the target analytes in this sample were qualified J- and non-detections were assigned UJ qualifiers.**

8. Were reported units appropriate for the sample matrix/matrices and analytical method(s)? Specify if wet or dry units were used for soil. Yes

Comments: The analytical results for the submitted sample were reported in concentration units of micrograms per liter (µg/L) and milligrams per liter (mg/L). These units were acceptable for the sample matrix and the analysis requested.

9. Did the laboratory provide any specific initial and/or continuing calibration results? Yes

Comments: Limited summary calibration data were reported for Method 200.8 and Method 8260B.

Limited summary results for Method 200.8 interference check samples were also included in the laboratory report.

10. If initial and/or continuing calibration results were provided, were the results within acceptable limits? No

Comments: The available summary calibration results were within data validation limits, with the following exceptions.

**The reported recovery for chloromethane in the continuing calibration verification (CCV) for Method 8260B batch B\_R277284 was outside the acceptance limits of 70-130% at 69%. Chloromethane was not detected in the associated samples analyzed in this batch and the results were assigned UJ qualifiers.**

**The reported recovery for chloromethane in the continuing calibration verification (CCV) for Method 8260B batch B\_R277382 was outside the acceptance limits of 70-130% at 68%. Chloromethane was not detected in the associated samples analyzed in this batch and the results were assigned UJ qualifiers.**

The available summary results for Method 200.8 interference check samples were within data validation limits.

11. Was the total number of laboratory blank samples prepared equal to at least 5% of the total number of samples or analyzed as required by the method? Yes

Comments: The total number of laboratory blank samples prepared was equal to at least 5% of the total number of samples.

12. Were target analytes reported as not detected in the laboratory blanks? Yes

Comments: Target analytes were not detected in the laboratory blanks.

13. Was the total number of MS samples prepared equal to at least 5% of the total number of samples or analyzed as required by the method? Yes

Comments: The total number of matrix spike samples prepared was equal to at least 5% of the total number of samples.

Matrix spikes were prepared as summarized below.

Method	Analyte(s)	Batch	MS Sample Source
200.8	Arsenic	36597	RXY-HV-41
200.8	Arsenic	R123787	RXY-HV-62
8260B	VOCs	B_R277284	Not Associated
8260B	VOCs	B_R277382	Not Associated

Not Associated – The MS sample source was not associated with this project.



### VALIDATION CRITERIA CHECKLIST

<p>14. For MS/MSDs prepared from project samples, were percent recoveries and RPDs within data validation or laboratory quality control (QC) limits?</p> <p>Comments: The percent recoveries and RPDs for MS/MSDs prepared from project samples were within data validation and laboratory QC limits.</p> <p>The percent recoveries and RPD values for MS/MSDs prepared from non-project samples were evaluated and considered but data were not qualified based on those results since matrix similarity to project samples could not be guaranteed.</p>	Yes
<p>15. Was the total number of LCSs analyzed equal to at least 5% of the total number of samples or analyzed as required by the method?</p> <p>Comments: The total number of LCS/LFB samples analyzed was equal to at least 5% of the total number of samples.</p>	Yes
<p>16. Were LCS/LCSD percent recoveries and LCS/LCSD RPDs within data validation or laboratory QC limits?</p> <p>Comments: The LCS and LFB percent recoveries were within laboratory QC limits.</p> <p>The laboratory did not analyze LCSD/LFBD for the analyses reported in this data set.</p>	Yes
<p>17. Were surrogate recoveries within laboratory QC limits?</p> <p>Comments: The surrogate recoveries were within laboratory QC limits.</p>	Yes
<p>18. Were the number of trip blank, field blank, and/or equipment blank samples collected equal to at least 10% of the total number of samples or as required by the project guidelines, QAPP, SAP, or permit?</p> <p>Comments: The number of trip, field, and equipment blanks collected was equal to at least 10% of the total number of samples. One field blank sample, FB-1, and one equipment blank sample, EB-1, were collected as part of this sample set.</p>	Yes
<p>19. Were target analytes reported as not detected in the trip blank, field blank, and/or equipment blank samples?</p> <p>Comments: Target analytes were reported as not detected in the field or equipment blank samples.</p>	Yes
<p>20. Was the number of field duplicates collected equal to at least 10% of the total number of samples or as required by the project guidelines, QAPP, SAP, or permit?</p> <p>Comments: The number of field duplicates collected was equal to at least 10% of the number of samples. Sample BD-1 was collected as a field duplicate of sample RXY-HV-41.</p>	Yes
<p>21. Were field duplicate RPD values within data validation QC limits (soil 0-50%, water 0-30%, or air 0-25%)?</p> <p>Comments: As indicated in the Field Duplicate Summary Table at the end of this report, field duplicate RPD values were within the data validation QC limits of 0-30% for water samples. Qualification of data was not required.</p>	Yes
<p>22. For laboratory duplicates prepared from project samples, were RPDs within laboratory QC limits?</p> <p>Comments: Laboratory duplicates were not prepared for the analyses reported in this data set.</p>	N/A

### VALIDATION CRITERIA CHECKLIST

23. Were the following data relationships realistic and acceptable?

- Target analytes were reported by more than one method (e.g., 8260/8270, EPH/8270) and the results were in agreement? N/A

Comments: Target analytes were not reported by more than one method.

- Both total and dissolved metals analyses were performed and the total metals results were greater than or equal to the dissolved metals results? No

Comments: Total arsenic and dissolved arsenic were reported for the non-blank samples in this data set. The total arsenic concentrations were greater than or equal to the dissolved concentrations in the samples, except sample RXY-HV-43. The difference between the dissolved and total arsenic metals concentrations in sample RXY-HV-43 was within the measurement uncertainty (less than or equal to the reporting limit) and qualification of the data was not required.

**FIELD DUPLICATE SUMMARY**

<b>Client Sample ID: RXY-HV-43</b> <b>Field Duplicate Sample ID: BD-1</b>				
<b>Method</b>	<b>Analyte</b>	<b>Laboratory Result</b>	<b>Duplicate Result</b>	<b>Relative Percent Difference (RPD)</b>
E200.8	Arsenic, Dissolved	0.004 mg/L	0.004 mg/L	0.0%
E200.8	Arsenic, Total	0.003 mg/L	0.004 mg/L	28.6%
SW8260B	cis-1,2-Dichloroethene	197 µg/L	198 µg/L	0.5%
SW8260B	trans-1,2-Dichloroethene	59 µg/L	59 µg/L	0.0%
SW8260B	Trichloroethene	1.2 µg/L	1.2 µg/L	0.0% +/-RL

Field duplicate RPD control limits are not to exceed 30% for water as established by USEPA New England Environmental Data Review Supplement for Regional Data Review Elements and Superfund Specific Guidance/Procedures, EQADR-Supplement0, April 2013.

+/-RL – Indicates that the detections in both of the samples were within two times the reporting limit. Qualification of data was not required.



### DATA QUALIFICATION SUMMARY

Abbreviation	Reason
HT-AN	Sample was analyzed outside of the method holding time.
HRRF	The %D between the initial calibration RRF and the opening CCV RRF was outside the acceptable limits.

Analyte	Method	Field Sample ID	Lab Sample ID	Result	Limit	Units	Reviewer Qualifier	DV Flag Reasons
1,1,1,2-Tetrachloroethane	SW8260B	RXY-HV-62	H17030330-003	ND	1	µg/L	UJ	HT-AN
1,1,1-Trichloroethane	SW8260B	RXY-HV-62	H17030330-003	ND	1	µg/L	UJ	HT-AN
1,1,2,2-Tetrachloroethane	SW8260B	RXY-HV-62	H17030330-003	ND	1	µg/L	UJ	HT-AN
1,1,2-Trichloroethane	SW8260B	RXY-HV-62	H17030330-003	ND	1	µg/L	UJ	HT-AN
1,1-Dichloroethane	SW8260B	RXY-HV-62	H17030330-003	ND	1	µg/L	UJ	HT-AN
1,1-Dichloroethene	SW8260B	RXY-HV-62	H17030330-003	ND	1	µg/L	UJ	HT-AN
1,1-Dichloropropene	SW8260B	RXY-HV-62	H17030330-003	ND	1	µg/L	UJ	HT-AN
1,2,3-Trichloropropane	SW8260B	RXY-HV-62	H17030330-003	ND	1	µg/L	UJ	HT-AN
1,2-Dibromoethane	SW8260B	RXY-HV-62	H17030330-003	ND	1	µg/L	UJ	HT-AN
1,2-Dichlorobenzene	SW8260B	RXY-HV-62	H17030330-003	ND	1	µg/L	UJ	HT-AN
1,2-Dichloroethane	SW8260B	RXY-HV-62	H17030330-003	ND	1	µg/L	UJ	HT-AN
1,2-Dichloropropane	SW8260B	RXY-HV-62	H17030330-003	ND	1	µg/L	UJ	HT-AN
1,3-Dichlorobenzene	SW8260B	RXY-HV-62	H17030330-003	ND	1	µg/L	UJ	HT-AN
1,3-Dichloropropane	SW8260B	RXY-HV-62	H17030330-003	ND	1	µg/L	UJ	HT-AN
1,4-Dichlorobenzene	SW8260B	RXY-HV-62	H17030330-003	ND	1	µg/L	UJ	HT-AN
2,2-Dichloropropane	SW8260B	RXY-HV-62	H17030330-003	ND	1	µg/L	UJ	HT-AN
2-Butanone	SW8260B	RXY-HV-62	H17030330-003	ND	20	µg/L	UJ	HT-AN
2-Chlorotoluene	SW8260B	RXY-HV-62	H17030330-003	ND	1	µg/L	UJ	HT-AN
4-Chlorotoluene	SW8260B	RXY-HV-62	H17030330-003	ND	1	µg/L	UJ	HT-AN
Benzene	SW8260B	RXY-HV-62	H17030330-003	1.1	1	µg/L	J-	HT-AN
Bromobenzene	SW8260B	RXY-HV-62	H17030330-003	ND	1	µg/L	UJ	HT-AN



Analyte	Method	Field Sample ID	Lab Sample ID	Result	Limit	Units	Reviewer Qualifier	DV Flag Reasons
Bromochloromethane	SW8260B	RXY-HV-62	H17030330-003	ND	1	µg/L	UJ	HT-AN
Bromodichloromethane	SW8260B	RXY-HV-62	H17030330-003	ND	1	µg/L	UJ	HT-AN
Bromoform	SW8260B	RXY-HV-62	H17030330-003	ND	1	µg/L	UJ	HT-AN
Bromomethane	SW8260B	RXY-HV-62	H17030330-003	ND	1	µg/L	UJ	HT-AN
Carbon tetrachloride	SW8260B	RXY-HV-62	H17030330-003	ND	1	µg/L	UJ	HT-AN
Chlorobenzene	SW8260B	RXY-HV-62	H17030330-003	ND	1	µg/L	UJ	HT-AN
Chloroethane	SW8260B	RXY-HV-62	H17030330-003	ND	1	µg/L	UJ	HT-AN
Chloroform	SW8260B	RXY-HV-62	H17030330-003	ND	1	µg/L	UJ	HT-AN
Chloromethane	SW8260B	RXY-HV-43	H17030330-001	ND	1	µg/L	UJ	HDRRF
Chloromethane	SW8260B	RXY-HV-41	H17030330-002	ND	1	µg/L	UJ	HDRRF
Chloromethane	SW8260B	RXY-HV-62	H17030330-003	ND	1	µg/L	UJ	HDRRF, HT-AN
Chloromethane	SW8260B	FB-1	H17030330-004	ND	1	µg/L	UJ	HDRRF
Chloromethane	SW8260B	EB-1	H17030330-005	ND	1	µg/L	UJ	HDRRF
Chloromethane	SW8260B	BD-1	H17030330-006	ND	1	µg/L	UJ	HDRRF
cis-1,2-Dichloroethene	SW8260B	RXY-HV-62	H17030330-003	72	50	µg/L	J-	HT-AN
cis-1,3-Dichloropropene	SW8260B	RXY-HV-62	H17030330-003	ND	1	µg/L	UJ	HT-AN
Dibromochloromethane	SW8260B	RXY-HV-62	H17030330-003	ND	1	µg/L	UJ	HT-AN
Dibromomethane	SW8260B	RXY-HV-62	H17030330-003	ND	1	µg/L	UJ	HT-AN
Dichlorodifluoromethane	SW8260B	RXY-HV-62	H17030330-003	ND	1	µg/L	UJ	HT-AN
Ethylbenzene	SW8260B	RXY-HV-62	H17030330-003	6.1	1	µg/L	J-	HT-AN
m,p-Xylene	SW8260B	RXY-HV-62	H17030330-003	1.1	1	µg/L	J-	HT-AN
Methylene Chloride	SW8260B	RXY-HV-62	H17030330-003	ND	1	µg/L	UJ	HT-AN
MTBE	SW8260B	RXY-HV-62	H17030330-003	ND	1	µg/L	UJ	HT-AN
o-Xylene	SW8260B	RXY-HV-62	H17030330-003	3.4	1	µg/L	J-	HT-AN
Styrene	SW8260B	RXY-HV-62	H17030330-003	ND	1	µg/L	UJ	HT-AN
Tetrachloroethene	SW8260B	RXY-HV-62	H17030330-003	ND	1	µg/L	UJ	HT-AN
Toluene	SW8260B	RXY-HV-62	H17030330-003	ND	1	µg/L	UJ	HT-AN
trans-1,2-Dichloroethene	SW8260B	RXY-HV-62	H17030330-003	79	50	µg/L	J-	HT-AN



Analyte	Method	Field Sample ID	Lab Sample ID	Result	Limit	Units	Reviewer Qualifier	DV Flag Reasons
trans-1,3-Dichloropropene	SW8260B	RXY-HV-62	H17030330-003	ND	1	µg/L	UJ	HT-AN
Trichloroethene	SW8260B	RXY-HV-62	H17030330-003	ND	1	µg/L	UJ	HT-AN
Trichlorofluoromethane	SW8260B	RXY-HV-62	H17030330-003	ND	1	µg/L	UJ	HT-AN
Vinyl Chloride	SW8260B	RXY-HV-62	H17030330-003	234	50	µg/L	J-	HT-AN
Xylenes, Total	SW8260B	RXY-HV-62	H17030330-003	4.6	1	µg/L	J-	HT-AN



## Tier II Data Validation Report Summary

Client: Montana Department of Environmental Quality (MDEQ)	Laboratory: Energy Laboratories
Project Name: Roxy Cleaners Interim Action	Sample Matrix: Soil
Project Number: 776-023-002	Sample Start Date: 04/07/2017
Date Validated: 05/19/2017	Sample End Date: 04/07/2017
Parameters Included: <ul style="list-style-type: none"><li>Toxicity Characteristic Leaching Procedure (TCLP) Volatile Organic Compounds (VOC) by Environmental Protection Agency (EPA) Test Methods for Evaluating Solid Waste (SW-846) Method 8260B and Method 1311</li></ul>	
Laboratory Project ID: H17040140	
Data Validator: Charles Ballek, Senior Chemist	
Reviewer: Mike Phillips, Senior Chemist	

### DATA EVALUATION CRITERIA SUMMARY

A Tier II Data Validation was performed by Trihydro Corporation's Chemical Data Evaluation Services Group on the analytical data report package generated by Energy Laboratories, Inc. located in Helena, Montana evaluating samples from the MDEQ Roxy Cleaners site located in Havre, Montana.

Precision, accuracy, method compliance, and completeness of this data package were assessed during this data review.

Laboratory accuracy was established by reviewing the demonstrated percent recoveries (%R) of the following items to verify that data are not biased.

- Matrix spike (MS) samples
- Laboratory control samples (LCS)
- Organic system monitoring compounds (surrogates)

Method compliance was established by reviewing sample integrity, holding times, detection limits, surrogate recoveries, laboratory blanks, initial and continuing calibrations (where applicable) percent recoveries, and LCS percent recoveries against method-specific requirements.

Completeness was evaluated by determining the overall ratio of the number of samples and analyses planned versus the number of samples with valid analyses. Determination of completeness included a review of the chain-of-custody (CoC), laboratory analytical methods, and other laboratory and field documents associated with this analytical data set.

### SAMPLE NUMBERS TABLE

Client Sample ID	Laboratory Sample Number
RXY - Drum 3	H17040140-001





## Tier II Data Validation Report Summary

The laboratory data were reviewed to evaluate compliance with the methods and the quality of the reported data. Assessment of CoC completeness is included in Item 3 of the Data Validation Checklist. A check mark (✓) indicates that the referenced validation criteria were deemed acceptable, whereas a crossed circle (⊗) indicates validation criteria for which the data have been qualified by the data validator. An empty circle (○) indicates that the specified criterion does not apply to the reviewed data. Details are noted in the tables below.

### Validation Criteria

- ✓ Data Completeness
- ✓ CoC Documentation (Item 3)
- ✓ Holding Times and Preservation (Items 6 and 7)
- Initial and Continuing Calibrations (Items 9 and 10)
- ✓ Laboratory Blanks (Items 11 and 12)
- ✓ MS (Items 13 and 14)
- ✓ LCS (Items 15 and 16)
- ✓ System Monitoring Compounds (i.e., Surrogates) (Item 17)
- Field, Equipment, and Trip Blanks (Items 18 and 19)
- Field Duplicates (Items 20 and 21)
- Laboratory Duplicates (Item 22)
- Data Relationships (Item 23)

### Guidance References

Chemical data validation was conducted in accordance with the United States Environmental Protection Agency (USEPA) Contract Laboratory Program (CLP) National Functional Guidelines for the analyses listed below, or by the appropriate method if not covered in the National Functional Guidelines.

- Data for organic analyses were evaluated according to validation criteria set forth in the USEPA CLP National Functional Guidelines for Superfund Organic Methods Data Review, document number EPA-540-R-2016-002, September 2016 with additional reference to the USEPA CLP National Functional Guidelines for Organic Data Review, document number EPA 540/R-99/008, October 1999.
- Project-specific Quality Assurance Project Plans (QAPP) data validation requirements, as applicable.
- Trihydro Data Validation Variance Documentation, February 2017.





## Tier II Data Validation Report Summary

### OVERALL DATA PACKAGE ASSESSMENT

Based on a data validation review, the data are acceptable as delivered. Data qualified by the laboratory are discussed in Item 2 of the Validation Criteria Checklist.

The purpose of validating data and assigning qualifiers is to assist in proper data interpretation. Data that are not qualified meet the site data quality objectives.

Please see the Data Qualification Summary table at the end of this report for a complete list of samples and analytes qualified.

Data qualifiers were not applied as a result of this validation.

### Data Completeness

The analyses were performed as requested on the CoC records. The associated samples were received by the laboratory and analyzed properly unless otherwise noted in the Criteria Checklist below. The complete data package consisted of 11 data points. No data points were rejected. The data completeness measure for this data package is calculated to be 100% and is acceptable.

<b>VALIDATION CRITERIA CHECKLIST</b>	
1. Was the report free of non-conformances identified by the laboratory?	Yes
Comments: The laboratory did not report non-conformances related to this data set.	
2. Were the data free of data qualification flags and/or notes used by the laboratory? If no, define.	Yes
Comments: The laboratory did not apply data qualifiers or notes to results reported for this data set.	
3. Were sample CoC forms and custody procedures complete?	Yes
Comments: The CoC record from field to laboratory was complete and custody was maintained as evidenced by field and laboratory personnel signatures, dates, and times of receipt.  Custody seals were not present nor required since the samples were delivered to the laboratory by project personnel and custody was maintained at all times.	
4. Were detection limits in accordance with the quality assurance project plan (QAPP), permit, or method, or indicated as acceptable?	Yes
Comments: The detection limits appeared to be acceptable.  Sample RXY-Drum 3 was diluted by a factor of 100 times for the analysis of TCLP VOCs.  Final determination of the data quality based on detection limits will be established by the project team.	
5. Were the reported analytical methods and constituents in compliance with the QAPP, permit, or CoC?	Yes
Comments: The reported analytical methods were in compliance with the CoC and the laboratory reported the requested constituents in accordance with the CoC.	
6. Were samples received in good condition within method-specified requirements?	Yes
Comments: Samples were received in good condition as noted on the Sample Receipt Checklist.  Samples were received on ice, in good condition, with the cooler temperature within the recommended temperature range of 4°C ± 2°C at 2.8°C as noted on the CoC and the <i>Work Order Receipt Checklist</i> .  The laboratory indicated that the sample containers were intact and sufficient sample mass was provided to complete the requested analyses.	
7. Were samples extracted/digested and analyzed within method-specified or technical holding times?	Yes
Comments: The samples were extracted and analyzed within method-specific holding times.	
8. Were reported units appropriate for the sample matrix/matrices and analytical method(s)? Specify if wet or dry units were used for soil.	Yes
Comments: The analytical results for the submitted sample were reported in concentration units of milligrams per liter (mg/L). These units were acceptable for the sample matrix and the analysis requested.	
9. Did the laboratory provide any specific initial and/or continuing calibration results?	No
Comments: Calibration data was not reported for this data set.	
10. If initial and/or continuing calibration results were provided, were the results within acceptable limits?	N/A
Comments: Calibration data was not reported for this data set.	



**VALIDATION CRITERIA CHECKLIST**

11. Was the total number of laboratory blank samples prepared equal to at least 5% of the total number of samples or analyzed as required by the method?	Yes
Comments: The total number of laboratory blank samples prepared was equal to at least 5% of the total number of samples.	
12. Were target analytes reported as not detected in the laboratory blanks?	Yes
Comments: Target analytes were not detected in the laboratory blanks.	
13. Was the total number of MS samples prepared equal to at least 5% of the total number of samples or analyzed as required by the method?	Yes
Comments: The total number of matrix spike samples prepared was equal to at least 5% of the total number of samples. A matrix spike was prepared for Method 8260B batch B_108627 from sample RXY - Drum 3. The laboratory did not prepare an MSD for the batch reported in this data set.	
14. For MS/MSDs prepared from project samples, were percent recoveries and RPDs within data validation or laboratory quality control (QC) limits?	Yes
Comments: The recoveries for the MS prepared from the project sample were within laboratory QC limits. The laboratory did not analyze an MSD for the batch reported in this data set.	
15. Was the total number of LCSs analyzed equal to at least 5% of the total number of samples or analyzed as required by the method?	Yes
Comments: The total number of LCS samples analyzed was equal to at least 5% of the total number of samples.	
16. Were LCS/LCSD percent recoveries and LCS/LCSD RPDs within data validation or laboratory QC limits?	Yes
Comments: The LCS percent recoveries were within laboratory QC limits. The laboratory did not analyze an LCSD for the batch reported in this data set.	
17. Were surrogate recoveries within laboratory QC limits?	Yes
Comments: The surrogate recoveries were within laboratory QC limits.	
18. Were the number of trip blank, field blank, and/or equipment blank samples collected equal to at least 10% of the total number of samples or as required by the project guidelines, QAPP, SAP, or permit?	No
Comments: Trip, field, and equipment blank samples were not submitted for this sample set.	
19. Were target analytes reported as not detected in the trip blank, field blank, and/or equipment blank samples?	N/A
Comments: Trip, field, and equipment blank samples were not submitted for this sample set.	
20. Was the number of field duplicates collected equal to at least 10% of the total number of samples or as required by the project guidelines, QAPP, SAP, or permit?	No
Comments: Field duplicates were not collected as part of this sample set.	
21. Were field duplicate RPD values within data validation QC limits (soil 0-50%, water 0-30%, or air 0-25%)?	N/A
Comments: Field duplicates were not collected as part of this sample set.	



**VALIDATION CRITERIA CHECKLIST**

22. For laboratory duplicates prepared from project samples, were RPDs within laboratory QC limits? N/A

Comments: Laboratory duplicates were not prepared for the analyses reported in this data set.

23. Were the following data relationships realistic and acceptable?

- Target analytes were reported by more than one method (e.g., 8260/8270, EPH/8270) and the results were in agreement? N/A

Comments: The target analytes were not reported by more than one method.

- Both total and dissolved metals analyses were performed and the total metals results were greater than or equal to the dissolved metals results? N/A

Comments: Metals analyses were not performed as part of this data set.



## DATA QUALIFICATION SUMMARY

Data qualifiers were not applied as a result of this validation.



## Tier II Data Validation Report Summary

Client: Montana Department of Environmental Quality	Laboratory: ALS Environmental
Project Name: Roxy Cleaners Interim Action	Sample Matrix: Air
Project Number: 776-023-002	Sample Start Date: 03/16/2016
Date Validated: 04/28/2016	Sample End Date: 03/16/2016
Parameters Included: <ul style="list-style-type: none"><li>▪ Volatile Organic Compounds (VOC) by US Environmental Protection Agency (EPA) Method TO-15</li><li>▪ Methane by EPA Method 3C</li></ul>	
Laboratory Project ID: P1601765	
Data Validator: James Gianakon, Environmental Chemist	
Reviewer: Charles Ballek, Senior Chemist	

### DATA EVALUATION CRITERIA SUMMARY

A Tier II Data Validation was performed by Trihydro Corporation's Chemical Data Evaluation Services Group on the analytical data report package generated by ALS Laboratory Group located in Simi Valley, California evaluating samples from the MDEQ Roxy Cleaners site located in Havre, Montana.

Precision, accuracy, method compliance, and completeness of this data package were assessed during this data review. Precision was determined by evaluating the calculated relative percent difference (RPD) values from:

- Field duplicate pairs
- Laboratory duplicate pairs

Laboratory accuracy was established by reviewing the demonstrated percent recoveries (%R) of the following items to verify that data are not biased.

- Laboratory control samples (LCS)
- Organic system monitoring compounds (surrogates)

Method compliance was established by reviewing sample integrity, holding times, detection limits, surrogate recoveries, laboratory blanks, initial and continuing calibrations (where applicable), and the LCS percent recoveries against method-specific requirements.

Completeness was evaluated by determining the overall ratio of the number of samples and analyses planned versus the number of samples with valid analyses. Determination of completeness included a review of the chain-of-custody (CoC), laboratory analytical methods, and other laboratory and field documents associated with this analytical data set.





## Tier II Data Validation Report Summary

### SAMPLE NUMBERS TABLE

Client Sample ID	Laboratory Sample Number
RXY01 (Apartment)	P1601765-001
RXY02 (Garage)	P1601765-002
RXY03 (DUP)	P1601765-003
RXY04 (AMBIENT)	P1601765-004



## Tier II Data Validation Report Summary

The laboratory data were reviewed to evaluate compliance with the methods and the quality of the reported data. Assessment of CoC completeness is included in Item 3 of the Data Validation Checklist. A check mark (✓) indicates that the referenced validation criteria were deemed acceptable, whereas a crossed circle (⊗) indicates validation criteria for which the data have been qualified by the data validator. An empty circle (○) indicates that the specified criterion does not apply to the reviewed data. Details are noted in the tables below.

### Validation Criteria

- ✓ Data Completeness
- ✓ CoC Documentation (Item 3)
- ✓ Holding Times and Preservation (Items 6 and 7)
- Initial and Continuing Calibrations (Item 9)
- ✓ Laboratory Blanks (Item 10)
- MS/MSD (Item 12)
- ✓ LCS (Item 14)
- ✓ System Monitoring Compounds (i.e., Surrogates) (Item 16)
- Field, Equipment, and Trip Blanks (Item 17)
- ✓ Field Duplicates (Item 19)
- ✓ Laboratory Duplicates (Item 21)

### Guidance References

Chemical data validation was conducted in accordance with the United States Environmental Protection Agency (USEPA) Contract Laboratory Program (CLP) National Functional Guidelines for the analyses listed below, or by the appropriate method if not covered in the National Functional Guidelines.

- Data for organic analyses were evaluated according to validation criteria set forth in the USEPA CLP National Functional Guidelines for Superfund Organic Methods Data Review, document number EPA-540-R-014-002, August 2014 with additional reference to the USEPA CLP National Functional Guidelines for Organic Data Review, document number EPA 540/R-99/008, October 1999.
- Review of field duplicates was conducted according to the USEPA New England Environmental Data Review Supplement for Regional Data Review Elements and Superfund Specific Guidance/Procedures, EQADR-Supplement0, April 2013.
- Air and vapor data for samples collected in canisters and analyzed by EPA organics Method TO-15 were reviewed with reference to the USEPA Hazardous Waste Support Branch Validating Air Samples Volatile Organic Analysis of Ambient Air in Canister by Method TO-15, standard operating procedure number HW-31 revision 4, October 2006.
- Trihydro Data Validation Variance Documentation, February 2016.
- Project-specific Quality Assurance Project Plans (QAPP) data validation requirements, as applicable.





## Tier II Data Validation Report Summary

### OVERALL DATA PACKAGE ASSESSMENT

Based on a data validation review, the data are acceptable as delivered. Data qualified by the laboratory are discussed in Item 2 of the Validation Criteria Checklist.

The purpose of validating data and assigning qualifiers is to assist in proper data interpretation. Data that are not qualified meet the site data quality objectives.

Please see the Data Qualification Summary table at the end of this report for a complete list of samples and analytes qualified.

Data qualifiers were not applied as a result of this validation.

### Data Completeness

The analyses were performed as requested on the CoC records. The associated samples were received by the laboratory and analyzed properly unless otherwise noted in the Criteria Checklist below. The complete data package consisted of 20 data points. No data points were rejected. The data completeness measure for this data package is calculated to be 100% and is acceptable.

<b>VALIDATION CRITERIA CHECKLIST</b>	
1. Was the report free of non-conformances identified by the laboratory? Comments: The laboratory did not report non-conformances related to this data set.	Yes
2. Were the data free of data qualification flags and/or notes used by the laboratory? If no, define. Comments: The data were free of data qualification flags or other notes used by the laboratory.	Yes
3. Were sample CoC forms and procedures complete? Comments: The CoC record from the field to the laboratory was complete and custody was maintained as evidenced by the field and laboratory personnel signatures, dates, and times of receipt.	Yes
4. Were detection limits in accordance with the quality assurance project plan (QAPP), permit, or method, or indicated as acceptable? Comments: The reporting limits for the data set were reviewed and appeared to be acceptable. The following dilutions were applied to the project samples. <u>Method TO-15</u> : Dilution factors of 1.64 to 1.93 times were applied to the VOCs analyses of the submitted samples. <u>Method 3C</u> : Dilution factors of 1.64 to 1.93 times were applied to the methane analyses of the submitted samples.	Yes
5. Were the reported analytical methods and constituents in compliance with the QAPP, permit, or CoC? Specify if any analytes were reported by more than one method. Comments: The reported analytical methods and constituents were found to be in compliance with the CoC. There were no analytes that were reported by more than one method.	Yes
6. Were samples received in good condition within method-specified requirements? Comments: Samples were received intact and in good condition. The laboratory indicated in the case narrative that the canisters and regulating valves used for sampling were cleaned down to the method reporting limit (MRL) for this project.	Yes
7. Were samples extracted/digested and analyzed within method-specified or technical holding times? Comments: Samples were analyzed within method-specified holding times.	Yes
8. Were reported units appropriate for the sample matrix/matrices and analytical method(s)? Specify if wet or dry units were used for soil. Comments: The results were reported in concentration units of micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ), parts per billion by volume (ppbV), and percent volume by volume (%v/v), which were acceptable for the sample matrix and the analyses requested.	Yes
9. Did the laboratory provide any specific initial and/or continuing calibration results? Comments: Initial and/or continuing calibration results were not provided by the laboratory.	No
10. If initial and/or continuing calibration results were provided, were the results within acceptable limits? Comments: Initial and/or continuing calibration results were not provided by the laboratory.	N/A



<b>VALIDATION CRITERIA CHECKLIST</b>	
11. Was the total number of laboratory blank samples prepared equal to at least 5% of the total number of samples or analyzed as required by the method?	Yes
Comments: The total number of laboratory blank samples prepared was equal to at least 5% of the total number of samples.	
12. Were target analytes reported as not detected in the laboratory blanks?	Yes
Comments: Target analytes were not detected above the MDL in the laboratory blank samples.	
13. Was the total number of MS samples prepared equal to at least 5% of the total number of samples or analyzed as required by the method?	No
Comments: The analysis of matrix spikes is not required by Methods TO-15 and 3C.	
14. For MS/MSDs prepared from project samples, were percent recoveries and RPDs within data validation or laboratory quality control (QC) limits?	N/A
Comments: The analysis of matrix spikes is not required by Methods TO-15 and 3C.	
15. Was the total number of LCSs analyzed equal to at least 5% of the total number of samples or analyzed as required by the method?	Yes
Comments: The total number of LCS samples analyzed was equal to at least 5% of the total number of samples.	
16. Were LCS/LCSD percent recoveries and LCS/LCSD RPDs within data validation or laboratory QC limits?	Yes
Comments: The LCS recoveries were within laboratory QC limits. LCSDs were not analyzed as part of this data set.	
17. Were surrogate recoveries within laboratory QC limits?	Yes
Comments: Surrogate recoveries were within laboratory QC limits.	
18. Were the number of trip blank, field blank, and/or equipment blank samples collected equal to at least 10% of the total number of samples or as required by the project guidelines, QAPP, SAP, or permit?	No
Comments: The number of trip, field, and equipment blanks collected was not equal to at least 10% of the total number of samples. Trip, field, and equipment blank samples were not collected as part of this sample set.	
19. Were target analytes reported as not detected in the trip blank, field blank, and/or equipment blank samples?	N/A
Comments: Trip, field, and equipment blank samples were not collected as part of this sample set.	
20. Was the number of field duplicates collected equal to at least 10% of the total number of samples or as required by the project guidelines, QAPP, SAP, or permit?	Yes
Comments: The number of field duplicates collected was equal to at least 10% of the number of samples. Sample RXY03 (DUP) was collected as a duplicate of sample RXY02 (Garage).	
21. Were field duplicate RPD values within data validation QC limits (soil 0-50%, water 0-30%, or air 0-25%)?	Yes
Comments: As indicated in the Field Duplicate Summary Table at the end of this report, field duplicate RPD values were within the data validation QC limits of 0-25% for air samples.	



**VALIDATION CRITERIA CHECKLIST**

22. For laboratory duplicates prepared from project samples, were RPDs within laboratory QC limits? Yes

Comments: A laboratory duplicate was prepared for Method TO-15 batch MS9040716B from sample RXY04. The RPDs for laboratory duplicates prepared from project samples were within laboratory acceptance limits



### FIELD DUPLICATE SUMMARY

Client Sample ID: RXY02 (Garage) Field Duplicate Sample ID: RXY03 (Dup)				
Method	Analyte	Laboratory Result ( $\mu\text{g}/\text{m}^3$ )	Duplicate Result ( $\mu\text{g}/\text{m}^3$ )	Relative Percent Difference (RPD)
TO-15	cis-1,2-Dichloroethene	0.43	0.41	4.8%
TO-15	Tetrachloroethene	27	26	3.8%
TO-15	Trichloroethene	1.2	1.2	0.0%

Field duplicate RPD control limits are not to exceed 25% for air or vapor as established by USEPA New England Environmental Data Review Supplement for Regional Data Review Elements and Superfund Specific Guidance/Procedures, EQADR-Supplement0, April 2013.



## DATA QUALIFICATION SUMMARY

Data qualifiers were not applied as a result of this validation



### Tier III Data Validation Report Summary

Client: Montana Department of Environmental Quality (MDEQ)	Laboratory: ALS Environmental
Project Name: Roxy Cleaners Interim Action	Sample Matrix: Air
Project Number: 776-023-002	Sample Start Date: 05/18/2016
Date Validated: 04/24/2017	Sample End Date: 05/18/2016
Parameters Included:	
<ul style="list-style-type: none"> <li>▪ Volatile Organic Compounds (VOC) by Environmental Protection Agency (EPA) Modified Method TO-15</li> <li>▪ Methane by EPA Modified Method TO-3</li> </ul>	
Laboratory Project ID: P1602655	
Data Validator: James Gianakon, Environmental Chemist / Charles Ballek, Senior Chemist	
Draft Reviewer: Mike Phillips, Senior Chemist	Final Reviewer: Christina Hiegel, P.E.

#### DATA EVALUATION CRITERIA SUMMARY

A Tier III Data Validation was performed by Trihydro Corporation's Chemical Data Evaluation Services Group on the analytical data report package generated by ALS Environmental in Simi Valley, California evaluating samples from the MDEQ Roxy Cleaners site located in Havre, Montana.

Laboratory accuracy was established by reviewing the demonstrated percent recoveries (%R) of the following items to verify that data are not biased.

- Laboratory control samples (LCS)
- Organic system monitoring compounds (surrogates)

Method compliance was established by reviewing sample integrity, holding times, detection limits, surrogate recoveries, laboratory blanks, initial and continuing calibrations (where applicable), and the LCS percent recoveries against method-specific requirements.

Completeness was evaluated by determining the overall ratio of the number of samples and analyses planned versus the number of samples with valid analyses. Determination of completeness included a review of the chain-of-custody (CoC), laboratory analytical methods, and other laboratory and field documents associated with this analytical data set.

#### SAMPLE NUMBERS TABLE

Client Sample ID	Laboratory Sample Number
RXY-Subslab	P1602655-001
RXY-PRE	P1602655-002
RXY-Post	P1602655-003





## Tier III Data Validation Report Summary

The laboratory data were reviewed to evaluate compliance with the methods and the quality of the reported data. Assessment of CoC completeness is included in Item 3 of the Data Validation Checklist. A check mark (✓) indicates that the referenced validation criteria were deemed acceptable, whereas a crossed circle (⊗) indicates validation criteria for which the data have been qualified by the data validator. An empty circle (○) indicates that the specified criterion does not apply to the reviewed data. Details are noted in the tables below.

### Validation Criteria

- ✓ Data Completeness
- ✓ CoC Documentation
- ✓ Holding Times and Preservation
- Field Duplicates
- Field, Equipment, and Trip Blanks
- ✓ Initial and Continuing Calibrations
- ✓ Instrument Tunes
- ✓ Internal Standards
- ✓ System Performance Checks
- ✓ Laboratory Blanks
- ✓ LCS
- Matrix spike (MS) and matrix spike duplicate (MSD)
- ✓ System Monitoring Compounds (i.e. Surrogates)
- Laboratory Duplicates

### Guidance References

Chemical data validation was conducted in accordance with the United States Environmental Protection Agency (USEPA) Contract Laboratory Program (CLP) National Functional Guidelines for the analyses listed below, or by the appropriate method if not covered in the National Functional Guidelines.

- Data for organic analyses were evaluated according to validation criteria set forth in the USEPA CLP National Functional Guidelines for Superfund Organic Methods Data Review, document number EPA-540-R-2016-002, September 2016 with additional reference to the USEPA CLP National Functional Guidelines for Organic Data Review, document number EPA 540/R-99/008, October 1999.
- Air and vapor data for samples collected in canisters and analyzed by EPA organics Method TO-15 were reviewed with reference to the USEPA Hazardous Waste Support Branch Validating Air Samples Volatile Organic Analysis of Ambient Air in Canister by Method TO-15, standard operating procedure number HW-31 revision 4, October 2006.
- Trihydro Data Validation Variance Documentation, February 2017.
- Project-specific Quality Assurance Project Plans (QAPP) data validation requirements, as applicable.





## Tier III Data Validation Report Summary

### OVERALL DATA PACKAGE ASSESSMENT

Based on a data validation review, the data are acceptable as delivered. Data qualified by the laboratory are discussed in Item 2 of the Validation Criteria Checklist.

The purpose of validating data and assigning qualifiers is to assist in proper data interpretation. Data that are not qualified meet the site data quality objectives.

Please see the Data Qualification Summary table at the end of this report for a complete list of samples and analytes qualified.

Data qualifiers were not applied as a result of this validation.

### Data Completeness

The analyses were performed as requested on the CoC records. The samples were received by the laboratory and analyzed properly unless otherwise noted in the Criteria Checklist below. The complete data package consisted of 15 data points. No data points were rejected. The data completeness measure for this data package is calculated to be 100% and is acceptable.

<b>TABLE 1. GENERAL VALIDATION CRITERIA CHECKLIST</b>	
1. Was the report free of non-conformances identified by the laboratory? Comments: The laboratory did not identify non-conformances related to this data set.	Yes
2. Were the data free of data qualification flags or other notes used by the laboratory? If no, define. Comments: The laboratory used the following data qualification flag in the laboratory report. D – The reported result is from a dilution	No
3. Were sample CoC forms and procedures complete? Comments: The CoC record from the field to the laboratory was complete and custody was maintained as evidenced by the field and laboratory personnel signatures, dates, and times of receipt.	Yes
4. Were detection limits in accordance with the quality assurance project plan (QAPP), permit, or method, or indicated as acceptable? Comments: The reporting limits for the data set were reviewed and appeared to be acceptable. The following dilutions were applied to the project samples. <u>Method TO-15</u> : Dilution factors of 3.63 to 1460 times were applied to the VOCs analyses of the submitted samples. <u>Method 3C</u> : A dilution factor of 1.45 times was applied for the methane analysis of sample RXY-Post, a dilution of 1.46 times was applied for sample RXY-Subslab, and a dilution of 1.53 times was applied for sample RXY-PRE.	Yes
5. Were the reported analytical methods and constituents in compliance with the QAPP, permit, or CoC? Comments: The reported analytical methods were in compliance with the CoC and the laboratory reported the requested constituents in accordance with the CoC.	Yes
6. Were samples received in good condition within method-specified requirements? Comments: Samples were received intact and in good condition. The final vacuums from the field and receipt vacuums measured by the laboratory were compared by the project team and the vacuums appeared to be acceptable indicating canister integrity. Helium was not used as a tracer gas during the sampling the sampling train was not evaluated for leaks. The laboratory indicated that the sample containers were cleaned, prior to sampling, down to the method reporting limit (MRL) reported for this project. The canister certification results were not available for review.	Yes
7. Were samples extracted/digested and analyzed within method-specified or technical holding times? Comments: The samples were analyzed within method-specific holding times.	Yes
8. Were reported units appropriate for the sample matrix/matrices and analytical method(s)? Specify if wet or dry units were used for soil. Comments: The results were reported in concentration units of micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ), parts per billion by volume (ppbV), and parts per million by volume (ppmV), which were acceptable for the sample matrix and the analyses requested.	Yes
9. Was the number of field duplicate samples collected equal to at least 10% of the total number of samples or as required by the project guidelines, QAPP, SAP, or permit? Comments: The number of field duplicates collected was not equal to at least 10% of the number of samples. Field duplicates were not collected as part of this sample set.	No



<b>TABLE 1. GENERAL VALIDATION CRITERIA CHECKLIST</b>	
<p>10. Were field duplicate RPD values within data validation quality control (QC) limits (soil 0-50%, water 0-30%, or air 0-25%)?</p> <p>Comments: Field duplicates were not collected as part of this sample set.</p>	N/A
<p>11. Were the number of trip blank, field blank, and/or equipment blank samples collected equal to at least 10% of the total number of samples or as required by the project guidelines, QAPP, SAP, or permit?</p> <p>Comments: The number of trip, field, and equipment blanks collected was not equal to at least 10% of the total number of samples. Trip, field, and equipment blank samples were not collected for this sample set.</p>	No
<p>12. Were target analytes reported as not detected in the trip blank, field blank, and/or equipment blank samples?</p> <p>Comments: Trip, field, and equipment blank samples were not collected for this sample set.</p>	N/A

**TABLE 2. VALIDATION CRITERIA CHECKLIST FOR VOC ANALYSES (TO-15)**

1. Were instrument calibrations within data validation QC limits and analyzed at the appropriate frequency?	Yes
Comments: The initial and continuing calibrations were analyzed at appropriate frequencies and the results for the target analytes were within data validation limits.	
2. Were the instrument tunes within data validation control limits and analyzed at the appropriate frequency?	Yes
Comments: Instrument tunes were performed at the required frequency and the results were within data validation limits.	
3. Were the internal standards within data validation control limits?	Yes
Comments: The area counts and retention times for the internal standards were within method control limits.	
4. Was the total number of laboratory blank samples prepared equal to at least 5% of the total number of samples or analyzed as required by the method?	Yes
Comments: The total number of laboratory blank samples prepared was equal to at least 5% of the total number of samples.	
5. Were target analytes reported as not detected in the laboratory blanks?	Yes
Comments: Target analytes were reported as not detected in the laboratory blank.	
6. Was the total number of LCSs analyzed equal to at least 5% of the total number of samples or analyzed as required by the method?	Yes
Comments: The total number of LCS samples analyzed was equal to at least 5% of the total number of samples.	
7. Were LCS/LCSD percent recoveries and LCS/LCSD RPDs within data validation or laboratory QC limits?	Yes
Comments: The LCS percent recoveries were within laboratory QC limits. Analyses of LCSDs were performed but not reported as part of this data set.	
8. Was the total number of MS samples prepared equal to at least 5% of the total number of samples or analyzed as required by the method?	No
Comments: Analysis of matrix spike samples is not required by Method TO-15.	
9. For MS/MSDs prepared from project samples, were percent recoveries and RPDs within data validation or laboratory QC limits?	N/A
Comments: Analysis of matrix spike samples is not required by Method TO-15.	
10. Were surrogate recoveries within laboratory QC limits?	Yes
Comments: Surrogate recoveries were within laboratory QC limits.	
11. Were laboratory duplicates prepared?	No
Comments: Laboratory duplicates were not prepared for Method TO-15 batch MS13052716.	
12. Were laboratory duplicates RPD values within the laboratory acceptance limits?	N/A
Comments: Laboratory duplicates were not prepared for Method TO-15.	



**TABLE 3. VALIDATION CRITERIA CHECKLIST FOR METHANE ANALYSES (TO-3 MODIFIED)**

1. Were instrument calibrations within data validation QC limits and analyzed at the appropriate frequency?	Yes
Comments: The initial and continuing calibrations were analyzed at appropriate frequencies and the results were within data validation limits.	
2. Was the total number of laboratory blank samples prepared equal to at least 5% of the total number of samples or analyzed as required by the method?	Yes
Comments: The total number of laboratory blank samples prepared was equal to at least 5% of the total number of samples.	
3. Were target analytes reported as not detected in the laboratory blanks?	Yes
Comments: Target analytes were reported as not detected in the laboratory blank.	
4. Was the total number of LCSs analyzed equal to at least 5% of the total number of samples or analyzed as required by the method?	Yes
Comments: The total number of LCS samples analyzed was equal to at least 5% of the total number of samples.	
5. Were LCS/LCSD percent recoveries and LCS/LCSD RPDs within data validation or laboratory QC limits?	Yes
Comments: The LCS percent recoveries were within laboratory QC limits. Analyses of LCSDs were performed but not reported as part of this data set.	
6. Was the total number of MS samples prepared equal to at least 5% of the total number of samples or analyzed as required by the method?	No
Comments: Analysis of matrix spike samples is not required by Method TO-3 modified.	
7. For MS/MSDs prepared from project samples, were percent recoveries and RPDs within data validation or laboratory QC limits?	N/A
Comments: Analysis of matrix spike samples is not required by Method TO-3 modified.	
8. Were surrogate recoveries within laboratory QC limits?	N/A
Comments: Analysis of surrogates is not required by Method TO-3 modified.	
9. Were laboratory duplicates prepared?	No
Comments: Laboratory duplicates were not analyzed for Method TO-3 modified.	
10. Were laboratory duplicates RPD values within the laboratory acceptance limits?	N/A
Comments: Laboratory duplicates were not analyzed for Method TO-3 modified.	

**ATTACHMENT A**  
**BATCH MATCH TABLE**

**BATCH MATCH TABLE**

<b>Field Sample ID</b>	<b>Lab Sample ID</b>	<b>TO-15</b>	<b>TO-3 Modified</b>
RXY-Subslab	P1602655-001	MS13052716	FD8052616
RXY-PRE	P1602655-002	MS13052716	FD8052616
RXY-Post	P1602655-003	MS13052716	FD8052616

**ATTACHMENT B**  
**DATA QUALIFICATION SUMMARY**

## DATA QUALIFICATION SUMMARY

Data qualifiers were not applied as a result of this validation.



### Tier III Data Validation Report Summary

Client: Montana Department of Environmental Quality (MDEQ)	Laboratory: ALS Environmental
Project Name: Roxy Cleaners Interim Action	Sample Matrix: Air
Project Number: 776-023-002	Sample Start Date: 03/01/2017
Date Validated: 04/24/2017	Sample End Date: 03/01/2017
Parameters Included: <ul style="list-style-type: none"><li>▪ Volatile Organic Compounds (VOC) by Environmental Protection Agency (EPA) Modified Method TO-15</li><li>▪ Methane by EPA Modified Method TO-3</li></ul>	
Laboratory Project ID: P1701182	
Data Validator: Charles Ballek, Senior Chemist	
Draft Reviewer: Mike Phillips, Senior Chemist	Final Reviewer: Christina Hiegel, P.E.

#### DATA EVALUATION CRITERIA SUMMARY

A Tier III Data Validation was performed by Trihydro Corporation's Chemical Data Evaluation Services Group on the analytical data report package generated by ALS Environmental in Simi Valley, California evaluating samples from the MDEQ Roxy Cleaners site located in Havre, Montana.

Precision, accuracy, method compliance, and completeness of this data package were assessed during this data review. Precision was determined by evaluating the calculated relative percent difference (RPD) values from:

- Field duplicate pairs
- Laboratory control sample (LCS) and laboratory control sample duplicate (LCSD) pairs

Laboratory accuracy was established by reviewing the demonstrated percent recoveries (%R) of the following items to verify that data are not biased.

- LCS/LCSD samples
- Organic system monitoring compounds (surrogates)

Method compliance was established by reviewing sample integrity, holding times, detection limits, surrogate recoveries, laboratory blanks, initial and continuing calibrations (where applicable), and the LCS/LCSD percent recoveries against method-specific requirements.

Completeness was evaluated by determining the overall ratio of the number of samples and analyses planned versus the number of samples with valid analyses. Determination of completeness included a review of the chain-of-custody (CoC), laboratory analytical methods, and other laboratory and field documents associated with this analytical data set.





## Tier III Data Validation Report Summary

### SAMPLE NUMBERS TABLE

Client Sample ID	Laboratory Sample Number
RXY01	P1701182-001
RXY02	P1701182-002
RXY03	P1701182-003
RXY04	P1701182-004



## Tier III Data Validation Report Summary

The laboratory data were reviewed to evaluate compliance with the methods and the quality of the reported data. Assessment of CoC completeness is included in Item 3 of the Data Validation Checklist. A check mark (✓) indicates that the referenced validation criteria were deemed acceptable, whereas a crossed circle (⊗) indicates validation criteria for which the data have been qualified by the data validator. An empty circle (○) indicates that the specified criterion does not apply to the reviewed data. Details are noted in the tables below.

### Validation Criteria

- ✓ Data Completeness
- ✓ CoC Documentation
- ✓ Holding Times and Preservation
- ✓ Field Duplicates
- Field, Equipment, and Trip Blanks
- ✓ Initial and Continuing Calibrations
- ✓ Instrument Tunes
- ✓ Internal Standards
- ✓ System Performance Checks
- ✓ Laboratory Blanks
- ✓ LCS/LCSD
- Matrix spike (MS) and matrix spike duplicate (MSD)
- ✓ System Monitoring Compounds (i.e. Surrogates)
- Laboratory Duplicates

### Guidance References

Chemical data validation was conducted in accordance with the United States Environmental Protection Agency (USEPA) Contract Laboratory Program (CLP) National Functional Guidelines for the analyses listed below, or by the appropriate method if not covered in the National Functional Guidelines.

- Data for organic analyses were evaluated according to validation criteria set forth in the USEPA CLP National Functional Guidelines for Superfund Organic Methods Data Review, document number EPA-540-R-2016-002, September 2016 with additional reference to the USEPA CLP National Functional Guidelines for Organic Data Review, document number EPA 540/R-99/008, October 1999.
- Air and vapor data for samples collected in canisters and analyzed by EPA organics Method TO-15 were reviewed with reference to the USEPA Hazardous Waste Support Branch Validating Air Samples Volatile Organic Analysis of Ambient Air in Canister by Method TO-15, standard operating procedure number HW-31 revision 4, October 2006.
- Review of field duplicates was conducted according to the USEPA New England Environmental Data Review Supplement for Regional Data Review Elements and Superfund Specific Guidance/Procedures, EQADR-Supplement0, April 2013
- Trihydro Data Validation Variance Documentation, February 2017.
- Project-specific Quality Assurance Project Plans (QAPP) data validation requirements, as applicable.





## Tier III Data Validation Report Summary

### OVERALL DATA PACKAGE ASSESSMENT

Based on a data validation review, the data are acceptable as delivered. Data qualified by the laboratory are discussed in Item 2 of the Validation Criteria Checklist.

The purpose of validating data and assigning qualifiers is to assist in proper data interpretation. Data that are not qualified meet the site data quality objectives.

Please see the Data Qualification Summary table at the end of this report for a complete list of samples and analytes qualified.

Data qualifiers were not applied as a result of this validation.

### Data Completeness

The analyses were performed as requested on the CoC records. The samples were received by the laboratory and analyzed properly unless otherwise noted in the Criteria Checklist below. The complete data package consisted of 20 data points. No data points were rejected. The data completeness measure for this data package is calculated to be 100% and is acceptable.

<b>TABLE 1. GENERAL VALIDATION CRITERIA CHECKLIST</b>	
1. Was the report free of non-conformances identified by the laboratory?  Comments: The laboratory did not identify non-conformances related to this data set.	Yes
2. Were the data free of data qualification flags or other notes used by the laboratory? If no, define.  Comments: The laboratory did not apply data qualification flags to data for this sample set.	Yes
3. Were sample CoC forms and procedures complete?  Comments: The CoC record from the field to the laboratory was complete and custody was maintained as evidenced by the field and laboratory personnel signatures, dates, and times of receipt.	Yes
4. Were detection limits in accordance with the quality assurance project plan (QAPP), permit, or method, or indicated as acceptable?  Comments: The detection limits appeared to be acceptable. The following dilutions were applied. <u>Method TO-15 / TO-3 Modified</u> : Sample RXY01 was diluted by a factor of 1.26 times for the analysis of VOCs and methane, a dilution of 1.48 times was applied for the analyses of sample RXY02, sample RXY03 was diluted by a factor of 1.55 times, and a dilution of 1.43 times was applied for the analyses of sample RXY04,.	Yes
5. Were the reported analytical methods and constituents in compliance with the QAPP, permit, or CoC?  Comments: The reported analytical methods were in compliance with the CoC and the laboratory reported the requested constituents in accordance with the CoC.	Yes
6. Were samples received in good condition within method-specified requirements?  Comments: Samples were received intact and in good condition. The final vacuums from the field and receipt vacuums measured by the laboratory were compared by the project team and the vacuums appeared to be acceptable indicating canister integrity.  Helium was not used as a tracer gas during the sampling and the sampling train was not evaluated for leaks.  The laboratory indicated that the sample containers were cleaned, prior to sampling, down to the method reporting limit (MRL) reported for this project. The canister certification results were not available for review.	Yes
7. Were samples extracted/digested and analyzed within method-specified or technical holding times?  Comments: The samples were analyzed within method-specific holding times.	Yes
8. Were reported units appropriate for the sample matrix/matrices and analytical method(s)? Specify if wet or dry units were used for soil.  Comments: The results were reported in concentration units of micrograms per cubic meters ( $\mu\text{g}/\text{m}^3$ ), parts per billion by volume (ppbV), and parts per million by volume (ppmV), which were acceptable for the sample matrix and the analyses requested.	Yes
9. Was the number of field duplicate samples collected equal to at least 10% of the total number of samples or as required by the project guidelines, QAPP, SAP, or permit?  Comments: The number of field duplicates collected was equal to at least 10% of the number of samples.  Sample RXY03 was collected as field duplicate of sample RXY02.	Yes

**TABLE 1. GENERAL VALIDATION CRITERIA CHECKLIST**

10. Were field duplicate RPD values within data validation quality control (QC) limits (soil 0-50%, water 0-30%, or air 0-25%)?	Yes
Comments: As indicated in the Field Duplicate Summary Table at the end of this report, field duplicate RPD values were within data validation QC limits of 0-25% for air samples.	
11. Were the number of trip blank, field blank, and/or equipment blank samples collected equal to at least 10% of the total number of samples or as required by the project guidelines, QAPP, SAP, or permit?	No
Comments: Trip, field, and equipment blank samples were not collected for this sample set.	
12. Were target analytes reported as not detected in the trip blank, field blank, and/or equipment blank samples?	N/A
Comments: Trip, field, and equipment blank samples were not collected for this sample set.	



**TABLE 2. VALIDATION CRITERIA CHECKLIST FOR VOC ANALYSES (TO-15)**

1. Were instrument calibrations within data validation QC limits and analyzed at the appropriate frequency?	Yes
Comments: The initial and continuing calibrations were analyzed at appropriate frequencies and the results for the target analytes were within data validation limits. The results for several analytes were outside the data validation limits in the continuing calibration verification (CCV) analyzed on 03/14/2017; however, those were not target analytes for this project and qualification action was not required.	
2. Were the instrument tunes within data validation control limits and analyzed at the appropriate frequency?	Yes
Comments: Instrument tunes were performed at the required frequency and the results were within data validation limits.	
3. Were the internal standards within data validation control limits?	Yes
Comments: The area counts and retention times for the internal standards were within method control limits.	
4. Was the total number of laboratory blank samples prepared equal to at least 5% of the total number of samples or analyzed as required by the method?	Yes
Comments: The total number of laboratory blank samples prepared was equal to at least 5% of the total number of samples.	
5. Were target analytes reported as not detected in the laboratory blanks?	Yes
Comments: Target analytes were reported as not detected in the laboratory blank.	
6. Was the total number of LCSs analyzed equal to at least 5% of the total number of samples or analyzed as required by the method?	Yes
Comments: The total number of LCS samples analyzed was equal to at least 5% of the total number of samples.	
7. Were LCS/LCSD percent recoveries and LCS/LCSD RPDs within data validation or laboratory QC limits?	Yes
Comments: The LCS percent recoveries were within laboratory QC limits. Analyses of LCSDs were performed but not reported as part of this data set.	
8. Was the total number of MS samples prepared equal to at least 5% of the total number of samples or analyzed as required by the method?	No
Comments: Analysis of matrix spike samples is not required by Method TO-15.	
9. For MS/MSDs prepared from project samples, were percent recoveries and RPDs within data validation or laboratory QC limits?	N/A
Comments: Analysis of matrix spike samples is not required by Method TO-15.	
10. Were surrogate recoveries within laboratory QC limits?	Yes
Comments: Surrogate recoveries were within laboratory QC limits.	
11. Were laboratory duplicates prepared?	No
Comments: Laboratory duplicates were not prepared for Method TO-15 batch MS9031417.	
12. Were laboratory duplicates RPD values within the laboratory acceptance limits?	N/A
Comments: Laboratory duplicates were not prepared for Method TO-15.	



**TABLE 3. VALIDATION CRITERIA CHECKLIST FOR METHANE ANALYSES (TO-3 MODIFIED)**

1. Were instrument calibrations within data validation QC limits and analyzed at the appropriate frequency?	Yes
Comments: The initial and continuing calibrations were analyzed at appropriate frequencies and the results were within data validation limits.	
2. Was the total number of laboratory blank samples prepared equal to at least 5% of the total number of samples or analyzed as required by the method?	Yes
Comments: The total number of laboratory blank samples prepared was equal to at least 5% of the total number of samples.	
3. Were target analytes reported as not detected in the laboratory blanks?	Yes
Comments: Target analytes were reported as not detected in the laboratory blank.	
4. Was the total number of LCSs analyzed equal to at least 5% of the total number of samples or analyzed as required by the method?	Yes
Comments: The total number of LCS samples analyzed was equal to at least 5% of the total number of samples.	
5. Were LCS/LCSD percent recoveries and LCS/LCSD RPDs within data validation or laboratory QC limits?	Yes
Comments: The LCS and LCSD percent recoveries and LCS/LCSD RPDs were within laboratory QC limits.	
6. Was the total number of MS samples prepared equal to at least 5% of the total number of samples or analyzed as required by the method?	No
Comments: Analysis of matrix spike samples is not required by Method TO-3 modified.	
7. For MS/MSDs prepared from project samples, were percent recoveries and RPDs within data validation or laboratory QC limits?	N/A
Comments: Analysis of matrix spike samples is not required by Method TO-3 modified.	
8. Were surrogate recoveries within laboratory QC limits?	N/A
Comments: Analysis of surrogates is not required by Method TO-3 modified.	
9. Were laboratory duplicates prepared?	No
Comments: Laboratory duplicates were not analyzed for Method TO-3 modified.	
10. Were laboratory duplicates RPD values within the laboratory acceptance limits?	N/A
Comments: Laboratory duplicates were not analyzed for Method TO-3 modified.	

**TABLE 4. FIELD DUPLICATE SUMMARY**

<b>Client Sample ID: RXY02</b> <b>Field Duplicate Sample ID: RXY03</b>				
Method	Analyte	Laboratory Result	Duplicate Result	Relative Percent Difference (RPD)
TO-15	Tetrachloroethene	3.2 µg/m <sup>3</sup>	3.3 µg/m <sup>3</sup>	3.1%
TO-15	Trichloroethene	0.16 µg/m <sup>3</sup>	0.17 µg/m <sup>3</sup>	6.1% +/-RL
TO-3 Modified	Methane	3.3 ppmV	3.4 ppmV	3.0%
<p>Field duplicate RPD control limits are not to exceed 25% for air or vapor as established by USEPA New England Environmental Data Review Supplement for Regional Data Review Elements and Superfund Specific Guidance/Procedures, EQADR-Supplement0, April 2013.</p> <p>+/-RL – Indicates that the detections in both of the samples were within two times the reporting limit. Qualification of data was not required.</p>				

**ATTACHMENT A**  
**BATCH MATCH TABLE**

**BATCH MATCH TABLE**

<b>Field Sample ID</b>	<b>Lab Sample ID</b>	<b>TO-15</b>	<b>TO-3 Modified</b>
RXY01	P1701182-001	MS9031417	FD8031517
RXY02	P1701182-002	MS9031417	FD8031517
RXY03	P1701182-003	MS9031417	FD8031517
RXY04	P1701182-004	MS9031417	FD8031517

**ATTACHMENT B**  
**DATA QUALIFICATION SUMMARY**

## DATA QUALIFICATION SUMMARY

Data qualifiers were not applied as a result of this validation.



### Tier III Data Validation Report Summary

Client: Montana Department of Environmental Quality (MDEQ)	Laboratory: ALS Environmental
Project Name: Roxy Cleaners Interim Action	Sample Matrix: Air
Project Number: 776-023-002	Sample Start Date: 04/06/2017
Date Validated: 05/--/2017	Sample End Date: 04/06/2017
Parameters Included:	
<ul style="list-style-type: none"> <li>▪ Volatile Organic Compounds (VOC) by Environmental Protection Agency (EPA) Modified Method TO-15</li> <li>▪ Methane by EPA Modified Method TO-3</li> </ul>	
Laboratory Project ID: P1701182	
Data Validator: Charles Ballek, Senior Chemist	
Draft Reviewer:	Final Reviewer:

#### DATA EVALUATION CRITERIA SUMMARY

A Tier III Data Validation was performed by Trihydro Corporation's Chemical Data Evaluation Services Group on the analytical data report package generated by ALS Environmental in Simi Valley, California evaluating samples from the MDEQ Roxy Cleaners site located in Havre, Montana.

Precision, accuracy, method compliance, and completeness of this data package were assessed during this data review. Precision was determined by evaluating the calculated relative percent difference (RPD) values from:

- Laboratory duplicate pairs
- Laboratory control sample (LCS) and laboratory control sample duplicate (LCSD) pairs

Laboratory accuracy was established by reviewing the demonstrated percent recoveries (%R) of the following items to verify that data are not biased.

- LCS/LCSD samples
- Organic system monitoring compounds (surrogates)

Method compliance was established by reviewing sample integrity, holding times, detection limits, surrogate recoveries, laboratory blanks, initial and continuing calibrations (where applicable), and the LCS/LCSD percent recoveries against method-specific requirements.

Completeness was evaluated by determining the overall ratio of the number of samples and analyses planned versus the number of samples with valid analyses. Determination of completeness included a review of the chain-of-custody (CoC), laboratory analytical methods, and other laboratory and field documents associated with this analytical data set.

#### SAMPLE NUMBERS TABLE

Client Sample ID	Laboratory Sample Number
RXY-POST	P1701789-001
RXY-PRE	P1701789-002
RXY-SUBSLAB	P1701789-003





## Tier III Data Validation Report Summary

The laboratory data were reviewed to evaluate compliance with the methods and the quality of the reported data. Assessment of CoC completeness is included in Item 3 of the Data Validation Checklist. A check mark (✓) indicates that the referenced validation criteria were deemed acceptable, whereas a crossed circle (⊗) indicates validation criteria for which the data have been qualified by the data validator. An empty circle (○) indicates that the specified criterion does not apply to the reviewed data. Details are noted in the tables below.

### Validation Criteria

- ✓ Data Completeness
- ✓ CoC Documentation
- ✓ Holding Times and Preservation
- Field Duplicates
- Field, Equipment, and Trip Blanks
- ✓ Initial and Continuing Calibrations
- ✓ Instrument Tunes
- ✓ Internal Standards
- ✓ System Performance Checks
- ✓ Laboratory Blanks
- ✓ LCS/LCSD
- Matrix spike (MS) and matrix spike duplicate (MSD)
- ✓ System Monitoring Compounds (i.e. Surrogates)
- ✓ Laboratory Duplicates

### Guidance References

Chemical data validation was conducted in accordance with the United States Environmental Protection Agency (USEPA) Contract Laboratory Program (CLP) National Functional Guidelines for the analyses listed below, or by the appropriate method if not covered in the National Functional Guidelines.

- Data for organic analyses were evaluated according to validation criteria set forth in the USEPA CLP National Functional Guidelines for Superfund Organic Methods Data Review, document number EPA-540-R-2016-002, September 2016 with additional reference to the USEPA CLP National Functional Guidelines for Organic Data Review, document number EPA 540/R-99/008, October 1999.
- Air and vapor data for samples collected in canisters and analyzed by EPA organics Method TO-15 were reviewed with reference to the USEPA Hazardous Waste Support Branch Validating Air Samples Volatile Organic Analysis of Ambient Air in Canister by Method TO-15, standard operating procedure number HW-31 revision 4, October 2006.
- Trihydro Data Validation Variance Documentation, February 2017.
- Project-specific Quality Assurance Project Plans (QAPP) data validation requirements, as applicable.



## Tier III Data Validation Report Summary

### OVERALL DATA PACKAGE ASSESSMENT

Based on a data validation review, the data are acceptable as delivered. Data qualified by the laboratory are discussed in Item 2 of the Validation Criteria Checklist.

The purpose of validating data and assigning qualifiers is to assist in proper data interpretation. Data that are not qualified meet the site data quality objectives.

Please see the Data Qualification Summary table at the end of this report for a complete list of samples and analytes qualified.

Data qualifiers were not applied as a result of this validation.

### Data Completeness

The analyses were performed as requested on the CoC records. The samples were received by the laboratory and analyzed properly unless otherwise noted in the Criteria Checklist below. The complete data package consisted of 15 data points. No data points were rejected. The data completeness measure for this data package is calculated to be 100% and is acceptable.

**TABLE 1. GENERAL VALIDATION CRITERIA CHECKLIST**

1. Was the report free of non-conformances identified by the laboratory?	Yes
Comments: The laboratory did not identify non-conformances related to this data set.	
2. Were the data free of data qualification flags or other notes used by the laboratory? If no, define.	No
Comments: The laboratory applied the following data qualification flag to data for this sample set. D – The reported result is from a dilution.	
3. Were sample CoC forms and procedures complete?	Yes
Comments: The CoC record from the field to the laboratory was complete and custody was maintained as evidenced by the field and laboratory personnel signatures, dates, and times of receipt.	
4. Were detection limits in accordance with the quality assurance project plan (QAPP), permit, or method, or indicated as acceptable?	Yes
Comments: The detection limits appeared to be appropriate. The following dilutions were applied. <u>Method TO-15 / TO-3 Modified</u> : Sample RXY-SUBSLAB was diluted by a factor of 1.31 times for the analysis of VOCs and methane and by a factor of 3.8 times for the analysis of tetrachloroethene. A dilution of 1.45 times was applied for the analyses of sample RXY-POST. Sample RXY-PRE was diluted by a factor of 1.45 times for the analysis of methane and by a factor of a dilution of 15.3 times for the VOCs. A note on the CoC indicated requested detection limits of 0.1 micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ) for the identified TO-15 analytes but the laboratory was unable to reach that level except for the MDL for tetrachloroethene in sample RXY-POST. Reporting limits for the Method TO-15 analytes ranged from 0.13 $\mu\text{g}/\text{m}^3$ to 1.5 $\mu\text{g}/\text{m}^3$ .	
5. Were the reported analytical methods and constituents in compliance with the QAPP, permit, or CoC?	Yes
Comments: The reported analytical methods were in compliance with the CoC and the laboratory reported the requested constituents in accordance with the CoC.	
6. Were samples received in good condition within method-specified requirements?	Yes
Comments: Samples were received intact and in good condition. The final vacuums from the field and receipt vacuums measured by the laboratory were compared and the vacuums appeared to be acceptable indicating canister integrity. Helium was not used as a tracer gas during the sampling and the sampling train was not evaluated for leaks. The laboratory indicated that the sample containers were cleaned, prior to sampling, down to the method reporting limit (MRL) reported for this project. The canister certification results were not available for review.	
7. Were samples extracted/digested and analyzed within method-specified or technical holding times?	Yes
Comments: The samples were analyzed within method-specific holding times.	
8. Were reported units appropriate for the sample matrix/matrices and analytical method(s)? Specify if wet or dry units were used for soil.	Yes
Comments: The results were reported in concentration units of micrograms per cubic meters ( $\mu\text{g}/\text{m}^3$ ), parts per billion by volume (ppbV), and parts per million by volume (ppmV), which were acceptable for the sample matrix and the analyses requested.	



**TABLE 1. GENERAL VALIDATION CRITERIA CHECKLIST**

9. Was the number of field duplicate samples collected equal to at least 10% of the total number of samples or as required by the project guidelines, QAPP, SAP, or permit?	No
Comments: The number of field duplicates collected was not equal to at least 10% of the number of samples. Field duplicates were not collected as part of this sample set.	
10. Were field duplicate RPD values within data validation quality control (QC) limits (soil 0-50%, water 0-30%, or air 0-25%)?	N/A
Comments: Field duplicates were not collected as part of this sample set.	
11. Were the number of trip blank, field blank, and/or equipment blank samples collected equal to at least 10% of the total number of samples or as required by the project guidelines, QAPP, SAP, or permit?	No
Comments: Trip, field, and equipment blank samples were not collected for this sample set.	
12. Were target analytes reported as not detected in the trip blank, field blank, and/or equipment blank samples?	N/A
Comments: Trip, field, and equipment blank samples were not collected for this sample set.	

**TABLE 2. VALIDATION CRITERIA CHECKLIST FOR VOC ANALYSES (TO-15)**

1. Were instrument calibrations within data validation QC limits and analyzed at the appropriate frequency?	Yes
Comments: The initial and continuing calibrations were analyzed at appropriate frequencies and the results for the target analytes were within data validation limits. The results for several analytes were outside the data validation limits in the continuing calibration verification (CCV) analyzed on 03/14/2017; however, those were not target analytes for this project and qualification action was not required.	
2. Were the instrument tunes within data validation control limits and analyzed at the appropriate frequency?	Yes
Comments: Instrument tunes were performed at the required frequency and the results were within data validation limits.	
3. Were the internal standards within data validation control limits?	Yes
Comments: The area counts and retention times for the internal standards were within method control limits.	
4. Was the total number of laboratory blank samples prepared equal to at least 5% of the total number of samples or analyzed as required by the method?	Yes
Comments: The total number of laboratory blank samples prepared was equal to at least 5% of the total number of samples.	
5. Were target analytes reported as not detected in the laboratory blanks?	Yes
Comments: Target analytes were reported as not detected in the laboratory blank.	
6. Was the total number of LCSs analyzed equal to at least 5% of the total number of samples or analyzed as required by the method?	Yes
Comments: The total number of LCS samples analyzed was equal to at least 5% of the total number of samples.	
7. Were LCS/LCSD percent recoveries and LCS/LCSD RPDs within data validation or laboratory QC limits?	Yes
Comments: The LCS and LCSD percent recoveries and LCS/LCSD RPDs were within laboratory QC limits.	
8. Was the total number of MS samples prepared equal to at least 5% of the total number of samples or analyzed as required by the method?	No
Comments: Analysis of matrix spike samples is not required by Method TO-15.	
9. For MS/MSDs prepared from project samples, were percent recoveries and RPDs within data validation or laboratory QC limits?	N/A
Comments: Analysis of matrix spike samples is not required by Method TO-15.	
10. Were surrogate recoveries within laboratory QC limits?	Yes
Comments: Surrogate recoveries for the submitted samples and QC analyses were within laboratory QC limits.	
11. Were laboratory duplicates prepared?	Yes
Comments: A laboratory duplicate was prepared for Method TO-15 batch MS13042417 from sample RXY-PRE.	
12. Were laboratory duplicates RPD values within the laboratory acceptance limits?	Yes
Comments: Laboratory duplicates RPD values were within the laboratory acceptance limits.	

**TABLE 3. VALIDATION CRITERIA CHECKLIST FOR METHANE ANALYSES (TO-3 MODIFIED)**

1. Were instrument calibrations within data validation QC limits and analyzed at the appropriate frequency?	Yes
Comments: The initial and continuing calibrations were analyzed at appropriate frequencies and the results were within data validation limits.	
2. Was the total number of laboratory blank samples prepared equal to at least 5% of the total number of samples or analyzed as required by the method?	Yes
Comments: The total number of laboratory blank samples prepared was equal to at least 5% of the total number of samples.	
3. Were target analytes reported as not detected in the laboratory blanks?	Yes
Comments: Target analytes were reported as not detected in the laboratory blank.	
4. Was the total number of LCSs analyzed equal to at least 5% of the total number of samples or analyzed as required by the method?	Yes
Comments: The total number of LCS samples analyzed was equal to at least 5% of the total number of samples.	
5. Were LCS/LCSD percent recoveries and LCS/LCSD RPDs within data validation or laboratory QC limits?	Yes
Comments: The LCS and LCSD percent recoveries and LCS/LCSD RPDs were within laboratory QC limits.	
6. Was the total number of MS samples prepared equal to at least 5% of the total number of samples or analyzed as required by the method?	No
Comments: Analysis of matrix spike samples is not required by Method TO-3 modified.	
7. For MS/MSDs prepared from project samples, were percent recoveries and RPDs within data validation or laboratory QC limits?	N/A
Comments: Analysis of matrix spike samples is not required by Method TO-3 modified.	
8. Were surrogate recoveries within laboratory QC limits?	N/A
Comments: Analysis of surrogates is not required by Method TO-3 modified.	
9. Were laboratory duplicates prepared?	Yes
Comments: A laboratory duplicate was prepared for Method TO-3 Modified batch FD8041717 from sample RXY-PRE.	
10. Were laboratory duplicates RPD values within the laboratory acceptance limits?	Yes
Comments: Laboratory duplicates RPD values were within the laboratory acceptance limits.	

**ATTACHMENT A**  
**BATCH MATCH TABLE**

**BATCH MATCH TABLE**

<b>Field Sample ID</b>	<b>Lab Sample ID</b>	<b>TO-15</b>	<b>TO-3 Modified</b>
RXY-POST	P1701789-001	MS13042417	FD8041717
RXY-PRE	P1701789-002	MS13042417	FD8041717
RXY-SUBSLAB	P1701789-003	MS13042417	FD8041717

**ATTACHMENT B**  
**DATA QUALIFICATION SUMMARY**

## DATA QUALIFICATION SUMMARY

Data qualifiers were not applied as a result of this validation.

**APPENDIX K**

**WASTE DISPOSAL DOCUMENTATION**

Location Helena → Haure Date 09/07/2016

Project / Client MDEQ SRS Rasy Cleaners

Pg 11 776-023-001

0505 Joel Riebl (SRS departs

Helena

0847 SR arrives in Haure

\* Using PID to collect system readings.

0905 Row with Korb construction

arrives to check out concrete reveal

- remove concrete sin next to the ramp where the low spot is

0923 Restored the down "low SVE vacuum" system alarm after preliminary maintenance items

\* Waiting to hear back if all the concrete will be removed, replaced with concrete or asphalt

1124 Site Owner Michael Hamilton stopped

by - has concern over the high →

low sections of the pavers poured

concrete. Have call with Mr. Hamilton

Simon Gleason, &amp; Joel Riebl regarding

the condition of the concrete, the

drainage, → the cracking, &amp;

the new pour

\* SR wait for Saturday and

Date 09/08/2016

Location

Project / Client

Pg 12

1145 Nothing to report is the remaining concrete will be removed or not,

we update Sam Ringsto - or Korb

Construction. Departs Haure

1605 SR arrives back in Helena

- Joel Riebl.

(1500) Took the used activated carbon from the first SAC drum to the Hill County disposal landfill. The 55-gallon capacity material was taken by Brad and taken to the designated call Sam & Joel disposed - (SR)

Location Havre -

Date 12/15/2016

Project / Client MDEQ Havre Roxy Cleaners

776-023-002

Pg 1

0710 Arrived at remediation system - pip is thawed out. No damage seen. The heater breaker tripped and the system breezy. Restarted the SVE system -

1050 Collected system reading using PID meter. Not seeing much vapor data with PID 3 hours after start up.

\* Met with Property owner Michael Hamilton, he opened the basement door so date seen the vapor port could be collected. No vacuum noted detached at the sample port 3 hours after start up -

1130 shut down the system and reset the operating hours seen 12 on FR sat to 24 hours on. On Friday Saturday ~ -25 F air temperatures are forecast.

1155 SR departs Havre -

1605 SR arrives in Helena

--S. J. R. R.

J. R. R.

Location Helena → Havre → Helena Date 12/29/2016

Project / Client

Pg 1

0630 Joel Ribicki (SR) departs Helena.

1000 SR arrives at the former Roxy Cleaners in Havre. System is running -

\* Collect System data; use PID meter.

1015 Shift down SVE system; change oil (next oil change ~ 7,500 hours).

Greased blower, checked air filters and KO tank, and heat exchanger discharge.

Restarted SVE system -

SR departs site.

1315 SR arrives at Hill County landfill and took the used carbon drum #2 to the land fill. They asked that it be placed with the trash.

\* Arrived back to the former Roxy Cleaners. Shut down the SVE system and reset the system to run 12 hours on; 12 hours off.

Restarted the SVE system -

SR departs Havre -

1635-1725 In Great Falls for another project.

1905 SR arrives at the Helena office.

J. R. R.

Pg 1

Date 04/10/2017

MDEQ Havre Solvent Site

Former Roxy Cleaners

0855 Joul Riebli (JR) dropped out  
 The "RXY-Drum3" media carbon-  
 sample at Energy labs in Helena.  
 - Joul Riebli;

Date 5/17/2017

Pg 1/2

0750 Depart Havre Hold  
 0805 Purchase scoop at North 40  
 0810 Joul Riebli (JR) arrives at the  
 former Roxy Cleaners. SVE system  
 is running  
 \* Use ppbRAE 3000 S/N 594-905182  
 for vapor monitoring  
 0830 Collect SVE system data.  
 0837 shut down SVE system. ~~transval~~  
 The used GAC media from the  
 drum to three trash bags.  
 \* checked knock out tank, heat exchanger,  
 air filter and inlet filter. The  
 grease gun is not functioning  
 0947 Restarted the SVE system  
 0950 JR departs the site.  
 1010 Disposed the three bags of used  
 GAC media at the Hill County  
 land fill. Total weight 220 lbs  
 1030 Stopped by Napa and purchased  
 a grease gun  
 1040 Arrive back at the former  
 Roxy Cleaners  
 1109 shut down the SVE system  
 and greased the blower

**From:** James Gleason  
**Sent:** Tuesday, September 06, 2016 2:53 PM  
**To:** vincentc@co.hill.mt.us  
**Subject:** Disposal of Granulated Carbon  
**Attachments:** B16071730.pdf

Good Afternoon Mr. Vincent,

I left you a voicemail, but thought I would follow up by email.

We are running the SVE system at the old Creative Leisure building on 1<sup>st</sup> St., and have some old filter material to dispose of. The material (about a 50 gallon drum's worth) is granulated carbon and has been analyzed by Energy Labs. The constituents (VOCs) that might have been a concern were not detected in the laboratory's analysis (copy of the lab report is attached).

We would like to bag up the material and dispose of it at the local landfill – is there anything else that we need to provide for documentation?

Thanks very much,  
Jim

**James Gleason, P.E.**  
**Environmental Engineer, Statistician**



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1252 Commerce Drive  
Laramie, Wyoming 82070  
(307) 745-7474 (phone)  
(307) 745-7729 (fax)  
[jgleason@trihydro.com](mailto:jgleason@trihydro.com)

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**From:** James Gleason  
**Sent:** Saturday, December 10, 2016 6:33 AM  
**To:** vincentc@co.hill.mt.us  
**Cc:** Joel Riebli  
**Subject:** Filter Material Disposal  
**Attachments:** H16100494.pdf

Good Morning Clay,

We need to dispose of another canister's worth of carbon filter material, as we did in August (if you'll recall). I have attached the laboratory results for testing the filter material - all constituents were non-detect by the leaching to ground water test method. I believe that last time, you contacted the landfill supervisor to give him your ok for disposal?

Mr. Joel Riebli will be in town around mid-week to take the material to the landfill as before. Please let us know if there is anything else that we need to do to get this done. I will be traveling and not in the office early this week, but will be available by cell phone (970 672 6618) if you need to speak with me or have any questions.

Thanks, and I hope your weekend is going well.

Jim

**From:** Clay Vincent <vincentc@co.hill.mt.us>  
**Sent:** Friday, December 16, 2016 4:36 PM  
**To:** Joel Riebli  
**Subject:** RE: Filter Material Disposal

**Follow Up Flag:** Follow up  
**Due By:** Wednesday, December 28, 2016 10:00 AM  
**Flag Status:** Flagged

Yes it will be fine. I let them know.

---

**From:** Joel Riebli [mailto:jriebli@trihydro.com]  
**Sent:** Friday, December 16, 2016 1:46 PM  
**To:** James Gleason ; vincentc@co.hill.mt.us  
**Subject:** RE: Filter Material Disposal

Hi Clay,

Have you had the chance to see if the filter material can be accepted at the landfill. I'm planning on visiting Havre on Thursday December 29 and hope to take the filter material to the landfill for disposal if approved.

Thanks,

-Joel Riebli  
307-760-2793

---

**From:** Joel Riebli  
**Sent:** Monday, December 12, 2016 7:27 AM  
**To:** James Gleason <jgleason@trihydro.com>; [vincentc@co.hill.mt.us](mailto:vincentc@co.hill.mt.us)  
**Subject:** RE: Filter Material Disposal

Hi Clay,

I will be in Havre on Tuesday, December 13 for my December visit to the area.

Thanks,

**Joel Riebli**  
**Environmental Engineer**



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2707 Broadwater Ave  
Helena, Montana 59601  
(406) 558-4180 (Office)  
(406) 558-4181 (Fax)  
[jriebli@trihydro.com](mailto:jriebli@trihydro.com)

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---

**From:** James Gleason  
**Sent:** Saturday, December 10, 2016 6:33 AM  
**To:** [vincentc@co.hill.mt.us](mailto:vincentc@co.hill.mt.us)  
**Cc:** Joel Riebli <[jriebli@trihydro.com](mailto:jriebli@trihydro.com)>  
**Subject:** Filter Material Disposal

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Mr. Joel Riebli will be in town around mid-week to take the material to the landfill as before. Please let us know if there is anything else that we need to do to get this done. I will be traveling and not in the office early this week, but will be available by cell phone (970 672 6618) if you need to speak with me or have any questions.

Thanks, and I hope your weekend is going well.

Jim

**From:** Clay Vincent <vincentc@co.hill.mt.us>  
**Sent:** Friday, December 30, 2016 8:10 AM  
**To:** Joel Riebli  
**Subject:** RE: Filter Material Disposal

Good. I hope it worked out ok. We have been fighting wind for several days there and it seems to be worse then normal this year. Let me know if you have questions.

---

**From:** Joel Riebli [mailto:jriebli@trihydro.com]  
**Sent:** Friday, December 30, 2016 7:08 AM  
**To:** Clay Vincent  
**Cc:** James Gleason  
**Subject:** RE: Filter Material Disposal

Hi Clay,

FYI, I did take the carbon filter material from the 85 gallon capacity drum to the Hill County landfill on 12/29/2016.

Thanks,

-Joel Riebli

---

**From:** Clay Vincent [<mailto:vincentc@co.hill.mt.us>]  
**Sent:** Friday, December 16, 2016 4:36 PM  
**To:** Joel Riebli <[jriebli@trihydro.com](mailto:jriebli@trihydro.com)>  
**Subject:** RE: Filter Material Disposal

Yes it will be fine. I let them know.

---

**From:** Joel Riebli [<mailto:jriebli@trihydro.com>]  
**Sent:** Friday, December 16, 2016 1:46 PM  
**To:** James Gleason <[jgleason@trihydro.com](mailto:jgleason@trihydro.com)>; [vincentc@co.hill.mt.us](mailto:vincentc@co.hill.mt.us)  
**Subject:** RE: Filter Material Disposal

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Thanks,

-Joel Riebli  
307-760-2793

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**From:** Joel Riebli  
**Sent:** Monday, December 12, 2016 7:27 AM  
**To:** James Gleason <[jgleason@trihydro.com](mailto:jgleason@trihydro.com)>; [vincentc@co.hill.mt.us](mailto:vincentc@co.hill.mt.us)  
**Subject:** RE: Filter Material Disposal

Hi Clay,

I will be in Havre on Tuesday, December 13 for my December visit to the area.

Thanks,

**Joel Riebli**  
**Environmental Engineer**



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**To:** [vincentc@co.hill.mt.us](mailto:vincentc@co.hill.mt.us)  
**Cc:** Joel Riebli <[jriebli@trihydro.com](mailto:jriebli@trihydro.com)>  
**Subject:** Filter Material Disposal

Good Morning Clay,

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Mr. Joel Riebli will be in town around mid-week to take the material to the landfill as before. Please let us know if there is anything else that we need to do to get this done. I will be traveling and not in the office early this week, but will be available by cell phone (970 672 6618) if you need to speak with me or have any questions.

Thanks, and I hope your weekend is going well.

Jim

**From:** James Gleason  
**Sent:** Monday, May 08, 2017 2:21 PM  
**To:** Clay Vincent  
**Cc:** Joel Riebli  
**Subject:** RE: Filter Material Disposal

Thank you sir, we shall do so.

---

**From:** Clay Vincent [mailto:vincentc@co.hill.mt.us]  
**Sent:** Monday, May 8, 2017 2:13 PM  
**To:** James Gleason <jgleason@trihydro.com>  
**Subject:** RE: Filter Material Disposal

That will be fine, just make sure your trucks weigh through and put the information in the box in the office for us to bill. Thank you!

---

**From:** James Gleason [mailto:jgleason@trihydro.com]  
**Sent:** Monday, May 08, 2017 8:26 AM  
**To:** [vincentc@co.hill.mt.us](mailto:vincentc@co.hill.mt.us)  
**Cc:** Joel Riebli <[jriebli@trihydro.com](mailto:jriebli@trihydro.com)>  
**Subject:** Filter Material Disposal

Good Morning Mr. Vincent,

We need to dispose of another canister's worth of carbon filter material, as we did in December. I have attached the laboratory results for testing the filter material - all constituents were non-detect by the leaching to ground water test method. I believe that last time, you contacted the landfill supervisor to give him your ok for disposal?

Mr. Joel Riebli will be in town May 25, 26 to take the material to the landfill as before. Please let us know if there is anything else that we need to do to get this done.

Thanks, and I hope your spring is going well.

Jim

**James Gleason, P.E.**  
**Senior Engineer**



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1252 Commerce Drive  
Laramie, Wyoming 82070  
(307) 745-7474 (phone)  
(307) 745-7729 (fax)  
[jgleason@trihydro.com](mailto:jgleason@trihydro.com)

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**From:** James Gleason  
**Sent:** Monday, May 08, 2017 8:26 AM  
**To:** 'vincentc@co.hill.mt.us'  
**Cc:** Joel Riebli  
**Subject:** Filter Material Disposal  
**Attachments:** H17040140.pdf

Good Morning Mr. Vincent,

We need to dispose of another canister's worth of carbon filter material, as we did in December. I have attached the laboratory results for testing the filter material - all constituents were non-detect by the leaching to ground water test method. I believe that last time, you contacted the landfill supervisor to give him your ok for disposal?

Mr. Joel Riebli will be in town May 25, 26 to take the material to the landfill as before. Please let us know if there is anything else that we need to do to get this done.

Thanks, and I hope your spring is going well.

Jim

**James Gleason, P.E.**  
**Senior Engineer**



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**From:** Joel Riebli  
**Sent:** Wednesday, September 07, 2016 3:30 PM  
**To:** James Gleason  
**Subject:** RE: Disposal of Granulated Carbon

The activated carbon from the first 85-gallon system drum (activated carbon with about 55-gallons capacity) was disposed at the Hill Country disposal landfill. Brad took the bagged carbon and took it to the designated cell. They did not provide any paperwork.

-Joel

Sent via the Samsung Galaxy S™ III, an AT&T 4G LTE smartphone

----- Original message -----

**From:** James Gleason  
**Date:** 09/07/2016 07:08 (GMT-07:00)  
**To:** Joel Riebli  
**Subject:** Fwd: Disposal of Granulated Carbon

Hi Joel,

Please see email below. I can send you the lab report later this morning but I expect you won't have a way to print it.  
Sent from my iPhone

Begin forwarded message:

**From:** Clay Vincent <[vincentc@co.hill.mt.us](mailto:vincentc@co.hill.mt.us)>  
**Date:** September 6, 2016 at 4:23:58 PM MDT  
**To:** 'James Gleason' <[jgleason@trihydro.com](mailto:jgleason@trihydro.com)>  
**Subject:** RE: Disposal of Granulated Carbon

If you bring out the lab slip and can get it to the landfill employees showing that it is non hazardous they will show you where to put it. It should not be a problem.

---

**From:** James Gleason [<mailto:jgleason@trihydro.com>]  
**Sent:** Tuesday, September 06, 2016 2:53 PM  
**To:** [vincentc@co.hill.mt.us](mailto:vincentc@co.hill.mt.us)  
**Subject:** Disposal of Granulated Carbon

Good Afternoon Mr. Vincent,

I left you a voicemail, but thought I would follow up by email.

We are running the SVE system at the old Creative Leisure building on 1<sup>st</sup> St., and have some old filter material to dispose of. The material (about a 50 gallon drum's worth) is granulated carbon and has been analyzed by Energy Labs. The constituents (VOCs) that might have been a concern were not detected in the laboratory's analysis (copy of the lab report is attached).

We would like to bag up the material and dispose of it at the local landfill – is there anything else that we need to provide for documentation?

Thanks very much,  
Jim

**James Gleason, P.E.**  
**Environmental Engineer, Statistician**

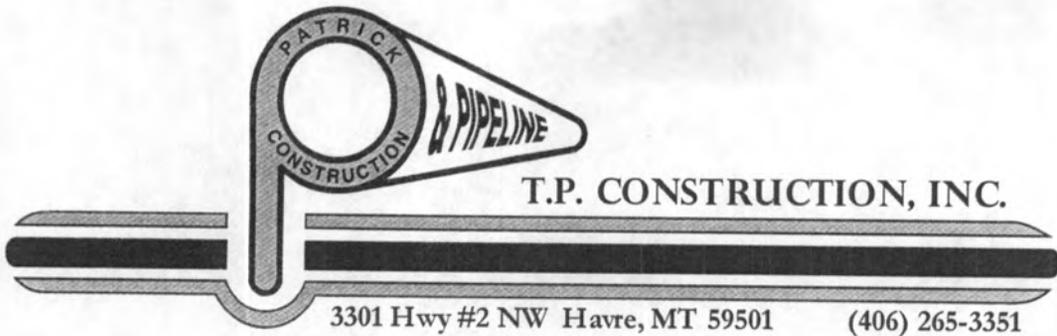
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# Invoice

Invoice Number:  
120415clear6

Invoice Date:  
Dec 8, 2015

Page:  
1

**Sold To:**

Remington Technologies, LLC  
8100 Arkins Ct  
Loveland, CO 80538

**Ship To:**

Remington Technologies, LLC  
8100 Arkins Ct  
Loveland, CO 80538

Customer ID: REM001	Customer PO	Payment Terms Net 30 Days
------------------------	-------------	------------------------------

Quantity	Unit	Item	Description	Unit Price	Extension
1.00			Soil Removal & Disposal, Per Armstrong  MC-1235 auth. 008400 -12. <u>00</u>	357.50	357.50

Total	357.50
Less Discount	
<b>Total Invoice Amount</b>	<b>357.50</b>
<b>TOTAL \$</b>	<b>357.50</b>

Thank you for your business