August 27, 2019

Ms. Susan von Gonten
New Mexico Environment Department
Petroleum Storage Tank Bureau
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505

Re: Final Remediation Plan
Shamrock No. 63, 3624 Cerrillos Road, Santa Fe, New Mexico
Facility#29206, Release ID #4509, WPID #18604

Dear Ms. von Gonten:

Daniel B. Stephens & Associates, Inc. (DBS&A) is pleased to submit the enclosed Final Remediation Plan (FRP) for the above-referenced site. The plan has been prepared in accordance with your direction and applicable sections of the Petroleum Storage Tank Regulations and DBS&A standard operating procedures. Pending approval of the FRP and potential responses to comments, DBS&A intends to invoice the full amount budgeted for Deliverable ID 18604-2.

Please contact us at (505) 822-9400 if you have any questions or require additional information.

Sincerely,

DANIEL B. STEPHENS & ASSOCIATES, INC.

Thomas Golden, P.E.
Project Engineer

John Casey, P.E.
Senior Engineer

TG/ed
Enclosure
cc: Katherine MacNeil, NMED PSTB

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Final Remediation Plan

Shamrock No. 63

3624 Cerrillos Road

Santa Fe, New Mexico

Prepared for **New Mexico Environment Department**
Petroleum Storage Tank Bureau

August 27, 2019

Daniel B. Stephens & Associates, Inc.

6020 Academy NE, Suite 100 • Albuquerque, New Mexico 87109

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1. Introduction

Daniel B. Stephens & Associates, Inc. (DBS&A) has prepared this Phase 3 Final Remediation Plan (FRP) on behalf of Mr. James Polk, Responsible Party (RP) for the Shamrock No. 63 site (the site) in Santa Fe, New Mexico. This FRP was prepared in accordance with applicable sections of Part 119 of the New Mexico Petroleum Storage Tank Regulations (PSTR) and Work Plan ID (WPID) No. 18604 (DBS&A, 2018c), which was approved by the New Mexico Environment Department (NMED) Petroleum Storage Tank Bureau (PSTB) on June 25, 2019 (NMED, 2019).

1.1 Site Summary

The Shamrock No. 63 site is located at 3624 Cerrillos Road in Santa Fe, New Mexico (Figure 1). Impacts associated with the site is believed to be the result of releases from a former underground storage tank (UST) system that was removed by Basin Engineering Inc. (Basin) in April 2006, as well as from dispenser islands associated with a previous fueling station on the property. Field observations during the UST removal in 2006 indicated that a release had occurred. Subsequent site characterization by Basin indicated that soil and groundwater contaminants were present in association with the release.

Additional site characterization conducted by DBS&A further defined the extent of soil and dissolved-phase impacts, and revealed an area of residual light nonaqueous-phase liquid (LNAPL) accumulation under the adjacent parcel to the southwest of the former Shamrock No. 63 property.

1.2 Site History

Historical aerial photographs indicate that prior to 1958, the site was occupied by a bulk fueling facility with six aboveground storage tanks (ASTs) and four dispenser islands. Between 1979 and 1988, the parcel was subdivided, the ASTs and dispenser islands were removed, and the Shamrock No. 63 station was constructed on the eastern portion of the original bulk fueling plant

property. A hotel was constructed on the western portion of the former bulk fueling facility in 1991. Manny's Auto Sales occupies the eastern portion of the former facility (Figure 2).

The UST system was removed from the site on April 19, 2006. Basin conducted a minimum site assessment (MSA) and additional investigations in 2006 and 2007. Results of soil sampling revealed minor impacts to soil in the northwest corner of the former UST nest and near the diesel fuel dispensing island. Two soil borings were advanced in the area of the former UST nest in December 2006 and soil samples were collected. The samples showed impacts to soil at depths of up to 75 feet below ground surface (bgs). The first five monitor wells (MW-1 through MW-5) (Figure 2) were installed at the site between 2007 and 2011 (Basin, 2014).

In May 2014, Basin personnel installed three new on-site groundwater monitor wells (MW-6 through MW-8) (Figure 2) and completed a semiannual groundwater monitoring event. Results of groundwater monitoring completed after well installation showed that LNAPL was present in newly installed monitor well MW-6 at thicknesses up to 1.52 feet. This was the first observed occurrence of LNAPL at the site. Analytical results from groundwater samples collected from the other site wells showed numerous contaminants of concern (COCs) to be present at concentrations above New Mexico Groundwater Quality Control Commission (NMWQCC) and New Mexico Environmental Improvement Board (NMEIB) standards.

DBS&A completed groundwater monitoring in September 2014 with broadly similar results, and installed six new monitor wells in March 2015 (MW-9 through MW-14) (Figure 2). Since well installation, LNAPL has been observed in new monitor wells MW-9 (up to 0.99 foot) and MW-10 (up to 5.31 feet). Dissolved-phase contaminants above applicable standards were present in groundwater samples collected from new monitor wells MW-11 and MW-14. In 2015 DBS&A also completed quarterly groundwater monitoring, monthly LNAPL recovery events, and an indoor air screening survey of structures (DBS&A, 2015a and 2015b). Groundwater monitoring results indicated that the extents of LNAPL and dissolved-phase impacts were not delineated west of new monitor wells MW-10 and MW-11 or east of new monitor well MW-14.

In 2016 DBS&A submitted a work plan to the NMED PSTB to perform additional site investigation. The work plan was approved on June 26, 2017 under WPID #17887 (NMED, 2017) and authorized the installation of additional wells to delineate the extent of LNAPL and

dissolved-phase contaminants at the site, as well as continued groundwater monitoring and soil vapor extraction (SVE) pilot testing. New groundwater monitor wells were installed between October 4 and 10, 2017 (DBS&A, 2017). SVE pilot testing was conducted following installation of the new wells (DBS&A, 2018b).

DBS&A completed a groundwater monitoring event in October 2017. As in previous monitoring events completed in 2015, LNAPL accumulations were noted in wells MW-6, MW-9, and MW-10. One or more dissolved-phase COCs were detected at concentrations exceeding the applicable standards in groundwater samples collected from wells MW-1, MW-2, MW-3, MW-5, MW-7, MW-8, MW-11, and MW-14 (DBS&A, 2018a). Groundwater monitoring and LNAPL recovery activities were conducted at the site between January 23 and 26, 2018 (DBS&A, 2018b).

1.3 Site Hydrogeology

The geology underlying the site consists of a veneer of unconsolidated alluvial sediments underlain by the Pleistocene/Pliocene-age Ancha Formation. The Ancha Formation deposits comprise heterogeneous alluvial materials, composed of predominantly silty or clayey sand with varying amounts of gravel. The contact between the surficial alluvial martial and the underlying sediments of the Ancha Formation is typically not discernable in borehole cuttings (Figures 3 and 4).

Groundwater at the site occurs under unconfined conditions and is encountered at depths ranging between 76 and 84 feet bgs. The groundwater flow direction beneath the site is locally variable, but has generally been to the southeast with a typical gradient on the order of 0.008 foot per foot (ft/ft) (Figure 5).

1.4 Distribution of Contaminants

1.4.1 Contaminants of Concern

Field observations and laboratory analytical results indicate that soil and groundwater at the site have been impacted by normal operation of the former site facilities, primarily with gasoline and minor diesel fuels. COCs at the site include LNAPL and dissolved-phase petroleum hydrocarbons including benzene, toluene, ethylbenzene, and total xylenes (BTEX), methyl tertiary-butyl ether (MTBE), and naphthalenes, as well as the fuel additives 1,2-dichloroethane (EDC) and 1,2 dibromoethane (EDB).

1.4.2 Distribution of Contaminants in Soil

The lateral and vertical distribution of contaminants in the vadose zone has been relatively well defined by previous investigations, which established the former Shamrock No. 63 USTs and earlier fuel dispensers as the sources of site impacts. Initial soil borings and well installations following removal of the USTs from the former Shamrock No. 63 station indicated that soil was impacted extending from 15 feet bgs to the water table in the vicinity of the former Shamrock No. 63 tank pit, near well MW-1. During the MSA, minor shallow soil impacts were present near the former diesel fuel dispenser west of well MW-8 in the upper 10 feet of the soil column. Based on subsequent borehole installations, clean soil is present near the surface throughout the remainder of the site.

Investigations conducted in 2014 and 2015 indicated that soil was impacted extending from near the surface to the water table at wells MW-6 and MW-9, near the former bulk plant fuel dispensers (Figure 6). Although analytical results indicate that both gasoline and diesel fuel were released from the former bulk plant fuel dispensers, diesel contaminants appear to be a minor component of the overall mass of hydrocarbons present beneath the site. Very high hydrocarbon recovery rates from wells during the SVE pilot test indicate that the majority of the vadose zone impacts consist of gasoline-related constituents.

Hydrocarbon impacts are limited to deeper soil in the vicinity of wells MW-5, MW-7, MW-10, and MW-11. DBS&A has prepared a map depicting the approximate thickness and distribution of

impacted soil at the site (Figure 6). The volume of vadose zone materials impacted by the hydrocarbon release is approximately 1.3 million cubic feet.

1.4.3 LNAPL Impacts

LNAPL accumulations have consistently been observed in site wells MW-6, MW-9, and MW-10 at thicknesses up to 5.31 feet. LNAPL has not been observed in any other site wells. The extent of the LNAPL plume is well-delineated to the south, east, and west of wells MW-6, MW-9, and MW-10, but remains undefined upgradient to the north under the Cerrillos Road right-of-way (ROW). LNAPL is well-defined downgradient. It is reasonable to assume that accumulations are limited to the immediate vicinity.

As a general rule, LNAPL occurrence and thickness vary inversely with water levels. When water levels are high, soil containing free-phase hydrocarbons may be submerged, resulting in little or no LNAPL accumulation in wells. Conversely, when water levels are low, LNAPL may drain from saturated soils into the well and accumulate at the water table. Water levels at the site have fluctuated only slightly since installation of wells MW-6, MW-9, and MW-10, and LNAPL accumulations have been largely consistent over time, responding primarily to baildown recovery activities.

The LNAPL plume is currently undefined under the Cerrillos Road ROW, and baildown tests have not been conducted to constrain the actual formation thickness of LNAPL-saturated soil. However, DBS&A analyzed recent LNAPL thicknesses using the seven methodologies outlined in the U.S. Environmental Protection Agency (EPA) guidance document *How to Effectively Recover Free Product at Leaking Underground Storage Tank Sites: A Guide for State Regulators* (U.S. EPA, 1996). Based on median values from the EPA guidance, and assuming an LNAPL plume area of roughly 8,400 square feet and formation porosity of 30 percent, DBS&A calculates that the current LNAPL plume volume is roughly 6,500 gallons.

1.4.4 Distribution of Contaminants in Water

A dissolved-phase contaminant plume extends approximately 100 to 200 feet downgradient from known source areas and LNAPL accumulations. BTEX constituents, MTBE, EDB, EDC,

and total naphthalenes have been detected in groundwater at concentrations exceeding the NMWQCC standards across an area bounded in the downgradient direction by wells MW-4, MW-12, MW-13, and MW-19. The dissolved-phase plume remains undefined west of wells MW-17 and MW-18, where benzene and EDC concentrations exceed the NMWQCC standards. Benzene was also present at concentrations just above the NMWQCC standard in wells MW-8 and MW-15 at the eastern margin of the plume, which remains partially delineated in the vicinity of these wells. Concentrations of COCs in well MW-8 are slightly higher than in nearby downgradient wells, perhaps due to the well's location in a potentially higher-permeability zone. Plume maps for selected constituents based on analytical results from the most recent monitoring event in January 2018 are presented in Figures 7 through 10.

The distribution of MTBE (Figure 8) compared to that of other fuel constituents indicates two separate releases associated with the site, consistent with site history and the distribution of LNAPL and vadose-zone impacts. The highest concentrations of dissolved-phase COCs in groundwater are centered on-site near the former Shamrock No. 63 UST nest and to the west in the vicinity of the LNAPL plume. Highly elevated solute concentrations do not appear to extend under the Best Western hotel or other occupied structures on the site and adjacent parcels. Some clear historical trends are evident, including generally decreasing concentrations of BTEX constituent concentrations in wells MW-1, MW-2, MW-3, MW-4, MW-5, and MW-7, and increasing MTBE concentrations in wells MW-2, MW-3, and MW-7. The partial delineation by existing wells and decreasing solute concentrations at impacted distal wells (e.g., MW-8, MW-15, and MW-18) indicate that the dissolved-phase contaminant plume likely does not extend a significant distance beyond the current well network.

2. Contractor Qualifications

DBS&A is a licensed contractor in the state of New Mexico and holds a GS-29 license (License #89947). EnviroWorks of Edgewood, New Mexico has been selected to serve as the general contractor at the site and will coordinate conveyance line trenching and backfill, as well as installation of the remediation system. The equipment manufacturer will be Intellishare Environmental (Intellishare) of Menomonie, Wisconsin. All work will be performed under the supervision of a professional engineer licensed in the state of New Mexico.

3. Remediation Goals/Cleanup Standards

3.1 Exposure Pathways

Potential exposure pathways at the site include soil vapor, soil, and groundwater. Shallow soil has been impacted near former bulk plant dispensers in the Best Western hotel parking lot, and may potentially constitute an exposure risk via the direct contact pathway. Impacted shallow soil is currently capped by asphalt pavement. Impacted shallow soils do not extend under any portion of the hotel structure. Any impacted vadose zone soil that may be present under site structures is at a depth of greater than 40 feet near the far northeast corner of the Best Western hotel building in the vicinity of well MW-11. Based on current EPA guidance, petroleum hydrocarbons in soil at this depth are not considered a risk via the vapor intrusion pathway.

At the site, contaminated soil under the former tank pit begins at approximately 15 feet bgs and extends to the water table near well MW-1. Due to the depth of clean cover, this is not considered a risk via the direct contact pathway. The MSA indicated that limited shallow soil impacts were associated with the former diesel fuel dispenser west of well MW-8 (Figure 2). Based on subsequent borehole installations, clean soil is present near the surface throughout the remainder of the site. Occupied structures associated with the current used car lot are located approximately 125 feet south of the release points, over an area with little to no subsurface impacts.

The vapor intrusion pathway is not considered complete for petroleum hydrocarbons at the site due to the depth of groundwater and LNAPL, as well as the lack of shallow soil impacts under site structures. However, concentrations of the halogenated organic compounds EDB and EDC in groundwater under the northeast corner of the Best Western hotel building in the vicinity of well MW-11 may exceed the March 2017 New Mexico vapor intrusion screening levels (VISLs) for these compounds. The VISLs corresponding to the vapor intrusion pathway from groundwater for EDC and EDB are 22.3 micrograms per liter (µg/L) and 1.76 µg/L, respectively. These compounds are comparatively stable in the vadose zone and may diffuse upward in the vapor phase from the water table to shallow soil. Based on the distribution of EDB and EDC in groundwater as shown on Figures 9 and 10, only a small portion of the hotel structure

potentially overlies groundwater containing concentrations of these constituents above the VISLs.

Groundwater impacts to municipal or domestic production wells constitute a potential exposure pathway. Based on data obtained from the New Mexico Office of the State Engineer (OSE) online database, the nearest water production well is a domestic well located approximately 0.1 mile upgradient to the northwest of the site; the nearest downgradient production well is a domestic well located approximately 0.4 mile southeast of the site. It is not known if these wells remain in use. The closest currently active city production well is located approximately 2.5 miles northeast of the site. Based on the distances to these wells and the apparent stability of the plume, the risk to water production wells is minimal.

3.2 Remediation Goals/Performance Standards

Gasoline-related COCs include BTEX, MTBE, naphthalenes, EDB, and EDC. Although it may not be possible to completely remove all of the COCs from the subsurface, the selected method of remediation, when properly applied, should provide the most cost-effective means of mitigating hydrocarbons at the site and protecting receptors. Remediation goals selected to meet the groundwater and soil vapor points of exposure include the following:

- Mitigation of vapor-phase hydrocarbon contaminants and minimization of potential impacts to receptors
- Removal of the residual soil total petroleum hydrocarbons (TPH) to below the PSTB action levels of 100 milligrams per kilogram (mg/kg) and 100 parts per million by volume (ppmv) to the extent practical, with an emphasis on BTEX constituents
- Remediation of groundwater to meet NMWQCC standards for BTEX, MTBE, and naphthalenes

The proposed performance standards include the following:

- Within three years of system operation, document that site soil has met NMED criteria by demonstrating that extracted vapor concentrations contain less than 100 ppmv of volatile organic compounds (VOCs).

- Maintain minimum runtime of 90 percent for major remediation equipment. This is achievable through proper preventive maintenance of equipment and the use of telemetry to provide DBS&A with instant notification of system shutdowns via text message and/or e-mail.

- Document efficacy of the vapor treatment system by collecting system influent and effluent air samples at a minimum frequency of once per month to demonstrate optimization of mass removal and destruction of contaminants prior to discharge to the atmosphere.

DBS&A has calculated the estimated time to cleanup following the method outlined by Kroopnick (1998), which indicates that the soils can be remediated to NMED criteria in approximately three years (Appendix B).

4. Description of Proposed Remediation System

4.1 Overview

The remediation system designed for the site is an SVE system. The system will use vertical wells to remove LNAPL and vadose zone soil contaminants. Four existing monitor wells (MW-1, MW-2, MW-11, and MW-16) will be connected to the system, along with five new dedicated 4-inch-diameter SVE wells (SVE-1 through SVE-5) screened above the water table to minimize production of condensate and maximize the open screen. Details on well construction and anticipated operating parameters are provided in Table 1. Monitor wells MW-5 and MW-7 will also be connected to the system, but will only be used as contingency wells and to optimize pulsing toward the end of system operation.

The wells will be plumbed to common manifolds in an equipment compound that will be located on the west side of the Manny's Auto Sales property (Figure 11). This compound will be enclosed by a 6-foot-tall, gated chain link fence that will be tied into existing chain link fence run along the property boundary. The SVE system will consist of an extraction blower, a vapor-liquid separator, and a thermal oxidizer, as described in Section 4.2. The SVE blower, vapor-liquid separator, and associated equipment will be provided within a modified shipping container to reduce noise and mitigate theft and vandalism.

The remediation system is designed to achieve the goals outlined in Section 3 through the following primary processes:

- Recovery of contaminant mass from the release area and vicinity using SVE
- Reduction of hydrocarbon groundwater impacts by diffusing mass from a liquid to a vapor phase that can be removed via the SVE system

The proposed remediation system is detailed in the engineering drawings (Appendix A), supporting calculations (Appendix B), product cut sheets (Appendix C), and technical specifications (Appendix D).

4.2 Aboveground Treatment Equipment

The proposed aboveground equipment, as shown in the mechanical series of the drawings (Appendix A), will include the following:

- *Inlet piping manifold:* SVE wells will be piped to a common piping manifold using individual schedule (SCH) 40 polyvinyl chloride (PVC) conveyance lines. The conveyance piping will connect to the influent manifold, consisting of a 4-inch SCH 40 PVC header, with 2-inch SCH 40 PVC riser and fittings. Each riser will include a vacuum gauge, isolation valve, sample port, and ¼-inch threaded plug for a manometer-type insertion flow meter.

- *Equipment enclosure:* The SVE blower, vapor-liquid separator, and associated equipment and controls will be located within a modified shipping container. This enclosure will be used to reduce noise and mitigate vandalism and theft of remediation equipment. The enclosure will be provided with an insulated floor, walls, ceiling, and steel access doors; the floor will be sealed with a non-skid bed liner. Heating and cooling will be provided via a wall-mounted heater and vent fan with sound-insulated inlet/outlet louvers and a thermostat. A floor sump and high level sensor will be included in the event of a water leak from tanks or process piping. Noise will be reduced in accordance with City of Santa Fe Environmental Regulations 10-2.5. The site is zoned C-2 (commercial), so the maximum allowable sound level is 55 decibels (dB) as measured 1 foot inside the property line, 3 to 6 feet above ground surface, and at least 4 feet from walls and other reflective surfaces.

- *Vapor-liquid separator:* The piping manifold will connect to a 100-gallon vapor-liquid separator, including a 50-gallon liquid-holding capacity. The vapor-liquid separator will include a liquid coalescing media internal to the separator. External devices will include a 6-inch sediment clean-out port, sight tube and 3-point level switch, vacuum relief valve, and bottom drain valve that will be connected, using a condensate transfer pump, to a 200-gallon, single-walled, polyethylene storage tank. The condensate storage tank bottom drain valve will provide access for disposal.

- *SVE blower:* The SVE blower will be a Sutorbuilt 4007 positive displacement blower, or equivalent, capable of maintaining an extraction flow rate of 250 standard cubic feet per minute (scfm) at 70 inches water column vacuum at an elevation of 6,630 feet above mean sea level (feet msl). A 10-horsepower (hp), 480-volt, 3-phase completely enclosed fan-cooling variable speed motor will be provided, equipped with a variable frequency drive (VFD) located at the main control panel. The blower will be mounted on a steel discharge silencer with adjustable motor base for belt tensioning. The blower inlet will include a particulate filter, and the discharge piping from the blower will be galvanized steel and will include a sample port, pressure gauge, and temperature gauge.

- *Thermal oxidizer*: The oxidizer used for treatment of extracted soil vapor will be an Intellishare thermal oxidizer designed to operate at concentrations between 0 and 25 percent of the lower explosive limit (LEL) and rated at a maximum of 250 scfm. The base and reactor will be composed of A-36 carbon steel, with a 300-series stainless steel stack. The treatment unit will discharge through a stack that will vent at a height of approximately 14 feet above the ground surface.

- *Control panel:* The control panel will consist of a NEMA 4 enclosure, or equivalent enclosure rated for outdoor use, with an interior swing door. A fused main disconnect will be located in a separate enclosure mounted next to the control panel. The panel will have circuit breakers for protection of all motors. Each motor will have a Hand-Off-Auto switch with green run light indicators. Red lights will be labeled for all alarms. The panel will include intrinsically safe barriers for all switches and surge and lightning protection for the controls and telephone line. The system will be controlled with an Allen Bradley programmable logic control (PLC) that has data logging capability and a touch-screen graphical user interface. The PLC will be sized with two additional inputs and outputs beyond the number required to run the system and an uninterruptible power supply. The panel will include a control transformer, emergency stop switch, and ground fault interrupter outlet. The control panel will be labeled with an Underwriters Laboratory certification sticker.

4.3 Vertical Wells, Piping, and Trenching

The proposed remediation system will require the completion of five vertical SVE wells, connection of six existing monitor wells, and associated conveyance piping and trenching (Appendix A). The minimum area of influence anticipated to be affected by the system is shown on Figure 11. SVE pilot testing conducted in 2017 showed that variable subsurface conditions exist at the site. On the west side of the site, soil is tighter resulting in lower flow and lower radius of influence (ROI) (30 to 40 feet). Similar flow conditions were observed in the vicinity of wells MW-6 and MW-9, but the ROI was much higher (on the order of 100 feet). On the east side of the site, higher well flow was achievable with only half the applied well vacuum (DBS&A, 2018a). Flow control valves will be used to optimize flow and vacuum conditions for specific wells, as identified through SVE pilot testing.

4.3.1 Vertical Extraction Wells

Five vertical SVE wells (SVE-1 through SVE-5) will be constructed at the site, including three shallow wells and two deep wells. Installation of well materials will be accomplished using hollow stem auger drilling technologies, as follows:

- The typical groundwater elevation observed on the site is between 75 and 80 feet bgs. On average, the new deep wells will be screened approximately 3 feet above the static water table. Fine-grained near-surface soils (clayey sand and silty sand) and at grade paving will help to limit short circuiting of ambient air with the subsurface for the shallow well installations.

- Target screen intervals for the new wells are detailed in Table 1 and have been selected to minimize overlap with other remediation wells, while optimizing mass removal from the full thickness of contaminated soil. Wells will be constructed with 15 to 30 feet of 4-inch-diameter, 0.020-inch machine-cut PVC well screen.

- The top of each SVE well will be enclosed in a 2-foot-square, flush-mount, hinged well vault, surrounded by a 6-inch-thick, 3,000 pounds per square inch (psi), high-early-strength concrete pad (Appendix A).

4.3.2 Vertical Monitor Well

One additional monitor well (MW-20) is needed to define the western extent of impacted groundwater at the site. The location is shown on Figure 11. The well would be constructed similar to other on-site wells, including approximately 20 feet of 2-inch-diameter SCH 40 PVC well screen with 5 feet above and 15 feet below the static water table. Specific well materials are shown on Detail 2 of the Civil Details (Appendix A, Drawing C-2).

4.3.3 Conveyance Line Piping and Trenching

Details of conveyance piping trenches are shown on Drawing C-2 (Appendix A). The primary SVE conveyance piping for the extraction wells will be 2-inch-diameter SCH 40 PVC. In addition, pairs of 1-inch high density polyethylene (HDPE) piping will be installed to each well. This contingency piping could be used with an active skimming system to remove residual diesel fuel, if needed, after the gasoline has been removed. This contingency piping could also be used for polishing to apply amendments, such as ozone, after the source area mass is removed. The conveyance piping and contingency piping will be placed below ground in trenches supported in plastic spacers. The piping circuits will be backfilled with flowable fill in accordance with the specifications (Appendix D). The non-paved surfaces will be brought to grade with native gravel to match the existing land surface. Paved surfaces will be machine-cut and replaced with material and thickness similar to existing conditions.

Due to the shallow depth of the trenching and piping, it is not anticipated that contaminated media will be encountered during installation of the remediation system. All of the wells and piping are located on private land; therefore, a traffic control plan is not required. Utility service lines (electric and natural gas) will be extended from existing services located on the south side of Cerrillos Road. Potential roadwork for these services, if needed, will be handled by the utility companies.

When the system is completed, each piping circuit will have an isolation valve, a sample port, a vacuum gauge, and a threaded plug for an insertion type flow meter, as shown in the system schematic in Drawing M-3 (Appendix A). The sample port will be used for collecting air samples and as a secondary measuring point for manifold well vacuum.

4.4 Utility Requirements/Utility Clearances

PNM is the electrical service provider in Santa Fe. A new three-phase electrical service connection will be required for the remediation system, which will be supplied through belowground power lines. A site visit was completed with a PNM distribution engineer to assess potential options for bringing power to the site, and two alternatives were identified. The first alternative (Option A) uses an existing 3-phase power pole located on the west side of the Best Western parking lot. PNM would install a riser/dip from the pole to bring 3-phase power below ground, where it can be extended to the site through a utility trench.

A second alternative (Option B) uses existing 3-phase power located south of the Best Western hotel. The power would be extended on existing single-phase power poles coming from the southwest corner of the Best Western parking lot. A new pole would be installed with three new pole-mounted transformers adjacent to an existing power pole south of Manny's Auto Sales office building, and a dip/riser would be installed taking power below ground. Power would be brought to the site in a utility trench that follows the fence boundary between the two properties. PNM engineers are currently evaluating feasibility and cost for the two options. PNM and DBS&A will also be evaluating voltage losses from both alternatives to determine if additional equipment (e.g., a pad-mounted transformer) would be required. This analysis and the selected option will be discussed in a future work plan for FRP implementation. The locations of the two options are shown on Drawing G-3 (Appendix A).

NM Gas Company is the provider for natural gas service at the site. An extension of an existing service line will be installed in an existing easement along Cerrillos Road and brought on to the site. The extension is expected to be approximately 450 feet in total length, including a boring under a residential entrance on the east side of the auto sales property.

A detailed site survey was not performed during preparation of this FRP; therefore, a private utility locate service will be used to identify the location of on-site utilities. New Mexico One Call will also be contacted prior to subsurface excavation activities. The locations of utilities in the installation area will be shown on the record drawings following implementation of the FRP.

4.5 As-Built Report Preparation and Submittal

Following implementation of the FRP, record drawings signed and sealed by DBS&A's Engineer of Record will be prepared and submitted to the NMED PSTB Project Manager as part of an as-built report. The report will conform to the requirements of 20.5.119.1925.D NMAC and will include, but not be limited to, the following:

- Area/vicinity map
- Detailed site diagram with locations of underground utilities and other subsurface structures on or adjacent to the site's property boundaries, buildings, monitor wells, storage tanks and lines, sumps, impoundments, pit areas, water lines, and other relevant structures
- Summary of site conditions
- Any deviations from the drawings and specifications included in the FRP
- Tabulation of pertinent data including, but not limited to, flow rates, pressures, temperatures, contaminant concentrations, and groundwater elevations at startup
- Boring logs and well completion diagrams
- Inventory of purchased equipment
- Discussion of the data collection methods
- Laboratory results with chain-of-custody records and laboratory quality assurance/quality control (QA/QC)
- Characterization of wastes, including handling and disposal
- Elevation survey results
- Detailed description of remedial system and as-built drawings
- Discussion of system startup and shakedown
- Identification and explanation of operational adjustments made for optimum system performance

- Discussion of the remedial system's performance criteria
- Summary and recommendations
- Familiarity statement by the DBS&A qualified representative

4.6 Operations

Operation of the remediation system will include initial startup activities and regular maintenance. Safety controls will be installed to automatically shut down the system under certain circumstances, including malfunction or failure of any integral system component or loss of power. System monitoring objectives include tracking the progress of mass removal, maximizing treatment efficiency, and documenting compliance with permits issued for this project. Controls will also be implemented to protect equipment from weather and vandalism.

Progress of the source area abatement will be evaluated by monitoring the concentration of VOCs in the extracted air—from both the system as a whole and from individual SVE wells—and documenting system efficiency under different well operating configurations. The total mass of VOCs and chemical composition of extracted vapors will be quantified and tracked. To document hydrocarbon recovery efficiency, influent and effluent vapor will be tested daily for the first week of operations, weekly for the remainder of the first month, and biweekly thereafter. Extracted vapor concentrations are expected to be at their highest levels during the first month of system operation.

To ensure that the project objectives are achieved, an authorized representative of DBS&A will have direct supervisory control over all aspects of the project. All drilling, construction, and equipment setup activities conducted during the project will be performed under the direction of a New Mexico licensed professional engineer. All activities proposed in this FRP will be conducted in accordance with DBS&A standard operating procedures (SOPs), applicable federal and state regulations, and frequent communication with the PSTB Project Manager and other stakeholders.

4.7 Contingency Plan

If there is a change in site conditions that threatens public health, safety, or the environment, DBS&A will reevaluate the extraction well network. The most likely change in conditions would be a substantial change in groundwater elevation or flow direction. Additional vertical wells could be installed to maintain control of the LNAPL plume.

As stated previously, the vapor intrusion pathway is not believed to be complete for nearby buildings based on the depth or concentrations of contaminants. Vacuum induced by the SVE system will be extremely effective at reducing potential threat to structures by drawing subsurface vapor contaminants toward wells and away from structures. However, if vapor is found to be accumulating in areas outside the reach of the system as proposed, additional vertical extraction wells could be drilled.

5. Remediation System Operation and Maintenance

5.1 Overview

Operation and maintenance (O&M) of the remediation system and monitoring of the subsurface conditions is required at regular intervals to accomplish the following tasks:

- Collect data on system operation
- Maximize the system's mechanical performance
- Optimize the SVE operating configurations
- Document groundwater quality in response to system operation
- Perform general equipment preventive maintenance

5.2 Off-Gas Vapor Monitoring

Off-gas emission concentrations will be measured to document system effectiveness, regulatory compliance, and hydrocarbon recovery rates. Total ionizable volatile compound concentrations will be measured during each O&M event using a photoionization detector (PID). DBS&A proposes that influent and effluent air samples from the system be collected and analyzed for TPH and BTEX using EPA methods 8015B and 8021, respectively, on the following schedule:

- *Startup and shakedown:* Collect system influent/effluent samples within 4 hours of startup and again approximately 48 hours after startup.
- *Second week to end of first month:* Collect system influent/effluent samples weekly until the end of the first month of operation.
- *Remainder of first quarter and subsequent quarters of O&M:* Collect one influent and one effluent sample every two weeks.

Field and laboratory analytical data will be used to optimize system operation and to calculate system efficiency, extraction rates, emission rates, and quantities of recovered hydrocarbons.

To minimize the potential to emit regulated substances to the environment, the remediation system is designed and will be constructed and operated such that malfunction or failure of any integral component results in automatic shutdown of the entire system.

5.3 SVE System Operation and Maintenance

SVE system startup will require daily site visits for the first three days of operation to document system performance and hydrocarbon recovery rates. During this initial startup period, the SVE system will be adjusted to obtain optimum performance. Applied vacuum and resultant flow rates and vapor concentrations in each individual SVE well will be recorded using a form similar to the example provided in Appendix E. Vacuum from and fluid levels in surrounding wells will be observed to determine the radius of influence for each treatment well. These data will allow for optimization of the remediation system operational schedule and will maximize hydrocarbon removal from the site.

Because the actual subsurface conditions at the site are difficult to precisely predict, specific SVE well flow rates, operating configurations, and vacuum can only be estimated from data collected during the SVE pilot test and from extraction well design (Appendix B). Actual remediation system performance will be documented in the quarterly O&M reports submitted for the site.

After the startup period, the system will be operated and maintained for optimal efficiency. O&M and evaluation of the SVE system will be performed on a monthly, quarterly, and annual basis. Informal electronic reports on system performance will be provided to the PSTB Project Manager monthly. Quarterly reports will be provided both electronically (as a compiled PDF) and in hard copy.

In case of a change in site conditions that threatens public health, safety, and welfare or the environment, the system will be shut down immediately. The change in conditions will be

evaluated and, if necessary, modifications will be made to the system and its operations to remedy the risk to the public or the environment.

5.3.1 Quarterly Activities

On a quarterly basis, DBS&A will evaluate the efficacy of coalescing media and filters and will replace those materials that exhibit a decrease in performance. DBS&A will also prepare and submit a report to the PSTB documenting all O&M activities and groundwater monitoring results for the previous quarter.

5.3.2 Monthly Activities

DBS&A proposes to perform the following activities on a monthly basis:

- Measure SVE well flow rates and vacuum and air sparge flow rates and pressure
- Adjust and maintain flow rates at design specifications
- Adjust flow rates and applied well vacuum to maximize mass removal rates
- Empty knockout tank and dispose of condensate as required
- Collect, recycle, and dispose of LNAPL (if applicable); check and clean filters
- Respond to system shutdowns
- Conduct other miscellaneous activities necessary to ensure efficient and effective system performance
- Perform routine preventive maintenance on all equipment and motors
- Calculate system extraction and emission rates and destruction efficiency

5.4 One Year of Quarterly Monitoring and Reporting

Subsequent to system installation, DBS&A will initiate quarterly groundwater monitoring in accordance with DBS&A SOPs. A total of 20 groundwater monitor wells associated with the site will be gauged during each monitoring event. All wells that do not contain LNAPL will be

sampled. In the event that remedial activities cause a decrease in site concentrations, the sampling program may be adjusted in future years.

Fluid levels will be gauged using an electronic interface probe to determine if LNAPL is present and to determine the depth to water. If detected by the interface probe, the LNAPL thickness will be measured to within 0.01 foot. The interface probe will be decontaminated before each measurement using a solution of deionized water and soap.

Prior to sampling, the wells will be purged using new dedicated, disposable polyethylene hand bailers by bailing a minimum of three casing volumes or until groundwater chemistry has stabilized. If a well is purged dry, it will be sampled when the well has recharged. During purging groundwater field parameters (dissolved oxygen [DO], oxidation/reduction potential [ORP], electrical conductivity [EC], pH, and temperature) will be measured using a YSI Professional or equivalent device.

After purging, each well will be sampled for laboratory analysis, provided it contains a sufficient amount of groundwater. To minimize volatilization and ensure sample integrity, new dedicated, disposable polyethylene bottom-emptying devices will be used to transfer groundwater samples from the bailers to the appropriate containers. Samples collected for VOC analysis will be transferred from bailers into laboratory-prepared 40-milliliter (mL) glass sample bottles that contain mercuric chloride as a preservative. The bottled groundwater samples will be labeled and preserved on ice in an insulated cooler for delivery to Hall Environmental Analysis Laboratory (HEAL) in Albuquerque, New Mexico for analysis.

Groundwater samples will be analyzed for VOCs using EPA method 8260B (full list) and EDB using EPA method 504.1. Groundwater samples will be accompanied by full chain-of-custody documentation at all times.

Following completion of each quarter of sampling and O&M, and upon receipt of laboratory analytical reports, DBS&A will prepare and submit to the NMED PSTB Project Manager a quarterly monitoring report conforming to 20.5.119.1926 NMAC. The report will include, but not be limited to, the following:

- Area/vicinity map
- Detailed site diagram with locations of buildings, monitor wells, storage tanks and lines, sumps, impoundments, pit areas, water lines, and other relevant structures
- Summary of site conditions
- Discussion of the sampling collection procedures
- Laboratory results with chain-of-custody records and quality assurance information
- Tabulation and graphs of groundwater and NAPL levels (if applicable) in each well
- Monitor well data in tabular and graphical form with recent and historical groundwater elevations, NAPL elevations, and laboratory data
- Groundwater elevation map
- Groundwater contaminant and isoconcentration maps with contaminant concentrations for each well
- Identification and explanation of any operational adjustments made for system optimization
- Discussion of actual system operation and effectiveness compared to expected parameters used for the remedial design
- Evaluation of contaminant reduction
- Familiarity statement by the DBS&A Project Manager
- Description of actions taken or future plans for the recovery of contaminant mass
- Summary and recommendations

5.5 Health and Safety Requirements

DBS&A has updated the current site-specific health and safety plan (HASP) for the proposed field activities at the site related to the remediation system installation and operation pursuant to the requirements of CFR 1910.120. The current HASP is provided as Appendix F. A copy of the HASP will be kept on-site during all field activities.

6. Permits

6.1 Air Quality Bureau Notice of Intent

Upon final approval of the FRP by the PSTB and prior to system operation, a request for a no permit required (NPR) status will be submitted to the NMED Air Quality Bureau using notice of intent (NOI) forms. A copy of the application is provided as Appendix G.

6.2 Office of the State Engineer Well Permits

Permits from the OSE will be required for the new vertical wells planned to be constructed at the site. Permit applications will be submitted upon approval of the work plan for well installation, and permit approvals will be provided with subsequent reports.

7. Notifications

DBS&A will provide public notice in accordance with 20.5.119.1923.D.10 NMAC, as follows:

- Legal notice of the submission of the FRP will be published twice in the *Santa Fe New Mexican*, a newspaper of general circulation in Santa Fe County, on August 29 and September 5, 2019. The certified affidavit of publication for each legal notice is included in Appendix H. The format for the legal notice follows the guidelines dictated in 20.5.119.1923.D.D.10.b NMAC.

- A notice containing the specified information listed in the regulation will be posted at the Shamrock No. 63 site along Cerrillos Road.

- In accordance with the above-cited regulation, DBS&A will provide notice of submission of the FRP by certified mail to adjacent property owners. DBS&A intends to mail a total of 56 certified letters.

A copy of the text of the legal notice and a list of certified addresses are provided in Appendix H.

8. Implementation Schedule

A schedule for implementing this FRP is provided in Appendix I. Implementation milestones include the following:

- Approval of the FRP
- Installation of vertical wells and conveyance piping
- Installation of remediation equipment
- System startup
- Submittal of the final as-built report
- Quarterly O&M reports

9. Evaluation of Remedial Actions

The remediation system performance will be evaluated annually in accordance with 20.5.119.127 NMAC. The system evaluation will be incorporated into the fourth quarter monitoring report and submitted to the NMED PSTB Project Manager. This evaluation will provide NMED with the information necessary to determine whether the remedial approach undertaken is successful in achieving the remedial action objectives. Key elements of the report include the following:

- Contaminant plume maps with contaminant levels from each well
- Groundwater maps showing intrinsic bioremediation parameters
- Evaluation of SVE system performance based on mass of fuel compounds removed
- Evaluation of the rate of natural attenuation
- Summary and recommendations

In the event that the data collected during the first six months of operation suggest that the system as installed has not been effective at removing or reducing contaminant mass, DBS&A may propose an alternative approach or change to the existing remediation plan. A variety of technologies could augment the removal. DBS&A believes that the remedial approach documented in this FRP is a prudent and cost-effective approach to achieve removal of contaminant mass in the most expeditious time frame and to ultimately bring the site to closure.

10. Statement of Familiarity

This FRP was prepared on behalf of Mr. James Polk, RP for the Shamrock No. 63 site. Preparation of all engineering drawings and specifications was conducted under the direction and supervision of Thomas Golden, a New Mexico Licensed Professional Engineer (License #22750).

August 27, 2019

Thomas Golden, P.E.
Project Engineer

Date

References

Daniel B. Stephens & Associates, Inc. (DBS&A). 2018a. *SVE pilot test report, Shamrock #63 UST site, 3624 Cerrillos Road, Santa Fe, New Mexico, Facility #29206, Release ID #4509.* Prepared for the New Mexico Environment Department, Santa Fe, New Mexico. January 19, 2018.

DBS&A. 2018b. *Second groundwater monitoring and LNAPL recovery report, Shamrock #63, 3624 Cerrillos Road, Santa Fe, New Mexico, Facility #29206, Release ID #4509.* Prepared for the New Mexico Environment Department, Santa Fe, New Mexico. April 10, 2018.

DBS&A. 2018c. *Final remediation plan development, Shamrock #63, Santa Fe, New Mexico, Facility #: 29206. Release ID #: 4509.* Transmitted by letter from Thomas Golden and John E. Casey to Susan von Gonten, New Mexico Environment Department Petroleum Storage Tank Bureau regarding Work plan for final remediation plan preparation, Shamrock #63, 3624 Cerrillos Road, Santa Fe, New Mexico, Facility #: 29206, Release ID #: 4509. December 4, 2018.

Kroopnick, P.M. 1998. Selecting the appropriate abatement technology: Estimating the life-cycle costs of treating hydrocarbon vapors extracted from soil. *Pollution Engineering* (November): 36-40.

New Mexico Environment Department (NMED). 2019. Letter from Dana Bahar to Jim Polk, Polk Oil Company, regarding Approval of Phase 3 fixed-price workplan for Shamrock No. 63, 3624 Cerrillos Road, Santa Fe, New Mexico, Facility #: 29206, Release ID #: 4509, WPID #:18604. June 25, 2019.

Figures



Image source: ESRI ArcGIS Online and data partners, including imagery from agencies supplied via the Content Sharing Program.

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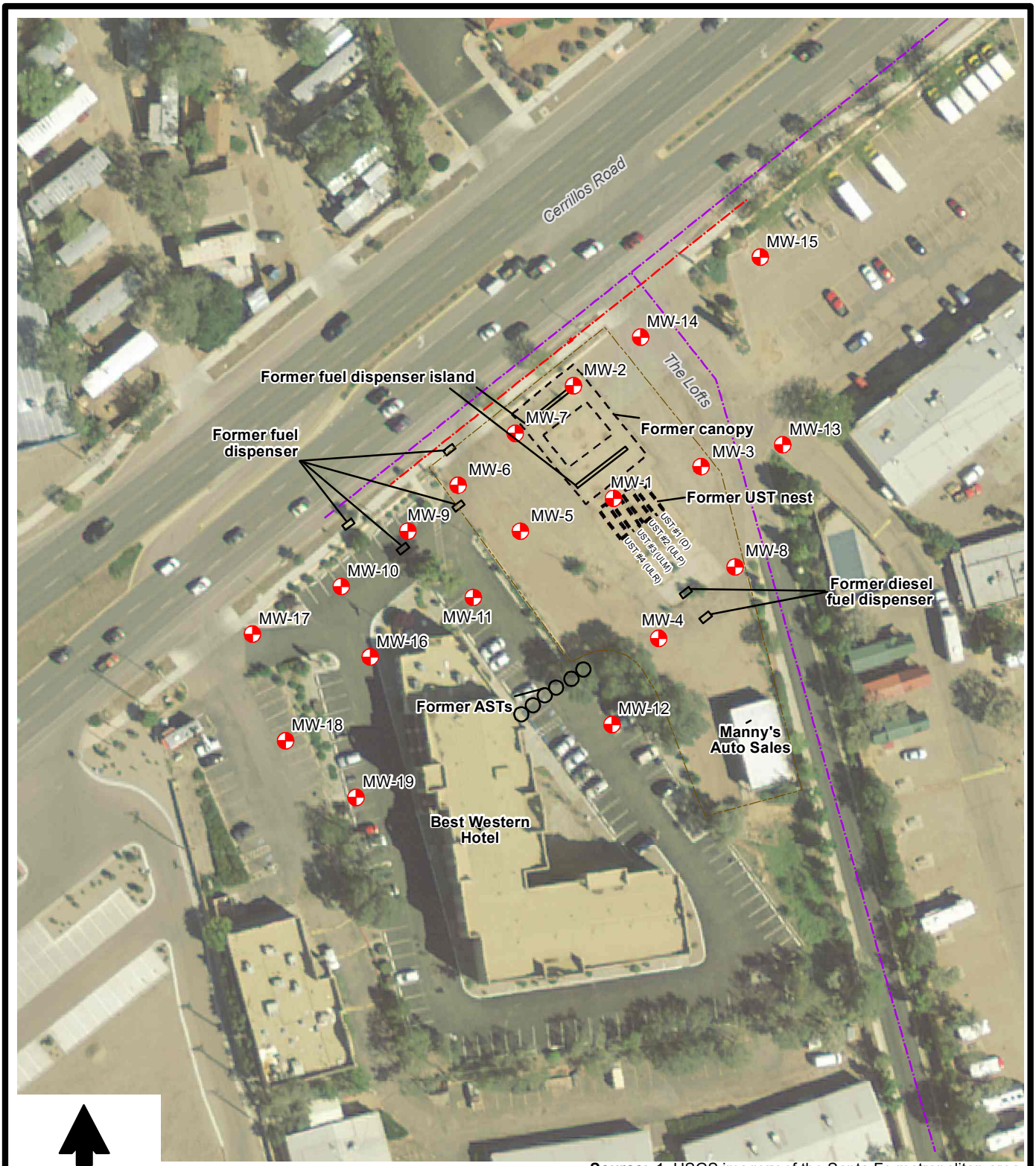
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Feet

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JN BE14.0012

SHAMROCK NO. 63
3624 CERRILLOS ROAD
SANTA FE, NEW MEXICO
Area Map

Figure 1



Explanation

- Monitor well
- Property line
- Sanitary sewer
- Buried electric/telecom

Source: 1. USGS imagery of the Santa Fe metropolitan area.
2. Fuel dispenser and AST locations detemined in consultation with NMED-PSTB.

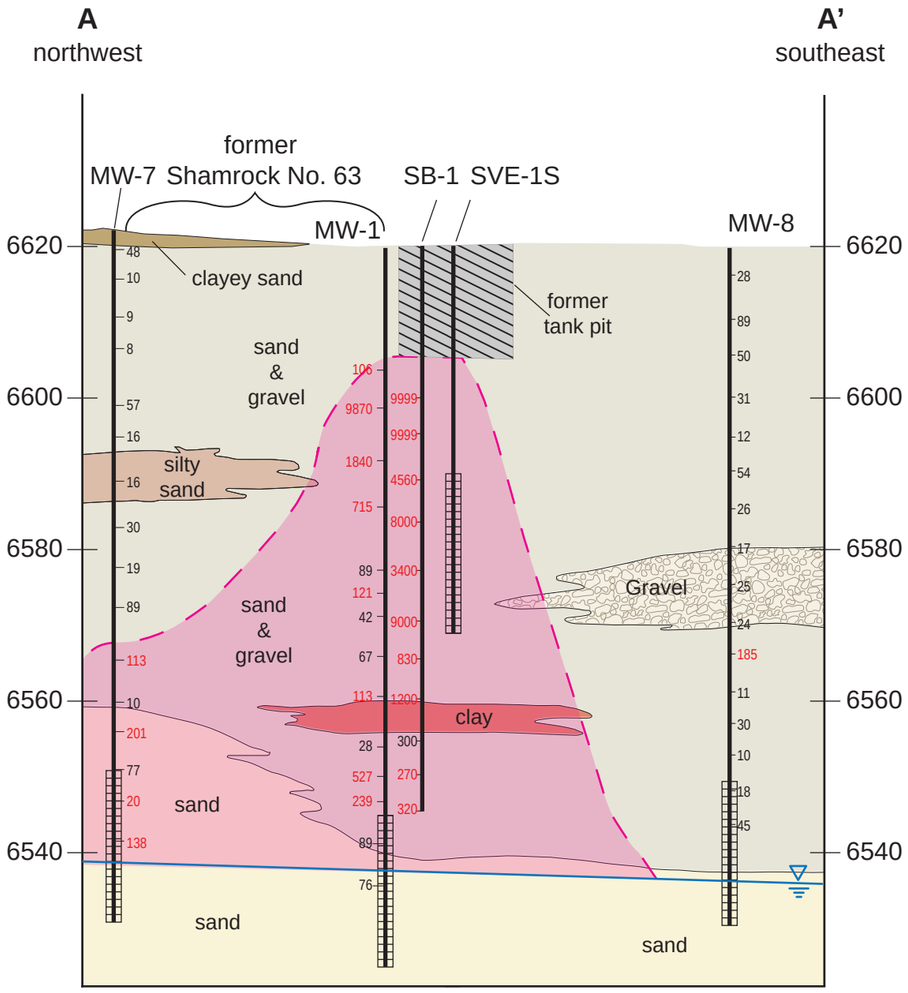
SHAMROCK NO. 63
3624 CERRILLOS ROAD
SANTA FE, NEW MEXICO

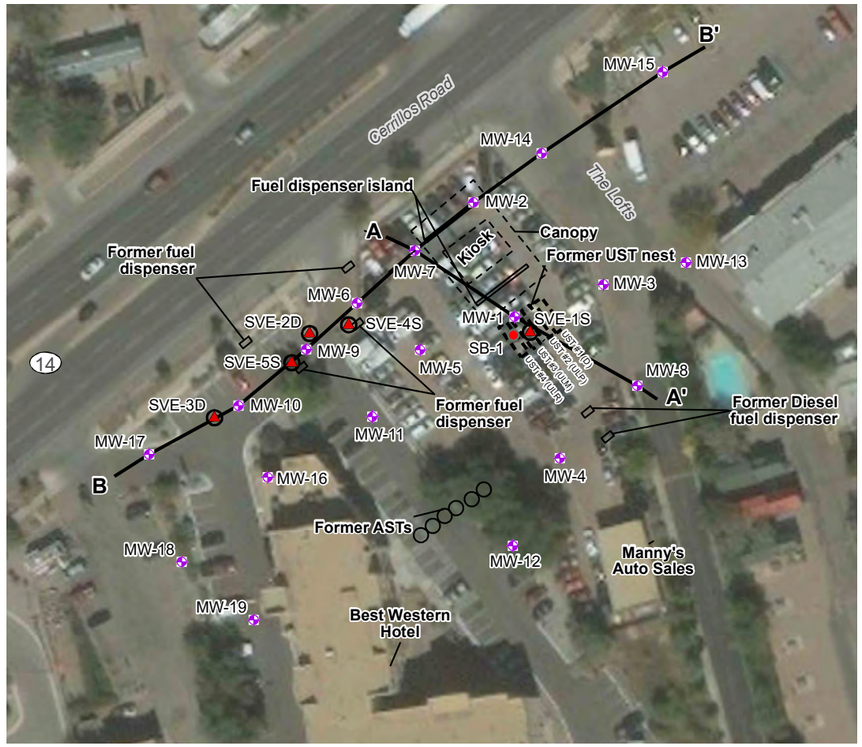
Site Map

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JN BE14.0012

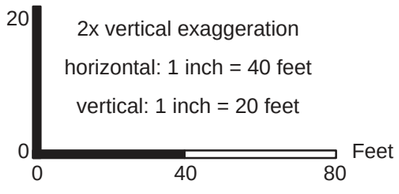
Figure 2

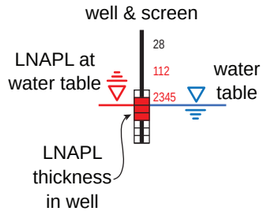
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Source: 1. Adapted from ESRI ArcGIS Online and data partners imagery.
2. Fuel dispenser and AST locations detemined in consultation with NMED-PSTB.





PID readings (ppm) are shown at the depth taken next to each well; readings >100ppm are highlighted in red to show areas of actionable contamination.

Explanation

- gravel
- gravelly sand
- sand, few gravels or fines
- silty sand, silty sand w/gravel
- clay
- hydrocarbon impacted soils
- clayey sand, clayey sand & gravel

SHAMROCK No. 63

Cross Section A-A'

B
southwest

B’
northeast

former fuel dispenser

former fuel dispenser

former Shamrock 63 location

SVE-2D

MW-6

SVE-5S

SVE-3D

MW-17

MW-10

MW-9

SVE-4S

MW-7

MW-2

MW-14

MW-15

6620

6600

6580

6560

6540

clayey sand & gravel

silty sand & gravel

silty sand

silty sand

clay

gravelly sand

clayey sand

clay

sand & gravel

silty sand

sand & gravel

clay

sand

clayey & silty sand w/ gravel

sand & gravel

silty sand

sand & gravel

clay

sand

sand

sand

sand

sand

20

2x vertical exaggeration

horizontal: 1 inch = 40 feet

vertical: 1 inch = 20 feet

0

0 40 80 Feet

well & screen

LNAPL at water table

water table

LNAPL thickness in well

PID readings (ppm) are shown at the depth taken next to each well; readings >100ppm are highlighted in red to show areas of actionable contamination.

Explanation

- clayey sand, clayey sand & gravel
- gravelly sand
- sand, few gravels or fines
- silty sand, silty sand w/gravel
- clay
- hydrocarbon impacted soils

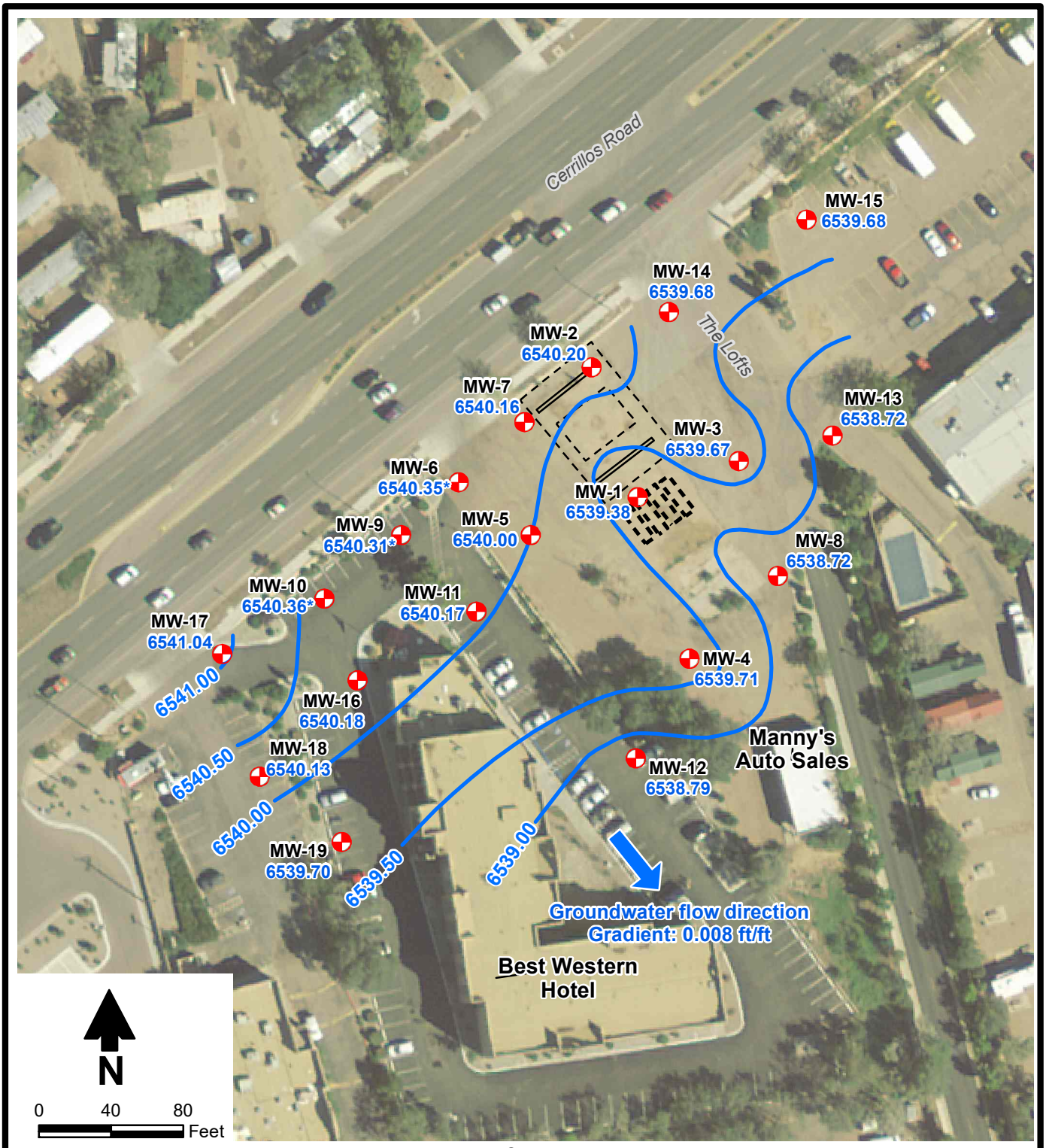
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06/13/2018 JN BE14.0012.00

SHAMROCK No. 63

Cross Section B-B’

Figure 4



Source: 1. USGS imagery of the Santa Fe metropolitan area.
2. Fuel dispenser and AST locations detemined in consultation with NMED-PSTB.

Explanation

- Monitor well
- Potentiometric surface elevation contour (ft msl)
- **MW-1** Monitor well designation
- **6539.38** Potentiometric surface elevation (ft msl)
- **6540.35*** Potentiometric surface elevation corrected for LNAPL thickness

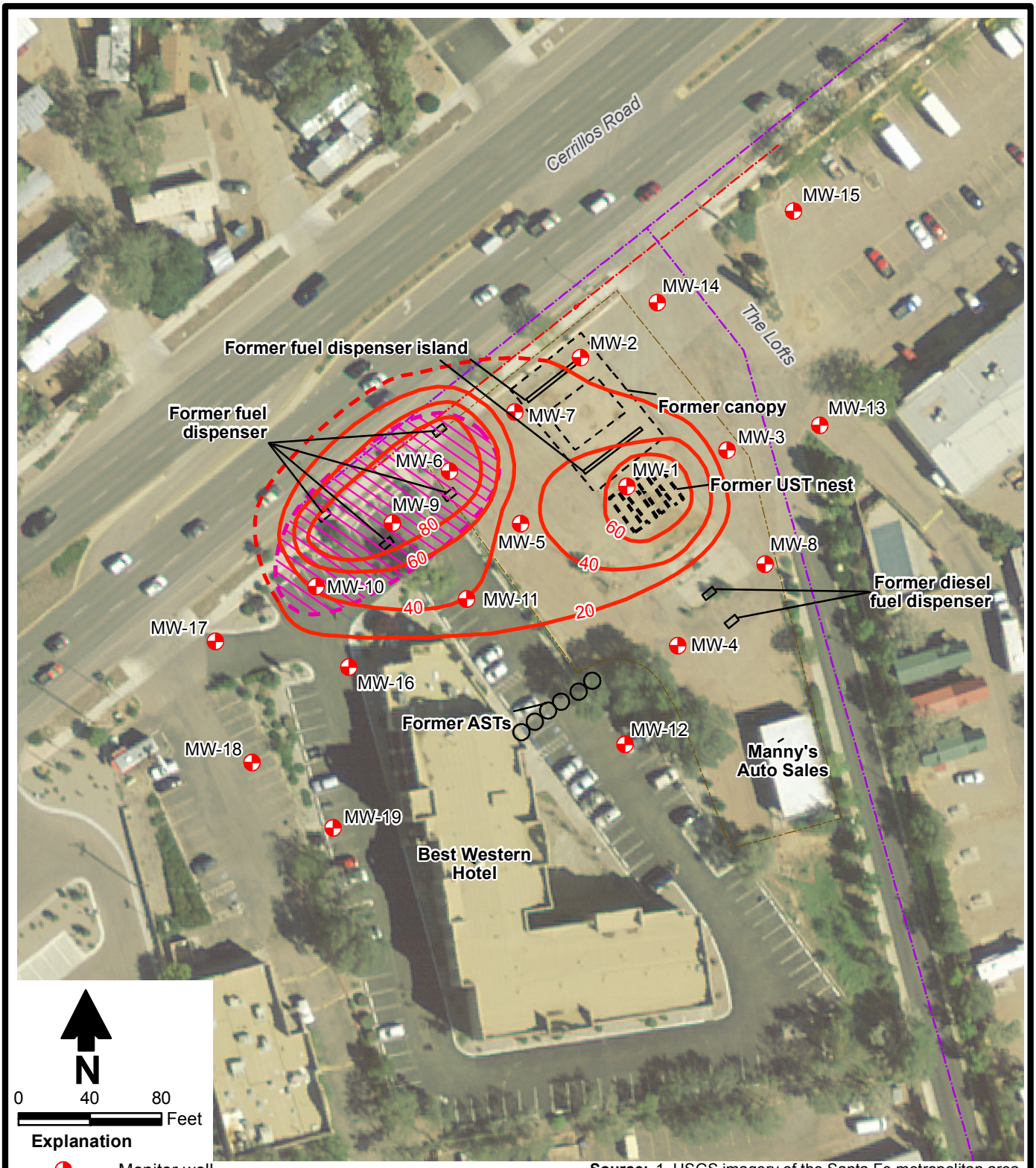
SHAMROCK NO. 63
3624 CERRILLOS ROAD
SANTA FE, NEW MEXICO

Potentiometric Surface Elevations
January 23, 2018

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6/14/2018
JN BE14.0012

Figure 5

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Source: 1. USGS imagery of the Santa Fe metropolitan area.
2. Fuel dispenser and AST locations detemined in consultation with NMED-PSTB.

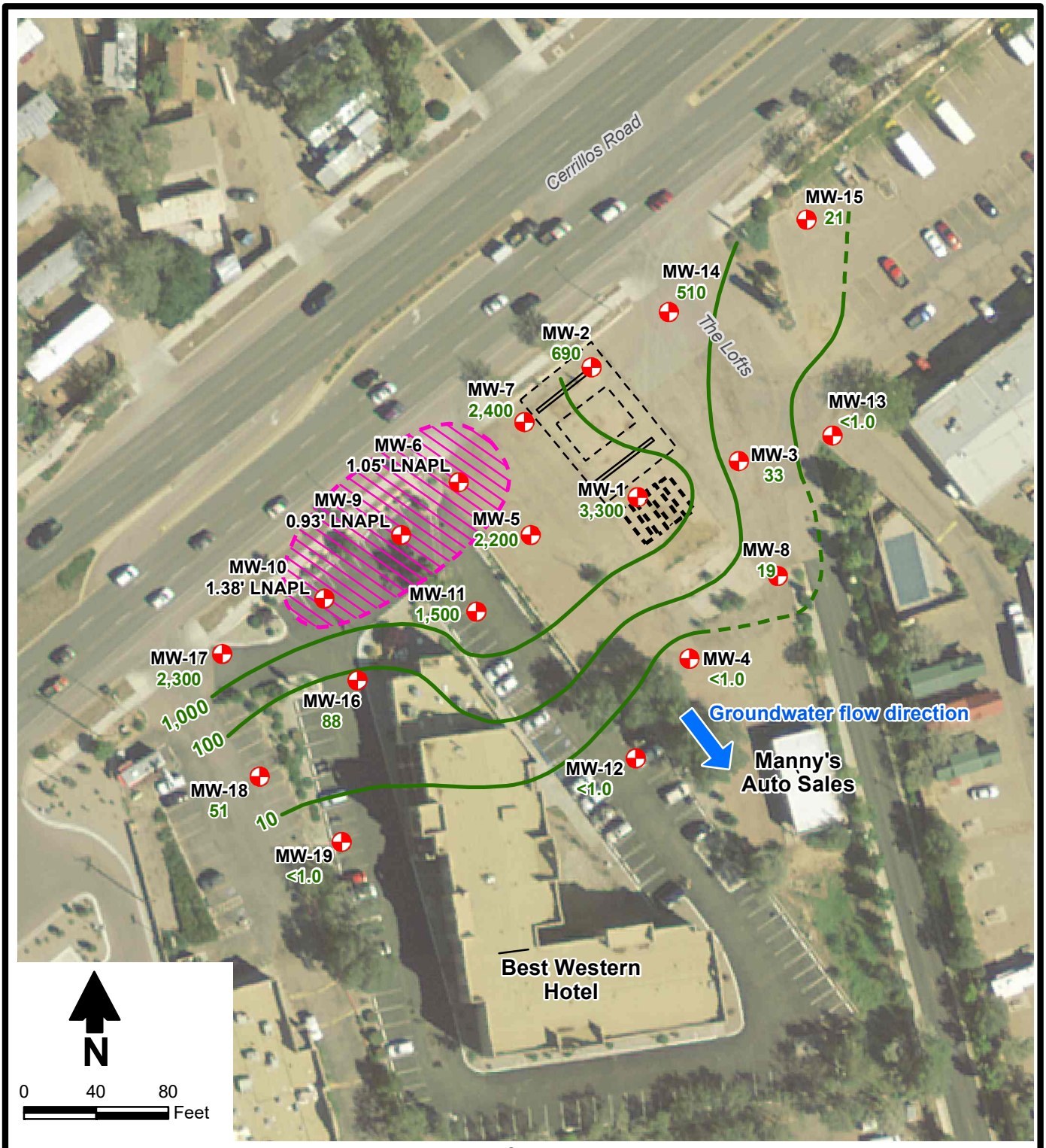
SHAMROCK #63
3624 CERRILLOS ROAD
SANTA FE, NEW MEXICO

Distribution and Thickness of Hydrocarbon Impacted Soil January 2018

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6/12/2018
JN BE14.0012

Figure 6

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Source: 1. USGS imagery of the Santa Fe metropolitan area.
2. Fuel dispenser and AST locations detemined in consultation with NMED-PSTB.

Explanation

- Monitor well
- Benzene isoconcentration contour (µg/L) (dashed where inferred)
- LNAPL

MW-1 Monitor well designation
3,300 Benzene concentration (µg/L)

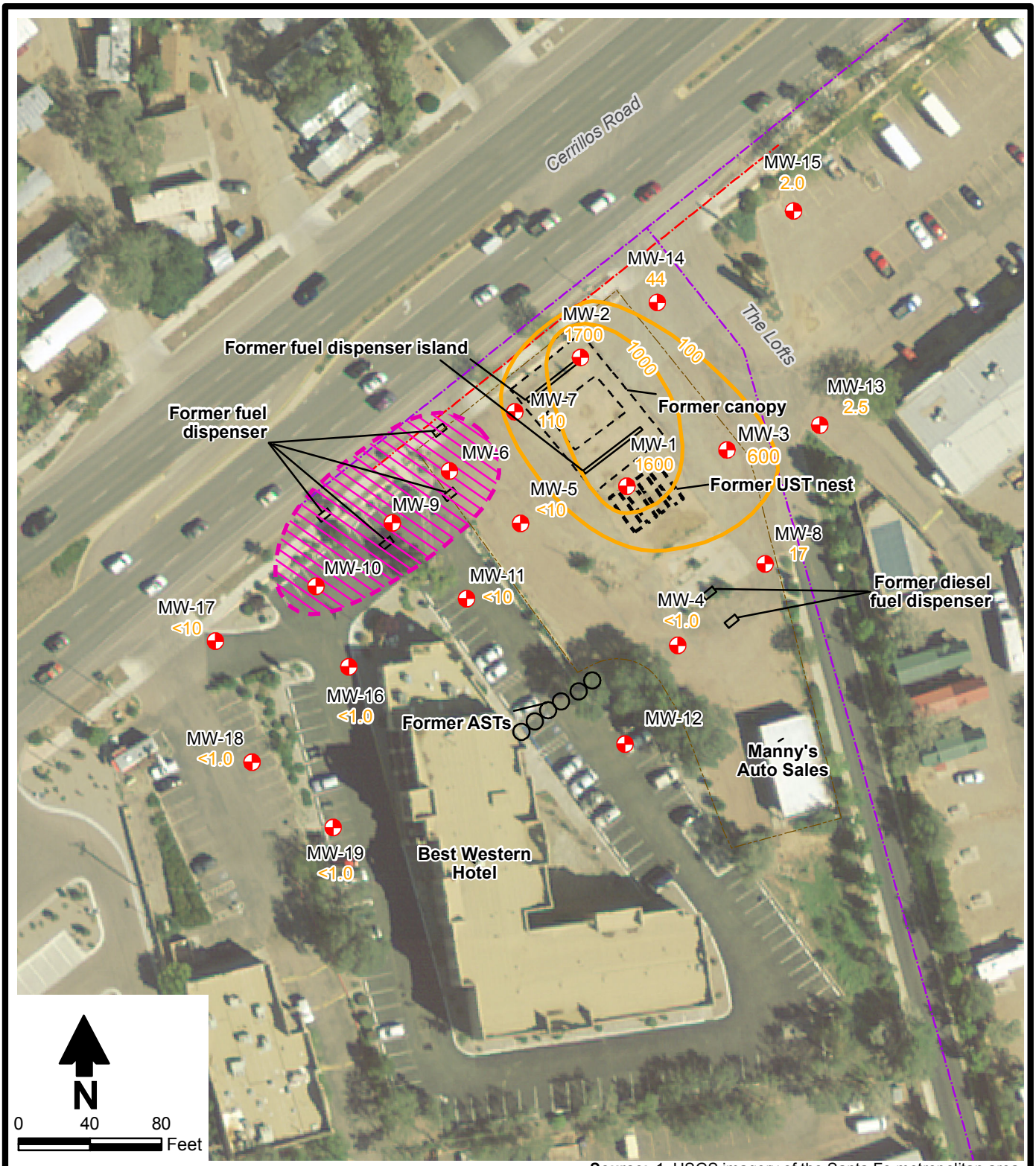
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Benzene Isoconcentration Map
January 23 through 25, 2018

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Figure 7

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Source: 1. USGS imagery of the Santa Fe metropolitan area.
2. Fuel dispenser and AST locations detemined in consultation with NMED-PSTB.

Explanation

- Monitor well
- MTBE isoconcentration contour (µg/L)d
- Property line
- Sanitary sewer
- Buried electric/telecom
- LNAPL

Note: MTBE = Methyl tert-butyl ether

MW-19 Monitor well designation
<1.0 EDC Concentration (µg/L)

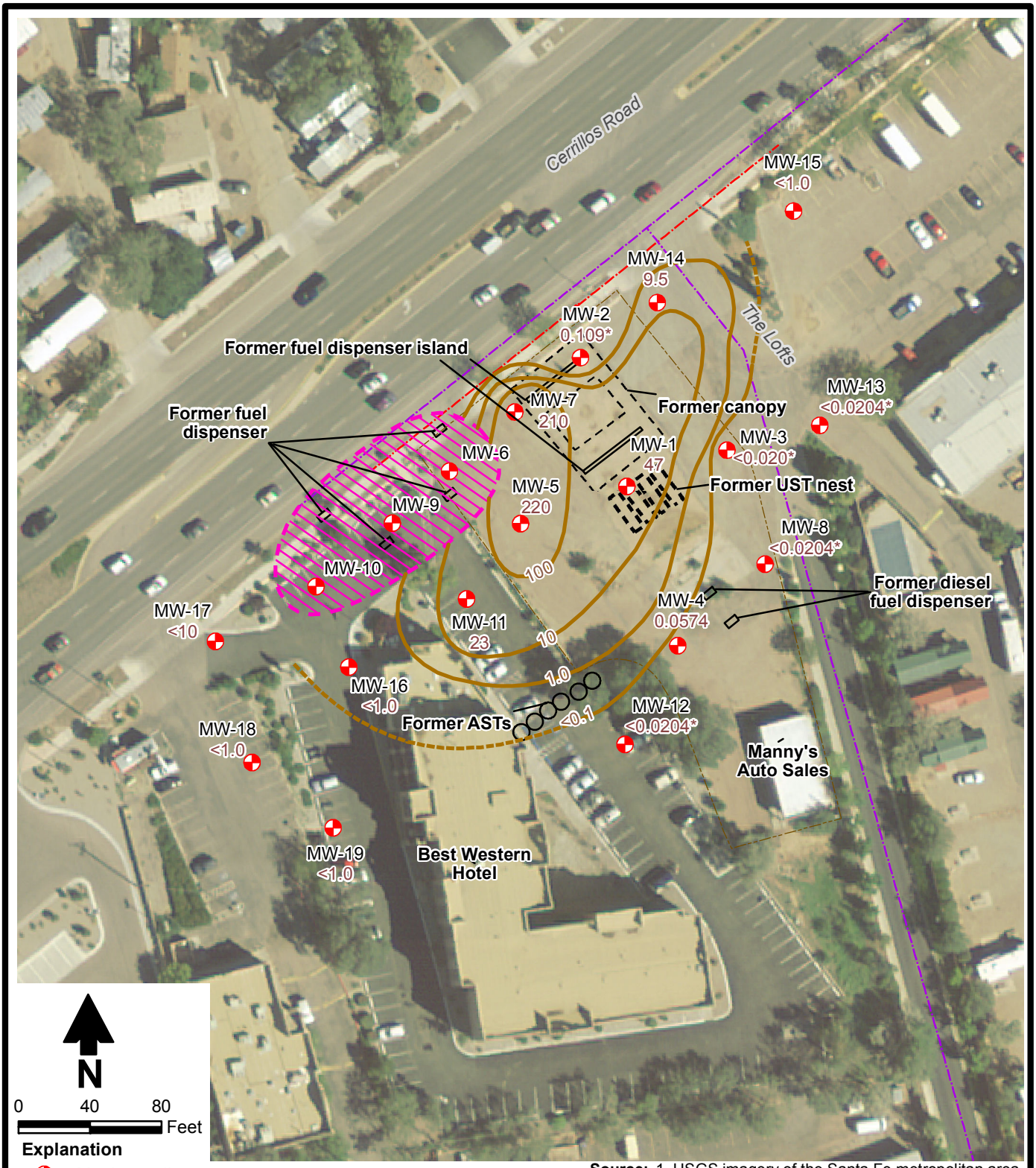
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MTBE Isoconcentration Map
January 2018

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JN BE14.0012

Figure 8

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Explanation

- Monitor well
- EBD isoconcentration contour (µg/L) (dashed where inferred)
- Property line
- Sanitary sewer
- Buried electric/telecom
- LNAPL

Source: 1. USGS imagery of the Santa Fe metropolitan area.
2. Fuel dispenser and AST locations detemined in consultation with NMED-PSTB.

Note: 1. EDB = 1,2 Dibromoethane
2. Asterisk (*) denotes laboratory data from June 2015

MW-19 Monitor well designation
<1.0 EDB Concentration (µg/L)

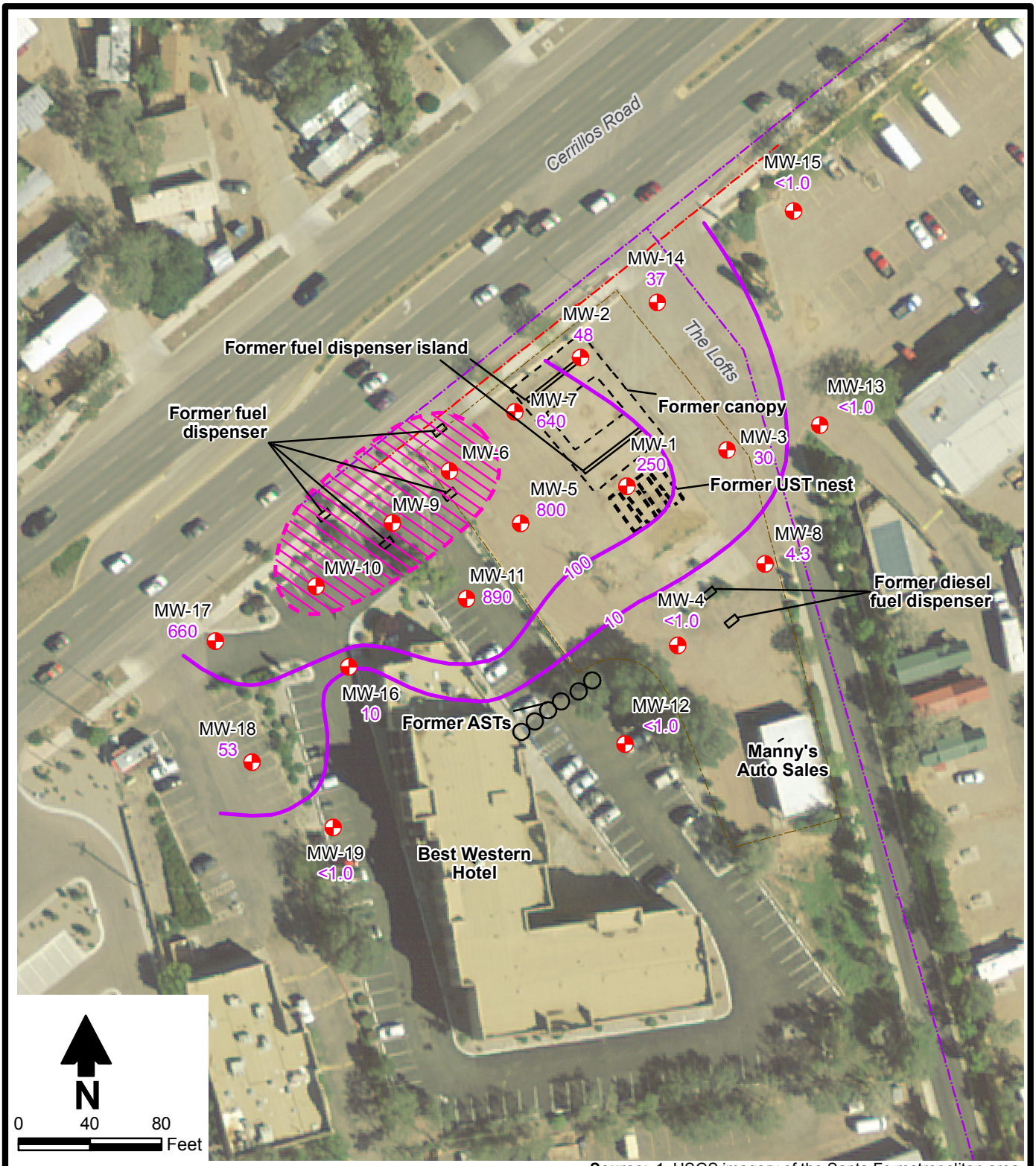
SHAMROCK NO. 63
3624 CERRILLOS ROAD
SANTA FE, NEW MEXICO

EDB Isoconcentration Map
January 2018

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6/15/2018
JN BE14.0012

Figure 9

T:\Marketing\Proposals in Progress\DB18.xxxx.PR_NMED Shamrock 63\GIS\MXDs\F09_EDB.mxd



Source: 1. USGS imagery of the Santa Fe metropolitan area.
2. Fuel dispenser and AST locations detemined in consultation with NMED-PSTB.

Explanation

- Monitor well
- EDC isoconcentration contour (µg/L)
- Property line
- Sanitary sewer
- Buried electric/telecom
- LNAPL

Note: EDC = 1,2-Dichloroethane

MW-19 Monitor well designation

<1.0 EDC Concentration (µg/L)

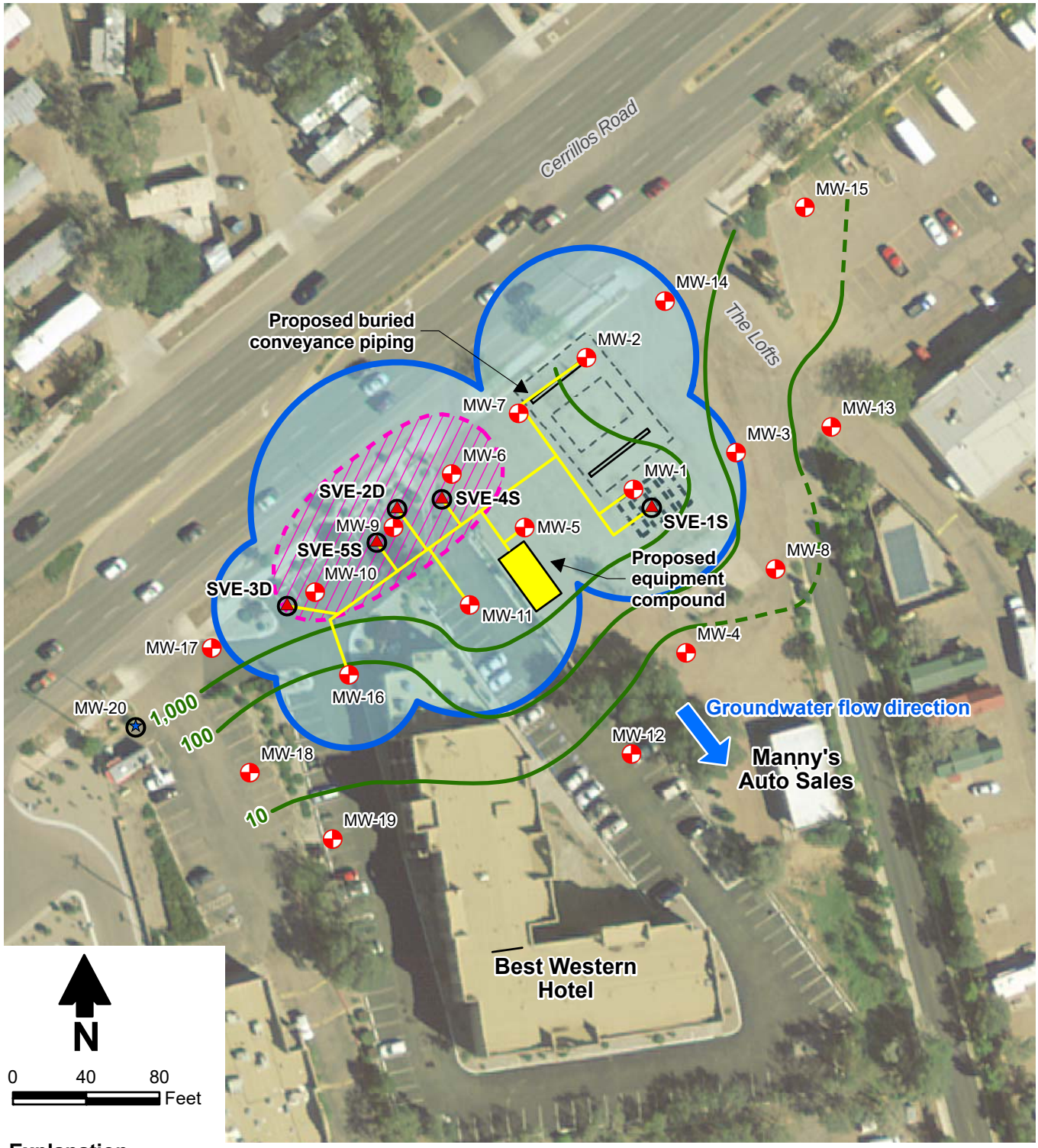
SHAMROCK NO. 63
3624 CERRILLOS ROAD
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EDC Isoconcentration Map
January 2018

Daniel B. Stephens & Associates, Inc.
6/14/2018
JN BE14.0012

Figure 10

T:\Marketing\Proposals in Progress\DB18.xxxx.PR_NMED Shamrock 63\GIS\MXDs\F10_EDC.mxd



Explanation

- Proposed monitor well
- Proposed SVE well
- Monitor well
- Proposed SVE conveyance line
- Benzene isoconcentration contour (µg/L) (dashed where inferred)
- Former fuel dispenser infrastructure
- Approximate SVE ROI (radius varies)
- Approximate extent of LNAPL
- Proposed equipment compound

Source: 1. USGS imagery of the Santa Fe metropolitan area.
2. Fuel dispenser and AST locations detemined in consultation with NMED-PSTB.

SHAMROCK NO. 63
3624 CERRILLOS ROAD
SANTA FE, NEW MEXICO

Proposed Technical Approach

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8/20/2019
JN BE14.0012

Figure 11

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Table

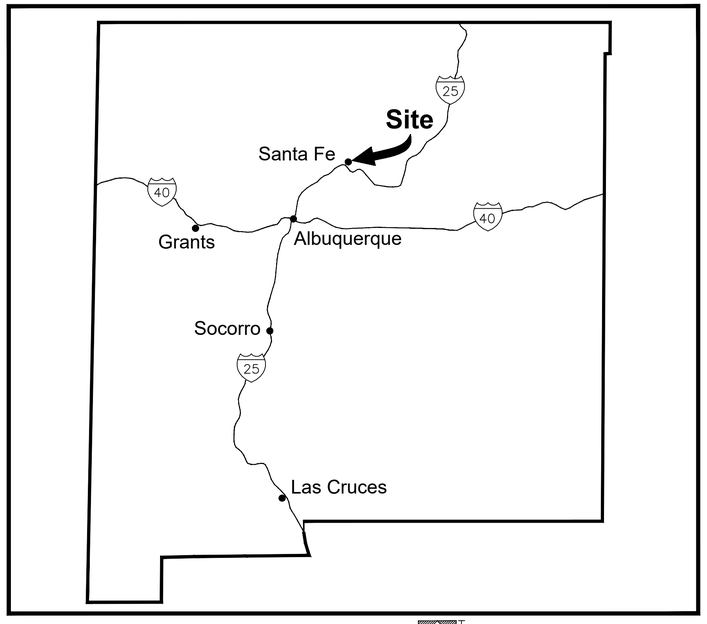
Table 1. Proposed Remediation Wells

Well	Well Screen (feet bgs)	Applied Well Vacuum (inches water)	Well Flow (scfm)	Assumed ROI (feet)
MW-1	NA	25	30	60
SVE-1S	30–50	25	60	60
MW-2	75–90	25	35	60
MW-11	72–92	50	5	60
MW-16	70–90	50	5	40
SVE-2D	45–75	50	30	80
SVE-3D	45–75	50	30	40
SVE-4S	15–30	50	15	60
SVE-5S	15–30	50	15	60
		Total	225	

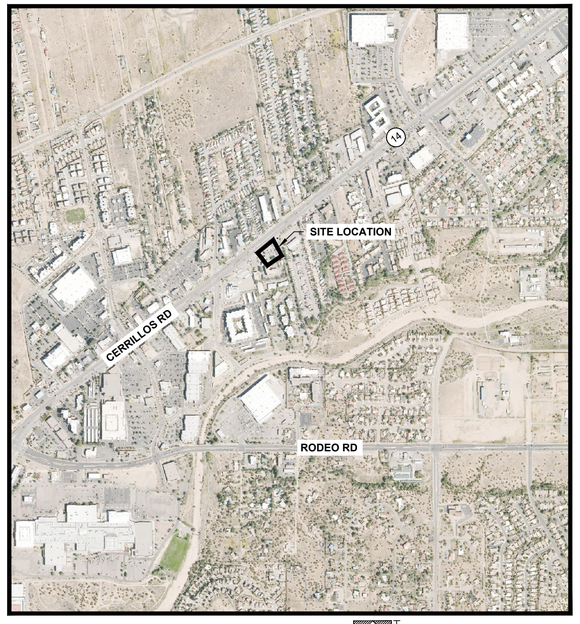
Note: Existing wells MW-5 and MW-7 will be connected to the remediation system for contingency purposes.
bgs = Below ground surface
scfm = Standard cubic feet per minute
ROI = Radius of influence
NA = Not applicable

Appendix A

Engineering Drawings



VICINITY MAP
NTS
NORTH



SITE MAP
NTS
NORTH

SHAMROCK NO. 63 SITE

SANTA FE, NEW MEXICO

PREPARED FOR

NEW MEXICO ENVIRONMENT DEPARTMENT

INDEX OF DRAWINGS — **REVISION**

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SHAMROCK NO. 63 SITE
SVE SYSTEM INSTALLATION
SANTA FE, NEW MEXICO

COVER SHEET AND INDEX

SHT. 1 OF 8
DWG NO. G-0

JOB NO.
BE14.0012

S:\PROJECTS\BE14.0012_SHAMROCK_63\CAD\PRODUCTION\G-0 TITLE SHEET.DWG August 19, 2019 - 2:14 PM BY: SAMSON, JEFFREY

GENERAL CONSTRUCTION NOTES:

A. ALL WORK ON THIS PROJECT SHALL BE PERFORMED IN ACCORDANCE WITH APPLICABLE FEDERAL, STATE AND LOCAL LAWS, ORDINANCES, AND REGULATIONS CONCERNING CONSTRUCTION SAFETY AND HEALTH.

B. THE CONTRACTOR IS RESPONSIBLE FOR OBTAINING ALL REQUIRED CONSTRUCTION PERMITS AND APPROVALS OF LIKE KIND PRIOR TO START OF CONSTRUCTION.

C. PROJECT DOCUMENTS CONSIST OF THESE DRAWINGS, PROJECT SPECIFICATIONS, PROJECT CONTRACTS, AND ANY AND ALL SUBSEQUENT EXECUTED PROJECT DOCUMENTATION ISSUED AS, OR WITH, CHANGE ORDERS, AND RFI'S (REQUEST FOR INFORMATION.) THE CONTRACTOR SHALL REVIEW ALL PROJECT DOCUMENTS AND VERIFY ALL DIMENSIONS, QUANTITIES, AND FIELD CONDITIONS. ANY CONFLICTS OR OMISSIONS WITH THE DOCUMENTS SHALL BE REPORTED TO THE ENGINEER/PROJECT MANAGER FOR CLARIFICATION PRIOR TO PERFORMANCE OF ANY WORK IN QUESTION. IN THE EVENT THE CONTRACTOR DOES NOT NOTIFY THE ENGINEER/PROJECT MANAGER, THE CONTRACTOR ASSUMES FULL RESPONSIBILITY AND ANY AND ALL EXPENSE FOR ANY REVISIONS NECESSARY OR CORRECTIONAL WORK REQUIRED.

D. THE LOCATION OF BURIED UTILITIES ARE BASED UPON INFORMATION PROVIDED TO THE ENGINEER BY OTHERS AND MAY NOT REFLECT ACTUAL FIELD CONDITIONS. EXISTING BURIED UTILITIES SHALL BE VERIFIED BY THE CONTRACTOR PRIOR TO CONSTRUCTION. THE CONTRACTOR SHALL USE ANY MEANS APPROVED BY THE ENGINEER/PROJECT MANAGER TO LOCATE UNDERGROUND UTILITIES INCLUDING, BUT NOT LIMITED TO, ELECTRONIC LOCATING EQUIPMENT AND/OR POT HOLING. ANY DAMAGE TO ANY OTHER UTILITIES AND/OR COLLATERAL DAMAGE CAUSED BY THE CONTRACTOR SHALL BE THE FULL RESPONSIBILITY OF THE CONTRACTOR.

E. EXISTING FENCING THAT IS NOT DESIGNATED FOR REMOVAL SHALL NOT BE DISTURBED. ANY FENCING THAT IS DISTURBED OR ALTERED BY THE CONTRACTOR SHALL BE RESTORED TO ITS ORIGINAL CONDITION AT THE CONTRACTOR'S EXPENSE. IF THE CONTRACTOR DESIRES TO REMOVE FENCING TO ACCOMMODATE CONSTRUCTION ACTIVITIES, THE CONTRACTOR SHALL OBTAIN THE OWNER'S WRITTEN PERMISSION BEFORE FENCE IS REMOVED. CONTRACTOR SHALL RESTORE THE FENCE TO ITS ORIGINAL CONDITION AT THE EARLIEST OPPORTUNITY TO THE SATISFACTION OF THE OWNER. WHILE ANY FENCING IS REMOVED, THE CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR SECURITY OF THE SITE UNTIL THE FENCE IS RESTORED.

F. AT THE END OF EACH WORK DAY, THE CONTRACTOR SHALL CLEAN AND PICK UP THE WORK AREA TO THE SATISFACTION OF THE ENGINEER/PROJECT MANAGER. AT NO TIME SHALL THE WORK BE LEFT IN A MANNER THAT COULD ENDANGER THE WORKERS OR THE PUBLIC.

G. ALL MATERIALS AND WORKMANSHIP SHALL CONFORM TO PROJECT SPECIFICATIONS AND PLANS, AS AMENDED AND REVISED BY THE ENGINEER. ALL INSTALLATION DETAILS ARE TYPICAL AND MAY BE CHANGED TO BETTER FIT EXISTING LOCAL CONDITIONS UPON APPROVAL BY THE ENGINEER.

H. ONLY THE CONTRACTOR SHALL BE RESPONSIBLE FOR SAFETY OF ALL WORK. ALL WORK, INCLUDING WORK WITHIN TRENCHES, SHALL BE IN ACCORDANCE WITH THE OCCUPATIONAL SAFETY AND HEALTH ACT (OSHA).

I. REFERENCES MADE TO STANDARD SPECIFICATIONS AND STANDARD DRAWINGS REFER TO THE NEW MEXICO CHAPTER OF THE AMERICAN PUBLIC WORKS ASSOCIATION (APWA–NM) STANDARDS FOR PUBLIC WORKS CONSTRUCTION.

J. THE CONTRACTOR SHALL NOT INSTALL ITEMS AS SHOWN ON THESE PLANS WHEN IT IS OBVIOUS THAT FIELD CONDITIONS ARE DIFFERENT THAN SHOWN IN THE PLANS. SUCH CONDITIONS SHALL BE BROUGHT TO THE ATTENTION OF THE ENGINEER IN A TIMELY MANNER. IN THE EVENT THE CONTRACTOR DOES NOT NOTIFY THE ENGINEER IN A TIMELY MANNER, THE CONTRACTOR ASSUMES FULL RESPONSIBILITY AND EXPENSE FOR ANY REVISIONS NECESSARY, INCLUDING ENGINEERING DESIGN FEES.

K. EXISTING SITE IMPROVEMENTS WHICH ARE DAMAGED OR DISPLACED BY THE CONTRACTOR SHALL BE REMOVED AND REPLACED BY THE CONTRACTOR AT THE CONTRACTOR'S EXPENSE. REPAIRS SHALL BE APPROVED BY THE OWNER PRIOR TO CONSTRUCTION OF THE REPAIRS. REPAIRS SHALL BE ACCEPTED BY THE OWNER PRIOR TO FINAL PAYMENT.

WORK WITHIN ADJACENT RIGHT–OF–WAY

L. PRIOR TO BEGINNING ANY CONSTRUCTION ACTIVITIES WITHIN ADJACENT RIGHT–OF–WAYS OR WITHIN PROPERTY NOT OWNED BY THE OWNER OF THE PROJECT SITE, THE CONTRACTOR SHALL ASSURE THAT ALL PERMITS AND PERMISSIONS REQUIRED HAVE BEEN OBTAINED IN WRITING.

SURVEY MONUMENTS, PROPERTY CORNERS, BENCHMARKS

M. THE CONTRACTOR SHALL NOTIFY THE OWNER AT LEAST SEVEN (7) DAYS BEFORE BEGINNING ANY CONSTRUCTION ACTIVITY THAT COULD DAMAGE OR DISPLACE SURVEY MONUMENTS, PROPERTY CORNERS, OR PROJECT BENCHMARKS SO THESE ITEMS MAY BE RELOCATED.

N. ANY SURVEY MONUMENTS, PROPERTY CORNERS, OR BENCHMARKS THAT ARE NOT IDENTIFIED FOR RELOCATION ARE THE RESPONSIBILITY OF THE CONTRACTOR TO PRESERVE AND PROTECT, RELOCATION OR REPLACEMENT OF THESE ITEMS SHALL BE DONE BY THE OWNER'S SURVEYOR AT THE EXPENSE OF THE CONTRACTOR.

DESIGN SURVEY

O. NO DESIGN SURVEY WAS OBTAINED FOR THIS PROJECT. ANY DISCREPANCIES BETWEEN THE ENGINEER'S DESIGN AND SITE SURFACE CONDITIONS SHALL BE BROUGHT TO THE ENGINEER'S ATTENTION IMMEDIATELY.

PAVEMENT

P. WHEN ABUTTING NEW PAVEMENT TO EXISTING PAVEMENT, CUT EXISTING PAVEMENT EDGE TO A NEAT, STRAIGHT LINE AS NECESSARY TO REMOVE ANY BROKEN OR CRACKED PAVEMENT AND MATCH NEW PAVEMENT ELEVATION TO EXISTING.

Q. ALL UTILITIES AND UTILITY SERVICE LINES SHALL BE INSTALLED AND APPROVED PRIOR TO PAVING.

CONSTRUCTION LIMITS

R. SHALL BE AS SHOWN ON PLANS.

UTILITIES

S. UTILITY LINES, PIPELINES, OR UNDERGROUND UTILITY LINES SHOWN ON THESE DRAWINGS ARE SHOWN IN AN APPROXIMATE LOCATION ONLY BASED ON THE INFORMATION PROVIDED TO THE ENGINEER BY OTHERS. THIS INFORMATION MAY BE INACCURATE OR INCOMPLETE. ADDITIONALLY, UNDERGROUND LINES MAY EXIST THAT ARE NOT SHOWN. THE CONTRACTOR SHALL VERIFY THE LOCATION OF ANY UTILITY LINE, PIPELINE, OR UNDERGROUND UTILITY LINE IN OR NEAR THE AREA OF THE WORK IN ACCORDANCE WITH CHAPTER 62, ARTICLE 14–1, THROUGH 14–8, NMSA 1978.

T. THE CONTRACTOR SHALL CONTACT THE STATEWIDE UTILITY LOCATOR SERVICE AT 811 AT LEAST FIVE WORKING DAYS BEFORE BEGINNING CONSTRUCTION. AFTER THE UTILITIES ARE SPOTTED, THE CONTRACTOR SHALL EXPOSE ALL PERTINENT UTILITIES TO VERIFY THEIR VERTICAL AND HORIZONTAL LOCATION. IF A CONFLICT EXISTS BETWEEN EXISTING UTILITIES AND PROPOSED CONSTRUCTION, THE CONTRACTOR SHALL NOTIFY THE ENGINEER SO THAT THE CONFLICT CAN BE RESOLVED WITH MINIMAL DELAY.

U. THE CONTRACTOR SHALL EXERCISE DUE CARE TO AVOID DISTURBING ANY EXISTING UTILITIES, ABOVE OR BELOW GROUND. UTILITIES THAT ARE DAMAGED BY CARELESS CONSTRUCTION SHALL BE REPAIRED OR REPLACED AT THE CONTRACTOR'S EXPENSE.

V. THE CONTRACTOR SHALL COORDINATE ANY REQUIRED UTILITY INTERRUPTIONS WITH THE OWNER AND AFFECTED UTILITY COMPANY A MINIMUM OF FIVE (5) WORKING DAYS BEFORE THE INTERRUPTION.

W. THE CONTRACTOR SHALL MAINTAIN A RECORD DRAWING SET OF PLANS AND PROMPTLY LOCATE ALL UTILITIES, EXISTING OR NEW, IN THEIR CORRECT LOCATION, HORIZONTAL AND VERTICAL. THIS RECORD SET OF DRAWINGS SHALL BE MAINTAINED ON THE PROJECT SITE AND SHALL BE AVAILABLE TO THE OWNER AND ENGINEER AT ANY TIME DURING CONSTRUCTION. RECORD INFORMATION SHALL INCLUDE HORIZONTAL AND VERTICAL COORDINATE CALLOUTS, LINE SIZES, LINE TYPES, BURIAL DEPTHS, AND ALL OTHER PERTINENT INSTALLATION INFORMATION. IN ADDITION ALL ITEMS THAT ARE INSTALLED EXACTLY AS DESIGNED SHALL BE NOTED AS SUCH.

EROSION CONTROL, ENVIRONMENTAL PROTECTION, AND STORM WATER POLLUTION PREVENTION PLAN

X. THE CONTRACTOR SHALL CONFORM TO ALL CITY OF SANTA FE, STATE OF NEW MEXICO, AND FEDERAL DUST AND EROSION CONTROL REGULATIONS. THE CONTRACTOR SHALL PREPARE AND OBTAIN ANY DUST CONTROL OR EROSION CONTROL PERMITS FROM THE APPROPRIATE REGULATORY AGENCIES.

Y. THE CONTRACTOR SHALL PROMPTLY REMOVE OR STABILIZE ANY MATERIAL EXCAVATED WITHIN THE RIGHT–OF–WAY OR ADJACENT PROPERTY TO KEEP IT FROM WASHING OFF THE PROJECT SITE.

Z. THE CONTRACTOR SHALL ENSURE THAT NO SOIL ERODES FROM THE SITE ONTO ADJACENT PROPERTY BY CONSTRUCTION OF TEMPORARY EROSION CONTROL BERMS OR INSTALLING SILT FENCES AT THE PROPERTY LINES (OR LIMITS OF CONSTRUCTION WHERE DESIGNATED) AND WETTING SOIL TO PREVENT IT FROM BLOWING.

AA. WATERING, AS REQUIRED FOR CONSTRUCTION DUST CONTROL, SHALL BE CONSIDERED INCIDENTAL TO CONSTRUCTION AND NO MEASUREMENT OR PAYMENT SHALL BE MADE. CONSTRUCTION AREAS SHALL BE WATERED FOR DUST CONTROL IN COMPLIANCE WITH CITY, COUNTY AND STATE ORDINANCES. THE CONTRACTOR SHALL BE RESPONSIBLE FOR COORDINATING WITH THE CITY OF SANTA FE FOR AVAILABILITY AND USE OF WATER. THE CONTRACTOR SHALL BE RESPONSIBLE FOR SUPPLYING ALL EQUIPMENT AND MATERIALS NECESSARY FOR OBTAINING, METERING, AND PAYING FOR WATER.

AB. THE CONTRACTOR SHALL PROPERLY HANDLE AND DISPOSE OF ALL ASPHALT AND CONCRETE REMOVED ON THE PROJECT BY HAULING TO AN APPROVED DISPOSAL SITE IN ACCORDANCE WITH THE REQUIREMENTS OF THE CITY OF SANTA FE.

AC. ALL WASTE PRODUCTS FROM THE CONSTRUCTION SITE, INCLUDING ITEMS DESIGNED FOR REMOVAL, CONSTRUCTION WASTE, CONSTRUCTION EQUIPMENT WASTE PRODUCTS (OIL, GAS, TIRES, ETC.), DRILLING MUD AND WATER, GARBAGE, GRUBBING, EXCESS CUT MATERIAL, VEGETATIVE DEBRIS, ETC. SHALL BE APPROPRIATELY DISPOSED OF OFFSITE AT NO ADDITIONAL COST TO THE OWNER. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO OBTAIN ANY PERMITS REQUIRED FOR HAUL OR DISPOSAL OF WASTE PRODUCTS. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO ENSURE THAT THE WASTE DISPOSAL SITE COMPLIES WITH APPROPRIATE REGULATIONS REGARDING THE ENVIRONMENT, ENDANGERED SPECIES, AND ARCHAEOLOGICAL RESOURCES.

AD. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE CLEANUP AND REPORTING OF SPILLS OF HAZARDOUS MATERIALS ASSOCIATED WITH THE CONSTRUCTION SITE. HAZARDOUS MATERIALS INCLUDES GASOLINE, DIESEL FUEL, MOTOR OIL, SOLVENTS, CHEMICALS, PAINT, ETC. WHICH MAY BE A THREAT TO THE ENVIRONMENT. THE CONTRACTOR SHALL REPORT THE DISCOVERY OF PAST OR PRESENT SPILLS TO THE NEW MEXICO HAZARDOUS WASTE BUREAU AT 1–505–476–6000 AND THE ENGINEER.

AE. THE CONTRACTOR SHALL COMPLY WITH ALL APPLICABLE REGULATIONS CONCERNING SURFACE AND UNDERGROUND WATER. CONTACT WITH SURFACE WATER BY CONSTRUCTION EQUIPMENT AND PERSONNEL SHALL BE MINIMIZED. EQUIPMENT MAINTENANCE AND REFUELING OPERATIONS SHALL BE PERFORMED IN AN ENVIRONMENTALLY SAFE MANNER IN COMPLIANCE WITH CITY, COUNTY, STATE, AND EPA REGULATIONS.

AF. THE CONTRACTOR SHALL COMPLY WITH ALL APPLICABLE REGULATIONS CONCERNING CONSTRUCTION NOISE AND HOURS OF OPERATION AS STATED IN THE SPECIFICATIONS OR IMPOSED BY THE OWNER, CITY OR COUNTY AUTHORITIES.

TRAFFIC CONTROL

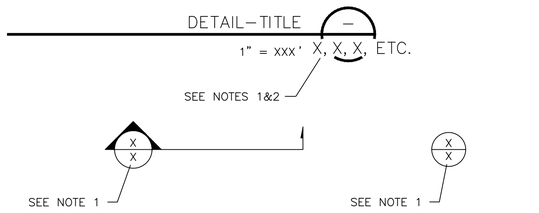
AG. THE CONTRACTOR SHALL PROVIDE ALL REQUIRED TRAFFIC CONTROL PLANS AND TRAFFIC CONTROL EQUIPMENT. ALL SIGNS, BARRICADES, CHANNELIZATION DEVICES, SIGN FRAMES AND ERECTION OF SUCH DEVICES SHALL CONFORM TO THE REQUIREMENTS OF "MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES FOR STREETS AND HIGHWAYS" LATEST EDITION. TRAFFIC CONTROL PLANS SHALL BE APPROVED BY THE COUNTY AND NMDOT PRIOR TO CONSTRUCTION.

MISCELLANEOUS SYMBOLS:

NOTE: SYMBOLS ARE NOT SHOWN TO SCALE ON PLAN OR PROFILE DRAWINGS, AND INDICATE APPROXIMATE LOCATION ONLY.

- EXISTING CHAIN LINK FENCE
- EXISTING ROD IRON FENCE
- PROPOSED CHAIN LINK FENCE
- C — C — C — PROPOSED CONVEYANCE LINE
- E — E — PROPOSED OVERHEAD ELECTRIC
- GAS — NATURAL GAS
- EXISTING POWER POLE
- EXISTING MONITOR WELL
- PROPOSED MONITOR WELL
- PROPOSED SVE RECOVERY WELL
- NATIVE MATERIAL
- FLOWABLE FILL
- CEMENT – BENTONITE GROUT
- SILICA SAND
- BENTONITE PELLET SEAL

LEGEND:



NOTES:

1. IF SECTION, DETAIL, SCHEMATIC, OR DIAGRAM IS DRAWN ON THE SAME SHEET THAT IT IS TAKEN FROM, THE SHEET NUMBER SHALL BE REPLACED WITH A HYPHEN.
2. IF THE SECTION, DETAIL, SCHEMATIC, OR DIAGRAM IS REFERENCED ON MULTIPLE SHEETS, ALL SHEETS SHOULD BE LISTED TO THE OUTSIDE RIGHT OF THE DETAIL–TITLE BUBBLE, AND SEPARATED WITH A COMMA.

ABBREVIATIONS:

ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS
DI	DUCTILE IRON
DIA	DIAMETER
EL	ELBOW
EXIST	EXISTING
FT	FEET
H	HEIGHT
HDPE	HIGH DENSITY POLYETHYLENE
HOR	HORIZONTAL
INV	INVERT ELEVATION
LF	LINEAR FEET
MIN	MINIMUM
N/A	NOT APPLICABLE
NMED	NEW MEXICO ENVIRONMENT DEPARTMENT
NTS	NOT TO SCALE
P/L	PROPERTY LINE
PSI	POUNDS PER SQUARE INCH
PVC	POLY VINYL CHLORIDE
RED	REDUCER
ROW	RIGHT OF WAY
SCH	SCHEDULE
STD	STANDARD
SVE	SOIL VAPOR EXTRACTION
TBD	TO BE DETERMINED
VERT	VERTICAL
W	WIDTH
W/	WITH

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SHAMROCK NO. 63 SITE
SVE SYSTEM INSTALLATION
SANTA FE, NEW MEXICO

GENERAL NOTES AND LEGEND

SHT. 2 OF 8
DWG NO. G-1

JOB NO. BE14.0012

S:\PROJECTS\BE14.0012_SHAMROCK_63\CAD\PRODUCTION\G-1 GENERAL NOTES AND LEGEND.DWG August 20, 2019 – 2:14 PM BY: THOMAS, RYAN



EXPLANATION

- EXISTING MONITOR WELL
- POWER POLE
- PROPOSED SVE RECOVERY WELL
- PROPOSED MONITOR WELL
- PROPOSED SVE CONVEYANCE LINE
- PROPOSED CHAIN LINK FENCE
- EXISTING CHAIN LINK FENCE
- EXISTING ROD IRON FENCE
- PROPOSED BURIED ELECTRIC SERVICE LINE
- PROPOSED NATURAL GAS SERVICE LINE

N

30' 0' 15' 30'

SCALE: 1" = 30'

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SHAMROCK NO. 63 SITE
SVE SYSTEM INSTALLATION
SANTA FE, NEW MEXICO

GENERAL SITE PLAN

SHT. 3 OF 8
DWG NO. G-2

JOB NO.
BE14.0012

S:\PROJECTS\BE14.0012_SHAMROCK_63\CAD\PRODUCTION\G-2 GENERAL SITE PLAN.DWG August 21, 2019 - 2:14 PM BY: SAMSON, JEFFREY



KEY NOTES

1. PROPOSED 2" SCH 40 PVC CONVEYANCE LINE (4,5 / C-2)
2. PROPOSED SVE RECOVERY WELL ACCESS VAULT (1,3 / C-2)
3. PROPOSED MONITOR WELL (2 / C-2)
4. PROPOSED EQUIPMENT COMPOUND (1 / M-2)
5. PROPOSED SVE MANIFOLD (1 / M-3)
6. PROPOSED MODIFIED SHIPPING CONTAINER (1 / M-2)
7. PROPOSED THERMAL OXIDIZER (1 / M-2) (1 / M-3)
8. PROPOSED SVE CONVEYANCE TRENCH (4,6 / C-2)
9. PROPOSED SVE CONVEYANCE TRENCH (4,7 / C-2)

EXPLANATION

- EXISTING MONITOR WELL
- POWER POLE
- PROPOSED SVE RECOVERY WELL
- PROPOSED MONITOR WELL
- C C — PROPOSED SVE CONVEYANCE LINE
- PROPOSED CHAIN LINK FENCE
- EXISTING CHAIN LINK FENCE
- EXISTING ROD IRON FENCE
- E — PROPOSED OVERHEAD ELECTRIC
- GAS — NATURAL GAS

N

20' 0' 10' 20'

SCALE: 1" = 20'

REMEDIATION SYSTEM SITE PLAN (1 / C-1)

1" = 20'

S:\PROJECTS\BE14.0012_SHAMROCK_63\CAD\PRODUCTION\C-1 REMEDIATION SYSTEM SITE PLAN.DWG August 20, 2019 - 2:14 PM BY: SAMSON, JEFFREY

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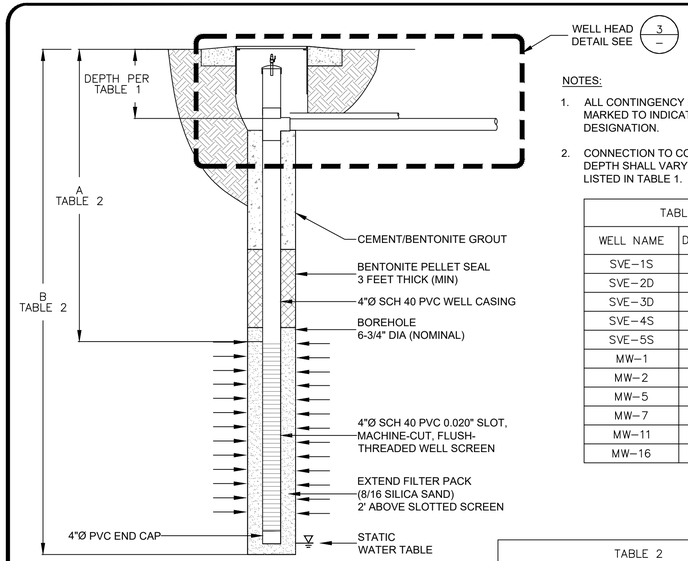
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SHAMROCK NO. 63 SITE
SVE SYSTEM INSTALLATION
SANTA FE, NEW MEXICO

REMEDIATION SYSTEM SITE PLAN

SHT. 4 OF 8
DWG NO. C-1

JOB NO. BE14.0012



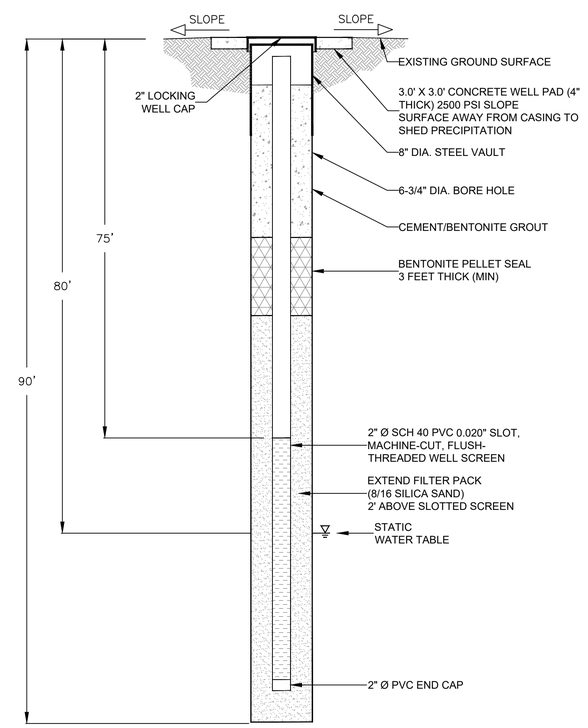
NOTES:

1. ALL CONTINGENCY PIPING SHALL BE MARKED TO INDICATE THE WELL DESIGNATION.
2. CONNECTION TO CONVEYANCE PIPING DEPTH SHALL VARY FOR EACH WELL AS LISTED IN TABLE 1.

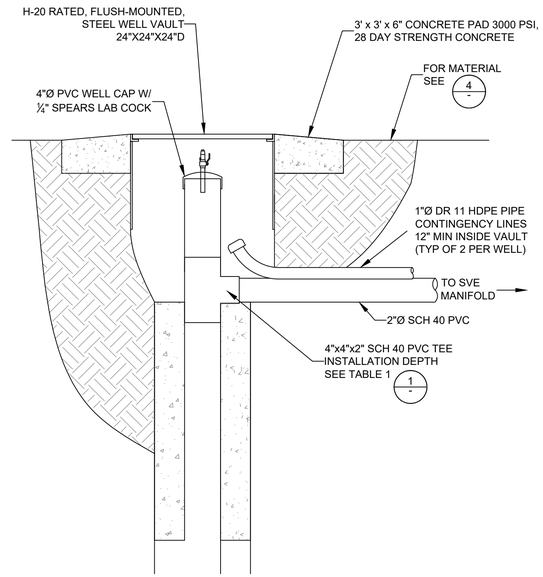
TABLE 1	
WELL NAME	DEPTH (FT BGS)
SVE-1S	3.0
SVE-2D	3.5
SVE-3D	3.0
SVE-4S	3.5
SVE-5S	3.5
MW-1	3.0
MW-2	4.5
MW-5	2.5
MW-7	4.0
MW-11	2.5
MW-16	2.5

TABLE 2		
WELL NAME	A (FT BGS)	B (FT BGS)
SVE-1S	30	50
SVE-2D	45	75
SVE-3D	45	75
SVE-4S	15	30
SVE-5S	15	30

VERTICAL SVE WELL CONSTRUCTION DETAIL 1 — NTS C-1



MONITOR WELL DESIGN 2 — NTS C-1



SVE WELL HEAD DETAIL 3 — TYPE OF 8 — NTS C-1

GENERAL NOTES:

1. NEW VAULTS SHALL BE H-20 TRAFFIC RATED AND BE PROVIDED WITH SPRING ASSISTED HINGES.
2. PLACE 3/4" GRAVEL IN BOTTOM OF VAULT TO THICKNESS OF 3" MIN.
3. IN PAVED AREAS, VAULTS SHALL BE INSTALLED FLUSH WITH EXISTING PAVEMENT.

TRENCH NOTES:

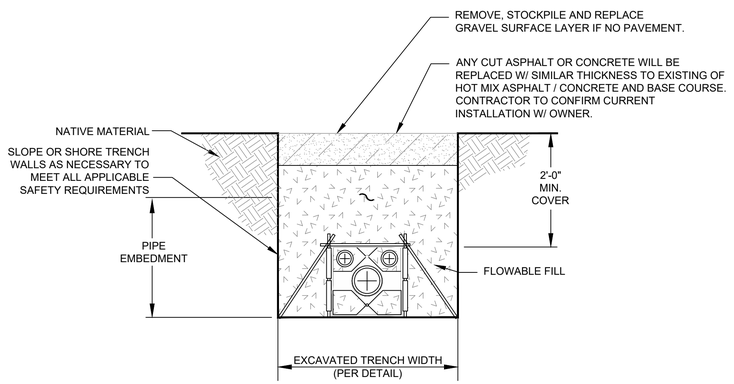
A. TRENCH WIDTH MAY VARY DUE TO NUMBER OF PIPES IN THE TRENCH.

B. PVC PIPE PER SPECIFICATION SECTION 22 05 03.02 AND HDPE PIPE PER SPECIFICATION SECTION 22 05 03.01.

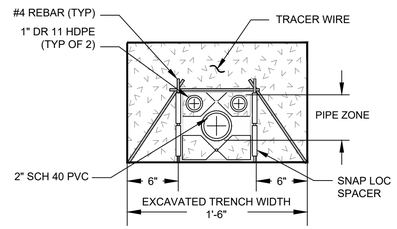
C. PIPES SUPPORTED EVERY 5' LENGTH WITH CHAIRS. CHAIRS SECURED TO THE SUBSURFACE TO PREVENT THE PIPE FROM FLOATING.

D. SECURE PIPES TO PIPE SUPPORT EVERY 10' LENGTH WITH TIE WIRE.

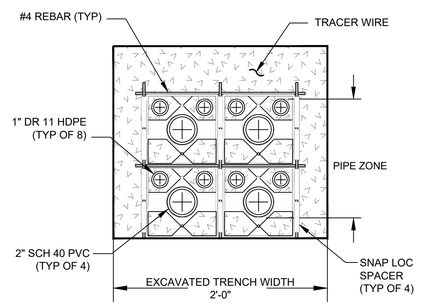
E. FLOWABLE FILL PER SPECIFICATION SECTION 31 23 24.



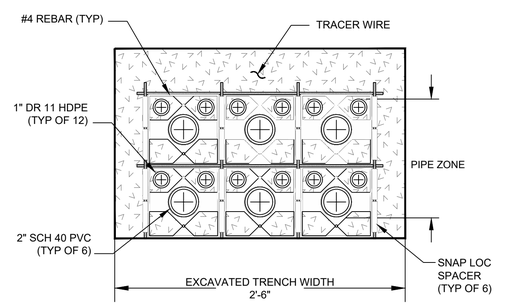
TYPICAL SVE PIPING TRENCH SECTION 4 — NTS C-1



SVE PIPING CONFIGURATION 5 — NTS C-1



SVE PIPING CONFIGURATION 6 — NTS C-1



SVE PIPING CONFIGURATION 7 — NTS C-1

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CHECKED BY: JS
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2905 RODEO PARK DRIVE EAST
SANTA FE, NEW MEXICO 57505

SHAMROCK NO. 63 SITE
SVE SYSTEM INSTALLATION
SANTA FE, NEW MEXICO

CIVIL DETAILS

SHT. 5 OF 8
DWG NO. C-2
JOB NO. BE14.0012

S:\PROJECTS\BE14.0012_SHAMROCK_63\CAD\PRODUCTION\C-2 CIVIL DETAILS.DWG August 21, 2019 - 2:14 PM BY: SAMSON, JEFFREY

B-1

SVE BLOWER
PROVIDED BY INTELLISHARE
SUTORBILT 4007
POSITIVE DISPLACEMENT BLOWER
250 SCFM @ 70" H2O VACUUM
SEALED BEARINGS, VARIABLE DRIVE
10 HP 480 VAC/3 PH/60 HZ

T-1

THERMAL OXIDIZER
W/ CATALYTIC OPTION
PROVIDED BY INTELLISHARE
250 SCFM
650-1750 DEGREES F
MAX 25% LEL

P-1

CONDENSATE TRANSFER PUMP
PROVIDED BY INTELLISHARE
AMT MODEL 368C-95
10 GPM, 80 TDH
1/2 HP 230 VAC/3 PH/60 HZ

S-1

VAPOR/LIQUID SEPARATOR
PROVIDED BY INTELLISHARE
100 GALLON NOMINAL, 50
GALLON LIQUID HOLDING
CAPACITY

C-1

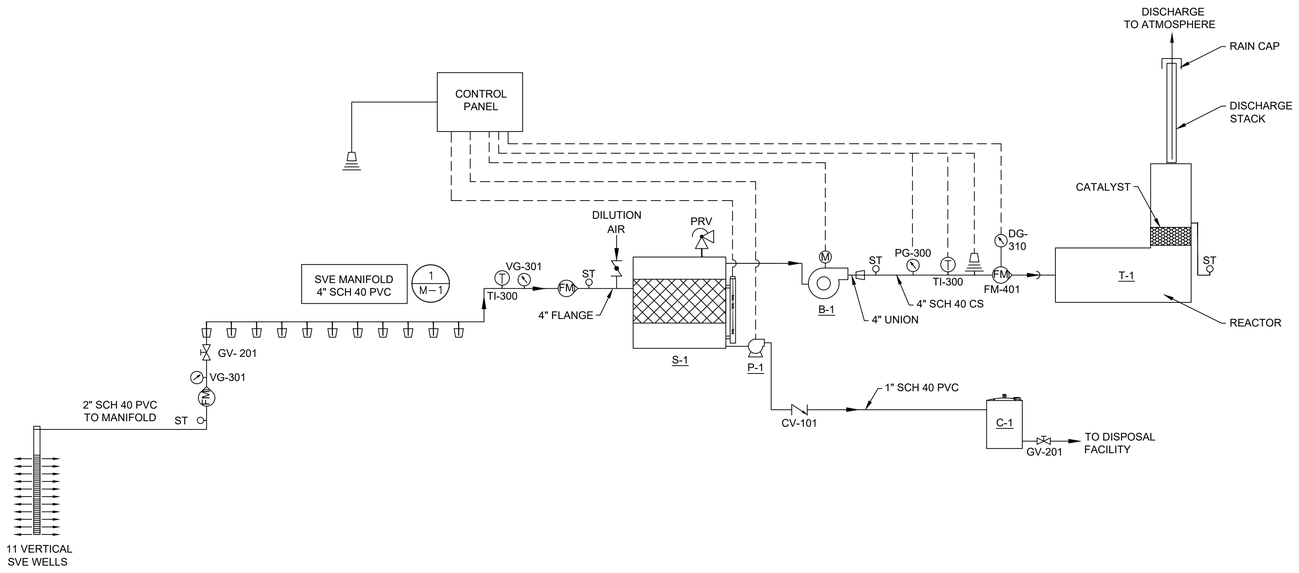
CONDENSATE STORAGE TANK
200 GALLON POLYETHYLENE
30" DIA, 70-1/2" HIGH

ABBREVIATION KEY

BFV	BUTTERFLY VALVE
BV	BALL VALVE
CS	CARBON STEEL
CV	CHECK VALVE
DG	DIFFERENTIAL PRESSURE GAUGE
DIA	DIAMETER
F	FARENHEIT
FM	FLOW METER
GPM	GALLONS PER MINUTE
GV	GATE VALVE
H2O	WATER
HP	HORSEPOWER
HZ	HERTZ
LEL	LOWER EXPLOSIVE LIMIT
M	MOTOR
NG	NATURAL GAS
PG	PRESSURE GAUGE
PH	PHASE
PRV	PRESSURE RELIEF VALVE
PSIG	POUNDS PER SQUARE INCH
PVC	POLYVINYL CHLORIDE
SCFM	STANDARD CUBIC FEET PER MINUTE
SCH.	SCHEDULE
SVE	SOIL VAPOR EXTRACTION
ST	SAMPLE TAP
TI	TEMPERATURE INDICATOR
VG	VACUUM GAUGE
VAC	VOLTS ALTERNATING CURRENT

SYMBOL LEGEND

- BALL VALVE
- BUTTERFLY VALVE
- CHECK VALVE
- ELECTRICAL
- FM — FLOW METER
- GATE VALVE
- LEL SENSOR
- M — MOTOR
- PRESSURE RELIEF VALVE
- PRESSURE/VACUUM GAUGE
- REDUCING FITTING
- SAMPLE TAP
- SYSTEM FLOW DIRECTION
- T — TEMPERATURE GAUGE



GENERAL NOTES:

1. VALVE AND GAUGE IDENTIFIER REFERS TO SCHEDULE IN ASSOCIATED TECHNICAL SPECIFICATION.
2. CONTRACTOR TO INSTALL AND MAKE ALL CONNECTIONS FOR A FULLY FUNCTIONING SYSTEM.

PROCESS AND INSTRUMENTATION DIAGRAM 2
NTS -

S:\PROJECTS\BE14.0012_SHAMROCK_63\CAD\PRODUCTION\M-1 M-2 M-3.DWG August 20, 2019 - 2:14 PM BY: SAMSON, JEFFREY

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SANTA FE, NEW MEXICO

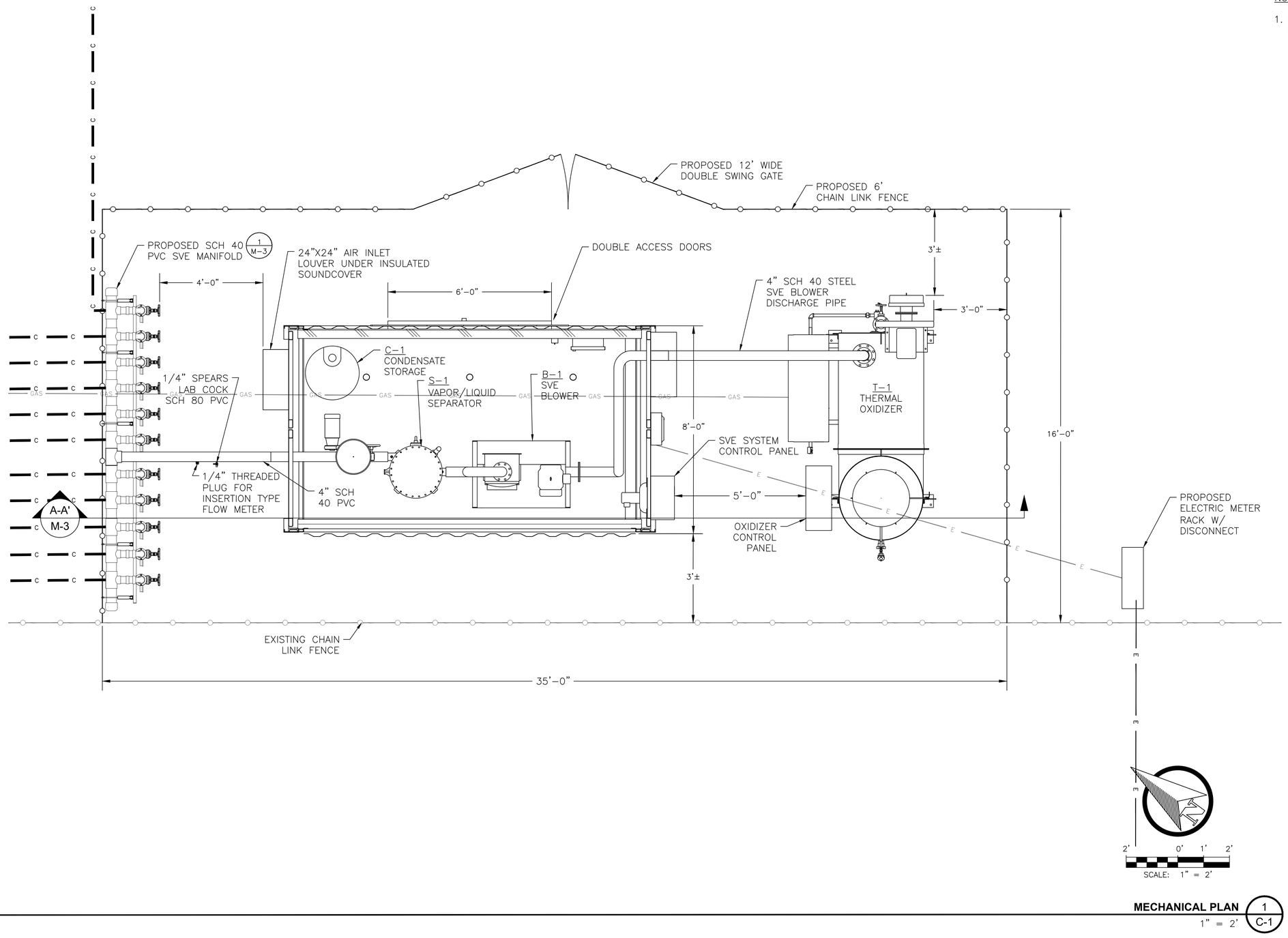
PROCESS AND INSTRUMENTATION DIAGRAM

SHT. 6 OF 8
DWG NO. M-1

JOB NO. BE14.0012

NOTES:

1. PROPOSED CHAIN LINK FENCE TO MATCH THE EXISTING FENCE.



MECHANICAL PLAN (1 / C-1)

1" = 2'

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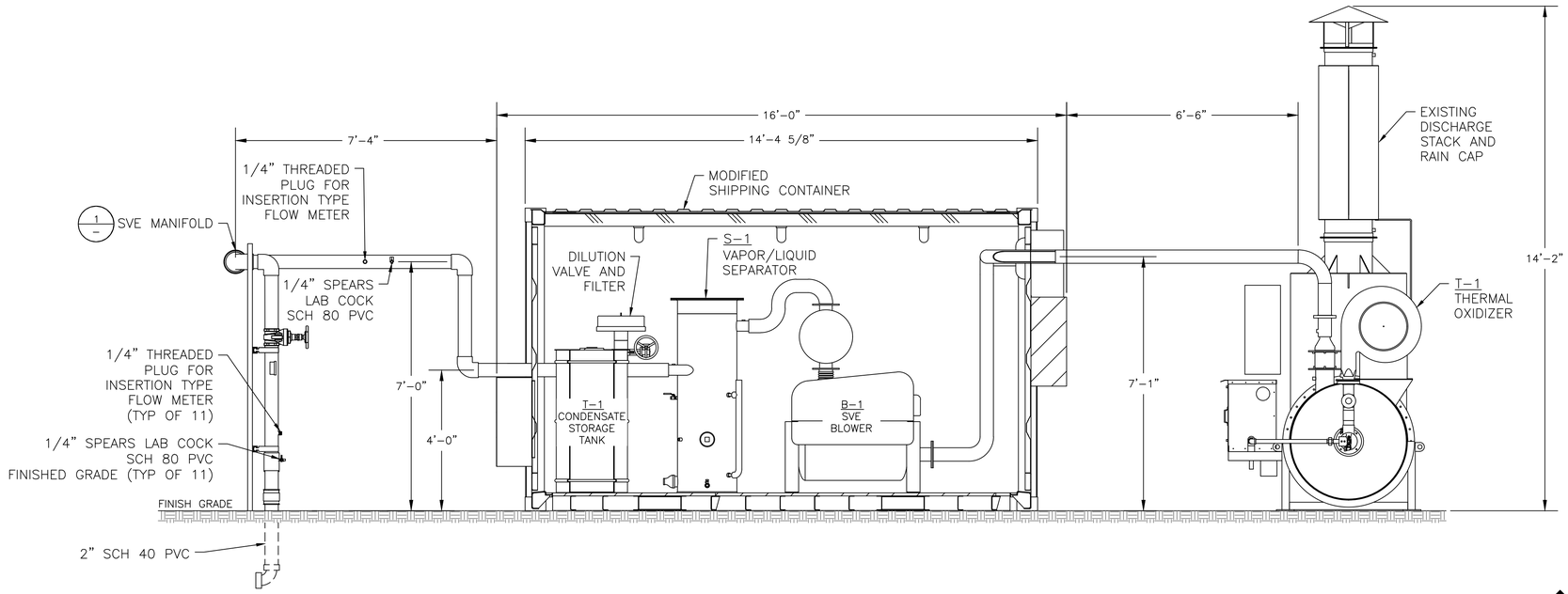
SHAMROCK NO. 63 SITE
SVE SYSTEM INSTALLATION
SANTA FE, NEW MEXICO

MECHANICAL PLAN

SHT. 7 OF 8
DWG NO. M-2

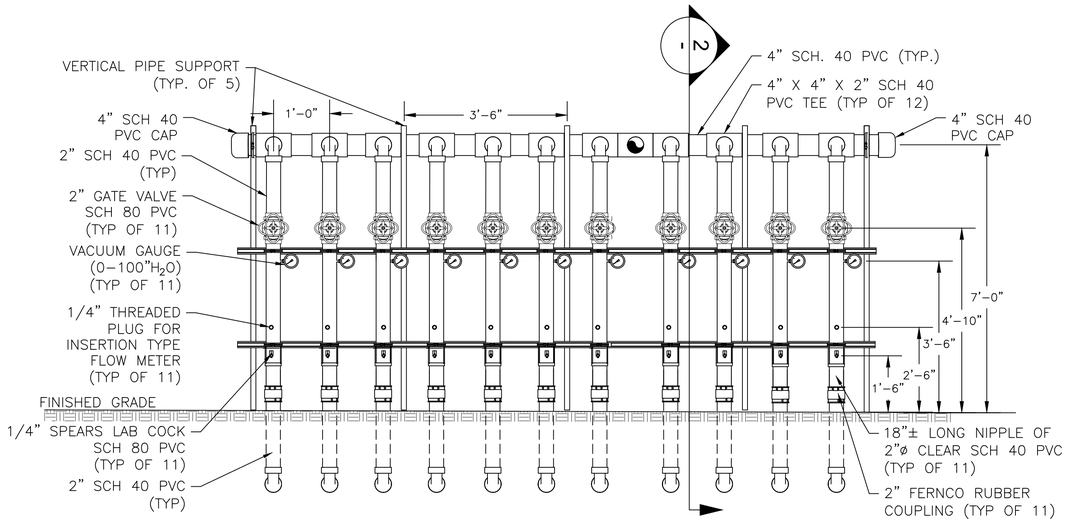
JOB NO. BE14.0012

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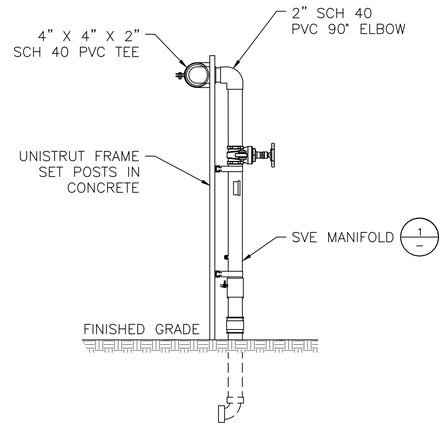
SVE EQUIPMENT ELEVATION A-A' (M-2)

NTS



SVE MANIFOLD 1 / M-2

NTS



PIPE SUPPORT DETAIL 2 / -

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SVE SYSTEM INSTALLATION
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ELEVATION AND MECHANICAL DETAILS

SHT. 8 OF 8
DWG NO. M-3

JOB NO. BE14.0012

Appendix B

Calculations

Calculation Cover Sheet

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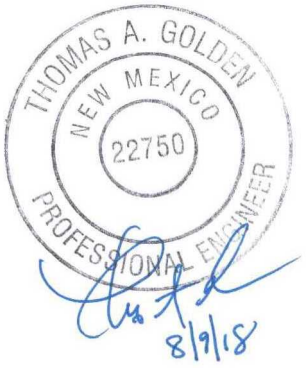
Project Name Shamrock #63 SVE System Project Number DB18.1174.PR

Calculation Number DB18.1174-001 Discipline Engineering No. of Sheets 6

PROJECT: Shamrock #63 SVE System

SITE: Shamrock 63, Santa Fe, New Mexico

SUBJECT: Determination of LNAPL volumes, effluent emission rates, and expected removal time of LNAPL with soil vapor extraction remediation



SOURCES OF DATA:
A. GIS map document F11_Tech Approach.mxd
B. AcuVac SVE Pilot Test Report, October 2017
C. Rotameter Flow Measurement, January 29, 2010

SOURCES OF FORMULAE & REFERENCES:
1. How To Effectively Recover Free Product At Leaking Underground Storage Tank Sites: A Guide For State Regulators (EPA 510-R-96-001), September 1996
2. Remediation Technologies for Soils and Groundwater – Bahandari et al, March 2007
3. A practical approach to the design, operation and monitoring of in-situ soil venting systems, Ground Water Monitoring Review, Spring Issue, 1990, p. 159-177
4. Selecting the Appropriate Abatement Technology, Kroopnick, Dr. Peter M., November 1998

☐ Preliminary Calculation ☒ Final Calculation Supersedes Calculation No. _____

Rev. No.	Revision	Calculation By	Date	Checked By	Date	Approved By	Date
0	Proposal	TG/TH	07/30/2018	JC	08/09/2018	TG	08/09/2018

1.0 OBJECTIVES

1. Determine the volume of light non-aqueous phase liquid (LNAPL) present at the site.
2. Calculate the expected LNAPL removal time at the site.

2.0 GIVEN

Soil vapor concentrations and the extent and measured thickness of LNAPL from the October 2017 SVE pilot test completed by AcuVac[B]. Based on the SVE pilot test completed by AcuVac[B], design flow rate of 60 standard cubic feet per minute (scfm) from extraction wells in the vicinity of the LNAPL plume.

3.0 METHOD

Theissen polygons are used to estimate spatially varying quantities. Perpendicular bisectors to lines connecting locations where the quantity of interest (here, LNAPL thickness) is known are drawn. The perpendicular bisectors and their intersections with each other and the LNAPL boundary define polygons, each with one known value of LNAPL thickness, that are used to estimate the extent of each know value. ArcGIS is used to generate initial Theissen polygons which were manually refined to eliminate polygons that exist outside the extent of the plume.

EPA document 510-R-96-001, *How To Effectively Recover Free Product At Leaking Underground Storage Tank Sites: A Guide For State Regulators*[1], presents seven methods for estimating product thickness in a subsurface formation. These methods are based on a variety of material properties, including fluid densities, surface tension, displacement pressure, and coefficients, such as the "formation factor". The equations and definitions for the methods are presented together in Appendix 1, as well as in the spreadsheet PSH_calcs.xls. The thickness at each well is estimated with each method presented. After the thickness is estimated, a volume of product for each polygon can be determined by multiplying the median or average product thickness by the areal extent of the corresponding Theissen polygon[A] and the soil porosity. For this analysis, it will be assumed that 60% of the available LNAPL volume is recoverable, which is slightly more aggressive than standard industry practice[2]. It will also be assumed that the maximum daily LNAPL removal rate is governed by the concept that 100 liters of vapor is required to remove one gram of LNAPL[3].

To calculate the time needed to remove the recoverable LNAPL, first determine the expected initial influent concentration of TPH by converting the field measurements for TPH determined in parts per million by volume (ppmv) to mass concentrations. Use the calculated volume of LNAPL to estimate a total mass of contaminant that requires removal. Kroopnick[4] states that the concentration of organic vapors observed historically at soil vapor extraction sites decreases exponentially with time and can be described by the formula:

$$C_t = C_0 \, e^{(-RF*t)} \qquad \text{[eqn. 1]}$$

Where: C_t = vapor concentration of a contaminant at time, t
C_0 = initial vapor contaminant concentration
RF = removal factor

This behavior can be modeled to estimate a time for LNAPL removal. For each simulated day of system operation, the estimated initial mass of recoverable LNAPL is reduced by the LNAPL removed on the previous day. At the same time, the initial concentration is reduced according to equation 1. The removal factor, RF, is then adjusted by trial and error (or using the Excel Solver utility) to force the vapor concentration and mass of LNAPL remaining to simultaneously approach zero.

4.0 SOLUTION

Calculate an estimated LNAPL thickness for each polygon using the seven methods presented in EPA document 510-R-96-001. The results of this analysis are presented below for the polygon based on well MW-6; results for all polygons are given in PSH_calcs.xls attached at the end of this calculation.

Table 1: Summary of product thickness estimation methods for MW-6

Method	Thickness (ft)
Method of de Pastrovich (1979)	0.40
Method of Hall, et. al. (1984)	0.79
Method of Blake and Hall (1984)	0.30
Method of Ballestero et. al. (1994)	0.30
Method of Schiegg (1985)	-1.42
Method of Farr et. al. (1990)	0.33
Method of Lenhard and Parker (1990)	0.32

Only positive estimated values of LNAPL thickness will be considered valid. Compute the median LNAPL thickness for all positive values:

$H_{f,Median}$ = MEDIAN(0.40, 0.79, 0.30, 0.30, 0.33, 0.32) = 0.33 feet

Use GIS software to determine the areal extent of LNAPL[A]:

$A_{Polygon}$ = 2,800 ft^2

Calculate the estimated volume of LNAPL within the polygon using the LNAPL thickness, polygon area, and assumed soil porosity, ϕ, of 30%.

$V_{LNAPL} = H_f * A_{Polygon} * \phi$ = 0.33 ft * 2,800 ft^2 * 0.30 * 7.481 gal/ft^3 ≈ 2,046 gal

Calculate the recoverable volume of LNAPL:

$V_{rec} = V_{LNAPL} * 0.60 = 2{,}046 \text{ gal} * 0.60 = 1{,}227 \text{ gal}$

Table 2: Summary of median product thickness, LNAPL Volume, and recoverable LNAPL

Well	Median Effective Thickness (ft)	Median LNAPL Volume (gallons)	Median Recoverable LNAPL (gallons)
MW-6	0.33	2,046	1,227
MW-9	0.18	1,313	788
MW-10	0.57	3,097	1,858
	Total	**6,455**	**3,873**

The sample calculations given below are for the flow from wells SVE-2D and SVE-3D, which will be located in the vicinity of the LNAPL plume.

Assume the total standard well flow is 60 ft^3/min based on the expected total length of open well screen. Convert standard flow to actual flow assuming standard temperature is 520 R, standard pressure is 14.696 psia, and actual atmospheric pressure is 11.34 psia[C]. An applied well vacuum of 50 inches water column (1.80 psi) is also factored into the actual pressure. Actual temperature for the three 8-hour pilot tests is given in AcuVac[A] as approximately 60 °F. Convert actual temperature to standard units:

° R = °F + 459.69 = 60 + 459.69 = 520 °R

Calculate actual well flow[C]:

$$ACFM = SCFM * \left(\frac{T_{act}°}{T_{std}°}\right)\left(\frac{P_{std}}{P_{act}}\right) = \left(\frac{520°R}{520°R}\right)\left(\frac{14.696\,psia}{11.34\,psia - 1.80}\right) \approx 90\,cfm$$

The following calculations utilize a well flow of 90 ft^3/min (acfm).

Compute the volume of air that passes through the system per day:

V_{air} = 90 ft^3/min * 60 min/hr * 24 hr/day = 129,600 ft^3/day

Compute the maximum mass of contaminant removed per day based on assumptions stated above:

R_{max} = (129,600 ft^3/day) * (100 L / 3.534 ft^3) * (1 gr / 100 L) = 36,677 gr/day

R_{max} = (36,677 gr/day) * (0.002205 lb/gr) = **R_{max} = 81 lb/day**

Convert field measurements for TPH from ppmv to mass concentrations using the average value over the eight hour pilot test, C_{ppmv}, of 80,894 ppmv:

$C_0 = C_{ppmv} * \rho_{air} * (MW_{fuel} / MW_{air})$

C_0 = (80,894 / 1E6) * (1.184 g/L) * (1E6 µg/g) * (103 g/mol / 29 g/mol) = **C_0 = 340,179 µg/L**

Assume this is the initial vapor concentration of TPH, C_0.

Based on the method described by Kroopnick[4], model SVE system performance (see Cleanup time estimation.xls). Convert the calculated volume of recoverable LNAPL into a mass assuming a specific gravity for LNAPL of 0.75:

$M_{rec} = \gamma_{LNAPL} * V_{rec}$ = (62.4 lb/ft^3 * 0.75) * (ft^3 / 7.481 gal) * (3,873 gal) = 24,399 lb

Two time steps are calculated below using computed values for the maximum vapor extraction flow rate, 90 ft^3/min (acfm), initial vapor concentration, 340,179 µg/L, and maximum daily removal based on the vapor extraction flow rate, 81 lb/day.

After one day, the total mass of LNAPL remaining will be reduced by the maximum daily removal:

M_{rem}(1 day) = $M_{rec} - R_{max}$ = 24,399 lb – 81 lb = 24,319 lb

After one day, the vapor concentration will be reduced according to equation 1 (note that the removal factor for this equation has already been set):

$C_1 = C_0 e^{(-RF*1)}$ = (340,179 µg/L) * e (-0.146368 * 1) = 335,236 µg/L

Subsequent time steps can be treated similarly; however, after some time, the vapor concentration will not be sufficient for the maximum mass to be removed and R_{max} will not apply. Thus for each time step, the removal rate must be calculated. Consider the time step at 300 days – the removal rate can be calculated based on the vapor concentration and flow rate at that time step:

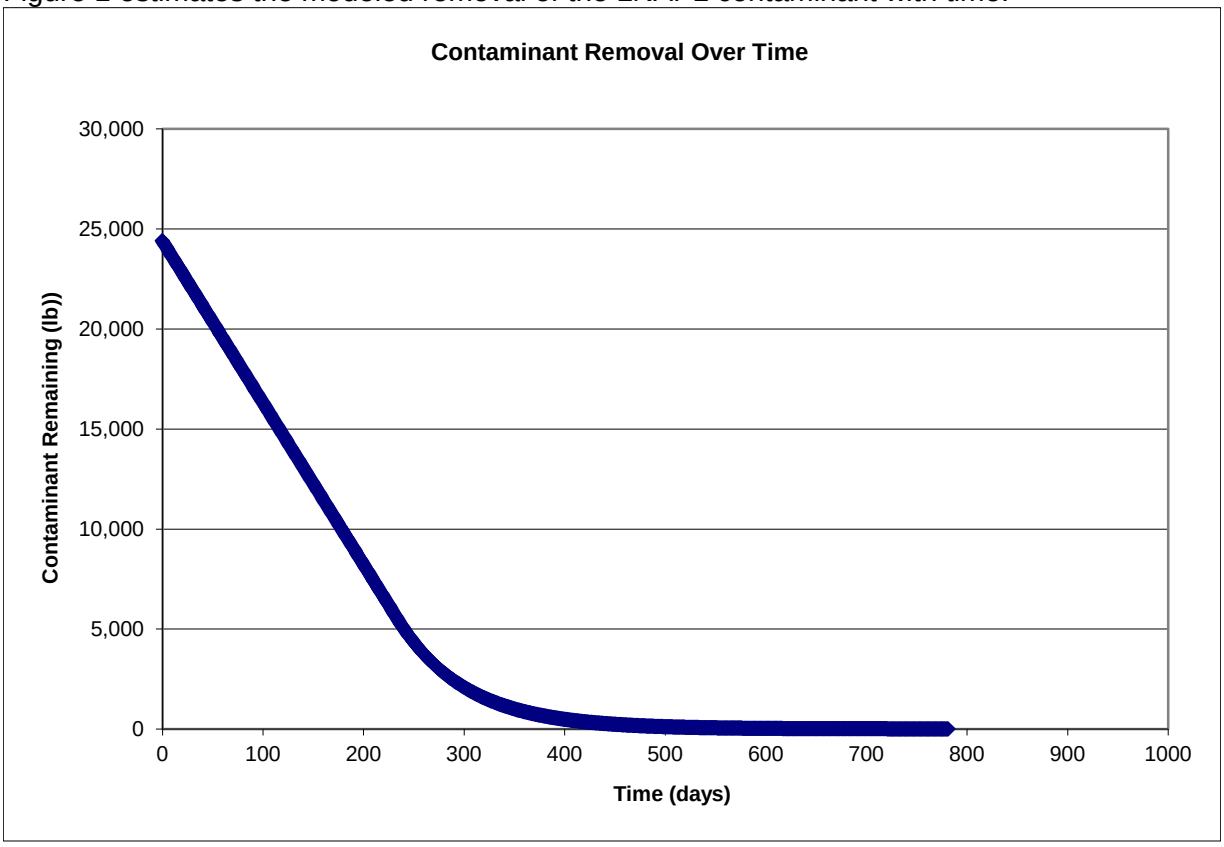
$R_{300} = C_{400} * V_{air}$
R_{300} = (4,214 µg/L) * (28.3 L/ft^3) * (90 ft^3/min) * (lb / 453,592,370 µg) * (1,440 min/day)
R_{300} = 30 lb/day

The mass remaining at the next time step (301 days) will be equal to the mass remaining at the current time step minus the removal rate at the current time step (400 days):

$M_{301} = M_{300} - R_{300}$ = 2,084 lb – 30 lb = 2,054 lb

Using a spreadsheet (Cleanup time estimate.xls) these values can be calculated and the removal factor, RF, can be determined by adjusting the value until both the LNAPL mass remaining and the vapor concentration simultaneously approach zero. For this system, RF is determined to be 0.146368.

Figure 1 estimates the modeled removal of the LNAPL contaminant with time:



This figure illustrates how the mass of contaminant remaining asymptotically approaches zero. Therefore, use 2-log removal as an estimation of the total cleanup time. For this system, the amount of LNAPL mass remaining is less than 1% of the initial mass (24,399 lb * .01 = 244 lb) after 446 days or approximately **1.2 years**.

While all calculations presented above are based on industry standard practice, it should be noted that these are theoretical removal rates based an assumed linear rate of removal (i.e. doubling the well flow doubles the concentration received), and that actual SVE removal is a non-linear process.

Table 2. Summary of measured product thickness, estimated product thickness, NAPL Volume, and recoverable NAPL

			Calculated from EPA document		
Well	Area	Measured NAPL well thickness[A]	Median NAPL formation thickness	Median NAPL volume	Recoverable NAPL volume
	ft^2	ft	ft	gal	gal
MW-6	2,800	1.2	0.33	2,046	1,227
MW-9	3,200	0.7	0.18	1,313	788
MW-10	2,400	2.2	0.57	3,097	1,858
Totals	8,400			6,455	3,873

Values Used in Calculations	
Assumed porosity	30%
Conversion from CF to gal	7.481
Assumed recoverable NAPL	60%

Notes

A. Measured NAPL = thickness in the well casing (2017)

Time (days)	Contaminant Remaining (pounds)	Maximum SVE Flowrate (acfm)	SVE Vapor Concentration (µg/L)	Daily Removal (lbs/day)
0	24,399	80	340,179	81
1	24,319	80	335,236	81
2	24,238	80	330,365	81
3	24,157	80	325,565	81
4	24,076	80	320,834	81
5	23,995	80	316,172	81
6	23,914	80	311,578	81
7	23,833	80	307,051	81
8	23,753	80	302,590	81
9	23,672	80	298,193	81
10	23,591	80	293,860	81
11	23,510	80	289,590	81
12	23,429	80	285,382	81
13	23,348	80	281,236	81
14	23,267	80	277,149	81
15	23,186	80	273,122	81
16	23,106	80	269,154	81
17	23,025	80	265,243	81
18	22,944	80	261,389	81
19	22,863	80	257,591	81
20	22,782	80	253,848	81
21	22,701	80	250,160	81
22	22,620	80	246,525	81
23	22,540	80	242,943	81
24	22,459	80	239,413	81
25	22,378	80	235,934	81
26	22,297	80	232,506	81
27	22,216	80	229,128	81
28	22,135	80	225,798	81
29	22,054	80	222,517	81
30	21,974	80	219,284	81
31	21,893	80	216,098	81
32	21,812	80	212,958	81
33	21,731	80	209,864	81
34	21,650	80	206,814	81
35	21,569	80	203,809	81
36	21,488	80	200,848	81
37	21,408	80	197,930	81
38	21,327	80	195,054	81
39	21,246	80	192,219	81
40	21,165	80	189,427	81
41	21,084	80	186,674	81
42	21,003	80	183,962	81
43	20,922	80	181,289	81
44	20,842	80	178,655	81
45	20,761	80	176,059	81
46	20,680	80	173,501	81
47	20,599	80	170,980	81
48	20,518	80	168,495	81
49	20,437	80	166,047	81
50	20,356	80	163,634	81
51	20,276	80	161,257	81
52	20,195	80	158,914	81
53	20,114	80	156,604	81
54	20,033	80	154,329	81
55	19,952	80	152,087	81
56	19,871	80	149,877	81
57	19,790	80	147,699	81
58	19,710	80	145,553	81
59	19,629	80	143,438	81
60	19,548	80	141,354	81
61	19,467	80	139,300	81
62	19,386	80	137,276	81
63	19,305	80	135,281	81
64	19,224	80	133,316	81
65	19,144	80	131,378	81
66	19,063	80	129,470	81
67	18,982	80	127,588	81
68	18,901	80	125,734	81
69	18,820	80	123,907	81
70	18,739	80	122,107	81

Time (days)	Contaminant Remaining (pounds)	Maximum SVE Flowrate (acfm)	SVE Vapor Concentration (µg/L)	Daily Removal (lbs/day)
71	18,658	80	120,333	81
72	18,578	80	118,584	81
73	18,497	80	116,861	81
74	18,416	80	115,163	81
75	18,335	80	113,490	81
76	18,254	80	111,841	81
77	18,173	80	110,216	81
78	18,092	80	108,614	81
79	18,012	80	107,036	81
80	17,931	80	105,481	81
81	17,850	80	103,948	81
82	17,769	80	102,438	81
83	17,688	80	100,950	81
84	17,607	80	99,483	81
85	17,526	80	98,037	81
86	17,446	80	96,613	81
87	17,365	80	95,209	81
88	17,284	80	93,826	81
89	17,203	80	92,462	81
90	17,122	80	91,119	81
91	17,041	80	89,795	81
92	16,960	80	88,490	81
93	16,880	80	87,204	81
94	16,799	80	85,937	81
95	16,718	80	84,688	81
96	16,637	80	83,458	81
97	16,556	80	82,245	81
98	16,475	80	81,050	81
99	16,394	80	79,873	81
100	16,314	80	78,712	81
101	16,233	80	77,568	81
102	16,152	80	76,441	81
103	16,071	80	75,331	81
104	15,990	80	74,236	81
105	15,909	80	73,157	81
106	15,828	80	72,094	81
107	15,748	80	71,047	81
108	15,667	80	70,014	81
109	15,586	80	68,997	81
110	15,505	80	67,995	81
111	15,424	80	67,007	81
112	15,343	80	66,033	81
113	15,262	80	65,074	81
114	15,182	80	64,128	81
115	15,101	80	63,196	81
116	15,020	80	62,278	81
117	14,939	80	61,373	81
118	14,858	80	60,481	81
119	14,777	80	59,602	81
120	14,696	80	58,736	81
121	14,615	80	57,883	81
122	14,535	80	57,042	81
123	14,454	80	56,213	81
124	14,373	80	55,396	81
125	14,292	80	54,591	81
126	14,211	80	53,798	81
127	14,130	80	53,017	81
128	14,049	80	52,246	81
129	13,969	80	51,487	81
130	13,888	80	50,739	81
131	13,807	80	50,002	81
132	13,726	80	49,275	81
133	13,645	80	48,559	81
134	13,564	80	47,854	81
135	13,483	80	47,158	81
136	13,403	80	46,473	81
137	13,322	80	45,798	81
138	13,241	80	45,132	81
139	13,160	80	44,477	81
140	13,079	80	43,830	81
141	12,998	80	43,193	81
142	12,917	80	42,566	81

Time (days)	Contaminant Remaining (pounds)	Maximum SVE Flowrate (acfm)	SVE Vapor Concentration (µg/L)	Daily Removal (lbs/day)
143	12,837	80	41,947	81
144	12,756	80	41,338	81
145	12,675	80	40,737	81
146	12,594	80	40,145	81
147	12,513	80	39,562	81
148	12,432	80	38,987	81
149	12,351	80	38,421	81
150	12,271	80	37,862	81
151	12,190	80	37,312	81
152	12,109	80	36,770	81
153	12,028	80	36,236	81
154	11,947	80	35,709	81
155	11,866	80	35,190	81
156	11,785	80	34,679	81
157	11,705	80	34,175	81
158	11,624	80	33,679	81
159	11,543	80	33,189	81
160	11,462	80	32,707	81
161	11,381	80	32,232	81
162	11,300	80	31,763	81
163	11,219	80	31,302	81
164	11,139	80	30,847	81
165	11,058	80	30,399	81
166	10,977	80	29,957	81
167	10,896	80	29,522	81
168	10,815	80	29,093	81
169	10,734	80	28,670	81
170	10,653	80	28,254	81
171	10,573	80	27,843	81
172	10,492	80	27,439	81
173	10,411	80	27,040	81
174	10,330	80	26,647	81
175	10,249	80	26,260	81
176	10,168	80	25,878	81
177	10,087	80	25,502	81
178	10,007	80	25,132	81
179	9,926	80	24,767	81
180	9,845	80	24,407	81
181	9,764	80	24,052	81
182	9,683	80	23,703	81
183	9,602	80	23,358	81
184	9,521	80	23,019	81
185	9,441	80	22,684	81
186	9,360	80	22,355	81
187	9,279	80	22,030	81
188	9,198	80	21,710	81
189	9,117	80	21,394	81
190	9,036	80	21,083	81
191	8,955	80	20,777	81
192	8,875	80	20,475	81
193	8,794	80	20,178	81
194	8,713	80	19,885	81
195	8,632	80	19,596	81
196	8,551	80	19,311	81
197	8,470	80	19,030	81
198	8,389	80	18,754	81
199	8,309	80	18,481	81
200	8,228	80	18,213	81
201	8,147	80	17,948	81
202	8,066	80	17,687	81
203	7,985	80	17,430	81
204	7,904	80	17,177	81
205	7,823	80	16,927	81
206	7,743	80	16,681	81
207	7,662	80	16,439	81
208	7,581	80	16,200	81
209	7,500	80	15,965	81
210	7,419	80	15,733	81
211	7,338	80	15,504	81
212	7,257	80	15,279	81
213	7,177	80	15,057	81
214	7,096	80	14,838	81

Time (days)	Contaminant Remaining (pounds)	Maximum SVE Flowrate (acfm)	SVE Vapor Concentration (µg/L)	Daily Removal (lbs/day)
215	7,015	80	14,623	81
216	6,934	80	14,410	81
217	6,853	80	14,201	81
218	6,772	80	13,994	81
219	6,691	80	13,791	81
220	6,611	80	13,591	81
221	6,530	80	13,393	81
222	6,449	80	13,199	81
223	6,368	80	13,007	81
224	6,287	80	12,818	81
225	6,206	80	12,632	81
226	6,125	80	12,448	81
227	6,044	80	12,267	81
228	5,964	80	12,089	81
229	5,883	80	11,913	81
230	5,802	80	11,740	81
231	5,721	80	11,570	81
232	5,640	80	11,401	81
233	5,559	80	11,236	81
234	5,479	80	11,073	80
235	5,399	80	10,912	78
236	5,320	80	10,753	77
237	5,243	80	10,597	76
238	5,167	80	10,443	75
239	5,092	80	10,291	74
240	5,018	80	10,142	73
241	4,945	80	9,994	72
242	4,873	80	9,849	71
243	4,802	80	9,706	70
244	4,732	80	9,565	69
245	4,664	80	9,426	68
246	4,596	80	9,289	67
247	4,529	80	9,154	66
248	4,463	80	9,021	65
249	4,398	80	8,890	64
250	4,334	80	8,761	63
251	4,271	80	8,633	62
252	4,209	80	8,508	61
253	4,148	80	8,384	60
254	4,088	80	8,263	59
255	4,028	80	8,143	59
256	3,970	80	8,024	58
257	3,912	80	7,908	57
258	3,855	80	7,793	56
259	3,799	80	7,679	55
260	3,744	80	7,568	54
261	3,689	80	7,458	54
262	3,636	80	7,350	53
263	3,583	80	7,243	52
264	3,531	80	7,138	51
265	3,480	80	7,034	51
266	3,429	80	6,932	50
267	3,379	80	6,831	49
268	3,330	80	6,732	48
269	3,282	80	6,634	48
270	3,234	80	6,537	47
271	3,187	80	6,442	46
272	3,141	80	6,349	46
273	3,095	80	6,257	45
274	3,050	80	6,166	44
275	3,006	80	6,076	44
276	2,962	80	5,988	43
277	2,919	80	5,901	42
278	2,876	80	5,815	42
279	2,835	80	5,731	41
280	2,793	80	5,647	41
281	2,753	80	5,565	40
282	2,713	80	5,484	39
283	2,673	80	5,405	39
284	2,634	80	5,326	38
285	2,596	80	5,249	38
286	2,558	80	5,173	37

Time (days)	Contaminant Remaining (pounds)	Maximum SVE Flowrate (acfm)	SVE Vapor Concentration (µg/L)	Daily Removal (lbs/day)
287	2,521	80	5,097	37
288	2,484	80	5,023	36
289	2,448	80	4,950	36
290	2,413	80	4,878	35
291	2,378	80	4,807	35
292	2,343	80	4,738	34
293	2,309	80	4,669	34
294	2,275	80	4,601	33
295	2,242	80	4,534	33
296	2,210	80	4,468	32
297	2,178	80	4,403	32
298	2,146	80	4,339	31
299	2,115	80	4,276	31
300	2,084	80	4,214	30
301	2,054	80	4,153	30
302	2,024	80	4,093	29
303	1,994	80	4,033	29
304	1,965	80	3,974	29
305	1,937	80	3,917	28
306	1,909	80	3,860	28
307	1,881	80	3,804	27
308	1,853	80	3,748	27
309	1,827	80	3,694	27
310	1,800	80	3,640	26
311	1,774	80	3,587	26
312	1,748	80	3,535	25
313	1,723	80	3,484	25
314	1,697	80	3,433	25
315	1,673	80	3,383	24
316	1,648	80	3,334	24
317	1,624	80	3,286	24
318	1,601	80	3,238	23
319	1,578	80	3,191	23
320	1,555	80	3,145	23
321	1,532	80	3,099	22
322	1,510	80	3,054	22
323	1,488	80	3,010	22
324	1,466	80	2,966	21
325	1,445	80	2,923	21
326	1,424	80	2,880	21
327	1,403	80	2,838	20
328	1,383	80	2,797	20
329	1,363	80	2,757	20
330	1,343	80	2,716	20
331	1,323	80	2,677	19
332	1,304	80	2,638	19
333	1,285	80	2,600	19
334	1,266	80	2,562	18
335	1,248	80	2,525	18
336	1,230	80	2,488	18
337	1,212	80	2,452	18
338	1,194	80	2,416	17
339	1,177	80	2,381	17
340	1,160	80	2,347	17
341	1,143	80	2,313	17
342	1,126	80	2,279	16
343	1,110	80	2,246	16
344	1,094	80	2,213	16
345	1,078	80	2,181	16
346	1,062	80	2,149	15
347	1,047	80	2,118	15
348	1,031	80	2,087	15
349	1,016	80	2,057	15
350	1,001	80	2,027	15
351	987	80	1,998	14
352	973	80	1,969	14
353	958	80	1,940	14
354	944	80	1,912	14
355	931	80	1,884	14
356	917	80	1,857	13
357	904	80	1,830	13
358	891	80	1,803	13

Time (days)	Contaminant Remaining (pounds)	Maximum SVE Flowrate (acfm)	SVE Vapor Concentration (µg/L)	Daily Removal (lbs/day)
359	878	80	1,777	13
360	865	80	1,751	13
361	852	80	1,726	12
362	840	80	1,701	12
363	828	80	1,676	12
364	816	80	1,652	12
365	804	80	1,628	12
366	792	80	1,604	12
367	780	80	1,581	11
368	769	80	1,558	11
369	758	80	1,535	11
370	747	80	1,513	11
371	736	80	1,491	11
372	725	80	1,469	11
373	715	80	1,448	10
374	704	80	1,427	10
375	694	80	1,406	10
376	684	80	1,385	10
377	674	80	1,365	10
378	664	80	1,346	10
379	654	80	1,326	10
380	645	80	1,307	9
381	636	80	1,288	9
382	626	80	1,269	9
383	617	80	1,251	9
384	608	80	1,232	9
385	599	80	1,214	9
386	591	80	1,197	9
387	582	80	1,179	8
388	573	80	1,162	8
389	565	80	1,145	8
390	557	80	1,129	8
391	549	80	1,112	8
392	541	80	1,096	8
393	533	80	1,080	8
394	525	80	1,065	8
395	517	80	1,049	8
396	510	80	1,034	7
397	502	80	1,019	7
398	495	80	1,004	7
399	488	80	989	7
400	481	80	975	7
401	474	80	961	7
402	467	80	947	7
403	460	80	933	7
404	453	80	920	7
405	447	80	906	7
406	440	80	893	6
407	434	80	880	6
408	427	80	867	6
409	421	80	855	6
410	415	80	842	6
411	409	80	830	6
412	403	80	818	6
413	397	80	806	6
414	391	80	794	6
415	386	80	783	6
416	380	80	771	6
417	374	80	760	5
418	369	80	749	5
419	364	80	738	5
420	358	80	728	5
421	353	80	717	5
422	348	80	707	5
423	343	80	696	5
424	338	80	686	5
425	333	80	676	5
426	328	80	666	5
427	323	80	657	5
428	319	80	647	5
429	314	80	638	5
430	309	80	629	5

Time (days)	Contaminant Remaining (pounds)	Maximum SVE Flowrate (acfm)	SVE Vapor Concentration (µg/L)	Daily Removal (lbs/day)
431	305	80	619	4
432	300	80	610	4
433	296	80	602	4
434	292	80	593	4
435	287	80	584	4
436	283	80	576	4
437	279	80	567	4
438	275	80	559	4
439	271	80	551	4
440	267	80	543	4
441	263	80	535	4
442	259	80	527	4
443	255	80	520	4
444	252	80	512	4
445	248	80	505	4
446	244	80	497	4
447	241	80	490	4
448	237	80	483	3
449	234	80	476	3
450	230	80	469	3
451	227	80	462	3
452	224	80	456	3
453	220	80	449	3
454	217	80	442	3
455	214	80	436	3
456	211	80	430	3
457	208	80	423	3
458	205	80	417	3
459	202	80	411	3
460	199	80	405	3
461	196	80	399	3
462	193	80	393	3
463	190	80	388	3
464	187	80	382	3
465	185	80	377	3
466	182	80	371	3
467	179	80	366	3
468	177	80	360	3
469	174	80	355	3
470	171	80	350	3
471	169	80	345	2
472	166	80	340	2
473	164	80	335	2
474	162	80	330	2
475	159	80	325	2
476	157	80	321	2
477	155	80	316	2
478	152	80	311	2
479	150	80	307	2
480	148	80	302	2
481	146	80	298	2
482	144	80	294	2
483	141	80	289	2
484	139	80	285	2
485	137	80	281	2
486	135	80	277	2
487	133	80	273	2
488	131	80	269	2
489	129	80	265	2
490	127	80	261	2
491	126	80	257	2
492	124	80	254	2
493	122	80	250	2
494	120	80	246	2
495	118	80	243	2
496	117	80	239	2
497	115	80	236	2
498	113	80	232	2
499	111	80	229	2
500	110	80	226	2
501	108	80	222	2
502	107	80	219	2

Time (days)	Contaminant Remaining (pounds)	Maximum SVE Flowrate (acfm)	SVE Vapor Concentration (µg/L)	Daily Removal (lbs/day)
503	105	80	216	2
504	103	80	213	2
505	102	80	210	2
506	100	80	207	1
507	99	80	204	1
508	98	80	201	1
509	96	80	198	1
510	95	80	195	1
511	93	80	192	1
512	92	80	189	1
513	90	80	187	1
514	89	80	184	1
515	88	80	181	1
516	87	80	179	1
517	85	80	176	1
518	84	80	173	1
519	83	80	171	1
520	82	80	168	1
521	80	80	166	1
522	79	80	164	1
523	78	80	161	1
524	77	80	159	1
525	76	80	156	1
526	74	80	154	1
527	73	80	152	1
528	72	80	150	1
529	71	80	148	1
530	70	80	145	1
531	69	80	143	1
532	68	80	141	1
533	67	80	139	1
534	66	80	137	1
535	65	80	135	1
536	64	80	133	1
537	63	80	131	1
538	62	80	129	1
539	61	80	127	1
540	60	80	126	1
541	59	80	124	1
542	59	80	122	1
543	58	80	120	1
544	57	80	118	1
545	56	80	117	1
546	55	80	115	1
547	54	80	113	1
548	53	80	112	1
549	53	80	110	1
550	52	80	109	1
551	51	80	107	1
552	50	80	105	1
553	50	80	104	1
554	49	80	102	1
555	48	80	101	1
556	47	80	99	1
557	47	80	98	1
558	46	80	97	1
559	45	80	95	1
560	45	80	94	1
561	44	80	92	1
562	43	80	91	1
563	43	80	90	1
564	42	80	88	1
565	41	80	87	1
566	41	80	86	1
567	40	80	85	1
568	39	80	83	1
569	39	80	82	1
570	38	80	81	1
571	38	80	80	1
572	37	80	79	1
573	37	80	78	1
574	36	80	76	1

Time (days)	Contaminant Remaining (pounds)	Maximum SVE Flowrate (acfm)	SVE Vapor Concentration (µg/L)	Daily Removal (lbs/day)
575	35	80	75	1
576	35	80	74	1
577	34	80	73	1
578	34	80	72	1
579	33	80	71	1
580	33	80	70	1
581	32	80	69	0
582	32	80	68	0
583	31	80	67	0
584	31	80	66	0
585	30	80	65	0
586	30	80	64	0
587	29	80	63	0
588	29	80	62	0
589	29	80	61	0
590	28	80	60	0
591	28	80	60	0
592	27	80	59	0
593	27	80	58	0
594	26	80	57	0
595	26	80	56	0
596	26	80	55	0
597	25	80	55	0
598	25	80	54	0
599	24	80	53	0
600	24	80	52	0
601	24	80	51	0
602	23	80	51	0
603	23	80	50	0
604	23	80	49	0
605	22	80	49	0
606	22	80	48	0
607	21	80	47	0
608	21	80	46	0
609	21	80	46	0
610	20	80	45	0
611	20	80	44	0
612	20	80	44	0
613	20	80	43	0
614	19	80	43	0
615	19	80	42	0
616	19	80	41	0
617	18	80	41	0
618	18	80	40	0
619	18	80	40	0
620	17	80	39	0
621	17	80	38	0
622	17	80	38	0
623	17	80	37	0
624	16	80	37	0
625	16	80	36	0
626	16	80	36	0
627	16	80	35	0
628	15	80	35	0
629	15	80	34	0
630	15	80	34	0
631	15	80	33	0
632	14	80	33	0
633	14	80	32	0
634	14	80	32	0
635	14	80	31	0
636	13	80	31	0
637	13	80	30	0
638	13	80	30	0
639	13	80	29	0
640	13	80	29	0
641	12	80	29	0
642	12	80	28	0
643	12	80	28	0
644	12	80	27	0
645	12	80	27	0
646	11	80	27	0

Time (days)	Contaminant Remaining (pounds)	Maximum SVE Flowrate (acfm)	SVE Vapor Concentration (µg/L)	Daily Removal (lbs/day)
647	11	80	26	0
648	11	80	26	0
649	11	80	25	0
650	11	80	25	0
651	10	80	25	0
652	10	80	24	0
653	10	80	24	0
654	10	80	24	0
655	10	80	23	0
656	10	80	23	0
657	9	80	23	0
658	9	80	22	0
659	9	80	22	0
660	9	80	22	0
661	9	80	21	0
662	9	80	21	0
663	8	80	21	0
664	8	80	20	0
665	8	80	20	0
666	8	80	20	0
667	8	80	20	0
668	8	80	19	0
669	8	80	19	0
670	7	80	19	0
671	7	80	18	0
672	7	80	18	0
673	7	80	18	0
674	7	80	18	0
675	7	80	17	0
676	7	80	17	0
677	7	80	17	0
678	6	80	17	0
679	6	80	16	0
680	6	80	16	0
681	6	80	16	0
682	6	80	16	0
683	6	80	15	0
684	6	80	15	0
685	6	80	15	0
686	6	80	15	0
687	5	80	15	0
688	5	80	14	0
689	5	80	14	0
690	5	80	14	0
691	5	80	14	0
692	5	80	14	0
693	5	80	13	0
694	5	80	13	0
695	5	80	13	0
696	5	80	13	0
697	4	80	13	0
698	4	80	12	0
699	4	80	12	0
700	4	80	12	0
701	4	80	12	0
702	4	80	12	0
703	4	80	12	0
704	4	80	11	0
705	4	80	11	0
706	4	80	11	0
707	4	80	11	0
708	3	80	11	0
709	3	80	11	0
710	3	80	10	0
711	3	80	10	0
712	3	80	10	0
713	3	80	10	0
714	3	80	10	0
715	3	80	10	0
716	3	80	10	0
717	3	80	9	0
718	3	80	9	0

Time (days)	Contaminant Remaining (pounds)	Maximum SVE Flowrate (acfm)	SVE Vapor Concentration (µg/L)	Daily Removal (lbs/day)
719	3	80	9	0
720	3	80	9	0
721	3	80	9	0
722	3	80	9	0
723	2	80	9	0
724	2	80	9	0
725	2	80	8	0
726	2	80	8	0
727	2	80	8	0
728	2	80	8	0
729	2	80	8	0
730	2	80	8	0
731	2	80	8	0
732	2	80	8	0
733	2	80	7	0
734	2	80	7	0
735	2	80	7	0
736	2	80	7	0
737	2	80	7	0
738	2	80	7	0
739	2	80	7	0
740	2	80	7	0
741	1	80	7	0
742	1	80	7	0
743	1	80	6	0
744	1	80	6	0
745	1	80	6	0
746	1	80	6	0
747	1	80	6	0
748	1	80	6	0
749	1	80	6	0
750	1	80	6	0
751	1	80	6	0
752	1	80	6	0
753	1	80	6	0
754	1	80	5	0
755	1	80	5	0
756	1	80	5	0
757	1	80	5	0
758	1	80	5	0
759	1	80	5	0
760	1	80	5	0
761	1	80	5	0
762	1	80	5	0
763	1	80	5	0
764	1	80	5	0
765	0	80	5	0
766	0	80	5	0
767	0	80	5	0
768	0	80	4	0
769	0	80	4	0
770	0	80	4	0
771	0	80	4	0
772	0	80	4	0
773	0	80	4	0
774	0	80	4	0
775	0	80	4	0
776	0	80	4	0
777	0	80	4	0
778	0	80	4	0
779	0	80	4	0
780	0	80	4	0
781	0	80	4	0

Calculations by Well from EPA Guidance

MW-6

2.25		β_{ao}	air-oil scaling factor
1.80		β_{ow}	oil-water scaling factor
0.019		D	function of interfluid displacement pressure and hydrostatics
0.25	g/cm^3	$\Delta\rho$	density difference between water and hydrocarbon (ρ_w-ρ_o)
12.5	cm (fine sand)	F	formation factor
980	cm/s^2	g	acceleration of gravity
0	cm	h_a	distance from the water table to bottom of mobile hydrocarbon
40	cm (fine sand)	$h_{c,dr}$	average water capillary height under drainage conditions
36.576	cm	H_o	hydrocarbon thickness measured in the well
6.51	cm H2O	P^{ow}_d	water-hydrocarbon displacement pressure
5.21	cm H2O	P^{ao}_d	air-hydrocarbon displacement pressure
1.00	g/cm^3	ρ_w	density of water
0.75	g/cm^3	ρ_o	density of hydrocarbon liquid
0.300		ϕ	soil porosity
72	dynes/cm	σ_{aw}	surface tension of water
32	dynes/cm	σ_{ao}	surface tension of hydrocarbon
40	dynes/cm	σ_{ow}	hydrocarbon-water interfacial tension
0.091		S_r	residual saturation
27.4	cm	x	distance from the water table to interface between free product and groundwater in the well -- x is equal to the product of the thickness of the hydrocarbon and the hydrocarbon density

Explanation:

	Value from EPA 510-R-96-001 Appendix
	Value from field approximations
	Calculated value

THICKNESS CALCULATIONS FOR MW-6

From How to Effectively Recover Free Product At Leaking Underground Storage Tank Sites:
A Guide for State Regulators. (EPA 510-R-96-001). September 1996.

0.41	Average of the 6 methods with positive thicknesses (ft)
0.33	Median of the 6 methods with positive thicknesses (ft)
0.30	Min of the 6 methods with positive thicknesses (ft)
0.79	Max of the 6 methods with positive thicknesses (ft)

Method of de Pastrovich (1979)

$$H_f = \frac{H_0(\rho_w - \rho_o)}{\rho_o}$$

H_f = 12.19 cm in formation
0.40 ft in formation

Method of Hall, et. al. (1984)

$$H_f = H_0 - F$$

H_f = 24.08 cm in formation
0.79 ft in formation

Method of Blake and Hall (1984)

$$H_f = H_o - (x + h_a)$$

H_f = 9.144 cm in formation
0.3 ft in formation

Method of Ballestero et. al. (1994)

$$H_f = ((1 - \rho_o) \bullet H_0) - h_a$$

H_f = 9.144 cm in formation
0.3 ft in formation

Method of Schiegg (1985)

$$H_f = H_0 - 2(h_{c,dr})$$

H_f = -43.42 cm in formation
-1.42 ft in formation

Method of Farr et. al. (1990)

$$H_f = \emptyset(1 - S_r)D\left[\frac{H_0}{D} - 1\right]$$

$$D = \frac{P_d^{ow}}{\Delta\rho g} - \frac{P_d^{ao}}{\rho_o g}$$

D = 0.019
H_f = 9.97 cm in formation
0.33 ft in formation

Method of Lenhard and Parker (1990)

$$H_f = \left[\frac{\rho_0\beta_{ao}H_0}{\rho_0\beta_{ao} - \beta_{ow}(1 - \rho_0}\right] - h_{c,dr}$$

$$\beta_{ao} = \frac{\sigma_{aw}}{\sigma_{ao}} \qquad \beta_{ow} = \frac{\sigma_{aw}}{\sigma_{ow}}$$

β_{ao} = 2.25
β_{ow} = 1.8
H_f = 9.88 cm in formation
0.32 ft in formation

MW-9

2.25		β_{ao}	air-oil scaling factor
1.80		β_{ow}	oil-water scaling factor
0.019		D	function of interfluid displacement pressure and hydrostatics
0.25	g/cm^3	$\Delta\rho$	density difference between water and hydrocarbon (ρ_w-ρ_o)
7.5	cm (med sand)	F	formation factor
980	cm/s^2	g	acceleration of gravity
0	cm	h_a	distance from the water table to bottom of mobile hydrocarbon
25	cm (med sand)	$h_{c,dr}$	average water capillary height under drainage conditions
21.336	cm	H_o	hydrocarbon thickness measured in the well
6.51	cm H2O	P^{ow}_d	water-hydrocarbon displacement pressure
5.21	cm H2O	P^{ao}_d	air-hydrocarbon displacement pressure
1.00	g/cm^3	ρ_w	density of water
0.75	g/cm^3	ρ_o	density of hydrocarbon liquid
0.300		ϕ	soil porosity
72	dynes/cm	σ_{aw}	surface tension of water
32	dynes/cm	σ_{ao}	surface tension of hydrocarbon
40	dynes/cm	σ_{ow}	hydrocarbon-water interfacial tension
0.091		S_r	residual saturation
16.0	cm	x	distance from the water table to interface between free product and groundwater in the well -- x is equal to the product of the thickness of the hydrocarbon and the hydrocarbon density

Explanation:

- Value from EPA 510-R-96-001 Appendix
- Value from field approximations
- Calculated value

THICKNESS CALCULATIONS FOR MW-9

From How to Effectively Recover Free Product At Leaking Underground Storage Tank Sites: A Guide for State Regulators. (EPA 510-R-96-001). September 1996.

0.23	Average of the 6 methods with positive thicknesses (ft)
0.18	Median of the 6 methods with positive thicknesses (ft)
0.13	Min of the 6 methods with positive thicknesses (ft)
0.45	Max of the 6 methods with positive thicknesses (ft)

Method of de Pastrovich (1979)

$$H_f = \frac{H_0(\rho_w - \rho_o)}{\rho_o}$$

H_f = 7.11 cm in formation
0.23 ft in formation

Method of Hall, et. al. (1984)

$$H_f = H_0 - F$$

H_f = 13.84 cm in formation
0.454 ft in formation

Method of Blake and Hall (1984)

$$H_f = H_o - (x + h_a)$$

H_f = 5.334 cm in formation
0.175 ft in formation

Method of Ballestero et. al. (1994)

$$H_f = ((1 - \rho_o) \bullet H_0) - h_a$$

H_f = 5.334 cm in formation
0.175 ft in formation

Method of Schiegg (1985)

$$H_f = H_0 - 2(h_{c,dr})$$

H_f = -28.66 cm in formation
-0.94 ft in formation

Method of Farr et. al. (1990)

$$H_f = \emptyset(1 - S_r)D\left[\frac{H_0}{D} - 1\right]$$

$$D = \frac{P_d^{ow}}{\Delta\rho g} - \frac{P_d^{ao}}{\rho_o g}$$

D = 0.019
H_f = 5.81 cm in formation
0.19 ft in formation

Method of Lenhard and Parker (1990)

$$H_f = \left[\frac{\rho_0\beta_{ao}H_0}{\rho_0\beta_{ao} - \beta_{ow}(1 - \rho_0}\right] - h_{c,dr}$$

$$\beta_{ao} = \frac{\sigma_{aw}}{\sigma_{ao}} \qquad \beta_{ow} = \frac{\sigma_{aw}}{\sigma_{ow}}$$

β_{ao} = 2.25
β_{ow} = 1.8
H_f = 4.09 cm in formation
0.13 ft in formation

MW-10

2.25		β_{ao}	air-oil scaling factor
1.80		β_{ow}	oil-water scaling factor
0.019		D	function of interfluid displacement pressure and hydrostatics
0.25	g/cm^3	$\Delta\rho$	density difference between water and hydrocarbon (ρ_w-ρ_o)
12.5	cm (fine sand)	F	formation factor
980	cm/s^2	g	acceleration of gravity
0	cm	h_a	distance from the water table to bottom of mobile hydrocarbon
75	cm (fine sand)	$h_{c,dr}$	average water capillary height under drainage conditions
67.056	cm	H_o	hydrocarbon thickness measured in the well
6.51	cm H2O	$P^{ow}{}_d$	water-hydrocarbon displacement pressure
5.21	cm H2O	$P^{ao}{}_d$	air-hydrocarbon displacement pressure
1.00	g/cm^3	ρ_w	density of water
0.75	g/cm^3	ρ_o	density of hydrocarbon liquid
0.300		ϕ	soil porosity
72	dynes/cm	σ_{aw}	surface tension of water
32	dynes/cm	σ_{ao}	surface tension of hydrocarbon
40	dynes/cm	σ_{ow}	hydrocarbon-water interfacial tension
0.091		S_r	residual saturation
50.3	cm	x	distance from the water table to interface between free product and groundwater in the well -- x is equal to the product of the thickness of the hydrocarbon and the hydrocarbon density

Explanation:

- Value from EPA 510-R-96-001 Appendix
- Value from field approximations
- Calculated value

THICKNESS CALCULATIONS FOR MW-10

From How to Effectively Recover Free Product At Leaking Underground Storage Tank Sites: A Guide for State Regulators. (EPA 510-R-96-001). September 1996.

0.79	Average of the 6 methods with positive thicknesses (ft)
0.57	Median of the 6 methods with positive thicknesses (ft)
0.54	Min of the 6 methods with positive thicknesses (ft)
1.79	Max of the 6 methods with positive thicknesses (ft)

Method of de Pastrovich (1979)

$$H_f = \frac{H_0(\rho_w - \rho_o)}{\rho_o}$$

H_f = 22.35 cm in formation
0.73 ft in formation

Method of Hall, et. al. (1984)

$$H_f = H_0 - F$$

H_f = 54.56 cm in formation
1.79 ft in formation

Method of Blake and Hall (1984)

$$H_f = H_o - (x + h_a)$$

H_f = 16.76 cm in formation
0.55 ft in formation

Method of Ballestero et. al. (1994)

$$H_f = ((1 - \rho_o) \bullet H_0) - h_a$$

H_f = 16.76 cm in formation
0.55 ft in formation

Method of Schiegg (1985)

$$H_f = H_0 - 2(h_{c,dr})$$

H_f = -82.94 cm in formation
-2.72 ft in formation

Method of Farr et. al. (1990)

$$H_f = \emptyset(1 - S_r)D\left[\frac{H_0}{D} - 1\right]$$

$$D = \frac{P_d^{ow}}{\Delta\rho g} - \frac{P_d^{ao}}{\rho_o g}$$

D = 0.019
H_f = 18.28 cm in formation
0.60 ft in formation

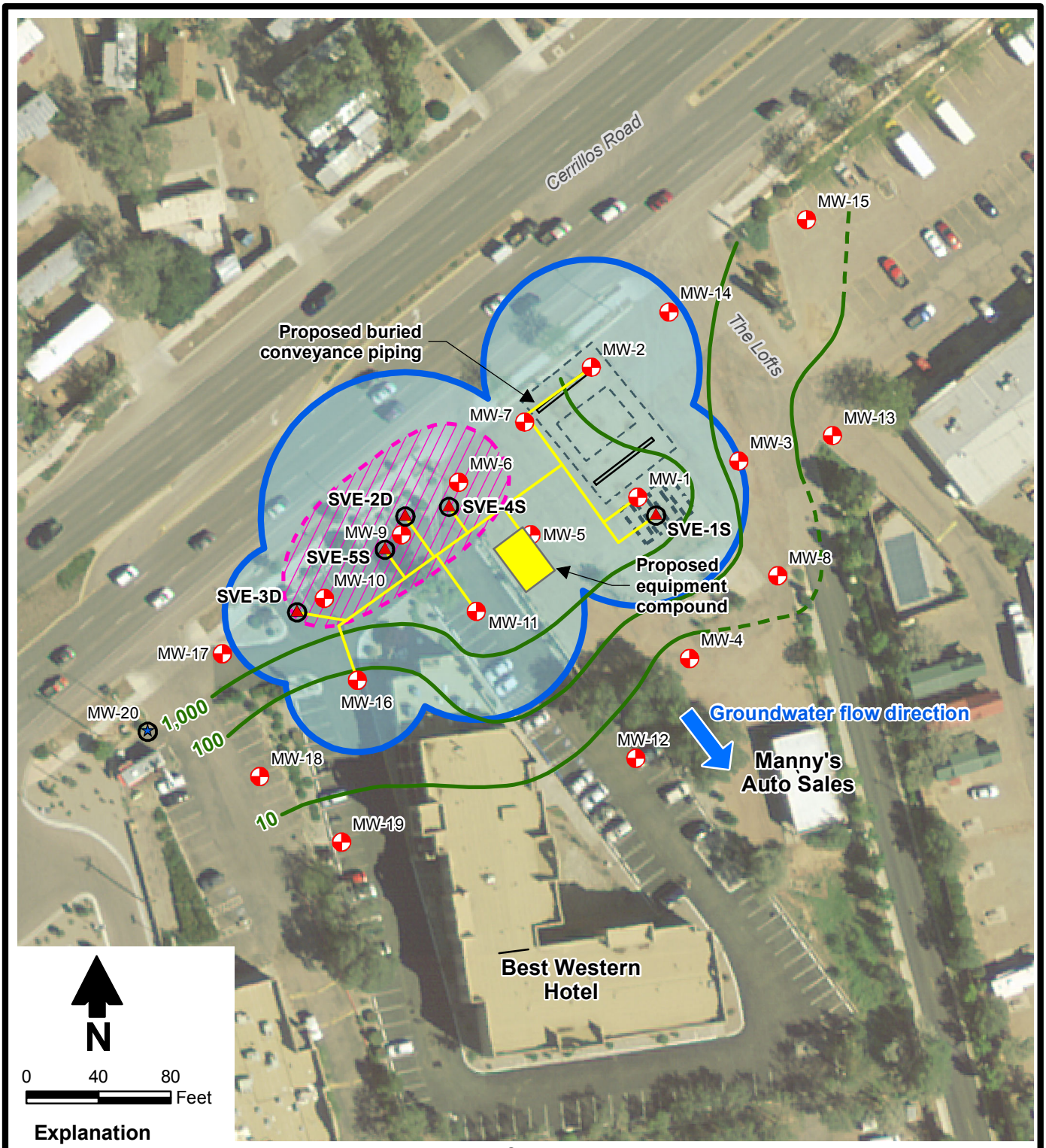
Method of Lenhard and Parker (1990)

$$H_f = \left[\frac{\rho_0\beta_{ao}H_0}{\rho_0\beta_{ao} - \beta_{ow}(1 - \rho_0}\right] - h_{c,dr}$$

$$\beta_{ao} = \frac{\sigma_{aw}}{\sigma_{ao}} \qquad \beta_{ow} = \frac{\sigma_{aw}}{\sigma_{ow}}$$

β_{ao} = 2.25
β_{ow} = 1.8
H_f = 16.44 cm in formation
0.54 ft in formation

References



Explanation

- Proposed monitor well
- Proposed SVE well
- Monitor well
- Approximate SVE ROI (radius varies)
- Benzene isoconcentration contour (µg/L) (dashed where inferred)
- Approximate extent of LNAPL

Source: 1. USGS imagery of the Santa Fe metropolitan area.
2. Fuel dispenser and AST locations detemined in consultation with NMED-PSTB.

SHAMROCK NO. 63
3624 CERRILLOS ROAD
SANTA FE, NEW MEXICO

Proposed Technical Approach

Daniel B. Stephens & Associates, Inc.
6/18/2018
JN BE14.0012

Figure 11

T:\Marketing\Proposals in Progress\DB18.xxxx.PR_NMED Shamrock 63\GIS\MXDs\F11_Tech Approach.mxd

EXTRACTION WELL MW-6
OPERATING DATA TEST #SVE-1
TABLE #1B

B

Location: Shamrock #63, Santa Fe, NM

Project Date 10/23/2017	Units	EXTRACTION WELL MW-6 DTGW	GWU (GWD)	Vacuum "H_2O	Vapor Flow SCFM	OBSERVATION WELL MW-9 DTGW	GWU (GWD)
Well Data							
TD	ft bgs	90.0	-	-	-	92.00	-
Screen	ft	70.0 - 90.0	-	-	-	72.0 - 92.0	-
Well Size	in	2.0	-	-	-	2.0	-
Static Data- 0750 Hrs							
DTGW	ft bgs	82.33	-	-		79.90	-
DTGW Hydro Equivalent	ft bgs	81.68	-	-		79.46	-
DTNAPL	ft bgs	81.45	-	-		79.30	-
NAPL	ft bgs	0.88	-	-		0.60	-
Drawdown Data							
Data Logger 0620 hrs Static	ft	7.88	-	-	-	9.87	-
Data Logger 0630 hrs Start	ft	7.49	(0.39)	25	4.72	9.90	0.03
Data Logger 0700 hrs	ft	7.68	(0.20)	25	4.72	9.92	0.05
Data Logger 0730 hrs	ft	7.68	(0.20)	25	4.71	9.93	0.06
Data Logger 0800 hrs	ft	7.68	(0.20)	25	4.71	9.93	0.06
Data Logger 0830 hrs	ft	7.28	(0.60)	50	6.94	9.95	0.08
Data Logger 0900 hrs	ft	7.62	(0.26)	50	7.35	9.96	0.09
Data Logger 0930 hrs	ft	7.65	(0.23)	50	7.35	9.96	0.09
Data Logger 1000 hrs	ft	7.66	(0.22)	50	6.54	9.97	0.10
Data Logger 1030 hrs	ft	7.62	(0.26)	50	6.54	9.98	0.11
Data Logger 1100 hrs	ft	7.63	(0.25)	50	6.54	9.98	0.11
Data Logger 1130 hrs	ft	7.60	(0.28)	75	7.78	9.99	0.12
Data Logger 1200 hrs	ft	7.64	(0.24)	75	7.78	9.99	0.12
Data Logger 1230 hrs	ft	7.65	(0.23)	75	7.74	10.00	0.13
Data Logger 1300 hrs	ft	7.67	(0.21)	75	7.74	10.01	0.14
Data Logger 1330 hrs	ft	7.69	(0.19)	75	7.74	10.01	0.14
Data Logger 1400 hrs	ft	7.69	(0.19)	75	7.72	10.01	0.14
Data Logger 1430 hrs Stop	ft	7.69	(0.19)	75	7.72	10.02	0.15
Data Logger 1500 hrs Static	ft	7.72	(0.16)	-		9.95	0.08
DTGW 1500 hrs		81.82	-	-		80.37	-
DTGW Hydro Equivalent		81.60	-	-		79.66	-
DTNAPL		81.52	-	-		79.41	-
NAPL		0.30	-	-		0.96	-
Average GW Upwelling / (Depression)		-	(0.26)	-			0.10

OBSERVATION WELLS
INDUCED HYDRAULIC GRADIENT DATA
TEST #SVE-1
TABLE #1C

Location: Shamrock #63, Santa Fe, NM								
Project Date 10/23/2017		**MW-6**	**MW-9**	**MW-7**	**MW-5**	**MW-11**	**MW-10**	**MW-2**
Well Data								
TD	ft	90.0	92.0	90.0	90.0	92.0	92.0	90.0
Screen	ft	70.0 90.0	72.0- 92.0	70.0 90.0	75.0 - 90.0	72.0- 92.0	72.0- 92.0	75.0 - 90.0
Well Size	in	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Distance From EW	ft	0	43.0	49.0	50.0	73.0	99.0	100.00
Static/Start Data - 0620 hrs								
DTGW	ft	82.33	79.90	82.43	81.14	77.79	78.72	82.07
DTGW - Hydro Equivalent	ft	81.68	79.46	82.43	81.14	77.79	78.31	82.07
DTNAPL	ft	81.45	79.30	-	-	-	78.17	-
NAPL	ft	0.88	0.60	-	-	-	0.55	-
Drawdown Data - 1500 hrs								
DTGW	ft	81.82	80.37	82.35	81.08	77.82	78.73	82.02
DTGW - Hydro Equivalent	ft	81.60	79.66	82.35	81.08	77.82	78.26	82.02
DTNAPL	ft	81.52	79.41	-	-	-	78.09	-
LNAPL	ft	0.30	0.96	-	-	-	0.64	-
Change ion Hydro Equavalent	ft	0.08	(0.20)	0.08	0.06	(0.03)	0.06	0.05

Specific Gravity .74

SCHEDULE A
TEST #SVE-1
SUMMARY TEST DATA

		DATA ELEMENT						
	Units	STATIC 6:20	START 6:30	1 7:00	2 7:30	3 8:00	4 8:30	5 9:00
Influent Vapor Data								
Horiba TPH	ppmv	ND	ND	ND	55,770	75,720	77,870	74,890
Horiba CO_2	%	ND	ND	ND	2.06	2.54	2.40	2.10
Horiba CO	%	ND	ND	ND	1.78	4.22	4.36	4.34
Lumidor O_2	%	ND	ND	ND	6.9	5.7	5.9	5.5
Lumidor H_2S	ppm	ND	ND	ND	3.1	2.1	2.0	2.0
Influent Vapor	°F	OFF	50.0	52.0	54.0	54.0	56.0	56.0
Extraction Well- Well SVE-1								
Well Flow	scfm	0.00	4.72	4.72	4.71	4.71	6.94	7.35
Well Vacuum	"H_2O	OFF	25.0	25.0	25.0	25.0	50.0	50.0
Observation Well Data- Vacuum (Pressure)								
MW-9 - 43.0 ft	"H_2O	0.90	0.94	0.99	1.15	1.83	2.16	2.35
MW-7 - 50.0 ft	"H_2O	ND	ND	ND	ND	ND	ND	ND
MW-5 - 49.0 ft	"H_2O	ND	ND	ND	ND	ND	ND	ND
MW-11 - 73.0 ft	"H_2O	0.41	0.72	1.01	1.27	1.34	1.71	1.87
MW-10 - 99.0 ft	"H_2O	0.51	0.62	0.88	1.10	1.26	1.56	1.75
MW-2 - 100.0 ft	"H_2O	ND	ND	ND	ND	ND	ND	ND
ATMOSPHERIC DATA								
Barometric Pressure	"Hg	30.31	30.31	30.31	30.31	30.32	30.32	30.34
Absolute Pressure	"Hg	23.73	23.73	23.73	23.73	23.73	23.73	23.75

( ) Indicates Well Pressure
ND - No Recorded Data

SCHEDULE A
TEST #SVE-1
SUMMARY TEST DATA

		DATA ELEMENT						
	Units	7 9:30	8 10:00	9 10:30	10 11:00	11 11:30	12 12:00	13 12:30
Influent Vapor Data								
Horiba TPH	ppmv	**ND**	**77,550**	**ND**	**76,240**	**82,700**	**79,980**	**ND**
Horiba CO_2	%	**ND**	**2.53**	**ND**	**2.47**	**2.60**	**4.58**	**ND**
Horiba CO	%	**ND**	**4.48**	**ND**	**4.40**	**5.34**	**1.72**	**ND**
Lumidor O_2	%	**ND**	**5.7**	**ND**	**8.9**	**6.9**	**6.7**	**ND**
Lumidor H_2S	ppm	**ND**	**2.1**	**ND**	**3.0**	**3.0**	**3.0**	**ND**
Influent Vapor	°F	**56.0**	**56.0**	**58.0**	**60.0**	**60.0**	**60.0**	**62.0**
Extraction Well- Well SVE-1								
Well Flow	scfm	**7.35**	**6.54**	**6.52**	**6.51**	**7.75**	**7.75**	**7.74**
Well Vacuum	"H_2O	**50.0**	**50.0**	**50.0**	**50.0**	**75.0**	**75.0**	**75.0**
Observation Well Data- Vacuum (Pressure)								
MW-9 - 43.0 ft	"H_2O	**2.53**	**2.83**	**2.87**	**2.94**	**2.97**	**3.06**	**2.98**
MW-7 - 50.0 ft	"H_2O	**2.10**	**2.55**	**2.55**	**2.63**	**2.65**	**2.73**	**2.65**
MW-5 - 49.0 ft	"H_2O	**2.23**	**2.65**	**2.64**	**2.73**	**2.74**	**2.81**	**2.78**
MW-11 - 73.0 ft	"H_2O	**2.13**	**2.51**	**2.53**	**2.57**	**2.60**	**2.70**	**2.58**
MW-10 - 99.0 ft	"H_2O	**2.04**	**2.29**	**2.31**	**2.36**	**2.36**	**2.44**	**2.35**
MW-2 - 100.0 ft	"H_2O	**1.96**	**2.26**	**2.26**	**2.33**	**2.29**	**2.31**	**2.25**
ATMOSPHERIC DATA								
Barometric Pressure	"Hg	**30.35**	**30.37**	**30.37**	**30.37**	**30.35**	**30.35**	**30.33**
Absolute Pressure	"Hg	**23.76**	**23.77**	**23.77**	**23.77**	**23.76**	**23.76**	**23.74**

( ) Indicates Well Pressure
ND - No Recorded Data

SCHEDULE A
TEST #SVE-1
SUMMARY TEST DATA

		DATA ELEMENT						
	Units	14 13:00	15 13:30	16 14:00	17 14:30	Static 15:00	Average Data	Maximum Data
Influent Vapor Data								
Horiba TPH	ppmv	**81,110**	**ND**	**72,340**	**ND**	**ND**	**75,417**	**82,700**
Horiba CO_2	%	**4.70**	**ND**	**3.52**	**ND**	**ND**	**2.95**	**4.70**
Horiba CO	%	**1.82**	**ND**	**1.28**	**ND**	**ND**	**3.37**	**5.34**
Lumidor O_2	%	**6.5**	**ND**	**6.3**	**ND**	**ND**	**6.5**	**8.9**
Lumidor H_2S	ppm	**3.1**	**ND**	**2.0**	**ND**	**ND**	**2.5**	**3.1**
Influent Vapor	°F	**62**	**62**	**64**	**64**	**OFF**	**58**	**64**
Extraction Well- Well SVE-1								
Well Flow	scfm	**7.74**	**7.74**	**7.72**	**7.72**	**OFF**	**6.72**	**7.75**
Well Vacuum	"H_2O	**75.0**	**75.0**	**75.0**	**75.0**	**OFF**	**54.4**	**75.0**
Observation Well Data- Vacuum (Pressure)								
MW-9 - 43.0 ft	"H_2O	**2.96**	**2.91**	**2.95**	**2.79**	**2.02**	**2.42**	**3.06**
MW-7 - 50.0 ft	"H_2O	**2.60**	**2.51**	**2.54**	**2.38**	**2.16**	**2.54**	**2.73**
MW-5 - 49.0 ft	"H_2O	**2.72**	**2.65**	**2.67**	**2.53**	**1.99**	**2.65**	**2.81**
MW-11 - 73.0 ft	"H_2O	**2.57**	**2.51**	**2.52**	**2.35**	**2.05**	**2.09**	**2.70**
MW-10 - 99.0 ft	"H_2O	**2.30**	**2.26**	**2.27**	**2.13**	**1.95**	**1.90**	**2.44**
MW-2 - 100.0 ft	"H_2O	**2.18**	**2.07**	**2.09**	**1.97**	**1.79**	**2.18**	**2.33**
ATMOSPHERIC DATA								
Barometric Pressure	"Hg	**30.32**	**30.31**	**30.30**	**30.28**	**30.27**	**30.33**	**30.37**
Absolute Pressure	"Hg	**23.73**	**23.72**	**23.72**	**23.71**	**23.70**	**23.74**	**23.77**

( ) Indicates Well Pressure
ND - No Recorded Data

EXTRACTION WELL MW-9
OPERATING DATA TEST #SVE-2
Table #1B

Location: Shamrock #63, Santa Fe, NM

					EXTRACTION WELL				OBSERVATION WELL	
					MW-9				MW-6	
Project Date 10/20/2017				**Units**	**DTGW**	**GWD GWU**	**Vacuum "H_2O**	**Vapor Flow SCFM**	**DTGW**	**GWD GWU**
Well Data										
TD				ft bgs	92.0	-	-	-	90.00	-
Screen				ft	72.0 - 92.0	-	-	-	70.0 - 90.0	-
Well Size				in	2.0	-	-	-	2.0	-
Static Data- 0750 Hrs										
DTGW				ft bgs	79.53	-	-		82.02	-
DTGW Hydro Equivalent				ft bgs	79.20	-	-		80.80	-
DTNAPL				ft bgs	79.34	-	-		81.32	-
NAPL				ft bgs	0.19	-	-		0.70	-
Drawdown Data										
Data Logger	0820	hrs	Start	ft	13.08	-	-	-	7.65	-
Data Logger	0830	hrs		ft	14.92	1.84	25	11.91	7.70	0.05
Data Logger	0900	hrs		ft	14.83	1.75	25	11.91	7.72	0.07
Data Logger	0930	hrs		ft	14.95	1.87	25	11.91	7.73	0.08
Data Logger	1000	hrs		ft	14.89	1.81	25	11.91	7.74	0.09
Data Logger	1030	hrs		ft	17.01	3.93	50	17.09	7.77	0.12
Data Logger	1100	hrs		ft	17.20	4.12	50	17.09	7.79	0.14
Data Logger	1130	hrs		ft	16.95	3.87	50	17.09	7.80	0.15
Data Logger	1200	hrs		ft	16.97	3.89	50	17.09	7.54	(0.11)
Data Logger	1230	hrs		ft	17.00	3.92	50	17.09	7.81	0.16
Data Logger	1300	hrs		ft	16.90	3.82	50	17.09	7.82	0.17
Data Logger	1330	hrs		ft	19.45	6.37	75	17.21	7.55	(0.10)
Data Logger	1400	hrs		ft	18.61	5.53	75	17.18	7.86	0.21
Data Logger	1430	hrs		ft	19.46	6.38	75	17.18	7.86	0.21
Data Logger	1500	hrs		ft	18.94	5.86	75	17.18	7.88	0.23
Data Logger	1530	hrs		ft	18.81	5.73	75	17.21	7.53	(0.12)
Data Logger	1600	hrs		ft	19.06	5.98	75	17.21	7.88	0.23
Data Logger	1630	hrs	Stop	ft	18.55	5.47	75	17.21	7.00	(0.65)
Data Logger	1700	hrs	Static	ft	12.80	(0.28)	-	-	7.89	0.24
DTGW	1700	hrs			79.86	-	-	-	81.95	-
DTGW Hydro Equivalent					79.32	-	-	-	81.51	-
DTNAPL					79.13	-	-	-	81.36	-
NAPL					0.73	-	-	-	0.59	-
Average GW Upwelling / (Depression)					-	4.24	-	-		0.05

OBSERVATION WELL DATA
TEST #SVE-2
TABLE #1C

Location: Shamrock #63, Santa Fe, NM									
Project Date 10/20/2017		**MW-9**	**MW-6**	**MW-10**	**MW-11**	**MW-5**	**MW-16**	**MW-7**	**MW-12**
Well Data									
TD	ft	90.0	92.0	90.0	92.0	90.0	90.0	90.0	92.0
Screen	ft	70.0 90.0	72.0- 92.0	70.0 90.0	72.0- 92.0	75.0- 90.0	70.0 90.0	70.0 90.0	72.0 - 92.0
Well Size	in	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Distance From EW	ft	0	43.0	56.0	59.0	72.0	84.0	93.0	179.00
Static/Start Data - 0620 hrs									
DTGW	ft	79.53	82.02	78.57	77.62	80.93	76.30	82.29	76.12
DTGW - Hydro Equivalent	ft	79.39	81.50	78.14	77.62	80.93	76.30	82.29	76.12
DTNAPL	ft	79.34	81.32	77.99	-	-	-	-	-
NAPL	ft	0.19	0.70	0.58	-	-	-	-	-
Drawdown Data - 1500 hrs									
DTGW	ft	79.86	81.95	78.55	77.73	81.02	76.44	82.30	76.04
DTGW - Hydro Equivalent	ft	79.32	81.51	78.07	77.73	81.02	76.44	82.30	76.04
DTNAPL	ft	79.13	81.36	77.90	-	-	-	-	-
LNAPL	ft	0.73	0.59	0.65	-	-	-	-	-
Change ion Hydro Equavalent	ft	0.07	(0.01)	0.07	(0.11)	(0.09)	(0.14)	(0.01)	0.08

Specific Gravity .74

SCHEDULE A
TEST # SVE-2
SUMMARY OF TEST DATA

SHAMROCK #63
SANTA FE, NM
Ocotber 20, 2017

10/22/2017	Units	DATA ELEMENT						
		STATIC 8:20	START 8:30	1 9:00	2 9:30	3 10:00	4 10:30	5 11:00
Influent Vapor Data								
Horiba TPH	ppmv	ND	ND	83,120	80,300	ND	81,160	75,330
Horiba CO_2	%	ND	ND	2.68	2.28	ND	2.50	2.30
Horiba CO	%	ND	ND	5.28	5	ND	4	4.14
Lumidor O_2	%	ND	ND	5.7	4.8	ND	5.5	5.3
Lumidor H_2S	ppm	ND	ND	4	3	ND	0	0
Influent Vapor	°F	OFF	60.0	60.0	60.0	60.0	60.0	60.0
Extraction Well- Well SVE-1								
Well Flow	scfm	0.00	11.91	11.91	11.91	11.91	17.09	17.09
Well Vacuum	"H_2O	OFF	25.0	25.0	25.0	25.0	50.0	50.0
Observation Well Data- Vacuum (Pressure)								
MW-6 - 43.0 ft	"H_2O	(0.49)	0.21	1.03	1.38	1.67	2.39	2.85
MW-10 - 56.0 ft	"H_2O	0.00	0.35	0.50	0.90	1.24	1.61	2.09
MW-11 - 59.0 ft	"H_2O	(0.06)	0.23	0.70	1.03	1.32	1.71	2.44
MW-5 - 72.0 ft	"H_2O	ND	ND	ND	0.71	1.15	1.68	2.14
MW-16 - 84.0 ft	"H_2O	(0.03)	0.46	0.44	0.77	1.14	1.54	2.05
MW-7 - 93.0 ft	"H_2O	ND	ND	ND	0.31	0.69	1.10	1.49
MW-12 - 179.0 ft	"H_2O	ND	ND	ND	ND	ND	ND	ND
ATMOSPHERIC DATA								
Barometric Pressure	"Hg	29.98	29.98	29.98	29.98	29.98	29.98	29.98
Absolute Pressure	"Hg	23.46	23.46	23.46	23.46	23.46	23.46	23.46

( ) Indicates Well Pressure
ND - No Recorded Data

SCHEDULE A
TEST SVE-2
SUMMARY OF TEST DATA

SHAMROCK #63
SANTA FE, NM
Ocotber 20, 2017

10/22/2017	Units	DATA ELEMENT						
		7 11:30	8 12:00	9 12:30	10 13:00	11 13:30	12 14:00	13 14:30
Influent Vapor Data								
Horiba TPH	ppmv	**ND**	**ND**	**78,010**	**ND**	**85,960**	**ND**	**86,750**
Horiba CO_2	%	**ND**	**ND**	**1.87**	**ND**	**2.20**	**ND**	**2.62**
Horiba CO	%	**ND**	**ND**	**3.76**	**ND**	**5.56**	**ND**	**5.80**
Lumidor O_2	%	**ND**	**ND**	**5.5**	**ND**	**4.8**	**ND**	**5.2**
Lumidor H_2S	ppm	**ND**	**ND**	**0.0**	**ND**	**2.0**	**ND**	**2.0**
Influent Vapor	°F	**60.0**	**60.0**	**62.0**	**62.0**	**62.0**	**62.0**	**62.0**
Extraction Well- Well SVE-1								
Well Flow	scfm	**17.09**	**17.09**	**17.06**	**17.06**	**17.18**	**17.18**	**17.18**
Well Vacuum	"H_2O	**50.0**	**50.0**	**50.0**	**50.0**	**75.0**	**75.0**	**75.0**
Observation Well Data- Vacuum (Pressure)								
MW-6 - 43.0 ft	"H_2O	**3.12**	**3.15**	**3.21**	**3.22**	**3.49**	**3.62**	**4.00**
MW-10 - 56.0 ft	"H_2O	**2.46**	**2.64**	**2.42**	**2.37**	**2.85**	**2.87**	**3.32**
MW-11 - 59.0 ft	"H_2O	**2.73**	**2.72**	**2.82**	**2.86**	**3.05**	**3.07**	**3.49**
MW-5 - 72.0 ft	"H_2O	**2.50**	**2.53**	**2.60**	**2.63**	**2.78**	**2.85**	**3.26**
MW-16 - 84.0 ft	"H_2O	**2.68**	**2.53**	**2.45**	**2.66**	**2.74**	**2.85**	**3.17**
MW-7 - 93.0 ft	"H_2O	**1.75**	**1.77**	**1.81**	**1.80**	**1.93**	**2.03**	**2.35**
MW-12 - 179.0 ft	"H_2O	**0.06**	**0.25**	**0.22**	**0.23**	**0.21**	**0.24**	**0.41**
ATMOSPHERIC DATA								
Barometric Pressure	"Hg	**29.97**	**29.95**	**29.91**	**29.89**	**29.87**	**29.86**	**29.85**
Absolute Pressure	"Hg	**23.46**	**23.44**	**23.41**	**23.40**	**23.38**	**23.37**	**23.36**

( ) Indicates Well Pressure
ND - No Recorded Data

SCHEDULE A
TEST SVE-2
SUMMARY OF TEST DATA

SHAMROCK #63
SANTA FE, NM
Ocotber 20, 2017

10/22/2017	Units	DATA ELEMENT						
		14 15:00	15 15:30	16 16:00	17 16:30	Static 17:00	Average Data	Maximum Data
Influent Vapor Data								
Horiba TPH	ppmv	**ND**	**81,890**	**ND**	**ND**	**ND**	**81,565**	**86,750**
Horiba CO_2	%	**ND**	**2.10**	**ND**	**ND**	**ND**	**2.32**	**2.68**
Horiba CO	%	**ND**	**4.78**	**ND**	**ND**	**ND**	**4.83**	**5.80**
Lumidor O_2	%	**ND**	**5.4**	**ND**	**ND**	**ND**	**5.3**	**5.7**
Lumidor H_2S	ppm	**ND**	**2.0**	**ND**	**ND**	**ND**	**1.7**	**4.1**
Influent Vapor	°F	**62**	**60**	**60**	**60**	**OFF**	**61**	**62**
Extraction Well- Well SVE-1								
Well Flow	scfm	**17.18**	**17.21**	**17.21**	**17.21**	**OFF**	**15.91**	**17.21**
Well Vacuum	"H_2O	**75.0**	**75.0**	**75.0**	**75.0**	**OFF**	**54.4**	**75.0**
Observation Well Data- Vacuum (Pressure)								
MW-6 - 43.0 ft	"H_2O	**4.12**	**4.27**	**4.43**	**4.39**	**1.45**	**2.97**	**4.43**
MW-10 - 56.0 ft	"H_2O	**3.55**	**3.70**	**3.92**	**3.91**	**2.73**	**2.39**	**3.92**
MW-11 - 59.0 ft	"H_2O	**3.66**	**3.80**	**3.98**	**4.01**	**2.51**	**2.57**	**4.01**
MW-5 - 72.0 ft	"H_2O	**3.36**	**3.53**	**3.70**	**3.67**	**2.37**	**2.61**	**3.70**
MW-16 - 84.0 ft	"H_2O	**3.38**	**3.52**	**3.70**	**3.76**	**2.54**	**2.34**	**3.76**
MW-7 - 93.0 ft	"H_2O	**2.46**	**2.59**	**2.75**	**2.73**	**2.16**	**1.84**	**2.75**
MW-12 - 179.0 ft	"H_2O	**0.49**	**0.64**	**0.76**	**0.75**	**0.75**	**0.39**	**0.76**
ATMOSPHERIC DATA								
Barometric Pressure	"Hg	**29.84**	**29.83**	**29.82**	**29.82**	**29.82**	**29.91**	**29.98**
Absolute Pressure	"Hg	**23.36**	**23.35**	**23.34**	**23.34**	**23.34**	**23.41**	**23.46**

( ) Indicates Well Pressure
ND - No Recorded Data

EXTRACTION WELL MW-10
OPERATING DATA TEST #SVE-3
TABLE #1B

Location: Shamrock #63, Santa Fe, NM

					EXTRACTION WELL				OBSERVATION WELL	
					MW-10				MW-16	
Project Date 10/22/2017				**Units**	**DTGW**	**GWD GWU**	**Vacuum "H_2O**	**Vapor Flow SCFM**	**DTGW**	**GWD GWU**
Well Data										
TD				ft bgs	92.0	-	-	-	90.00	-
Screen				ft	72.0 - 92.0	-	-	-	70.0 - 90.0	-
Well Size				in	2.0	-	-	-	2.0	-
Static Data- 0750 Hrs										
DTGW				ft bgs	78.91	-	-		76.64	-
DTGW Hydro Equivalent				ft bgs	77.48	-	-		76.64	-
DTNAPL				ft bgs	78.09	-	-		-	-
NAPL				ft bgs	0.82	-	-		-	-
Drawdown Data										
Data Logger	0820	hrs	Start	ft	13.80	-	-	-	12.60	-
Data Logger	0830	hrs		ft	15.29	1.49	20	3.24	12.60	0.00
Data Logger	0900	hrs		ft	15.26	1.46	20	3.20	12.77	0.17
Data Logger	0930	hrs		ft	15.34	1.54	20	3.20	12.75	0.15
Data Logger	1000	hrs		ft	15.43	1.63	20	3.17	12.78	0.18
Data Logger	1030	hrs		ft	16.33	2.53	40	4.39	12.78	0.18
Data Logger	1100	hrs		ft	16.98	3.18	40	4.38	12.78	0.18
Data Logger	1130	hrs		ft	16.98	3.18	40	4.37	12.78	0.18
Data Logger	1200	hrs		ft	16.97	3.17	40	4.37	12.80	0.20
Data Logger	1230	hrs		ft	17.01	3.21	40	4.37	12.80	0.20
Data Logger	1300	hrs		ft	16.97	3.17	40	4.37	12.81	0.21
Data Logger	1330	hrs		ft	18.36	4.56	60	5.91	12.83	0.23
Data Logger	1400	hrs		ft	18.82	5.02	60	5.91	12.82	0.22
Data Logger	1430	hrs		ft	18.80	5.00	60	5.91	12.80	0.20
Data Logger	1500	hrs		ft	18.98	5.18	60	5.91	12.82	0.22
Data Logger	1530	hrs		ft	18.81	5.01	60	5.90	12.85	0.25
Data Logger	1600	hrs		ft	18.79	4.99	60	5.90	12.85	0.25
Data Logger	1630	hrs	Stop	ft	18.77	4.97	60	5.90	12.85	0.25
Data Logger	1700	hrs	Static	ft	13.86	0.06	-		12.67	0.07
DTGW	1700	hrs			78.42	-	-		78.42	-
DTGW Hydro Equivalent					78.39	-	-		78.42	-
DTNAPL					78.38	-	-		-	-
NAPL					0.04	-	-		-	-
Average GW Upwelling					-	3.488	-			0.192

OBSERVATION WELL DATA
TEST #SVE-3
TABLE #1C

Location: Shamrock #63, Santa Fe, NM									
Project Date 10/22/2017		**MW-10**	**MW-16**	**MW-9**	**MW-17**	**MW-11**	**MW-6**	**MW-18**	**MW-19**
Well Data									
TD	ft	92.0	90.0	92.0	90.0	92.0	90.0	90.0	90.0
Screen	ft	72.0- 92.0	70.0 90.0	72.0- 92.0	70.0 90.0	72.0- 92.0	70.0 90.0	70.0 90.0	70.0 90.0
Well Size	in	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Distance From EW	ft	0.0	49.0	56.0	65.0	85.0	99.0	106.0	135.00
Static Data - 0620 hrs									
DTGW	ft	78.91	76.64	80.21	78.95	77.95	82.38	76.64	76.30
DTGW - Hydro Equivalent	ft	78.30	76.64	79.60	78.95	77.95	81.67	76.64	76.30
DTNAPL	ft	78.09	-	79.39	-	-	81.42	-	-
NAPL	ft	0.82	-	0.82	-	-	0.96	-	-
Static Data - 1500 hrs									
DTGW	ft	78.42	76.62	80.11	78.82	77.82	82.34	76.62	76.23
DTGW - Hydro Equivalent	ft	78.39	76.62	79.51	78.82	77.82	81.64	76.62	76.23
DTNAPL	ft	78.38	-	79.30	-	-	81.39	-	-
LNAPL	ft	0.04	-	0.81	-	-	0.95	-	-
Change ion Hydro Equavalent	ft	(0.09)	0.02	0.09	0.13	0.13	0.03	0.02	0.07

Specific Gravity .74

SCHEDULE A
Test # SVE-3
SUMMARY OF TEST DATA

SHAMROCK #63
SANTA FE, NM
October 22, 2017

		DATA ELEMENT						
	Units	STATIC 8:20	START 8:30	1 9:00	2 9:30	3 10:00	4 10:30	5 11:00
Influent Vapor Data								
Horiba TPH	ppmv	ND	ND	82,100	ND	79,340	84,180	83,050
Horiba CO_2	%	ND	ND	1.30	ND	1.30	1.22	1.10
Horiba CO	%	ND	ND	5.22	ND	4.08	5	4.72
Lumidor O_2	%	ND	ND	5.9	ND	5.7	6.0	6.2
Lumidor H_2S	ppm	ND	ND	7	ND	6	6	3
Influent Vapor	°F	OFF	37.0	48.0	50.0	56.0	56.0	60.0
Extraction Well- Well SVE-1								
Well Flow	scfm	OFF	3.24	3.20	3.20	3.18	4.40	4.38
Well Vacuum	"H_2O	OFF	20.0	20.0	20.0	20.0	40.0	40.0
Observation Well Data- Vacuum (Pressure)								
MW-16 - 49.0 ft	"H_2O	1.43	2.07	2.17	2.25	2.27	2.32	2.41
MW-9 - 56.0 ft	"H_2O	2.27	2.60	2.66	2.69	2.73	2.70	2.83
MW-17 - 65.0 ft	"H_2O	1.11	2.22	2.42	2.47	2.49	2.49	2.68
MW-11 - 85.0 ft	"H_2O	1.95	2.48	2.64	2.63	2.64	2.64	2.77
MW-6 - 99.0 ft	"H_2O	2.30	2.61	2.68	2.71	2.73	2.70	2.78
MW-18 - 106.0 ft	"H_2O	ND	ND	ND	ND	ND	2.35	2.73
MW-19 - 135.0 ft	"H_2O	0.00	1.21	1.96	2.31	2.12	2.34	2.49
ATMOSPHERIC DATA								
Barometric Pressure	"Hg	30.31	30.31	30.32	30.32	30.32	30.32	30.33
Absolute Pressure	"Hg	23.72	23.72	23.73	23.73	23.73	23.73	23.74

( ) Indicates Well Pressure
ND - No Recorded Data

SCHEDULE A
TEST SVE-3
SUMMARY OF TEST DATA

		DATA ELEMENT						
	Units	7 11:30	8 12:00	9 12:30	10 13:00	11 13:30	12 14:00	13 14:30
Influent Vapor Data								
Horiba TPH	ppmv	**ND**	**89,380**	**ND**	**80,120**	**87,230**	**92,080**	**ND**
Horiba CO_2	%	**ND**	**1.33**	**ND**	**1.14**	**0.80**	**0.78**	**ND**
Horiba CO	%	**ND**	**5.92**	**ND**	**4.60**	**6**	**4.23**	**ND**
Lumidor O_2	%	**ND**	**6.8**	**ND**	**5.4**	**5.2**	**5.2**	**ND**
Lumidor H_2S	ppm	**ND**	**2**	**ND**	**2**	**2**	**2**	**ND**
Influent Vapor	°F	**62.0**	**62.0**	**62.0**	**62.0**	**64.0**	**64.0**	**64.0**
Extraction Well- Well SVE-1								
Well Flow	scfm	**4.37**	**4.37**	**4.37**	**4.37**	**5.91**	**5.91**	**5.91**
Well Vacuum	"H_2O	**40.0**	**40.0**	**40.0**	**40.0**	**60.0**	**60.0**	**60.0**
Observation Well Data- Vacuum (Pressure)								
MW-16 - 49.0 ft	"H_2O	**2.53**	**2.35**	**2.34**	**2.14**	**2.08**	**1.82**	**1.70**
MW-9 - 56.0 ft	"H_2O	**2.83**	**2.60**	**2.47**	**2.31**	**2.18**	**2.18**	**2.01**
MW-17 - 65.0 ft	"H_2O	**2.63**	**2.52**	**2.27**	**2.24**	**2.10**	**2.12**	**1.96**
MW-11 - 85.0 ft	"H_2O	**2.70**	**2.55**	**2.36**	**2.22**	**2.13**	**2.03**	**1.87**
MW-6 - 99.0 ft	"H_2O	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
MW-18 - 106.0 ft	"H_2O	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
MW-19 - 135.0 ft	"H_2O	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
ATMOSPHERIC DATA								
Barometric Pressure	"Hg	**30.34**	**30.33**	**30.32**	**30.32**	**30.30**	**30.28**	**30.27**
Absolute Pressure	"Hg	**23.75**	**23.74**	**23.73**	**23.73**	**23.72**	**23.70**	**23.69**

( ) Indicates Well Pressure
ND - No Recorded Data

SCHEDULE A
TEST SVE-3
SUMMARY OF TEST DATA

SHAMROCK #63
SANTA FE, NM
October 22, 2017

	Units	DATA ELEMENT						
		14 15:00	15 15:30	16 16:00	17 16:30	Static 17:00	Average Data	Maximum Data
Influent Vapor Data								
Horiba TPH	ppmv	**87,830**	**ND**	**91,690**	**ND**	**ND**	**85,700**	**92,080**
Horiba CO_2	%	**1.10**	**ND**	**1.32**	**ND**	**ND**	**1.14**	**1.33**
Horiba CO	%	**6.30**	**ND**	**5.69**	**ND**	**ND**	**5.24**	**6.46**
Lumidor O_2	%	**5.7**	**ND**	**5.6**	**ND**	**ND**	**5.8**	**6.8**
Lumidor H_2S	ppm	**2**	**ND**	**2**	**ND**	**ND**	**4**	**7**
Influent Vapor	°F	**64**	**66**	**66**	**66**	**OFF**	**59**	**66**
Extraction Well- Well SVE-1								
Well Flow	scfm	**5.91**	**5.90**	**5.90**	**5.90**	**OFF**	**4.73**	**5.91**
Well Vacuum	"H_2O	**60.0**	**60.0**	**60.0**	**60.0**	**OFF**	**43.5**	**60.0**
Observation Well Data- Vacuum (Pressure)								
MW-16 - 49.0 ft	"H_2O	**1.49**	**1.51**	**1.39**	**1.37**	**1.21**	**2.01**	**2.53**
MW-9 - 56.0 ft	"H_2O	**1.82**	**1.75**	**1.70**	**1.69**	**1.48**	**2.34**	**2.83**
MW-17 - 65.0 ft	"H_2O	**1.87**	**1.80**	**1.67**	**1.69**	**1.45**	**2.21**	**2.68**
MW-11 - 85.0 ft	"H_2O	**1.74**	**1.69**	**1.64**	**1.57**	**1.54**	**2.25**	**2.77**
MW-6 - 99.0 ft	"H_2O	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
MW-18 - 106.0 ft	"H_2O	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
MW-19 - 135.0 ft	"H_2O	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
ATMOSPHERIC DATA								
Barometric Pressure	"Hg	**30.26**	**30.25**	**30.24**	**30.24**	**30.24**	**30.30**	**30.34**
Absolute Pressure	"Hg	**23.68**	**23.68**	**23.67**	**23.67**	**23.67**	**23.71**	**23.75**

( ) Indicates Well Pressure
ND - No Recorded Data

Daniel B. Stephens & Associates, Inc.

MEMORANDUM

TO: Gundar Peterson, PE

FROM Tom Golden, Kelly Isaacson

DATE. January 29, 2010

SUBJECT: Rotameter flow measurement

In response to Katherine MacNeil's email, we researched the apparent discrepancy between standard cubic feet per minute (SCFM) measurements given by a rotameter and the SCFM calculated by AcuVac in their soil vapor extraction (SVE) pilot test reports. The results of our research are summarized below

Definition of variables

ACFM actual cubic feet per minute (cfm) at a given temperature, pressure (elevation), and operating conditions

CFM_{meter}: cubic feet per minute (cfm) measured by a rotameter In the documentation provided, this is also called observed cfm and indicated scfm.

SCFM: equivalent flow in cubic feet per minute (cfm) at STP

STP: standard temperature and pressure, 70°F and 14 7 psi.

ρ density of a fluid, given in mass per unit volume

Problem statement

In the AMEC calculation provided regarding cfm measured with a rotameter, the author reports that the correct reporting unit from a rotameter calibrated for STP is SCFM. The AcuVac documentation refers to the flow rate measured with a rotameter as ACFM and converts this value to SCFM in the field. Does the value measured on the rotameter by AcuVac need to be converted to SCFM?

Solution

The need for the definition of three different types of CFM arises from the difference in calibration versus operation temperature and pressure conditions.

An analysis of the free body diagram of the float in a rotameter is given by Wellin[1], which shows that Q is dependent on the area of flow and density of air:

$$Q = K \cdot \frac{A}{\sqrt{\rho}} \qquad (1)$$

When a rotameter is calibrated at STP, $\sqrt{\rho}$ is absorbed into the value of K, because ρ (air) is defined. When the density of the air is changed (i.e. elevation of the rotameter is changed), the

calibrated rotameter no longer yields flow rate in SCFM, but instead what we will call CFM_{meter}.

The Dwyer technical documentation[2] for the VFC series rotameter used by AcuVac acknowledges this fact in the third paragraph under "Operation", which states,

"the flowmeter is calibrated to operate at a specific set of conditions, and deviation from those standard conditions will require correction for the calibration to be valid. In practice, the reading taken from the flowmeter scale must be corrected back to standard conditions to be used with the scale units. The correct location to measure the actual pressure and temperature is at the exit of the flowmeter, except under vacuum applications where they should be measured at the flowmeter inlet."

The conversion given to convert CFM_{meter} to SCFM[1,2] is a non linear relationship:

$$Q(SFCM) = CFM_{meter} \sqrt{\frac{P_{actual}}{P_{calibration}} \cdot \frac{T_{calibration}}{T_{actual}}} \qquad (2)$$

It can be noted that the calibration temperature and pressure are generally STP; however, calibration information should be provided by the flowmeter manufacturer

The relationship between SCFM and ACFM is linear:

$$ACFM = SCFM \ \frac{P_{standard}}{P_{actual}} \cdot \frac{T_{actual}}{T_{standard}} \qquad (3)$$

For completeness, the relationship between ACFM and CFM_{meter} is given by

$$ACFM = CFM_{meter} \sqrt{\frac{P_{standard}}{P_{actual}} \ \frac{T_{actual}}{T_{standard}}} \qquad (4)$$

Supporting documentation

Two Dwyer specification sheets for rotameters[2] (including the VFC Series Visi-Float used by AcuVac) are attached, which include the calculation of SCFM from the meter reading. This calculation is also discussed in Wellin[1]

The correct conversion from SCFM to ACFM is included in the documentation with the AMEC calculation (page 3 of 4 from King Correction Formulae & Sizing)[3], as well as in Wellin[1].

Implications

The primary problem here is one of terminology, although there are implications if formulas in either the AcuVac or AMEC documents were used to back-calculate ACFM/SCFM values. Although it may not be intuitive, ACFM is not the value read straight from the meter, rather the

calculated actual volumetric flow rate through the meter.

Page 2 of the AMEC calculation gives an equation to calculate ACFM. This non-linear equation is the correct way to calculate ACFM from CFM_{meter}. It is not the correct way to calculate SCFM from ACFM or vice versa.

For most SVE applications in New Mexico (i.e. 3000-7000 feet elevation, air temperature of 50-70°F), the value of CFM_{meter} falls between the ACFM and SCFM, such that ACFM > CFM_{meter} > SCFM.

In the design equation given in the AMEC calculation

$$Q = kA(gh)^{0.5} \qquad (5)$$

the fluid density, ρ(air), is included in the calibration coefficient, *k*, a fact which is not acknowledged by the AMEC calculation. While the equation is valid for the calibration conditions, the flow rate read from the meter must be corrected as indicated above in equation 2 to reflect the correct SCFM.

Conclusions

In the problem statement of the AMEC calculation regarding CFM used in SVE systems, the correct answer to the question "What is the correct reporting unit directly read off the scale; SCFM, ACFM, or other?" is "other", and in this discussion is termed CFM_{meter}.

Additionally, AcuVac is correct in converting the CFM value read on the flowmeter to SCFM to adjust for changes in temperature and pressure, with the non-linear relationship given above, although what they call ACFM in their sample calculation is actually CFM_{meter}.

In summary, both the SCFM value in the AMEC calculation[4] and the ACFM value in the AcuVac report[5] refer to the value measured at the flowmeter, CFM_{meter}, therefore, both equations provided are true, but do not represent the actual relationship between true SCFM and ACFM.

APPENDIX

APPENDIX

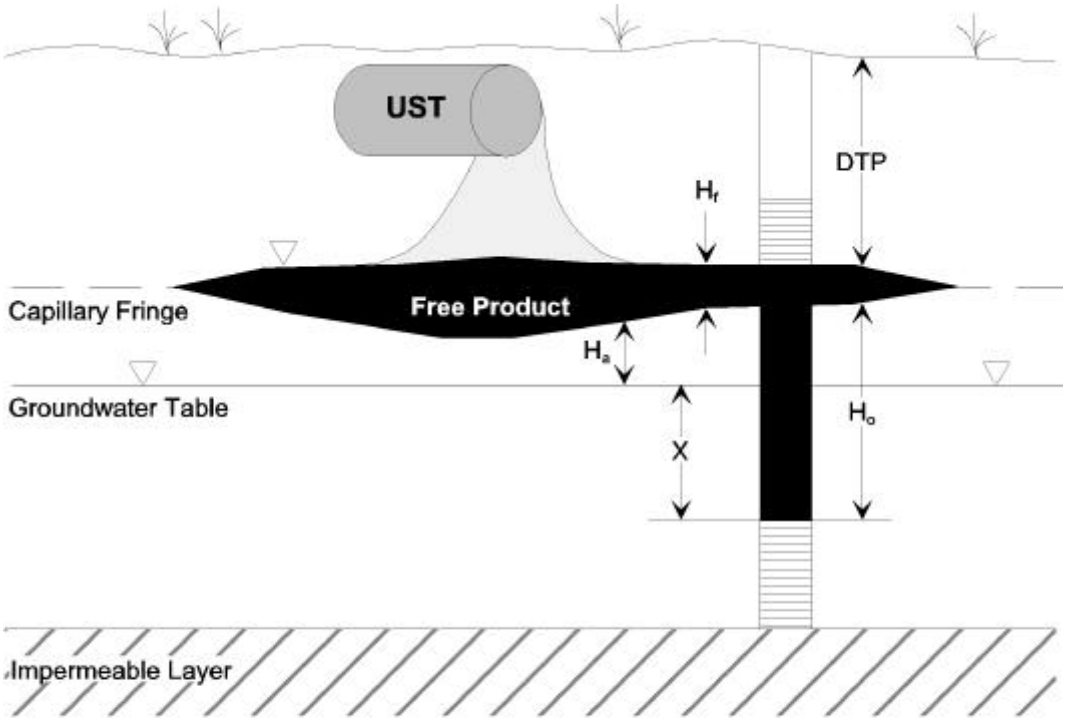
Chapter IV presented various methods for estimating the volume of free product in the subsurface. The results of seven methods were compared for data representative of the same site conditions. Each of these methods are described in greater detail in this Appendix. To facilitate comparison, a uniform terminology has been adopted. Exhibit A-1 lists the variables that appear in the various equations. Exhibit A-2 is a diagram showing the relationship of the variables and characteristics of free product in the vicinity of a monitor well. Experimental data from Abdul *et al*. (1989) and parameter values for the example calculations are presented in Exhibit A-3.

Exhibit A-1
Variables Appearing in Volume Estimation Equations

b_{ao}	=	air-oil scaling factor
b_{ow}	=	oil-water scaling factor
D	=	function of interfluid displacement pressures and hydrostatics
Δr	=	density difference between water and hydrocarbon ($r_w - r_o$)
F	=	formation factor
g	=	acceleration of gravity
h_a	=	distance from water table to bottom of mobile hydrocarbon
$h_{c,dr}$	=	average water capillary height under drainage conditions
H_f	=	thickness of mobile hydrocarbon in the adjacent formation
H_o	=	hydrocarbon thickness measured in the well
P_d^{ow}	=	water-hydrocarbon displacement pressure
P_d^{ao}	=	air-hydrocarbon displacement pressure
r_w	=	density of water
r_o	=	density of the hydrocarbon liquid
V_o	=	volume of hydrocarbon in the adjacent formation per unit area
f	=	soil porosity
s_{aw}	=	surface tension of water (= 72 dynes/cm @ 20°C)
s_{ao}	=	surface tension of hydrocarbon
s_{ow}	=	hydrocarbon-water interfacial tension (= $s_{aw} - s_{ao}$)
S_r	=	residual saturation
x	=	distance from water table to interface between free product and groundwater in the well-- x is equal to the product of the thickness of the hydrocarbon and the hydrocarbon density ($H_o - r_o$)

Exhibit A-2

Relationship of Variables and Characteristics
of Free Product in the Vicinity of a Monitor Well



Legend

H_o = apparent (wellbore) product thickness
H_f = actual formation free product thickness
DTP = depth to wellbore product level from ground surface
H_a = free product distance to groundwater table, within formation
X = interface distance below groundwater table, within well

Modified from Ballestero *et al.* (1994).

Exhibit A-3

Parameters and Experimental Data Used In Calculating Free Product Thickness Based on Measurements of Free Product in Monitor Wells

Parameters listed in the following table correspond to the variables appearing in the seven equations described previously.

Parameter Values

r_o = 0.84 gm/cm^3	s_{aw} = 72 dynes/cm	f =0.424
r_w = 1.00 gm/cm^3	s_{ao} = 32 dynes/cm	S_r = 0.091
F = 7.5 (med.sand)	s_{ow} = 40 dynes/cm	P_d^{ao} = 5.21 cm H_2O
$h_{c,dr}$ = 17	b_{ao} =2.25	P_d^{ow} = 6.51 cm H_2O
g = 980 cm/s^2	b_{ow} =1.8	D = 0.035

The data appearing in the following table are from Abdul *et al*. (1989). Their experiment essentially involved introducing dyed diesel fuel into an acrylic column containing well-graded sand and a minature monitor well. The cylinder was initially filled with water from the bottom and then allowed to drain until equilibrium was reached. Diesel fuel was then allowed to infiltrate from the surface. The height of diesel fuel in the sand and well was measured and recorded. The experiment was repeated 5 times.

Experimental Data

Trial Number	**H_o (cm)**	**h_a (cm)**	**x [$H_o \cdot r_o$] (cm)**
1	6	17	5.04
2	63	9	52.92
3	68	6.5	57.12
4	73	2	61.32
5	84	0	70.56

Method of de Pastrovich (1979)

$$H_f = \frac{H_o \left(r_w - r_o \right)}{r_o}$$

This method depends only upon the density (r_o) of the liquid hydrocarbon relative to the density of water. For a hydrocarbon liquid with a density of 0.8, and assuming that the density of water (r_w) is equal to 1, the hydrocarbon thickness in the formation (the actual thickness) is only one-fourth the thickness measured in the well (the apparent thickness). Stated another way, the hydrocarbon thickness measured in the well is four times greater than the actual thickness in the formation. The principal weakness of this method is that it does not account for the effects of different soil types. Exhibit III-12 illustrates that in general, the ratio of apparent to true free product thickness increases as soil grain size decreases. Thus, this method may be more accurate in finer grained soil (*e.g.*, silt, clay) than in coarser-grained soil (*e.g.*, sand, loam)

Method of Hall, *et al.* (1984)

$$H_f = H_o - F$$

This method depends upon a "formation factor" (*F*), which is apparently empirical, and not related to any other type of formation factor (*e.g.*, those found in petroleum literature) (Ballestero *et al.*, 1994). For a fine sand, *F* is equal to 12.5 cm; for a medium sand, *F* is equal to 7.5 cm; and for a coarse sand, *F* is equal to 5 cm. The principal weakness of this method is in selecting an appropriate value for F, especially when the soil is either not one of the three types mentioned above or is layered. Hall *et al.* (1984) also report that there must be a minimum thickness of hydrocarbon in the well for this method to be valid. For a fine sand, the minimum thickness is equal to 23 cm; for a medium sand, the minimum thickness is equal to 15 cm; and for a coarse sand, the minimum thickness is equal to 8 cm.

Method of Blake and Hall (1984)

$$H_f = H_o - \left(x + h_a\right)$$

This method is relatively straightforward, depending only upon measured lengths, however, the parameter h_a is difficult to accurately measure especially in the field. Ballestero *et al*. (1994) indicate that h_a should equal the height of the water capillary fringe when the thickness of hydrocarbon in the formation is relatively small since no pore water is displaced. As the thickness of free product builds up, the water capillary fringe becomes depressed as pore water is displaced and the value of h_a diminishes. When the hydrocarbon lens reaches the water table, the value of h_a becomes zero. At this point, the thickness of hydrocarbon in the formation is equal to the distance between the top of the free product layer and the true elevation of the water table. Both of these measurements can be obtained using the methodology illustrated in Exhibit III-10.

Method of Ballestero *et al*. (1994)

$$H_f = \left(\left(1 - r_o\right) \cdot H_o\right) - h_a$$

This method is essentially equivalent to the method of Blake and Hall (1984) when an actual measurement of their parameter "*x*" is not available, but the product density and thickness of product in the monitor well are known. Recall that *x* is equal to the product of the thickness of the hydrocarbon in the well and the hydrocarbon density ($H_o \cdot r_o$).

Rearranging the above equation and substituting *x* for ($H_o \cdot r_o$) yields the same equation. The principal limitation of this method (as well as the method of Blake and Hall) is that the parameter h_a is difficult to measure in the field. When h_a has decreased to zero, the thickness of the free product layer in the soil is equal to the distance between the top of the free product layer measured in the well and the true (corrected) elevation of the water table. Both of these measurements can be obtained using the methodology illustrated in Exhibit III-10.

Method of Schiegg (1985)

$$H_f = H_o - 2\left(h_{c,dr}\right)$$

This method essentially attempts to correct the exaggerated thickness of free product in a well by subtracting a constant (2 $h_{c,dr}$) that depends on the soil type. The finer the soil, the greater the constant. Typical values of $h_{c,dr}$, as reported by Bear (1972), are 2-5 cm for coarse sand, 12-35 cm for medium sand, and 35-70 for fine sand. The principal weakness of this method is that it relies on a parameter that is difficult to accurately determine. Values for $h_{c,dr}$ vary by a factor of 2 over the range from low to high. Also, it is possible for this method to yield a negative value if there is only a thin layer of free product in the well.

Method of Farr *et al*. (1990)

$$V_o = f\left(1 - S_r\right) D\left[\left(\frac{H_o}{D}\right) - 1\right]$$

$$D = \frac{P_d^{ow}}{\Delta r\, g} - \frac{P_d^{ao}}{r_o\, g}$$

This method is dependent upon conditions of static equilibrium. Farr *et al*. (1990) present several variations of this equation for different soil types and different extent of liquid hydrocarbon in the unsaturated zone. The above equation is based on equation #15 in their paper, which is valid for unconsolidated sand with very uniform pore sizes. The principal limitation of this method is in obtaining values for P_d^{ow} and P_d^{ao}, neither of which is easily measured in the field. Ballestero *et al*. (1994) present and discuss this method, however there is a discrepancy in the formulation of the "D" term, which is not possible to resolve based on the information provided. Ballestero *et al*. (1994) also mistakenly assume that H_f and V_o are equivalent. The relationship between H_f and V_o is discussed later in this Appendix.

Method of Lenhard and Parker (1990)

$$H_f = \frac{r_o \, b_{ao} \, H_o}{b_{ao} \, r_o - b_{ow} \left(1 - r_o\right)}$$

$$b_{ao} = \frac{s_{aw}}{s_{ao}}$$

$$b_{ow} = \frac{s_{aw}}{s_{ow}}$$

This method is dependent upon conditions of static equilibrium; it assumes a theoretical, vertical saturation profile based on generalized capillary pressure relationships. Extensions of this method allow consideration of residual oil trapped above and below the mobile zone by a fluctuating water table. The principal limitations of this method are that it does not account for dynamic conditions or small-scale heterogeneities, and few of the parameters can be measured in the field. Parameters from published literature for pure compounds may be substituted but it is uncertain how applicable such values are to aged mixtures of petroleum hydrocarbons in the subsurface.

Relationship Between V_o and H_f

Although both the thickness of hydrocarbon in the soil (H_f) and specific oil volume (V_o) can be expressed in dimensions of length [L], they are not equivalent terms. Vertical integration of the hydrocarbon content in the soil yields the volume (V_o) of hydrocarbon in the medium per unit area, whereas H_f is merely the corrected thickness of the free product layer in the geologic formation. V_o actually has dimensions of L^3/L^2 and is commonly expressed in terms of cubic feet per square foot. To determine H_f, V_o must be divided by the effective porosity. In the unsaturated zone, effective porosity is equal to the product of porosity [f] times the quantity 'one minus the residual saturation' ($1-S_r$). The length dimension of the V_o term

is equivalent to the height that a specified volume of liquid hydrocarbon would rise in an empty box measuring one unit of length on each side. The length dimension of the H_f term is equivalent to the height that the same specified volume of liquid hydrocarbon would rise in the same box filled with a porous media (*e.g.*, sand) of porosity f and residual saturation S_r. Obviously, the height of the rise in the box filled with a porous media would be higher than in the empty box. To illustrate this point, consider an empty box that measures one unit of length on each side. Take a specific volume of liquid and pour it into the box. The depth of liquid in the box is equivalent to the specific volume of the liquid. Now consider the same box but this time it is filled with marbles that are packed so that the pore spaces represent only 25 percent of the total volume. If the same volume of liquid is poured into this box, the height of the liquid will be four times greater than the height in the empty box.

Relevance To Free Product Recovery

Each of the above methods for determining volume of free product has its strengths and weaknesses. In general, none of the methods is particularly reliable under any given set of conditions either in the field or in the laboratory. Although there have been some creative attempts to compensate for the limitations of some of the methods, it is not usually possible to predict the accuracy. For example, Huntley *et al*. (1992) apply the methods of Farr *et al*. (1990) and Lenhard and Parker (1990) to a stratified system, with each layer represented by its own specific capillary pressure-saturation curves. The profiles generated by the layered model match measured hydrocarbon saturations better than the use of a single "average" layer. However, the study indicates that predicted saturations can be erroneous if the system is not in equilibrium, and hence in violation of the assumption of hydrostatic pressure distribution. These non-equilibrium effects can be caused by rising or falling water table elevations. Unfortunately, like anisotropy, non-equilibrium is most often the rule, and isotropy and equilibrium are the exceptions. To estimate the volume of free product in the subsurface, no one method should be relied on exclusively. Select the methods that are most appropriate to the site conditions and determine a volume using each method. In this way a reasonable range of values can be established.

From: Peterson, Gundar
Sent: Wednesday, September 03, 2008 3:28 PM
To: Golden, Tom
Subject: 50% recoverable hydrocarbons

Remediation Technologies for Soils and Groundwater (Paperback)
by Alok Bhandari (Editor), Rao Y. Surampalli (Editor), Pascale Champagne (Editor), Say Kee Ong (Editor), R. D. Tyagi (Editor)Paperback: 456 pages
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A Practical Approach to the Design, Operation, and Monitoring of In Situ Soil-Venting Systems

by P.C. Johnson, C.C. Stanley, M.W. Kemblowski, D.L. Byers, and J.D. Colthart

Abstract

When operated properly, in situ soil venting or vapor extraction can be one of the most cost-effective remediation processes for soils contaminated with gasoline, solvents, or other relatively volatile compounds. The components of soil-venting systems are typically off-the-shelf items, and the installation of wells and trenches can be done by reputable environmental firms. However, the design, operation, and monitoring of soil-venting systems are not trivial. In fact, choosing whether or not venting should be applied at a given site is a difficult decision in itself. If one decides to utilize venting, design criteria involving the number of wells, well spacing, well location, well construction, and vapor treatment systems must be addressed. A series of questions must be addressed to decide if venting is appropriate at a given site and to design cost-effective in situ soil-venting systems. This series of steps and questions forms a "decision tree" process. The development of this approach is an attempt to identify the limitations of in situ soil venting, and subjects or behavior that are currently difficult to quantify and for which future study is needed.

Introduction

When operated properly, in situ soil venting or vapor extraction can be a cost-effective remediation process for soils contaminated with gasoline, solvents, or other relatively volatile compounds. A "basic" system, such as the one shown in Figure 1, couples vapor extraction (recovery) wells with blowers or vacuum pumps to remove vapors from the vadose zone and thereby reduce residual levels of soil contaminants. More complex systems incorporate trenches, air injection wells, passive wells, and surface seals. Above-ground treatment systems condense, adsorb, or incinerate vapors; in some cases vapors are simply emitted to the atmosphere through diffuser stacks. In situ soil venting is an especially attractive treatment option because the soil is treated in place, sophisticated equipment is not required, and the cost is typically lower than other options.

The basic phenomena governing the performance of soil-venting systems are easily understood. By applying a vacuum and removing vapors from extraction wells, vapor flow through the unsaturated soil zone is induced. Contaminants volatilize from the soil matrix and are swept by the carrier gas flow (primarily air) to the extraction wells or trenches. Many complex processes occur on the microscale, however, the three main factors that control the performance of a venting operation are the chemical composition of the contaminant, vapor flow rates through the unsaturated zone, and the flow path of carrier vapors relative to the location of the contaminants.

The components of soil-venting systems are typically off-the-shelf items, and the installation of wells and trenches can be done by reputable environmental firms. However, the design, operation, and monitoring of soil-venting systems is not trivial. In fact, choosing whether or not venting should be applied at a given site is a difficult question in itself. If one decides to utilize venting, design criteria involving the number of wells, well spacing, well location, well construction, and vapor treatment systems must be addressed. It is the current state-of-the-art that such questions are answered more by experience than by rigorous logic. This is evidenced by published soil venting "success stories" (see Hutzler et al. 1988 for a good review), which rarely include insight into the design process.

In this paper, a series of questions are presented that must be addressed to:

- Decide if venting is appropriate at a given site.
- Design cost-effective in situ soil-venting systems.

This series of steps and questions forms a "decision tree" process. The development of this approach is an attempt to identify the limitations of in situ soil venting, and subjects or behavior that are currently difficult to quantify and for which future study is needed.

The "Practical Approach"

Figure 2 presents a flow chart of the process discussed in this paper. Each step of the flow chart will be discussed in detail, and where appropriate, examples are given.

The Site Characterization

Whenever a soil contamination problem is detected or suspected, a site investigation is conducted to charac-

then Figure 8 predicts that ~ 100 l-air/g-gasoline will be required. This is the minimum amount of vapor required, because it is based on an equilibrium-based model. The necessary minimum average vapor flow rate is then equal to the spill mass times the minimum required vapor flow/mass gasoline divided by the desired duration of venting. Use of this approach is illustrated in the service station site example provided at the end of this paper.

Figure 8 also illustrates that there is a practical limit to the amount of residual contaminant that can be removed by venting alone. For example, it will take a minimum of 100 l-vapor/g-gasoline to remove 90 percent of the weathered gasoline defined in Table 2, while it will take about 200 l-air/g-gasoline to remove the remaining 10 percent. In the case of gasoline, by the time 90 percent of the initial residual has been removed, the residual consists of relatively insoluble and non-volatile compounds. It is important to recognize this limitation of venting, and when setting realistic cleanup target levels, they should be based on the potential environmental impact of the residual rather than any specific total residual hydrocarbon levels. Because mandated cleanup levels are generally independent of the remediation method, this also indicates that soil venting will often be one of many processes used during a given site remediation. It is not difficult to envision that in the future soil venting may be followed or coupled with enhanced biodegradation to achieve lower cleanup levels.

It is appropriate to mention at this point that the mathematical models presented in this paper are being used as "tools" to help plan and design venting system. As with any models, they are mathematical descriptions of processes that at best approximate real phenomena, and care should be taken not to misapply or misinterpret the results.

Are There Likely to Be Any Negative Effects of Soil Venting?

It is possible that venting will induce the migration of off-site contaminant vapors toward the extraction wells. This may occur at a service station, which is often in close proximity to other service stations. If this occurs, one could spend a lot of time and money to unknowingly clean up someone else's problem. The solution is to establish a "vapor barrier" at the perimeter of the contaminated zone. This can be accomplished by allowing vapor flow into any perimeter ground water monitoring wells (which often have screened intervals extending above the saturated zone), which then act as passive air supply wells. In other cases it may be necessary to install passive air injection wells, or trenches, as illustrated in Figure 9a.

As pointed out by Johnson et al. (1988), the application of a vacuum to extraction wells can also cause a water table rise. In many cases contaminated soils lie just above the water table and they become water saturated, as illustrated in Figure 9b. The maximum rise occurs at, or below the vapor extraction well, where the water table rise will be equal to the vacuum at that point

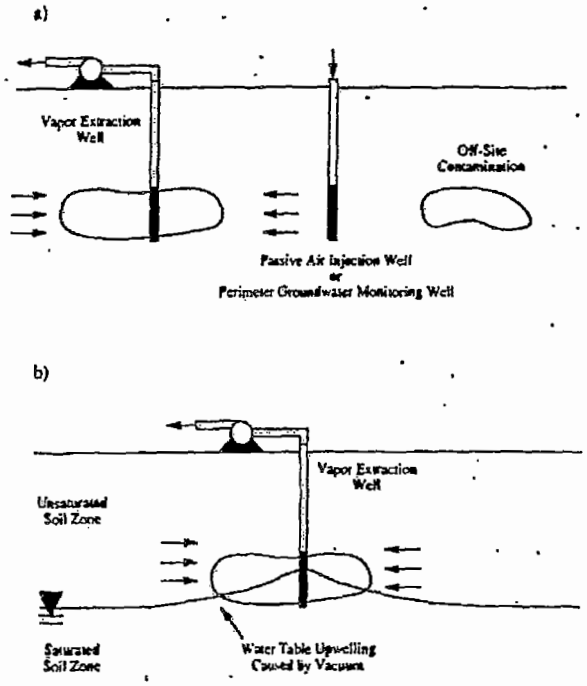


Figure 9. (a) Use of passive vapor wells to prevent migration of off-site contaminant vapors. (b) Water table rise caused by the applied vacuum.

expressed as an equivalent water column height (i.e., in ft H_2O). The recommended solution to this problem is to install a dewatering system, with ground water pumping wells located as close to vapor extraction wells as possible. The dewatering system must be designed to ensure that contaminated soils remain exposed to vapor flow. Other considerations not directly related to venting system design, such as soluble plume migration control and free-liquid product yield, will also be factors in the design of the ground water pumping system.

Design Information

If venting is still a remediation option after answering the questions above, then more accurate information must be collected. Specifically, the soil permeability to vapor flow, vapor concentrations, and aquifer characteristics need to be determined. These are obtained by two field experiments: air permeability and ground water pumping tests, described briefly next.

Air Permeability Tests

Figure 10 depicts the setup of an air permeability test. The object of this experiment is to remove vapors at a constant rate from an extraction well, while monitoring with time the transient subsurface pressure distribution at fixed points. Effluent vapor concentrations are also monitored. It is important that the test be conducted properly to obtain accurate design information. The extraction well should be screened through the soil zone that will be vented during the actual operation. In many cases existing ground water monitoring wells are sufficient, if their screened sections extend above the water table. Subsurface pressure monitoring probes can be

4

Selecting the Appropriate Abatement Technology

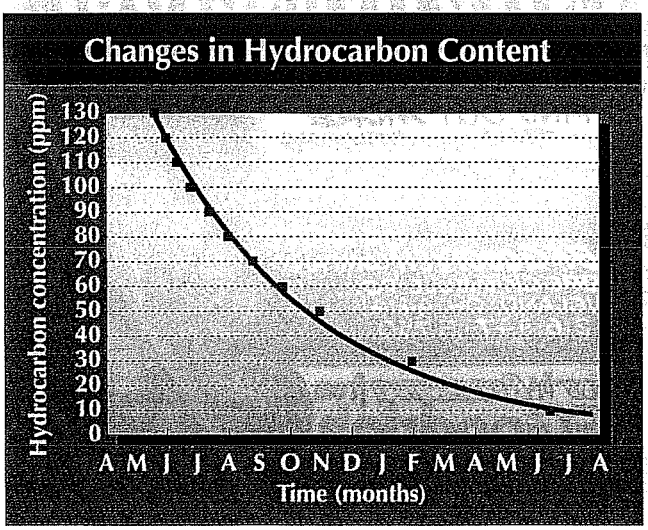
Estimating the life-cycle costs of treating hydrocarbon vapors extracted from soil.

by Dr. Peter M. Kroopnick



Vapor extraction systems commonly are used to remediate soil contaminated with volatile and semivolatile hydrocarbons. The source of this contamination usually is a leak from an underground storage tank (UST), although accidental spills from pipelines and aboveground tanks also are common. The typical vapor extraction system consists of a vacuum pump attached to shallow extraction wells completed in the vadose zone. The rate of extraction depends on the diffusion and advection of vapor from the contaminated zone, and on the bulk permeability of the soil.

Control of emissions from soil-vent systems increasingly is required. In these cases, the factor that limits the rate of hydrocarbon extraction very often is not the rate of extraction from the ground, but rather the capacity of the abatement device. The concentration of hydrocarbon in the extracted vapor usually is high at the beginning of a remediation and displays an exponential decrease over time (Kroopnick, 1995). There are various strategies for selecting the technology and capacity for the treatment system based on life-cycle costing principles. The devices discussed are vapor-phase granular activated carbon, catalytic oxidation with and without a heat recovery system and thermal oxidation.



● *Figure 1. Changes in hydrocarbon content of a vapor-stream during a soil-vent cleanup (squares). The solid line represents an exponential decay with a removal factor of 0.38 per day.*

Vapor removal from the vadose zone

A soil-vent feasibility study often is performed to determine the site-specific parameters necessary to design a successful and efficient soil-vent system. The key parameters that must be determined are the location of the contaminant, the permeability of the various soil layers and the ability to induce air flow preferentially through the contaminated area. It also is important to ascertain the actual hydrocarbon concentra-

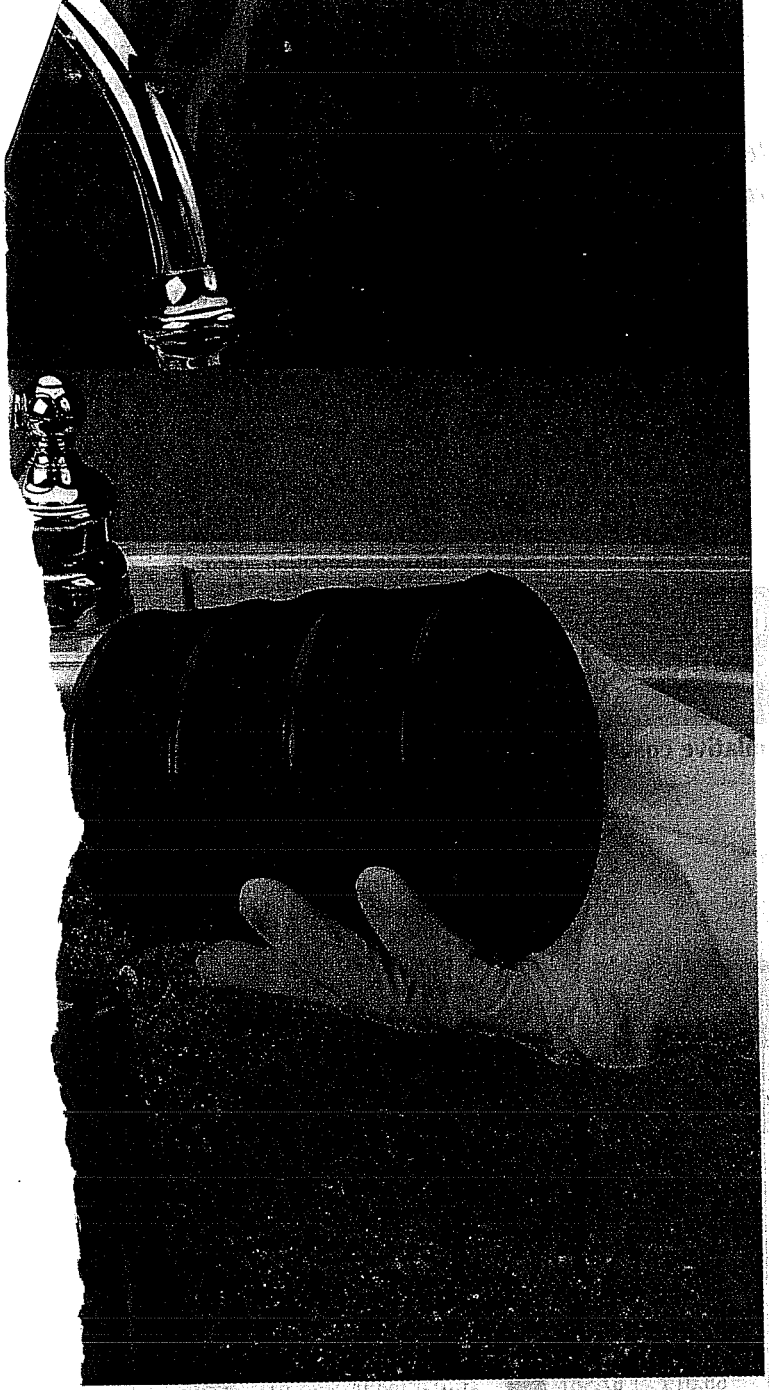


Table 1. Vapor Abatement Cost Analysis Program Input Data Worksheet

Site name:			
Shaded items are model inputs	**Devices**		
Device parameters	**Unit 1**	**Unit 2**	
Maximum device flow rate (scfm)	200	200	A
Maximum device HC concentration (ppmV)	3900	7500	B
Maximum device HC concentration (%LFL) *D = B/13,000*	30%	30%	D
Maximum HC removal (pounds/day) *E = A*B*1.016/mol.wt.*	147	284	E
Installation costs			
Engineering design			F
Equipment purchase			G
Permitting			H
Utilities			I
Installation construction			J
Supplies			K
Startup			L
Total installation costs *M = F+G+H+I+J+K+L*			M
Ongoing costs (monthly)			
Unit lease (purchase price/12)			N
Maintenance visits			O
Sampling per Air Board			P
Disposables (fixed monthly)			Q
Disposables (per pound of carbon)			R
Daily costs (except fuel) *S = (N+O+P+Q)/30*			S
Fuel costs @ zero HC concentration ($/day)			T
Fuel cost @ max. HC concentration (see E)			U
Efficiency factor *V = T-U/T*			V
Daily operating cost, zero HC *W = S+T*			W
Daily operating cost, max. HC *X = W-V*E*			X
Fuel factor *Y = T*V/E*			Y
Site parameters			
Total mass to be removed (pounds)	40,000	40,000	
Starting concentration (ppmV)	10,000	10,000	
Molecular weight of contaminant	85	85	
Expected flow rate (scfm)	200	200	
Interest rate for NPV calculation	10%	10%	
VACAP output			
Cleanup time (to 99%)			
Total cost			
Total cost as NPV			

tion and expected flow rate so the appropriate vacuum pump and emissions-control device can be selected. The cost effectiveness of a venting system thus depends on the quality of the design and its engineering and construction.

Two factors are critical to effective design and operation. The first is the extraction system itself, which includes the number, spacing and location of the extraction wells, as well as the size and type of the manifold and its layout. The second is the vapor treatment system. Carbon generally is inexpensive to purchase, install and permit. However, when high levels of volatile organic compounds (VOCs) are present, carbon can be extremely expensive to recycle. On the other hand, although thermal or catalytic oxidation systems require higher capital expenditure and take time to permit, they are relatively inexpensive to operate because they do not generate hazardous waste. Table 1 illustrates the operating cost categories and parameters for two hypothetical abatement methods. Determining which method to use requires a thorough understanding of the changes in VOC concentration that occur during the soil venting process.

The change in the hydrocarbon content in the vapor stream during a soil-vent cleanup is shown in Figure 1. The site is a retail service station with two vapor-extraction wells. The change in discharge concentrations of hydrocarbons over time, measured with a portable photoionization detector (PID) instrument, indicates a decrease from 130 parts per million by volume (ppmv) to 10 ppmv during the first two months of operation. Following a rapid initial decrease, a slow (asymptotic) decline toward the baseline value is observed. This is typical for soil-vent remediation systems. For comparison, an exponential decay curve of the form:

$$C_t = C_0 \exp(-RF \cdot t)$$

where C_t equals the concentration of hydrocarbon in the vapor phase at time t, C_0 equals the initial concentration at time 0, t equals time and RF is the removal factor, also is shown.

This exponential decay is observed at many sites.

A mathematical model simulates the cost of treating extracted volatiles.

Buscheck and Peargin (1991) conducted a survey of 143 operating vapor extraction systems and found two distinct decay patterns. The first conforms to the exponential model, while the second exhibits a decay with a non-zero asymptote for the mass removal. This latter pattern usually occurs in non-homogeneous formations where slow diffusion from the less permeable zone limits the rate of cleanup (Tormey et al., 1992).

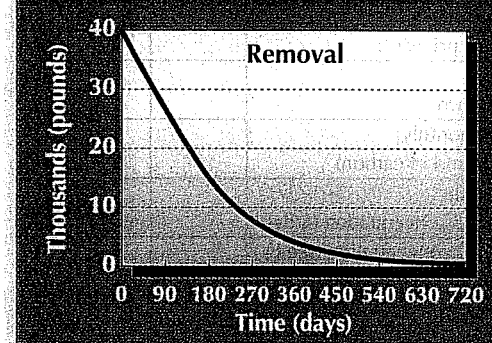
Simulating a remediation

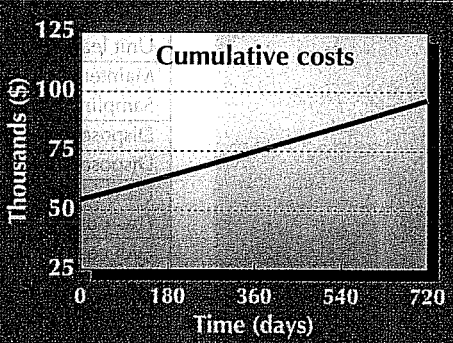
In most cases, the hydrocarbon concentration decreases very rapidly at startup and is followed by an asymptotic approach to zero. To estimate the life-cycle costs for operating an abatement device, this exponential change with time first must be simulated for each site. Exact mathematical models have been proposed for these systems (Johnson et al., 1988). However, because the field data needed to run an exact model usually are not obtainable, we have taken an empirical approach for the purpose of developing a cost analysis methodology.

The model chosen for this simulation is a first order decay process in which the amount of material removed at each time step is calculated based on the assumption that the total remaining mass and the vapor phase concentration approach zero simultaneously. The simulation is performed on a personal computer using a spreadsheet, or with an in-house program called the Vapor Abatement Cost Analysis Program (VACAP) (Kroopnick, 1995). Site-specific data must be obtained for the initial concentration of hydrocarbon in the extractable vapor and for the total amount of contamination to be treated. For each abatement device, information is required for the rate of flow through the device, and for the maximum hydrocarbon concentration the device safely can process.

A critical part of the simulator is the removal rate factor (RF), equivalent to the exponential decay factor in the equation. In the models shown, the RF is adjusted to force both the mass of hydrocarbon remaining and the current concentration to simultaneously approach zero. Figure 2 shows a simulation for a catalytic oxidizer with a heat exchanger. For each time step, the hydrocarbon concentration in the vapor phase is decreased using the equation. If the current concentration is greater than the abatement unit can handle, it must be diluted to an acceptable level. In that case, the effective flow from the soil is reduced as shown in the daily flow column of Figure 2. This dilution usually is accomplished by opening a bleed

Results for VACAP Analysis of a Catalytic Oxicizer with a Heat Exchanger





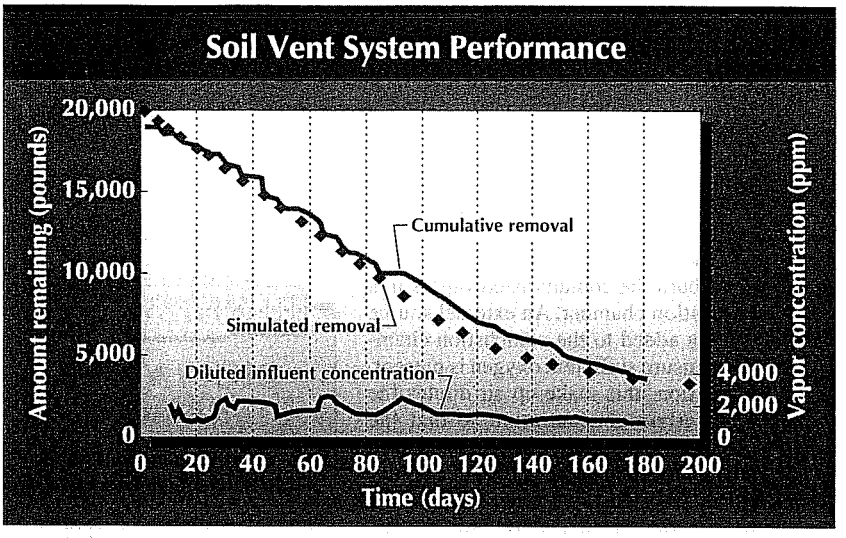
Time (days)	Contaminant left (pounds)	Daily removal (pounds/day)	Daily flow (cfm)	Vapor concentration (ppmv)	Daily cost ($)	Cumulative cost ($)	Cost NPV @10%
0	40,000	0.0	0	10,000	49	54,950	54,950
30	35,652	144.9	96	8090	52	56,495	56,488
60	31,303	144.9	118	6545	52	58,040	58,014
90	26,955	144.9	146	5295	52	59,585	59,528
120	22,607	144.9	181	4284	52	61,130	61,029
150	18,388	129.7	200	3466	54	62,695	62,537
180	14,894	104.9	200	2804	58	64,373	64,140
210	12,066	84.9	200	2268	61	66,154	65,828
240	9779	68.7	200	1835	63	68,019	67,581
270	7929	55.6	200	1485	65	69,951	69,383
300	6432	45.0	200	1201	67	71,939	71,221
330	5220	36.4	200	972	68	73,971	73,085
360	4241	29.4	200	786	69	76,039	74,966
390	3448	23.8	200	636	70	78,136	78,858
420	2806	19.3	200	515	71	80,256	78,756
450	2288	15.6	200	416	72	82,396	80,654
480	1868	12.6	200	337	72	84,551	82,551
510	1528	10.2	200	272	72	86,718	84,444
540	1253	8.3	200	220	73	88,895	86,329
570	1031	6.7	200	178	73	91,081	88,206
600	851	5.4	200	144	73	93,273	90,073
630	706	4.4	200	117	73	95,470	91,930
660	588	3.5	200	94	73	97,672	93,775
690	493	2.9	200	76	74	99,877	95,607
720	416	2.3	200	62	74	102,085	97,427

● ***Figure 2. Results for the VACAP analysis of a catalytic oxidizer with a heat exchanger.***

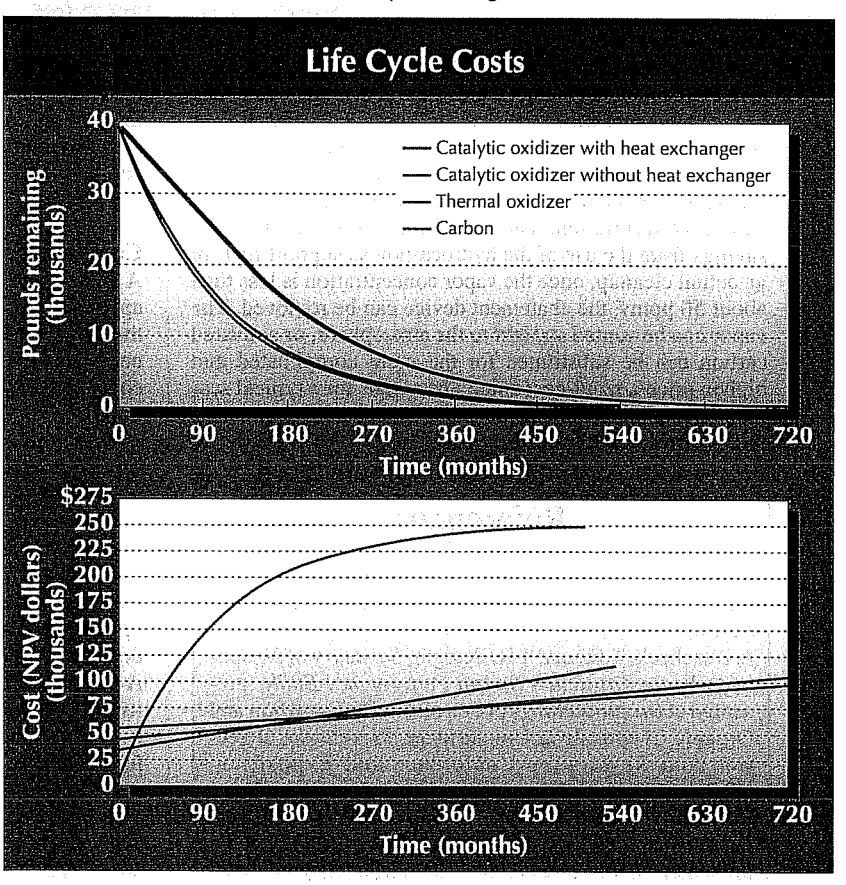
valve and is simulated as shown in Figure 2 by decreasing the total flow of air into the unit.

If the newly calculated concentration is less than the maximum the abatement unit can handle, the entire process stream is admitted to the unit, and the amount of hydrocarbon removed for that time step is subtracted from the remaining mass. For the unit in this example, the maximum influent concentration of 3900 ppmv is reached after 150 days, as shown in Figure 2. The effects of variable geologic conditions are considered by adjusting the decay factor by approximately ±10 percent to simulate the relative effects of very permeable sand or much less permeable clay.

Figure 3 shows actual data and a simulation for a retail petroleum site where the defective UST was removed and four vapor extraction wells were installed. The underlying soil were of mixed lithology, ranging from silty clay to sandy gravel, and had concentrations of total petroleum hydrocarbons as gasoline in excess of 11,000 mg/kg. Initial mass balance calculations indicated that approximately 20,000 pounds of hydrocarbon could be recovered. Vapor concentrations from the wells initially exceeded 20,000 ppmv of gasoline, and were diluted by manually opening a bleed valve until the vapor concentration remained below 3900 ppmv on day 110. See the lowest curve in Figure 3. The upper curve shows the decrease in total mass. Note that the curve is nearly linear between days 30 and 110. This is due to the nearly constant removal rate, which was controlled by the dilution process. The results of the VACAP model are shown by the diamond symbols and appear to match the observed removal rate.



• ***Figure 3. Comparison of VACAP model with data collected during remediation of a site contaminated by a leaking UST.***



• ***Figure 4. The upper figure shows the decrease in the mass remaining versus time. The lower figure shows the increasing cumulative costs for each of the three abatement devices. Note: Figures are for illustrative purposes only.***

Abatement devices

The assumptions for estimating the costs and treatment capacity for each unit must be based on vendor and engineering experience. The worksheet can be used to evaluate and compare total costs to treat a volatile contaminant.

Vapor-phase activated carbon is used as the baseline abatement technology. In our experience, the adsorption efficiency of carbon is about 25 percent for most hydrocarbons. For the sake of comparison, the maximum flow rate through the carbon has been established to be 200 standard cubic feet per minute (scfm). Due to safety standards, the maximum hydrocarbon concentration in the process stream will be kept below 100 percent of the lower flammability limit (LFL).

The catalytic oxidizer is a natural gas heated unit. The gasoline generates a rise in temperature across the catalyst equivalent to about 20°F for each one percent of LFL. Thus, a process stream of 30 percent of LFL causes the catalyst temperature to rise from a light off point of 650°F to 1250°F. This represents the maximum temperature the unit can sustain without damaging the catalyst. Installation costs can be based on experience at similar sites. Catalyst replacement every six months to 12 months of operation also must be considered. The equivalent cost savings for the amount of hydrocarbon usable as fuel could be as high as 90 percent as a result of using a heat exchanger, which preheats the process stream with the

Using the model, it is possible to compute the total cost of running designated equipment.

exhaust gas. A unit without the heat exchanger is less expensive, but results in an efficiency of only about 25 percent.

A thermal oxidizer unit uses natural gas to burn the contaminated vapors in a combustion chamber. An external source of air is added to the combustion chamber to ensure sufficient oxygen is present. In addition, this make-up air dilutes the hydrocarbon concentration so that the maximum contaminant level is estimated to be about 60 percent of LFL. Support fuel is required at all times to keep the combustion chamber above 1400°F. The effectiveness of a heat exchanger is similar to a catalytic unit.



REGULATORY IMPACT

The following regulation applies to hydrocarbon vapors:

▶ The Federal Clean Air Act, administered by local air pollution control agencies

Life-cycle costs

The proposed simulation model now can be used to compute the life-cycle costs for each of the abatement units. The user should first fill in the data in Figure 1. For each time step of the simulation, the daily cost is calculated based on the daily cost with no hydrocarbons in the process stream, minus the amount of fuel recovered from the current hydrocarbon concentration. The fuel factor represents the cost savings from the use of the hydrocarbon as support fuel. In an actual cleanup, once the vapor concentration is less than about 50 ppmv, the abatement device can be removed. The vapor can be vented straight to the atmosphere, or activated carbon can be substituted for the more complicated and higher-priced, fixed-cost units. The results for a typical scenario are presented in Figure 2.

For a relatively permeable formation, the time decay curves appear to be linear during the early part of the cleanup. This is because the process stream is diluted to meet the maximum hydrocarbon levels permitted by each unit. During this early stage, the number of pounds removed per day is constant for each abatement unit, and the relative slopes of the four curves reflect the flow rate and concentration for each device. The life-cycle costs for this simulation represent the sum of all the daily costs. The times and life-cycle costs to achieve removal of 99 percent of the contaminant mass indicate that while the carbon system achieves cleanup in the least time, 526 days, it will cost more than twice as much as any of the other alternatives considered here. See Figure 4. Net present value costs also are given, assuming a rather high inflation rate of 10 percent to emphasize the advantage of using current dollars to pay for future costs. The thermal unit requires 543 days but costs less. The catalytic system without a heat exchanger takes 728 days and costs still less, while using a heat exchanger reduces the final cost even further.

Conclusions

A mathematical model has been developed and shown applicable to vapor extraction of small sites. It calculates the expected time required to extract the volatile components adsorbed to soil, and then uses the time-dependent concentration data to drive an economic model that computes the total cost to run the designated equipment. The assumptions inherent in the model and the estimated performance characteristics for the various abatement devices must be developed for each site, but usually can be estimated from prior experience. The life-cycle model indicates that vapor phase carbon can be used to remediate a site very quickly, but the associated costs are more than twice that of the other abatement units. The thermal oxidizer initially appears to be very cost-effective, but this advantage decreases with respect to the catalytic unit for longer times. A heat exchanger raises the initial capital cost but pays for itself in about 200 days.

These evaluations should be considered generic and used for illustrative purposes only, because actual site conditions may vary considerably with respect to geologic complexity, quantity of material to be treated and chemical composition of the contaminant. The final decision as to the most appropriate abatement device also should take into account whether time or cost is the most important parameter, and whether the treated vapor stream complies with local air discharge regulations.

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- Buscheck, T.E., and T.R. Peargin, *Summary of Nationwide Vapor Extraction System Performance Study*, presented at the proceedings of Petroleum Hydrocarbon and Organic Chemicals in Groundwater, Prevention, Detection and Restoration Conference and Exposition, NWWA, Houston, Texas, 1991.
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- Tormey, D., E. Simonis and J. Bower, "Soil Vapor Extraction from Heterogeneous Sedimentary Deposits." *Hydrocarbon Contaminated Soil and Groundwater*, Lewis Publishing, Chelsea, Mich., 1992.

Reader Interest Review

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Calculation Cover Sheet

Daniel B. Stephens & Associates, Inc.

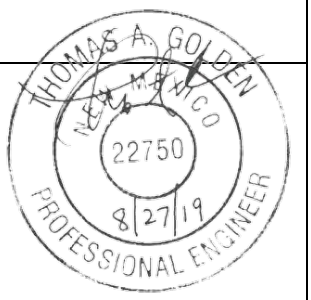
Project Name Shamrock 63 Project Number BE14.0012

Calculation Number BE14.0012-001 Discipline Engineering No. of Sheets 6

PROJECT: Shamrock 63

SITE: Shamrock 63, Santa Fe, New Mexico

SUBJECT: Determine pressure losses and size blowers for the SVE remediation system.



SOURCES OF DATA:

A. Computer Applications in Hydraulic Engineering, 6th edition, Haestad Methods, Inc, 2004, Table 1-2:Typical Roughness Coefficients

B. Fundamentals of Fluid Mechanics, 2nd edition, Bruce Munson, Donald Young and Theodore Okiishi, John Wiley & Sons, Inc, 1994

C. PVC pipe size & fittings dimensions from Commericial Industrial Supply

SOURCES OF FORMULAE & REFERENCES:

1. Computer Applications in Hydraulic Engineering, 6th edition, Haestad Methods, Inc, 2004.

2. Water Resources Engineering, Ralph Wurbs and Wesley James, Prentice Hall, 2002.

☐ Preliminary Calculation ☒ Final Calculation Supersedes Calculation No. _____

Rev. No.	Revision	Calculation By	Date	Checked By	Date	Approved By	Date
0		JES	7/8/19	KJ	7/16/19	TG	8/3/19

Project No. BE14.0012 Date 07/08/2019

Subject Pressure losses and remediation system blower design Sheet 1 of 6

By JES Checked By KJ Calculation No. BE14.0012-001

1.0 OBJECTIVE

Calculate the amount of pressure loss within the SVE pipe network, and use this information to size a system blower.

2.0 GIVEN

SVE conveyance pipe consisting of 2-inch schedule 40 PVC and equipment compound piping consisting of 6-inch SCH 40 PVC[C]; minor loss coefficients, K, for fittings within the system[B]; individual SVE well air flowrates[C]; and Darcy Weisbach roughness coefficients of 0.000005 for plastic pipe[A].

3.0 METHOD

Use the Darcy-Weisbach equation[2] to determine the amount of pressure loss within a given system. This equation is dependent on fluid properties (density and kinematic viscosity of the fluid), pipe material properties (expressed through the Darcy-Weisbach friction factor), pipe length, and pipe diameter. The Darcy-Weisbach friction factor[1] is dependent on the Darcy-Weisbach roughness coefficient[A], pipe diameter, and the Reynolds number[1].

The first step in determining the major and minor pressure losses within a given system is to determine the Reynolds number for the system. This unitless number describes the type of flow within the system. Reynolds numbers above 4,000 describe fully-developed turbulent flow[1]. In order to determine the Reynolds number, three variables are needed: the kinematic viscosity of the fluid, the characteristic length/diameter of the pipe, and the average fluid velocity.

$$\mathrm{Re} = \frac{\rho V D}{\mu} \qquad \text{eqn. 1}$$

Where
- Re = Reynolds number
- ρ = Fluid density
- V = Fluid velocity
- D = Pipe diameter
- μ = Kinematic viscosity

Calculate the Darcy-Weisbach friction factor[1].

$$f = \frac{1.325}{\left[\ln\left(\frac{k}{3.7D} + \frac{5.74}{\mathrm{Re}^{0.9}}\right)\right]^2} \qquad \text{eqn. 2}$$

Where f = Darcy-Weisbach friction factor
k = Darcy-Weisbach roughness coefficient
Re = Reynolds number
D = Pipe diameter

Calculate major pressure losses within the system[2].

$$H_{maj} = \frac{flV^2}{D2g} \qquad \text{eqn. 3}$$

Where H_{maj} = Major headlosses
f = Darcy-Weisbach friction factor
l = pipe length
D = Hydraulic diameter
V = Fluid velocity
g = Gravitational acceleration

Minor pressure losses are dependent on the type of fitting and the velocity head of the fluid flowing through the pipe network.

Calculate minor pressure losses within the system. The values of K are additive.

$$H_{\min} = K_m \frac{V^2}{2g} \qquad \text{eqn. 4}$$

Where H_{minor} = Minor head losses
K_m = Minor loss coefficient for fittings

Use the major and minor pressure losses, together with the expected applied extraction well vacuum of 60 in H_2O, to determine the expected blower operating vacuum.

4.0 SOLUTION

The Shamrock 63 State Lead site will consist of a single SVE system connected to 11 vertical wells. In October of 2017, a pilot test was conducted to collect site specific data in order to inform the remediation system design. The vacuum and flow data collected were used to estimate the flow for several proposed SVE wells based on calculated unit flowrates per length of exposed screen. The flow from each extraction well is conveyed to a 4-inch-diameter SCH 40 PVC SVE manifold through 2-inch SCH 40 PVC pipe.

Example calculations are provided below for MW-1 and the manifold. Calculations for all SVE lines and extraction wells are provided in the attached spreadsheet. The following equations display significant digits carried through in the spreadsheet.

First, determine the linear flow velocity and Reynold's number for each conveyance line at the anticipated flow rate assuming full pipe flow. Average inside diameter is 2.047 and 6.031 inches for the 2-inch and 6-inch SCH 40 PVC pipe, respectively [C]. Assume a dynamic viscosity and air density of 3.585 E-7 lbf*sec/ft^2 and 1.955 E-3 slug/ft^3, respectively, corresponding to an elevation of 6,630 feet above mean sea level.

V_{2PVC} = Q / A = (30 ft^3/min) * (min / 60 sec) / (π / 4 * (2.047 in / 12 in./ft)^2) = 21.9 ft/sec
V_{4PVC} = Q / A = (225 ft^3/min) * (min / 60 sec) / (π / 4 * (3.998 in / 12 in./ft)^2) = 43.0 ft/sec

Re_{2PVC} = ρ * V * D / μ = (1.955 E-3 slug/ft^3) * (21.9 ft/sec) * (2.047 in / 12 in./ft) / (3.585 E-7 lbf*sec/ft^2) = 20,355
Re_{4PVC} = ρ * V * D / μ = (1.955 E-3 slug/ft^3) * (43.0 ft/sec) * (3.998 in / 12 in./ft) / (3.585 E-7 lbf*sec/ft^2) = 78,163

The Reynold's numbers calculated above are indicative of turbulent flow. Use the calculated Reynolds numbers and a Darcy-Weisbach roughness coefficient of 0.000005[A] to calculate the Darcy-Weisbach friction factor following eqn. 2:

$$f_{2PVC} = \frac{1.325}{\left[ln\left(\frac{0.000005}{3.7 \times \left(\frac{2.047}{12}\right) + \frac{5.74}{20{,}355^{0.9}}}\right)\right]^2} = 0.0258$$

$$f_{4PVC} = \frac{1.325}{\left[ln\left(\frac{0.000005}{3.7 \times \left(\frac{3.998}{12}\right) + \frac{5.74}{78163^{0.9}}}\right)\right]^2} = 0.0189$$

The schedule of pipe and fittings for MW-1 (From the manifold to the well head) is presented in Table 1 below. The length of each pipe circuit is calculated using ArcMAP software.

Table 1: Pipe and fitting schedule for the conveyance line to MW-1

Pipe Section	Section Length (ft)	90° Elbow		Gate Valve		Entrance		Flow rate
		#	K	#	K	#	K	scfm
MW-1	120	5	1.5	1	1.0	1	0.5	30

Calculate major pressure losses for MW-1 using equation 3 together with the circuit length and flow rate from Table 1, the specific weight of air, and the Darcy friction factor calculated above. A sample calculation for MW-1 is provided with data summarized in Table 2 below:

$$H_{maj} = \frac{0.0258 \times 120\ ft \times 21.9^2 \frac{ft^2}{sec^2}}{\frac{2.047\ in.}{12\ {}^{in.}/_{ft}} \times 2 \times 32.2 \frac{ft}{sec^2}} = 134.7\ ft\ air$$

Convert this head loss from units of feet of air to units of inches of water.

$$134.7\ ft\ air \times \frac{0.06303 lbm/ft^3\ air}{62.37 lbm/ft^3\ water} \times \frac{12\ in.}{ft} = 1.63\ in. H_2O$$

Calculate minor pressure losses using equation 4 for fittings on the SVE-1 pipe circuit and data from Table 1. A sample calculation for pipe circuit MW-1 is provided with data summarized in Table 2 below:

$$K_m = (5 * 1.5) + (1 * 1.0) + (1 * 0.5) = 9.0$$

$$H_{min} = \frac{9.0 \times 21.9^2 \frac{ft^2}{sec^2}}{2 \times 32.2 \frac{ft}{sec^2}} \times \frac{0.06303\ lbm/ft^3\ air}{\frac{62.37\ lbm}{ft^3} water} \times \frac{12\ in.}{ft} = 0.81\ in\ H_2O$$

The total design pressure loss for the MW-1 line is the sum of the major and minor losses:

H_{H-1} = 1.63 + 0.81 = **2.44 in H_2O.**

The attached spreadsheet performs similar calculations for each SVE line in the proposed system. Table 2 below lists the line length, flow, vacuum, and maximum head loss for the line to an individual well head. A vacuum of 70 in H_2O is assumed at the blower.

Table 2: SVE Line and manifold pressure losses for the exisiting system

SVE Line	Total line length	Flow at Manifold[a]	Vacuum Pressure[a]	Max Head Loss[b]
	(ft)	(scfm)	(in H2O)	(in H2O)
MW-1	120	30	25.0	2.4
SVE-1S	136	60	25.0	9.5
MW-2	135	35	25.0	3.5
MW-11	99	5	50.0	0.1
MW-16	160	5	50.0	0.1
SVE-2D	92	30	50.0	1.9
SVE-3D	151	30	50.0	2.6
SVE-4S	58	15	50.0	0.4
SVE-5S	98	15	50.0	0.6
Manifold	16	225	60.0	2.2

[a] Based on pilot test data collected October, 2017

[b] Lowest vacuum at the well head assuming 70" H2O blower vacuum

In order to ensure sufficient available vacuum at each SVE well head, the blower will need to be sized for the well circuit with the largest pressure loss through the branched SVE system. Therefore, the greatest calculated pressure loss would be for SVE-1S (9.5 in H_2O). In addition to the conveyance line loss, there are losses from the blower through the compound piping and manifold. Major pressure losses for the compound and manifold piping can be calculated using equation 3 together with an approximate length of 4-inch PVC pipe and flow rate, the specific weight of air, and the Darcy friction factor calculated above.

$$H_{maj(bldg)} = \frac{0.0189 \times 16\,ft \times 18.9^2\,\frac{ft^2}{sec^2}}{\frac{3.998\,in.}{12 in/ft} \times 2 \times 32.2\frac{ft}{sec^2}} \times \frac{0.06303 lbm/ft^3\ air}{62.37 lbm/ft^3\ water} \times \frac{12\,in.}{ft} = 0.32\,in.\ H_2O$$

Calculate minor pressure losses using equation 3 for fittings on the 4-inch PVC compound which include 2 elbows (K=1.5), 1 gate valve (K=1.0), as well as adding an entrance (K=0.5) and exit (K=1.0) loss out of the moisture separator.

$$K_m = 2 * 1.5 + 1*1.0 + 1*0.5 + 1*1.0 = 5.5$$

$$H_{\min(bldg)} = \frac{5.5 \times 43.0^2\,\frac{ft^2}{sec^2}}{2 \times 32.2\frac{ft}{sec^2}} \times \frac{0.06303\,lbm/ft^3\,air}{62.37\,lbm/ft^3\,water} \times \frac{12\,in.}{ft} = 1.92 in. H_2O$$

The total design pressure loss for the PVC pipe in the compound will be the sum of the major and minor losses:

ΔH_{bldg} = 0.32 + 1.92 = Δ**H_{bldg} = 2.24 in H_2O.**

Calculate the expected SVE blower total operating vacuum using the design pressure losses calculated above and the expected extraction well vacuum of 60 inH_2O:

H_{sys} = 9.5 in H_2O + 2.24 in H_2O + 60 in H_2O = 71.8 in H_2O

The blower at this site will be designed for 250 scfm at an applied vacuum of 70 inches of water. The blower will include a variable frequency drive (VFD), which can be adjusted to match specific air flow operating requirements for the vapor treatment equipment based on actual flow conditions and a variety of operating well configurations.

Total Headloss Summary

TABLE 2 - Summary of Total Design Headlosses

Existing System	Total System Flow Rate	Maximum Calculated Headloss	Vacuum/ Pressure at Blower	Vacuum/ Pressure at Blower
	(scfm)	(in H2O)	(in H2O)	(psi)
SVE	225	11.8	71.8	2.6

Table Flow Loss by Line

SVE Line #	Total line length	Flow at Manifold[a]	Vacuum Pressure[a]	Max Head Loss[b]
	(ft)	(scfm)	(in H2O)	(in H2O)
MW-1	120	30	25.0	2.4
SVE-1S	136	60	25.0	9.5
MW-2	135	35	25.0	3.5
MW-11	99	5	50.0	0.1
MW-16	160	5	50.0	0.1
SVE-2D	92	30	50.0	1.9
SVE-3D	151	30	50.0	2.6
SVE-4S	58	15	50.0	0.4
SVE-5S	98	15	50.0	0.6
Manifold	16	225	60.0	2.2

[a] Based on pilot test data collected October, 2017

[b] Lowest permissible vacuum in line at the well head assuming 70" H2O blower vacuum

Major Headloss Calculations

SVE Compound Piping (Existing)

CONSTANTS

Pipe Roughness	smooth			
e/d	smooth		Altitude (ft)	6630
Dynamic Viscosity, u	3.585E-07	lbf-sec/ft^2		
k, Roughness Height, ft	5.00E-06			
Air Density	0.06302636	lbm/ft^3 =	1.955E-03	slugs/ft^3
Water Density	62.37	lbm/ft^3		
Gravitational Acceleration,g	32.2	ft/s^2		

Major Headlosses

$$h_L = f\left(\frac{L}{D}\right)v^2 / 2g$$

well conveyance pipe, dia = 2.047 in (2" SCH 40 PVC)
Manifold conveyance pipe, dia = 3.998 in (4" SCH 40 PVC)

Table 1. Major Headlosses

Piping Run[a]	Run Length,L (ft)	Flow Rate Q (cfm)	Actual Pipe Diameter, D (in)	Actual Pipe Diameter, D (ft)	X-Sectional Area, A (ft^2)	Velocity V (ft/min)	Velocity V (ft/s)	Reynolds #	Friction Factor, f	L/D	hL (ft air)	hL (ft water)	hL (in water)
Blower to SVE Manifold	16	225	3.998	0.333	0.087	2581	43.0	78,163	0.0189	48.0	26.1	0.03	0.32
MW-1	120	30	2.047	0.171	0.023	1313	21.9	20,355	0.0258	703.5	134.7	0.14	1.63
SVE-1S	136	60	2.047	0.171	0.023	2625	43.8	40,709	0.0219	797.3	518.0	0.52	6.28
MW-2	135	35	2.047	0.171	0.023	1531	25.5	23,747	0.0248	791.4	198.6	0.20	2.41
MW-11	99	5	2.047	0.171	0.023	219	3.6	3,392	0.0428	580.4	5.1	0.01	0.06
MW-16	160	5	2.047	0.171	0.023	219	3.6	3,392	0.0428	938.0	8.3	0.01	0.10
SVE-2D	92	30	2.047	0.171	0.023	1313	21.9	20,355	0.0258	539.3	103.3	0.10	1.25
SVE-3D	151	30	2.047	0.171	0.023	1313	21.9	20,355	0.0258	885.2	169.5	0.17	2.06
SVE-4S	58	15	2.047	0.171	0.023	656	10.9	10,177	0.0309	340.0	19.5	0.02	0.24
SVE-5S	98	15	2.047	0.171	0.023	656	10.9	10,177	0.0309	574.5	32.9	0.03	0.40

Minor Headloss Calculations

SVE Compound Piping (Existing)

Appurtenance	Minor Loss Coeff. (Kl)
90° elbow	1.5
45° elbow	0.4
Branch Flow (BF) Tees	2
Gate valve	1.0
Gate Valves (3/4 Closed)	17
Flow Meter	0.64
Entrance	0.5
Exit	1

Minor Headlosses

$$h_L = k_L v^2 / 2g$$

Table 2. Minor Headlosses

Piping Run[a]	Quantinty of Appurtenances 90°	45°	Slip Tees (Branch Flow)	Gate Valve (Fully Open)	Gate Valve (3/4 Closed)	Flow Meter	Entrance	Exit	Kl Sum	Velocity,v (ft/S)	hL (ft air)	hL (ft water)	hL (in water)
Blower to SVE Manifold	2	0	0	1	0	0	1	1	5.5	43.0	158.0	0.16	1.92
MW-1	5	0	0	1	0	0	1	0	9.0	21.9	66.9	0.07	0.81
SVE-1S	5	0	0	1	0	0	1	0	9.0	43.8	267.6	0.27	3.24
MW-2	5	0	0	1	0	0	1	0	9.0	25.5	91.0	0.09	1.10
MW-11	4	0	0	1	0	0	1	0	7.5	3.6	1.5	0.00	0.02
MW-16	3	1	0	1	0	0	1	0	6.4	3.6	1.3	0.00	0.02
SVE-2D	4	0	0	1	0	0	1	0	7.5	21.9	55.7	0.06	0.68
SVE-3D	3	1	0	1	0	0	1	0	6.4	21.9	47.6	0.05	0.58
SVE-4S	4	0	0	1	0	0	1	0	7.5	10.9	13.9	0.01	0.17
SVE-5S	4	0	0	1	0	0	1	0	7.5	10.9	13.9	0.01	0.17

Total Design Headloss

SVE Compound Piping (Existing)

Table 3. Total Headlosses

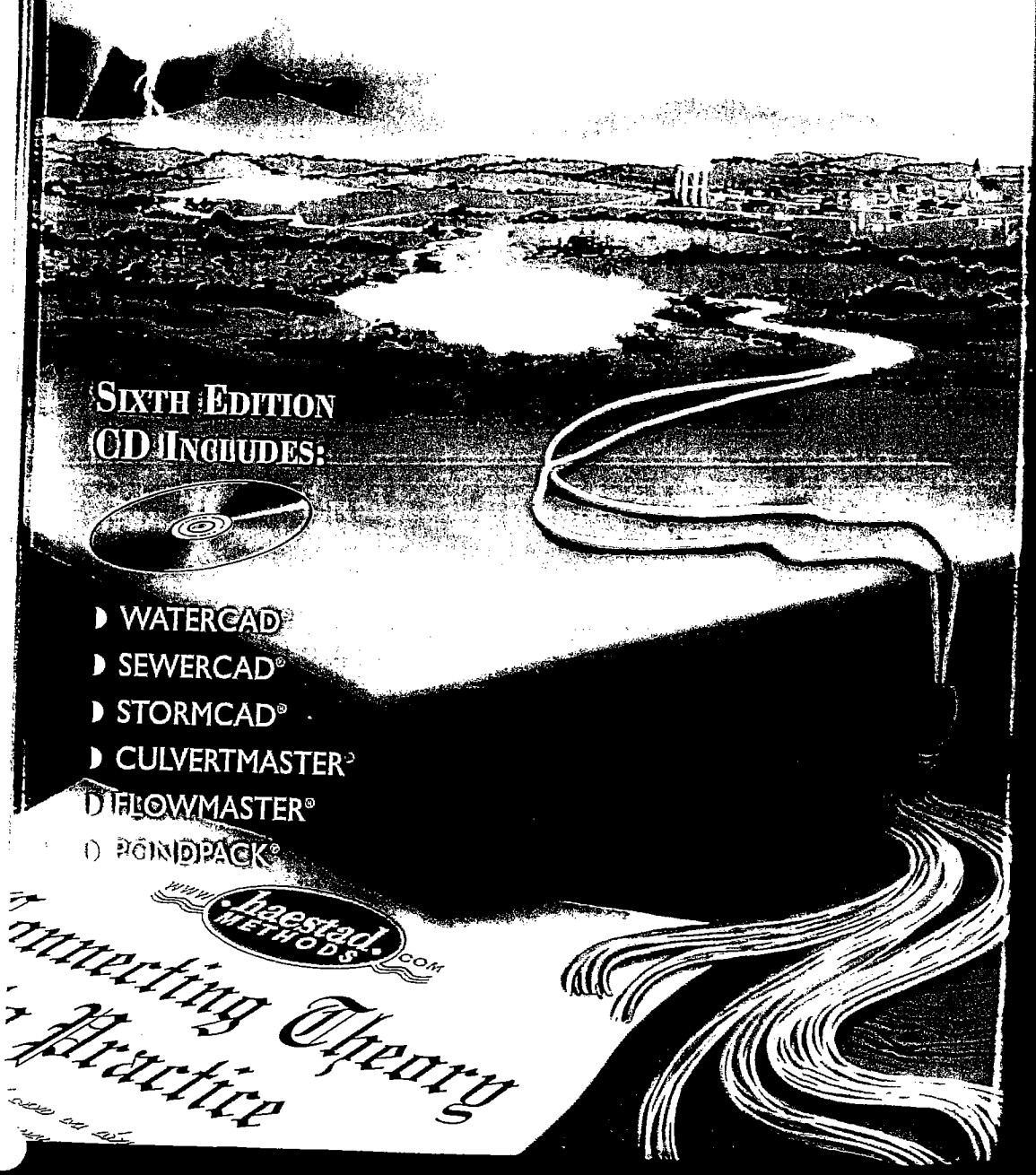
Piping Run	hL (ft air)	hL (ft water)	hL (in water)	
Blower to SVE Manifold	184.1	0.19	2.23	
MW-1	201.6	0.20	2.44	
SVE-1S	785.6	0.79	9.53	
MW-2	289.7	0.29	3.51	
MW-11	6.7	0.01	0.08	
MW-16	9.6	0.01	0.12	
SVE-2D	159.0	0.16	1.93	
SVE-3D	217.1	0.22	2.63	
SVE-4S	33.4	0.03	0.41	
SVE-5S	46.9	0.05	0.57	
Maximum headloss				
SVE-1S	969.7	1.0	11.8	in H2O
			0.86	in Hg

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given particle in the direction of flow, and at other times detract from it. The result is that velocity distributions captured at different times will be quite different from one another, and will be far more chaotic than the velocity distribution of a laminar flow section.

By strict interpretation, the changing velocities in turbulent flow would cause it to be classified as unsteady flow. Over time, however, the average velocity at any given point within the section is essentially constant, so the flow is assumed to be steady.

The velocity at any given point within the turbulent section will be closer to the mean velocity of the entire section than with laminar flow conditions. Turbulent flow velocities are closer to the mean velocity because of the continuous mixing of flow, particularly the mixing of low-velocity flow near the channel walls with the higher-velocity flow toward the center.

To classify flow as either turbulent or laminar, an index called the ***Reynolds number*** is used. It is computed as follows:

$$Re = \frac{4VR}{\nu}$$

where Re = Reynolds number (unitless)
V = average velocity (m/s, ft/s)
R = hydraulic radius (m, ft)
ν = kinematic viscosity (m^2/s, ft^2/s)

If the Reynolds number is below 2,000, the flow is generally laminar. For flow in closed conduits, **if the Reynolds number is above 4,000, the flow is generally turbulent**. Between 2,000 and 4,000, the flow may be either laminar or turbulent, depending on how insulated the flow is from outside disturbances. In open channels, laminar flow occurs when the Reynolds number is less than 500 and turbulent flow occurs when it is above 2,000. Between 500 and 2,000, the flow is transitional.

Example 1-1: Flow Characteristics

A rectangular concrete channel is 3 m wide and 2 m high. The water in the channel is 1.5 m deep and is flowing at a rate of 30 m^3/s. Determine the flow area, wetted perimeter, and hydraulic radius. Is the flow laminar or turbulent?

Solution

From the section's shape (rectangular), we can easily calculate the area as the rectangle's width multiplied by its depth. Note that the depth used should be the actual depth of flow, not the total height of the cross-section. The wetted perimeter can also be found easily through simple geometry.

$$A = 3.0\ \text{m} \times 1.5\ \text{m} = 4.5\ \text{m}^2$$

$$P_w = 3.0\ \text{m} + 2 \times 1.5\ \text{m} = 6.0\ \text{m}$$

Table 1-2: Typical Roughness Coefficients

Material	Manning's Coefficient n	Hazen-Williams C	Darcy-Weisbach Roughness Height	
			k (mm)	k (ft)
Asbestos cement	0.011	140	0.0015	0.000005
Brass	0.011	135	0.0015	0.000005
Brick	0.015	100	0.6	0.002
Cast-iron, new	0.012	130	0.26	0.00085
Concrete:				
Steel forms	0.011	140	0.18	0.006
Wooden forms	0.015	120	0.6	0.002
Centrifugally spun	0.013	135	0.36	0.0012
Copper	0.011	135	0.0015	0.000005
Corrugated metal	0.022	–	45	0.15
Galvanized iron	0.016	120	0.15	0.0005
Glass	0.011	140	0.0015	0.000005
Lead	0.011	135	0.0015	0.000005
Plastic	0.009	150	0.0015	0.000005
Steel:				
Coal-tar enamel	0.010	148	0.0048	0.000016
New unlined	0.011	145	0.045	0.00015
Riveted	0.019	110	0.9	0.003
Wood stave	0.012	120	0.18	0.0006

1.5 Pressure Flow

For pipes flowing full, many of the friction loss calculations are greatly simplified because the flow area, wetted perimeter, and hydraulic radius are all functions of pipe radius (or diameter). Table 1-3 presents the three pipe friction loss equations that are commonly used to design pressure pipe systems.

There is much more information presented about pressure piping systems in Chapter 6, including further discussion on pumping systems, minor losses, and network analysis.

Table 1-3: Three Pipe Friction Loss Equations

Equation	Q (m^3/s); D (m)	Q (cfs); D (ft)	Q (gpm); D (in.)
Darcy-Weisbach	$S_f = \frac{0.083 f Q^2}{D^5}$	$S_f = \frac{0.025 f Q^2}{D^5}$	$S_f = \frac{0.031 f Q^2}{D^5}$
Hazen-Williams	$S_f = \frac{10.7}{D^{4.87}}\left(\frac{Q}{C}\right)^{1.852}$	$S_f = \frac{4.73}{D^{4.87}}\left(\frac{Q}{C}\right)^{1.852}$	$S_f = \frac{10.5}{D^{4.87}}\left(\frac{Q}{C}\right)^{1.852}$
Manning	$S_f = \frac{10.3(nQ)^2}{D^{5.33}}$	$S_f = \frac{4.66(nQ)^2}{D^{5.33}}$	$S_f = \frac{13.2(nQ)^2}{D^{5.33}}$

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COVER PHOTO Visualization of the flow around a flattened ellipsoid at a 10° angle of attack. Dye injection in the hydrodynamic tunnel of the ONERA. (Courtesy Bureau National d'Études et de Recherches Aerospatiales, Châtillion, Hauts-de-Seine.)

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■ TABLE B.3
Physical Properties of Air at Standard Atmospheric Pressure (BG Units)[a]

Temperature (°F)	Density, ρ (slugs/ft^3)	Specific Weight[b], γ (lb/ft^3)	Dynamic Viscosity, μ (lb·s/ft^2)	Kinematic Viscosity, ν (ft^2/s)	Specific Heat Ratio, k (—)	Speed of Sound, c (ft/s)
−40	2.939 E − 3	9.456 E − 2	3.29 E − 7	1.12 E − 4	1.401	1004
−20	2.805 E − 3	9.026 E − 2	3.34 E − 7	1.19 E − 4	1.401	1028
0	2.683 E − 3	8.633 E − 2	3.38 E − 7	1.26 E − 4	1.401	1051
10	2.626 E − 3	8.449 E − 2	3.44 E − 7	1.31 E − 4	1.401	1062
20	2.571 E − 3	8.273 E − 2	3.50 E − 7	1.36 E − 4	1.401	1074
30	2.519 E − 3	8.104 E − 2	3.58 E − 7	1.42 E − 4	1.401	1085
40	2.469 E − 3	7.942 E − 2	3.60 E − 7	1.46 E − 4	1.401	1096
50	2.420 E − 3	7.786 E − 2	3.68 E − 7	1.52 E − 4	1.401	1106
60	2.373 E − 3	7.636 E − 2	3.75 E − 7	1.58 E − 4	1.401	1117
70	2.329 E − 3	7.492 E − 2	3.82 E − 7	1.64 E − 4	1.401	1128
80	2.286 E − 3	7.353 E − 2	3.86 E − 7	1.69 E − 4	1.400	1138
90	2.244 E − 3	7.219 E − 2	3.90 E − 7	1.74 E − 4	1.400	1149
100	2.204 E − 3	7.090 E − 2	3.94 E − 7	1.79 E − 4	1.400	1159
120	2.128 E − 3	6.846 E − 2	4.02 E − 7	1.89 E − 4	1.400	1180
140	2.057 E − 3	6.617 E − 2	4.13 E − 7	2.01 E − 4	1.399	1200
160	1.990 E − 3	6.404 E − 2	4.22 E − 7	2.12 E − 4	1.399	1220
180	1.928 E − 3	6.204 E − 2	4.34 E − 7	2.25 E − 4	1.399	1239
200	1.870 E − 3	6.016 E − 2	4.49 E − 7	2.40 E − 4	1.398	1258
300	1.624 E − 3	5.224 E − 2	4.97 E − 7	3.06 E − 4	1.394	1348
400	1.435 E − 3	4.616 E − 2	5.24 E − 7	3.65 E − 4	1.389	1431
500	1.285 E − 3	4.135 E − 2	5.80 E − 7	4.51 E − 4	1.383	1509
750	1.020 E − 3	3.280 E − 2	6.81 E − 7	6.68 E − 4	1.367	1685
1000	8.445 E − 4	2.717 E − 2	7.85 E − 7	9.30 E − 4	1.351	1839
1500	6.291 E − 4	2.024 E − 2	9.50 E − 7	1.51 E − 3	1.329	2114

[a]Based on data from R. D. Blevins, *Applied Fluid Dynamics Handbook*, Van Nostrand Reinhold Co., Inc., New York, 1984.
[b]Density and specific weight are related through the equation $\gamma = \rho g$. For this table $g = 32.174$ ft/s^2.

PVC Pipe & Fittings Dimensions (Sch 40 / Sch 80)

This entry was posted on May 20, 2018 by admin.

Looking for PVC dimensions? Check out this post for PVC pipe and fittings information for both schedule 40 and schedule 80 PVC. Click through to the Lasco Tech Docs for detailed fittings dimensions and see our PVC pipe sizing chart below for pipe OD, IS, wall thickness and more.

PVC Fittings Dimensions:

Lasco Technical Fittings Dimensions Information - Sch 40, Sch 80, 80 CPVC

PVC Pipe Dimensions:

Sch 40 PVC Pipe Dimensions

Schedule 40 PVC Pipe Dimensions

Nom. Pipe Size (in)	O.D.	Average I.D.	Min. Wall	Nominal Wt./Ft.	Maximum W.P. PSI*
1/8	0.405	0.249	0.068	0.051	810
1/4	0.540	0.344	0.088	0.086	780
3/8	0.675	0.473	0.091	0.115	620
1/2	0.840	0.602	0.109	0.170	600
3/4	1.050	0.804	0.113	0.226	480
1	1.315	1.029	0.133	0.333	450
1-1/4	1.660	1.360	0.140	0.450	370
1-1/2	1.900	1.590	0.145	0.537	330
2	2.375	2.047	0.154	0.720	280
2-1/2	2.875	2.445	0.203	1.136	300
3	3.500	3.042	0.216	1.488	260
3-1/2	4.000	3.521	0.226	1.789	240
4	4.500	3.998	0.237	2.118	220
5	5.563	5.016	0.258	2.874	190
6	6.625	6.031	0.280	3.733	180
8	8.625	7.942	0.322	5.619	160
10	10.750	9.976	0.365	7.966	140
12	12.750	11.889	0.406	10.534	130
14	14.000	13.073	0.437	12.462	130
16	16.000	14.940	0.500	16.286	130
18	18.000	16.809	0.562	20.587	130
20	20.000	18.743	0.593	24.183	120
24	24.000	22.544	0.687	33.652	120

Sch 80 PVC Pipe Dimensions

Schedule 80 PVC Pipe Dimensions

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The roughness component in the Darcy-Weisbach equation is a function of both the channel material and the Reynolds number, which varies with velocity and hydraulic radius.

$$V = \sqrt{\frac{8g}{f}RS}$$

where V = flow velocity (m/s, ft/s)
g = gravitational acceleration (m/s^2, ft/s^2)
f = Darcy-Weisbach friction factor (unitless)
R = hydraulic radius (m, ft)
S = friction slope (m/m, ft/ft)

The Darcy-Weisbach friction factor, f, can be found using the Colebrook-White equation for fully developed turbulent flow, as follows:

Free Surface

$$\frac{1}{\sqrt{f}} = -2\log\left(\frac{k}{12R} + \frac{2.51}{Re\sqrt{f}}\right)$$

Full Flow (Closed Conduit)

$$\frac{1}{\sqrt{f}} = -2\log\left(\frac{k}{14.8R} + \frac{2.51}{Re\sqrt{f}}\right)$$

where k = roughness height (m, ft)
R = hydraulic radius (m, ft)
Re = Reynolds number (unitless)

This iterative search for the correct value of f can become quite time-consuming for hand computations and computerized solutions of many pipes. Another method, developed by Swamee and Jain, solves directly for f in full-flowing circular pipes. This equation is:

$$f = \frac{1.325}{\left[\log_e\left(\frac{k}{3.7D} + \frac{5.74}{Re^{0.9}}\right)\right]^2}$$

where f = friction factor (unitless)
k = roughness height (m, ft)
D = pipe diameter (m, ft)
Re = Reynolds number (unitless)

Typical Roughness Factors

Typical pipe roughness values for each of these methods are shown in Table 1-2. These values will vary depending on the manufacturer, workmanship, age, and other factors. For this reason, the following table should be used only as a guideline.

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Ralph A. Wurbs • Wesley P. James



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Replacing the dependent variable with the nonrepeating independent variable μ gives

$$\pi_2 = \mu V^a D^b \rho^c$$

$$F^0L^0T^0 = FL^{-2}T(LT^{-1})^a(L)^b(FL^{-4}T^2)^c$$

$$F: \quad 0 = 1 + c \qquad c = -1$$

$$T: \quad 0 = 1 - a - 2 \qquad a = -1$$

$$L: \quad 0 = -2 - 1 + b + 4 \qquad b = -1$$

$$\pi_2 = \frac{\mu}{VD\rho} = \frac{1}{\text{Re}} \tag{3.24}$$

where Re is the Reynolds number. Selecting ℓ as the next nonrepeating variable gives

$$\pi_3 = \ell V^a D^b \rho^c$$

$$F^0L^0T^0 = L(LT^{-1})^a L^b(FL^{-4}T^2)^c$$

$$F: \quad 0 = c \qquad c = 0$$

$$T: \quad 0 = -a \qquad a = 0$$

$$L: \quad 0 = 1 + b \qquad b = -1$$

$$\pi_3 = \frac{L}{D} \tag{3.25}$$

The remaining nonrepeating variable is ε, so that

$$\pi_4 = \varepsilon V^a D^b \rho^c$$

solving for exponents gives

$$\pi_4 = \frac{\varepsilon}{D} \tag{3.26}$$

where π_4 is the relative roughness of the pipe.

The equation for the pressure drop in a pipe (Eq. 3.22) can be written in terms of

$$\frac{\Delta P}{\rho V^2} = \phi\left(\frac{1}{\text{Re}}, \frac{L}{D}, \frac{\varepsilon}{D}\right) \tag{3.27}$$

Equation 3.27 forms the basis for the Darcy–Weisbach equation for headloss ($h_f = \Delta P/\gamma$) in a pipe

$$h_L = f\frac{L}{D}\frac{V^2}{2g} \tag{3.28}$$

where the friction factor (f) is a function of Re and ε/D and is given in the Moody chart presented in Chapter 4.

Appendix C

Product Cut Sheets

Intellishare Environmental, Inc.

Gas Fired Thermal Oxidizer

About Our Gas Fired Thermal Oxidizer

The Intellishare thermal oxidizer was developed on a modular platform allowing for maximum flexibility in system selection. Each system can be configured multiple ways to fit nearly any space requirement. All units are designed to incorporate our heat recovery and catalyst modules and are built for long term reliability and performance.

Intellishare Environmental specializes in the engineering and manufacturing of oxidation technology for soil and groundwater remediation, VOCs , HAPs and odor abatement.

Features & Benefits

Modular Construction: We can help you spend your project dollars wisely! Our units are built to allow catalyst modules, heat exchangers and LEL monitors to be easily field inserted at any time.

High Temperature Combustion Chamber: Low outer skin temperature and greater than 99% destruction efficiency.

Intellishare One Touch Controls: Reduces operator error and increases uptime by taking the guesswork out of operation. Walks the operator through basic system tasks such as start-up, shut-down and trouble-shooting.

PLC: PLC offers unlimited programming flexibility without control panel modification.

Honeywell Flame Control: Provides exceptional reliability in display of burner system status and flame strength.

Automatic Dilution Control: Reduces operator site time by automatically adjusting to varying hydrocarbon concentrations preventing temperature overshoots and system shut-downs.

UL Listed Controls: Certified UL compliant.

Options

Catalyst: Metal monolith

Electrical Rating: Class 1 Division 1/2, Group D

Safety Rating: SIL—Safety Integrity Level

LEL Monitor: Catalytic or IR type with 4-20 mA output

Air Flow: Sensor or transmitter with 4-20 mA output

Recording: Up to four 4-20 mA input, paper or paperless

Process Blower: Centrifugal Fan

SVE Blower: Multiple SVE blowers or vacuums

Additional Sizes: 250-3000 SCFM

System Specification

Model:	250 CFM
Air Flow:	100-250 SCFM
Pressure Drop:	Maximum 12" WC
Concentrations:	0-20% LEL
Input Voltage:	230V/1Ph/60Hz or 208-230V/460V/3Ph/50-60Hz
Overall Size:	8' L, 6' W, 7' H
Overall Weight:	3000 lb
Reactor:	Carbon Steel
Heat Exchanger:	309 Stainless Steel
Main Control Panel:	Nema 4
Disconnect:	600 VAC
Control Type:	Allen Bradley PLC
Operator Interface:	Touch Screen
Flame Arrestor:	Spiral crimped element
Stack:	304 Stainless Steel
Insulation:	6-8" Ceramic Fiber
Exterior:	Painted
Base:	A-36 Carbon Steel
Catalyst:	400 CPSI Precious Metal Monolith
Inlet & Outlet:	Flanged
Lifting:	Forklift or Crane
Purge/Dilution:	Automatic
Burner:	Primary 750,000 BTUH
Temp Range:	1400-1800° F
Max Temp:	1800° F
Thermocouples:	Type K
Temp Control:	Honeywell or PLC
Heat Recovery:	Nominal 50-60%

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CLEAN AIR SOLUTIONS



Special Points of Interest:

- Highest efficiency design for lowest operating cost
- Multiple Layouts
- Highest uptime percentage of any oxidizer
- Compact footprint
- Remote Interface

Other Products & Services:

Electric Catalytic Oxi-

Gas Fired Catalytic

Electric Thermal Oxi-

Thermal Accelerator

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Regenerative Thermal

Complete Soil Remediation Oxidizer Pack-

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Emergency Response

Operation & Maintenance Guide

INTELLISHARE ENVIRONMENTAL

CLEAN AIR SOLUTIONS

Client:

Geo Logic

Project:

Shamrock 63 Sante Fe NM

Equipment:

250 CFM Thermal Oxidizer with Catalyst Module

Unit Number N-19-2235

2019

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INTRODUCTION

Purpose

Intellishare Environmental, Inc.' s 250 CFM Thermal Oxidizer with Catalyst Module destroys organic vapor contaminants which are discharged from soil vapor extraction, ground water treatment systems, or other systems during site remediation.

Precautions

Lower Explosive Limit (LEL)

It is important to understand the meaning of the term Lower Explosive Limit (LEL), sometimes also referred to as Lower Flammability Limit (LFL).

Lower Explosive Limit: Gases or vapors which form flammable mixtures with air or oxygen have a minimum concentration of vapor in air or oxygen below which propagation of flame does not occur on contact with a source of ignition (LEL).

There is also a maximum proportion of vapor or gas in air above which propagation of flame does not occur (UFL). These boundary line mixtures of vapor or gas with air, which if ignited will just propagate flame, are known as the "lower and upper flammable or explosive limits", and are usually expressed in terms of percentage by volume of gas or vapor in air.

The LEL is based upon normal atmospheric temperatures and pressures and the general effect of increase of temperature or pressure is to decrease the lower limit and increase the upper limit.

Applicable codes require thermal solvent processing systems to operate no higher than 25% LEL without an LEL monitor and control. Insurance companies may require LEL systems if an oxidation system is added to existing machinery.

For further information concerning the maintenance of safe LEL levels, the operator should refer to NFPA Bulletin 86A and FM Loss Prevention Bulletin No. 14.15. These bulletins will delineate how safety interlocks can be implemented in the operator's system.

!! DANGER!

Never operate the catalytic or thermal oxidizer at a concentration of vapors greater than 25% of the LEL. Even low concentrations of extremely volatile vapors may cause an explosion within the reactor system with the possibility of serious personal injury and property damage.

!! DANGER!

It is the operator's responsibility to make certain that the concentration of vapors entering the catalytic or thermal oxidizer remains less than 25% of the LEL of the vapors.

Site Considerations

1. Sites being remediated may contain equipment using relatively large quantities of gas, oil, steam, and/or electricity. Any high energy equipment carries with it a potential danger to personnel and property, and must be treated accordingly.

2. All equipment must be installed and operated in accordance with OSHA regulations, all applicable electrical, plumbing, steam boiler and building codes, necessary permits secured, and meet the requirements of your insurance carrier. Unless specified in our proposal, these are areas of customer responsibility.

3. The area should be maintained free from any hazards that would prevent easy movement around the catalytic reactor and electrical control cabinet. No flammable or otherwise hazardous materials should be stored in the immediate vicinity of the catalytic reactor. No work materials, papers or other materials should be placed on the catalytic reactor.

4. Review the operation of the oxidizer with your site safety officer before starting the unit. Any suggestions and additions should be included with these instructions.

   All those involved in the operation of the system should read and understand the complete operating instructions before starting the unit. Safety meetings of all those involved with the system should be held periodically in conjunction with implementing acceptable maintenance procedures.

5. Any change in process load, temperature, ventilation or other modification should be checked with Intellishare Environmental, Inc. in advance to determine equipment capabilities.

6. Determination of catalyst or thermal efficiency in hydrocarbon oxidation is made by gas analysis of samples drawn from the system prior to and immediately after the catalyst exit face or in a thermal oxidizer system prior to and immediately after the combustion chamber. A gas analysis should be performed in the event the operator suspects any loss of catalytic activity via visual inspection or by observing that the temperature rise across the catalyst has been reduced. Before attempting any corrective measures, contact Intellishare Environmental, Inc. We will assist in determining corrective action, and if applicable, will provide specific instructions.

7. It is our desire to provide the operator with the safest and most productive equipment possible. Revised national safety standards and technological improvements will require the user to periodically review this equipment, and may require upgrading for compliance.

Process Definition

Volatile Organic Compounds (VOCs)

Volatile Organic Compounds (VOCs) are hydrocarbons which, in a gaseous or vapor form, regulatory agencies have determined contribute to air pollution. Specifically, these are hydrocarbon compounds which can enter the atmosphere (become volatile) and which chemically react with each other and other elements in the air as a result of exposure to sunlight. Such chemical reaction due to sunlight is called "photo-chemical activity". This photo-chemical activity results in what we commonly call "smog".

Catalytic Reaction

With reference to chemistry, a catalyst is a material which allows or causes a chemical reaction to take place under certain conditions which would not ordinarily occur given those conditions. For example, given a compound such as gasoline, mixed with sufficient oxygen for burning, if it was desired to ignite the mixture by simply raising the air temperature (as opposed to ignition by exposure to a flame or spark), the air temperature would have to be raised to over 1,000°F.

However, in the presence of the proper catalyst, the gasoline would combust (oxidize) with the air temperature at only 500°F. Thus, the catalyst causes the reaction to occur, even though the temperature is such that the burning could not possibly take place without the presence of the catalyst.
A unique property of the catalyst is that it is not consumed in the reaction. When a hydrocarbon burns, it is converted to carbon dioxide and water.

Thermal Oxidizer Mode

During thermal operation, VOC-laden air is delivered from the SVE system, into the heat exchanger and into the system's combustion chamber. The treated air is then directed over the hot side of the heat exchanger and finally, the treated air is exhausted into the atmosphere.

Catalyst Mode

During catalytic operation, VOC-laden air is delivered from the SVE system, into the heat exchanger and into the system's combustion chamber. The pre-heated air is then directed through the catalyst module. When the VOC-laden air passes through the catalyst, an exothermic (heat producing) reaction takes place. The VOCs in the air stream are converted to carbon dioxide and water vapor and the air temperature is raised by the process. The treated air is then directed over the hot side of the heat exchanger and finally, the treated air is exhausted into the atmosphere.

SYSTEM SPECIFICATION

Manufacturing Information

Manufacturer:	Intellishare Environmental, Inc.
Model:	TO250
Type:	Thermal Oxidizer with Catalyst Module
Serial Number:	N-19-2235
Date of Manufacture:	2019

Operating Specification

All values established for required VOC destruction efficiency

Maximum VOC Content:	25% LEL
VOC Destruction Efficiency:	99% Thermal 98% Catalytic
Maximum Process Air Stream:	250 SCFM
Temperature Control Method:	Firing rate of burner controlled via temperature PID loop PLC
Thermal Up to Temperature:	1350˚ F
Thermal Operating Temperature:	1400-1450˚ F
Thermal Mode High Limit Safety:	1600˚ F
Thermal Exit Dilution Control:	1450˚ F
Catalyst Ready Temperature:	550˚ F
Catalyst Inlet Temperature Control:	650-750˚ F
Catalyst Inlet High Temperature Safety:	900˚ F
Catalyst Exit Dilution Control:	950˚ F
Catalyst Temperature High Limit Safety:	1100˚ F
Inlet Air Flow Pressure:	0.4” w.c.
Catalyst Differential Pressure:	6-8” w.c.

Mechanical Specification

Inner Wetted Material:	High Temperature Refractory
Outer Skin Material:	Carbon Steel
Outer Skin Thickness:	7 Gauge
Temperature Sensors:	K-Type Thermocouples

Burner and Associated Equipment

Manufacturer:	Eclipse
Model:	TJ 0100
Type:	Primary Air Burner
Maximum Fire Rating:	750,000 BTU/HR
Voltage Input:	480/3/60

Instruments

Inlet Temperature Control:	PLC
Outlet Temperature Control:	PLC
High Temperature Limits:	Watlow
Chart Recorder:	ABB

Master Bill of Material

Master Bill of Material (cont)

Component Data

Please refer to accompanying CD for component specification information.

MAINTENANCE & SAFETY

System Maintenance

Though relatively trouble-free in operation, the oxidizer is primarily a piece of combustion equipment with consequent mechanical rotating equipment in the form of fans and motors, temperature and fuel controls with safety interlocks, an electrical control system, loop controls to maintain temperature and flow rate parameters for maximum efficiency, and other components. Many elements of the oxidizer design are included in compliance with Factory Mutual (FM), Industrial Risk Insurers (IRI), and National Fire Protection Association (NFPA) requirements.

As such, like any piece of combustion equipment, the oxidizer must be regularly maintained and should be fully inspected and evaluated at least annually.

A checklist of maintenance items and recommendations is included as a separate entry in this manual. The maintenance items should be reviewed and carried out on an as needed basis and at least once per year.

Regular maintenance not only assures compliance with the appropriate clean air regulatory agency requirements, and the requirements of safety regulatory bodies and insurance carriers; it also helps maintain equipment efficiency for minimum operating costs.

Preventive Maintenance Evaluation Program

As an aid to maintaining oxidizer operation at peak efficiency, Intellishare Environmental, Inc. offers a Preventive Maintenance Evaluation which includes a complete inspection and evaluation of oxidizer components and performance along with tuning and adjustment, as needed.

It is recommended that the Preventive Maintenance Evaluation be performed at least once per year.

A check list and evaluation summary is provided with each inspection. The summary identifies maintenance requirements and recommendations for corrective action if any is required.

The preventive maintenance evaluation is custom tailored to the particular piece of equipment inspected, but includes:

1. Mechanical
An external and internal inspection of the oxidizer and mechanical components is performed. This includes fan and motor assemblies, burner (or heater on electric units), catalyst, reactor chamber, stack and observation ports, access doors, ductwork, dampers, and linkages.

2. Electrical
Electrical components are visually inspected and electrically tested for proper function. This includes switches, lights, relays, timers, controllers, recorders, motors, motor starters, motor drives, damper and/or valve actuators, disconnects, wiring, alarm detection and annunciation, and logic circuits.

3. Process Control Loops
The temperature and pressure control loops are inspected and tested to verify correct operation of sensors, loop controllers, and end control devices. This includes tests of the electric heater\burner firing rate, fan variable speed drive or vortex damper reaction, actuator performance, and loop tuning adjustment as needed.

1. Catalyst Evaluation and Oxidation Efficiency Test
An oxidation efficiency test is performed using a portable detector unit. Additionally, samples of the catalyst are sent for independent destruction efficiency evaluation. The catalyst evaluation and oxidation efficiency tests are valuable for detecting potential problems (should any exist) early, helping to avoid clean air compliance problems before they occur.

Preventive Maintenance Evaluation Initiation

For complete information on the Preventive Maintenance Evaluation Program contact the Technical Services Department of Intellishare Environmental, Inc.

Maintenance Checklist

Properly maintained equipment ensures maximum operating performance and minimum operating costs. Following is a schedule of suggested regular maintenance. Please refer to each individual manual for a more comprehensive maintenance list.

Main Components	Test	Monthly	Quarterly	Semi-Annually	Annually
Fan Mounting Bolts	Tightness	X			
Fan Motor Bearings	Lubrication	X			
Fan Motor Amperage	Windings	X			
Gas Train	Leaks	X			
Burner/Flame Visual	Quality	X			
Flame Strength	Signal	X			
Dilution Valve Linkage	Moves Freely	X			
Instrumentation	Condensate	X			
Temperature Controller	Accuracy				X
Electrical Wiring Terminals	Tightness			X	X
Flame Arrestor	Pressure Drop				X
Catalyst	Signs of plugging or discoloration				X
Chart Recorder (if equipped)	Download data	X			
Gas Booster (if equipped)	Belt Tension	X			
Gas Booster (if equipped)	Lubrication	X			
Gas Booster (if equipped)	Vibration	X			
Destruction Efficiency	Various				X
LEL Meter (if equipped)	Calibration		X		

Oxidizer Mode Change Instructions

!! DANGER!

Improper set-up could result in personal injury or permanent equipment damage. It is strongly recommended that Intellishare Environmental, Inc. be contracted to perform system mode changes. It is extremely critical that all temperature settings, inserts, damper positions, airflow and gas settings are correct.

Catalytic Mode to Thermal Mode

	Temperature Controllers
1.	Main power to the oxidizer control panel is required to be on for controller adjustment.
2.	Adjust the **High Limit Temperature Controller**. Open sub panel inner swing door on control cabinet. High Limit Temperature Controller is located on back panel of Control Cabinet. Press and hold set/reset button. Turn limit set point dial clockwise to read 1500 degree F. and then release the set/reset button. New limit set point is entered 3 seconds after the limit set point knob stops moving. Close Sub Panel Door.
3.	On the **Inlet Temperature Controller**, press set up button until CONTRL is displayed. Press the function button until SP Hi is displayed. Use the up arrow display until 1600 is displayed.
4.	Press set up button until ALARMS is displayed. Press the function button until A1S1VA is displayed. Used the up arrow display button until 1500 is displayed.
5.	Press the set up button until ALARMS is displayed. Press the function button until A1S2VA appears. Use the up arrow display button until 1350 is displayed.
6.	Press the display button until SP appears in the lower display. Use the up arrow display key until 1400 is displayed. Press display again and the inlet temperature control set points are complete.
7.	On the **Outlet Temperature Controller**, press the set up button until CONTRL is displayed. Press the function button until SP Hi appears. Use the up arrow display button until 1600 is displayed.
8.	Press the display button until SP appears in the lower display. Use the up arrow display key until 1500 is displayed. Press display again and the outlet temperature control set points are complete.
9.	Press the Start button on the Operator Interface Panel to start the Oxidizer.
10.	Adjust LEL if equipped

Catalytic Mode to Thermal Mode (continued)

	Catalyst Mechanical Removal
	Note: When reinstalling components, make sure flange gaskets are in good condition and proper position. Replace gaskets where necessary. Once the catalyst is removed note any unusual wear and/or discoloration.
1.	Cool Oxidizer to within 40 degree of ambient temperature.
2.	Remove the catalyst access cover bolts.
3.	Remove catalyst.
4.	Replace catalyst access cover and cover hardware.

Thermal Mode to Catalytic Mode	
	Controllers
1.	Main power to the oxidizer control panel is required to be on for controller adjustment.
2.	Adjust the **High Limit Temperature Controller**. Open sub panel inner swing door on control cabinet. High Limit Temperature Controller is located on back panel of Control Cabinet. Press and hold set/reset button. Turn limit set point dial counter clockwise to read 1200 degree F. and then release the set/reset button. New limit set point is entered 3 seconds after the limit set point knob stops moving. Close Sub Panel Door.
3.	On the **Inlet Temperature Controller**, press set up button until CONTRL is displayed. Press the function button until SP Hi is displayed. Use the down arrow display until 1100 is displayed.
4.	Press set up button until ALARMS is displayed. Press the function button until A1S1VA is displayed. Use the down arrow display button until 900 is displayed.
5.	Press the set up button until ALARMS is displayed. Press the function button until A1S2VA appears. Use the down arrow display button until 550 is displayed.
6.	Press the display button until SP appears in the lower display. Use the down arrow display key until 600 is displayed. Press display again and the inlet temperature control settings are complete.
7.	On the **Outlet Temperature Controller**, press the set up button until CONTRL is displayed. Press the function button until SP Hi appears. Use the up arrow display button until 1100 is displayed.
8.	Press the display button until SP appears in the lower display. Use the down arrow display key until 900 is displayed. Press display again and the outlet temperature control set points are complete.
9.	Press the Start button on the Operator Interface Panel to start the Oxidizer.
10.	Adjust LEL if equipped.

Thermal Mode to Catalytic Mode (continued)

Catalyst Mechanical Installation	
	Note: When reinstalling components, make sure flange gaskets (if supplied) are in good condition and proper position. Replace gaskets where necessary. Inspect the catalyst module and catalyst retaining ring. The catalyst should be free of debris and the catalyst retaining ring should be tight.
1.	Using a small crane, install the Catalyst Module. Lifting points on top of catalyst flange. (Orientation is not critical)
2.	Using a small crane, install the exhaust outlet transition and exhaust stack. (Outlet transition thermocouple port should line up with removed thermocouple)
3.	Connect any sample tubing from the exhaust outlet transition and exhaust stack.
4.	Install the thermocouple located in the exhaust outlet transition.
5.	Connect the thermocouple wiring.

Safety Instructions for Equipment Operation and Maintenance

PLEASE READ THIS ENTIRE SECTION BEFORE ATTEMPTING TO OPERATE OR PERFORM WORK ON THIS EQUIPMENT. FOLLOW THE INSTRUCTIONS CAREFULLY AND COMPLETELY. SAFETY IS THE RESPONSIBILITY OF EVERYONE.

This section describes safety instructions and general precautions to be followed when operating this equipment. This section also contains precautionary information to be heeded when performing maintenance, repairs or testing on the equipment. The information is intended as a guide to safe operation and maintenance of your system. It does not supersede or replace either the provisions of a safety program or any specific safety procedures established by the equipment user. Intellishare Environmental, Inc. has endeavored to use reasonable care and good judgment in identifying the potential hazards associated with this equipment. It is not possible to anticipate and address every hazardous situation. Neither can it address specific situations that may be unique to the user of the equipment. *Planning, concern, common sense, maturity and the elimination of careless practices is necessary in any safety program.*

Only properly trained and authorized personnel should be allowed to work on or around this equipment. It is the responsibility of the equipment user to establish appropriate safety health practices and to determine the applicable or regulatory limitations prior to use. All personnel involved with or affected by this equipment should read and understand this document, and all pertaining user supplied safety documents. It is strongly recommended that a barrier be erected around the equipment to deter unauthorized entrance into the installation area.

At no time shall any of the equipment controls be modified, bypassed or rendered inoperative without prior authorization from an Intellishare Environmental representative. To do so may result in equipment damage, personal injury or death.

This equipment has been designed and manufactured for use in conjunction with specific user equipment. The operation of this equipment under conditions outside of the original design, or with equipment other than the original design may be extremely hazardous. At no time should this equipment be used for anything other than its original design specifications. This equipment has been designed to discontinue operation in the event of an unexpected malfunction. Do not attempt to re-start the equipment until the source of the malfunction has been identified and eliminated.

Hazard Communication

Industry throughout the United States has established a uniform method for identifying the potential severity of a hazard. This method has also been further documented in various publications including those published by the American National Standards Institute. Intellishare Environmental, Inc. has used reasonable care to assure that the hazards included in this section conform to these established standards. The hazard levels are as follows:

(DANGER) An immediate hazard that will result in severe personal injury or death.

(WARNING) A hazard or unsafe practices which could result in severe personal injury or death.

(CAUTION) A hazard or unsafe practices which could result in minor personal injury, product damage, or property damage.

General Information (WARNING) Chemical Reactions

There are a number of hazards that inevitably occur due to the physical and chemical nature of the equipment. This equipment contains materials and chemical substances that may have adverse impact on the human body. Personnel responsible for the erection, maintenance and/or operation of this equipment should be knowledgeable and exercise care to provide protection against hazards to all affected personnel as well as equipment.

Electrical (DANGER) Electrocution

High voltage is present at many points of this equipment. Although every precaution has been taken to insure the safety of the operator, coming into contact with this voltage may result in serious injury or death. Only trained and qualified electricians should be allowed to work on the electrical components of this equipment. Observe all OSHA Lockout/Tagout requirements pertaining to this type of equipment to prevent accidental electrocution. The electrical power should be disconnected and locked out before entering into any electrical compartment. The equipment should be properly grounded and all interconnecting wiring should be installed in accordance with local, state and NEC codes.

Common system voltages include:

Ignition Circuits	6000+ Volts AC (Design Specific)
Electric Heater Circuits	208 / 240 / 480 Volts AC (Design Specific)
Motor Circuits	208 / 240 / 480 Volts AC (Design Specific)
Control Circuits	120 Volts AC (Design Specific)

Gas Train (DANGER) Fire or Explosion

Many of the equipment designs incorporate a natural gas or propane fuel train and burner to process contaminants. Unless authorized by a representative of Intellishare Environmental, do not attempt to modify or adjust components on the gas train. Personnel affected by this equipment should be trained on how to shut off the gas supply to the equipment in the event of a gas leak. Only trained and qualified personnel should be allowed to work on the gas train. Observe all OSHA Lockout/Tagout requirements pertaining to this type of equipment to prevent accidental releases of combustible gases. Observe all NFPA guidelines during installation, troubleshooting, and maintenance procedures performed on the equipment. Periodic inspection should be performed along with leak detection and indicator accuracy verification. System shutdown devices are incorporated into the gas train and these devices should be inspected periodically for proper operation. No open flame or spark emitting devices should be allowed in the area of the gas train.

High Temperature (CAUTION) Heat and Burns

Many of the equipment designs operate in a wide range of temperatures between 400° F and 1600° F. Although the equipment is insulated to reduce external surface temperatures, personnel should exercise caution when working on or around the equipment. Contact with hot surfaces may result in burn injuries. It is strongly recommended that the equipment be shut down and allowed to cool before any work is performed in this area.

Rotating Equipment (WARNING) Caught In or Struck By

Many of the equipment designs incorporate rotating components (i.e. motor drives, blowers, fans, etc...) into the design process. Use extreme caution when working on or around these components. Do not wear loose clothing or jewelry, and keep long hair protected. Observe all OSHA Lockout/Tagout requirements pertaining to this type of equipment to prevent accidental or automatic controlled starts. Remove all tools, electrical cords, and debris from the area before attempting to restart the equipment. Never attempt to repair or adjust rotating equipment while it is running. Always insure that all equipment guards are installed before attempting to start rotating equipment.

Confined Space (DANGER) Suffocation or Asphyxiation

The interior chambers of this equipment are confined space areas that may not contain enough oxygen to support human life. **Suffocation is possible.** According to OSHA guidelines, the minimum safe environment must contain at least 19.5 % oxygen for personnel to work in a confined space. The oxygen content in a normal environment is approximately 21%. In addition to the verification of oxygen content, it is extremely important to test the atmosphere within the confined space for hazardous chemical concentrations. **Asphyxiation is possible.** The atmosphere within the confined space must be checked for site-specific chemicals before entry is allowed. Observe all OSHA requirements pertaining to confined space before allowing personnel to enter these areas. **Do not enter into any confined space area until the atmosphere in that space has been tested by qualified personnel with the appropriate testing equipment.**

Slippery / Elevated Surfaces (CAUTION) Slips, Trips, or Falls

When working at elevations, observe the OSHA requirements for use of ladders, man-lifts, and safety restraint devices. Always be aware of slippery surfaces that may be caused by rain, snow, or ice. Do not climb on system piping or components as equipment damage or personal injury may occur.

Safety Precautions

The Intellishare Environmental, Inc. equipment and systems have been designed in such a manner as to present a minimum of safety hazards. It is, however, incumbent upon operating and maintenance personnel to follow safety procedures when in the area of the system and controls.

!! DANGER!

Never introduce concentrations exceeding 25% of the lower explosive limit (LEL) to a Catalytic Oxidizer.

Never introduce concentrations exceeding 50% of the LEL to a thermal oxidizer.

Operation >25% of the LEL must be accompanied by an LEL sensor alarm in accordance with NFPA Standards.

Potential Hazards / Concerns

- Only competent, safety conscious personnel should have access to the area.
- Only qualified personnel should work on the electrical panel and controls. Follow all electrical and safety codes.
- Individuals working with this system must be familiar with the equipment and hazards involved and be fully trained in the operation of the equipment.
- All areas around the system must be restricted to authorized personnel only.
- Personnel in the area must wear safety equipment in compliance with plant and/or site safety standards.
- The system must be “shut down” and “locked out” before working on any part of the system. Possible injury to personnel could otherwise occur.
- All safety guards and devices must be correctly installed and in place before operating equipment.
- Do not touch the flame rod or spark ignitor, or ground the electrode while the oxidizer is operating. This is an electrical shock hazard.
- Check for gas leaks every week in the gas train and main gas line. A gas leak could produce a dangerous explosive condition. Repair all gas leaks immediately.
- Do not operate the oxidizer with the purge cycle shortened or bypassed. The purge cycle is factory-set for safe operation and must not be changed.
- Do not change damper or valve settings without first consulting Intellishare Environmental, Inc.

- Any fires that occur within the oxidizer and its related equipment should not be extinguished with water. Either a build-up of flammable substances or a faulty electrical circuit would most likely cause these fires. The proper fire fighting equipment must be available and operators must be trained in the use of the fire fighting equipment.

TERMS & WARRANTY

Standard Terms & Conditions

Prices

Prices are quoted in U.S. dollars and may be accepted only within 90 days from date of quotation by Intellishare Environmental, Inc. Quotations do not include taxes unless otherwise noted. Orders accepted prior to any price increase will be invoiced as quoted provided Intellishare Environmental is allowed to ship under its normal delivery schedule. Intellishare Environmental may adjust prices on any order changed by the Purchaser after acceptance of the order by Intellishare Environmental.

Cancellations

Orders cancelled by the Purchaser are subject to a cancellation charge which may include engineering service, work in progress, special purchased parts changes and other similar charges.

Shipping Schedules

Intellishare Environmental, Inc. will not be liable for any loss or damage from delays in shipping beyond Intellishare Environmental's reasonable control. Shipments delayed at Purchaser's request will be invoiced and dated on the day shipment is ready and a 1% per month service charge will be added. Intellishare Environmental reserves the right to make partial shipments and to invoice pro rata upon such shipments.

Electrical Equipment and Installation

Electrical equipment includes only those electrical components referred to in the quotation. Changes to electrical equipment to comply with any local, state, provincial or national regulations are the Purchaser's responsibility unless Intellishare Environmental specifically agrees to meet said regulations.

Acceptance and Testing of Equipment

Purchaser will upon delivery inspect and test the equipment and notify Intellishare Environmental in writing within 30 days of installation of all defects discovered, including failure of the equipment to meet quoted performance standards. Failure to give such notice constitutes irrevocable acceptance of the equipment, the equipment will be deemed to conform to the terms of this Agreement and Purchaser will be bound to pay for the equipment. Upon notification of a defect as above provided, Intellishare Environmental will repair the equipment and correct the system's performance.

Risk of Loss

Quotations are F.O.B., place of shipment, unless otherwise noted. The risk of loss of the equipment will pass to Purchaser upon Intellishare Environmental's delivery of the equipment to a carrier. Claims for damage in shipment must be filed by Purchaser with the carrier.

Limitation of Liability

In no event will Intellishare Environmental, its subcontractors or representatives, be held responsible, or liable for any claim, whether in warranty, contract, tort or strict liability for any special, indirect, incidental or consequential damages resulting from

the purchase of equipment (including but not limited to incidental or consequential damages for labor, lost profits, lost sales, injury to person or to property or any other incidental loss or damages).

Purchaser agrees that Purchaser's exclusive remedy and Intellishare Environmental's sole liability on any such claim will be limited to reimbursement from Intellishare Environmental of the purchase price actually received by Intellishare Environmental from Purchaser for the equipment in question.

Security Interest

Purchaser grants Intellishare Environmental a security interest in the equipment to secure payment of the balance due hereunder. Purchaser authorizes Intellishare Environmental to file this Agreement as a Financing Statement or to sign on behalf of Purchaser and file any other Financing Statements with respect to the equipment in any place Intellishare Environmental deems necessary.

Attorney's Fees

Purchaser will be liable for all reasonable expenses and attorney's fees incurred by Intellishare Environmental in enforcing its rights and remedies under this Agreement.

Ordinances

Any and all required licenses, certificates and operating permits will be the sole responsibility of the Purchaser unless otherwise specified by Intellishare Environmental, Inc.

Indemnification

Purchaser shall indemnify and save Intellishare Environmental, Inc. harmless against all losses or claims for bodily injury (including death) and property damage relating to the equipment or sustained by Seller while Seller or Seller's agents, employees or representatives are at a location selected by Purchaser except Purchaser shall not indemnify Seller if said damages are the result of Seller's willful and wanton acts.

Miscellaneous

The terms and conditions contained herein and any other terms and conditions stated in Intellishare Environmental's proposal or specifications attached hereto will constitute the entire agreement between Intellishare Environmental and Purchaser. The terms and conditions stated herein are applicable to all orders accepted by Intellishare Environmental, Inc. unless otherwise specifically agreed to by Intellishare Environmental in writing. Purchaser will be deemed to have assented to all such terms if any part of the described equipment is to be accepted. If Purchaser finds any terms not acceptable, Purchaser must so notify Intellishare Environmental within 10 days. Any additional or different terms contained in Purchaser's order to response hereto will be deemed objected to by Intellishare Environmental and will be of no effect. This proposal and its acceptance will be governed in all respects by the laws of Wisconsin. In the event of a breach, both parties agree that any suit will be brought in the jurisdiction of Wisconsin.

Warranty

Scope and Duration

Intellishare Environmental warrants to buyer that the products to be delivered will (a) be free from defects in material and manufacturing workmanship (b) conform to manufacturer's applicable product descriptions attached to Seller's quotation. If no product descriptions or specifications are attached to the quotation, manufacturer's specification in effect on the date of shipment will apply.

For oxidizers utilizing a catalyst, Intellishare Environmental guarantees the conversion efficiency of the system as long as the catalyst bed temperatures are kept within a specified range and certain neutralizers are kept out of the air stream. Please see accompanying list of catalyst poisons.

Purchaser is responsible to limit the introduction of hydrocarbon vapors, which exceed the LEL rating of the system as specified by the National Fire Protection Association (NFPA) & Intellishare Environmental. Detonation and damage as a result of LEL excess is solely the purchaser's responsibility.

Intellishare Environmental guarantees the conversion efficiency of the system in thermal mode of 99% and catalytic mode of 98% for non-methane hydrocarbons (NMHC).

The product warranties are for a period of 12 months from the date of shipment.

Intellishare Environmental shall rely on process and chemical information provided by Purchaser or its agents and shall not be liable for inaccurate data, undisclosed or unknown process or chemical materials.

Warranty Exclusions

Warranty coverage does not include (a) freight, labor, travel or living expenses associated with parts replacement (b) normal maintenance items such as lubrication, fan belts and cleaning of the equipment.

In the event the customer, or any installation contractor employed by the customer, contracts outside Intellishare Environmental for installation work or erection of quoted equipment, the customer will assume full responsibility for workmanship resulting from said contract.

Catalyst Deactivation & Poisoning Agents

The following partial list of poisoning agents and inhibitors has been found to have a detrimental effect on the activity of the noble metal catalyst. Catalyst exposure to these substances must be avoided. The catalyst manufacturer's warranty applies to all claims.

Substance	Effect	Remedial Action
Coating Agents - rust - dirt - inorganic oxide	Covers catalyst active site.	Non-phosphate detergent washing usually effective for removal. Factory reactivation or replacement usually required. Non-phosphate detergent washing may be effective.
Glass Forming Coating Agents - organic silicates (esters) - silicones - phosphorus containing materials	Covers catalyst active site.	Factory reactivation or replacement usually required. Non-phosphate detergent washing may be effective.
Poisons – Heavy Metal Complexes - Mercury - Lead - Zinc - Tin - Arsenic - Antimony, etc.	Permanent catalyst deactivation	Factory reactivation or replacement required.
Sulfides	Permanent catalyst deactivation	Depending on exposure and sulfide concentration, factory reactivation, non-phosphate detergent washing or replacement is required.
Halogens - fluorine - chlorine - bromine - iodine - halogenated hydrocarbons	Covers active site-resulting in temporary or permanent deactivation.	Activity usually returns if exposed to low concentrations and upon removal of halogen source. Prolonged exposure with water (or protons) can corrode, dissolve the catalyst substrate and require repair or replacement.
Note: Does not apply to HD or t-HD catalysts which have been specifically designed to be tolerant of and/or destroy halogenated hydrocarbons (excluding fluorine).		
Organic Droplets and Aerosols	Covers active site. Possible cause of catalyst hot spot.	Such materials may carburize on the catalyst forming a refractory material or become a hot spot source causing substrate deterioration. Factory reactivation or replacement is required.

Oxidation Catalyst Warranty & Limitation of Remedy & Liability

1. Johnson Matthey Environmental Products (JMEP), strictly for the period stated, warrants subject to all terms and conditions herein, that the catalyst furnished hereunder, when operated in accordance with the inlet conditions stated in attached TABLE I, shall provide minimum contaminant removal/destruction efficiency or not exceed maximum allowable unconverted contaminant concentration in the stack gas, as presented in TABLE I, whichever is less stringent. Any other performance curves submitted are for the Buyer's convenience and the performance indicated thereon is not offered by JMEP, nor to be construed by the Buyer as a proposal or contract obligation. The term "contaminant removal/destruction efficiency" shall be defined as that percentage of incoming hydrocarbon content oxidized to form carbon dioxide. Performance tests, if required, conducted at Purchaser's expense. Catalyst shall be considered accepted if tests show performance warranty has been fulfilled.

2. In the event the catalyst fails to perform as described in Paragraph 1 above, JMEP shall have the option of either; a) replacing FOB shipping point, the non-performing catalyst. b) providing FOB shipping point, additional catalyst. c) Make whatever repairs or modifications to the catalyst configuration it considers necessary to enable the catalyst to meet guarantees. The cost of providing such modifications, including materials, labor and engineering shall be borne by JMEP. Costs of installing modifications shall be borne by Buyer.

   In the event JMEP chooses to provide a replacement charge of catalyst, Buyer agrees to provide field installation for the new catalyst, return the original catalyst to JMEP and accept replacement catalyst as fulfillment of all obligations borne by JMEP and agrees to make no further demands.

   For the avoidance of doubt, the election by JMI of any of the above remedies shall not extend the warranty period.

3. The maximum liability of JMEP under this warranty shall not exceed the catalyst purchase price. JMEP, in no event shall be liable for production losses or indirect or consequential damages resulting from failure of catalyst to meet warranty.

4. The warranty period is Twelve (12) calendar months and shall commence from the date of initial start-up or from a date ninety (90) days after shipment, whichever date occurs first. Buyer agrees to promptly notify JMEP, in writing, as to the date of initial start-up.

5. a) The following contaminants are known catalyst deactivators and contribute to shortened catalyst life; heavy and base metals such as lead, mercury, arsenic, antimony, zinc, copper, tin, iron, nickel and chrome, sulfur and phosphorous. Hence the total content of these element(s) analyzed on the catalyst by quantitative methods must not exceed 10 grams/ft3 with the exceptions shown below in 5(c). Contaminants in excess of these amounts shall void the warranty unless failure is due solely to defects in the equipment.

   b) Exposure to excessive temperatures significantly reduces catalyst life. Hence, at no time shall the catalyst outlet temperature be permitted to exceed 1250 F. Normal continuous operating temperature shall not exceed 1200 F for more than 15 minutes during any 24 hour period. Exposure to temperatures exceeding these values will automatically void the warranty. It is for this reason that the use of a high temperature alarm set for 1200 F and shutdown system set for 1250 F along with a temperature recorder is recommended.

   c) Chlorine containing compounds in the exhaust must not exceed 10 ppm. Silicon and fluorine containing compounds must be absent. Contaminants in excess of these amounts shall void the warranty.

   d) Periodic cleaning of particulates, etc., may be found necessary to maintain catalyst activity. If required, this shall not be construed as evidence of catalyst non-performance. Buyer shall conduct catalyst cleaning in strict accordance with JMEP procedure during warranty period.

6. Unit must be designed such that 1) no bypass around catalyst blocks or catalyst bed can occur, 2) blocks are oriented according to JM's recommendations, 3) flow is evenly distributed across catalyst bed. Failure to do so shall void the warranty.

7. Except as stated above, in the equipment warranty, and in the standard terms and conditions of sale, JMEP makes no other warranties, expressed or implied, including the implied warranties of merchantability and fitness for any particular purpose.

8. The foregoing is Seller's only obligation and Buyer's exclusive remedy for breach of warranty and, except for gross negligence, willful misconduct and remedies permitted under the performance, inspection and acceptance and the patent clauses hereof, the foregoing is Buyer's exclusive remedy against Seller for all claims arising hereunder or relating hereto whether such claims are based on breach of contract, (or) (including negligence and strict liability) or other theories.

   Buyer's failure to submit a claim as provided above shall specifically waive all claims based on latent defects. In no event shall Buyer be entitled to incidental or consequential damages. Any action arising hereunder or relating hereto whether based on breach of contract (or) (including negligence and strict liability) or other theories, must be commenced within one (1) year after the cause of action accrues or it shall be barred.

MECHANICAL DRAWINGS

Process & Instrumentation Diagram (P&ID)

General Arrangement Drawing

Oxidizer Installation/Catalyst Drawing

LOGIC SEQUENCE

System Pre-Start			
Step	**Display**	**Operator Action**	**Remarks**
1	No Message	Turn On Main Power	Once main power voltage and phase has been verified, engage power disconnect.
2	System Off Check Control Power and E-Stop (Only when enabled)	Turn On Control Power & Pull E-Stop Switch Out. Press Reset (F4) to clear any alarms.	120VAC control power is applied to PLC outputs and other external devices. The following pre-start safe conditions must be met prior to the "System Ready to Start" state is achieved. -E-Stop -Control Power -Temperature Control Valve TCV-1, closed -Gas Train Blocking Valve, closed -Gas Pressure Switches satisfied **Warning:** Prior to starting the oxidizer close all SVE well valves and fully open the SVE dilution valve. Confirm the SVE automatic dilution valve is full open. Failure to close the SVE wells can result in damage to equipment and can cause injury to personnel. **Warning:** High concentrations of hydrocarbons can cause detonation and damage to the equipment or injury to personnel. Only trained operators should be allowed to operate and adjust the system.

System Start-Up

Step	Display	Operator Action	Remarks
1	System Ready to Start	Push START Button (F1).	Operator may abort the start-up sequence by pressing the stop or reset on the operator display or the emergency stop button located on the exterior of the control panel. Automatic startup sequence is initiated. With no alarm condition present and all safe limits proven, the system fan is started.
2	Burner Enabled Flame Not Established	None. Automatic operation.	SVE/AS run contact is enabled. System purges for 30 seconds, controlled by flame safety. The controls check to assure that; -System fan running contacts close -System air flow is proven -Gas pressure switches are satisfied -Catalyst dp is satisfied, (if equipped -Main fuel valve is proven closed -Temperature limits are satisfied -SVE/AS run signal is satisfied. Once air flow is proven and the purge timer has expired, the burner pilot gas valve is opened and fuel is introduced to the pilot flame port. The burner ignition transformer is turned on and the spark igniter attempts to light the pilot flame. Once the burner pilot flame is established the spark ignition is disabled. The flame controller assures the flame stability. The main gas valves are opened and main gas supply is opened to the burner. Note: Verify air flow to the oxidizer is within maximum air flow requirements. Oxidizer process inlet should always be under negative pressure of -2 to 5” w.c.
3	Burner On. Heating to Setpoint	None. Automatic	The firing rate valve modulates to drive and hold the oxidizer temperature to a field adjustable set point on the inlet temperature control device.

System Start-Up (Continued)			
Step	**Display**	**Operator Action**	**Remarks**
4	Burner On. Soaking at Set Point	None Automatic	Once the minimum operating temperature is achieved on the outlet temperature controller (1350 deg F for thermal mode) a 120 second PLC timer is activated to allow the oxidizer to reach a steady state. Dilution air damper control is enabled.

Putting the System On-Line			
Step	**Display**	**Operator Action**	**Remarks**
1	Burner On Inlet Opened	Open SVE Wells and or begin treating water	**Warning:** Always open the SVE wells slowly. High concentrations can cause detonation and damage to the equipment or injury to personnel. Only trained operators should be allowed to operate and adjust the system.
System Shut-Down			
1	Cool Down	Push SYSTEM STOP button (F2).	The oxidizer enters into the shutdown mode. The burner is disabled, the SVE interlock relay is de-energized, the dilution damper is driven open and the combustion fan remains on to cool the reactor.
2	Cool Down 240 Seconds	None. Automatic operation.	The combustion fan is shut off after a timed cool-down period.
3	"System Ready to Start"	- - - - - -	The system may be re-started.

System Stand-by (Disabled)			
1	Standby	Push Standby Button (F3)	Pressing the Standby button opens the automatic dilution valve. The oxidizer to system ready continues to be enabled and the SVE/AS alarm from others panel is ignored. Push Stand-by mode again to return to "Burner on System inlet open"

System Run Time			
Step	**Display**	**Operator Action**	**Remarks**
1	None	Push RUN TIME Button (>).	Press RUN TIME button to display system operating hours. 10 second timer automatically resets screen.



Alarm History			
Step	**Display**	**Operator Action**	**Remarks**
1	None.	Push Right Arrow button (>) Twice.	Press Right Arrow button to display system operating hours. (Figure 2) Screen display clears Alarm History after 10 seconds..



Alarm Conditions

Each of the following alarm conditions initiates 240 second cool-down. Exceptions are emergency stop and control power, which initiates a hard shutdown.

The alarm which first causes a shutdown is the one displayed. Subsequent faults are disregarded by the controls until the first alarm is cleared. Note: Some alarms may not be present in every system.

Display	Description	Operator Action
High L.E.L. After Correcting Fault, Press RESET.	The LEL monitor has detected an LEL in excess of 50% in the process airstream.	Check for: -Concentrations too high. -Proper dilution operation.
Inlet Temperature High After Correcting Fault, Press RESET.	The inlet temperature has risen above the alarm setpoint. Excess temperature can damage or destroy the catalyst. It can also damage the reactor or scrubber if equipped.	Check for: - Malfunctioning firing rate actuator, loose or broken linkage. - Proper setup, function of inlet temperature control loop. -Proper air flow rate
Outlet Temperature High After Correcting Fault, Press RESET.	The combustion chamber or catalyst outlet temperature has risen above the alarm setpoint. Excess temperature can damage or destroy the catalyst. It can also damage the reactor or scrubber.	Check for: - Malfunctioning dilution air actuator, loose or broken linkage. - Proper setup, function of outlet temperature control loop. - High solvent loading in process air stream.
System Operating Temperature Lost, Press RESET.	Once the system operating temperature is reached a 5 minute timer is enabled to allow the system to recover and reach operating temperature.	Check for: -Low inlet gas pressure. -Proper air flow rate. -Malfunctioning firing rate actuator, loose or broken linkage.
System Ready Temperature Not Reach, Press RESET.	Once the system is enabled it has 60 minutes to reach operating temperature.	Check for: Low inlet gas pressure. -Proper air flow rate. -Malfunctioning firing rate actuator or broken linkage.
Low Gas Pressure at Gas Booster. After Correcting Fault, Press RESET.	Low inlet gas pressure has been detected at the inlet of the gas booster.	Check for: -Gas supply valves closed. -Improper switch setting. -Faulty gas booster.

Alarm Conditions (continued)

Display	Description	Operator Action
Aux. Interrupt Fault. After Correcting Fault, Press RESET.	The customer auxiliary interlock has opened. This is a dry contact site equipment interlock provided by the customer. It is used to shut down the oxidizer when necessary according to site equipment failure or other condition(s).	Check for cause.
Water Level High. After Correcting Fault, Press RESET.	High water level in the knock-out pot.	Check for: -Drain the knock-out pot.
System Blower Motor Off. After Correcting Fault, Press RESET.	The SVE blower motor starter has failed to energize on startup or has opened while the motor was running.	Check for: - High motor current draw. - Fan obstruction. - Seized fan or motor bearings. - Fan out of balance.
Combustion Blower Motor Off. After Correcting Fault, Press RESET.	The combustion blower motor starter has failed to energize on startup or has opened while the motor was running.	Check for: - High motor current draw. - Fan obstruction. - Seized fan or motor bearings. - Fan out of balance.
Gas Booster Motor Off. After Correcting Fault, Press RESET.	The gas booster motor starter has failed to energize on startup or has opened while the motor was running.	Check for: - High motor current draw. - Fan obstruction. - Seized fan or motor bearings. - Fan out of balance.
System Air Switch Not Closed. After Correcting Fault, Press RESET.	The system air proving switch has failed to close on startup or has opened after airflow was proven.	Check for: - Airflow restriction, such as a closed damper or debris. - Plugged airflow sensing tubing. - System fan malfunction.
Catalyst High Differential Pressure. After Correcting Fault, Press RESET.	The differential pressure across the catalyst has risen above the setpoint of the proving switch.	Check for: - Excess airflow through the oxidizer. - Catalyst fouling. - Plugged airflow sensing tubing.

Alarm Conditions (continued)

Display	Description	Operator Action
Flame Failure. After Correcting Fault, Press RESET.	The Honeywell flame safety programmer (FSG) has detected a fault condition. Requires manual reset of FSG located on control panel interior.	Check for: -UV Scanner operating properly. -Improper gas pressure -Malfunctioning spark ignitor
Low Gas Pressure. After Correcting Fault, Press RESET.	Low inlet gas pressure has been detected.	Check for: -Gas supply valves closed. -Improper switch setting. -Faulty main gas regulator.
High Gas Pressure. After Correcting Fault, Press RESET.	High gas pressure has been detected.	Check for: -Gas supply valves closed. -Faulty main gas regulator. -Improper switch setting.

ELECTRICAL DRAWINGS

CONTROLLER SET POINTS

Inlet Temperature Control

Group Prompt	Function Prompt	Value or Selection	Factory Setting
TUNING	PB or GAIN	PB 15	1.0
	RATE T	0.00	0.00
	I MIN or I RPM	1.0	1.0
	MANRST	Not Used	1.0
	PB2 or GAIN 2	Not Used	0.0
	RATE2T	Not Used	0.00
	I2 MIN or I2 RPM	Not Used	1.0
	CYCT1 or CT1	Not Used	20
	X3	Not Used	20
	CYC2T2 or CT2	Not Used	20
	X3	Not Used	20
	SECUR	Not Used	0
	LOCK	NONE	NONE
	AUTOMA	ENAB	ENAB
	A TUNE	ENAB	ENAB
	RN HLD	ENAB	ENAB
	SP SEL	ENAB	ENAB

Group Prompt	Function Prompt	Value or Selection	Factory Setting
SPRAMP	SPRAMP	DIS	DIS
	TI MIN	Not Used	3
	FINLSP	1400	1000
	SPRATE	ENAB	DIS
	EUHRUP	8400	0
	EUHRDN	0	0
	SPPROG	DIS	DIS

Group Prompt	Function Prompt	Value or Selection	Factory Setting
ATUNE	FUZZY	ENAB	DIS
	TUNE	DIS	TUNE
	DUPLEX	MAN	MAN
	AT ERR	Not Used	---

Group Prompt	Function Prompt	Value or Selection	Factory Setting
ALGOR	CTRALG	PIDA	PIDA
	TIMER	DIS	DIS
	PERIOD	Not Used	0:01
	START	Not Used	KEY
	L DISP	Not Used	TREM
	RESET	Not Used	KEY
	INCRMT	Not Used	MIN

Group Prompt	Function Prompt	Value or Selection	Factory Setting
OUTLAG	OUTLAG	CUR	(MOXL)
	4-20RG	Not Used	100
	CRANGE	4-20	4-20
	RLY TY	Not Used	MECH
	MTRT1	Not Used	5

Group Prompt	Function Prompt	Value or Selection	Factory Setting
INPUT1	IN1TYP	KH	KH
	XMITR1	Not Used	LIN
	IN1 HI	2400	2400
	IN1 LO	0	0
	RATIO1	1.0	1.00
	BIAS1	0.0	0.0
	FILTR1	5	1.0
	BRNOUT	UP	UP
	EMIS	1.0	1.0

Group Prompt	Function Prompt	Value or Selection	Factory Setting
INPUT2	IN2TYP	Not Used	1-5V
	LIN	Not Used	LIN
	IN2 HI	Not Used	2400
	IN2 LO	Not Used	0
	RATIO2	Not Used	1.00
	BIAS 2	Not Used	0.0
	FILTR2	Not Used	1.0

Inlet Temperature Control (continued)

Group Prompt	Function Prompt	Value or Selection	Factory Setting
CONTRL	PIDSET	ONE	ONE
	SW VAL	Not Used	0.00
	LSP'S	TWO	ONE
	RSPSRC	NONE	NONE
	SP TRK	NONE	NONE
	PWR UP	ALSP	AUTO
	PWROUT	LAST	FSAF
	SP Hi	1600	2400
	SP Lo	0	0
	ACTION	REV	REV
	OUT Hi	100	100
	OUT Lo	0	0
	D BAND	2.0	2.0
	HYST	0.5	0.5
	FAILSF	0	0.0
	FSMODE	LATCH	NOL
	PBorGN	PB	GAIN
	MINRPM	RPM	MIN

Group Prompt	Function Prompt	Value or Selection	Factory Setting
OPTION	AUXOUT	IN1	DIS
	ARANGE	4-20	4-20
	0 PCT	0	0
	100 PCT	2000	100
	DIG IN 1	SP2	NONE
	DIG1 COM	DIS	DIS
	DIG IN 2	NONE	NONE
	DIG2 COM	DIS	DIS

Group Prompt	Function Prompt	Value or Selection	Factory Setting
COM	ComADR	Not Used	Disable
	COMSTA	Not Used	0
	IRENAB	Not Used	Enable
	BAUD	Not Used	9600
	TX_DLY	Not Used	30
	WS_FLT	Not Used	FP_B
	SDENAB	Not Used	Enable
	SHDTIM	Not Used	0
	SDMODE	Not Used	Last
	SHD_SP	Not Used	LSP
	UNITS	Not Used	PCT
	CSRATO	Not Used	1.0
	CSP_BI	Not Used	0
	LOOPBACK	Not Used	Disable

Group Prompt	Function Prompt	Value or Selection	Factory Setting
ALARMS	A1S1TY	IN1	NONE
	A1S1VA	1600	90
	A1S1HL	HIGH	HIGH
	A1S1EV	Not Used	BEGN
	A1S2TY	NONE	NONE
	A1S2VA	Not Used	90
	A1S2HL	Not Used	HIGH
	A1S2EV	Not Used	BEGN
	A2S1TY	IN1	NONE
	A2S1VA	1350	90
	A2S1HL	HIGH	HIGH
	A2S1EV	Not Used	BEGN
	A2S2TY	NONE	NONE
	A2S2VA	Not Used	90
	A2S2HL	Not Used	HIGH
	A2S2EV	Not Used	BEGN
	ALHYST	0.1	0.0
	ALARM1	NOL	NOL
	BLOCK	DIS	DIS
	DIAGL	DIS	DIS

Inlet Temperature Control (continued)

Group Prompt	Function Prompt	Value or Selection	Factory Setting
DISPLY	DECMAL	NONE	NONE
	UNITS	F	F
	FREQ	60	60
	LDSPLY	ENABLE	ENABLE
	DISPLY	1400	SP
	2nd SP	70	2L
	LNGUAG	ENGL	ENGL

Notes:

1) Controller should be set to the automatic position. To change between the manual and automatic position, depress the M-A/Reset Button and observe the M or A indicated on the right middle area of the screen.

2) Enter in the Set Point temperature by pushing the Lower Display button until SP appears in lower left corner. SP should read 1400. 2nd Set Point (2L) should read 70.

3) Read Status: Skip

4) Program control setup before tuning setup.

Outlet Temperature Control

Group Prompt	Function Prompt	Value or Selection	Factory Setting
TUNING	PB or GAIN	PB 15	1.0
	RATE T	0.00	0.00
	I MIN or I RPM	1.0	1.0
	MANRST	Not Used	1.0
	PB2 or GAIN 2	Not Used	0.0
	RATE2T	Not Used	0.00
	I2 MIN or I2 RPM	Not Used	1.0
	CYCT1 or CT1	Not Used	20
	X3	Not Used	20
	CYC2T2 or CT2	Not Used	20
	X3	Not Used	20
	SECUR	Not Used	0
	LOCK	NONE	NONE
	AUTOMA	ENAB	ENAB
	A TUNE	ENAB	ENAB
	RN HLD	ENAB	ENAB
	SP SEL	ENAB	ENAB

Group Prompt	Function Prompt	Value or Selection	Factory Setting
SPRAMP	SPRAMP	DIS	DIS
	TI MIN	Not Used	3
	FINLSP	Not Used	1000
	SPRATE	DIS	DIS
	EUHRUP	Not Used	0
	EUHRDN	Not Used	0
	SPPROG	Not Used	DIS

Group Prompt	Function Prompt	Value or Selection	Factory Setting
ATUNE	FUZZY	ENAB	DIS
	TUNE	DIS	TUNE
	DUPLEX	MAN	MAN
	AT ERR	Not Used	---

Group Prompt	Function Prompt	Value or Selection	Factory Setting
ALGOR	CTRALG	PIDA	PIDA
	TIMER	DIS	DIS
	PERIOD	Not Used	0:01
	START	Not Used	KEY
	L DISP	Not Used	TREM
	RESET	Not Used	KEY
	INCRMT	Not Used	MIN

Group Prompt	Function Prompt	Value or Selection	Factory Setting
OUTLAG	OUTLAG	CUR	(MOXL)
	4-20RG	Not Used	100
	CRANGE	4-20	4-20
	RLY TY	MECH	MECH
	MTRT1	5	5

Group Prompt	Function Prompt	Value or Selection	Factory Setting
INPUT1	IN1TYP	KH or JH	KH
	XMITR1	Not Used	LIN
	IN1 HI	2400	2400
	IN1 LO	0	0
	RATIO1	1.0	1.00
	BIAS1	0.0	0.0
	FILTR1	5	1.0
	BRNOUT	UP	UP
	EMIS	1.0	1.0

Group Prompt	Function Prompt	Value or Selection	Factory Setting
INPUT2	IN2TYP	Not Used	1-5V
	LIN	Not Used	LIN
	IN2 HI	Not Used	2400
	IN2 LO	Not Used	0
	RATIO2	Not Used	1.00
	BIAS 2	Not Used	0.0
	FILTR2	Not Used	1.0

Outlet Temperature Control
(continued)

Group Prompt	Function Prompt	Value or Selection	Factory Setting
CONTRL	PIDSET	ONE	ONE
	SW VAL	Not Used	0.00
	LSP'S	ONE	ONE
	RSPSRC	NONE	NONE
	SP TRK	NONE	NONE
	PWR UP	ALSP	AUTO
	PWROUT	LAST	FSAF
	SP Hi	1600	2400
	SP Lo	0	0
	ACTION	REV	REV
	OUT Hi	100	100
	OUT Lo	0	0
	D BAND	2.0	2.0
	HYST	0.5	0.5
	FAILSF	0.0	0.0
	FSMODE	LATCH	NOL
	PBorGN	PB	GAIN
	MINRPM	RPM	MIN

Group Prompt	Function Prompt	Value or Selection	Factory Setting
OPTION	AUXOUT	IN1	DIS
	ARANGE	4-20	4-20
	0 PCT	0	0
	100 PCT	1600 or 2000	100
	DIG IN 1	NONE	NONE
	DIG1 COM	DIS	DIS
	DIG IN 2	NONE	NONE
	DIG2 COM	DIS	DIS

Group Prompt	Function Prompt	Value or Selection	Factory Setting
COM	ComADR	Not Used	Disable
	COMSTA	Not Used	0
	IRENAB	Not Used	Enable
	BAUD	Not Used	9600
	TX_DLY	Not Used	30
	WS_FLT	Not Used	FP_B
	SDENAB	Not Used	Enable
	SHDTIM	Not Used	0
	SDMODE	Not Used	Last
	SHD_SP	Not Used	LSP
	UNITS	Not Used	PCT
	CSRATO	Not Used	1.0
	CSP_BI	Not Used	0
	LOOPBACK	Not Used	Disable

Group Prompt	Function Prompt	Value or Selection	Factory Setting
ALARMS	A1S1TY	NONE	NONE
	A1S1VA	Not Used	90
	A1S1HL	Not Used	HIGH
	A1S1EV	Not Used	BEGN
	A1S2TY	Not Used	NONE
	A1S2VA	Not Used	90
	A1S2HL	Not Used	HIGH
	A1S2EV	Not Used	BEGN
	A2S1TY	Not Used	NONE
	A2S1VA	Not Used	90
	A2S1HL	Not Used	HIGH
	A2S1EV	Not Used	BEGN
	A2S2TY	Not Used	NONE
	A2S2VA	Not Used	90
	A2S2HL	Not Used	HIGH
	A2S2EV	Not Used	BEGN
	ALHYST	0.1	0.0
	ALARM1	NOL	NOL
	BLOCK	DIS	DIS
	DIAGL	DIS	DIS

Outlet Temperature Control
(continued)

Group Prompt	Function Prompt	Value or Selection	Factory Setting
DISPLY	DECMAL	NONE	NONE
	UNITS	F	F
	FREQ	60	60
	LDSPLY	ENABLE	ENABLE
	SP	1500	0
	LNGUAG	ENGL	ENGL

Notes:

1) Controller should be set to the automatic position. To change between the manual and automatic position, depress the M-A/Reset Button and observe the M or A indicated on the right middle area of the screen.

2) Enter in the Set Point temperature by pushing the Lower Display button until SP appears in lower left corner. SP should read 1500.

3) Read Status: Skip

4) Program control setup before tuning setup.

ABB Chart Recorder Settings

The ABB Chart Recorder may be programmed Manually, or by loading the program from the removable SD Card used to store logged information.

The SD Card supplied with the unit has a copy of the program settings for the chart recorder that may be used to restore settings, or to program an identical replacement controller. No documentation for manually programmed settings is currently available.

An additional copy of these settings is stored on the CD ROM that accompanies this manual. The program is a configuration file located in a folder labeled "VRD". The program must reside in a folder Labeled VRD to be recognized by the chart recorder.

Follow instructions within the ABB Chart recorder manual, or contact Intellishare Environmental for assistance, if reprogramming is necessary.

ABB Software – Datamanager & Emulation

To install ABB Emulation Software and Data Manager Software - Follow steps 1, 2, & 3. This software is furnished by ABB and is supplied on the CD ROM that accompanies this manual.

To install ABB Data Manager software only - Follow step 3. (Data Manager takes stored data from the chart recorder data files, verifies file integrity, and converts to xcell format)

Step 1) Install WINDOWS CE 5.0 Emulation software - Open CE 5.0 emulator file and double click (Setup.exe). Follow setup instructions and accept the license agreement.

Step 2) Install SM500 Emulation Software - Open ABB Software double click on DM.EXE A full screen window will pop up. Select SM500F. Follow setup instructions and accept the license agreement.

Step 3) Install Data Manager software - Open ABB Software double click on DM.EXE A full screen window will pop up. Select Install Data Manager Software. Follow setup instructions and accept the license agreement.

View Instruction Manuals in folder - SM500 Documentation

See an excerpt describing the chart recorder from the SM 500 Manual on the following page.

Operation

4.1 Powering up the Instrument

When power is first applied to the instrument, its processor carries out a number of self-tests and displays the start-up screen.

At the end of the start-up sequence, the instrument displays the Operator View that was being displayed

when the instrument was powered down.

4.2 Operator Keys and Door Features – Fig. 4.1

The instrument is operated via the Operator Keys located below the screen.

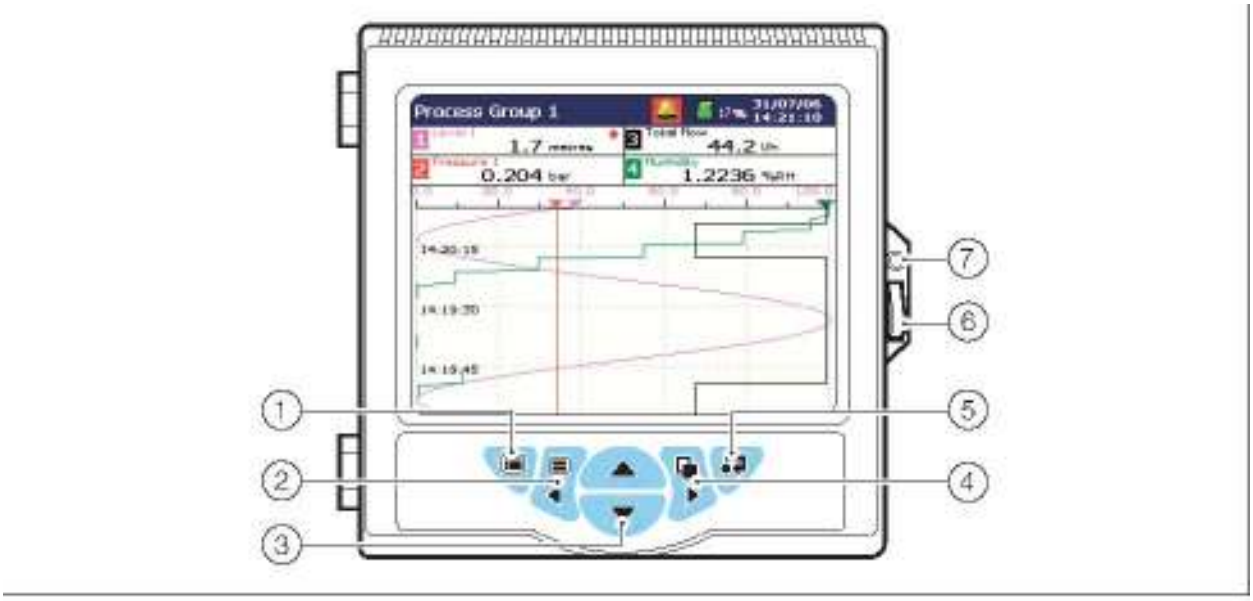


Fig. 4.1 Operator Keys and Door Features

Referring to Fig. 4.1, operator keys and door features are located as follows:

1. Menu Key – Displays or hides the context-sensitive operator menu associated with each view. Also cancels the menu without making a change or returns to the previous menu level.
2. Group Key – Selects a different process group or

   Left Key – Scroll left.
3. / Up/Down Keys – Highlights menu items and scrolls through previously recorded data.
4. View Key – Selects a different process view or log or

   Right Key – Scroll right.
5. Enter Key – Selects the highlighted menu item. If 'Screen Capture' is set to 'Enabled' during configuration and external archive media is inserted in the instrument, the operator can save a snapshot of any operator view to the external media if pressed when an operator menu is not displayed.
6. Door Release.
7. Door Lock (optional).

IM/SM500F Issue

Programming SM500 using PC (Emulator)

This section details programming the instrument manually using the pc and copying the file to an SD card and loading into the instrument.

Start the SM500 Emulator from Windows/Start menu on the PC and perform the following steps on the menu:

Programming:

Emulator
MENU button
Configuration
Operator1
OK
Edit Current Config
Menu button
Common Config
Setup Tab
- number of groups = 1
- Instrument tag = Oxidizer
Screen Tab
screen saver wait time = 2hrs
Time Tab
MM/DD/YY
Group Configuration
Recording Tab
Tag = Oxidizer1
Chart Tab
Chart View Enable = horizontal
Screen interval = 25min
Archive Tab
Archive File enables: *.d, *.a
Filename Tag: Oxidizer Data
New file interval: monthly
Channels 1.1-1.4
1.1
Analog I/P A1 Tab
Input type: T/C
Engineering Range: set to device
Tag: Inlet, Outlet, or LEL
Broken Sensor: upscale if T/C
Do the same for other channels

Menu out until it prompts to "Save Current Configuration".
* note where file is saved

You will be at the Emulator chart Screen (showing process values)

Menu Button
Logging
On-line (checked)
Recording Control
Primary

Copy File to SD Card

To copy the file to the SD card and move it to the instrument, perform the following:

Put the SD card into an SD slot on the PC or into and SD card reader attached to the PC

Navigate to the SD Card
- create folder "VRD"
- copy and paste .cfg file from the emulator to the SD card

Move file to the Chart Recorder

Place SD card in recorder
- go online or wait, it will automatically go online (Normal Operation)
- go to Logging and check offline (before dumping program off card onto Internal memory)
- go to MENU
Configuration
Operator
OK
Open a Configuration
Choose External Storage
Highlight desired program (on SD card) Press enter
Press MENU button and select Save as Current Configuration

Retrieve Data from Recorder to Card
To retrieve data (stored on the SD card) from the instrument perform the following:
Menu button
Logging
Offline
-Verify the red light is of on the back of the recorder
Remove card

View Data Recorded to the SD Card
- Install SD card in computer
- start Microsoft Excel software (Datamanager software must be installed prior to this)
- select the "open CSV" file icon
select "View Chart" icon

Blower Performance Run – 4007 CP

Tuthill

Quotation System 19.2.9

Performance Datasheet

Customer	:	Quote number	: 830218
Customer reference	:	Size	: 4007 CP Series (2-lobe)
Item	: 014	Based on curve number	: 0-4007
Application	:	Date last saved	: 09 Aug 2019 3:04 PM
Material	: Cast Iron		

Operating Conditions

Standard conditions :

(14.70 psi.a , 70.00 deg F , 0.00 %)

Condition	1	
System inlet volume flow	405.1	CFM
Flow at standard conditions , dry	250.0	SCFM
Mass flow	0.31	lbm/s
System inlet temperature	60.00	deg F
System inlet pressure	70.00	in H2O vac
Inlet pressure loss	0.15	psi
Product inlet pressure	74.15	in H2O vac
Product discharge pressure	16.15	in H2O.g
Discharge pressure loss	0.15	psi
System discharge pressure [p2]	12.00	in H2O.g
Product differential pressure	3.26	psi
System differential pressure [dp]	2.96	psi
Vacuum Relief Setting	98.00	in H2O vac
Actual system discharge volume	334.3	CFM

Site Conditions

Atmospheric pressure	11.50	psi.a
Elevation above sea level	6,630.0	ft
Ambient temperature	100.0	deg F
Relative humidity	36.00	%
Frequency	60	Hz
Set inlet to ambient site conditions	No	

Gas Data

Type of gas	Air	
Molecular weight (MW)	28.85	
Specific gravity	0.996	
Specific heat (Cp)	0.2414	Btu/(lb.deg F)
Ratio of specific heat (k)	1.40	

Performance

Actual inlet volumetric flow	411.9	CFM
Power, shaft [Ps]	7.41	hp
Inertial power	5.00	hp
Torque	0.25	hp/100 rpm
% of max torque	14.21	%
Quantity of units operating	1	
Speed	2989	rpm
% of max speed	83.04	%
Noise (with inlet and discharge silencers)	91	dB
Efficiency, volumetric [#,v]	86.13	%
Temperature rise	50.89	deg F
Discharge temperature	110.9	deg F
% of max temperature rise	17.55	%
% of max pressure rise	18.12	%

Vacuum Relief Condition

Power, shaft @ Vacuum Relief	9.52	hp
Temperature rise @ Vacuum relief	76.94	deg F
Discharge temperature @ Vacuum Relief	136.9	deg F
% of max temperature rise @ Vacuum Relief	26.53	%
% of max pressure rise @ Vacuum Relief	23.74	%

SUPPLY POWER: 460VAC/3PH/60Hz
FULL LOAD AMPS: 5 FLA
SCCR: 10kAIC

DSC100
PANEL DISCONNECT
40A, 3P

1L1
1L2
1L3

#12
BLK

MSP120

MS642

2L1
2L2
2L3

SET TO
4 AMPS

(237, 642)

B2
COMBUSTION AIR
BLOWER
2HP
460V/3PH/60Hz
3.4 FLA

MTR
GND
LUG

GROUND WIRE TO CONTROL PANEL

#12
BLK

1L1
1L2

CB152
3 AMPS

1560
1561

TO LINE 201

REV	BY	DATE	CHANGE
0	MEE	08/15/19	SUBMITTAL

INTELLISHARE ENVIRONMENTAL
CLEAN AIR SOLUTIONS

PROJECT ID: N-19-2235

TITLE: ELECTRICAL SCHEMATIC
GAS FIRED OXIDIZER

DRAWING NO.: N-19-2235-401

SCALE: NONE

DRAWN: MEE DATE: 08/15/19

CHECKED: DATE

APPROVED: DATE

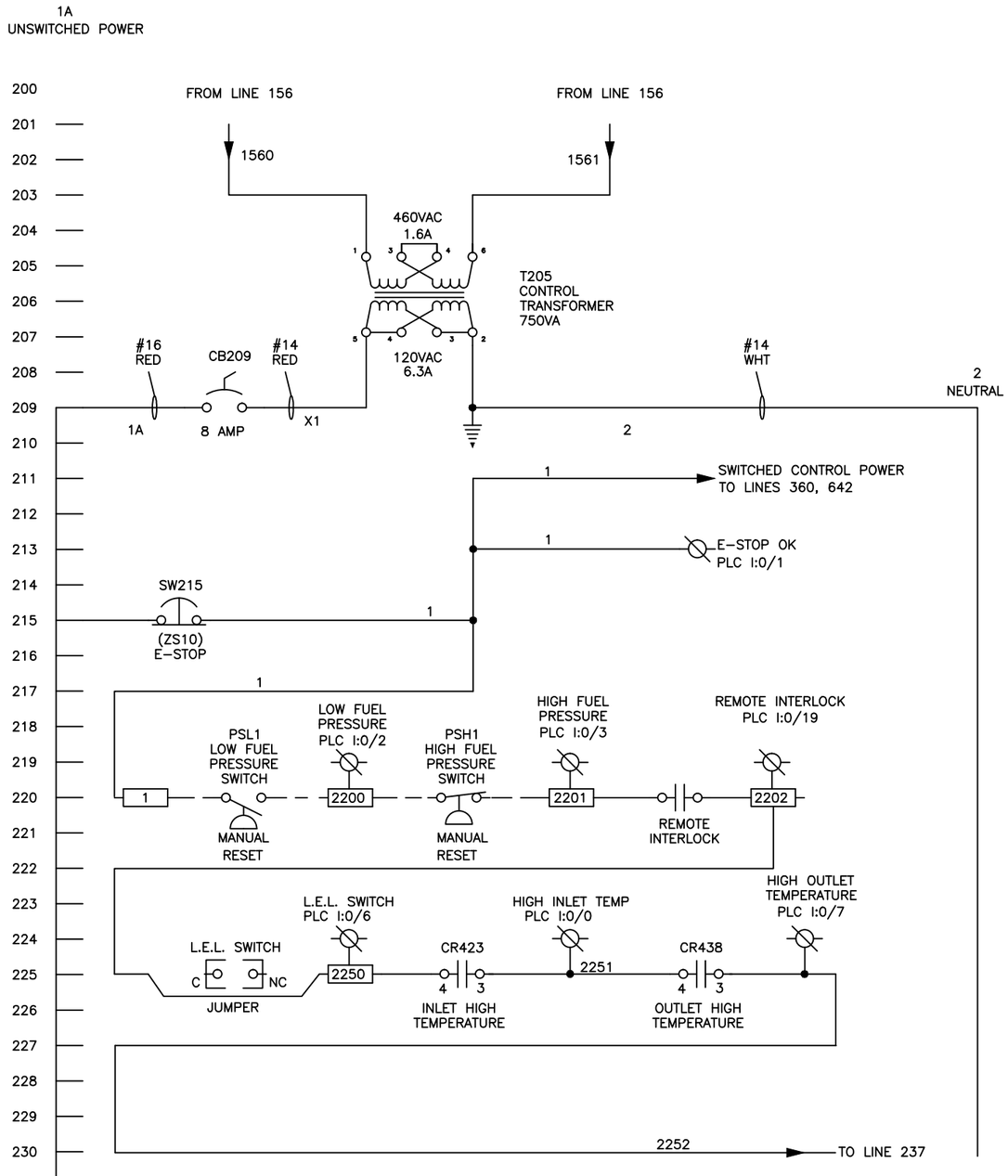
LAST DRAWN BY: DATE

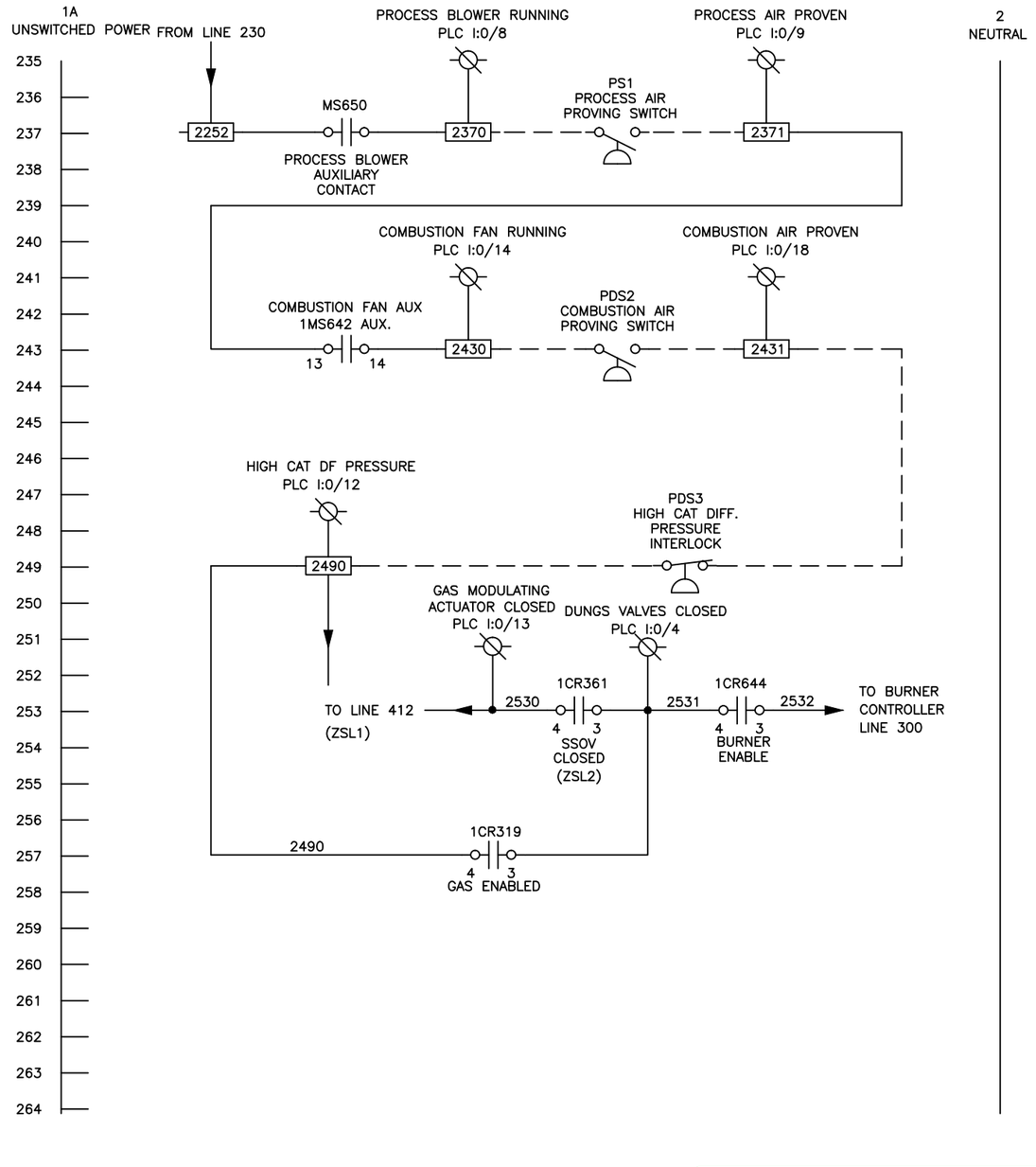
CUSTOMER:
GEO-LOGIC
SHAMROCK 63
SANTA FE, NM

EGAN NUMBER: .

PAGE 1 OF 10

LAST PLOTTED BY: DATE





0	MEE	08/15/19	SUBMITTAL
REV	BY	DATE	CHANGE

INTELLISHARE ENVIRONMENTAL
CLEAN AIR SOLUTIONS

PROJECT ID	N-19-2235
TITLE	ELECTRICAL SCHEMATIC GAS FIRED OXIDIZER
DRAWING NO.	N-19-2235-402
SCALE	NONE
DRAWN MEE DATE 08/15/19	
CHECKED DATE	
APPROVED DATE	
LAST DRAWN BY DATE	
CUSTOMER	GEO-LOGIC SHAMROCK 63 SANTA FE, NM
EGAN NUMBER .	PAGE 2 OF 10
LAST PLOTTED BY DATE	

1A
UNSWITCHED POWER

2
NEUTRAL

2
NEUTRAL

2532
FROM LINE 253

FSP1
HONEYWELL RM7897A1002
FLAME SAFETY CONTROLLER

1CR640
RESET
3030
9
5
3031

221818A
EXTENSION
CABLE BASE
CABLE
S7800A1142
DISPLAY
MODULE

6
BURNER
ENERGIZE

1A
5
LINE POWER

REMOVE JUMPER JR2

4
COMBUSTION
AIR OUTPUT
7
AIR FLOW
INTERLOCK

LINE
NEUTRAL L2
2

IGNITION
OUTPUT
10
3150
3150

PILOT ON
PLC I:0/11

PILOT VALVE
OUTPUT
(INTERMITTENT)
8
3170
3170

CR319
5
1
GAS ENABLED
257

BURNER ON
PLC I:0/16

MAIN SHUT-OFF
VALVE OUTPUT
9
3210
3210

FUEL OPEN

FLAME FAILURE
ALARM
3
3230

FLAME FAILURE
PLC I:0/15
MANUAL RESET

FLAME UV
SENSOR
F
BLUE
WHITE
2
UV1
UV SENSOR
YELLOW
GND
WHITE
22
SHUTTER

PRE-IGNITION
20
3590

3590

IGNITION TRANSFORMER
DONGAN PN: A06-SA6X
IT1
BLACK
WHITE
2
3150
INSULATOR
BOOT
SI1
FEED-THROUGH
INSULATOR
SPARK IGNITOR

MAIN GAS
SAFETY SHUTOFF
VALVE
BLOCK VALVE
ACTUATOR
2
1
SV1
3170
2
2

MAIN FUEL VALVE
ACTUATOR
3
1
SV2
2

1
FROM LINE 211
SWITCHED POWER
1

BLOCKING VALVE
CLOSED LIMIT SWITCH
3590

3590
CR361
5
1
FUEL CLOSED
ZSL2
253

3590

0	MEE	08/15/19	SUBMITTAL
REV	BY	DATE	CHANGE

INTELLISHARE ENVIRONMENTAL
CLEAN AIR SOLUTIONS

PROJECT ID
N-19-2235

TITLE
ELECTRICAL SCHEMATIC
GAS FIRED OXIDIZER

DRAWING NO.
N-19-2235-403

SCALE
NONE

DRAWN MEE DATE 08/15/19

CHECKED DATE

APPROVED DATE

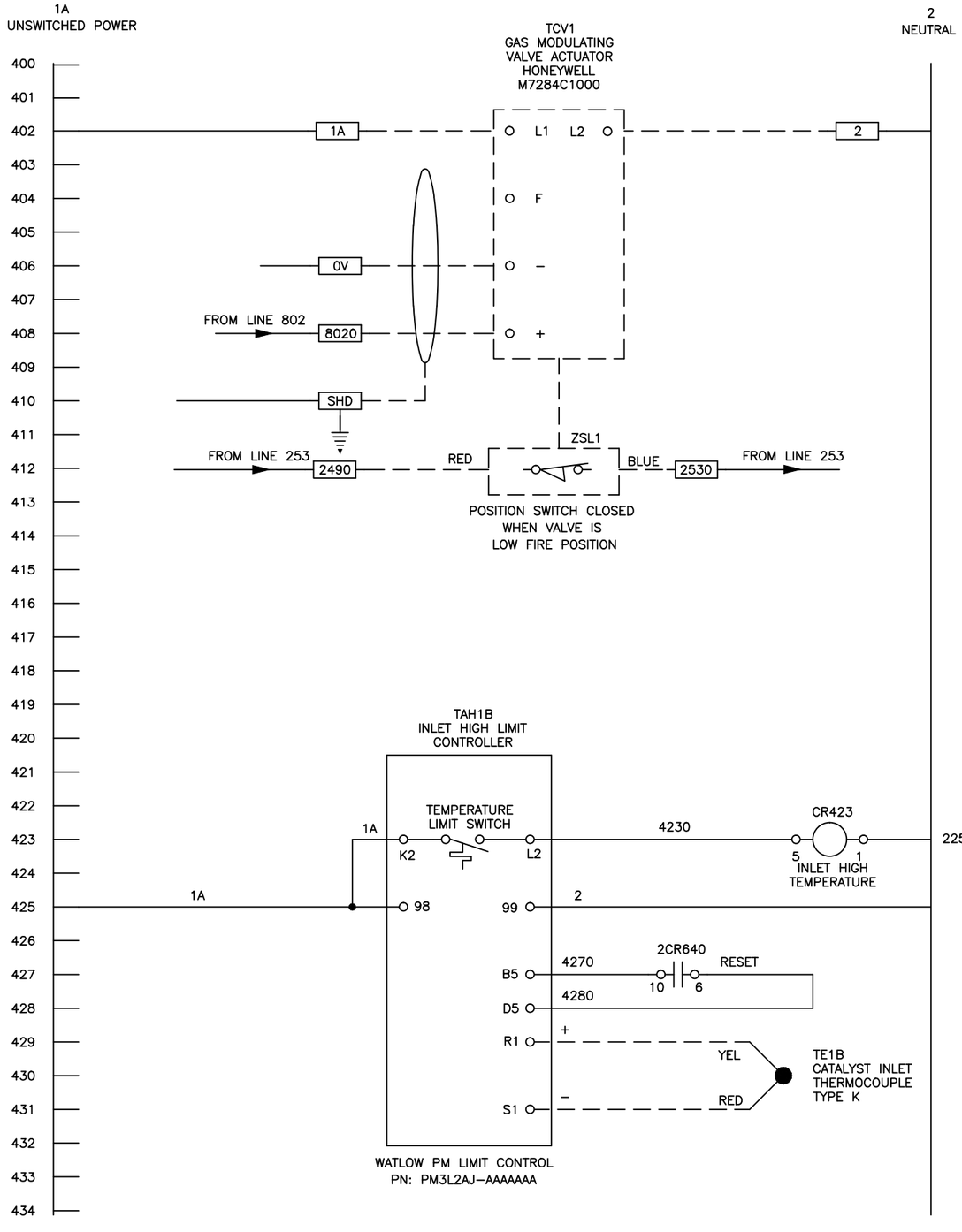
LAST DRAWN BY DATE

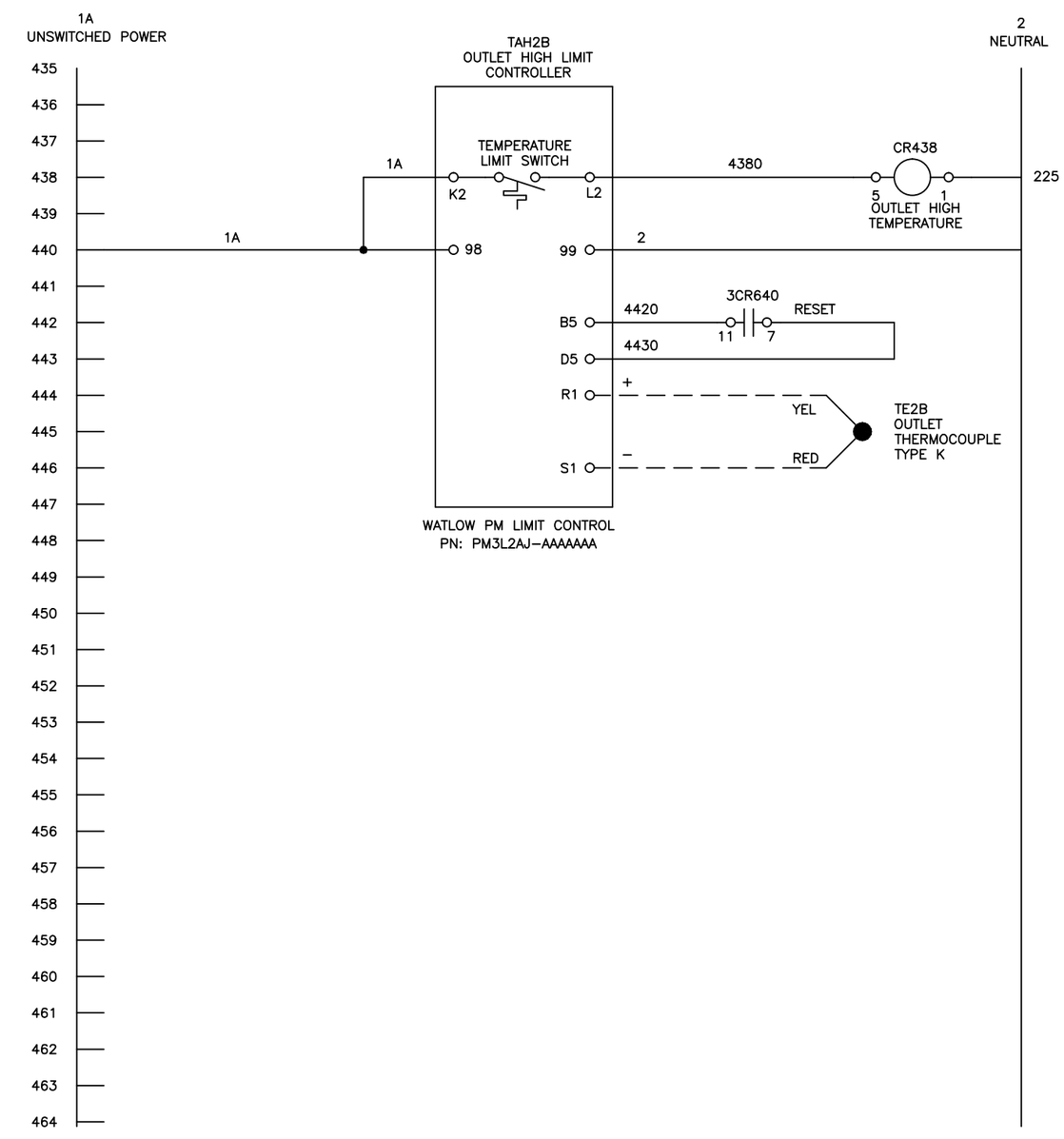
CUSTOMER
GEO-LOGIC
SHAMROCK 63
SANTA FE, NM

EGAN NUMBER .

PAGE 3 OF 10

LAST PLOTTED BY DATE





REV	BY	DATE	CHANGE
0	MEE	08/15/19	SUBMITTAL

INTELLISHARE ENVIRONMENTAL
CLEAN AIR SOLUTIONS

PROJECT ID: N–19–2235

TITLE: ELECTRICAL SCHEMATIC
GAS FIRED OXIDIZER

DRAWING NO.: N–19–2235–404

SCALE: NONE

DRAWN: MEE DATE: 08/15/19

CHECKED: DATE

APPROVED: DATE

LAST DRAWN BY: DATE

LAST PLOTTED BY: DATE

CUSTOMER: GEO–LOGIC
SHAMROCK 63
SANTA FE, NM

EGAN NUMBER: .

PAGE 4 OF 10

1A
UNSWITCHED POWER

500
501
502
503
504
505
506
507
508
509
510
511
512
513
514
515
516
517
518
519
520
521
522
523
524
525
526
527
528
529
530
531
532
533
534

2
NEUTRAL

1A
UNSWITCHED POWER

535
536
537
538
539
540
541
542
543
544
545
546
547
548
549
550
551
552
553
554
555
556
557
558
559
560
561
562
563
564

1A

TIR1
ABB
PAPERLESS CHART RECORDER
ABB SM500F PN: SM503FB/U000000E/STD

CHANNEL 1 — 1 2 3 4 — + A −
CHANNEL 2 — 1 2 3 4 — + B −
CHANNEL 3 — 1 2 3 4 — + −
1 2 3 4 — D
1 2 — E
1 2 3 — G

SPARE

RED
YEL
TE2C
OUTLET TEMPERATURE
TYPE-K

RED
YEL
TE1C
INLET TEMPERATURE
TYPE-K

2
NEUTRAL

REV	BY	DATE	CHANGE
0	MEE	08/15/19	SUBMITTAL

INTELLISHARE ENVIRONMENTAL
CLEAN AIR SOLUTIONS

PROJECT ID: N-19-2235

TITLE: ELECTRICAL SCHEMATIC
GAS FIRED OXIDIZER

DRAWING NO.: N-19-2235-405

SCALE: NONE

DRAWN: MEE DATE: 08/15/19

CHECKED: DATE

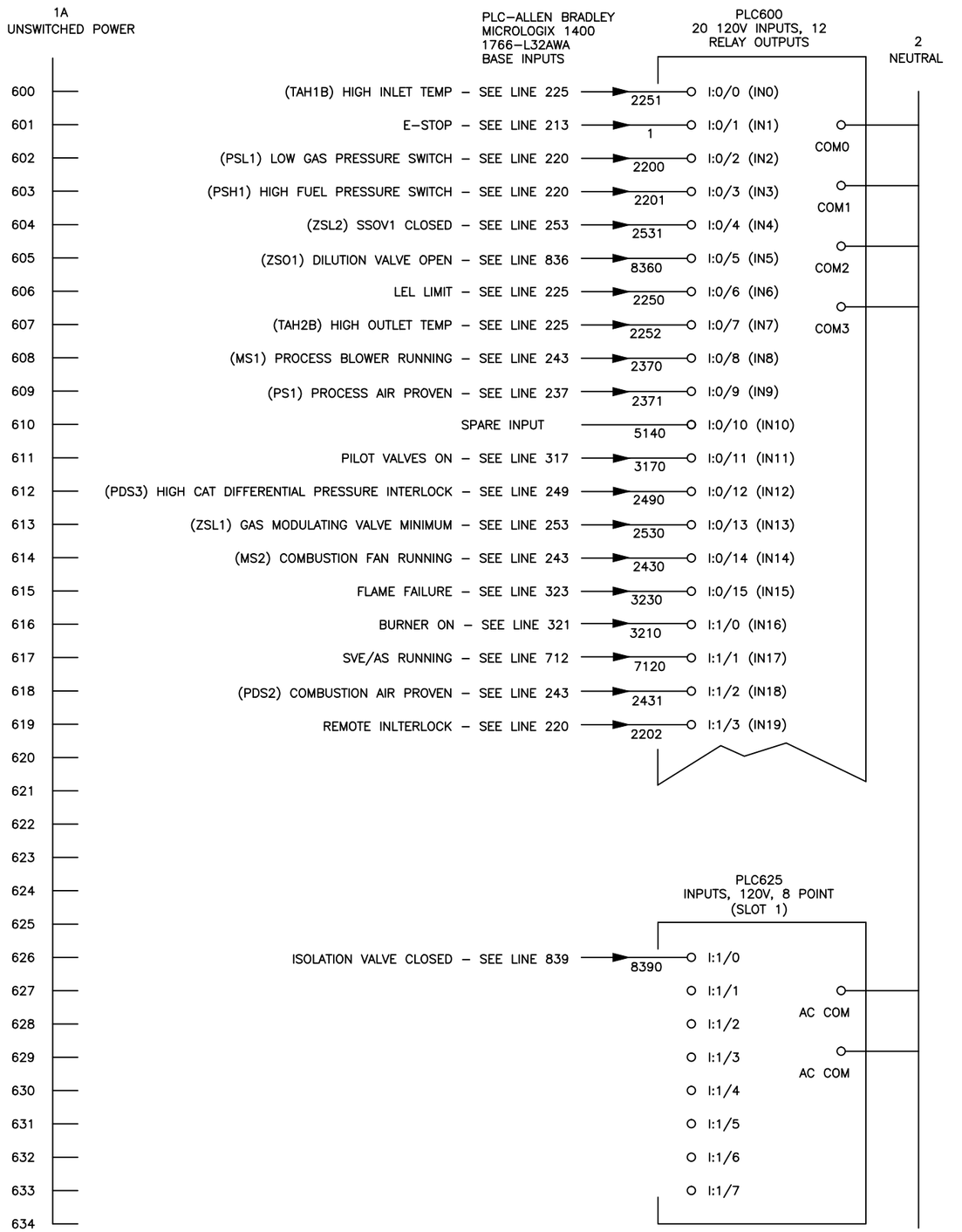
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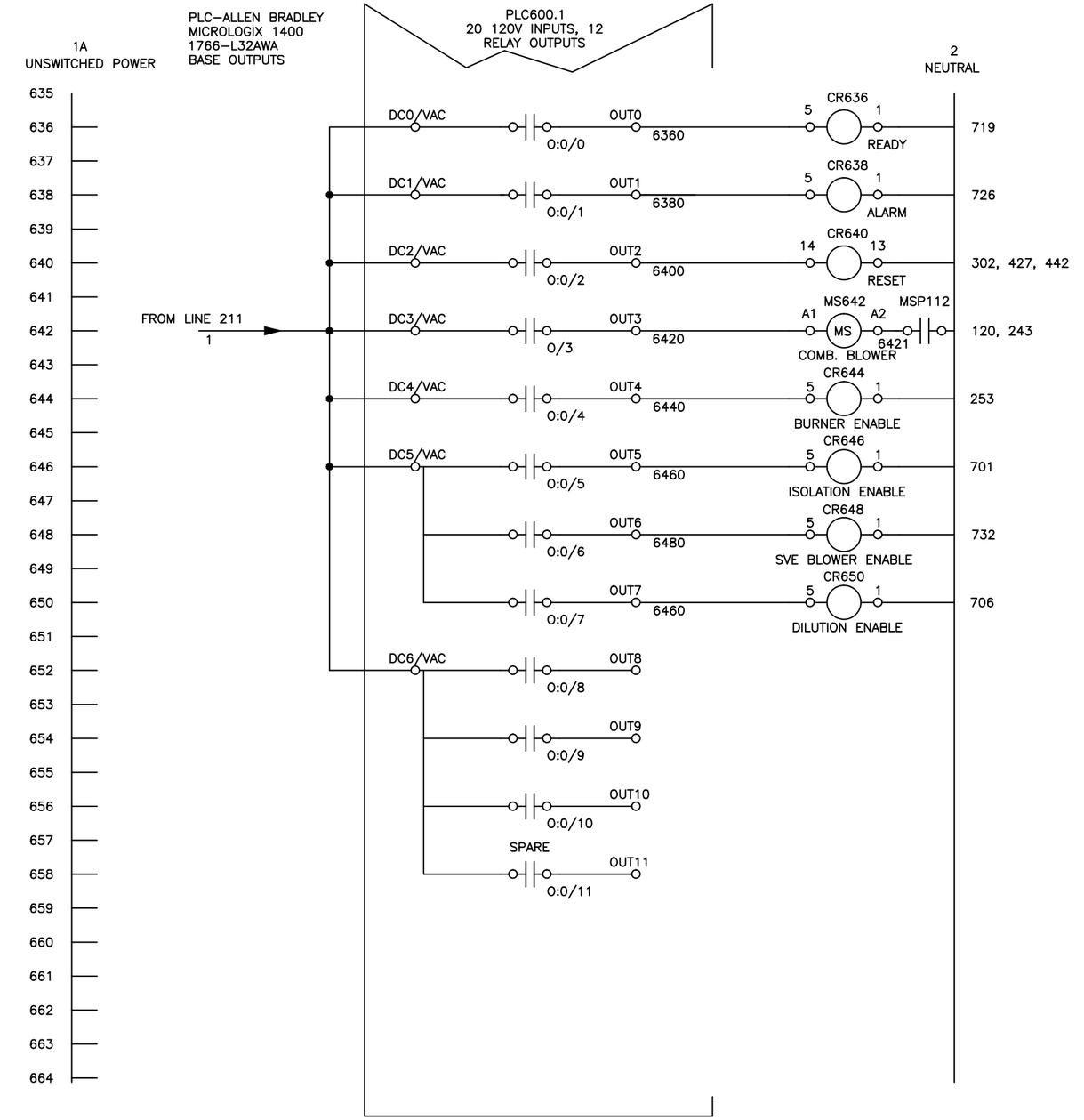
LAST DRAWN BY: DATE

LAST PLOTTED BY: DATE

CUSTOMER:
GEO-LOGIC
SHAMROCK 63
SANTA FE, NM

EGAN NUMBER: .





REV	BY	DATE	CHANGE
0	MEE	08/15/19	SUBMITTAL

INTELLISHARE ENVIRONMENTAL
CLEAN AIR SOLUTIONS

PROJECT ID: N–19–2235

TITLE: ELECTRICAL SCHEMATIC
GAS FIRED OXIDIZER

DRAWING NO.: N–19–2235–406

SCALE: NONE

DRAWN: MEE DATE: 08/15/19

CHECKED DATE

APPROVED DATE

LAST DRAWN BY DATE

CUSTOMER: GEO–LOGIC
SHAMROCK 63
SANTA FE, NM

EGAN NUMBER .

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LAST PLOTTED BY DATE

1A
UNSWITCHED POWER

2
NEUTRAL

FCV1 – PROCESS FLOW CONTROL SIGNAL
ENABLES 4–20mA SIGNAL TO CONTROL THE PROCESS FLOW VALVE
4mA=CLOSED, 20mA=OPEN
BREAKING THE 4–20mA SIGNAL SENDS VALVE TO FAIL–SAFE POSITION

FROM LINE 803 — 8030 — CR646 (4, 3) — 7011 — 7011 — SEE LINE 720 IN SVE PANEL
ISOLATION ENABLE
24– — SEE LINE 722 IN SVE PANEL
SHLD

TCV1 – DILUTION AIR CONTROL SIGNAL
ENABLES 4–20mA SIGNAL TO CONTROL THE DILUTION AIR VALVE
4mA=OPEN, 20mA=CLOSE
BREAKING THE 4–20mA SIGNAL SENDS VALVE TO FAIL–SAFE POSITION

FROM LINE 804 — 8040 — CR650 (4, 3) — 7061 — 7061 — SEE LINE 705 IN SVE PANEL
DILUTION ENABLE
24– — SEE LINE 707 IN SVE PANEL
SHLD

(YI–1 PROCESS RUNNING)
SVE / AS SYSTEM RUNNING CONTACT
DRY CONTACT IN SVE / AS PANEL IS CLOSED WHEN SYSTEM IS RUNNING

1A — 7120 — SVE/AS RUNNING PLC I:0/17
(SEE LINE 736 OF SVE SCHEMATICS)

(YO–1 OXIDIZER READY)
OXIDIZER READY CONTACTS FOR REMOTE INDICATION/USE
RELAY ENERGIZES WHEN SYSTEM IS READY TO RECEIVE PROCESS STREAM

7190 ORANGE — CR636 (4, 3, 2) — ORANGE 7191 (3) / ORANGE 7192 (2)

CONTACTS RATED 230V–16A MAX.

(YO–2 OXIDIZER ALARM)
SYSTEM ALARM CONTACTS FOR REMOTE INDICATION/USE
RELAY ENERGIZES WHEN SYSTEM IS IN ALARM.

7260 ORG — CR638 (4, 3, 2) — ORG 7261 (3) / ORG 7262 (2)

CONTACTS RATED 230V–16A MAX.

CUSTOMER BLOWER ENABLE/RUNNING CONTACTS
RELAY ENERGIZES WHEN THE CUSTOMER BLOWER SHOULD BE RUNNING.

7320 ORG — CR648 (4, 3) — ORG 7321
SVE BLOWER ENABLE
CONTACTS RATED 250V–3A MAX.

2252 — 2370
CUSTOMER BLOWER AUX CONTACT

** USE THESE CONTACTS WHEN OXIDIZER DOES NOT HAVE A PROCESS BLOWER

1A
UNSWITCHED POWER

2
NEUTRAL

PLC736
PLC, BASE,
20 120V INPUTS,
12 RELAY OUTPUTS
120V POWER
ALLEN BRADLEY
MICROLOGIX 1400

1A — 120/240 VAC
IP:
SN:
GW:
VAC NEUT
AC COMM
GND
2
COMMUNICATION PORT
PLC
ETHERNET

U741
ETHERNET SWITCH
5 PORT, 24VDC
24+ — +24V
0V — GND
0V — 0V
PORT1 PORT2 PORT3 PORT4 PORT5
#16 BLU/WHT

HMI
I745
OPERATOR
INTERFACE
DISPLAY
LCD, 7",
24VDC
IP:
SN:
GW:
+ — 24+
– — –24
GND

24+
–24
–24

1A — PS757
POWER SUPPLY
24VDC, 3.3A

1A — REC761
RECEPTACLE, 120V, 3A

REV	BY	DATE	CHANGE
0	MEE	08/15/19	SUBMITTAL

INTELLISHARE ENVIRONMENTAL
CLEAN AIR SOLUTIONS

PROJECT ID	N–19–2235
TITLE	ELECTRICAL SCHEMATIC GAS FIRED OXIDIZER
DRAWING NO.	N–19–2235-407
SCALE	NONE
DRAWN	MEE DATE 08/15/19
CHECKED	DATE
APPROVED	DATE
LAST DRAWN BY	DATE
CUSTOMER	GEO–LOGIC SHAMROCK 63 SANTA FE, NM
EGAN NUMBER	.
PAGE	7 OF 10
LAST PLOTTED BY	DATE

1A
UNSWITCHED POWER

2
NEUTRAL

PLC801
4 ANALOG OUTPUTS
1762–OF4 (SLOT 2)

I OUT 0 O:2.0 — 8020 — TO LINE 408 GAS VALVE

I OUT 0 O:2.1 — 8030 — TO LINE 710 PROCESS AIR VALVE

I OUT 0 O:2.2 — 8040 — TO LINE 706 DILUTION AIR VALVE

I OUT 0 O:2.3 — 8050 — RE–TRANSMIT CHAMBER TEMPERATURE –454 TO 2498F 4–20mA

ALG COM — 0V

4–20mA

PLC810
4 THERMOCOUPLE INPUTS
1762–IT4 (SLOT 3)

TE1A INLET TEMPERATURE TYPE K
YEL — IN0+ — I:3.0
RED — IN0–

TE2A OUTLET TEMPERATURE TYPE K
YEL — IN1+ — I:3.1
RED — IN1–

CONTROL PANEL TEMPERATURE TYPE K
YEL — IN2+ — I:3.2
RED — IN2–

YEL — IN3+ — I:3.3
RED — IN3–

1A
UNSWITCHED POWER

2
NEUTRAL

1A — ZSO–1 DILUTION AIR VALVE OPEN — 8360 — TO LINE 605
(FROM SVE PANEL – LINE 709)
DILUTION AIR OPEN
PLC I:0/5

1A — ZSC–1 PROCESS AIR VALVE CLOSED — 8390 — TO LINE 626
(FROM SVE PANEL – LINE 726)
PROCESS AIR CLOSED
PLC I:1/0

REV	BY	DATE	CHANGE
0	MEE	08/15/19	SUBMITTAL

PROJECT ID: N–19–2235

TITLE: ELECTRICAL SCHEMATIC
GAS FIRED OXIDIZER

DRAWING NO.: N–19–2235408

SCALE: NONE

DRAWN: MEE DATE: 08/15/19

CHECKED: DATE

APPROVED: DATE

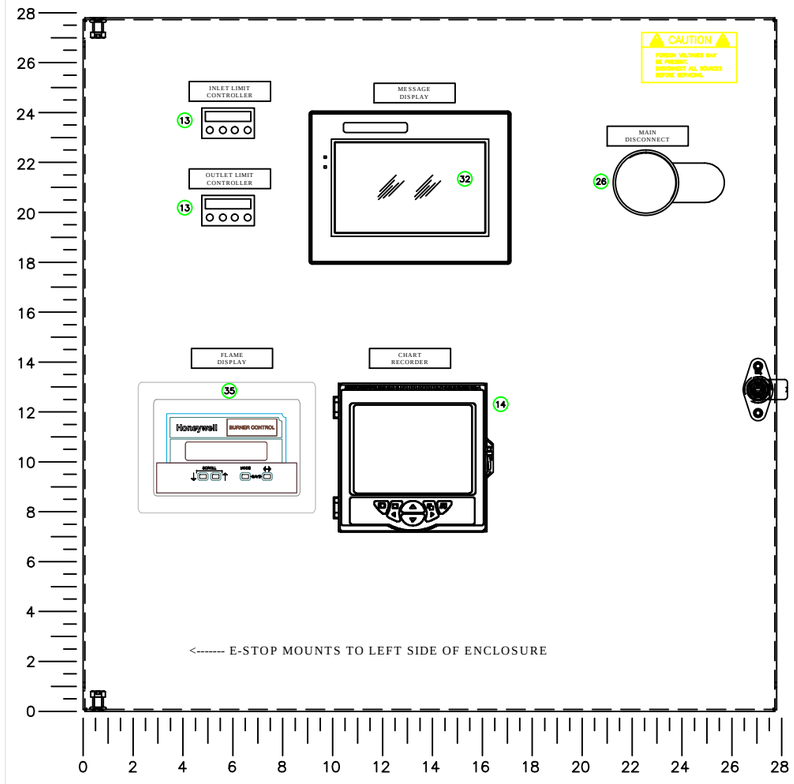
LAST DRAWN BY: DATE

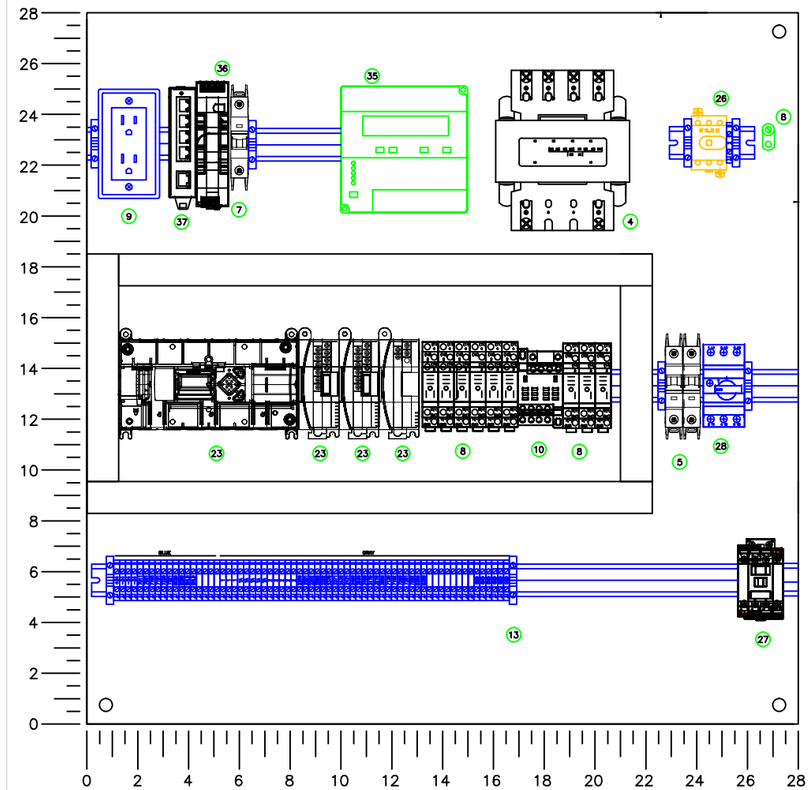
LAST PLOTTED BY: DATE

CUSTOMER: GEO–LOGIC
SHAMROCK 63
SANTA FE, NM

EGAN NUMBER: .

PAGE 8 OF 10





ITEM	QTY.	DESCRIPTION	PART NUMBER	MFG.
1	1	ENCLOSURE – 30" x 30" x 12", SS	C-SD303012SS	HOFFMAN
2	1	SUBPANEL – 30" x 30"	C-P3030	HOFFMAN
3	1	SWINGOUT KIT – 30" x 30"	C-SP3030	HOFFMAN
4	1	CONTROL TRANSFORMER 460-120, 750VA	PH750MQMJ, FG4	HAMMOND
5	1	CIRCUIT BREAKER 3A, 2P	FAZ-D3-2-NA	EATON
6	1	LOCKABLE PANEL HANDLE	CWHPTO	HOFFMAN
7	1	CIRCUIT BREAKER 8A, 1P	FAZ-D8-1-NA-SP	EATON
8	8	CONTROL RELAY – 1 POLE	700-HK36A1-4	A-B
	8	CONTROL RELAY BASE – 1 POLE	700-HN121	A-B
9	1	DUPLEX RECEPTACLE	1492-REC15G	A-B
10	1	CONTROL RELAY – 4 POLE	700-HC14A1-4	A-B
	1	CONTROL RELAY BASE – 4 POLE	700-HN128	A-B
11	5	CUSTOM DEVICE TAG	TAG-CUS	CUSTOM ENGRAVING
12	1	CUSTOM DEVICE TAG – WARNING LABEL	TAG-CUS	CUSTOM ENGRAVING
13	2	HIGH TEMPERATURE SWITCH – LV	PM3L2AJ-AAAAAAA	WATLOW
14	1	CHART RECORDER, PAPERLESS	SM503FB/U000000E/STD	ABB
15				
16	49	TERMINAL BLOCK	3044102	PHOENIX
	2	TERMINAL END BARRIER	3047028	PHOENIX
	1	TERMINAL BLOCK JUMPER	3032224	PHOENIX
	12	TERMINAL BLOCK BLUE	3044115	PHOENIX
	6	TERMINAL BLOCK – GROUNDING	KN-G10	AUD
17	7	DIN RAIL END CLAMP	KN-EB7	AUD
18				
19	1	35MM DIN RAIL – DEEP	101598.26	ENTERLEC
20	1	GROUND LUG	L70	CONNECTOR MFG
21	8	WIREWAY	F1X3WH6	PANDUIT
	8	WIREWAY COVER	C1WH6	PANDUIT
22				MACROMATIC
				MACROMATIC
				MACROMATIC
23	1	PLC BASE UNIT	1766-L32AWA	A-B
	1	PLC DISCRETE INPUT MODULE	1762-IA8	A-B
	1	PLC ANALOG OUTPUT MODULE	1762-OF4	A-B
	1	PLC THERMOCOUPLE INPUT MODULE	1762-IT4	A-B
24	1	PB E-STOP OPERATOR (E-STOP)	800FD-MT44X01	A-B
	1			
	1	PB E-STOP LEGEND	800F-15YE112	A-B
	1			
25				
26	1	NON-FUSED DISCONNECT	OT40F3	ABB
	1	NON-FUSED DISCONNECT SHAFT	OXP6X360	ABB
	1	NON-FUSED DISCONNECT HANDLE	OHB65J6, OHZX10	ABB
27	2	CONTACTOR	SC-E02-110VAC, SZA20T	FUJI
28	1	MOTOR CIRCUIT PROTECTOR, 2.5-4A	BM3RHB-004	FUJI
	2	MOTOR CIRCUIT PROTECTOR AUX CONTACT	BZ0W1A	FUJI
29				
30				
31				
32	1	OPERATOR INTERFACE, LCD, 24VDC	EA9-T7CL	AUD
33	1			
34	1	MOTOR CIRCUIT PROTECTOR, 4-6.3A	BM3RHB-6P3	FUJI
	2	MOTOR CIRCUIT PROTECTOR AUX CONTACT	BZ0W1A	FUJI
35	1	FLAME SAFEGUARD	RM7897A1002	HONEYWELL
	1	FLAME SAFEGUARD MOUNTING BASE	Q7800A-1005	HONEYWELL
	1	FLAME STRENGTH AMPLIFIER	R7861A1026	HONEYWELL
	1	PRE-PURGE TIMER 30 SEC.	ST7800A-1039	HONEYWELL
	1	FLAME SAFEGUARD DISPLAY COVER	204718A	HONEYWELL
	1	FLAME SAFEGUARD DISPLAY	S7800A1142	HONEYWELL
36	1	POWER SUPPLY, 24VDC, 80W, 3.5A	1606-XLE80E	A-B
	1	ETHERNET SWTICH, 5 PORT, 24VDC	2891001	PHOENIX
37	1	CABLE, ETHERNET, 7FT	C5E-STPBL-S3	AUD
	1	CABLE, ETHERNET, 3FT	C5E-STPYL-S7	AUD

A FLAME DISPLAY (11)

B (11)

C

D CHART RECORDER (11)

E MAIN DISCONNECT (11)

F MESSAGE DISPLAY (11)

G INLET LIMIT CONTROLLER (11)

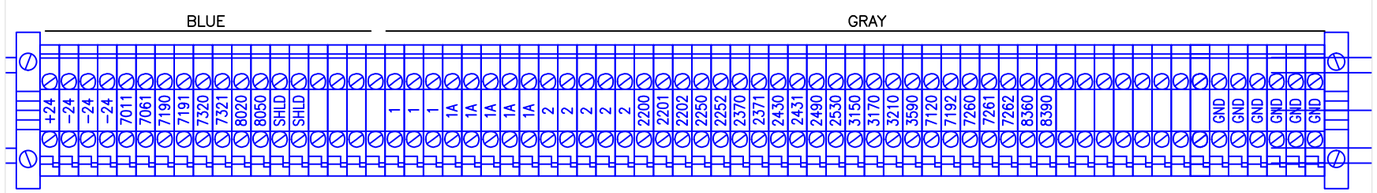
H OUTLET LIMIT CONTROLLER (11)

CAUTION (12)

FOREIGN VOLTAGES MAY BE PRESENT. DISCONNECT ALL SOURCES BEFORE SERVICING.

MCP1 – MAIN CONTROL PANEL 36"X30"X12"

ENLARGED VIEW OF TERMINAL BLOCKS



REV	BY	DATE	CHANGE
0	MEE	08/15/19	SUBMITTAL

INTELLISHARE ENVIRONMENTAL
CLEAN AIR SOLUTIONS

PROJECT ID: N-19-2235

TITLE: ELECTRICAL SCHEMATIC
GAS FIRED OXIDIZER

DRAWING NO.: N-19-2235-450

SCALE: NONE

DRAWN: MEE DATE: 08/15/19

CHECKED: DATE

APPROVED: DATE

LAST DRAWN BY: DATE

CUSTOMER: GEO-LOGIC
SHAMROCK 63
SANTA FE, NM

EGAN NUMBER: .

PAGE 9 OF 10

LAST PLOTTED BY: DATE

Wiring Instructions/Information

Field Connection	Terminal Strip	Function Text
Y	1	Low Fuel Pressure SW – Common
Y	2200	Low Fuel Pressure SW – Return
Y	2200	High Fuel Pressure SW – Common
Y	2201	High Fuel Pressure SW – Return
O	2201	Remote Interlock – Common (Optional)
O	2202	Remote Interlock – Return (Optional)
O	2202	L.E.L. SW – Common (Optional)
O	2250	L.E.L. SW – Return (Optional)
Y	2252	SVE Blower Aux Contact – Common
Y	2370	SVE Blower Aux Contact – Return
Y	2370	Process Air Proving Switch – Common
Y	2371	Process Air Proving Switch – Return
Y	2430	Combustion Air SW – Common
Y	2431	Combustion Air SW – Return
Y	2431	High DF Pressure SW – Common
Y	2490	High DF Pressure SW – Return
Y	3150	Ignition Transformer – Black Wire
Y	2	Ignition Transformer – White Wire
Y	3170	Pilot Valve Solenoids
Y	2	Pilot Valve Neutral
Y	2	Saftey Shutoff Valve Neutral
Y	1	Gas Valve Closed SW – Common
Y	3590	Gas Valve Closed SW – Return
Y	2490	Gas Modulating Valve Actuator SW – Common
Y	2530	Gas Modulating Valve Actuator SW – Return
Y	1A	Isolation Valve Power
Y	8390	Isolation Valve Closed Position – Return
Y	1A	Dilution Valve Actuator SW – Common
Y	8360	Dilution Valve Actuator Open SW – Return
Y		
Y		
Y		
Y		

Terminal Block TB1 (Control Voltage)

Terminal block "TB1" represents all Control Voltage terminal connections. The "Field Conn." column is marked with an "Y" to identify required field connections, and an "O" for optional connections.

All wiring shall be RED 14 guage type THHN and must be isolated from low voltage wiring.

Warning: Follow appropriate guidlines when wiring to classified environment.

Field Connection	Terminal Strip	Function Text
Y	–24	Gas Valve Actuator – Analog Command (–)
Y	8020	Gas Valve Actuator – Analog Command (+)
Y	–24	Isolation Valve Actuator – Analog Command (–)
Y	7011	Isolation Valve Actuator – Analog Command (+)
Y	–24	Dilution Valve Actuator – Analog Command (–)
Y	7061	Dilution Valve Actuator – Analog Command (+)

Terminal Block TB2 (Low Voltage)

Terminal block "TB2" represents all Low Voltage terminal connections. The "Field Conn." column is marked with an "Y" to identify required field connections, and an "O" for optional connections.

All wiring shall be 18 AWG 3 conductor shielded belden cable or equivilent and must be isolated from high voltage wiring.

Warning: Follow appropriate guidlines when wiring to classified environment.

INCOMING POWER – 480V, 3 Phase

Incoming power shall be wired to the Fuse Block provided, see schematic line #101.
Wire must be sized to meet NEC & Local code requirements.

MOTOR CONNECTIONS

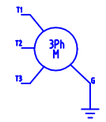
All field wiring for motors shall be black in color and sized to meet local and NEC requirements.

Connections are to be made directly from motor to overload block as shown on page 401 of the schematic.

All motor ground connections are to be connected to ground bar on panel.

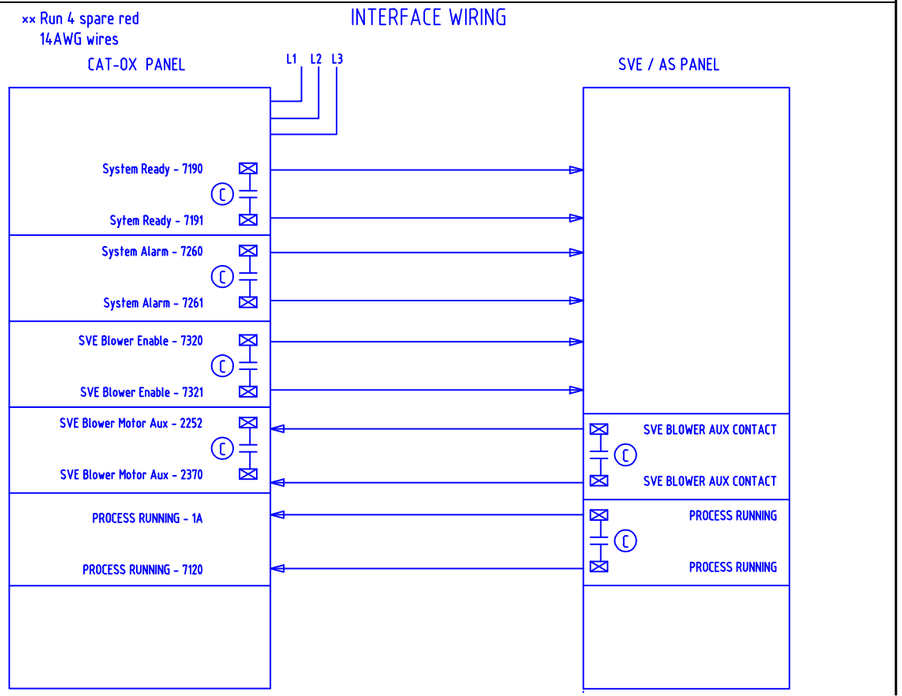
Always isolate from any low voltage wiring.

The motors to be wired are shown below:



LOAD	VOLTS	AMPS	WIRE
B2	480V	3.4	12AWG

INTERFACE WIRING



REV	BY	DATE	CHANGE
0	MEE	08/15/19	SUBMITTAL

INTELLISHARE ENVIRONMENTAL
CLEAN AIR SOLUTIONS

PROJECT ID: N–19–2235
TITLE: ELECTRICAL SCHEMATIC
GAS FIRED OXIDIZER
DRAWING NO.: N–19–2235–460
SCALE: NONE
DRAWN: MEE DATE: 08/15/19
CHECKED: DATE
APPROVED: DATE
LAST DRAWN BY: DATE
CUSTOMER: GEO–LOGIC
SHAMROCK 63
SANTA FE, NM
EGAN NUMBER: .
PAGE 10 OF 10
LAST PLOTTED BY: DATE

Straight Centrifugal Pumps

- ***Available in : 300 Series Investment Cast Stainless Steel, Cast Bronze and Cast Iron with Stainless Steel Impeller Construction***
- ***Viton® Mechanical Seal and O-Ring with Stainless Steel and Bronze Models***
- ***Buna-N Mechanical Seal and O-Ring with Cast Iron Models***
- ***Optional Silicon Carbide Mechanical Seals Available***
- ***Discharge Port Rotates in 90˚ Increments***
- ***Maximum Working Pressure 75 PSI***
- ***Max. Temperature 200˚F***
- ***Max. Flow 90 GPM***
- ***Max. Head 65 Ft. (28 PSI)***
- ***Self-cleaning, Semi-open Impellers***
- ***Available with Totally Enclosed Fan Cooled(TEFC) 56J Motors***
- ***1/3 HP to 2 HP Single and Three Phase, 3450 RPM Motors***

This line of AMT Straight Centrifugal pumps is designed for continuous-duty low pressure OEM, Industrial/Commercial and General Service applications including circulation, chemical processing, liquid transfer and cooling. These durable and compact pumps are available in a variety of construction and seal materials to meet your specification. The line also features a wide selection of single and three phase TEFC motors, up to 2 horsepower. All models feature Type 6 mechanical seals and O-rings. Pull-from-the-rear design for easy service without disturbing any piping. Self-cleaning impellers to prevent clogging and minimize maintenance.

AMT Centrifugal pumps are reliable, cost effective and low maintenance. Many are readily available **"Off-the Shelf"** for fast 24 hour shipment. For use with non-flammable liquids compatible with pump component materials.

Viton® is a registered trademark of E.I. DuPont

INDUSTRIAL DUTY

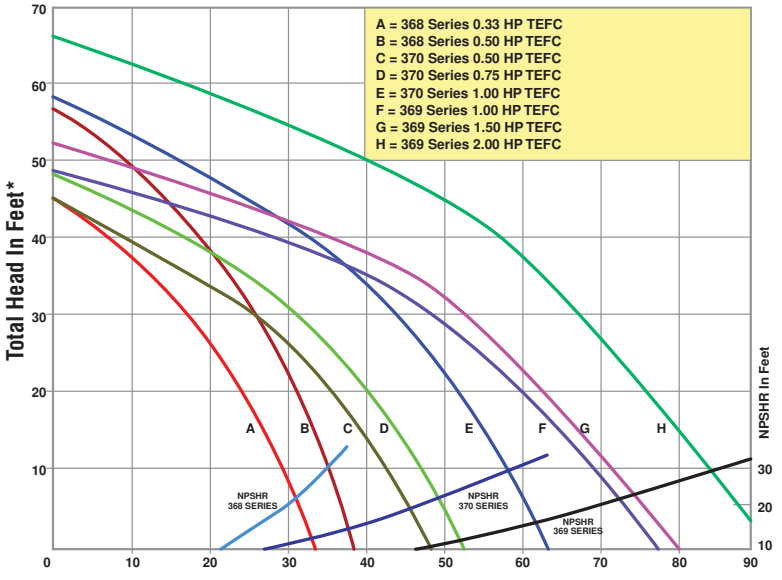


Bronze Centrifugal Pump



Stainless Steel Centrifugal Pump

Performance of Centrifugal Pumps



* Convert to PSI, divide by 2.31 Liquid-Water specific gravity 1.0

Straight Centrifugal Pumps

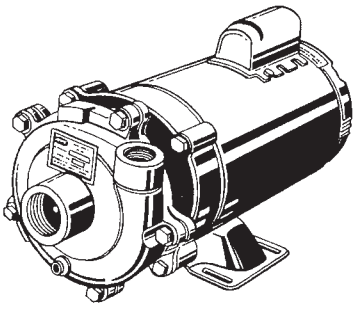
Pump Dimensional & Specification Data

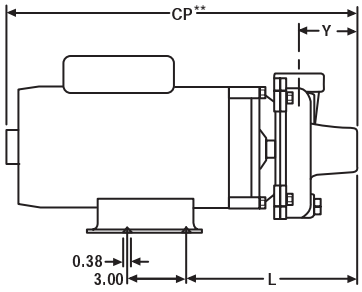
MODEL ‡	CURVE	HP	PH	ENG	60 HZ +	AMPS	SUC*	DIS*	AB**	CP**	L	X	Y	Z	ZZ	SHIPPING WT. XCI ‡ (-95)	SHIPPING WT. XB ‡ (-97)	SHIPPING WT. XSS ‡ (-98)
368A	A	1/3	1	TEFC	115/230	7 / 4	3/4"	1/2"	2.4	13.4	6.3	1.9	1.4	1.9	2.9	31 lbs.	32 lbs.	31 lbs.
368B	B	1/2	1	TEFC	115/230	9 / 5	3/4"	1/2"	2.4	13.3	6.3	1.9	1.4	1.9	2.9	33 lbs.	34 lbs.	33 lbs.
368C	B	1/2	3	TEFC	230/460	3 / 2	3/4"	1/2"	2.4	13.1	6.3	1.9	1.4	1.9	2.9	31 lbs.	32 lbs.	31 lbs.
370B	C	1/2	1	TEFC	115/230	9 / 5	1"	3/4"	3.0	13.3	6.3	2.4	1.4	2.1	3.3	33 lbs.	34 lbs.	33 lbs.
370F	C	1/2	3	TEFC	230/460	3 / 2	1"	3/4"	3.0	13.2	6.3	2.4	1.4	2.1	3.3	34 lbs.	35 lbs.	34 lbs.
370A	D	3/4	1	TEFC	115/230	9 / 5	1"	3/4"	3.0	13.8	6.3	2.4	1.4	2.1	3.3	37 lbs.	38 lbs.	37 lbs.
370C	D	3/4	3	TEFC	230/460	3 / 2	1"	3/4"	3.0	13.2	6.3	2.4	1.4	2.1	3.3	35 lbs.	36 lbs.	35 lbs.
370E	E	1	1	TEFC	115/230	12 / 6	1"	3/4"	3.0	15.1	6.3	2.4	1.3	2.1	3.3	39 lbs.	40 lbs.	39 lbs.
370D	E	1	3	TEFC	230/460	4 / 2	1"	3/4"	3.0	14.2	6.3	2.4	1.3	2.1	3.3	36 lbs.	37 lbs.	36 lbs.
369C	F	1	1	TEFC	115/230	12 / 6	1-1/4"	1"	3.0	14.2	6.3	2.5	1.3	2.0	3.4	40 lbs.	N/A.	40 lbs.
369F	F	1	3	TEFC	230/460	4 / 2	1-1/4"	1"	3.0	13.8	6.3	2.5	1.3	2.0	3.4	39 lbs.	N/A.	39 lbs.
369A	G	1-1/2	1	TEFC	115/230	18 / 9	1-1/4"	1"	3.0	15.1	6.3	2.5	1.3	2.0	3.4	48 lbs.	N/A.	48 lbs.
369B	G	1-1/2	3	TEFC	230/460	5 / 3	1-1/4"	1"	3.0	14.2	6.3	2.5	1.3	2.0	3.4	40 lbs.	N/A.	40 lbs.
369D	H	2	1	TEFC	115/230	22 / 11	1-1/4"	1"	3.0	15.4	6.3	2.5	1.3	2.0	3.4	52 lbs.	N/A.	52 lbs.
369E	H	2	3	TEFC	230/460	6 / 3	1-1/4"	1"	3.0	14.3	6.3	2.5	1.3	2.0	3.4	50 lbs.	N/A.	50 lbs.

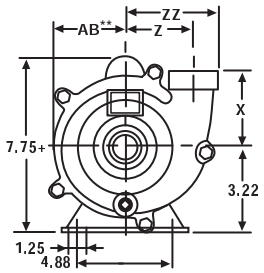
(*) Standard NPT (female) pipe thread.
(**) This dimension may vary due to motor manufacturer's specifications.
(+) 3-Phase motors can also operate on 50 Hz. (This will change Full Load Amps, Service Factor and RPM)
NOTE: Dimensions have a tolerance of ±1/8".
NOTE: Electric supply for ALL motors must be within ±10% of nameplate voltage rating(Ex. 230V ±10%= 207 to 253)

‡ *When Ordering Add the Correct-9x Suffix to Model Number Indicating Material Selection (ex: 368A-95)*

XCI (-95)=Cast Iron Construction with SS Impeller and Buna-N Seals, Max. Temperature 180˚F
XB (-97)=Cast Bronze Construction with Viton® Seals, Max. Temperature 200˚F
XSS (-98)=Stainless Steel Construction with Viton® Seals, Max. Temperature 200˚F







Standard Features

- Stainless Steel, Bronze & Cast Iron Construction
- Buna-N or Viton® Mechanical Seals and O-Rings Depending on Model
- Stainless Steel Hardware
- NEMA 56J TEFC Single and Three Phase Motors
- Stainless Steel Motor Shaft
- NEMA Base Mounted Motor
- Self-cleaning Impeller
- Discharge Rotates in 90˚ Increments
- Maximum Working Pressure to 75 PSI
- Max. Temperature 200˚F(Viton®), 180˚F (Buna-N)
- Front Drain Plug
- **"Off-the-Shelf"** Availability for Many Models

OFF THE SHELF PUMPS

Viton® is a registered trademark of E.I. DuPont

See price book pages 30 & 31

The Gorman-Rupp Company reserves the right to discontinue any model or change specifications at any time without incurring any obligation.

Data Sheet – ABATE™ VOC Metal Monolith Catalyst

- **Metal Monolith Support – FeCrAlloy -** DIN 1.4725, 0.002” foil thickness
- **Dimensional Parameters –** up to 36” Diameter & max. 24” x 24” square

Dimension	Tolerance	Dimension	Tolerance
Length	± .063 in	Width	± .063 in
Diameter	± .063 in	Height	± .050 in
Density	~ 30-36 lbs/ft3 of substrate		

- **Cell Density Available – Cells Per Square inch (cpsi)**

CPSI	16	25	50	100	200	300	400

- **Washcoat** – Promoted, high surface area, thermally stabilized Alumina based washcoat
- **Active Catalyst** – Platinum, Palladium, Rhodium – Chosen to meet requirements of application. Catalyst loadings are proprietary
- **Packaging** – Double wall cardboard boxes, typically shipped on a wooden pallet.





5555 Pleasantdale Road
Doraville, GA 30340

www,appliedcatalysts.com

678-332-1399

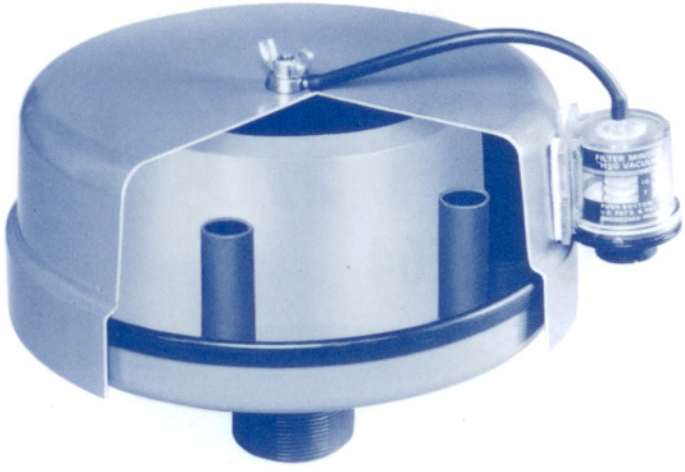
Air Intake Filter and Filter Silencer

The Series F72 Air Intake Filter and Filter Silencer is designed to mount directly on the inlet of an engine, blower or compressor. It will provide 16dB to 20dB noise reduction. The Polyurethane filter media has an efficiency of 98% on 10 micron particles and a stainless steel center core.

SERVICE LIFE & CLEANING: The service life of the element is dependent upon the surrounding environment and cannot be predicted.

To prevent COLLAPSING of the filter element, STODDARD SILENCERS recommends the differential pressure across the filter element NOT exceed 15 inches of water column. Positive indication that the element requires cleaning or replacement can be provided with STODDARD SILENCERS model A40-108 Pressure Drop Indicator, at an extra charge.

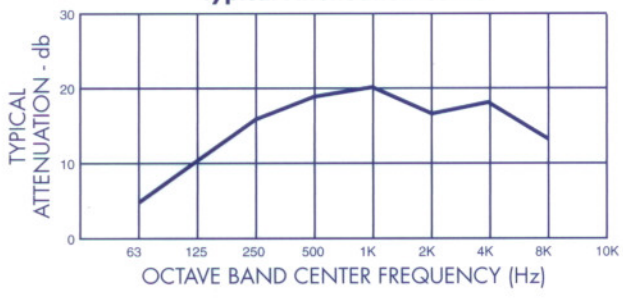
Wash in sink or large pan using either water and any good washday type detergent and rinse clean. Squeeze out filter by pressing it against metal grid. Let stand and allow to dry completely.



F72 shown with optional A40-108 Pressure Drop Indicator.

Pre-Filter wrap available at added cost
Consult Factory
(90% on 75 micron particles and larger)

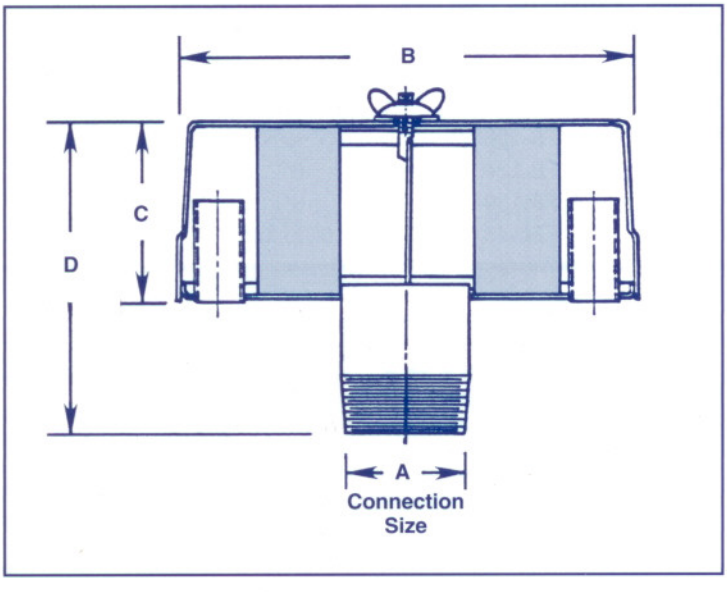
Typical Attenuation Curve



F72 Series

Model	A Connection Size	B	C	D	Rated CFM	Wt.	Replacement Element Number
F72-1	1" NPT	10	4	7	35	9	F8-119
F72-1½	1½" NPT	10	4	7	80	9	F8-119
F72-2	2" NPT	10	4	7	135	10	F8-119
F72-2½	2½" NPT	10	4	7	180	10	F8-119
F72-3	3" NPT	16	5	8	285	20	F8-120
F72-4	4" NPT	16	5	8	520	20	F8-120
F72-5	5" NPT/FLG	16	5	8	750	23	F8-120
F72-6	6" Flange	20	5	8	1235	40	F8-121
F72-8	8" Flange	20	10	13	2125	50	F8-122
F72-10	10" Flange	26	15½	20	3335	95	F8-123
F72-12	12" Flange	26	15½	20	4675	100	F8-123
F72-14	14" Flange	26	15½	20	5655	115	F8-123

Sizes 10", 12" and 14" are FILTERS only



Standard Filter Elements

F64 Intake Filter Silencer



Paper Elements (Replaceable)

Efficiency: 99% on 1 micron particles and larger

Element #	Housing Size
F8-108	1" to 2½"
F8-109	3" to 5"
F8-110	6"
F8-111	8"
F8-137	10" to 14"

F72 Intake Filter Silencer



Polyurethane Elements (Washable)

Efficiency: 98% on 10 micron particles and larger

Element #	Housing Size
F8-119	1" to 2½"
F8-120	3" to 5"
F8-121	6"
F8-122	8"
F8-123	10" to 14"

Alternate Elements for F64



Polyester Felt Elements (Washable)

Efficiency: 99% on 3 micron particles and larger

Element #	Housing Size
F8-151	1" to 2½"
F8-135	3" to 5"
F8-134	6"
F8-139	8"
F8-148	10" to 14"



Epoxy Coated Wire Mesh Elements (Washable)

Efficiency: 90% on 20 micron particles and larger

Element #	Housing Size
F8-129	1" to 2½"
F8-130	3" to 5"
F8-131	6"
F8-132	8"
F8-142	10" to 14"

Stoddard Silencers

Specialists in Industrial Silencing

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

LC-2500-2/04

PRINTED IN U.S.A.

PVC White Schedule 40 Fittings, Unions, & Saddles

MADE IN THE U.S.A. WITH PRIDE

TECHNICAL INFORMATION
WEIGHTS & DIMENSIONS

May 1, 2009

SUPERSEDES ALL PREVIOUS EDITIONS

SPEARS® MANUFACTURING COMPANY Since 1969 SYLMAR, CALIFORNIA

LPCB LOSS PREVENTION CERTIFICATION BOARD

UKAS QUALITY MANAGEMENT 007

Quality Systems Certificate No. 293
Corporate Facilities, Sylmar, CA
Assessed to ISO 9001: 2000

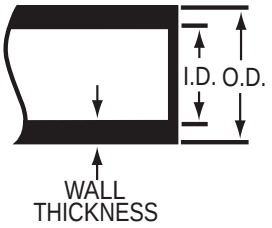
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www.spearsmfg.com

40-4-0509

PVC WHITE SCHEDULE 40 FITTINGS UNIONS & SADDLES

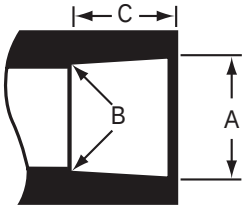
ASTM STANDARD DIMENSIONS

SCHEDULE 40 PIPE DIMENSIONS ASTM D 1785



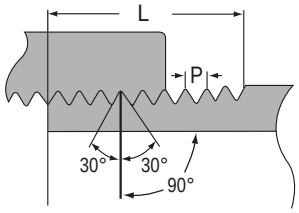
Nominal Pipe Size In.	Mean Outside Diameter In.	O. D. Tolerance In.	Minimum Wall Thickness In.
1/8	0.405	± 0.004	0.068
1/4	0.540	± 0.004	0.088
3/8	0.675	± 0.004	0.091
1/2	0.840	± 0.004	0.109
3/4	1.050	± 0.004	0.113
1	1.315	± 0.005	0.133
1-1/4	1.660	± 0.005	0.140
1-1/2	1.900	± 0.006	0.145
2	2.375	± 0.006	0.154
2-1/2	2.875	± 0.007	0.203
3	3.500	± 0.008	0.216
4	4.500	± 0.009	0.237
5	5.563	± 0.010	0.258
6	6.625	± 0.011	0.280
8	8.625	± 0.015	0.322
10	10.750	± 0.015	0.365
12	12.750	± 0.015	0.408

SCHEDULE 40 SOCKET DIMENSIONS ASTM D 2466



Nominal Size In.	Diameter			Socket Length Minimum C
	Entrance A	Bottom B	Tolerance A	
1/8	0.417	0.401	± 0.004	0.500
1/4	0.552	0.536	± 0.004	0.500
3/8	0.687	0.671	± 0.004	0.594
1/2	0.848	0.836	± 0.004	0.688
3/4	1.058	1.046	± 0.004	0.719
1	1.325	1.310	± 0.005	0.875
1-1/4	1.670	1.655	± 0.005	0.938
1-1/2	1.912	1.894	± 0.006	1.094
2	2.387	2.369	± 0.006	1.156
2-1/2	2.889	2.868	± 0.007	1.750
3	3.516	3.492	± 0.008	1.875
4	4.518	4.491	± 0.009	2.000
5	5.583	5.553	± 0.010	3.000
6	6.647	6.614	± 0.011	3.000
8	8.655	8.610	± 0.015	4.000
10	10.780	10.735	± 0.015	5.000
12	12.780	12.735	± 0.015	6.000

AMERICAN NATIONAL STANDARD TAPER PIPE THREADS (NPT) ANSI B1.20.1,ASTM F 1498



Nominal Size In.	Threads Per Inch.	Effective Thread Length L	Pitch Of Thread P
1/8	27	0.2639	0.03704
1/4	18	0.4018	0.05556
3/8	18	0.4078	0.05556
1/2	14	0.5337	0.07143
3/4	14	0.5457	0.07143
1	11-1/2	0.6828	0.08696
1-1/4	11-1/2	0.7068	0.08696
1-1/2	11-1/2	0.7235	0.08696
2	11-1/2	0.7565	0.08696
2-1/2	8	1.1375	0.12500
3	8	1.2000	0.12500
4	8	1.3000	0.12500
5	8	1.4063	0.12500
6	8	1.5125	0.12500
8	8	1.7125	0.12500

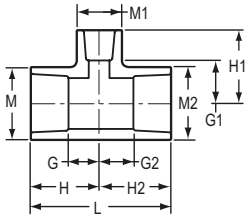
Molded Schedule 40 products are manufactured to ASTMD 2466 for use with pipe manufactured to ASTM D1785. Certain products carry reduced pressure handling capability and have maximum internal pressure ratings at 73° F noted.

Fabricated Schedule 40 pressure fittings (part numbers ending with "F") are manufactured to Spears® specifications for use with pipe manufactured to ASTM D1785. See publication FAB-7, General Specifications for Standard Fabricated Fittings for additional information.

All specified Schedule 40 products are manufactured from materials certified by NSF for use in potable water service.

REDUCING TEE **(continued)**

Socket x Socket x Socket



Part Number	Size	G	G1	G2	H	H1	H2	L	M	M1	M2	Approx. Wt. (Lbs.)
401-527[1]	6x6x1-1/2	1-3/8	3-7/8	1-3/8	4-27/32	5-3/16	4-27/32	9-11/16	7-1/4	2-11/16	7-1/4	3.60
401-528	6x6x2	1-3/8	3-19/32	1-3/8	4-27/32	4-31/32	4-27/32	9-11/16	7-3/16	2-11/16	7-3/16	3.39
401-529	6x6x2-1/2	2	3-15/16	2	5-1/2	5-15/16	5-1/2	10-15/16	7-3/16	3-15/16	7-3/16	4.29
401-530	6x6x3	2	3-23/32	2	5	5-19/32	5	10	7-1/4	4	7-1/4	3.89
401-532	6x6x4	2-17/32	3-5/8	2-17/32	6	5-5/8	6	12-1/16	7-3/16	5	7-3/16	4.54
401-533[1]	6x6x5	3-1/2	4-1/2	3-1/2	7	7-1/2	7	14	7-3/16	7-3/16	7-3/8	8.46
401-535[1]	6x6x8	5-3/8	5-1/2	5-3/8	8-7/8	9-1/2	8-7/8	17-3/4	9-1/2	9-3/4	9-1/2	19.21
401-537[1]	6x6x10	8	5-13/16	8	11-3/8	10-13/16	11-3/8	22-3/4	11-1/2	11-9/16	11-1/2	38.30
401-578[1]	8x8x2	2	5-7/8	2	6	7	6	12	9-1/4	4	9-1/4	11.71
401-579[1]	8x8x2-1/2	2	5-5/16	2	6	7-5/16	6	12	9-5/16	4	9-5/16	6.62
401-580	8x8x3	1-31/32	4-3/4	1-31/32	6-1/32	6-3/4	6-1/32	12-1/16	9-11/32	4	9-11/32	6.44
401-582	8x8x4	2-17/32	4-11/16	2-17/32	6-17/32	6-11/16	6-17/32	13-1/16	9-9/32	4-31/32	9-9/32	7.02
401-583[1]	8x8x5	3-21/32	5-1/4	3-21/32	7-21/32	8-1/4	7-21/32	15-5/16	9-5/16	7-1/4	9-5/16	10.60
401-585	8x8x6	3-5/8	4-3/4	3-5/8	7-21/32	7-25/32	7-21/32	15-11/32	9-11/32	7-1/4	9-11/32	8.90
401-589[1]	8x8x10	6-23/32	5-11/16	6-23/32	11-7/32	10-1/2	11-7/32	22-7/16	11-9/16	11-9/16	11-9/16	34.76
401-621F	10x10x2	4-7/8	7-1/4	4-7/8	10-1/8	9	10-1/8	20-1/4	11-1/2	2-11/16	11-1/2	19.60
401-623[1]	10x10x3	3-13/16	7	3-13/16	9-3/8	9	9-3/8	18-3/4	12	7-1/2	12	25.54
401-624[1]	10x10x4	3-27/32	7-3/8	3-27/32	9-11/32	9-3/8	9-11/32	18-11/16	12	7-1/2	12	25.63
401-628[1]	10x10x8	5-3/4	7-3/16	5-3/4	10-7/8	11-1/4	10-7/8	21-11/16	11-11/16	11-11/16	11-1/2	29.85
401-661F	12x12x2	5-1/4	8-1/4	5-1/4	11-1/2	10	11-1/2	23	13-1/2	2-11/16	13-1/2	25.00
401-663F	12x12x3	5-3/4	9	5-3/4	12	11-1/4	12	23	13-1/2	3-15/16	13-1/2	31.41
401-664F	12x12x4	7	9-5/16	7	13-1/4	11-9/16	13-1/4	26-1/2	13-9/16	5	13-9/16	32.40
401-666[1]	12x12x6	4-7/8	8-5/16	4-7/8	11-7/16	11-3/4	11-7/16	22-13/16	14-1/4	9-3/4	14-1/4	44.02
401-668	12x12x8	4-27/32	7-1/8	4-27/32	11-13/32	11-1/8	11-13/32	22-13/16	14-1/4	9-3/4	14-1/4	40.00
401-670	12x12x10	6-13/16	7-3/8	6-13/16	12-13/16	13-1/4	12-13/16	25-5/8	13-3/4	13-3/4	13-3/4	50.00
401-670F	12x12x10	10-1/4	10-3/8	10-1/4	16-1/2	15-5/8	16-1/2	33	13-9/16	11-1/2	13-9/16	50.00
401-676F	12x12x16	18-1/2	12-3/4	18-1/2	30-1/4	20-3/4	30-1/4	60-1/2	14-1/8	17	14-1/8	144.87
401-678F	12x12x18	14-1/4	13	17-7/8	23-1/4	22	23-7/8	47-3/4	19-1/8	19-1/8	19-1/8	252.00
401-691F	14x14x2	6	9-1/4	6	13	11	13	26	14-7/8	2-3/4	14-7/8	35.53
401-693F	14x14x3	6-1/2	9-9/16	6-1/2	13-1/2	11-13/16	13-1/2	27	14-7/8	3-15/16	14-7/8	38.35
401-694F	14x14x4	7-1/2	10	7-1/2	14-1/2	12-1/4	14-1/2	29	14-7/8	5	14-7/8	38.58
401-696F	14x14x6	8	10-1/4	8	15	13-1/2	15	30	14-7/8	7-1/8	14-7/8	45.70
401-698F	14x14x8	9-1/8	10-1/2	9-3/32	16-1/8	14-3/4	16-3/32	32-3/16	14-7/8	9-3/8	14-7/8	51.99

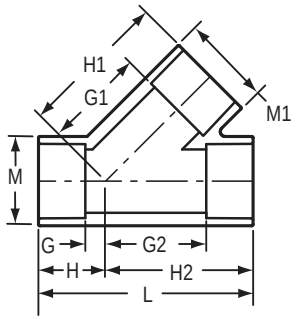
[1] Oultet sized with bushing

PVC WHITE SCHEDULE 40 FITTINGS
UNIONS & SADDLES

WYE

Socket x Socket x Socket

Pressure Rating
1/2" - 2" 235 psi @ 73°F
2-1/2" - 6" 200 psi @ 73°F
8" & Up 100 psi @ 73°F

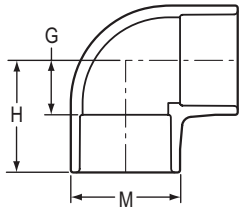


Part Number	Size	G	G1	G2	H	H1	H2	L	M	M1	Approx. Wt. (Lbs.)
475-005	1/2	1/4	1-3/16	1-3/16	1-1/8	2-1/16	2-1/16	3-3/16	1-5/32	1-5/32	.12
475-007	3/4	1/8	1-9/16	1-9/16	1-1/8	2-9/16	2-9/16	3-11/16	1-3/8	1-3/8	.18
475-010	1	9/32	1-13/16	1-13/16	1-13/32	2-15/16	2-15/16	4-11/32	1-23/32	1-23/32	.31
475-012	1-1/4	3/8	2-1/4	2-1/4	1-5/8	3-1/2	3-1/2	5-1/8	2-1/16	2-1/16	.50
475-015	1-1/2	1/2	2-19/32	2-9/16	1-7/8	3-31/32	3-15/16	5-13/16	2-11/32	2-11/32	.69
475-020	2	19/32	3-7/32	3-7/32	2-1/8	4-3/4	4-3/4	6-7/8	2-7/8	2-7/8	1.20
475-025	2-1/2	1	5-1/4	4-3/4	3	7-1/4	6-3/4	9-3/4	4-1/8	4-1/8	2.59
475-030	3	11/16	4-5/8	4-3/16	2-19/32	6-17/32	6-3/32	8-11/16	4-5/32	4-5/32	2.68
475-040	4	7/8	6	5-3/8	3-1/8	8-1/4	7-5/8	10-3/4	5-9/32	5-9/32	4.76
475-050F	5	3-3/4	10-1/8	9-5/16	6-3/4	13-1/8	12-5/16	19-1/8	6-1/16	6-1/16	13.26
475-060	6	1-5/16	8-21/32	8-1/16	4-5/16	11-21/32	11-1/16	15-3/8	7-9/16	7-9/16	12.09
475-080	8	1-3/4	11-1/2	11-9/16	5-3/4	15-17/32	15-19/32	21-5/16	9-3/4	9-3/4	25.76
475-080F	8	5-1/2	13-1/2	13-1/2	9-3/4	17-3/4	17-3/4	27-1/2	9-1/4	9-1/4	25.46
475-100	10	2-1/2	16-7/8	13-31/32	7-1/2	22-1/8	18-31/32	26-15/32	11-9/16	11-9/16	26.92
475-100F	10	6-7/8	16-7/8	16-7/8	12-1/8	22-1/8	22-1/8	34-1/4	11-1/2	11-1/2	45.11
475-120	12	2-11/16	16-1/8	16-7/32	8-3/4	22-7/32	22-9/32	31-1/32	13-21/32	13-21/32	41.85
475-120F	12	6-3/4	19-3/4	19-3/4	13	26	26	39	13-9/16	13-9/16	63.02
475-140F	14	6-7/8	21-1/8	21-1/8	13-7/8	28-1/8	28-1/8	42	14-7/8	14-7/8	90.24
475-160F	16	8-1/2	26-1/4	24-1/2	16-1/2	34-1/4	32-1/2	49	17	17	93.06
475-180F	18	9	28	27-3/4	18	37	36-3/4	54-3/4	19-1/8	19-1/8	151.20
475-200F	20	11-7/16	30-5/16	30-5/16	21-7/16	40-5/16	40-5/16	61-3/4	21-3/16	21-3/16	191.78
475-240F	24	11-3/4	34-3/4	34-3/4	25-3/4	46-3/4	46-3/4	70-1/2	25-3/8	25-3/8	420.00

PVC WHITE SCHEDULE 40 FITTINGS
UNIONS & SADDLES

90° ELBOW

Socket x Socket

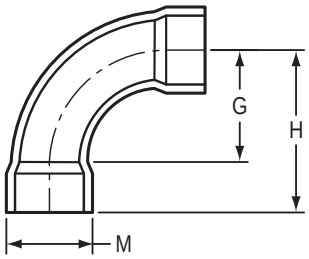


Part Number	Size	G	H	M	Approx. Wt. (Lbs.)
406-003	3/8	3/8	1-1/8	7/8	.03
406-005	1/2	1/2	1-1/4	1-1/16	.05
406-007	3/4	9/16	1-1/2	1-5/16	.07
406-010	1	11/16	1-13/16	1-5/8	.12
406-012	1-1/4	31/32	2-5/32	2	.20
406-015	1-1/2	1-1/16	2-3/8	2-7/32	.25
406-020	2	1-9/32	2-21/32	2-3/4	.37
406-025	2-1/2	1-15/16	3-7/32	3-5/16	.71
406-030	3	1-7/8	3-25/32	3-31/32	1.04
406-040	4	2-1/2	4-1/2	5	1.71
406-045F	4-1/2	7-1/8	9-5/8	5-1/2	3.13
406-050	5	3-1/16	6-1/8	6-5/32	3.58
406-060	6	3-1/2	6-29/32	7-9/32	5.03
406-080	8	4-7/16	8-15/32	9-5/16	8.75
406-100	10	5-29/32	10-7/8	11-5/8	17.82
406-100F	10	9-1/2	14-3/4	11-1/2	17.40
406-120	12	7-1/16	13-9/16	14-1/4	27.98
406-120F	12	10-1/2	16-3/4	13-9/16	25.94
406-140F	14	12-1/4	19-1/4	14-7/8	47.26
406-160F	16	14-1/8	22-1/8	17	69.70
406-180F	18	17-1/4	26-1/4	19-1/8	104.20
406-200F	20	18-3/4	28-3/4	21-3/16	131.93
406-240F	24	22-1/4	34-1/4	25-3/8	216.00

PVC WHITE SCHEDULE 40 FITTINGS
UNIONS & SADDLES

LONG SWEEP ELBOW

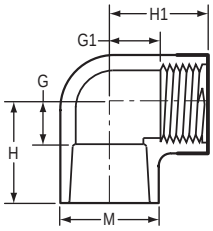
Socket x Socket



Part Number	Size	G	H	M	Approx. Wt. (Lbs.)
406-025LSF	2-1/2	5-7/16	7-7/16	3-1/4	1.26
406-030LSF	3	6-5/8	8-5/8	3-15/16	1.87
406-040LSF	4	8-3/8	10-5/8	5	2.69
406-060LSF	6	12-5/8	15-7/8	7-3/16	6.92
406-080LSF	8	22-9/16	26-13/16	9-1/4	19.43

90° ELBOW

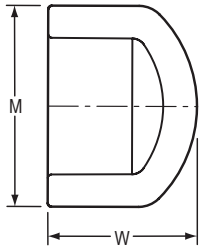
Socket x SR Fipt



Part Number		Size	G	G1	H	H1	M	Approx. Wt. (Lbs.)
407-005	407-005SR	1/2	1/2	9/16	1-1/4	1-1/4	1-1/16	.06
407-007	407-007SR	3/4	9/16	17/32	1-9/16	1-9/32	1-5/16	.08
407-010	---	1	11/16	21/32	1-13/16	1-9/16	1-5/8	.14
407-012	---	1-1/4	15/16	1-1/4	2-1/4	2-1/4	2	.25
407-015	---	1-1/2	1	1-1/16	2-5/16	2	2-1/4	.25
407-020	---	2	1-3/16	1-5/16	2-3/8	2-3/8	2-23/32	.46
407-025	---	2-1/2	1-1/2	1-1/2	3-1/2	3-1/16	3-5/16	.94
407-030	---	3	1-13/16	1-31/32	3-11/16	3-21/32	4	1.14
407-040	---	4	2-5/16	2-15/32	4-5/16	3-15/16	5-1/16	1.85

PVC WHITE SCHEDULE 40 FITTINGS
UNIONS & SADDLES

CAP
Socket



Part Number	Size	M	W	Approx. Wt. (Lbs.)
447-003	3/8	7/8	1	.01
447-005	1/2	1-3/32	1-1/32	.02
447-007	3/4	1-5/16	1-5/16	.04
447-010	1	1-9/16	1-9/16	.06
447-012	1-1/4	1-31/32	1-3/4	.09
447-015	1-1/2	2-1/4	1-7/8	.11
447-020	2	2-23/32	2-1/32	.17
447-025	2-1/2	3-5/16	2-9/16	.33
447-030	3	4	2-29/32	.49
447-040	4	5-1/16	3-1/8	.85
447-045F	4-1/2	5-1/4	3-1/4	.31
447-050	5	6-5/32	4-1/2	1.43
447-060	6	7-1/4	5	2.36
447-080	8	9-5/16	6-3/8	4.35
447-100F	10	11-13/16	5-1/4	5.22
447-120F	12	13-7/8	6-3/4	8.22
447-140F	14	15	7-3/8	8.75
447-160F	16	17	9	12.15
447-180F	18	19-1/16	9	17.58
447-200F	20	21-3/16	12-1/4	26.48
447-240F	24	25-1/2	13-1/2	40.26

THERMOPLASTIC FLANGES

TECHNICAL INFORMATION WEIGHTS & DIMENSIONS

January 1, 2009

SUPERSEDES ALL PREVIOUS EDITIONS

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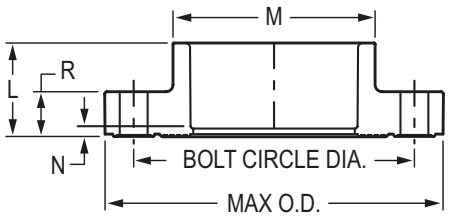
Quality Systems Certificate No. 293
Corporate Facilities, Sylmar, CA
Assessed to ISO 9001: 2000

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FL-4-0109

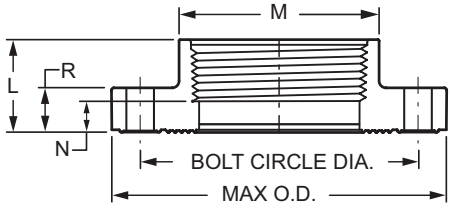
PVC & CPVC INJECTION MOLDED CLASS 150 FLANGES

F O P
Socket



P N		S		M	N	R	C	N	S	M	M O	A	
P C	CP C											P C	CP C
851-005	851-005C	1/2	1-1/16	1-9/32	1/8	9/16	2-3/8	4	1/2	2	3-1/2	.22	.24
851-007	851-007C	3/4	1-3/16	1-1/2	1/8	5/8	2-3/4	4	1/2	2	3-7/8	.31	.31
851-010	851-010C	1	1-5/16	1-13/16	3/16	3/4	3-1/8	4	1/2	2-1/4	4-1/4	.44	.47
851-012	851-012C	1-1/4	1-7/16	2-7/32	3/16	23/32	3-1/2	4	1/2	2-1/4	4-5/8	.41	.42
851-015	851-015C	1-1/2	1-23/32	2-1/2	1/4	3/4	3-7/8	4	1/2	2-1/2	5	.61	.64
851-020	851-020C	2	1-27/32	3	3/8	13/16	4-3/4	4	5/8	3	6	.82	.95
851-025	851-025C	2-1/2	2-1/4	3-1/2	1/2	1	5-1/2	4	5/8	3-1/4	7	1.63	1.67
851-030	851-030C	3	2-5/16	4-9/32	15/32	1-1/16	6	4	5/8	3-1/4	7-1/2	1.73	1.83
851-040	851-040C	4	2-5/8	5-7/16	1/4	1-1/4	7-1/2	8	5/8	3-1/2	9	2.88	3.00
851-050	851-050C	5	3-1/4	6-3/8	1/4	1	8-1/2	8	3/4	3-3/4	10-1/8	3.00	3.17
851-060	851-060C	6	3-1/4	7-9/16	1/4	1-3/8	9-1/2	8	3/4	4	11	4.06	4.34
851-080	851-080C	8	4-9/16	9-3/4	9/16	1-7/16	11-3/4	8	3/4	4-1/2	13-1/2	7.63	7.36

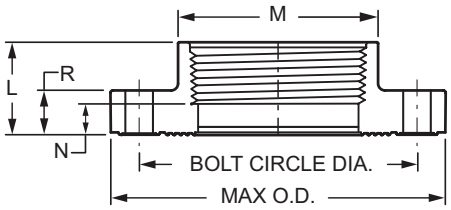
F O P
Fipt



P N		S		M	N	R	C	N	S	M	M O	A	
P C	CP C											P C	CP C
852-005	852-005C	1/2	1-1/16	1-5/16	9/32	9/16	2-3/8	4	1/2	2	3-1/2	.21	.22
852-007	852-007C	3/4	1-3/16	1-17/32	15/32	5/8	2-3/4	4	1/2	2	3-7/8	.30	.32
852-010	852-010C	1	1-5/16	1-13/16	7/16	3/4	3-1/8	4	1/2	2-1/4	4-1/4	.41	.48
852-012	852-012C	1-1/4	1-3/8	2-7/32	17/32	23/32	3-1/2	4	1/2	2-1/4	4-5/8	.44	.46
852-015	852-015C	1-1/2	1-3/4	2-1/2	19/32	3/4	3-7/8	4	1/2	2-1/2	5	.64	.74

F O P **(continued)**

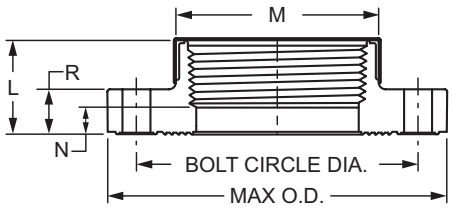
Fipt



P N		S		M	N	R	C	N	S	M	M O	A	
P C	CP C											P C	CP C
852-020	852-020C	2	1-27/32	3	7/8	7/8	4-3/4	4	5/8	3	6	.96	1.00
852-025	852-025C	2-1/2	2-1/4	3-1/2	15/16	1	5-1/2	4	5/8	3-1/4	7	1.65	1.41
852-030	852-030C	3	2-5/16	4-9/32	29/32	1-1/16	6	4	5/8	3-1/4	7-1/2	1.83	1.86
852-040	852-040C	4	2-1/16	5-7/16	5/16	1-1/4	7-1/2	8	5/8	3-1/2	9	2.79	2.86
852-060F	852-060CF	6	7	7-1/4	5-1/2	1-1/4	9-1/2	8	3/4	4	11	7.16	7.69
852-080F	852-080CF	8	8-15/16	9-11/16	7-3/16	1-3/8	11-3/4	8	3/4	4-1/2	13-1/2	13.41	13.92
852-100F	852-100CF	10	10-1/2	11-9/16	8-9/16	1-11/16	14-1/4	12	7/8	5	16	20.65	20.72

S R F O P

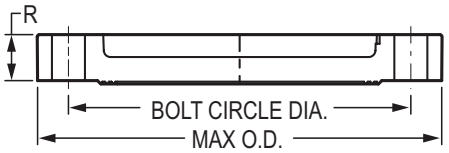
SR Fipt



P N		S		M	N	R	C	N	S	M	M O	A	
P C	CP C											P C	CP C
852-005SR	852-005CSR	1/2	1-3/32	1-7/32	11/32	9/16	2-3/8	4	1/2	2	3-1/2	.20	.22
852-007SR	852-007CSR	3/4	1-3/16	1-3/8	7/16	5/8	2-3/4	4	1/2	2	3-7/8	.27	.30
852-010SR	852-010CSR	1	1-7/16	1-23/32	17/32	21/32	3-1/8	4	1/2	2-1/4	4-1/4	.37	.39
852-012SR	852-012CSR	1-1/4	1-9/16	2-1/16	19/32	21/32	3-1/2	4	1/2	2-1/4	4-5/8	.49	.52
852-015SR	852-015CSR	1-1/2	1-3/4	2-7/16	3/4	3/4	3-7/8	4	1/2	2-1/2	5	.63	.67
852-020SR	852-020CSR	2	1-7/8	3-1/32	7/8	11/16	4-3/4	4	5/8	3	6	.99	1.06
852-025SR	852-025CSR	2-1/2	2-1/8	3-19/32	3/8	1	5-1/2	4	5/8	3-1/4	7	1.58	1.69
852-030SR	852-030CSR	3	2-5/16	4-9/32	15/16	1-1/16	6	4	5/8	3-1/4	7-1/2	1.79	1.94
852-040SR	852-040CSR	4	2-1/2	5-1/4	1	1-5/32	7-1/2	8	5/8	3-1/2	9	2.74	2.89

PVC & CPVC INJECTION MOLDED CLASS 150 FLANGES

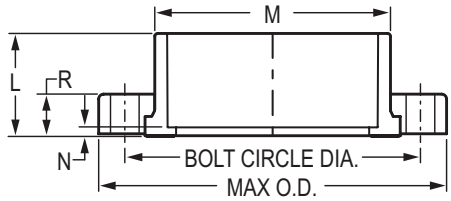
IN F ANGE



P N		S	R	C	N	S	M	M O	A	
P C	CP C								P C	CP C
853-005	853-005C	1/2	9/16	2-3/8	4	1/2	2	3-1/2	.21	.21
853-007	853-007C	3/4	5/8	2-3/4	4	1/2	2	3-7/8	.28	.30
853-010	853-010C	1	3/4	3-1/8	4	1/2	2-1/4	4-1/4	.41	.47
853-012	853-012C	1-1/4	23/32	3-1/2	4	1/2	2-1/4	4-5/8	.37	.40
853-015	853-015C	1-1/2	3/4	3-7/8	4	1/2	2-1/2	5	.62	.64
853-020	853-020C	2	13/16	4-3/4	4	5/8	3	5-15/16	.83	.88
853-025	853-025C	2-1/2	1	5-1/2	4	5/8	3-1/4	7	1.61	1.63
853-030	853-030C	3	1-1/16	6	4	5/8	3-1/4	7-5/8	1.56	1.64
853-040	853-040C	4	1-1/4	7-1/2	8	5/8	3-1/2	9	2.84	2.98
853-060	853-060C	6	1-3/8	9-1/2	8	3/4	4	11	4.36	4.45
853-080	853-080C	8	1-7/16	11-3/4	8	3/4	4-1/2	13-1/2	6.83	7.20
853-100	853-100C	10	1-11/16	14-1/4	12	7/8	5	16	11.32	11.80
853-120	853-120C	12	1-11/16	17	12	7/8	5	19	15.49	17.58

F S S

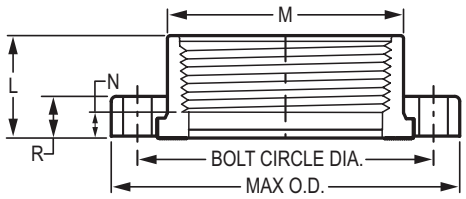
(Two Piece)
Socket



P N		S		M	N	R	C	N	S	M	M O	A	
P C	CP C											P C	CP C
854-005	854-005C	1/2	1-1/32	1-7/32	5/32	17/32	2-3/8	4	1/2	2	3-1/2	.19	.20
854-007	854-007C	3/4	1-1/8	1-7/16	5/32	9/16	2-3/4	4	1/2	2	3-7/8	.26	.27
854-010	854-010C	1	1-9/32	1-3/4	5/32	5/8	3-1/8	4	1/2	2-1/4	4-1/4	.36	.37
854-012	854-012C	1-1/4	1-13/32	2-5/32	5/32	11/16	3-1/2	4	1/2	2-1/4	4-5/8	.46	.45
854-015	854-015C	1-1/2	1-17/32	2-7/16	3/16	3/4	3-7/8	4	1/2	2-1/2	5	.56	.60
854-020	854-020C	2	1-11/16	2-15/16	3/16	13/16	4-3/4	4	5/8	3	6	.85	.91

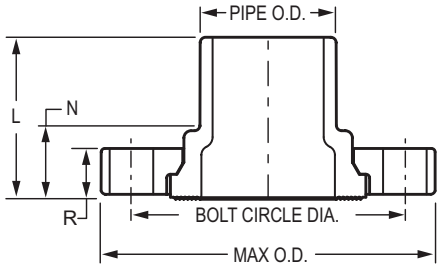
PVC & CPVC INJECTION MOLDED CLASS 150 FLANGES

F S S
(Two Piece)
Fipt



P N		S		M	N	R	C	N	S	M	M O	A	
P C	CP C											P C	CP C
855-005	855-005C	1/2	1-1/32	1-7/32	9/32	17/32	2-3/8	4	1/2	2	3-1/2	.19	.20
855-007	855-007C	3/4	1-5/32	1-3/8	13/32	9/16	2-3/4	4	1/2	2	3-7/8	.27	.28
855-010	855-010C	1	1-1/4	1-3/4	5/16	5/8	3-1/8	4	1/2	2-1/4	4-1/4	.36	.39
855-012	855-012C	1-1/4	1-3/8	2-1/8	13/32	11/16	3-1/2	4	1/2	2-1/4	4-5/8	.46	.47
855-015	855-015C	1-1/2	1-15/32	2-7/16	13/32	3/4	3-7/8	4	1/2	2-1/2	5	.55	.61
855-020	855-020C	2	1-9/16	2-31/32	1/2	13/16	4-3/4	4	5/8	3	6	.87	.94
855-025	855-025C	2-1/2	2	3-9/16	7/16	1	5-1/2	4	5/8	3-1/4	7	1.22	1.50
855-030	855-030C	3	2-1/8	4-1/4	1/2	1-1/16	6	4	5/8	3-1/4	7-1/2	1.73	1.79
855-040	855-040C	4	2-1/16	5-1/4	3/8	1-1/4	7-1/2	8	5/8	3-1/2	9	2.61	2.78
855-060F	855-060CF	6	7	7-1/4	5-1/2	1-1/4	9-1/2	8	3/4	4	11	7.62	7.69
855-080F	855-080CF	8	8-15/16	9-11/16	7-3/16	1-3/8	11-3/4	8	3/4	4-1/2	13-1/2	12.84	13.92
855-100F	855-100CF	10	10-1/2	11-9/16	8-9/16	1-11/16	14-1/4	12	7/8	5	16	20.65	20.72

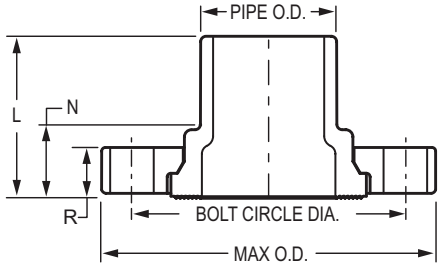
F S S
(Two Piece)
Spigot



P N		S		N	R	C	N	S	M	M O	A	
P C	CP C										P C	CP C
856-005	856-005C	1/2	1-3/4	29/32	17/32	2-3/8	4	1/2	2	3-1/2	.20	.21
856-007	856-007C	3/4	1-15/16	31/32	9/16	2-3/4	4	1/2	2	3-7/8	.29	.30
856-010	856-010C	1	2-3/16	1-1/32	5/8	3-1/8	4	1/2	2-1/4	4-1/4	.39	.41
856-012	856-012C	1-1/4	2-11/32	1-3/32	11/16	3-1/2	4	1/2	2-1/4	4-5/8	.50	.50

F S S **(continued)**

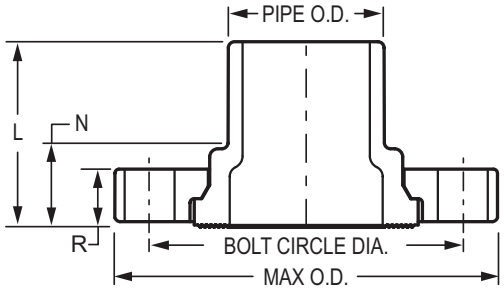
(Two Piece)
Spigot



P N		S		N	R	C	N	S	M	M O	A	
P C	CP C										P C	CP C
856-015	856-015C	1-1/2	2-5/8	1-9/32	3/4	3-7/8	4	1/2	2-1/2	5	.60	.65
856-020	856-020C	2	2-7/8	1-11/32	13/16	4-3/4	4	5/8	3	6	.94	1.00
856-025	856-025C	2-1/2	3-1/16	1-9/32	1	5-1/2	4	5/8	3-1/4	7	1.29	1.54
856-030	856-030C	3	3-3/8	1-7/16	1-1/16	6	4	5/8	3-1/4	7-1/2	1.82	1.88
856-040	856-040C	4	3-7/8	1-5/8	1-1/4	7-1/2	8	5/8	3-1/2	9	2.93	3.12
856-060	856-060C	6	4-3/4	1-25/32	1-9/32	9-1/2	8	3/4	4	11	4.62	4.79
856-080	856-080C	8	5-7/8	1-15/16	1-3/8	11-3/4	8	3/4	4-1/2	13-1/2	7.95	8.17
856-100	856-100C	10	8	2-1/4	1-5/8	14-1/4	12	7/8	5	16	15.61	16.09
856-120	856-120C	12	8-1/2	2-3/16	1-5/8	17	12	7/8	5	19	21.31	22.70

F S S

with Multi-Bolt Pattern Ring
(Two Piece)
Spigot



P N		S		N	R	C		N	S	M O	A	
P C	CP C					M	M				P C	CP C
M856-020	M856-020C	2	2-7/8	1-11/32	13/16	4-1/2	4-15/16	4	5/8	6	.94	1.00
M856-030	M856-030C	3	3-3/8	1-7/16	1-1/16	5-13/16	6-11/32	8	5/8	7-1/2	1.82	1.96
M856-040	M856-040C	4	3-7/8	1-5/8	1-1/4	7-3/32	7-1/2	8	5/8	9	2.98	3.24
M856-060	M856-060C	6	4-3/4	1-25/32	1-9/32	9-7/32	9-1/2	8	3/4	11	4.77	5.21
M856-080	M856-080C	8	5-7/8	1-15/16	1-3/8	11-1/2	11-3/4	8	3/4	13-1/2	7.95	8.32

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- Easy to clean surface
- Highly resistant to deterioration by exposure to UV light
- Tough and highly resistant to damage such as punctures
- Dimensional stability helps resist wrinkling and sagging
- Durable to help resist environmental stress-cracking or yellowing

Uses:

- External insulation on heating and air conditioning ducts
- Surfaces where temperature or condensation needs to be controlled.
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Differential pressure switch for air, flue and exhaust gases

AA-A2…

DUNGS®

UL Listed
- **UL 353**
- **File # MH 16628**

CSA Certified
- **CSA C22.2 No. LR 53222**
- **Certification # 201527**

FM Approved
- **Class 3510, 3530**
- **File # J.I. 1T7A8.AF**



European models tested to EN1854 per Gas Appliance Directive 90/396/EEC and per Pressure Equipment Directive 97/23/EC.

DUNGS is an ISO 9001 manufacturing facility.

Description

AA-A2… differential pressure switches are field adjustable, compact pressure switches for automatic burner controls. Available with hose or NPT threaded connections.

AA-A2-4… differential pressure switches are suitable for making and/or breaking a circuit when the medium pressure changes relative to the set point. AA-A2-4… versions feature hose connections.

AA-A2-6… differential pressure switches are suitable for making and/or breaking a circuit when the medium pressure changes relative to the set point. AA-A2-6… versions feature NPT threaded connections that also include a test button in the lower housing.

Application

Differential pressure monitoring in firing, ventilation and air-conditioning systems. The AA-A2… can be used as a pressure, vacuum or differential pressure switch for air and non-aggressive gases. Not suitable for natural gas, propane, butane and other combustable gases.

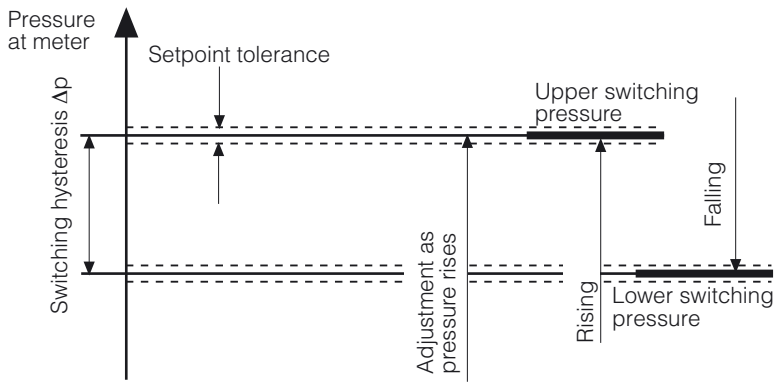
Printed in Germany • Rösler Druck • Edition 10.02 • Nr. 226 358

AA-A2… SPDT differential pressure switch in pressure and vacuum ranges. The differential pressure acts via the diaphragm against the force of the setting spring on the microswitch. The pressure switch operates without any auxiliary power

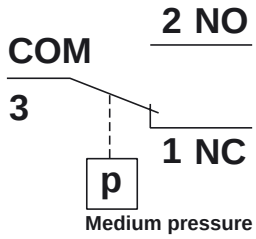
Specifications	AA-A2-4… Hose connection	AA-A2-6… Threaded connection
Max. operating pressure	7 PSI (500 mbar)	
Pressure connection	5/32" (4.6 mm) dia. positive 5/32" (4.6 mm) dia. negative	1/4" NPT positive 1/8" NPT negative 5/32" (4.6 mm) test connection
Temperature range	Ambient temperature Medium temperature	-40 °F to +140 °F (-40 °C to +60 °C) -40 °F to +140 °F (-40 °C to +60 °C)
Materials	Housing: Switch: Diaphragm: Switching contact:	Polycarbonate Polycarbonate NBR-based rubber Silver (Ag)
Electrical ratings	AC eff. DC	min. 24 V max. 250 V min. 24 V max. 48 V
Current ratings	AC 5 A resistive @ 120 VAC AC 2.5 A inductive @ 120 VAC DC min. 20 mA @ 24 VDC DC max. 1 A @ 48 VDC	
Electrical connection	Screw terminals via 1/2" NPT conduit connection	
Enclosure rating	NEMA Type 4	
Setting tolerance	±15% switching point deviation referred to set point, adjusted as pressure rises, vertical diaphragm position	
Installation position	Multipoised	

Installation position
Standard installation position is **vertical** upright diaphragm. When installed **horizontally**, the pressure switch switches at a pressure higher by approx. 0.2 in. W.C. When installed **upside down**, the pressure switch switches at a pressure lower by approx. 0.2 in. W.C. When installed in **other positions**, the pressure switch switches at pressure deviating from the set reference value by max. ± 0.2 in. W.C.

Definition of switching hysteresis Δp
The pressure difference between the upper and lower switching pressures.



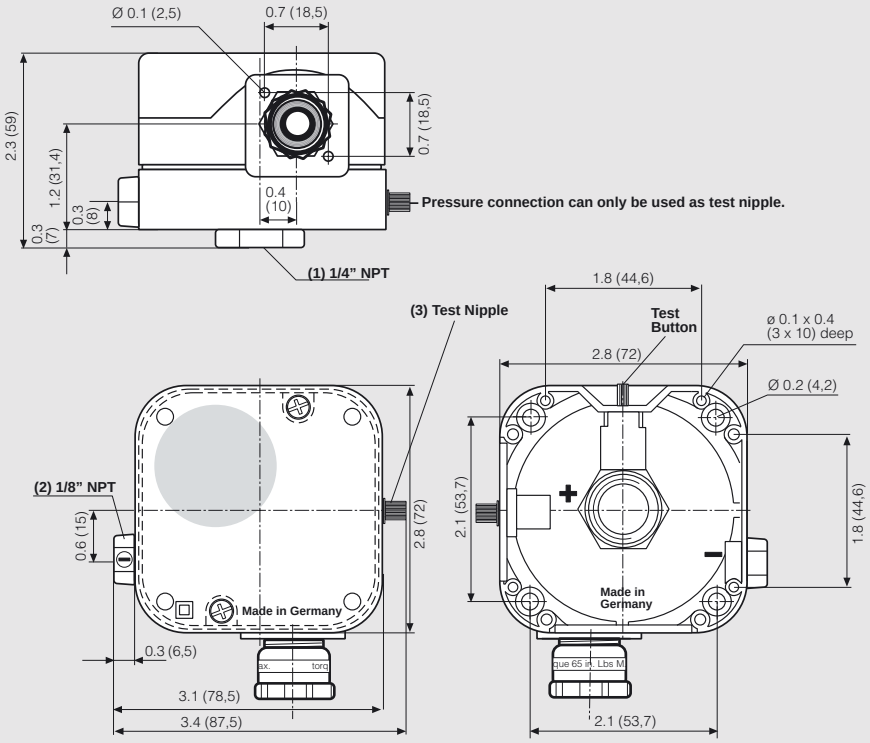
AA-A2… switching function
As pressure rises:
1 NC opens, 2 NO closes
As pressure falls:
1 NC closes, 2 NO opens



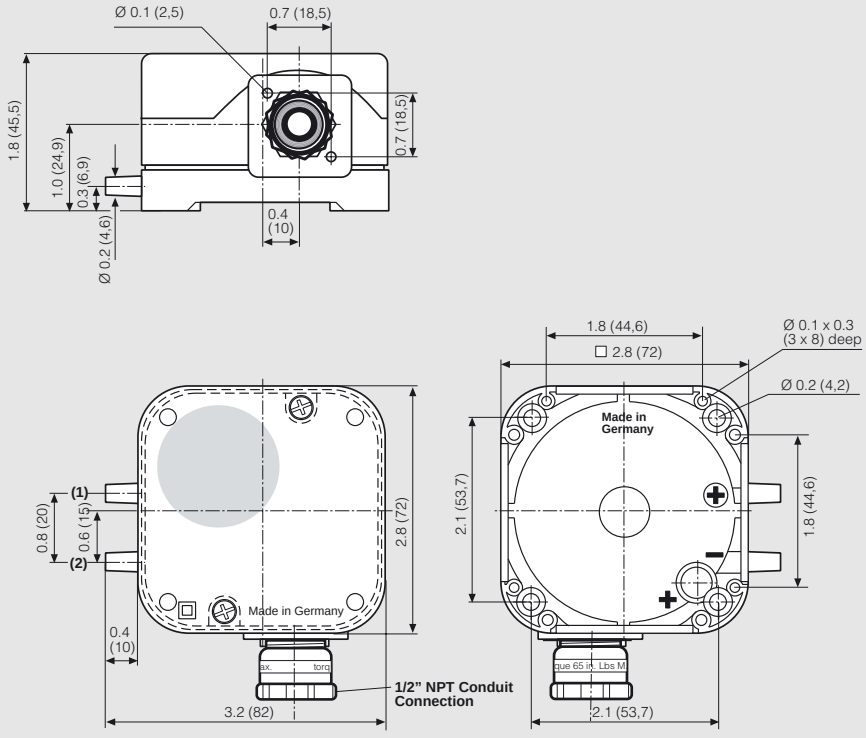
Dimensions inch (mm)

1 Pressure connection (+)
2 Pressure connection (–)
3 Test nipple p (+)

AA-A2-6… Threaded connection



AA-A2-4… hose connection



A2 test button

The AA-A2-6… threaded version is equipped with a test button.
When the test button is pressed, the connection to the **1/4" NPT** pressure connection is interrupted and the pressure below the diaphragm is relieved. The microswitch of the pressure switch changes the contact position from NO to NC. If the test button is released, the pressure below the diaphragm is built up again and the microswitch changes to its original position.

Differential pressure switch for air, flue and exhaust gases

AA-A2...

DUNGS®

Type	Version	Description	Order No.	Setting range In. W.C	Switching difference In. W.C.
AA-A2-4-...	AA-A2-4-2	Hose connection	46012-2	0.16 - 1.2"	≤ 0.12"
	AA-A2-4-3	Hose connection	46012-3	0.4 - 4"	≤ 0.20"
	AA-A2-4-5	Hose connection	46012-5	2 - 20"	≤ 0.40"
	AA-A2-4-6	Hose connection	46012-6	12 - 60"	≤ 1.20"
AA-A2-6-...	AA-A2-6-2	Threaded connection	46020-2	0.16 - 1.2"	≤ 0.12"
	AA-A2-6-3	Threaded connection	46020-3	0.4 - 4"	≤ 0.20"
	AA-A2-6-5	Threaded connection	46020-5	2 - 20"	≤ 0.40"
	AA-A2-6-6	Threaded connection	46020-6	12 - 60"	≤ 1.20"

Accessories for pressure switch	Order No.
Klima-Set (Duct mounting kit)	46000-5
Replacement cover	D228 732
Mounting bracket (metal)	D230 289
Mounting bracket (plastic)	D230 273
120 VAC light mounting set	D231 772
24 V light mounting set	D231 774
Replacement conduit adapter	46000-14
Electrical plug	D239 659
DIN connector	D210 318

We reserve the right to make any changes in the interest of technical progress.

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Model C12-17

Combustible Gas Transmitter

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PRODUCT WARRANTY

Analytical Technology, Inc. (Manufacturer) warrants to the Customer that if any part(s) of the Manufacturer's products proves to be defective in materials or workmanship within the earlier of 18 months of the date of shipment or 12 months of the date of start-up, such defective parts will be repaired or replaced free of charge. Inspection and repairs to products thought to be defective within the warranty period will be completed at the Manufacturer's facilities in Collegeville, PA. Products on which warranty repairs are required shall be shipped freight prepaid to the Manufacturer. The product(s) will be returned freight prepaid and allowed if it is determined by the manufacturer that the part(s) failed due to defective materials or workmanship.

This warranty does not cover consumable items, batteries, or wear items subject to periodic replacement including lamps and fuses.

Gas sensors, except oxygen sensors, are covered by this warranty, but are subject to inspection for evidence of extended exposure to excessive gas concentrations. Should inspection indicate that sensors have been expended rather than failed prematurely, the warranty shall not apply.

The Manufacturer assumes no liability for consequential damages of any kind, and the buyer by acceptance of this equipment will assume all liability for the consequences of its use or misuse by the Customer, his employees, or others. A defect within the meaning of this warranty is any part of any piece of a Manufacturer's product which shall, when such part is capable of being renewed, repaired, or replaced, operate to condemn such piece of equipment.

This warranty is in lieu of all other warranties (including without limiting the generality of the foregoing warranties of merchantability and fitness for a particular purpose), guarantees, obligations or liabilities expressed or implied by the Manufacturer or its representatives and by statute or rule of law.

This warranty is void if the Manufacturer's product(s) has been subject to misuse or abuse, or has not been operated or stored in accordance with instructions, or if the serial number has been removed.

Analytical Technology, Inc. makes no other warranty expressed or implied except as stated above.

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INTRODUCTION

Series C12-17 sensor/transmitters combine catalytic bead type gas sensors and an electronic amplifier that transmits gas concentration using a standard 4-20 mA signal. They are designed to continuously monitor combustible gas concentrations in ambient air near process tanks or piping, or in enclosed spaces where combustible gases may accumulate. C12-17 transmitters are available in two versions, one containing an integral display and single alarm relay, and a second that is a simple "blind transmitter" with no display or alarm functions.

Gas sensors are housed in a corrosion resistant stainless steel shell with a sintered metal flame arrestor isolating the sensing elements from the ambient air. A 3/4" NPT thread at the back of the sensor mates with the threaded entry on the explosion-proof transmitter enclosure. Series C12-17 sensor transmitters are designed for use in Class 1, Division 1, Groups A, B, C, or D locations.

A typical installation for the C12-17 is shown in Figure 1 below.

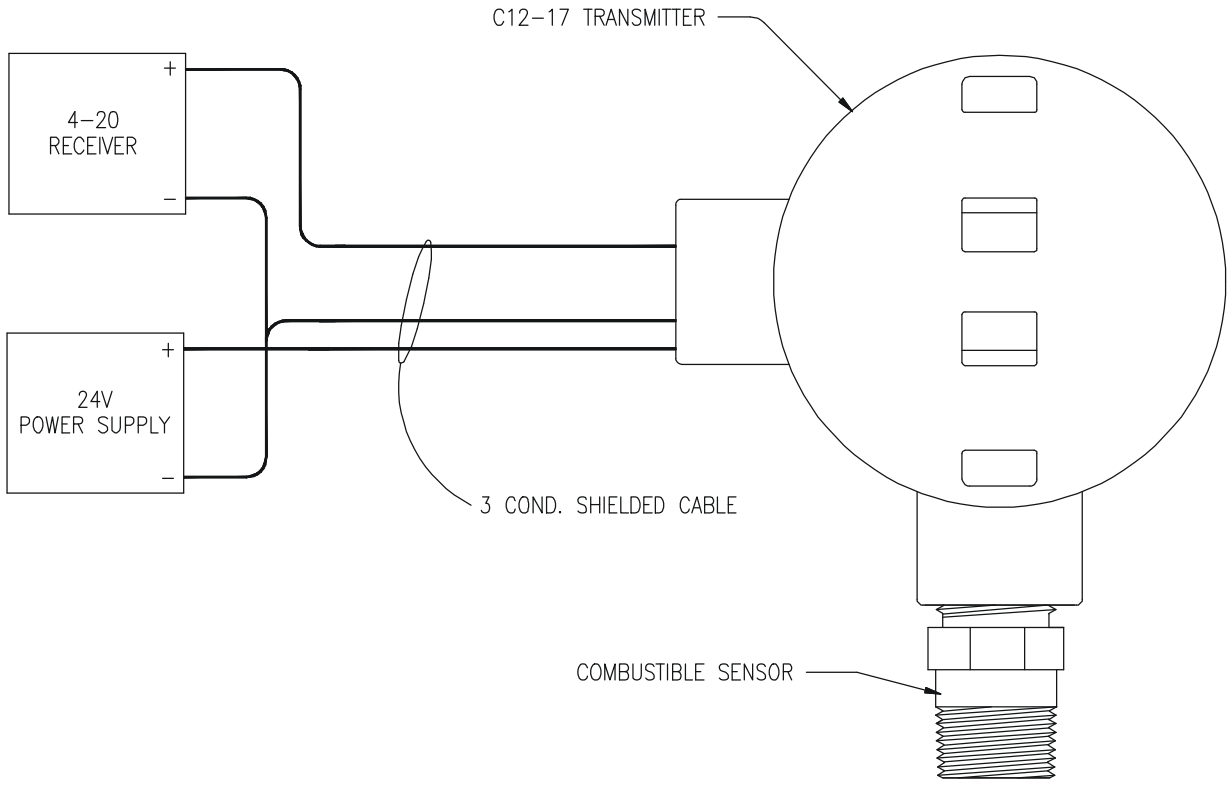


Figure 1: Typical System Diagram, (ATI-0145)

SPECIFICATIONS

Range:	0-100% LEL (Lower Explosive Limit) Standard 0-50% LEL Optional
Response Time (T90)	10 Seconds
Sensitivity:	1% LEL
Zero Drift:	< 2%/Month
Power:	10-28 VDC, 24 VDC at 100mA nominal
Output:	4-20 mA DC, 200 ohms maximum load at 12 VDC 800 ohms maximum load at 24 VDC 1000 ohms maximum load at 28 VDC
Display:	Optional 2 ½ digit LCD
Alarm:	Single setpoint or Trouble with SPDT, 1A, 125VAC; 1A, 30VDC alarm relay
Temperature Limits:	-40° to + 70° C.
Sensor Materials:	316 Stainless Steel
Enclosure (Blind): Area Classification:	Galvanized Cast Iron for blind transmitter NEC Class 1, Division 1, Groups B, C, & D
Enclosure (for Display): Area Classification:	Extruded Aluminum with glass window NEC Class 1, Division 1, Groups A, B, C, & D
Connections:	3 wire, 20 AWG, 500 feet max. (150 m.)
Sensor Cable Length:	Maximum 50 feet for separation between sensor and transmitter
Weight:	3 lbs. (1.4 Kg.)

INSTALLATION

Combustible gas sensor/transmitters are explosion-proof assemblies that are normally mounted directly to suitable explosion-proof conduit. To maintain the explosion-proof integrity of the transmitter, a suitable cable entry seal must be used in accordance with the applicable electrical code. Sensor/transmitters should be mounted with the sensor facing down as shown in Figure 2.

NOTE: Gas sensors are shipped with a protective plastic cap over the end. This cap should be left in place to avoid damage to the sensor during installation. If the detection system is to be activated within a few days of installation, the cap should be removed when installation is complete. Otherwise, leave the cap in place until the system is to be placed in service. **Be sure to leave the protective cap on the sensor if painting is to be done in the area of the sensor.**

Series C12-17 transmitters require connection to a DC power supply and connection of the 4-20 mA output to a receiving device such as a computer, recorder, or data logger. A 3-conductor cable may be used for this purpose and is made at the terminals marked TB1 on Figure 3. Transmitters with the optional display and relay may use a 2-wire connection if only the local relay is to be used. If the 4-20 mA output is to be used, a 3-wire connection is needed.

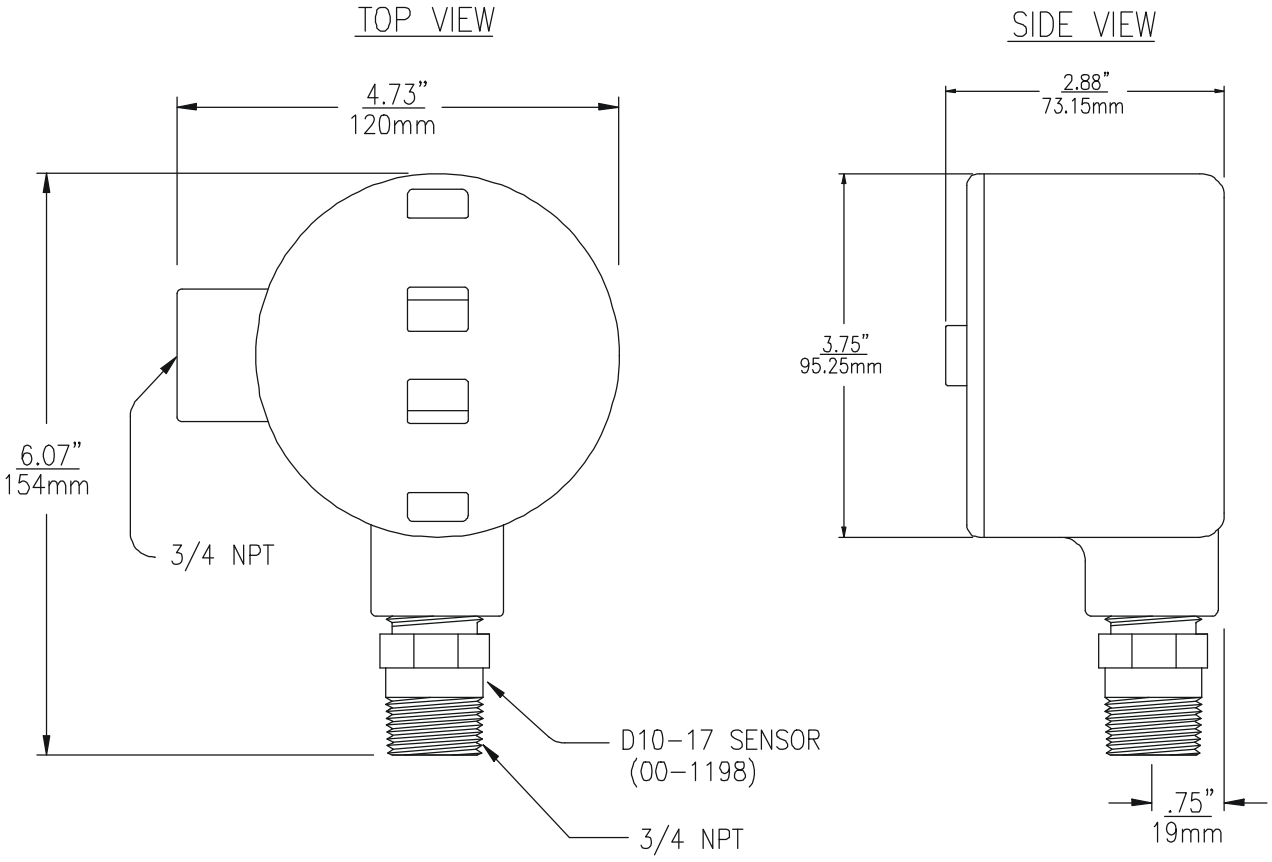


Figure 2: Combustible Gas Sensor/Transmitter Dimensions (ATI-046)

SENSOR LOCATION

Combustible gas sensors are used to detect a variety of gases or vapors. The proper sensor location will depend on what type of gas is expected. For gases that are lighter than air, such as methane, sensors should be located near the ceiling. For gases that are heavier than air, such as butane, sensors should be mounted near the floor. If the gas or vapor has a density near that of air, locate the sensor about 5 feet off the floor in enclosed areas. Gas sensors mounted outdoors should be located near anticipated leak sources (valves, flanges, compressors, etc.) and the location will depend on normal wind patterns and anticipated employee activity areas.

The following are a few common combustible gases, along with their relative density (air = 1.00). Densities less than one indicate gases that are lighter than air while those with densities greater than one are heavier than air. Combustible vapors from most solvents, such an Benzene, n-Hexane, Methanol, Ethanol, and MEK, are heavier than air and will tend to accumulate near the floor in enclosed spaces with little air movement.

Methane	0.55
Butane	2.11
Propane	1.55
Hydrogen	0.07
Ammonia	0.60

INTERFERENCES

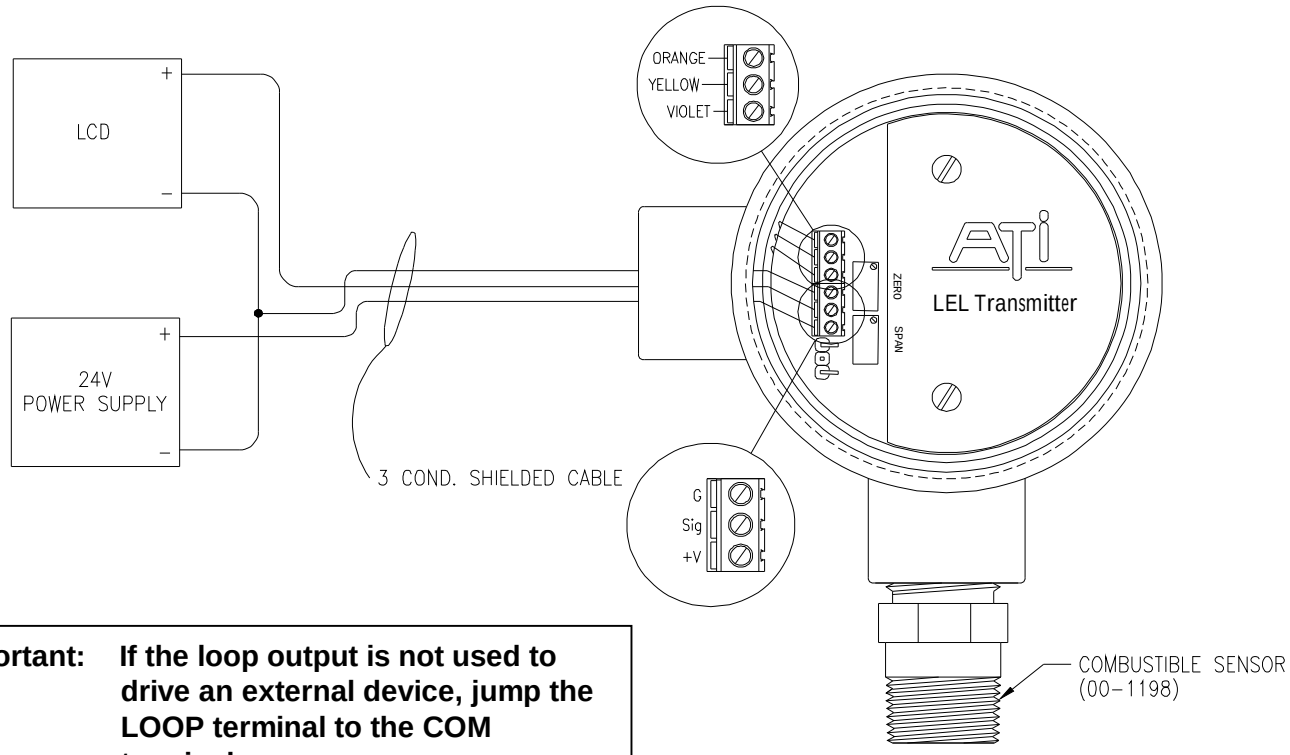
Combustible gas sensors contain two heated elements. One of these elements is active, and will allow combustible gases or vapors to burn on its catalytic surface. The other is passive, and does not react to gases. These two elements form two legs of a Wheatstone bridge measuring circuit. When combustible gas contacts the sensor, the active element burns this gas and the temperature of this element increases, changing its resistance. The transmitter measures the imbalance in the bridge circuit and transmits the data to the receiver for display and alarming purposes.

Combustible sensors are adversely affected by a few compounds that may be present in a given application. Probably the worst of these are silicone vapors from silicon based lubricants or sealants. High silicon vapor concentrations can cause complete loss of sensitivity in as little as a few hours. These sensors should not be used where silicon vapors are normally present, and sensors should be protected from these vapors if such compounds are in use temporarily.

Lead compounds and high levels of hydrogen sulfide can also cause degradation of combustible sensors. While lead vapors are not commonly encountered, they can also cause complete sensor failure if encountered. Hydrogen sulfide will cause reduced sensitivity over the first few weeks of exposure, but then will level out. The effect of hydrogen sulfide can normally be compensated for by re-calibration after the first few weeks of use.

ELECTRICAL CONNECTIONS - TRANSMITTER

External connections to the C12-17 transmitter can be made using 3 conductor cable. A 3-conductor cable uses a single conductor for the common of both the power supply and the output signal. Figure 3 shows typical connections to a power supply and a panel indicator running off the 4-20 mA signal from the C12-17 transmitter.



Important: **If the loop output is not used to drive an external device, jump the LOOP terminal to the COM terminal**

Figure 3: Transmitter customer connections (ATI-0237)

ELECTRICAL CONNECTIONS - SENSOR

Standard transmitters supplied with the sensor close coupled to the transmitter enclosure are factory wired as shown below. However, sensors can be supplied with up to 25 feet of cable for remote mounting. The wiring diagram for the extended cable version is also shown below. Extended cables should always be installed in suitable explosion-proof flexible conduit where required by the electrical code.

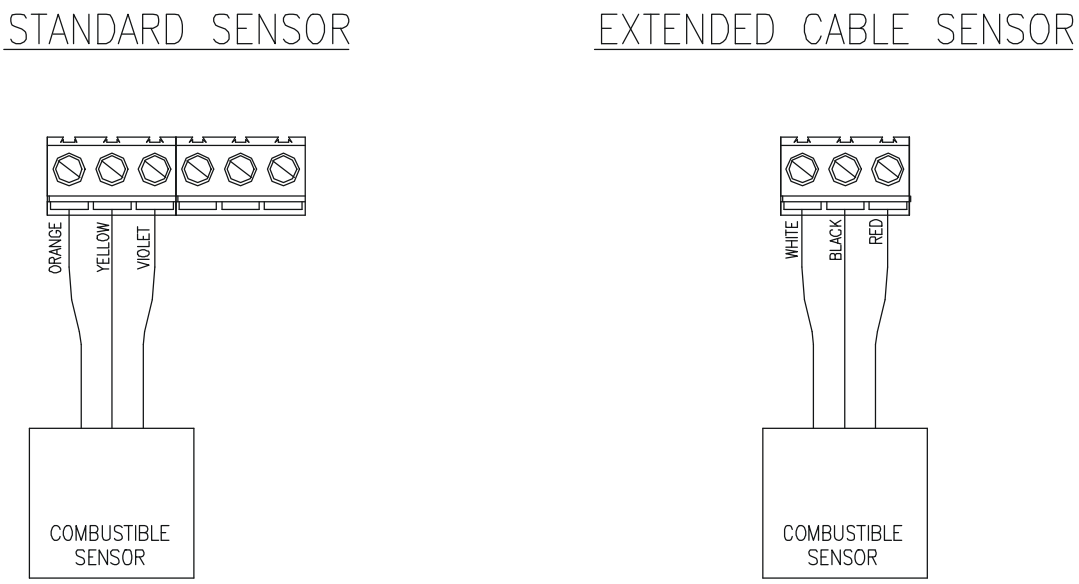


Figure 4: Sensor Connections to Transmitter (ATI-0144)

DUAL CONDULET SYSTEM

For some indoor applications, it is more convenient to mount the sensor toward the ceiling of the room while keeping the transmitter electronics down at a convenient elevation for making calibration adjustments. ATI's dual condulet system is designed for this purpose, and the interconnecting wiring is shown below. A special remote calibration adapter can be used with this system to allow gas to be fed from a point near the transmitter as shown in Figure 6.

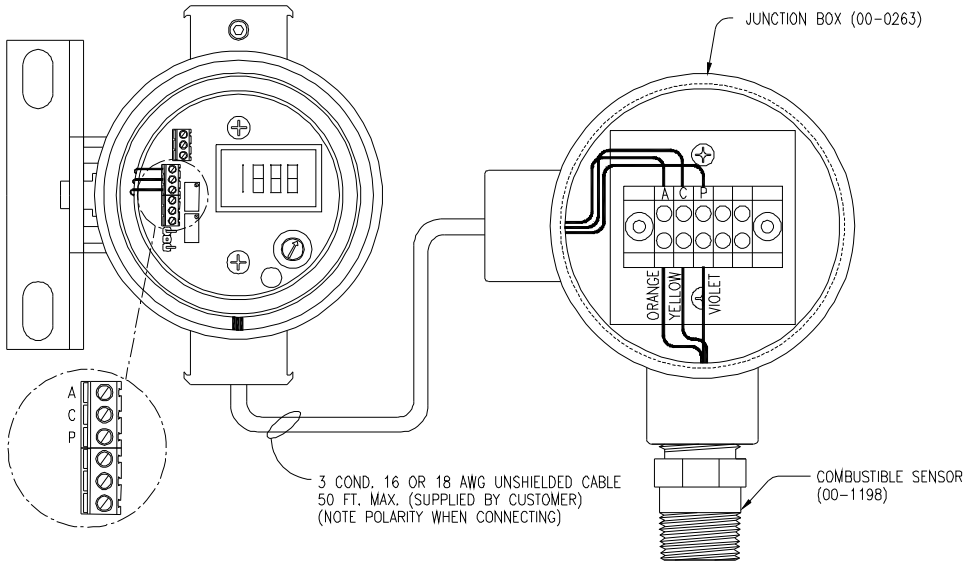


Figure 5: Dual Condulet Connections (ATI-0579)

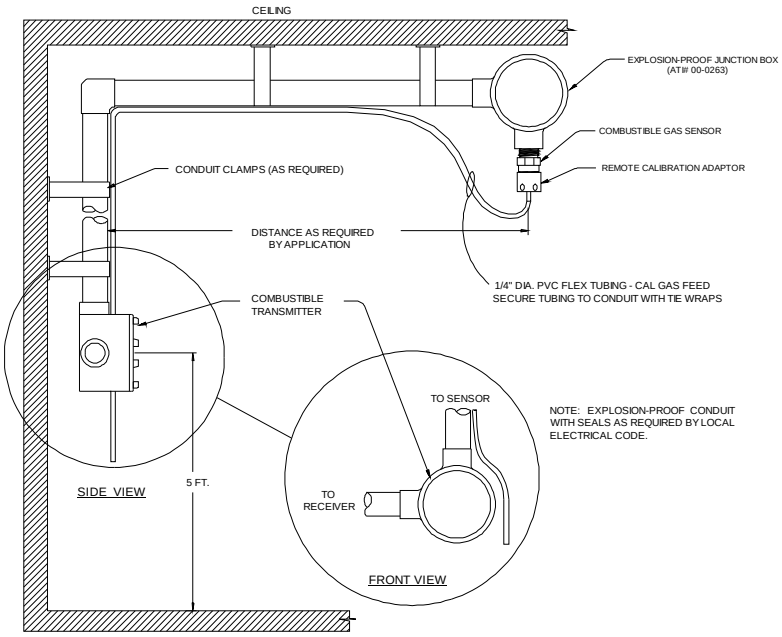


Figure 6: Dual Condulet Typical Installation

OPERATION

Once installation is complete, the C12-17 combustible gas transmitter is ready for operation. After verifying that electrical connections have been made properly, put the transmitter into operation by simply applying DC power. As soon as power is applied, the unit will begin to stabilize. Once stabilized, alarm system inhibit can be turned off, and the system will be in normal operation.

Note: The output of the transmitter will go to a high value when power is first applied. Alarm devices should be inhibited at this time so that alarm systems are not activated. The output will stabilize at 4 mA within about 10 minutes.

CALIBRATION

Combustible gas sensor/transmitters are factory calibrated for a standard range of 0-100% LEL Methane, using methane gas as the calibration standard. However, combustible gas sensors do not respond exactly the same to every combustible gas, and the percent of each gas that represents 100% LEL also differs for each gas. While methane gas standards can always be used for calibration, the value that the transmitter is adjusted to will vary depending on what type of gas the system is meant to detect.

Calibration of a combustible gas sensor/transmitter requires a digital voltmeter (DVM), a source of calibration gas, and a calibration adapter for the sensor. Calibration gas can be obtained in convenient disposable cylinders from specialty gas suppliers such as Scott Specialty Gases, Alphagaz, or Matheson Gas Products. Complete calibration kits may also be purchased from ATI. These kits contain one methane gas standard (1% methane in air, which is 20% LEL) in a disposable cylinder, a bottle of zero air, a cylinder regulator, and a calibration adapter.

Prior to calibration, remove the cover from the sensor/transmitter enclosure and connect a DVM to the test points (TP) shown in Figure 7. If the receiver for the system is near enough to easily see, you may use the digital display on the receiver instead of a DVM on the test points. The test points will provide a 40-200 mv. signal proportional to transmitter range. For a standard 0-100% LEL unit, 0% is 40 mv. and 100% is 200 mv.

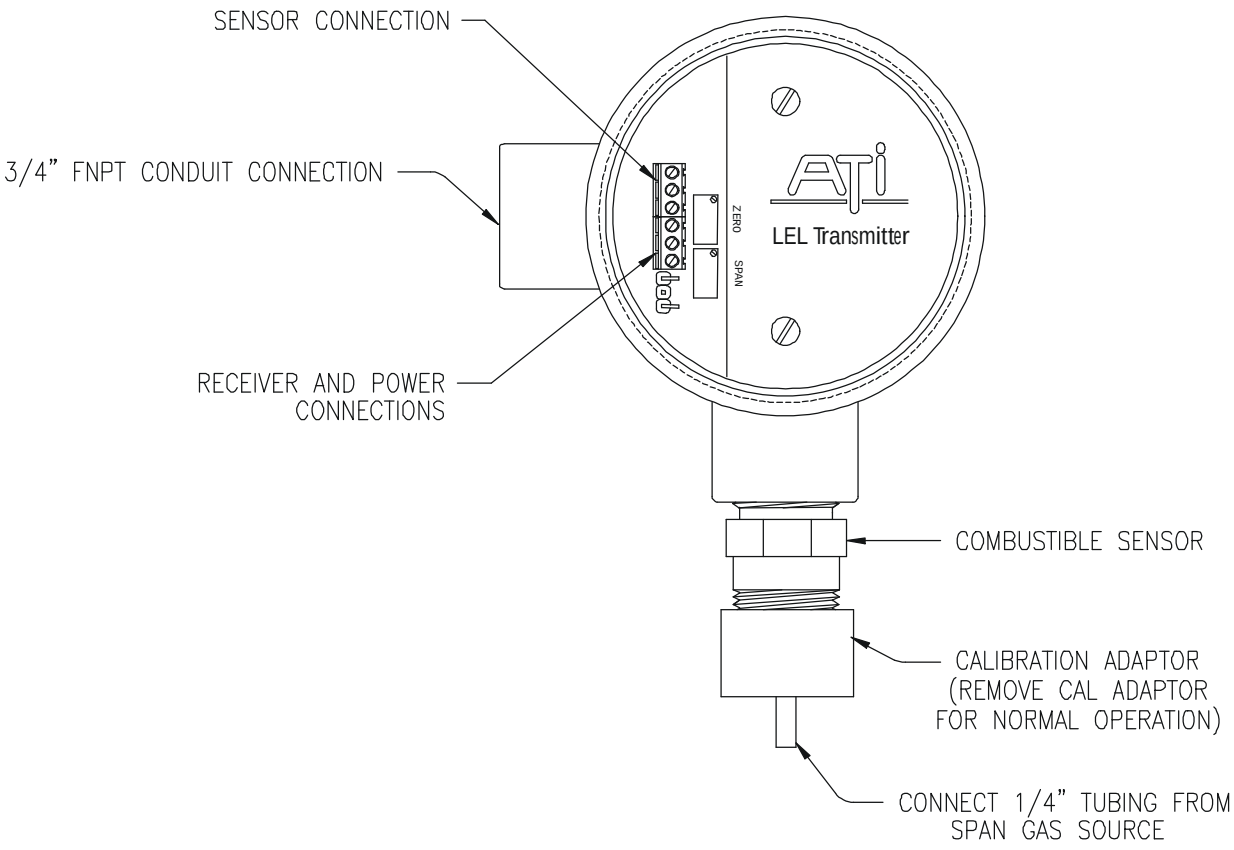


Figure 7: Sensor/Transmitter Connectors, Controls and Test Points (ATI-0143)

TRANSMITTER ZERO

The transmitter zero is adjusted with the sensor exposed to air that contains no combustible gas. Generally, the easiest method of zeroing the transmitter is to make the adjustment when you know that the area is free of combustibles. Because it is normally necessary to check the area with a portable combustible detector prior to removing the cover from the transmitter, the absence of an combustible gases or vapors can be verified fairly easily.

The transmitter can also be set to zero using "zero air" available in cylinders. Zero air cylinders and regulators are available from ATI or from specialty gas suppliers. Connect the zero air cylinder to the calibration adapter and adjust gas flow to 500 cc/min. When the DVM stabilizes near 40mV, adjust the zero potentiometer until the DVM reads 40 ± 0.5 mv.

NOTE: If using the ATI receiver display when adjusting the transmitter zero, place the receiver in the "Inhibit" mode. When in the inhibit mode, the blanking around zero is disabled so that the zero can be set accurately.

TRANSMITTER SPAN

The span setting for a combustible gas sensor/transmitter will depend on the gas or vapor for which the unit will be mainly used. To calibrate the system for applications where methane in the main combustible to be expected, connect tubing from your span gas cylinder (1% Methane) to the calibration adapter inlet. Turn on the gas flow and adjust to approximately 500 cc/min. (ATI calibration kits contain fixed flow regulators that automatically provide 500 cc/min. flow). The reading on the DVM attached to the transmitter test points will immediately start to increase. Allow the gas to flow to the sensor for 2-3 minutes and observe the reading on the DVM. The reading should be relatively stable ± 0.5 mv. Use the span potentiometer to adjust the DVM to 72 mv. This adjustment assumes the use of 1% methane gas standards, which are the equivalent of 20% LEL. If using another methane concentration, calculate the voltage setting as follows: (v/o = Volume Percent)

$$V = 40\ mV + [160\ mV \times (\text{Span Gas Concentration in } {}^{V}/_{O} \div 5\ {}^{V}/_{O})]$$

As an example, if your span gas cylinder is marked with a concentration of 2.5% Methane, the calculation would be:

$$V = 40\ mV + [160\ mV \times (2.5\ {}^{V}/_{O} \div 5\ {}^{V}/_{O})] = 120\ mV$$

When the span has been set, turn off the span gas flow and remove the calibration adapter from the sensor. Place the lid back on the transmitter enclosure and tighten the cover to insure the enclosure remains watertight. If the ATI receiver alarm relays were inhibited prior to calibration, press the **A/R** switch to return the system to normal operation.

TRANSMITTER FAULT INDICATION

The C12-17 combustible gas transmitter is designed to detect certain fault conditions in the sensor and transmitter and to indicate the fault conditions by driving the 4-20 mA output to below 2 mA. Receiving instruments that can identify this condition and provide a visual indication of the fault will provide added security for your gas detection system. When the C12 signal is used as an input to a PLC or computer system, the system should be programmed to recognize a 2 mA output as a fault condition for the transmitter.

The below 2 mA fault condition will be generated under the following conditions:

One of the sensor leads is not connected at the terminal block.
A sensor wire has broken in the interconnect wiring of a dual condulet installation.
The combustible sensing element has failed.

CALIBRATION FOR OTHER COMBUSTIBLE GASES

As previously mentioned, a combustible gas sensor has a slightly different response to each combustible gas or vapor. In addition, the LEL (Lower Explosive Limit) represents different percent concentrations for different gases. For instance, the LEL for methane is 5% by volume while the LEL for butane is 1.9% by volume. Because of these factors, a combustible transmitter must be adjusted differently if the system is meant to detect a gas or vapor other than methane.

A 1% methane gas standard may still be used for calibration of combustible transmitters when used for other gases. However, the voltage that you set at the transmitter test point will be different for each gas. Table 1 provides the voltage setting for various gases, and the corresponding percent LEL reading for each.

TABLE 1

GAS	VOLTAGE, mV	% LEL
Methane	72	20
Propane	98	36
n-Butane	96	35
n-Pentane	109	43
n-Hexane	127	56
Hydrogen	82	26
Methanol	77	23
Ethanol	83	27
Isopropyl Alcohol	109	43
Acetone	102	39
Methyl Ethyl Ketone	118	49
Benzene	120	50
Toluene	120	50
Acetylene	98	36
Di-ethyl Ether	109	43
Ammonia	67	16
n-Heptane	125	53

SENSOR RESPONSE TEST

While zero and span adjustments are required only periodically, gas sensors should be checked regularly for proper response. The response check can be done quickly by simply aiming the outlet tube from the span gas cylinder at the face of the sensor and turning on the gas flow for 10-20 seconds. The sensor should begin to respond within 5 seconds.

To observe the response at the transmitter, it is necessary to connect a DVM to the test points indicated in Figure 7. If the receiver is nearby, you may simply observe the digital display on the receiver. If the sensor does not respond, it should be replaced.

SENSOR REPLACEMENT

Combustible gas sensors used in the C12 are warranted for 12 months and generally last 5 years or more in the absence of poisoning agents. When sensor replacement is required, it can be done easily and quickly. Open the transmitter and remove the sensor cable from the sensor terminal block on the transmitter module. Unscrew the sensor from the explosion-proof transmitter housing using a wrench on the hex provided on the sensor. Screw in the replacement sensor.

Connect the new sensor to the terminal block (figure 3), on the transmitter board and replace the transmitter cover. After a new sensor has been connected, allow 4 hours for the new sensor to completely stabilize. Then perform a zero and span calibration as described on pages 11 through 13.

DISPLAY & RELAY OPTION

C12-17 transmitters supplied with the display and relay option offer additional features that make operation and calibration somewhat simpler. In addition, the relay allows for local alarm of a high gas condition without the need for wiring back and forth to a remote alarm module.

In normal operation, this version of the C12-17 will continuously display %LEL on the integral liquid crystal display. This display can be used for zeroing and calibration of the transmitter, eliminating the need for a separate DVM as described in the calibration section of this manual.

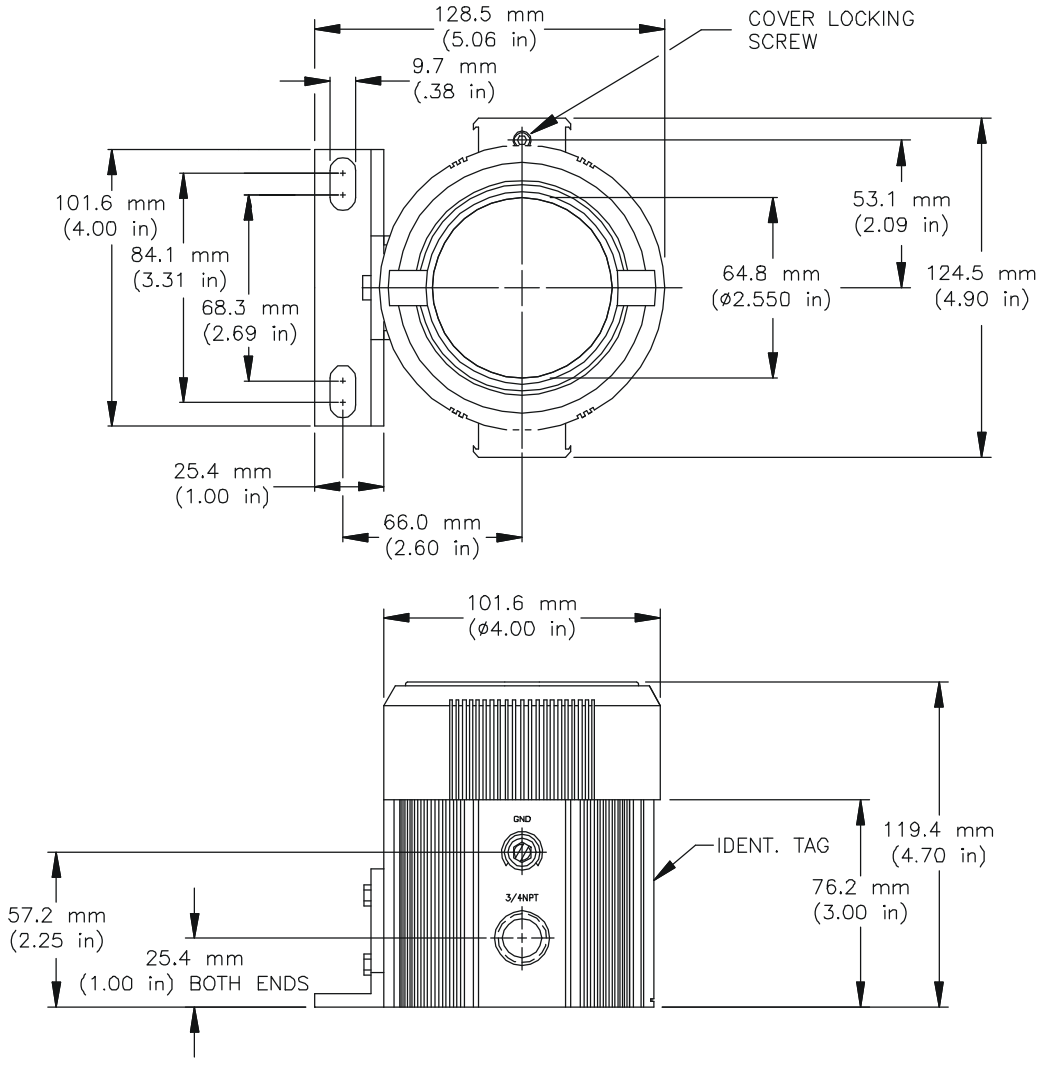


Figure 8 – Enclosure with Display Dimensional Drawing (ATI-0569)

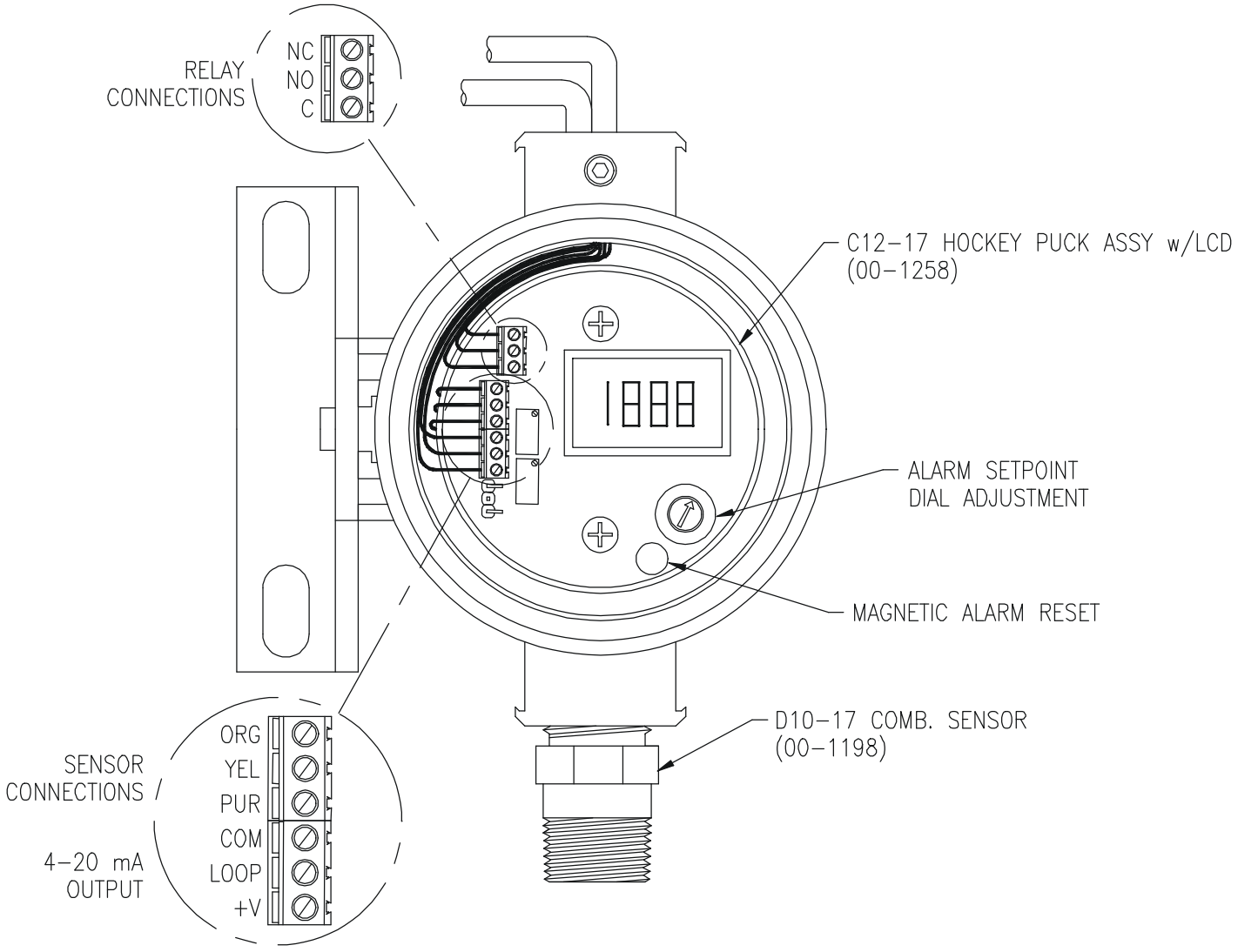


Figure 9 – Transmitter with Display Customer Connections (ATI-0570)

ALARM ADJUSTMENT

Units supplied with the optional display contain a single alarm setpoint and relay which may be used for local alarm functions. The SPDT internal relay is ideal for simple applications where only a local lamp or horn is needed when elevated gas levels are detected.

The alarm setpoint is adjusted using the calibrated dial on the front of the transmitter. The dial is marked 0-100 corresponding to 0-100% LEL. Note that the alarm setpoint cannot be set for a value below 5%. Simply adjust the dial to the desired value and the relay will actuate when the combustible gas level reaches that point. When the relay is activated, a decimal point to the left of the concentration display will indicate that the relay is latched.

The relay is a latching relay and must be reset manually. Reset is done using a magnet through the window of the display. A magnetic screwdriver is supplied with the transmitter for this purpose. If the relay activates and the gas concentration returns to normal, simply hold the magnet on the end of the screwdriver against the yellow dot in the window. The relay will immediately return to a deenergized state. Note that the relay will not reset until the gas concentration is below the setpoint.

TROUBLE FUNCTION

If the internal relay is not to be used for gas concentration alarming, its function can be changed to a trouble relay to provide local indication of a fault condition. If the setpoint is adjusted to “0”, the relay will automatically become a trouble relay. If any of the fault conditions described on page 13 occur, the relay will activate. The relay is non-latching and will reset if the fault condition clears.

When transmitter trouble is detected, the LCD display will indicate a “-1” value and the current loop will go to 2 mA. Transmitter operation will return to normal when the trouble condition is corrected.

C12-17 TRANSMITTER W/O DISPLAY
SPARE PARTS LIST

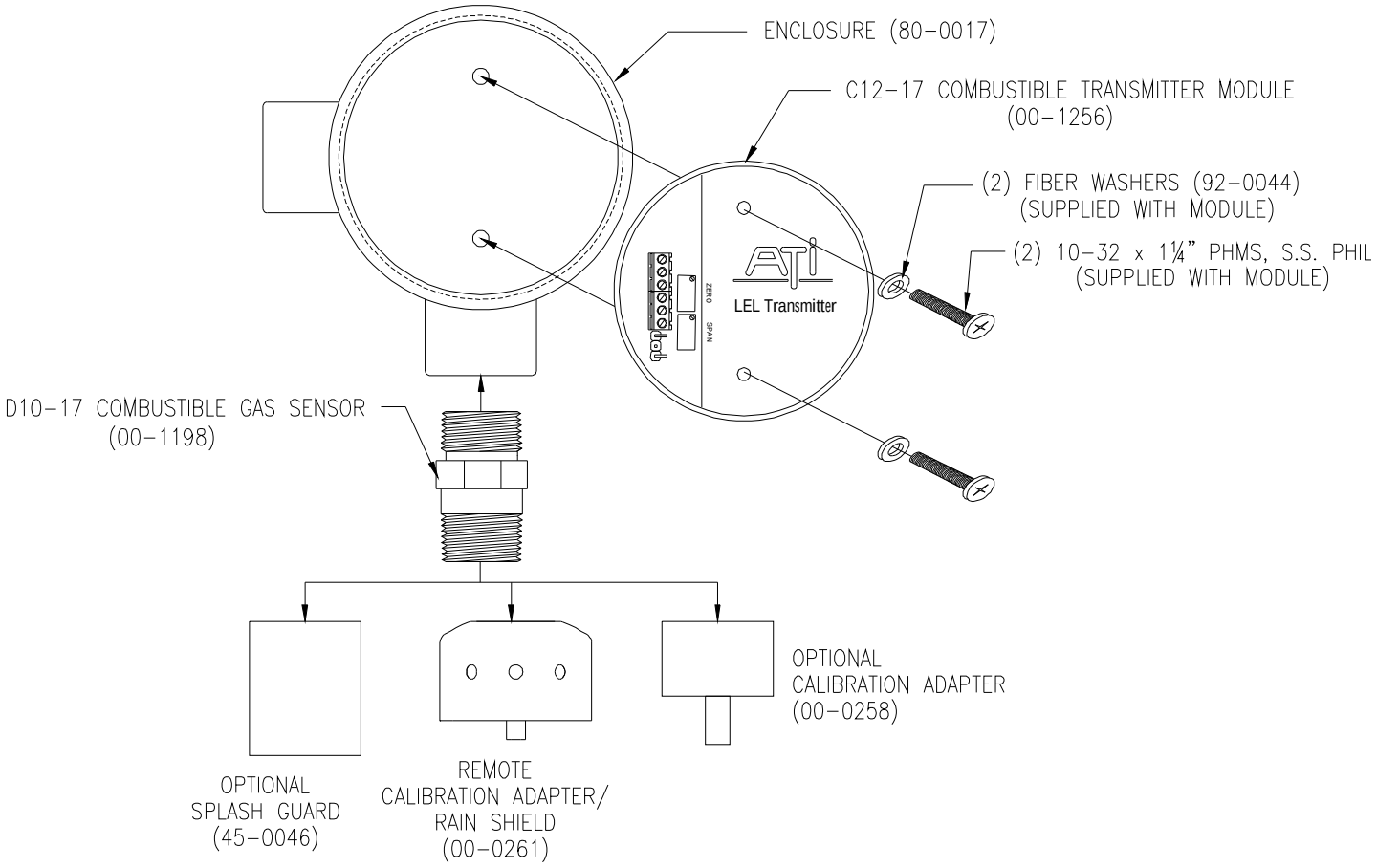


Figure 10 – Standard Combustible Transmitter Exploded View (ATI-0146)

Part Number	**Description**
00-1256	C12-17 Combustible Transmitter Module
80-0017	Explosion-proof Enclosure
00-1198	D10-17 Combustible Sensor Assembly
92-0043	10-32 x 1¼" PHMS, S.S. Phillips
92-0044	Fiber Washer
45-0046	Splash guard
00-0258	Calibration Adapter
00-0261	Remote Calibration Adapter/Rain Shield

C12-17 TRANSMITTER WITH DISPLAY
SPARE PARTS LIST

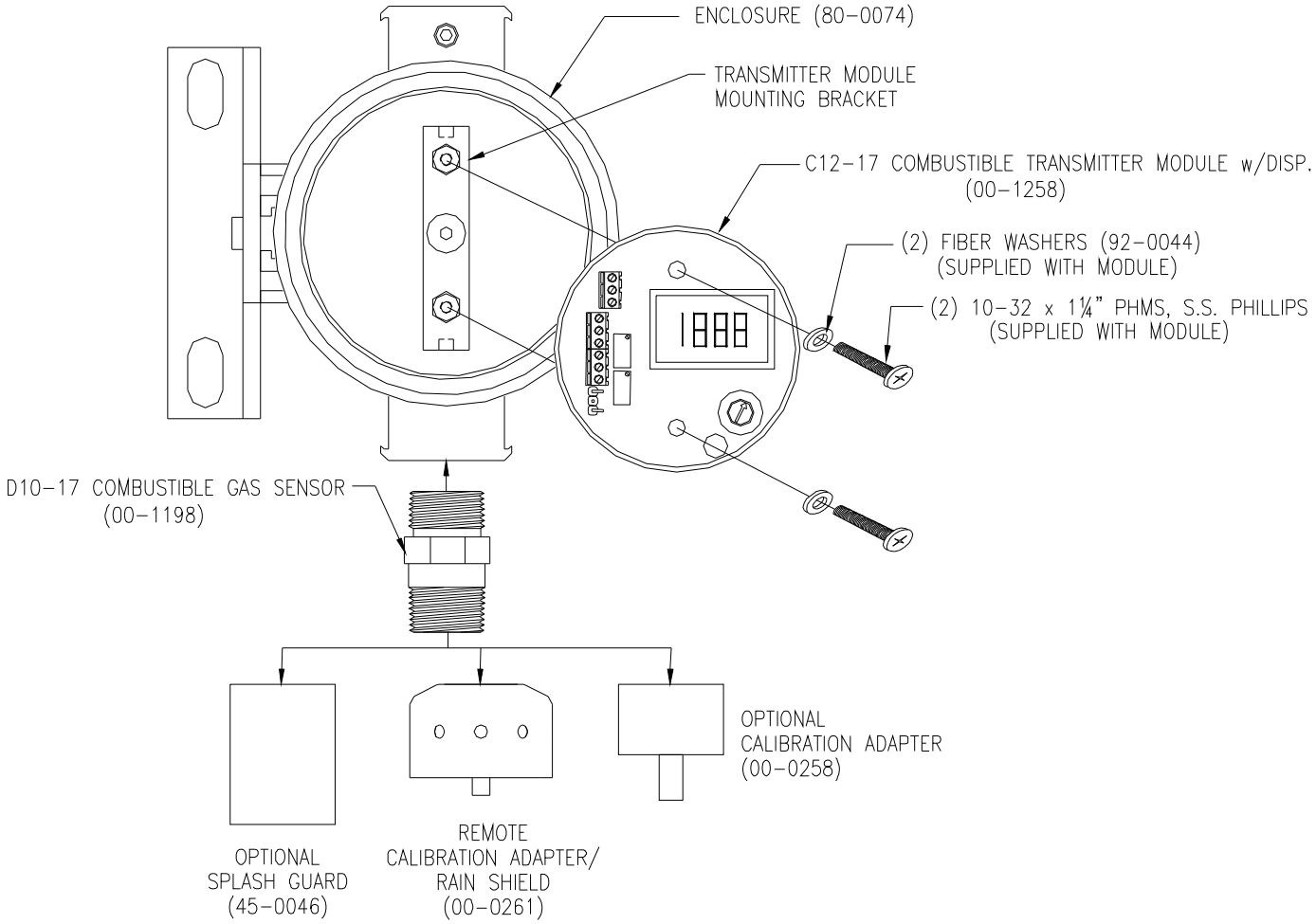
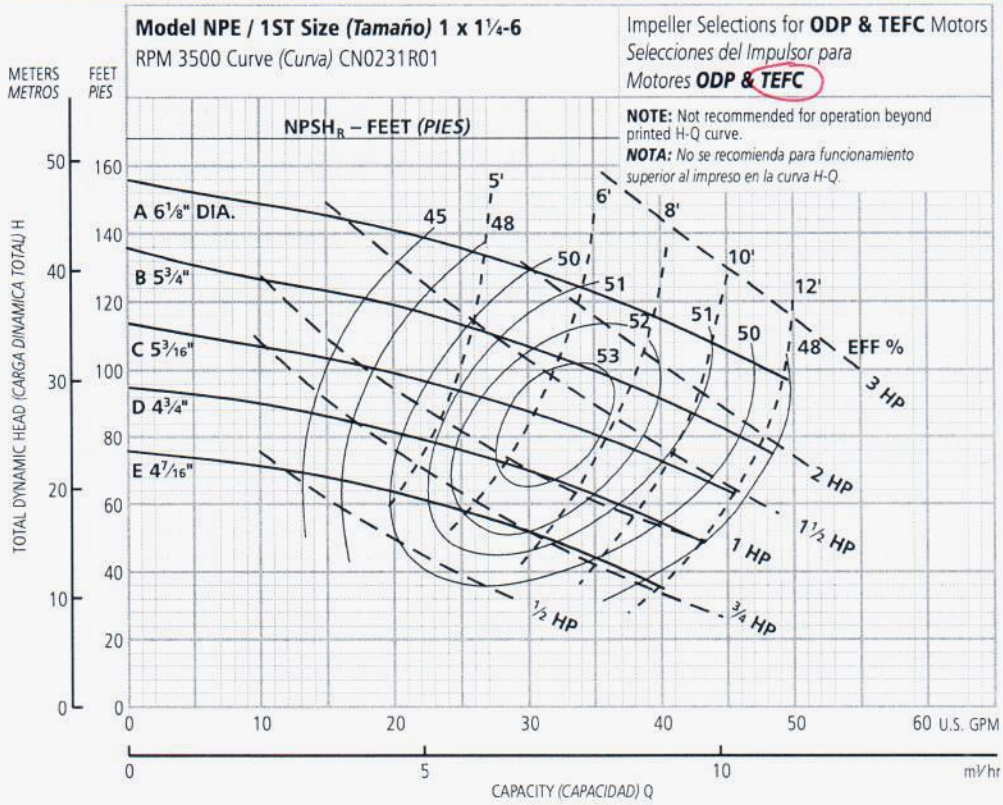


Figure 11 – Standard Combustible Transmitter Exploded View (ATI-0571)

Part Number	**Description**
00-1258	C12-17 Combustible Transmitter Module with Display
80-0074	Explosion-proof Enclosure for Display Module
00-1198	D10-17 Combustible Sensor Assembly
92-0043	10-32 x 1¼" PHMS, S.S. Phillips
92-0044	Fiber Washer
45-0046	Splash Guard
00-0258	Calibration Adapter
00-0261	Remote Calibration Adapter/Rain Shield

CONDENSATE PUMP

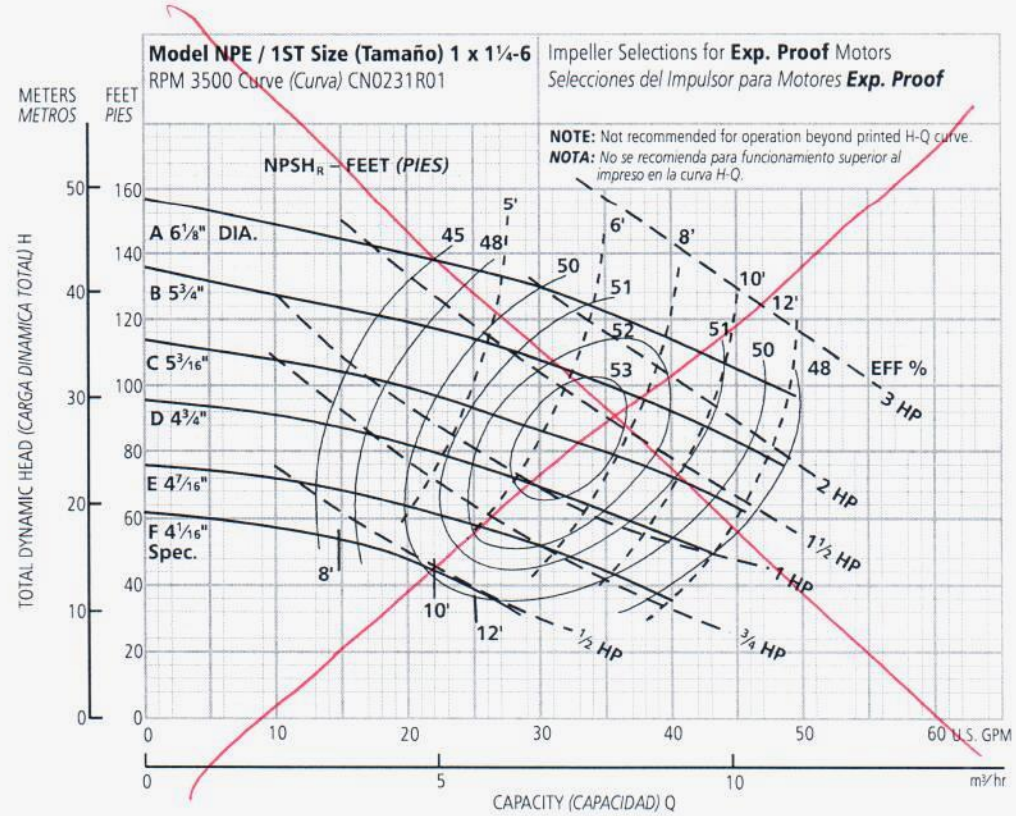
Performance Curves – 60 Hz, 3500 RPM
Curvas de Funcionamiento – 60 Hz, 3500 RPM



Ordering Code, *Código de Pedido*	Standard HP Rating, *Estándar HP Potencia*	Imp. Dia.
E	½	4⁷⁄₁₆"
D	¾	4¾
C	1	5³⁄₁₆
B	1½	5¾
A	2	6⅛

NOTE: Although not recommended, the pump may pass a ⁷⁄₁₆" sphere.

NOTA: *Si bien no se recomienda, la bomba puede pasar una esfera de ⁷⁄₁₆".*



Ordering Code, *Código de Pedido*	Standard HP Rating, *Estándar HP Potencia*	Imp. Dia.
F	½	4¹⁄₁₆" spec.
E	¾	4⁷⁄₁₆
D	1	4¾
C	1½	5³⁄₁₆
B	2	5¾
A	3	6⅛

NOTE: Although not recommended, the pump may pass a ⁷⁄₁₆" sphere.

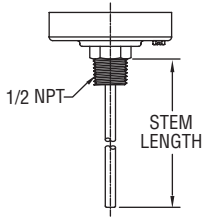
NOTA: *Si bien no se recomienda, la bomba puede pasar una esfera de ⁷⁄₁₆".*

BIMETAL THERMOMETER

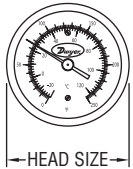
2″, 3″ or 5″ Dial, Dual Scale, ±1% FS Accuracy, External Reset

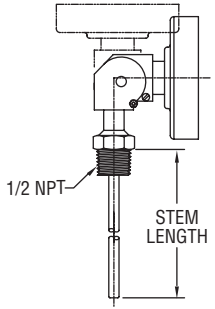
Scan here to watch product video





Back Connection





Adjustable Angle Connection

The **SERIES BT** Bimetal Thermometers offer accurate, reliable service even in the toughest environments. These corrosion resistant units are constructed from stainless steel and are hermetically sealed to prevent crystal fogging.

FEATURES/BENEFITS
- Hermetically sealed
- Adjustable dial position models

APPLICATIONS
- Chiller or boiler water temperature monitoring
- Treatment plant temperature monitoring

SPECIFICATIONS

Wetted Materials: 304 SS.
Housing Material: Series 300 SS.
Lens: Glass.
Accuracy: ±1% full-scale.
Response Time: ≤ 40 seconds.
Temperature Limits: Head: 200°F (93°C); Stem: Not to exceed 50% over-range or 1000°F (538°C) or 800°F (427°C) continuously.
Process Connection: 1/4″ NPT on 2″ dial size; 1/2″ NPT on 3″ or 5″ dial size.
Stem Diameter: 1/4″ OD.
Immersion Depth: Minimum 2″ in liquids, 4″ in gas.

MODEL CHART

Model	Dial Size	Stem Length	Connection	Range °F (°C)	Degree Div °F (°C)	Model	Dial Size	Stem Length	Connection	Range °F (°C)	Degree Div °F (°C)
BTB22551*	2″	2-1/2″	Back	0 to 250	2	**BTB3605D**	3″	6″	Back	0 to 250 (-20 to 120)	2 (2)
BTB2405D	2″	4″	Back	0 to 250 (-20 to 120)	2 (2)	**BTA54010D**	5″	4″	Adjustable	0 to 200 (-20 to 100)	2 (2)
BTB2409D	2″	4″	Back	200 to 1000 (100 to 550)	10 (5)	**BTA5405D**	5″	4″	Adjustable	0 to 250 (-20 to 120)	2 (2)
BTB32510D	3″	2-1/2″	Back	0 to 200 (-20 to 100)	2 (2)	**BTA5407D**	5″	4″	Adjustable	50 to 550 (10 to 290)	5 (5)
BTB3255D	3″	2-1/2″	Back	0 to 250 (-20 to 120)	2 (2)	**BTA56010D**	5″	6″	Adjustable	0 to 200 (-20 to 100)	2 (2)
BTB3257D	3″	2-1/2″	Back	50 to 550 (10 to 290)	5 (5)	**BTA5605D**	5″	6″	Adjustable	0 to 250 (-20 to 120)	2 (2)
BTB34010D	3″	4″	Back	0 to 200 (-20 to100)	2 (2)	**BTA5607D**	5″	6″	Adjustable	50 to 550 (10 to 290)	5 (5)
BTB3405D	3″	4″	Back	0 to 250 (-20 to 120)	2 (2)	**BTC3255D**	3″	2-1/2″	Lower	0 to 250 (-20 to 120)	2 (2)
BTB3407D	3″	4″	Back	50 to 550 (10 to 290)	5 (5)						

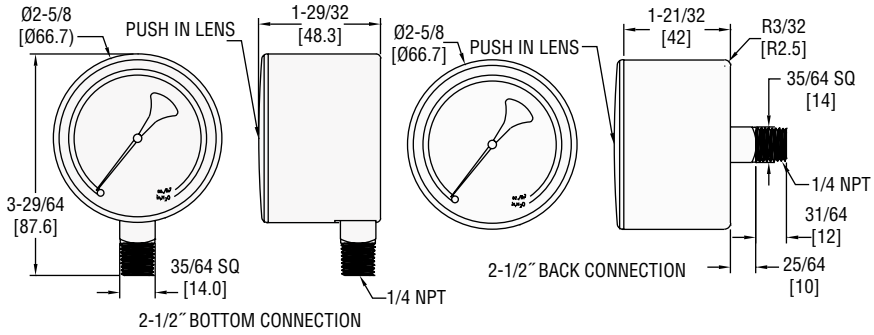
*Model offered in Fahrenheit scale only.

SERIES LPG3 | DWYER

LOW PRESSURE GAGE

1.6% FS Accuracy in a 2-1/2″ Gage





SERIES LPG3 Low Pressure Gages are designed to be especially sensitive with an elastic element that expands and contracts with very small changes in pressure for ASME Grade 1A accuracy. This series is meant for the measurement of low pressures of gases and liquids and is ideal for air flow indicators, liquid level indicators and draft gages. Our new low pressure gages are available in 2-1/2″ dial with either a bottom or back connection option.

SPECIFICATIONS

Service: Compatible gases and liquids.
Wetted Materials: Brass.
Housing Materials: Steel with black finish.
Lens: Polycarbonate.
Accuracy: 1.6% FS; ANSI B40.1 Grade 1A.
Pressure Limit: 110%.
Temperature Limits: -40 to 150°F (-40 to 65°C).
Size: 2-1/2″ (63 mm).
Process Connections: 1/4″ NPT, bottom or back.
Weight: 6.5 oz (184 g).

MODEL CHART

Model Bottom	Range in w.c./oz/in²	Model Back	Range in w.c./oz/in²
LPG3-D8122N	0 to 15 (0 to 8.6 oz/in²)	**LPG3-D8142N**	0 to 15 (0 to 8.6 oz/in²)
LPG3-D8222N	0 to 32 (0 to 18.5 oz/in²)	**LPG3-D8242N**	0 to 32 (0 to 18.5 oz/in²)
LPG3-D8422N	0 to 55 (0 to 32.0 oz/in²)	**LPG3-D8442N**	0 to 55 (0 to 32.0 oz/in²)
LPG3-D8622N	0 to 100 (0 to 58.0 oz/in²)	**LPG3-D8642N**	0 to 100 (0 to 58.0 oz/in²)
LPG3-D8822N	0 to 200 (0 to 116 oz/in²)	**LPG3-D8842N**	0 to 200 (0 to 116 oz/in²)
Model Bottom	**Range psi/kPa**	**Model Back**	**Range psi/kPa**
LPG3-D9922N	0 to 5 (0 to 35 kPa)	**LPG3-D9942N**	0 to 5 (0 to 35 kPa)
LPG3-D0022N	0 to 10 (0 to 70 kPa)	**LPG3-D0042N**	0 to 10 (0 to 70 kPa)

Series SG1

1.5″ Stainless Steel Industrial Pressure Gage

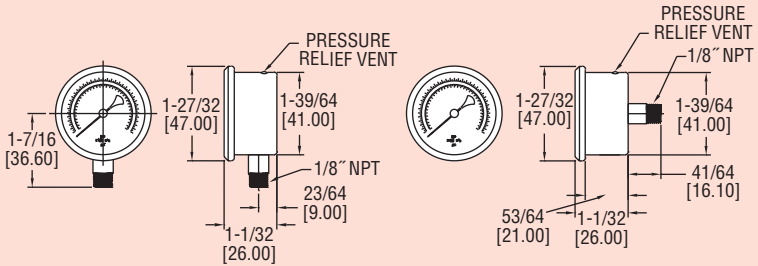
2.5% FS Accuracy, Brass Wetted Parts, Dual PSI/Bar x100 kPa Scales



SG1 Bottom



SG1 Back



The Series SG1 Gages are perfect for applications where resistance to corrosion is necessary. The stainless steel case and ring offer excellent protection from harsh processes. The SG1 gages are an economical choice where ambient corrosion and vibration are a concern. Gages are suitable for all fluids that are compatible with brass and bronze, and are available with bottom or back connections.

Model	Range
SG1-B10121N	0 to 30″ Hg
SG1-B10321N	0 to 30 psi
SG1-B10421N	0 to 60 psi
SG1-B10521N	0 to 100 psi
SG1-B10621N	0 to 160 psi
SG1-B10721N	0 to 200 psi
SG1-B11021N	0 to 300 psi

Note: Change ending 21N to 41N for back connection

OPTION
For NIST traceable calibration certificate, use order code NISTCAL-PG1.

SPECIFICATIONS
Service: Compatible gases and liquids.
Wetted Materials: Brass connector, bronze tube.
Housing: 304 SS.
Lens: Polycarbonate.
Accuracy: ±2.5% FS.
Pressure Limit: FS range.
Temperature Limits: -4 to 140°F (-20 to 60°C).
Size: 1.5″ (40 mm).
Process Connections: 1/8″ NPT.
Weight: 2.2 oz (63 g) bottom, 2.3 oz (65 g) back.

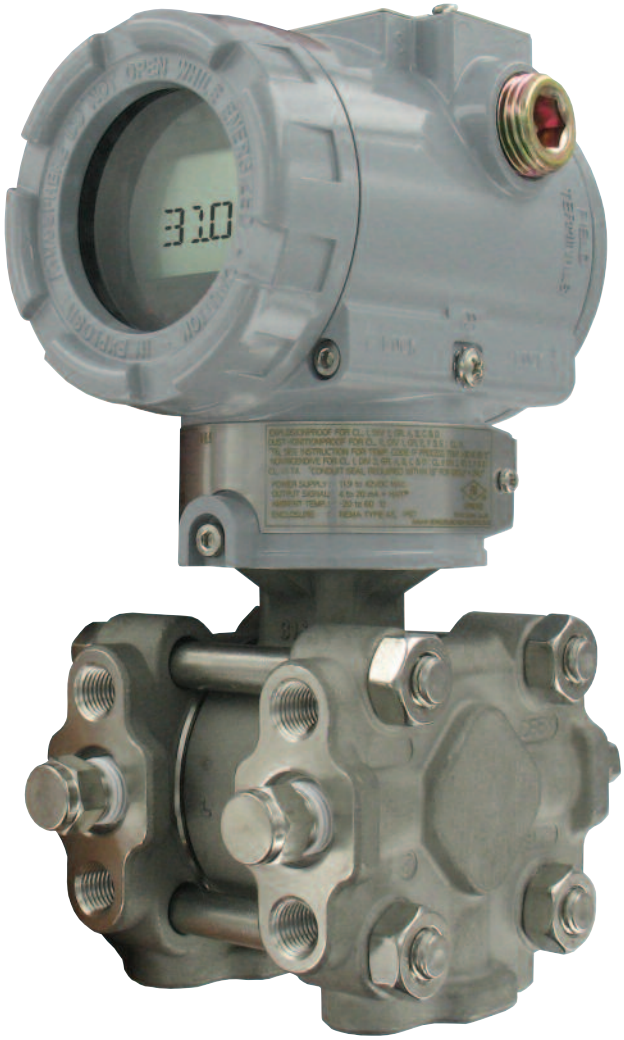
ACCESSORY
A-445B, U-Bracket Mounting Kit for 1.5″ Gage

Bulletin P-3100

Series 3100 Explosion-Proof Differential Pressure Transmitter

Specifications - Installation and Operating Instructions





DWYER INSTRUMENTS, INC.
P.O. BOX 373 • MICHIGAN CITY, INDIANA 46360, U.S.A.
Phone: 219/879-8000
Fax: 219/872-9057
www.dwyer-inst.com
e-mail: info@dwyermail.com

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Appendix I
3100 Smart Pressure Transmitter LCD Display Code

HART® is a registered Trademark of Hart Communication Foundation

Chapter 1 Introduction

The 3100 Smart Pressure Transmitter is calibrated at the factory before shipping. To ensure correct and efficient use of the instrument, please read the manual thoroughly and fully understand how to operate the instrument before operation.

1. The contents of this manual are subject to change without prior notice.
2. All rights are reserved. No part of this manual may be reproduced in any form without Dwyer Instruments, Inc. written permission.
3. If any question arises, errors are found or if any information is missing from this manual, please inform Dwyer Instruments, Inc.
4. The specifications covered by this manual are limited to standard transmitters and do not cover custom-made instrument.
5. Please note that changes in the specifications, construction, or component parts of the instrument may not immediately be reflected in this manual at the time of change, provided that postponement of revisions will not cause difficulty to the user from a functional or performance standpoint.

1.1 Using This Manual

The operating manual provides information on installing, operating, and maintaining the Mercoid® Model 3100 Smart Pressure Transmitter. The Chapters are organized as follows.

Chapter 2 Handling Cautions
Chapter 2 provides instructions on commissioning and operating the Model 3100 Smart Pressure Transmitters. Informations on software functions, configuration parameters, and on-line variables are also included.

Chapter 3 Transmitter Functions
Chapter 3 contains suggestions on handling the Model 3100 Smart Pressure Transmitter.

Chapter 4 Installation
Chapter 4 contains mechanical, environment consideration and electrical installation instructions for the Model 3100 Smart Pressure Transmitter.

Chapter 5 On-line Operation
Chapter 5 describes how to configure the parameters of the Model 3100 Smart Pressure Transmitter. See the following list for the details.

1. Regulations for circuit's Input/Output characteristics; Sensor or Output Trim
2. Changing the output characteristic; Range Configuration, Output Type, Dampening, Unit
3. Changing the general data; Tag No., Date, Message etc.

Chapter 6 Maintenance
Chapter 6 contains hardware diagnostics, troubleshooting and maintenance task.

1.2 Overview of Transmitter

The Mercoid® Smart Pressure Transmitter is a microprocessor based pressure transmitter with a capacitance sensor optimized for draft measurement. The Model 3100 has a true draft analog range from 0 to 20 mA. This transmitter is explosion-proof, high precision accuracy, reliability and has digital communication for remote communication system.

The Model 3100 is enabled with HART® communication with Host, HHT (HART® Communicator) or PC Configurator. The transmitter's various variables in host are able to be changed, configured and calibrated by users. The HART® Communication between DC power supply and transmitter requires a 250~ 550 Ohm resistance.

1.3 Software Compatibility

The Mercoid® Smart Pressure Transmitter's software is implemented at the factory. The following functions can be configured using a HHT (Hart® Communicator).

Function	Function Supports		
	ZERO/SPAN Button	PC/PDA	HART HHT
	Rev.58		
ZERO/SPAN	•	•	•
ZERO TRIM	•	•	•
ZERO Adj	•	•	•
Units set	•	•	•
Range set	•	•	•
Dampening set	•	•	•
LCD decimal set	•	•	Δ

• : Supported
Δ : Supported but update required

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Chapter 2 Handling Cautions

This chapter consists of cautions for transmitter handling, storage, installation, insulation and explosion structure, etc.

Step	Job	Job Details	Instrument
1	Unpacking	- Unpack transmitter packing	
2	Model and Specifications	- Make sure the transmitter nameplate matches the model number on the P.O.	
3	Storage	- In a dry, non-vibration and non-impact area - Ambient temperature around 77°F (25°C) and 65% relative humidity	
4	Calibration	- Configuration of the Range, Zero/Span, Unit, Tag, Dampening Time, Transfer Function, DA Trim and other parameters	- HHT - Pressure Source - Galvanometer
5	Installation Locations	- Where ambient temperature are constant - Exposure to chemical corrosion, etc. - Where shock and vibration are minimal - Where the area classification does not exceed the explosion-proof rating - Where maintenance is easy	(Engineering)
6	Mechanical Considerations	- Where the transmitter can be handled easily - Be cautious of process connections leaking	(Engineering)
7	Electrical Considerations	- 24 VDC (Power Supply is 11.9 Vdc – 45 Vdc) - For HART® communication, resistance on transmitter terminal loop should be between 250 – 550 Ohms	(Engineering)
8	Mounting and Installation	- When mounting the transmitter, an appropriate bracket should be used - The transmitter should be mounted securely to prevent swing	(Mounting and Installation)
9	Calibration on Spot	- Sensor Zero Trim should be done ten seconds after differential pressure stabilizes - Make sure that PV value is zero and current is 4 mA	HHT or Zero/Span button
10	Pressure	- Do not apply a regulated differential pressure and line pressure - Close the equalizing valve on the 3 valve manifold and then open the valve on high and low side slowly and simultaneously	(Applying pressure)
11	Operation	- Make sure the transmitter operates properly	Eye or HHT

2.1 Unpacking Transmitters

When moving the transmitter to the installation site, keep it in the original packaging. Unpack the transmitter at the installation site to avoid damage on the way.

2.2 Model and Specifications Check

The model number and specifications are indicated on the nameplate. Please check the specification and model number.

2.3 Storage

The following precautions must be observed when storing the instrument, especially for a long period of time.

1. Select a storage area that meets the following conditions:
   - is not exposed to rain or water.
   - minimal vibration and shock.
   - stored at normal temperature and humidity (approx. 77°F (25°C), 65% RH).

   The ambient temperature and relative humidity ratings are:

Ambient Temperature:	-40 to 185°F (-40 to 85°C) (without LCD module)
	-22 to 176°F (-30 to 80°C) (with LCD module)
General Use:	-4 to 140°F (-20 to 60°C)
Relative Humidity:	5% ~ 98% RH at 104°F (40°C)

2. When storing the transmitter, repack it the way it was delivered from the factory.

3. If storing a used transmitter, thoroughly clean the diaphragm surfaces, so that no media remains. Make sure the transmitter assemblies are securely mounted before storing.

2.4 Selecting Installation Locations

The transmitter is designed to withstand severe environmental conditions. However, to ensure stable and accurate operation, the following precautions must be observed when selecting an installation location.

1. Ambient Temperature
   Avoid locations subject to wide temperature variations or a significant temperature gradient. If the location is exposed to radiant heat from plant equipment, provide adequate insulation or ventilation.

2. Ambient Atmosphere
   Avoid installing the transmitter in a corrosive atmosphere. If the transmitter must be installed in a corrosive atmosphere, there must be adequate ventilation. Precautions must be put into place to prevent intrusion or stagnation of rainwater in conduits.

3. Shock and Vibration
   Select an installation site with minimum shock and vibration (although the transmitter is designed to be relatively resistant to shock and vibration).

4. Installation of Explosion-Proof Transmitters
   Explosion-Proof transmitters can be installed in hazardous areas according to the gas types for which they are certified.

5. Select a place where the transmitter can be maintenanced easily.

2.5 Calibration after Installation

1. Sensor Zero Trim should be done after transmitter is installed, because the zero point is not configured for mounting status.
2. When calibrating the Sensor Zero Trim apply a pressure for zero in advance, Sensor Zero Trim the sensor when the pressure is sufficiently stabilized (after approximately 10 seconds).
3. There are two ways to pressure zero. One way is to apply zero differential pressure (making pressure the same on both the high and low side). The other is to close High and Low side of a 3 valve manifold and open the equalizing valve.
4. Sensor Zero Trimming can also be done with the Zero/Span button or a HHT (HART® Communicator), PC or PDA configurator.
5. Refer to On-line Operation for configuring other parameters.

2.6 Pressure Connections

⚠ CAUTION Instrument installed in the process under pressure.
Never loosen or tighten as it may cause dangerous spouting of process fluid. If the process fluid is toxic or otherwise harmful, take appropriate care to avoid contact or inhalation of vapors even after disconnecting the instrument from process line for maintenance.

The following precautions must be observed in order to safely operate the transmitter under pressure.

1. Never apply a pressure higher than the specified maximum working pressure.
2. Confirm the option pressure of transmitter. It is necessary to use standardized and quality-approved parts.
3. There should be isolation valves in case of leakage.

2.7 Waterproofing Cable Conduit Connections

Apply a non-hardening sealant (silicone or tape, etc.) to the threads to waterproof the transmitter cable conduit connections.

2.8 Restrictions on Use of Radio Transceivers

⚠ WARNING Although the transmitter has been designed to resist high frequency electrical noise, if a radio transceiver is used near the transmitters external wiring, the transmitter may be affected by high frequency noise pickup. To test for such effects, bring the transceiver in slowly from a distance of several feet from the transmitter, and observe the measurement loop for noise affects. Always use the transceiver outside the area affected by noise.

2.9 Installation Resistance Test and Dielectric Strength Test

Since the transmitter has undergone insulation resistance and dielectric strength tests at the factory, normally these tests are not required. However, if required, observe the following precautions in the test procedures.

1. Do not perform such tests more frequently than necessary. Even test voltages, that do not cause visible damage to the insulation, may degrade the insulation and reduce safety margins.
2. Never apply a voltage exceeding 500VDC for the insulation resistance test, or a voltage exceeding 500VAC for the dielectric strength test.
3. Before conducting these tests, disconnect all signal lines from the transmitter terminals. Perform the tests in the following procedures.

   Insulation Resistance test

   1. Short-circuit the + and - SUPPLY terminals in the terminal box.
   2. Turn OFF the insulation tester. Then connect the insulation tester plus (+) lead-wire to the shorted SUPPLY terminals and the minus (-) lead wire to the grounding terminal.
3. Turn ON the insulation tester power and measure the insulation resistance. The voltage should be applied briefly to verify that insulation resistance is at least 20MΩ.

4. After completing the test and being very careful not to touch exposed conductors. Disconnect the insulation tester and connect a 100kW resistor between the grounding terminal and the short-circuiting SUPPLY terminals. Leave this resistor connected at least three seconds to discharge any static potential. Do not touch the terminal while it is discharging.

Dielectric Strength Test

1. Short-circuit the + and - SUPPLY terminals in the terminal box.
2. Turn off the dielectric strength tester. Then connect the tester between the shorted SUPPLY terminal and the grounding terminal. Be sure to connect the grounding lead of the dielectric strength tester to the ground terminal.
3. Set the current limit on the dielectric strength tester to 10 mA, then turn on the power and gradually increase the tester voltage from '0' to the specified voltage.
4. When the specified voltage is reached, hold it for one minute.
5. After completing this test, slowly decrease the voltage to avoid any voltage surges.

2.10 Explosion-Proof Rating

2-10-1. FM Certification

HAZARDOUS LOCATION ELECTRICAL EQUIPMENT
Equipment Rating: Explosion-Proof for use in Class I, Division 1, Groups A, B, C and D;
Dust- Ignition-Proof for Class II/III, Division 1, Groups E, F and G;
Nonincensive for use in Class I, Division 2, Groups A, B, C and D;
Suitable for use in Class II, Division 2, Groups E, F and G;
and Suitable for Class III, Division 1;
Hazardous (classified) location, indoor and outdoor
(NEMA Type 4X/IP67).

2.10.2 DEKRA/ATEX Certification

ATEX Certification number : DEKRA 11ATEX0192X
CE 0344 Ⓔx II 2 G

NOTICE **Model 3100 for potentially explosive atmosphere**

1. Ex d IIC T6...T4
2. Operating Temperature : -20°C ≤ T_{amb} ≤ +60°C
3. T6 for process ≤ 85°C;
4. T5 for process ≤ 100°C;
5. T4 for process ≤ 130°C;

NOTICE **Electrical Data**

1. Supply Voltage : 42 Vdc Max
2. Output Signal : 4 to 20 mA + HART

NOTICE **Electrical Connection : 2 x 1/2-14 NPT Female**

NOTICE **3100 ATEX Certification is according to the below standards**

EN 60079-0 : 2006
EN 60079-1 : 2007

NOTICE **Installation**

1. All wiring shall comply with local installation requirement.
2. The cable glands and blanking elements shall be of a certified flameproof type, suitable for the condition of use and correctly installed. Also those devices should be endured at the 130°C.
3. Housing Ground must be followed to “local electrical codes”. The most efficient ground procedure is to connect directly to the earth as least impedance.

1. How to Housing Ground:
   A. Internal Ground Connection:
      Internal ground connection screw is located in terminal in housing; the screw can be identified as ground sign.
   B. External Ground Assembly:
      This is located in the right side of housing and identified as ground sign. (Grounding with a cable lug)
2. When use tubing, stopping boxes must be connected with the wall of housing directly.
3. Tubing is installed a minimum of 5 threads.
4. Sensor is to be threaded a minimum of 7 threads and prevented from turing by tightening the housing rotation set screw.
5. Do not disassemble flameproof Joints but in an unavoidable case to disassemble it or need the specification of flameproof Joints, contact the manufacturer before doing.

NOTICE **Operation**

WARNING DO NOT OPEN WHEN AN EXPLOSIVE ATMOSPHERE MAY BE PRESENT.

1. Take care not to generate mechanical spark when access to the instrument and peripheral devices in hazardous location.

NOTICE **Maintenance and Repair**

The instrument modification or parts replacement by other than authorized representative of Dwyer/Mercoid is prohobited and will void KEMA/ATEX explosion-proof/flame-proof.

2.11 EMC Conformity Standards
EMI (Emission): EN55011
EMS (Immunity): EN50082-2

Dwyer Instruments, Inc. recommends customer use metal conduit wiring or twisted pair shield cable for signal wiring to conform with EMC regulation, when installing the Mercoid® 3100 transmitters.

Chapter 3 Transmitter Functions

3.1 Overview

This Chapter contains information on operating the Model 3100. Tasks that should be performed on the bench prior to installation are explained in this chapter.

3.2 Safety Messages

Procedures and instructions in this chapter may require special precautions to ensure the safety of the personnel performing the operations. Potential safety issues are indicated by a warning symbol (▲). Refer to the following safety messages before performing an operation preceded by this symbol.

3.3 Warning

DANGER **Explosion can result in death or serious injury:**

Do not remove the transmitter covers in explosion environments when the circuit is powered. Transmitter covers must be fully engaged to meet explosion-proof requirements.

WARNING **Electrical shock can result in serious injury:**

Only qualified personnel can install the transmitter.

3.4 Fail Mode Alarm

Mercoid® Smart Pressure Transmitter automatically and continuously performs self-diagnostic test. If the self-diagnostic test detects a failure, the transmitter drives the output outside of the normal operation values. The transmitter will drive its output low (down) or high (up) based on the position of the failure mode alarm jumper. See Table 3.1 for output values.

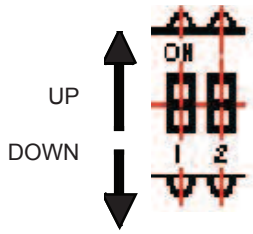
Level	4~20 mA Saturation	4~20 mA Alarm
Low/Down	3.9 mA	≤ 3.75 mA
High/Up	20.8 mA	≥ 21.75 mA

[Table 3.1 Standard Alarm and Saturation Values]

⚠ WARNING **Electrical shock can result in serious injury:**
Avoid contact with the leads and terminals. High voltage, that may be present, on leads can cause electrical shock.

Fail Safe mode can be set via Jumper switches provided on the LCD module or the main CPU module. The jumper switch for an indicating transmitter, located on the LCD module, can be set to the right (fail down i.e. ≤ 3.75 mA) or left (fail up i.e. ≥ 21.75 mA). For non-indicating transmitters the jumper switch is located on the main CPU module, it can be set up (fail up to ≥ 21.75 mA) or down (fail down to ≤ 3.75 mA). Refer to Figure 3-1 for detailed summary of jumper settings for both CPU and LCD modules.

Select Fail Mode	Both LCD Module and CPU Module		Only CPU Module
	CPU Module	LCD Module	CPU Module
Fail Down	Down	D	D
Fail Up	Down	U	U
	Up	U or D	



Fail Safe Mode Selection (LCD & CPU Module)
1. WR_EN (EEPROM Write Enable)
   DOWN : ENABLE
   UP : DISABLE
2. Fail Mode(Alarm)
   DOWN : LOW
   UP : HIGH

Fail Mode for LCD Module Selection Jumper Switch												
U	O	O	O		O	O	O	D		O	O	O	D
(If Down)					FAIL MODE					(If Up)			

Figure 3-1. Fail Mode and EEPROM-Write Selection Jumper Switch

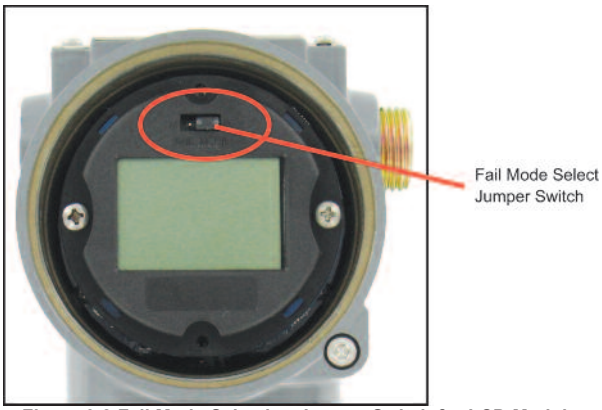


Figure 3-2 Fail Mode Selection Jumper Switch for LCD Module

3-5 EEProm-Write Enable / Disable Mode Switch

EEPROM (Electrically Erasable Programmable ROM), included on the CPU module, is used by the transmitter to save/restore configuration variables. To protect the transmitter from any unauthorized changes, a hardware lockout feature can be implemented by using the Write-Protect mode jumper switch provided on the main CPU Module. If the jumper switch is connected to DIS, this disables writing/changing of any data saved in the EEPROM. On the other hand, if the jumper switch is set to “EN”, changes can be made to the configuration data stored in the EEPROM. The factory default setting is “EN” (Enable) for all transmitters. The location of the Wire Protect Jumper Switch can be seen in Figure 3-3.

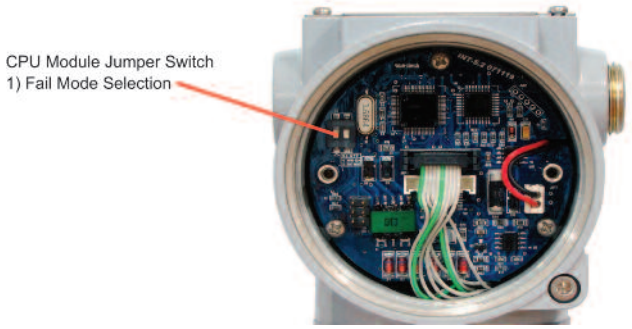


Figure 3-3. CPU Module Fail Mode, EEPROM-Write Selection Jumper Switch

The 3100 has two security settings.
1. Security Jumper: the transmitter configuration parameters are protected.

2. Physically removing Zero and Span Magnetic Buttons: you are unable to regulate zero and span locally.

3.5.1 Security Jumper (EEPROM Write Protect)

Prevents the transmitter’s configured parameters from being changed.

3.5.2 Zero and Span Buttons

By removing the Magnetic Buttons, you can’t configure the transmitter using the Zero and Span locally.

3.6 Configuration of Alarm and Security Jumper Procedures

Changing jumper position.
1. If the transmitter is installed, cutoff power.

2. Open the front cover. If the transmitter is powered, don’t open the cover.

3. Move the jumper to the preferred position.

4. Close the front housing covers. You must fully engage the cover to meet explosion-proof requirements.

3.7 Configuration of Zero and Span Procedures

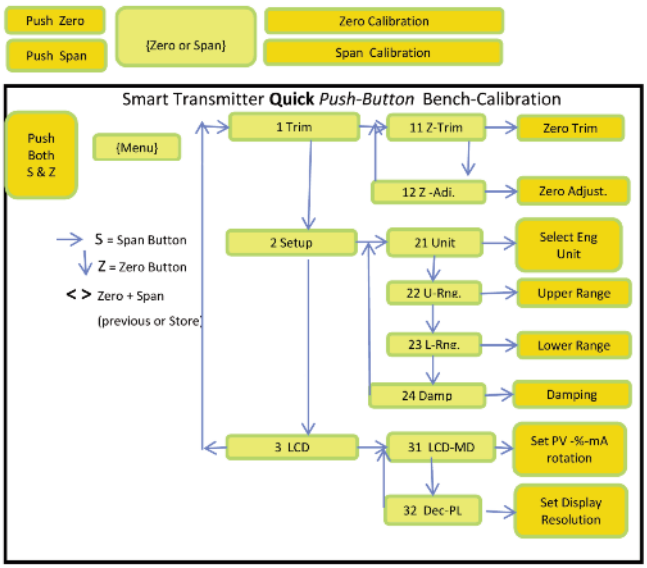
The ZERO and SPAN Buttons are under the transmitter's nameplate. The ZERO, SPAN, ZERO TRIM, ZERO ADJ, Units, Range, Dampening, LCD and decimal set functions are configurable using the ZERO / SPAN buttons.

Zero/Span Configuration Process

Remove both name plate screws on the upper part of transmitter. Remove top name plate to access the Zero and Span Buttons. (following Figure 3-4)

1. Zero Configurations
   Set the current process value for Lower Range Value (4 mA). Apply zero pressure for 10 seconds and push the Zero Button for 5 seconds. The LCD should display "Zero". Push the Zero button for 3 seconds, after 1 second the LCD should display "-ZE-". This message means the zero configuration is finished. If the zero configuration failed, the LCD will display "SPEr" or "SEtE", try repeating the zero configuration steps.
2. Span Configurations
   Apply the desired pressure for 10 seconds and push the Span Button for 5 seconds. The LCD should display "Span". Push the Span button for 3 seconds, after 1 second the LCD should display "-SP-". This message means that the span configuration is finished. If the span configuration failed the LCD will display "SPEr" or "SEtE", try repeating the span configuration steps.

- Please refer to Appendix 1 for the button error and LCD display message.
  The other functions supported by the ZERO / SPAN Buttons are below.



[Menu Tree for Zero+Span Button Function]

1. Moving between menus: Zero
2. Enter or moving to sub menu: Span
3. Moving to top menu: Zero+Span
   - Press the button for 3 seconds to execute each function. After 3 seconds press the Zero+Span buttons, the LCD display will change from Menu to Trim. To see the next menu, press the Zero button for 3 seconds. Use the Zero button to move down the directory.
   - Use the Span button to select the displayed menu. The same procedure will be used for the sub menus.

⚠ CAUTION 30 seconds without any action, the button function will return to normal operation.

4. How to select a numerical value
   A. Functions use numerical values: 12 Zero Adjustment, 22 Change Upper Range Value, 23 Change Lower Range Value, 24 Dampening Second
   B. How to select numerical value: First, select an increasing rate (10^n), then change each decimal value to increase or decrease as wanted. For example, select 3810 : Select increasing rate 1000 -> Increase 3 times -> Select increasing rate 100 -> Increase 8 times -> Select increasing rate as 10 -> Increase 1 time
   C. To select the increase / decrease steps: SelInc message will be displayed on the bottom of the LCD. Select parameter and press the Zero button : The decimal value will be changed when the Zero button is pressed. After set, press the span button to execute the parameter.
   D. To set the required values using Zero/Span buttons: VALUE message will be displayed on the bottom of the LCD.
      1. Press the Zero button, the menu will increase 1 item.
      2. Press the Span button, the menu will decrease 1 item.
      3. After setting, save the parameter by pressing the Zero+Span buttons.
   E. To set the final value, repeat C and D.
   F. After setting the final parameter, exit the menu by pressing the Zero+Span buttons.

5. Exercises for each function
   - ZERO TRIM
     1. Access the menu by pressing the Zero+Span buttons.
     2. Move to the sub directory using the Span button until the 1 TRIM message appears on the display.
     3. Change the Zero Trim Function by using the Span button until the 11 Z-TRIM message appears on the display.
   - ZERO ADJUSTMENT : Change the PV value to 14
     1. Exit the menu by pressing the Zero+Span button.
     2. Moving thru the sub directory using the Span button until 1 TRIM message appears.
     3. Moving thru the sub directory using the Zero button until 11 Z-TRIM message appears.
     4. Access the Zero Adjustment function by pressing the Span button until the 12 Z-ADJ messages appears.
     5. When the SelInc message appears, press the Zero button repetitively until the 10.0 message appears on the LCD. Set the value by pressing the Span button.
     6. When VALUE message appears, change the LCD value to 10.0 and press the Zero button, then press the Zero+Span buttons.
     7. When SelInc message appears, change the LCD value to 1.0 and press the Zero button, then set the value and press the Span button. Press the Zero+Span buttons after the LCD value changes to 14.0.
     8. To save the settings, press the Zero+Span buttons until the SelInc message appears.
   - CHANGE UNITS
     1. Access the menu by pressing the Zero+Span buttons.
     2. Moving to next menu by pressing the Zero button until the 1 TRIM message appears.
     3. Moving thru the sub directory press the Span button until the 2 SETUP message appears.
     4. Press the Span button to access 21 UNIT, press Span again to access Change Unit.
     5. Save the values by pressing the Span button when the desired value is displayed on the LCD.

- CHANGE UPPER RANGE VALUE
  1. Access the menu by pressing the Zero+Span buttons.
  2. Move to the next menu by pressing the Zero button until the 1 TRIM message appears.
  3. Press the Span button until the 2 SETUP message appears.
  4. Press the Span button until the 21 Unit message appears.
  5. Press the Zero button until the 22 U-RNG message appears.
  6. Press the Span button until the Zero Adjustment message appears.
- CHANGE LOWER RANGE VALUE
  1. Access the menu by pressing the Zero+Span buttons.
  2. Move the to next menu by pressing the Zero button until the 1 TRIM message appears.
  3. Press the Span button until the 2 SETUP message appears.
  4. Press the Span button until the 21 Unit message appears.
  5. Press the Zero button until the 22 U-RNG message appears.
  6. Press the Zero button until the 23 L-RNG message appears.
  7. Press the Span button until the Change Lower Range Value message appears.
- CHANGE LCD MODE (Cyclic or Fixed Display)
  1. Enter programming menu by pushing both (ZERO+SPAN) button together for 5 seconds. Release buttons when LCD displays Menu and display will automatically change to “1 TRIM” confirming access into programming menu.
  2. Push (ZERO) button when “1 TRIM” message appears on LCD. Release button when display changes to “2 SETUP”.
  3. Push (Zero) button and release when display changes to “3 LCD”.
  4. To move into sub directory push (Span) button after “3 LCD” message appears on display. Release button when 31 LCD-MD message is displayed.
  5. To enter this sub-menu, push (Span) button and release when display changes to 311. Bottom line of display will show current Mode setting e.g. NOR-RO, NOR-PVetc.
  6. Push (Zero) button to cycle through available mode options and select desired LCD rotation mode. Options are: NOR-RO (rotate all PV, %, mA), NOR-PV (fixed PV), NOR-% (fixed %), NOR-mA fixed, ENG-RO, ENG-PV, ENG-% or ENG-mA
  7. Push (Span) to save changes and EXIT programming mode.
- DECIMAL PLACE
  1. Access the menu by pressing the Zero+Span buttons.
  2. Move to the next menu by pressing the Zero button until the 1 TRIM message appears.
  3. Press the Span button until the 2 SETUP message appears.
  4. Press the Span button until the 3 LCD message appears.
  5. Press the Span button until the 31 DEC-PL message appears.
  6. Press the Span button until the Decimal Place message appears, the decimal place will appear on the second line of the LCD as follows.

Display	Explanation	Max. Value
AUTO	Target value will be displayed automatically	99999
5-0	No decimal place	99999
4-1	Display one decimal place	9999.9
3-2	Display two decimal places	999.99
2-3	Display three decimal places	99.999
1-4	Display four decimal places	9.9999

  7. The first line on the LCD will display 0.0.
  8. The Decimal Place can be changed by pressing the Zero button. Save the setting by pressing the Span button after the decimal place has been selected.
  9. The set value will display the PV value and Engineering value.
  10. The LCD will display LCD_OV and the saved Unit when the pressure is over or under a set value.

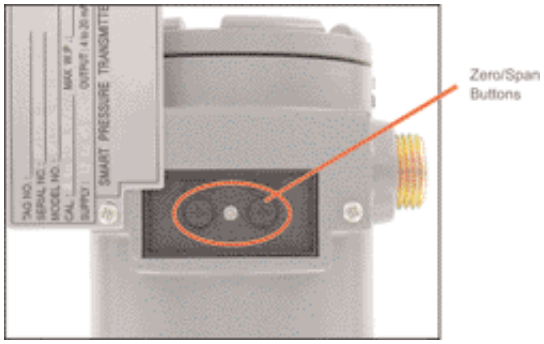
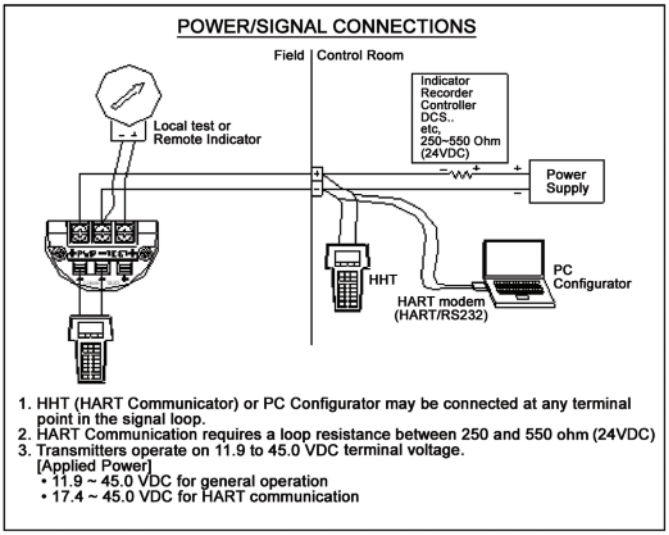


Figure 3-4 Transmitter Zero/Span Configuration Buttons

3.8 Commissioning on the Bench with HHT

The 3100 Pressure Transmitter can be commissioned using an HHT before or after installation.

▲ Connect an HHT (HART® HANDHELD Communicator) across the COMM pins for HART® communication. The TEST pin connections can be used for connecting a multimeter to measure the output current directly from the transmitter. Since the 3100 is a two wire loop powered transmitter, it requires an external loop power supply (11.9V to 45VDC) to enable HART® communication. Any HART® communication via HHT (or PC based configurator) requires a minimum 250 ~ 550 (max) ohm loop resistance.



[Figure 3-5 Connecting the Transmitter to HHT]

Chapter 4 Installation

4.1 Overview

The information in Chapter 4 explains installation.

4.2 Safety Messages

Procedures and instructions in this chapter may require special safety measures to ensure the safety of the personnel performing the operation. Potential installation safety issues are indicated by a safety alert symbol (▲). Refer to the following safety messages before installing the 3100 pressure transmitter.

4.3 Warning

DANGER Explosion can result in death or serious injury: Do not remove the transmitter covers in an explosion-proof environment when the circuit is powered. Both transmitter covers must be fully engaged to meet the explosion-proof requirements.

WARNING Electrical shock can result in serious injury: Only qualified personnel can wire the pressure transmitter.

WARNING Process leaks can cause death or serious injury: Install and tighten before applying pressure. If you don't, it can cause process leaks.

DANGER Electrical shock can result in death or serious injury: Avoid contact with the leads and terminals.

4.4 Commissioning on the Bench with Hand-Held Terminal

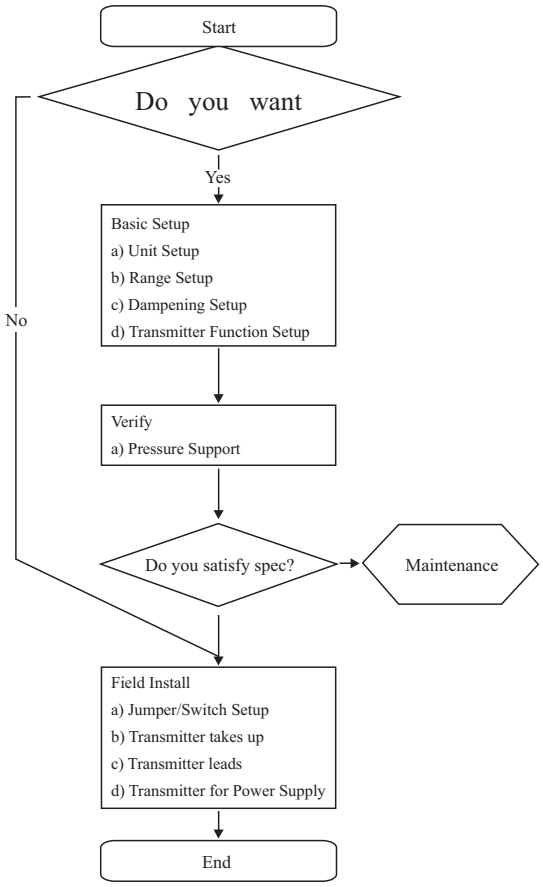
The 3100 Pressure Transmitter can be commissioned before and after installation. Commissioning is easier if the transmitter is configured on a bench with an HHT before installation.

4.5 General Considerations

The transmitter can be mounted near the process to minimize piping. Keep in mind that easy access is required for personnel, field calibration, and installation. Install the transmitter in an area with minimal vibration, shock, and temperature fluctuations.

4.6 Electrical Considerations (Power Supply)

The transmitter housing is composed of two parts. One side is electronics, and the other side is terminal block. The terminal block side is the transmitter's front side and is labeled "Field Terminal" on the housing. The terminal block can be accessed by removing the front cover. When wiring the power supply to the transmitter make sure the positive and negative wires are connected correctly.
A HHT configurator can be connected directly across the (COMM) pin terminal located just below the power supply (PWR) terminal block connections.



[Figure 4-1 Installation Flow Chart]

4.6.1 Power Supply

The 3100 Pressure Transmitter requires an 11.9 – 45 VDC power supply. A 250 ~ 550Ω (24 VDC) loop resistance is recommended for HART® communication. Loop resistance is the sum of the resistance in the loop.

Max. Loop Resistance [Ω] = (E-11.9) [vdc] / 0.022 [mA]

4.7 Wiring

4.7.1 Wiring Caution

1. Install the signal cables away from potential sources of electrical noise such as transformers, electrical motors, etc.
2. Before wiring, remove electrical conduit cap.
3. All screwed connections on the housing must be sealed with waterproof sealant. We recommend use of silicone based sealants to minimize post-hardening.
4. Avoid running DC signal and AC power cables in the same ducts/cable conduits to avoid signal noise issues.
5. All explosion-proof transmitters must meet the wiring & installation requirements specified within the applicable electrical codes.

4.7.2 Selecting the Wiring Materials

1. Use 600V shielded PVC wire or standard wire of the same class. (To ensure proper communication use 24 AWG or larger wire, and do not exceed 5000 feet)
2. Use shielded wire in areas with electrical noise.
3. In areas with high or low ambient temperatures, use wire or cable that is rated for the extreme temperatures.
4. If the wire or cable is going to be used in oil, solvent, toxic gas or liquid, make sure it is rated accordingly.
5. Process wire or cable must not be soldered to the terminal lug. Spade connectors are recommended to connect the process wires to the transmitter.

4.7.3 Connecting External Wires to Transmitter Terminal Box

1. Open the cover indicated "FIELD TERMINAL". Do not open the cover if the transmitter is located in an explosion-proof area and powered. Connect the power supply to the terminal indicated "+PWR"(left terminal) and "-" in the central terminal. Do not connect "+" power supply to "+" terminal "TEST". It will damage the test diode.
2. Seal and close the conduit connection to prevent humidity and explosion-proof atmosphere from entering the housing.
3. Transmitter power is supplied by signal wire. Do not install near high voltage wires or high voltage equipment.
4. Close the transmitter cover. To meet the explosion-proof ratings make sure the covers are fully engaged.
   NOTE: Do not power the transmitter with high voltage (AC). It can damage the transmitter.
5. You must connect a 250~550 Ohm Resistor in Current Loop (between Power Supply and Transmitter) for HART® Communication. See Figure 4-2.

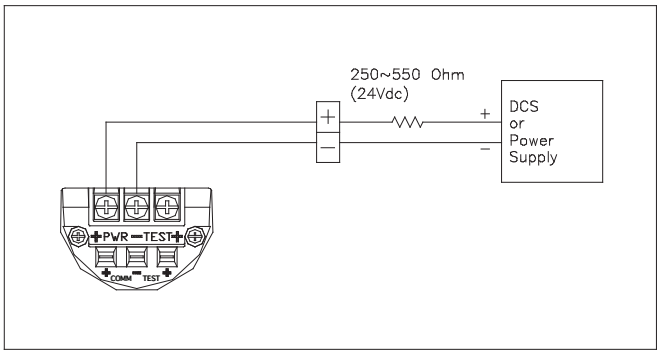


Figure 4-2 Wiring the 3100 Pressure Transmitter

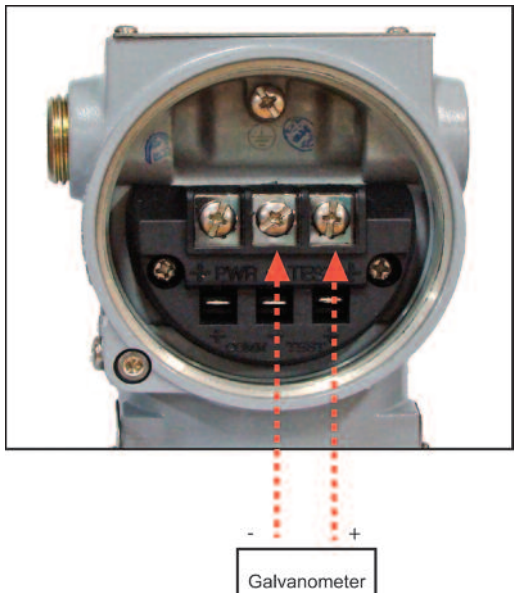


Figure 4-3 Picture of Transmitter Wiring Terminal

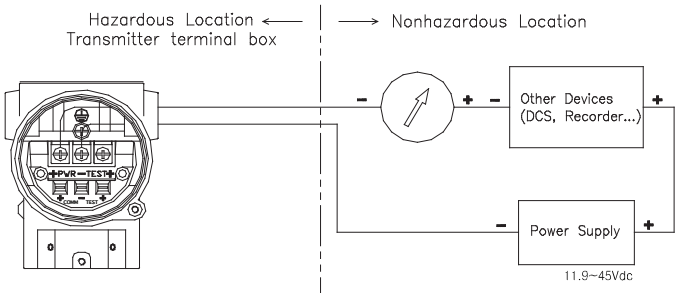
4.7.4 Wiring (Loop Configuration)

DANGER Explosion can result in death or serious injury: Do not remove the transmitter covers in an explosion-proof environment when the circuit is powered. Both transmitter covers must be fully engaged to meet explosion-proof requirements.

A. Loop Configuration

Mercoid® 3100 Pressure Transmitters use a two-wire system for power, 4~20mA analog signal transmission and HART® digital transmission.

A DC Power Supply is required for the transmitter loop. The transmitter and power supply should be connected as shown below.



B. Wiring Installation

General-use (Figure 4-4a)

1. Use metallic conduit or waterproof cable glands for wiring.
   a. Apply non-hardening sealant to the terminal box and the threads on the flexible metal conduit for waterproofing.

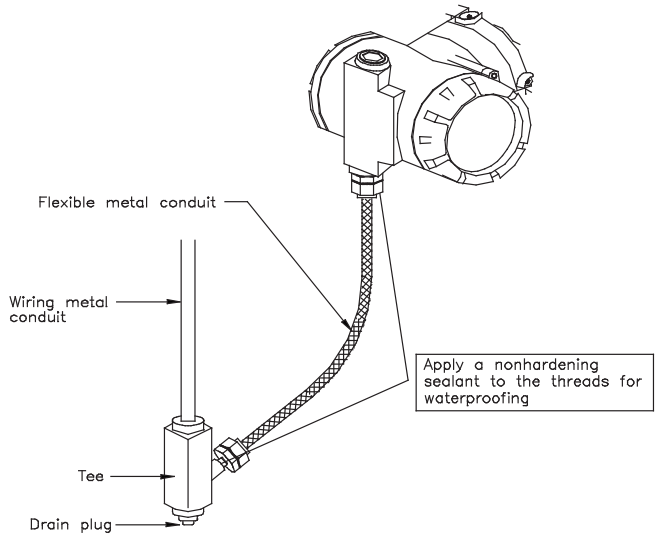


Figure 4-4a Typical Mounting using Flexible Metal Conduit

Explosion-proof

1. Explosion-proof metal conduit wiring (Figure 4-4b)
   a. A seal fitting must be installed near the terminal box port.
   b. Apply a non-hardening sealant to the threads of the terminal connection box.

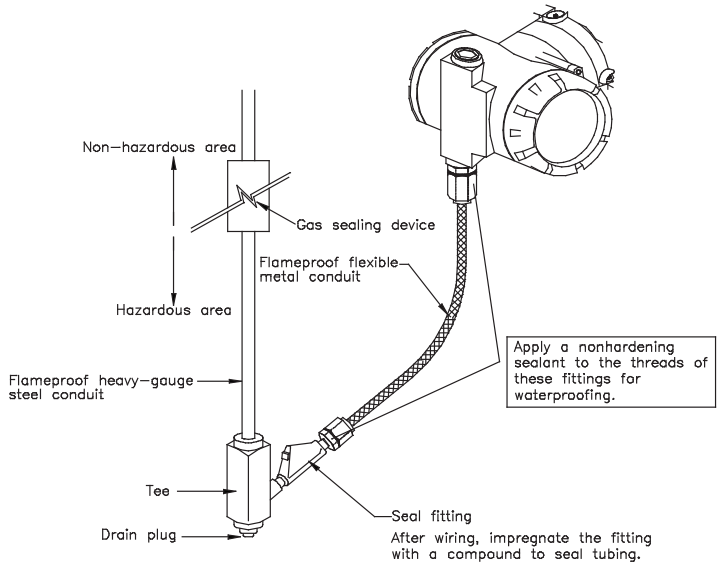
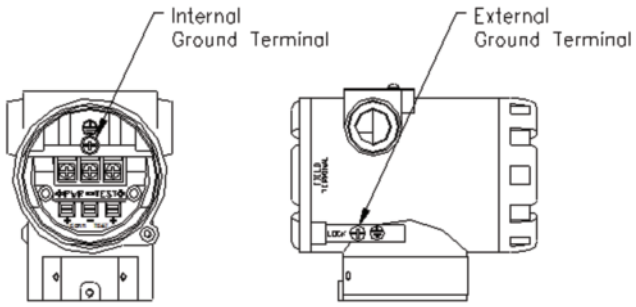


Figure 4-4b Typical Wiring using Explosion-Proof Conduit

4.7.5 Grounding

a. Grounding should satisfy KS requirements (grounding resistance should be 10 ohm or less). Grounding is required for explosion-proof applications and the ground resistance must be below 10 ohms.
   [Note] In case of Built-in Lightening Protector, Grounding should satisfy Special KS requirements (grounding resistance, 10 ohm or less).
b. There are ground terminals on the inside and outside of the transmitter. Either of these terminals may be used.
c. Use 600V insulated PVC wire for grounding.



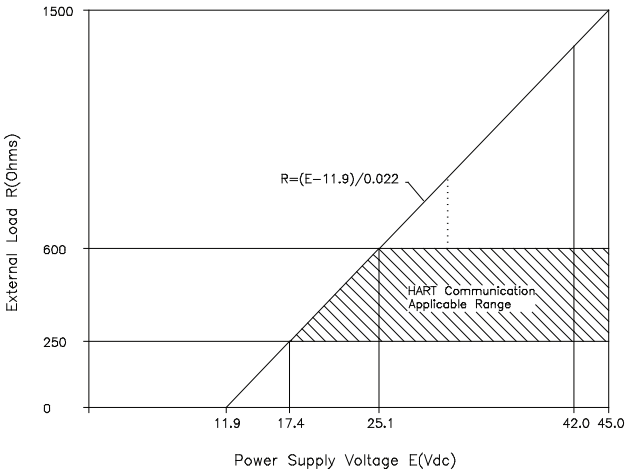
3100 Smart Pressure Transmitter
Internal and External Ground Terminal

4.7.6 Power Supply Voltage and Load Resistance

When configuring the loop, make sure that the external load resistance is within the range (see figure below). The transmitter supply voltage should be:

- Standard : 11.9 to 45 Vdc
- HART Communication : 17.4 to 45 Vdc

And maximum loop current is 24mA, Load resistance R:
R = (E-11.9) / 0.022 (E = Power Supply Voltage)



4.8 Mechanical Considerations

Figure 4-6 is a dimensional drawing for the 3100. Figure 4-7 shows how the A-630 angle bracket is mounted to a pipe.

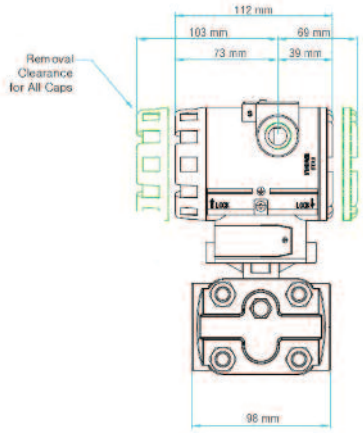


Figure 4-6. Model 3100 Outline Dimension Drawing

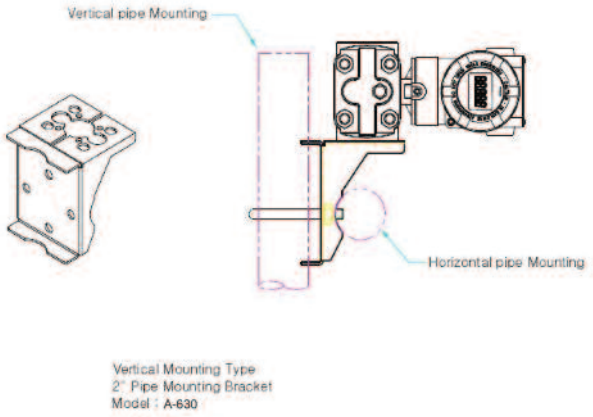


Figure 4-7. A-630 Mounting Bracket

4.8.1 Mounting

Avoid installing transmitters in environments with excessive vibration. If it cannot be avoided it is highly recommended to provide adequate support when mounting.

4.8.2 Transmitter Access

When selecting the installation location, accessibility must be taken into consideration.

- Housing rotation: The housing can be rotated 90°.
- Wiring terminals: The cover and wiring terminals are easily accessible.
- LCD/Circuits: Install the transmitter in a location where it can be seen. For transmitters without an LCD, the cover and jumpers are easily accessible.

4.9 Environmental Considerations

4.9.1 Ambient Temperature

The transmitter ambient temperature range is 4 to 180°F (-20 to 60°C). If the ambient temperature is going to exceed the temperature range, precautions must be taken to keep the temperature within the temperature limits.

4.9.2 Toxic and Moist Environments

The 3100 housing will protect the transmitter against moisture or toxic material. The electronic circuit is separated from the terminals. The housing covers have o-rings that seal the housing, but moisture can penetrate the housing thru the conduit. The transmitter should be mounted in a position to prevent moisture from entering the housing thru the conduit.

4.9.3 Installation in Hazardous Location

The transmitter is designed with an explosion-proof housing. Installation environment must not exceed the explosion-proof rating.

Chapter 5 On-Line Operation

5.1 Overview

This chapter describes how to configure the 3100 Smart Pressure Transmitter. The transmitter can be configured in On-Line or Off-Line mode. In On-Line Mode a compatible HHT or PC configuration device must be used.

5.2 Safety Messages

For added operator safety please pay specific attention to procedures outlined in this manual listed under the warning symbol (▲).

5.2.1 Warning

⚠ DANGER Explosion can result in death or serious injury: Do not remove the transmitter covers in explosion-proof environments when the circuit is powered. Both transmitter covers must be fully engaged to meet explosion-proof requirements.

⚠ DANGER Electrical shock can result in serious injury: When installing transmitters in close proximity of high voltage sources (near power lines) the transmitter leads can be subject to high voltages. Avoid contact with the leads and terminals.

5.2.2 Current to Passive Mode Configuration

For multi-drop mode the current output must be configured as passive mode. Please disregard any other messages shown on HHT.

5.3 Configuration Data Review

Before operating the transmitter make sure the configuration data on the nameplate matches the application.

5.4 Configuration Verification

Before the transmitter is ready for service, the configuration must be checked to confirm the settings are configured for the application.

5.4.1 Process Variable

There are two process variables in the 3100 Smart Pressure Transmitter. The primary variable and temperature compensated SV (Second Variable), the PV value outputs the 4~20mA analog value.

5.5 Basic Setup

The correlation variable must be configured before operating the transmitter.

5.5.1 Select Sensor Range

The pressure range must be selected when ordering the pressure transmitter.

5.5.2 Set Output Units

Select from the following engineering units:

Volumetric Flow Unit:

CubicFeet/min, Gallons/min, Liters/min, ImperialGallons/min, CubicMeter/hr, Ft/s, meters/s, Gallons/s, mGallons/day, Liters/s, mLiters/day, CubicFeet/s, CubicMeter/s, CubicMeter/day, ImperialGallons/hr, ImperialGallons/day, NormalCubicMeter/hr, NormalLiter/hr, StandardCubicFeet/min, CubicFeet/hr, CubicFeet/day, CubicMeters/min, Barrels/s, Barrels/min, Barrels/hr, Barrels/day, Gallons/hr, ImperialGallons/s, Liters/hr, Gallons/day

Mass Flow

Grams/s, Grams/min, Grams/hr, Kilograms/s, Kilograms/min, Kilograms/hr, Kilograms/day, MetricTons/min, MetricTons/hr, MetricTons/day, Pounds/s, Pounds/min, Pounds/hr, Pounds/day, ShortTons/min, ShortTons/hr, ShortTons/day, LongTons/hr, LongTons/day

Pressure

kPa, mmH2O, InH2O, InHg, FtH2O, mmHg, psi, bar, mbar, g/cm^2, Kg/cm^2, Pascals, MPa, torr, ATM

Miscellaneous

%

Time

Min, sec, hr, days

Mass

Grams, kilograms, metric tons, pounds, short tons, long tons, ounce

Volume

Gallons, liters, imperial gallons, cubic meters, barrels, bushels, cubic yards, cubic feet, cubic inches, bbl liq, normal cubic meter, normal liter, standard cubic feet, hectoliters

5.5.3 4-20mA Configuration

Set the Zero and Span for the 4~20mA analog output.

5.6 Detailed Setup

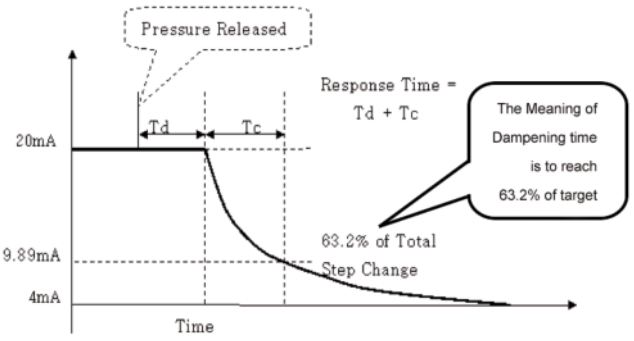
5.6.1 Set Fail Mode

When the sensor or microprocessor is not operating properly, the transmitter will output 3.75mA or 21.75mA based on the Fail Mode setting.

5.6.2 Set Dampening Time

The Dampening Seconds value changes the response time of the transmitter to smooth out variations caused by rapid process changes. Determine the appropriate dampening setting based on the required response time, signal stability, and other requirements of your system.

The Dampening Seconds can be set from 0-60 seconds; the default dampening value is 1.0 second.



5.7 Configuration of Information Variable

5.7.1 Set Tag

Tags are an easy way to classify transmitters in multi transmitter application. Tags can use 8 words/numbers.

5.7.2 Set Messages

When using several transmitters, the user can define each transmitter by using 32 words/numbers. This message is saved in EEPROM.

5.8 Diagnostics and Service

5.8.1 Loop Test

The Loop Test verifies the output of the transmitter, the integrity of the loop, and the operations of any recorders or similar devices installed in the loop. The following procedures are required for a loop test.

- Connect a reference meter to the transmitter.
- Select the Loop Test on the HHT and operate the Loop Test.
- Select current output (4mA/20mA/etc.)
- If the readings match, then the transmitter and the loop are configured and functioning properly. If the readings do not match, then you may have the current meter attached to the wrong loop, there may be a fault in the wiring, the transmitter may require an output trim, or the current meter may be malfunctioning.

5.9 Calibration

The scale is implemented by calibrating the transmitter. Trim function has several calibration functions. Smart transmitters operate differently than analog transmitter. A smart transmitter uses a microprocessor that contains information about the sensor's specific characteristics in response to pressure and temperature for calculating the process variable. 4-20mA configuration sets the transmitter's analog output to a selected upper and lower range and can be done with or without an applied pressure. 4-20mA configuration does not change the factory characterization curve stored in the microprocessor. Sensor trimming requires an accurate pressure input and adds additional compensation that adjusts the factory characterization curve to optimize transmitter performance over a specific pressure range. 4-20mA configuration provides the ability to readjust the 4~20mA sensor inputs without an applied pressure. Reranging does not change the factory or characterization curve stored in the microprocessor. Sensor trimming requires an accurate pressure input and adds additional compensation to the factory characterization curve to optimize transmitter performance over a specific pressure range. Rerange provides ability to readjust the 4~20 mA points sensor inputs.

5.9.1 Sensor Trim

The Sensor trim function adjusts the A/D signal conversion within the transmitter sensor electronics and determines how it digitally interprets any pressure changes applied to the sensor inputs. It is highly recommended to perform a sensor trim when first commissioning the transmitter on site. There are three ways to trim the sensor: Sensor zero trim, full trim and zero adjustment. Sensor zero trim is a one-point adjustment typically used to compensate for the mounting position. Two point trim is a full sensor trim, in which two accurate pressures are applied (equal to or greater than the range values), and the output is linear. You should always adjust the low trim value first to establish the correct offset.

5.9.2 D/A (Digital to Analog) Trim

The D/A trim function makes minor adjustments to the analog (4-20mA) output scaling from the transmitter. It is recommended to do a D/A trim on both hi (20mA) & low (4mA) values for best results. This function corrects any minuscule offsets within the D/A conversion of the transmitter

Chapter 6 Maintenance

6.1 Overview

This chapter describes diagnostic and maintenance.

6.2 Safety Messages

When the transmitter is in operation, operators should follow all safety messages. Potential safety issues are indicated by a safety alert symbol (▲). Refer to the following safety messages before performing any operation proceeded by a (▲) symbol.

6.2.1 Warning

DANGER Explosion can result in death or serious injury: Do not remove the transmitter covers in explosion-proof environments when the circuit is powered. Both transmitter covers must be fully engaged to meet explosion-proof requirements.

DANGER Electrical shock can result in serious injury: When installing transmitters in close proximity of high voltage sources (near power lines) the transmitter leads can be subject to high voltages. Avoid contact with the leads and terminals.

WARNING Electrical shock can result in death or serious injury:
Only qualified personnel can configure and wire the 3100 Smart Pressure Transmitter.

6.3 Hardware Diagnostics

If there is a failure despite a diagnostic message on the HHT, Table 6.1 can help troubleshoot the problem.

Symptom	Potential Source	Corrective Action
Transmitter does not Communicate with HART® Communicator	Loop Wiring	• Check for a 250-550 ohms resistance between the power supply and HHT. • Check for adequate voltage to the transmitter (the transmitter requires 11.9 ~ 45 Vdc). • Check for intermittent shorts, open circuits, and multiple grounds.
High Output	Sensor Input Failure	• Connect HHT and enter the transmitter test mode to isolate a sensor failure.
	Loop Wiring	• Check for dirty or defective terminals, interconnecting pins, or receptacles.
	Power Supply	• Check the output voltage of the power supply at the transmitter terminals. It should be 11.9 to 45 Vdc.
	Electronics Module	• Connect HHT and enter the transmitter test mode to isolate module failure. Check the sensor limits to ensure the calibration adjustments are within the sensor range.
Erratic Output	Loop Wiring	• Check the output voltage of the power supply at the transmitter terminals. It should be 11.9 to 45 Vdc. • Check for intermittent shorts, open circuits, and multiple grounds. • Check for proper polarity at the signal terminals.
	Electronics Module	• Connect HHT and enter the transmitter test mode to isolate an electronics mode failure.
Low Output or No Output	Sensor Element	• Connect HHT and enter the transmitter test mode to isolate a sensor failure. • Is the PV out of range.
	Loop Wiring	• Check for adequate voltage to the transmitter (the transmitter requires 11.9 ~ 45 Vdc). • Check for intermittent shorts, open circuits, and multiple grounds. • Check polarity of signal terminal. • Check the loop impedance.
	Electronics Module	• Connect HHT and check the sensor limits to ensure calibration adjustments are within the sensor range.

Table 6.1 Troubleshooting

6.4 Hardware Maintenance

The Mercoid® 3100 Smart Transmitter has no moving parts and requires little maintenance. If a transmitter fails, it must be returned to Dwyer Instruments, Inc. for inspection, repair, or replacement.

6.4.1 Test Terminals

The test terminals are marked TEST on the terminal block. The test and negative terminals are connected to the power terminals; so long as the voltage across the receptacles are below the diode threshold voltage, no current will pass through the diode. To ensure that current isn't leaking through the diode, test the reading with an indicating meter. The test connection should not exceed 10 ohms. A resistance value of 30 ohms will cause an approximate 10 percent of reading error.

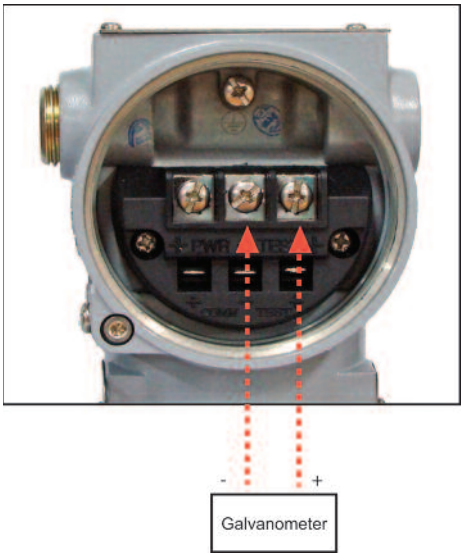


Figure 6-1 Test Terminals

6.4.2 Disassembling the Housing

The transmitter is designed with dual-compartment housing; one contains the electronics module, and the other contains all wiring terminals and communication terminal.



Figure 6-2 Structure of Housing

6.4.3 Fail Mode Jumper Switch and EEPROM-Write

Fail-mode jumper switch and EEPROM-Write is located behind the front cover.

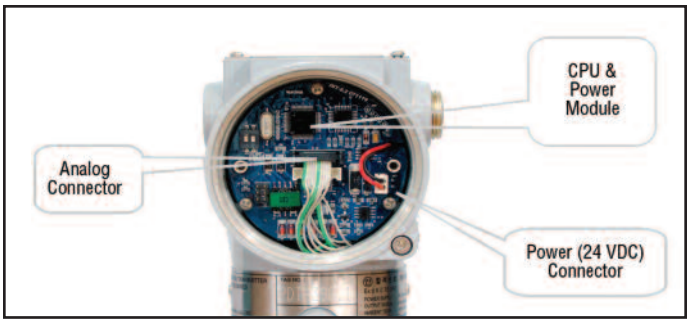


Figure 6-3 Structure of Electronics Module

Appendix I
3100 SMART PRESSURE TRANSMITTER - LCD DISPLAY CODE

Message	Description
ADJ-U	Zero adjustment value – used to configure transmitter when it is out of range (on higher side)
ADJ-L	Zero adjustment value – used to configure transmitter when it is out of range (on low side)
ZERO	Initial message when using Zero button
SPAN	Initial message when using Span button
BT-ERR	Button Sequence error
P-LOCK	Button input error - Protect Locked
ZT-ERR	Zero Trim value is over limit (10%)
-TR-	Zero Trim done
ZR-ERR	Setting Limit error when executing Zero button function
SP-ERR	Setting Limit error when executing Span button function
-ZR-	Zero button function done
-SP-	Span button function done
-ZA-	Zero Adjustment done
-DONE-	Configuration completed using buttons
RNGOVR	Limit error when executing other setting function
LCD_OV	Over Values for LCD
SCD-ER	Sensor Code Error
F-RST	Flash Setting Data Reset
F-LOCK	Flash Setting Data Reset, Protect Locked
F-FAIL	Flash Setting Data Reset Failure
-FR-	Flash Reset done
A-RST	Analog EEPROM Initializing Start
A-STOR	Analog EEPROM Stored
A-FAIL	Failure in writing configuration values on to the EEPROM of transmitter CPU
-AC-	Analog EEPROM Configuration done
S-FL	Sensor Fail
S-OP	Sensor Overpressure
AEP-RF	Check error with EEPROM on CPU board
TS-FL	Temperature Sensor Error
AEP-WF	Analog EEPROM write fail
EOSC	Crystal Element Defect Alarm
FAVE	Flash Access Violation

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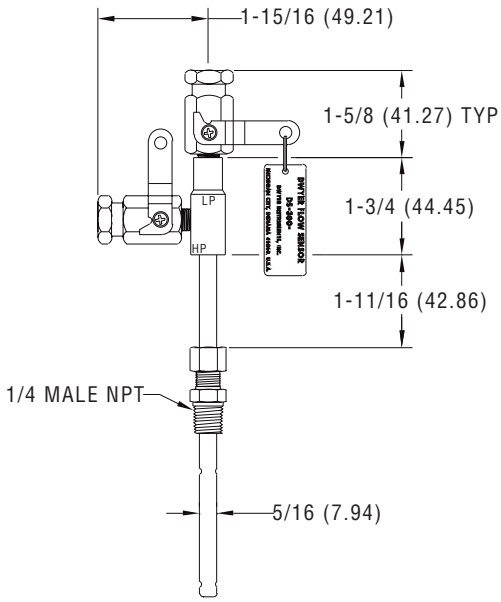
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e-mail: info@dwyermail.com

Series DS-300 Flow Sensors

Installation and Operating Instructions Flow Calculations





Series DS-300 Flow Sensors are averaging pitot tubes that provide accurate, convenient flow rate sensing. When purchased with a Dwyer Capsuhelic® for liquid flow or Magnehelic® for air flow, differential pressure gage of appropriate range, the result is a flow-indicating system delivered off the shelf at an economical price. Series DS-300 Flow Sensors are designed to be inserted in the pipeline through a compression fitting and are furnished with instrument shut-off valves on both pressure connections. Valves are fitted with 1/8″ female NPT connections. Accessories include adapters with 1/4″ SAE 45° flared ends compatible with hoses supplied with the Model A-471 Portable Capsuhelic® kit. Standard valves are rated at 200°F (93.3°C). Where valves are not required, they can be omitted at reduced cost. Series DS-300 Flow Sensors are available for pipe sizes from 1″ to 10″.

INSPECTION

Inspect sensor upon receipt of shipment to be certain it is as ordered and not damaged. If damaged, contact carrier.

INSTALLATION

General - The sensing ports of the flow sensor must be correctly positioned for measurement accuracy. The instrument connections on the sensor indicate correct positioning. The side connection is for total or high pressure and should be pointed upstream. The top connection is for static or low pressure.

Location - The sensor should be installed in the flowing line with as much straight run of pipe upstream as possible. A rule of thumb is to allow 10 - 15 pipe diameters upstream and 5 downstream. The table below lists recommended up and down piping.

PRESSURE AND TEMPERATURE

Maximum: 200 psig (13.78 bar) at 200°F (93.3°C).

Upstream and Downstream Dimensions in Terms of Internal Diameter of Pipe*

Upstream Condition	Minimum Diameter of Straight Pipe		
	Upstream		Downstream
	In-Plane	Out of Plane	
One Elbow or Tee	7	9	5
Two 90° Bends in Same Plane	8	12	5
Two 90° Bends in Different Plane	18	24	5
Reducers or Expanders	8	8	5
All Valves**	24	24	5

* Values shown are recommended spacing, in terms of internal diameter for normal industrial metering requirements. For laboratory or high accuracy work, add 25% to values.

** Includes gate, globe, plug and other throttling valves that are only partially opened. If valve is to be fully open, use values for pipe size change. **CONTROL VALVES SHOULD BE LOCATED AFTER THE FLOW SENSOR.**

DWYER INSTRUMENTS, INC.
P.O. BOX 373 • MICHIGAN CITY, INDIANA 46361, U.S.A.
Phone: 219/879-8000 **www.dwyer-inst.com**
Fax: 219/872-9057 **e-mail: info@dwyer-inst.com**

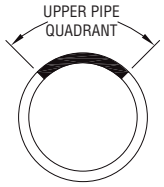
POSITION

Be certain there is sufficient clearance between the mounting position and other pipes, walls, structures, etc, so that the sensor can be inserted through the mounting unit once the mounting unit has been installed onto the pipe.

Flow sensors should be positioned to keep air out of the instrument connecting lines on liquid flows and condensate out of the lines on gas flows. The easiest way to assure this is to install the sensor into the pipe so that air will bleed into, or condensate will drain back to, the pipe.

For Air or Gas Flow

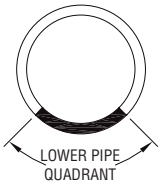
Install in upper quadrant of pipe



Condensate drains back to pipe

For Liquid or Steam Flow

Install in lower quadrant of pipe



Air bleeds back to pipe

INSTALLATION

1. When using an A-160 thred-o-let, weld it to the pipe wall. If replacing a DS-200 unit, an A-161 bushing (1/4˝ x 3/8˝) will be needed.

2. Drill through center of the thred-o-let into the pipe with a drill that is slightly larger than the flow sensor diameter.

3. Install the packing gland using proper pipe sealant. If the packing gland is disassembled, note that the tapered end of the ferrule goes into the fitting body.

4. Insert sensor until it bottoms against opposite wall of the pipe, then withdraw 1/16˝ to allow for thermal expansion.

5. Tighten packing gland nut finger tight. Then tighten nut with a wrench an additional 1-1/4 turns. Be sure to hold the sensor body with a second wrench to prevent the sensor from turning.

INSTRUMENT CONNECTION

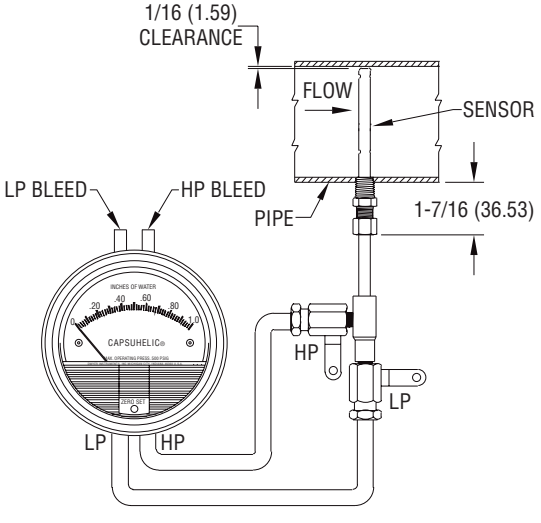
Connect the slide pressure tap to the high pressure port of the Magnehelic® (air only) or Capsuhelic® gage or transmitting instrument and the top connection to the low pressure port.

See the connection schematics below.

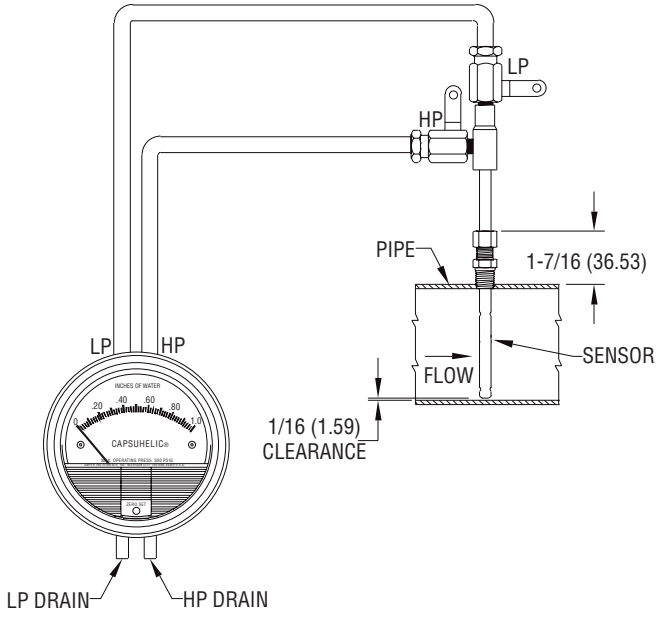
Bleed air from instrument piping on liquid flows. Drain any condensate from the instrument piping on air and gas flows.

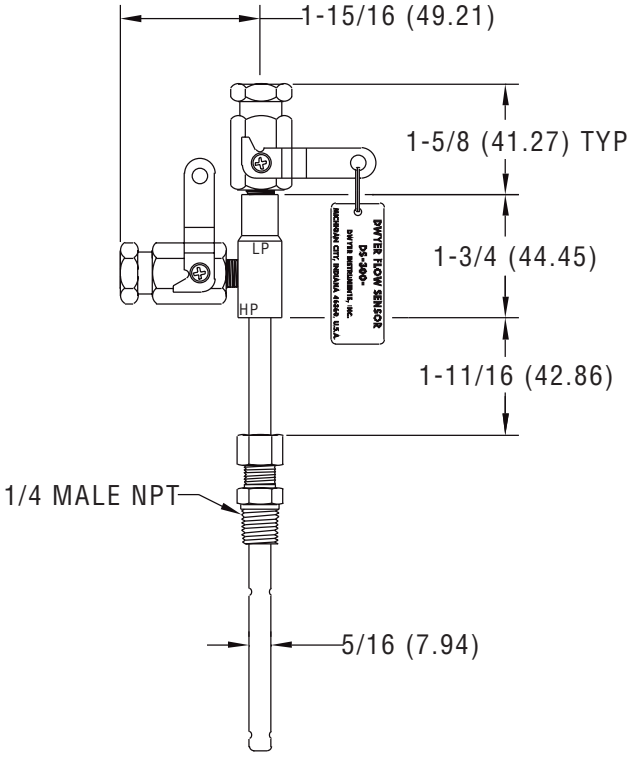
Open valves to instrument to place flow meter into service. For permanent installations, a 3-valve manifold is recommended to allow the gage to be zero checked without interrupting the flow. The Dwyer A-471 Portable Test Kit includes such a device.

Water Flow



Air or Gas Flow





Flow Calculations and Charts

The following information contains tables and equations for determining the differential pressure developed by the DS-300 Flow Sensor for various flow rates of water, steam, air or other gases in different pipe sizes.

This information can be used to prepare conversion charts to translate the differential pressure readings being sensed into the equivalent flow rate. When direct readout of flow is required, use this information to calculate the full flow differential pressure in order to specify the exact range of Dwyer Magnehelic® or Capsuhelic® gage required. Special ranges and calculations are available for these gages at minimal extra cost. See bulletins A-30 and F-41 for additional information on Magnehelic® and Capsuhelic® gages and DS-300 flow sensors.

For additional useful information on making flow calculations, the following service is recommended: Crane Valve Co. Technical Paper No. 410 “Flow of Fluids Through Valves, Fittings and Pipe.” It is available from Crane Valve Company, www.cranevalve.com.

Using the appropriate differential pressure equation from Page 4 of this bulletin,calculate the differential pressure generated by the sensor under normal operating conditions of the system. Check the chart below to determine if this value is within the recommended operating range for the sensor. Note that the data in this chart is limited to standard conditions of air at 60°F (15.6°C) and 14.7 psia static line pressure or water at 70°F (21.1°C). To determine recommended operating ranges of other gases, liquids an/or operating conditions, consult factory.

Note: the column on the right side of the chart which defines velocity ranges to avoid. Continuous operation within these ranges can result in damage to the flow sensor caused by excess vibration.

Pipe Size (Schedule 40)	Flow Coefficient “K”	Operating Ranges Air @ 60°F & 14.7 psia (D/P in. W.C.)	Operating Ranges Water @ 70°F (D/P in. W.C.)	Velocity Ranges Not Recommended (Feet per Second)
1	0.52	1.10 to 186	4.00 to 675	146 to 220
1-1/4	0.58	1.15 to 157	4.18 to 568	113 to 170
1-1/2	0.58	0.38 to 115	1.36 to 417	96 to 144
2	0.64	0.75 to 75	2.72 to 271	71 to 108
2-1/2	0.62	1.72 to 53	6.22 to 193	56 to 85
3	0.67	0.39 to 35	1.43 to 127	42 to 64
4	0.67	0.28 to 34	1.02 to 123	28 to 43
6	0.71	0.64 to 11	2.31 to 40	15 to 23
8	0.67	0.10 to 10	0.37 to 37	9.5 to 15
10	0.70	0.17 to 22	0.60 to 79	6.4 to 10

FLOW EQUATIONS

1. Any Liquid

$$Q\ (GPM) = 5.668 \times K \times D^2 \times \sqrt{\Delta P / S_f}$$

2. Steam or Any Gas

$$Q\ (lb/Hr) = 359.1 \times K \times D^2 \times \sqrt{p \times \Delta P}$$

3. Any Gas

$$Q\ (SCFM) = 128.8 \times K \times D^2 \times \sqrt{\frac{P \times \Delta P}{(T + 460) \times S_s}}$$

DIFFERENTIAL PRESSURE EQUATIONS

1. Any Liquid

$$\Delta P\ (in.\ WC) = \frac{Q^2 \times S_f}{K^2 \times D^4 \times 32.14}$$

2. Steam or Any Gas

$$\Delta P\ (in.\ WC) = \frac{Q^2}{K^2 \times D^4 \times p \times 128{,}900}$$

3. Any Gas

$$\Delta P\ (in.\ WC) = \frac{Q^2 \times S_s \times (T + 460)}{K^2 \times D^4 \times P \times 16{,}590}$$

Technical Notations

The following notations apply:

ΔP = Differential pressure expressed in inches of water column
Q = Flow expressed in GPM, SCFM, or PPH as shown in equation
K = Flow coefficient— See values tabulated on Pg. 3.
D = Inside diameter of line size expressed in inches.

For square or rectangular ducts, use: $D = \sqrt{\frac{4 \times \text{Height} \times \text{Width}}{\pi}}$

P = Static Line pressure (psia)
T = Temperature in degrees Fahrenheit (plus 460 = °Rankine)
p = Density of medium in pounds per square foot
S_f = Sp Gr at flowing conditions
S_s = Sp Gr at 60°F (15.6°C)

SCFM TO ACFM EQUATION

$$SCFM = ACFM \times \left(\frac{14.7 + PSIG}{14.7}\right) \left(\frac{520^*}{460 + °F}\right)$$

$$ACFM = SCFM \times \left(\frac{14.7}{14.7 + PSIG}\right) \left(\frac{460 + °F}{520}\right)$$

$$\text{POUNDS PER CUBIC FOOT STD.} = \text{POUNDS PER CUBIC FOOT ACT.} \times \left(\frac{14.7}{14.7 + PSIG}\right) \left(\frac{460 + °F}{520^*}\right)$$

$$\text{POUNDS PER CUBIC FOOT ACT.} = \text{POUNDS PER CUBIC FOOT STD.} \times \left(\frac{14.7 + PSIG}{14.7}\right) \left(\frac{520^*}{460 + °F}\right)$$

1 Cubic foot of air = 0.076 pounds per cubic foot at 60° F (15.6°C) and 14.7 psia.
* (520°= 460 + 60°) Std. Temp. Rankine

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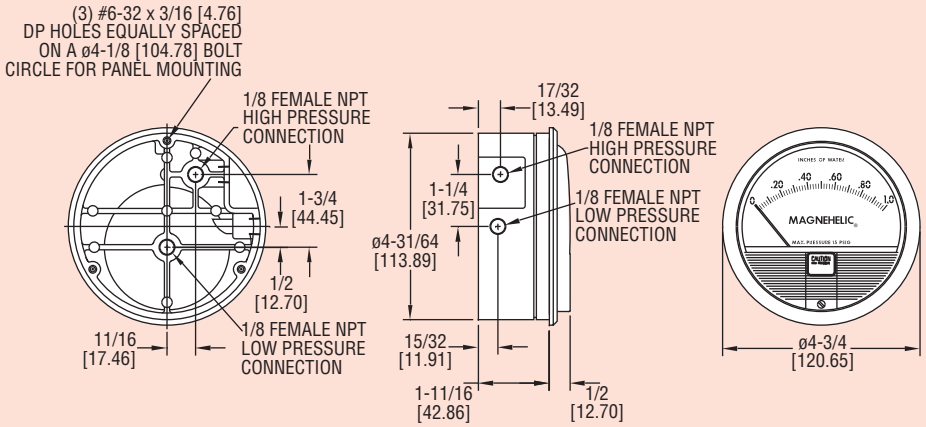
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Series 2000

Magnehelic® Differential Pressure Gages

Indicate Positive, Negative or Differential, Accurate within 2%





Dimensions, Standard Series 2000 Magnehelic® Pressure Gages. (Slightly different on medium and high pressure models)

Select the Dwyer® Magnehelic® gage for high accuracy – guaranteed within 2% of full scale – and for the wide choice of 81 models available to suit your needs precisely. Using Dwyer's simple, frictionless Magnehelic® gage movement, it quickly indicates low air or non-corrosive gas pressures – either positive, negative (vacuum) or differential. The design resists shock, vibration and over-pressures. No manometer fluid to evaporate, freeze or cause toxic or leveling problems. It's inexpensive, too.
The Magnehelic® gage is the industry standard to measure fan and blower pressures, filter resistance, air velocity, furnace draft, pressure drop across orifice plates, liquid levels with bubbler systems and pressures in fluid amplifier or fluidic systems. It also checks gas-air ratio controls and automatic valves, and monitors blood and respiratory pressures in medical care equipment.

Note: May be used with Hydrogen. When ordering a Buna-N diaphragm pressures must be less than 35 psi.

Mounting

A single case size is used for most models of Magnehelic® gages. They can be flush or surface mounted with standard hardware supplied. With the optional **A-610** Pipe Mounting Kit they may be conveniently installed on horizontal or vertical 1-1/4″ - 2″ pipe. Although calibrated for vertical position, many ranges above 1″ may be used at any angle by simply re-zeroing. However, for maximum accuracy, they must be calibrated in the same position in which they are used. These characteristics make Magnehelic® gages ideal for both stationary and portable applications. A 4-9/16″ hole is required for flush panel mounting. Complete mounting and connection fittings plus instructions are furnished with each instrument.



Flush...Surface... or Pipe Mounted



Vent Valves

In applications where pressure is continuous and the Magnehelic® gage is connected by metal or plastic tubing which cannot be easily removed, we suggest using Dwyer A-310A vent valves to connect gage. Pressure can then be removed to check or re-zero the gage.



High and Medium Pressure Models

Installation is similar to standard gages except that a 4-13/16″ hole is needed for flush mounting. The medium pressure construction is rated for internal pressures up to 35 psig and the high pressure up to 80 psig. Available for all models. Because of larger case, the medium pressure and high pressure models will not fit in a portable case size. Installation of the A-321 safety relief valve on standard Magnehelic® gages often provides adequate protection against infrequent overpressure.

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. Exterior finish is coated gray to withstand 168 hour salt spray corrosion test.
Accuracy: ±2% of full scale (±3% on - 0, -100 Pa, -125 Pa, 10MM and ±4% on - 00, -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.
Temperature Limits: 20 to 140°F.* (-6.67 to 60°C).
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).
Standard Accessories: Two 1/8″ NPT plugs for duplicate pressure taps, two 1/8″ pipe thread to rubber tubing adapter and three flush mounting adapters with screws. (Mounting and snap ring retainer substituted for 3 adapters in MP & HP gage accessories.)

*Low temperature models available as special option.
†For applications with high cycle rate within gage total pressure rating, next higher rating is recommended. See Medium and High pressure options at lower left.

OPTIONS AND ACCESSORIES



Transparent Overlays
Furnished in red and green to highlight and emphasize critical pressures.

Adjustable Signal Flag
Integral with plastic gage cover. Available for most models except those with medium or high pressure construction. Can be ordered with gage or separate.



LED Setpoint Indicator
Bright red LED on right of scale shows when setpoint is reached. Field adjustable from gage face, unit operates on 12-24 VDC. Requires MP or HP style cover and bezel.



A-432 Portable Kit
Combine carrying case with any Magnehelic® gage of standard range, except high pressure connection. Includes 9 ft (2.7 m) of 3/16″ I.D. rubber tubing, standhang bracket and terminal tube with holder.



A-605 Air Filter Gage Accessory Kit
Adapts any standard Magnehelic® gage for use as an air filter gage. Includes aluminum surface mounting bracket with screws, two 5 ft (1.5 m) lengths of 1/4″ aluminum tubing two static pressure tips and two molded plastic vent valves, integral compression fittings on both tips and valves.

Quality design and construction features

Bezel provides flange for flush mounting in panel.

Clear plastic face is highly resistant to breakage. Provides undistorted viewing of pointer and scale.

Precision litho-printed scale is accurate and easy to read.

Red tipped pointer of heat treated aluminum tubing is easy to see. It is rigidly mounted on the helix shaft.

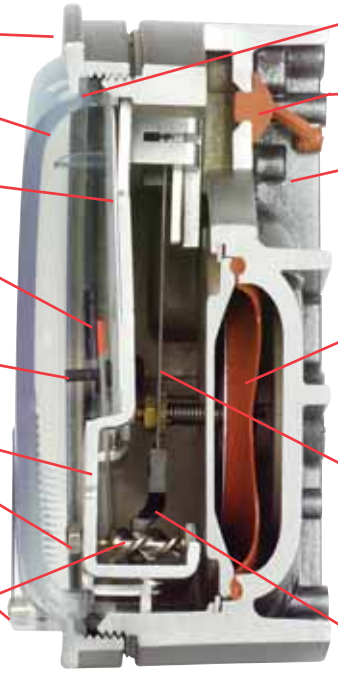
Pointer stops of molded rubber prevent pointer over-travel without damage.

"Wishbone" assembly provides mounting for helix, helix bearings and pointer shaft.

Jeweled bearings are shock-resistant mounted; provide virtually friction-free motion for helix. Motion damped with high viscosity silicone fluid.

Zero adjustment screw is conveniently located in the plastic cover, and is accessible without removing cover. O-ring seal provides pressure tightness.

Helix is precision made from an alloy of high magnetic permeability. Mounted in jeweled bearings, it turns freely, following the magnetic field to move the pointer across the scale.



O-ring seal for cover assures pressure integrity of case.

Blowout plug of silicone rubber protects against overpressure on 15 psig rated models. Opens at approximately 25 psig.

Die cast aluminum case is precision made and iridite-dipped to withstand 168 hour salt spray corrosion test. Exterior finished in baked dark gray hammerloid. One case size is used for all standard pressure options, and for both surface and flush mounting.

Silicone rubber diaphragm with integrally molded O-ring is supported by front and rear plates. It is locked and sealed in position with a sealing plate and retaining ring. Diaphragm motion is restricted to prevent damage due to overpressures.

Calibrated range spring is flat spring steel. Small amplitude of motion assures consistency and long life. It reacts to pressure on diaphragm. Live length adjustable for calibration.

Samarium Cobalt magnet mounted at one end of range spring rotates helix without mechanical linkages.

Series 2000 Magnehelic® Gage — Models and Ranges
Page V shows examples of special models built for OEM customers. For special scales furnished in ounces per square inch, inches of mercury, metric units, square root scales for volumetric flow, etc., contact the factory.

Model	Range Inches of Water
2000-00N†••	.05-0-.2
2000-00†••	0-.25
2000-0†•	0-.50
2001	0-1.0
2002	0-2.0
2003	0-3.0
2004	0-4.0
2005	0-5.0
2006	0-6.0
2008	0-8.0
2010	0-10
2012	0-12
2015	0-15
2020	0-20
2025	0-25
2030	0-30
2040	0-40
2050	0-50
2060	0-60
2080	0-80
2100	0-100
2120	0-120
2150	0-150
2160	0-160
2180	0-180
2250	0-250
Zero Center Ranges	
2300-00†••	0.125-0-0.125
2300-0†•	.25-0-.25
2301	.5-0-.5
2302	1-0-1
2304	2-0-2
2310	5-0-5
2320	10-0-10
2330	15-0-15

Model	Range PSI
2201	0-1
2202	0-2
2203	0-3
2204	0-4
2205	0-5
2210*	0-10
2215*	0-15
2220*	0-20
2230**	0-30

Model	Range, CM of Water
2000-15CM	0-15
2000-20CM	0-20
2000-25CM	0-25
2000-50CM	0-50
2000-80CM	0-80
2000-100CM	0-100
2000-150CM	0-150
2000-200CM	0-200
2000-250CM	0-250
2000-300CM	0-300
Zero Center Ranges	
2300-4CM	2-0-2
2300-10CM	5-0-5
2300-30CM	15-0-15

†These ranges calibrated for vertical scale position.
• Accuracy +/-3%
• • Accuracy +/-4%
*MP option standard
**HP option standard

Model	Range MM of Water
2000-6MM†••	0-6
2000-10MM†•	0-10
2000-15MM	0-15
2000-25MM	0-25
2000-30MM	0-30
2000-50MM	0-50
2000-80MM	0-80
2000-100MM	0-100
2000-125MM	0-125
2000-150MM	0-150
2000-200MM	0-200
2000-250MM	0-250
2000-300MM	0-300
Zero Center Ranges	
2300-6MM†••	3-0-3
2300-10MM†•	5-0-5
2300-20MM†•	10-0-10

Model	Range, Pa
2000-60NPA†••	10-0-50
2000-60PA†••	0-60
2000-100PA†•	0-100
2000-125PA†•	0-125
2000-250PA	0-250
2000-300PA	0-300
2000-500PA	0-500
2000-750PA	0-750
2000-1000PA	0-100 x 10
Zero Center Ranges	
Model	Range, Pa
2300-60PA†••	30-0-30
2300-100PA†•	50-0-50
2300-120PA	60-0-60
2300-200PA	100-0-100
2300-250PA	125-0-125
2300-300PA	150-0-150
2300-500PA	250-0-250
2300-1000PA	500-0-500

Model	Range, kPa
2000-0.5KPA	0-0.5
2000-1KPA	0-1
2000-1.5KPA	0-1.5
2000-2KPA	0-2
2000-2.5KPA	0-2.5
2000-3KPA	0-3
2000-4KPA	0-4
2000-5KPA	0-5
2000-8KPA	0-8
2000-10KPA	0-10
2000-15KPA	0-15
2000-20KPA	0-20
2000-25KPA	0-25
2000-30KPA	0-30
Zero Center Ranges	
2300-1KPA	.5-0-.5
2300-2KPA	1-0-1
2300-2.5KPA	1.25-0-1.25
2300-3KPA	1.5-0-1.5

Dual Scale Air Velocity Units
For use with pitot tube

Model	Range in W.C./ Velocity F.P.M.
2000-00AV†••	0-.25/300-2000
2000-0AV†•	0-.50/500-2800
2001AV	0-1.0/500-4000
2002AV	0-2.0/1000-5600
2005AV	0-5.0/2000-8800
2010AV	0-10/2000-12500

Dual Scale English/Metric Models

Model	Range, In. W.C.	Range, Pa or kPa
2000-OOD†••	0-.25	0-62 Pa
2000-OD†•	0-0.5	0-125 Pa
2001D	0-1.0	0-250 Pa
2002D	0-2.0	0-500 Pa
2003D	0-3.0	0-750 Pa
2004D	0-4.0	0-1.0 kPa
2005D	0-5.0	0-1.25 kPa
2006D	0-6.0	0-1.5 kPa
2008D	0-8.0	0-2.0 kPa
2010D	0-10	0-2.5 kPa
2015D	0-15	0-3.7 kPa
2020D	0-20	0-5 kPa
2025D	0-25	0-6.2 kPa
2050D	0-50	0-12.4 kPa
2060D	0-60	0-15 kPa

ACCESSORIES
A-299, Surface Mounting Bracket
A-300, Flat Flush Mounting Bracket
A-310A, 3-Way Vent Valve
A-321, Safety Relief Valve
A-432, Portable Kit
A-448, 3-piece magnet kit for mounting Magnehelic® gage directly to magnetic surface
A-605, Air Filter Kit
A-610, Pipe Mount Kit

OPTIONS — To order, add suffix: I.E. 2001-ASF
ASF, Adjustable Signal Flag
HP, High Pressure Option
LT, Low Temperatures to -20°F
MP, Med. Pressure Option
SP, Setpoint Indicator
Scale Overlays, Red, Green, Mirrored or Combination, Specify Locations



Ventilation Test Instruments



Model 9545

VelociCalc® Air Velocity Meters

Models 9535, 9535-A, 9545 and 9545-A

The Models 9535 and 9545 air velocity meters are like having multiple meters—for the price of just one. These meters simultaneously measure and data log several ventilation parameters using a single probe with multiple sensors. Both models measure velocity, temperature and calculate flow. The Model 9545 also measures relative humidity, and calculates dew point, and wet bulb temperature. Models 9535 and 9545 have telescopic straight probes; Models 9535-A and 9545-A have telescopic articulated probes.

Features and Benefits

- Simple to operate
- Accurate air velocity measurement
- Simultaneously measure temperature and velocity
- Displays up to three measurements simultaneously
- Measures humidity (Model 9545 and 9545-A)
- Calculates volumetric flow and actual/standard velocity
- Data log 12,700+ samples and 100 test IDs
- LogDat2™ downloading software included
- Articulated probe versions available (9535-A and 9545-A)

Applications

- HVAC system performance
- Commissioning
- Plant maintenance
- Critical environment certification
- Duct traverses

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Specifications

VelociCalc Models 9535 and 9545

Velocity

Range 0 to 6,000 ft/min (0 to 30 m/s)
Accuracy[1&2] ±3% of reading or ±3 ft/min (±0.015 m/s), whichever is greater
Resolution 1 ft/min (0.01 m/s)

Duct Size

Dimensions 1 to 250 inches in increments of 0.1 in. (1 to 635 cm in increments of 0.1 cm)

Volumetric Flow Rate

Range Actual range is a function of velocity and duct size

Temperature

Range (9535 and 9535-A)
0 to 200 °F (-18 to 93°C)
Range (9545 and 9545-A)
14 to 140°F (-10 to 60°C)
Accuracy[3] ±0.5°F (±0.3°C)
Resolution 0.1°F (0.1°C)

Relative Humidity (9545 only)

Range 0 to 95% RH
Accuracy[4] ±3% RH
Range 0.1% RH

Instrument Temperature Range

Operating (Electronics)
40 to 113°F (5 to 45°C)
Model 9535 Operating (Probe)
0 to 200°F (-18 to 93°C)
Model 9545 Operating (Probe)
14 to 140°F (-10 to 60°C)
Storage -4 to 140°F (-20 to 60°C)

Data Storage Capabilities

Range 12,700+ samples and 100 test IDs

Logging Interval

1 second to 1 hour

Time Constant

User selectable

External Meter Dimensions

3.3 in. x 7.0 in. x 1.8 in. (8.4 cm x 17.8 cm x 4.4 cm)

Meter Weight with Batteries

0.6 lbs. (0.27 kg)

Meter Probe Dimensions

Probe Length 40 in. (101.6 cm)
Probe Diameter of Tip
0.28 in. (7.0 mm)
Probe Diameter of Base
0.51 in. (13.0 mm)

Articulating Probe Dimensions

Articulating Section Length
7.8 in. (19.7 cm)
Diameter of Articulating Knuckle
0.38 in. (9.5 mm)

Power Requirements

Four AA-size batteries or AC adapter

	9535, 9535-A	9545, 9545-A
Velocity	●	●
Temperature	●	●
Flow	●	●
Humidity, wet bulb, dew point		●
Probe	Straight or -A articulated	Straight or -A articulated
Variable time constant	●	●
Manual data logging	●	●
Auto save data logging		●
Statistics	●	●
Review data	●	●
LogDat2 downloading software	●	●
Certificate of Calibration	●	●

Temperature compensated over an air temperature range of 40 to 150°F (5 to 65°C).
[2] The accuracy statement begins at 30 ft/min through 6,000 ft/min (0.15 m/s through 30 m/s)
[3] Accuracy with instrument case at 77°F (25°C), add uncertainty of 0.05°F/°F (0.03°C/°C) for change in instrument temperature.
[4] Accuracy with probe at 77°F (25°C). Add uncertainty of 0.1% RH/°F (0.2% RH/°C) for change in probe temperature. Includes 1% hysteresis.

Specifications are subject to change without notice

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Appendix D

Technical Specifications

Shamrock No. 63
Final Remediation Plan
Table of Contents

Specification Number	Description
TOC	Table of Contents

Division 22: Plumbing

22 05 03.01	HDPE pipe
22 05 03.02	PVC Piping
22 05 19	Gauges and Sensors
22 05 23	General Duty Valves
22 30 10	High Density Polyethylene Tanks

Division 31: Earthwork

31 10 00	Site Clearing
31 23 17	Trenching and Backfill
31 23 24	Flowable Fill

Division 44: Pollution Control Equipment

44 11 36	SVE Equipment



SECTION 22 05 03.01

HIGH DENSITY POLYETHYLENE PIPING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. HDPE pipe.
2. HDPE fittings.
3. HDPE burial.
4. HDPE joining.
5. HDPE testing.

B. Related Sections:
1. Section 31 23 17 - Trenching and Backfill
2. Section 31 23 24 - Flowable Fill

1.2 REFERENCES

A. ASTM International:
1. ASTM D1248 - Standard Specification for Polyethylene Molding and Extrusion Materials.
2. ASTM D2239 - Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameters.
3. ASTM D2122 - Determining Dimensions of Thermoplastic Pipe and Fittings.
4. ASTM D2241 - Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter.
5. ASTM D2447 - Standard Specification for Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter.
6. ASTM D2513 - Standard Specification for Thermoplastic Gas Pressure Pipe, Tubing, and Fittings.
7. ASTM D2609 - Standard Specification for Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe.
8. ASTM D2657 - Standard Practice for Heat-Joining Polyolefin Pipe and Fittings.
9. ASTM D2683 - Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.
10. ASTM D2774 - Underground Installation of Thermoplastic Pressure Piping.
11. ASTM D2837 - Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pressure Piping.
12. ASTM D3035 - Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.
13. ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fitting Materials.
14. ASTM F412 - Standard Terminology Relating to Plastic Piping System.

15. ASTM F1248 - Standard Test Method for Determination of Environmental Stress Crack Resistance (ESCR) of Polyethylene Pipe.

B. American Water Works Association:
1. AWWA C901 - Polyethylene (PE) Pressure Pipe and Tubing, ½ in. through 3 in., for Water Service.

1.3 SUBMITTALS

A. Product Data: Submit data on pipe sizes, materials and fittings. Submit manufacturers catalog information.

1.4 QUALITY ASSURANCE

A. Manufacturer Quality Assurance:
1. Manufacturer shall maintain a continuous quality control program.
2. Material certification shall be included verifying that the materials have been tested for conformance with ASTM D3350 and that the pipe material has exceeded 5,000 hours without failure when tested under F1248.

B. HDPE pipe and fittings shall be provided from one approved manufacturer.

C. Maintain one copy of each document on site.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum five years documented experience.

B. Installer: Company specializing in performing work of this section with minimum five years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. All necessary precautions shall be taken to prevent damage or contamination to pipe and other materials during shipment and delivery.

B. All materials shall be securely fastened to truck or rail car to prevent movement or damage during shipment.

C. Furnish temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

E. All pipe materials shall be handled in such a manner as to prevent damage. HDPE pipe shall not be dropped, rolled or pushed off from any height during delivery, storage or installation.

F. All pipe materials shall be stored off the ground in a dry location.

G. All pipe materials shall be stored in such a manner as to prevent sagging or bending.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Do not install underground piping when bedding is wet or frozen.

1.8 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.9 COORDINATION

A. Coordinate installation of buried piping with trenching.

PART 2 PRODUCTS

2.1 POLYETHYLENE PRODUCTS

A. Manufacturers:
1. ISCO Industries.
2. Polypipe, Inc.
3. Performance Pipe, Inc.
4. Substitutions: Permitted with the Engineer's approval.

B. Polyethylene Pipe: Pipe shall be provided in diameters, pressure classes, and dimension ratios (DR) as shown on the plans and in accordance with ASTM D3035. Also:
1. HDPE pipe shall be manufactured from extra high molecular weight polyethylene pipe materials meeting the requirements of cell classification PE345464C Standard PE Code Designation PE3408 as defined by ASTM D3350.
2. Fittings: AWWA C901, molded.
3. Joints: Butt fusion by a qualified technician, trained by an approved manufacturer's representative, and in accordance with the manufacturer's recommended procedures.

C. Typical Material Physical Properties: All pipe and fitting materials shall meet these typical physical properties:

D. HDPE Fittings:
1. The fittings shall be manufactured from the same cell class resin and fully pressure rated to the same pressure rating as the designed piping system.
2. Shall have a controlled outside diameter and produced to the SDR/DR rating for the pressure specified by the Engineer.
3. Shall be specifically manufactured to the standardized dimensions noted on the Drawings.

4. Where applicable, fittings shall meet the requirement of AWWA C901 or AWWA C906.
5. Butt fusion fittings shall be manufactured from the same material as the extruded pipe.
6. Shall be rated for the pressure service at least equal to that of the system pipe.
7. Shall have outlets manufactured to the same DR as that of system pipe.
8. Molded fittings shall be manufactured in accordance with ASTM D3261.
9. Socket fittings shall be manufactured in accordance with ASTM D2683.

2.2 UNDERGROUND PIPE MARKERS

A. Underground pipe marker shall be metallic detectable brightly colored plastic tape.

2.3 BEDDING AND COVER MATERIALS

A. Bedding, cover, and backfill shall be as specified in Sections 31 23 17 and 31 23 24 and as indicated on the Drawings.

PART 3 EXECUTION

3.1 EXAMINATION

A. Contractor shall inspect all piping to assure that the piping is free from defects in material and workmanship.

B. Compatibility of all pipe and fittings shall be verified.

C. Pipe, fittings and accessories that are cracked, damaged, not identified or in poor condition shall be rejected.

D. The Engineer shall have free access to all joints and test joints for determining the suitability of the joining process.

E. Where construction restrictions limit inspection of joints, the Engineer may have the person joining the pipe and or fittings perform a test joint in the presence of the Engineer.

F. The Engineer shall determine the method of testing either by visual examination or bent strap testing.

G. Verify excavations are to required grade, dry, and not over-excavated.

H. Verify trenches are ready to receive piping.

3.2 PREPARATION

A. Remove burrs.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.3 INSTALLATION - BURIED PIPING SYSTEMS

A. Verify connection size, location, and inverts are as indicated on Drawings.

B. Joining
1. The pipe and fittings shall be heat fused creating a homogeneous joint.
2. Joining shall be in accordance with the manufacturer's heat fusion recommendations.
3. Joints shall not be of the solvent welded type.
4. Each person making heat fusion joints shall demonstrate proficiency by making joints and test the trial fusion by bent strap testing in accordance with ASTM D2657.
5. Trial joints shall be allowed to cool completely prior to testing and shall not fail at the joint.
6. During construction, at the Engineer’s discretion, a trial fusion shall be made which shall then be allowed to cool and destructively bent strap tested.
7. If the trial fusion should fail, additional trial fusions shall be made and tested until successful fusions are completed.
8. The procedure used to join the trial fusion shall be used for the balance of the day's work, proved the procedure is within the limitations recommended by the manufacturer.
9. The Engineer shall have the authority to disallow any installer's from completing heat fusion of polyethylene pipe if that technician has consecutively failed trial joints.
10. Any person deemed unqualified by the Engineer will require training per Manufacturer’s guidelines at the expense of the Contractor and training shall be documented and submitted to the Engineer.
11. The equipment used to make the heat fusion joint shall be capable of recording the heating and fusion pressures used to join the pipe, recording heater temperature, and storing this information for retrieval.
12. Each field fusion shall be recorded by such equipment and this information shall be made available to the Engineer's representative.

C. Excavate pipe trench in accordance with Section 31 23 17.

D. Install pipe as indicated on Drawings.

E. Install pipe to allow for expansion and contraction without stressing pipe or joints.

F. Install detectable plastic ribbon tape continuously 12 inches above pipeline; coordinate with Section 31 23 17.

3.4 BURIAL

A. All polyethylene pipe must be installed to minimize shear and tensile stresses.

B. Pipe shall be installed in a trench as specified in the construction drawings.

C. Minimum burial depth is specified in the Drawings.

D. The Contractor shall take care to insure haunching material is well placed as to not disturb the pipeline.

E. Final backfill material may consist of the excavated material as specified in the Drawings provided it is free of unsuitable matter, such as clumps of clay, stones, construction debris, and frozen clods of dirt, unless final backfill is under a roadway.

F. Final backfill material shall be compacted as shown on the Drawings. Proctor density shall be determined by ASTM D698 for compaction and density of soils.

G. All polyethylene pipe shall use warning tape for future location.

3.5 FIELD QUALITY CONTROL

A. The Contractor shall test buried pipes in the SVE system by air pressurization testing.

B. The Contractor shall take all precautions to prevent harm, injury, or damage to people and materials.

C. The Contractor shall make every attempt to obtain successful results using the methods described herein. In the event the test results prove inconclusive, as determined by the Engineer, the Contractor may be required to test each pipeline reach hydrostatically, at no additional cost to the Owner.

D. The Contractor shall test each SVE line by applying a pressure of 10 psig and holding it for a minimum of 15 minutes. Measured pressure shall be at least 90% of the applied pressure (9 psig) at the end of the test period.

END OF SECTION

SECTION 22 05 03.02

PVC PIPING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Pipe and pipe fittings for the following system:
1. SVE conveyance system

B. Related Sections:
1. Section 22 05 23 - General Duty Valves.
2. Section 31 23 17 - Trenching and Backfill.

C. ASTM International:
1. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
2. ASTM D2235 - Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
3. ASTM D2464 - Standard Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
4. ASTM D2466 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
5. ASTM D2564 - Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.

1.2 SUBMITTALS

A. Product Data: Submit data on pipe sizes, materials and fittings. Submit manufacturers catalog information.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Furnish temporary end caps and closures on piping and fittings. Maintain in place until installation.

B. Protect piping from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.4 ENVIRONMENTAL REQUIREMENTS

A. Do not install underground piping when bedding is wet or frozen.

1.5 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.6 COORDINATION

A. Coordinate installation of buried piping with trenching.

PART 2 PRODUCTS

2.1 PVC PRODUCTS

A. PVC Pipe: ASTM D1785, Schedule 40, polyvinyl chloride (PVC) material.
   1. Fittings:ASTM D2466, Schedule 40, PVC.
   2. Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement.

2.2 UNDERGROUND PIPE MARKERS

A. Plastic Ribbon Tape: Bright colored, continuously printed, detectable metallic, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

2.3 BEDDING AND COVER MATERIALS

A. Bedding, cover, and backfill shall be as specified in Section 31 23 17 and as indicated on the Drawings.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify excavations are to required grade, dry, and not over-excavated.

B. Verify trenches are ready to receive piping.

3.2 PREPARATION

A. Remove burrs.

B. Remove dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.3 INSTALLATION - BURIED PIPING SYSTEMS

A. Verify connection sizes, locations, and inverts are as indicated on Drawings.

B. Excavate pipe trench in accordance with Section 31 23 17.

C. Install pipe to promote water to drain toward the well by maintaining a minimum slope of 1%.

D. Pipes to be secured in place by Snap-Loc spacers and rebar as shown on the Drawings. Spacers shall be stacked no more than 2 high to minimize the width of the trench and the volume of soil required for excavation.

E. Install plastic ribbon tape continuously buried 12 inches, above pipe line; coordinate with Section 31 23 17.

F. Pipe Cover and Backfilling:
   1. Backfill trench in accordance with Section 31 23 14 and as indicated on the Drawings.

3.4 INSTALLATION - ABOVE GROUND PIPING

A. Route piping in orderly manner and maintain appropriate gradients. Route parallel and perpendicular to fences and equipment.

B. Install piping to maintain headroom without interfering with use of space or taking more space than necessary.

C. Group piping whenever practical at common elevations.

D. Sleeve pipe passing through partitions, walls and floors.

E. Provide clearance in hangers and from structure and other equipment for access to valves and fittings. Provide access where valves and fittings are not accessible.

F. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

G. Install valves in accordance with the manufacturer's instructions.

H. Insulate piping as shown in the Drawings.

3.5 FIELD QUALITY CONTROL

A. The Contractor shall test each SVE line by applying a pressure of 10 psig and holding it for a minimum of 15 minutes. Measured pressure shall be at least 90% of the applied pressure (9 psig) at the end of the test period.

END OF SECTION

SECTION 22 05 19

GAUGES AND SENSORS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Analog dial-type vacuum gauges.

B. Accessories to be furnished and installed at the locations indicated on Drawings.

C. Allowances:
1. Gauges and sensors shall be considered incidental.

1.2 REFERENCES

A. Except as modified or supplemented herein, all gauges shall conform to the requirements of:
1. ANSI/ASME B40.100
2. ANSI Grade 2A or better

1.3 SUBMITTALS

A. Shop Drawings: Required.

B. Product Data: Required.

C. Manufacturer's Installation Instructions: Required.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Required.

B. Operation and Maintenance Data: Required.

1.5 WARRANTY

A. Furnish manufacturer’s warranty.

PART 2 PRODUCTS

2.1 VACUUM GAUGES

A. Manufacturers:

1. Dwyer Series LPG3 Low Pressure Gauge.
2. Substitutions: Permitted with the Engineer's approval.

2.2 GAUGE AND SENSOR CONSTRUCTION:

A. Dwyer Series LPG3
1. Unless otherwise specified, gauges shall be indicating dial type with:
a. Drawn steel housing.
b. Polycarbonate lens.

2.3 OPERATION

A. The dial shall be 3 inches diameter or less with a white background and black markings.

B. The units of measurement shall be indicated on the dial face.

C. Subdivisions of scale shall conform to the requirements of the governing standard.

D. Point travel shall be not less than 200 degrees or more than 270 degrees.

E. Connection shall be 1/4 in. male NPT.

2.4 MOUNTING

A. The mounting configuration of each gauge shall be as indicated on the Drawings.

B. Connections
1. As necessary, depending on the thickness class and size of the gauged pipe, a tap or saddle shall be located on the pipe, fitting or appurtenance to be gauged.
2. The attachment shall be made by an appropriately sized NPT nipple in the tap or saddle.
3. Nipples or elbows or combination thereof shall be long enough such that the edge of the gauge case does not contact the pipe; however, in no case shall the distance from the edge of the pipe to the centerline of the gauge exceed 6 inches without prior approval of the Engineer.

PART 3 EXECUTION

3.1 INSTALLATION

A. Gauges shall be installed at the locations indicated on the Drawings.

B. Gauges shall be installed per the manufacturer's guidelines and directions.

C. All gauges shall be installed in the vertical upright position, unless indicated otherwise in the Drawings.

D. Threaded connections shall be assembled using Teflon thread tap or Teflon thread sealer, as specified in the miscellaneous piping section.

3.2 FIELD QUALITY CONTROL

A. Test: Verify all gauge and sensor installations are free from leaks.

3.3 SCHEDULE

Gauge ID	Range	Manufacturer	Model	Count
VG-301	-100 to 0" w.c	Dwyer	LPG3	11

END OF SECTION

SECTION 22 05 23

GENERAL DUTY VALVES

PART 1 GENERAL

1.1 SUMMARY

A. Furnish all labor, materials, equipment, and incidentals required to install all valves necessary for the soil vapor extraction, treatment, and hot air injection systems including but not limited to wells, piping, and equipment.

B. Section Includes:
1. Gate valves.
2. Check valves.

1.2 REFERENCES

A. ASTM International:
1. ASTM D1785 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

1.3 SUBMITTALS

A. Product Data: Submit manufacturers catalog information with valve data and ratings for each service.

B. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures.

C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of valves.

B. Operation and Maintenance Data: Submit installation instructions, spare parts lists, exploded assembly views.

1.5 QUALITY ASSURANCE

A. Maintain one copy of each document on site.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Do not install valves underground when bedding is wet or frozen.

1.8 WARRANTY

A. Furnish one year manufacturer warranty for valves excluding packing.

1.9 EXTRA MATERIALS

A. Furnish two packing kits for each size valve.

PART 2 PRODUCTS

2.1 GATE VALVES

A. Manufacturers:
   1. King Brothers Industries, Model GVP.
   2. Substitutions: Permitted with the Engineer's approval.

B. 2-inch (GV-201): Schedule 40, 150 psi at 73 degrees F water temperature, maximum service temperature: 140 degrees F, ASTM D1785 PVC body and gate, hand-wheel, EPDM seals, regular port, glue socket ends.

2.2 CHECK VALVES

A. Ball Check Valves:
   1. Manufacturers:
      a. Spears, True Union 2000 Industrial Ball Check Valve.
      b. Substitutions: Permitted with the Engineer's approval.
   2. 1-inch (CV-101): 235 psi at 73 degrees F water temperature, maximum service temperature: 140 degrees F, ASTM D1785 PVC, spigot end.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify piping system is ready for valve installation.

3.2 INSTALLATION

A. Install valves with stems upright or horizontal, not inverted, unless indicated otherwise on the Drawings.

B. Install valves with clearance for installation of insulation and allowing access.

C. Provide access where valves and fittings are not accessible.

3.3 VALVE APPLICATIONS

A. Install valves at locations indicated on the Drawings in accordance with this Section.

B. Install ball, butterfly, or gate valves for shut-off and to isolate equipment, part of systems, or vertical risers.

C. Install ball, butterfly, or globe valves for throttling, bypass, or manual flow control services.

D. Install vertical ball check valves on discharge of condensate transfer pumps.

E. Install lug end butterfly valves adjacent to equipment when functioning to isolate equipment.

3.4 SCHEDULES

Valve ID	Valve Type	Material	Size, inches	Number of Valves
GV-201	Gate	PVC	2	12
CV-101	Check	PVC	1	1

END OF SECTION

SECTION 22 30 10

HIGH DENSITY POLYETHYLENE TANKS

PART 1 GENERAL

1.1 SUMMARY

A. This specification covers upright, single-walled, flat bottom SVE condensate storage tank assemblies. The tank is designed for aboveground, vertical installation, and is capable of containing fluids at atmospheric pressure.

1.2 MATERIALS

A. The material used shall be virgin polyethylene resin.

1.3 DIMENSIONS AND TOLERANCES

A. All dimensions will be taken with the tank in the vertical position, unfilled. Tank dimensions will represent the exterior measurements.

1.4 SUBMITTALS

A. Product Data: Submit complete information concerning materials of construction, fabrication, and fitting installation locations.

1.5 SCHEDULING

A. Schedule prior to connecting piping work.

1.6 COORDINATION

A. Coordinate work with location and placement of utilities.

PART 2 PRODUCTS

2.1 TANKS

A. Manufacturers:
   1. Snyder Industries, Inc
   2. Substitutions: Permitted with approval of Engineer.

B. Product Description:
   1. Polyethylene tanks shall be 200 gallon single-walled tanks.

2.2 WORKMANSHIP

A. The finished tank wall shall be free, as practicable, of visual defects such as foreign inclusions, air bubbles, pinholes, pimples, crazing, cracking and delaminating that will impair the serviceability of the vessel.

B. All edges where openings are cut into the tanks shall be trimmed smooth.

2.3 THREADED BULKHEAD FITTINGS

A. Furnish threaded bulkhead fittings as required to connect tank to piping as indicated on the Drawings.

B. The bulkhead fittings shall be constructed of polyvinyl chloride (PVC), polypropylene (PP), or other specified material. Gaskets shall be a minimum of ¼ in. thickness and constructed of EPDM.

PART 3 EXECUTION

3.1 DELIVERY, STORAGE AND HANDLING

A. Inspect tanks for damage.

B. Store products in areas protected from weather, moisture, or possible damage; do not store products directly on ground; handle products to prevent damage to interior or exterior surfaces.

3.2 EXAMINATION

A. Verify layout and orientation of tank accessories and piping connections prior to placement.

3.3 INSTALLATION

A. Install SVE condensate storage tank as indicated on the Drawings and in accordance with manufacturer's instructions.

B. Connect piping to tank.

C. Install tank accessories not factory-mounted to complete installation.

3.4 FIELD QUALITY CONTROL

A. Field Testing:
   1. Hydrostatically test the storage tank by filling with water to the overflow pipe level.
   2. Conduct test minimum of 24 hours.
   3. No leakage is permitted.

4. Adjust, repair, modify, or replace components of system failing to perform as specified and rerun tests.

3.5 Schedules

A. Storage Tank Schedule:

Stored Material	Tank Type & Number	Tank Dimensions (Nominal)	Tank Size (Capacity)
SVE condensate water	C-1	36 in. D x 78 in. H	200 gal

END OF SECTION

SECTION 31 10 00

SITE CLEARING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Removing surface debris.
2. Removing designated paving, curbs, and sidewalks.
3. Removing designated trees, shrubs, and other plant life.
4. Removing abandoned utilities.
5. Excavating topsoil.

B. Related Sections:
1. Section 31 23 17 - Trenching and Backfill

1.2 DEFINITIONS

A. Clearing: Clearing is the removal from the ground surface and disposal of trees, brush, shrubs, down timber, decayed wood, other vegetation, concrete, rubbish, and debris, as well as the removal of fences, stockpiled materials, and incidental structures.

B. Grubbing: Grubbing is the removal and disposal of all stumps, buried logs, roots, matted roots, and organic materials.

1.3 QUALITY ASSURANCE

A. Perform Work in accordance with applicable State of New Mexico Standard Specifications.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 DISPOSITION OF TREES AND SHRUBS

A. General
1. Trees and shrubs within the limits of work shall be removed only where shown on the Drawings. Do not cut or damage trees unless so indicated or unless written permission has been obtained from the affected property owner. Three copies of such permission shall be furnished to the ENGINEER before removal operations commence.

B. Trees and Shrubs To Be Removed

1. Trees and shrubs felled within the limits of work shall have their stumps grubbed and removed to a licensed disposal site. Depressions created by such removal shall be filled with suitable backfill and compacted to match properties of existing terrain.

3.2 CLEARING AND GRUBBING

A. Clear all items specified herein to the limits indicated or as directed by the ENGINEER and stockpile cleared and grubbed material onsite. Do not start earthwork operations in areas where clearing and grubbing is not complete, with the exception that stumps and large roots may be removed concurrent with excavation. Comply with erosion and sediment control and storm water management measures.

B. Clear and grub areas to be excavated, areas to receive fill, and areas upon which structures are to be constructed, as directed by the ENGINEER. Remove all trees, stumps, and root mats in these areas and dispose of them offsite at no cost to the property owner. Depressions made by the removal of stumps or roots shall be filled with suitable backfill.

C. The CONTRACTOR shall clear, grub, and strip the site area to the limits of disturbance shown on the Contract Drawings. Clearing and grubbing shall not be performed more than 60 days before excavation is to begin.

END OF SECTION

SECTION 31 23 17

TRENCHING AND BACKFILL

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. This Section shall be supplemental to 701 of the New Mexico Standard Specifications for Public Works Construction. Section 701 shall apply except as modified in this Section.

B. Related Sections:
   1. Section 22 05 03.02 - PVC Piping
   2. Section 31 10 00 - Site Clearing
   3. Section 31 23 24 - Flowable Fill

1.2 REFERENCES

A. New Mexico Standard Specifications for Public Works Construction:
   1. Section 701 - Trenching, Excavation and Backfill

1.3 DEFINITIONS

A. Utility: Any buried pipe, duct, conduit, or cable.

B. Trench Zone: The trench zone includes the portion of the trench from the top of the pipe zone to the existing surface.

C. Pipe Zone: The pipe zone shall include the full width of trench from the bottom of the pipe or conduit to a horizontal level 12 inches above the top of the pipe. Where multiple pipes or conduits are placed in the same trench, the pipe zone shall extend from the bottom of the lowest pipes to a horizontal level 12 inches above the top of the highest or topmost pipe.

D. Pipe Bedding: The pipe bedding shall be defined as a layer of material immediately below the bottom of the pipe or conduit and extending over the full trench width in which the pipe is bedded. Thickness of pipe bedding shall be as shown on the drawings or as described in these specifications.

E. Excess Excavated Material
   1. The Contractor shall make the necessary arrangements for and shall remove and dispose of all excess excavated material.
   2. No excavated material shall be deposited on private property unless written permission from the Engineer is secured by the Contractor.

1.4 TRENCH SAFETY

A. All excavations shall be performed, protected, and supported as required for safety. In all cases, Contractor shall ensure that all excavation and trenching methods meet or exceed safety requirements as set forth by local, state and federal agencies.

B. Barriers shall be placed at each end of all excavations and at such places as may be necessary along excavations to warn all traffic of such excavations.

C. No trench or excavation shall remain open and exposed to vehicular or foot traffic during non-working hours. The trench or excavation shall be fenced off, or covered with steel plates, spiked in place, or backfilled.

D. The Contractor shall notify the Engineer of all work-related accidents which may occur to persons or property at or near the project site, and shall provide the Engineer with a copy of all accident reports. All accident reports shall be signed by the Contractor or its authorized representative and submitted to the Engineer within twenty-four (24) hours of the accident's occurrence.

1.5 ACCESS

A. Unobstructed access must be provided to all driveways or other property or facilities that require routine use. Temporary closures of driveways require written approval of the property owner and confirmation from the Engineer.

1.6 PERMITS

A. The Contractor shall keep a copy of all the required permits in the job site and comply with all the terms and conditions of said permits.

1.7 QUALITY ASSURANCE

A. Perform Work in accordance with applicable State of New Mexico Standard Specifications for Public Works Construction.

1.8 COORDINATION

A. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities.

PART 2 PRODUCTS

2.1 FILL MATERIALS

A. Flowable Fill: All trenches to be backfilled with flowable fill per Specification 31 23 24 and the Drawings.

B. The Contractor shall dispose of the excess trench excavation material as specified in the Section 1.3.E.

PART 3 EXECUTION

3.1 TRENCHING

A. Excavation for pipe, fittings, and appurtenances shall be open trench to the depth and in the direction necessary for the proper installation of the facilities as shown on the plans.

B. Trench banks shall be kept as near to vertical as possible and shall be properly braced and sheeted.

3.2 BRACING

A. The Contractor's design and installation of bracing and shoring shall be consistent with OSHA rules, orders, and regulations.

B. Excavations shall be so braced, sheeted, and supported that they will be safe such that the walls of the excavation will not slide or settle and all existing improvements of any kind, either on public or private property, will be fully protected from damage.

C. The sheeting, shoring, and bracing shall be arranged so as not to place any stress on portions of the completed work until the general construction thereof has proceeded far enough to provide ample strength.

D. Care shall be exercised in the drawing or removal of sheeting, shoring, bracing, and timbering to prevent the caving or collapse of the excavation faces being supported.

3.3 TRENCH WIDTHS

A. Excavation and trenching shall be true to line with a minimum width of the largest outside diameter of the pipe(s) and spacer(s) + 12 inches and a maximum width of the largest outside diameter of the pipe + 24 inches. Trench widths are diagramed on the Drawings.

3.4 LENGTH OF OPEN TRENCH

A. The maximum allowable length of open trench shall be the distance necessary to accommodate the amount of pipe installed in a single day. Open trench during non-working hours shall be fenced off, or covered with steel plates

3.5 GRADE

A. Excavate the trench to the lines and grades shown on the Drawings with allowance for pipe thickness and for pipe base or special bedding.

B. The trench bottom shall be graded to provide a smooth, firm, and stable foundation that is free from rocks and other obstructions and shall be at a reasonably uniform grade.

3.6 CORRECTION OF OVER EXCAVATION

A. Where excavation is inadvertently carried below the design trench depth, suitable provision shall be made by the Contractor to adjust the excavation, as directed by the Engineer, to meet requirements incurred by the deeper excavation.

B. Over excavations shall be corrected by backfilling with approved graded crushed rock or gravel and shall be compacted to provide a firm and unyielding subgrade or foundation, as directed by the Engineer.

3.7 FOUNDATION STABILIZATION

A. Whenever the trench bottom does not afford a sufficiently solid and stable base to support the pipe or appurtenances, the Contractor shall excavate to a depth below the design trench bottom, as directed by the Engineer, and the trench bottom shall be backfilled with 3/4-inch rock and compacted to provide uniform support and a firm foundation.

B. Where rock is encountered, (see Section 3.10 C) it shall be removed to a depth at least 6 inches below grade and the trench shall be backfilled with 3/4-inch crushed rock to provide uniform support and a firm foundation.

C. If excessively wet, soft, spongy, unstable, or similarly unsuitable material is encountered at the surface upon which the bedding material is to be placed, the unsuitable material shall removed to a depth as determined in the field by the Engineer and replaced by crushed rock to provide uniform support and a firm foundation.

3.8 PLACEMENT

A. Trenches to be backfilled with flowable fill per Specification 31 23 24 Flowable Fill.

3.9 EXCAVATED MATERIAL

A. All excavated material shall not be stockpiled in a manner that will create an unsafe work area or obstruct sidewalks or driveways.

B. In confined work areas, the Contractor may be required to stockpile the excavated material off-site, as determined by the Engineer.

C. Rock excavation is defined as boulders, sedimentary, or igneous rock that cannot be removed without continuous use of pneumatic tools or blasting.

D. Excavated material shall be disposed of at the Contractor’s expense.

END OF SECTION

SECTION 31 23 24

FLOWABLE FILL

PART 1 GENERAL

1.1 Summary

A. Section Includes:
1. Flowable fill

B. Related Sections:
1. Section 31 23 17 - Trenching and Backfill.

1.2 References

A. ASTM International:
1. ASTM C33 - Standard Specification for Concrete Aggregates.
2. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.
3. ASTM C150 - Standard Specification for Portland Cement.
4. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
5. ASTM C403/C403M - Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance.
6. ASTM D4832 - Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders.

1.3 Definitions

A. Utility: Any buried pipe, duct, conduit, manhole, tank, or cable.

B. Excavatable Flowable Fill: Lean cement concrete fill used where future excavation may be required such as fill for utility trenches, bridge abutments, and culverts.

C. Non-Excavatable Flowable Fill: Lean cement concrete fill used where future excavation is not anticipated such as fill below structure foundations and filling abandoned utilities.

1.4 Submittals

A. Mix Design:
1. Submit flowable a fill mix design for each specified strength. Submit separate mix designs when admixtures are require for the following:
a. Flowable fill work during hot and cold weather;
b. Air entrained flowable fill work;
2. Identify design mix ingredients, proportions, properties, admixtures, and tests.
3. Compressive strength at 1 day and 7 days. Report compressive strength of each specimen and average specimen compressive strength.
4. Submit test results to certify flowable fill mix design properties meet or exceed specified requirements.

B. Delivery Tickets:
1. Submit duplicate delivery tickets indicating actual materials delivered to Project site.

1.5 Environmental Requirements

A. Do not install flowable fill during inclement weather or when ambient temperature is less than 40°F.

1.6 Field Measurements

A. Verify field measurements before installing flowable fill to establish quantities required to complete the Work.

PART 2 PRODUCTS

2.1 Flowable Fill

A. Flowable Fill: Excavatable type.

2.2 Materials

A. Portland Cement: ASTM C150 Type I/II - Normal/Moderate.

B. Fine Aggregates: ASTM C33.

C. Water: Clean and not detrimental to concrete.

2.3 Admixtures

A. Air Entrainment: ASTM C260.

2.4 Mixes

A. Mix and deliver flowable fill in accordance with ASTM C94/C94M, Option C.

B. Flowable Fill Design Mix:

Item	Excavatable
Cement Content	As specified by manufacturer
Fly Ash Content	As specified by manufacturer
Water Content	As specified by manufacturer
Air Entrainment	15–35 percent
28 Day Compressive Strength	Maximum 100 psi.
Unit Mass (Wet)	80–110 pcf
Temperature, Minimum at point of delivery	50°F

C. Provide water content in design mix to produce self-leveling, flowable fill material at time of placement.

D. Design mix air entrainment and unit mass are for laboratory design mix and source quality control only.

2.5 Source Quality Control

A. Test and analyze properties of flowable fill design mix and certify results for the following:
   1. Design mix proportions by weight of each material.
   2. Aggregate: ASTM C33 for material properties and gradation.
   3. Properties of plastic flowable fill design mix including:
      a. Temperature.
      b. Slump.
      c. Air entrainment.
      d. Wet unit mass.
      e. Yield.
      f. Cement factor.
   4. Properties of hardened flowable fill design mix including:
      a. Compressive strength at 1 day and 7 days. Report compressive strength of each specimen and average specimen compressive strength.
      b. Unit mass for each specimen and average specimen unit mass at time of compressive strength testing.

B. Prepare delivery tickets containing the following information:
   1. Project Designation.
   2. Date.
   3. Time.
   4. Class and Quantity of flowable fill.
   5. Actual batch proportions.
   6. Free moisture content of aggregate.
   7. Quantity of water withheld.

PART 3 EXECUTION

3.1 Examination

A. Verify trenching specified in Section 31 23 17 is complete.

B. Verify utility installation is complete and tested before placing flowable fill.

C. Verify excavation is dry.

3.2 Preparation

A. Support and restrain utilities and piping to prevent movement and flotation during installation of flowable fill as specified in the Drawings.

B. Protect structures and utilities from damage caused by hydraulic pressure of flowable fill before fill hardens.

C. Protect utilities to prevent intrusion of flowable fill.

3.3 Installation - Fill, Bedding, and Backfill

A. Place flowable fill in lifts to prevent lateral pressures from exceeding structural capacity of structures and utilities.

B. Place flowable fill evenly on both sides of utilities to maintain alignment.

C. Place flowable fill to elevations indicated on Drawings without vibration or other means of compaction.

3.4 Field Quality Control

A. Perform inspection and testing in accordance with ASTM C94/C94M.
1. Take samples for tests for every 30 cubic yards of flowable fill, or fraction thereof, installed each day.
2. Sample, prepare and test four compressive strength test cylinders in accordance with ASTM D4832. Test one specimen at 3 days, and one at 7 days.
3. Measure temperature at point of delivery when samples are prepared.

B. Defective Flowable Fill: Fill failing to meet the following test requirements or fill delivered without the following documentation.
1. Test Requirements:
   a. Minimum temperature at point of delivery.
   b. Compressive strength requirements for each type of fill.
2. Documentation: Duplicate delivery tickets.

C. The Contractor may cover the flowable fill within 24 hours after placement if a person weighing at least 150 pounds stands on a 4-inch by 4-inch wooden block and does not sink in the material more than 1 inch.

3.5 Cleaning

A. Remove spilled and excess flowable fill from Project site.

B. Restore facilities and site areas damaged or contaminated by flowable fill installation to existing condition before installation and as directed by the Engineer.

END OF SECTION

SECTION 44 11 36

SOIL VAPOR EXTRACTION SYSTEM

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes the equipment and installation of a Soil Vapor Extraction (SVE) System.

B. Related Sections:

1. Section 22 05 23 - General Duty Valves
2. Section 22 05 03.02 - PVC Piping
3. Section 22 30 10 - High Density Polyethylene Tanks

1.2 Acronym Definitions

A. scfm - standard cubic feet per minute

B. ppmv - parts per million by volume

C. VOC - volatile organic compound

D. TPH - total petroleum hydrocarbons

E. in. - inch

F. HP - horsepower

G. SVE - soil vapor extraction

H. VFD - variable frequency drive

1.3 PERFORMANCE REQUIREMENTS

A. The system shall remove 250 scfm of soil vapor using a conventional thermal oxidizer for vapor treatment. The system shall have a minimum of 98% destruction efficiency of incoming vapor concentrations. Vapor concentrations from SVE pilot testing in 2017 were as high as 230,000 micrograms per liter. Under no circumstances shall the discharge to the atmosphere, from all vapor streams, exceed the New Mexico Environment Department limits of 10 lbs/hr and 10 tons/year of a regulated air contaminant, using average hourly flow rates and data from laboratory samples collected and analyzed using standard EPA methods.

1.4 SUBMITTALS

A. The Manufacturer shall submit the following:
   1. Shop Drawings: Provide equipment dimensions, process connections, electrical diagrams, piping and instrumentation diagram, and all information necessary to relate the equipment to the specifications.
   2. Product Data: Submit system performance, noise data, and removal rates for benzene and gasoline range organics.
   3. Design Data: Provide basis of design to include flow rates and removal rates. Include calculations for removal rates.
   4. Test Reports: Indicate flow rates, power consumption, and removal rate.
   5. Manufacturer's Installation Instructions and Operation Manuals: Submit 1 copy of each equipment's installation instruction and operation manual
   6. Manufacturer's Field Reports: Provide data from installed systems with removal rates, operating costs, and length of operation.

1.5 DELIVERY, STORAGE, AND HANDLING

A. The Contractor will be responsible for safe and timely transportation of all necessary equipment and appurtenances to the site. The Contractor’s representative on site will inspect for damage and assumes the responsibility for any issues which may arise from equipment transportation.

B. The Contractor will be responsible for providing any equipment required for system unloading and temporary storage.

1.6 ENVIRONMENTAL REQUIREMENTS

A. All equipment supplied should be manufactured to perform in the anticipated weather conditions at the site, which may include low temperatures of -10°F and high temperatures of 100°F.

B. The equipment should be designed to operate at an elevation of 6,630 feet without adverse effect to performance and operation.

1.7 SCHEDULING

A. Schedule for construction, delivery, and startup to be coordinated with the Engineer. The Manufacturer is to provide the initial schedule and any changes.

1.8 COORDINATION

A. Coordinate work with the Engineer and other Contractors as required.

PART 2 PRODUCTS

2.1 VAPOR EXTRACTION EQUIPMENT

A. Suppliers:
1. Intellishare Environmental, Inc.
E4803 395th Avenue
Menomonie, WI 54751 USA
Contact: John Strey
Phone: 1.715.233.6115
Fax: 1.715.232.0669
Email: jstrey@intellishare-env.com

2.2 COMPONENTS

A. The SVE system shall consist of skid-mounted assemblies
1. Separate skid-mounted assemblies shall consist of:
a. SVE blower and vapor liquid separator
b. Thermal oxidizer with option to run in catalytic mode
2. Skids shall be constructed of a welded steel frame covered by a welded steel plate.
3. Control panels and local instrumentation and controls with the ability to be remotely accessed
4. Interconnected process piping
5. Electrical power connections
6. Natural gas feed connections

B. Equipment Enclosure
1. SVE blower, vapor-liquid separator, and associated equipment and controls will be located within a modified shipping container. This enclosure will be used to reduce noise and mitigate vandalism and theft of remediation equipment.
2. Noise restriction: per City of Santa Fe Environmental Regulations 10-2.5
a. 55 dBA, measured 1 foot inside the property line, 3 to 6 feet above ground surface, and at least 4 feet from walls and other reflective surfaces.
3. Interior
a. Floor sealed with non-skid bed liner
b. Insulated floor, walls, ceiling, and steel access door
c. Overhead lighting
d. Wall-mounted electric heater
e. Vent fan, sound-insulated inlet/outlet louvers, and thermostat

C. SVE Blowers
1. Blowers:
a. The SVE blower shall be a Sutorbilt 4007 positive displacement blower with 10-hp TEFC variable speed motor and a VFD located at the main control panel. The blower will be rated for 250 scfm at an applied vacuum of 70 inches water column, and shall have an automatic belt tensioner.

2. Filter, Discharge Silencer, Gauges and Sampling Port: A particulate filter shall be located on the inlet of the blower and the discharge of the blower will include a premium chamber discharge silencer, pressure gauge, temperature gauge, and sample port.
3. Vapor Liquid Separator: A vapor liquid separator shall be located on the inlet of the system and provide sufficient storage for 50 gallons of accumulated condensate. The vapor liquid separator shall include a liquid coalescing media internal to the separator and external devices will include three point liquid level switches mounted inside a clear PVC site glass. The separator shall have a condensate pump and bottom drain.

D. Thermal Oxidizer
1. Oxidizer Reactor: The reactor housing will be constructed of 7 gauge rolled steel. The Inlet and outlet connections are flanged. The reactor will be painted ISE standard grey two component paint.
2. Gas Pre-Heater: The unit will come equipped as standard with a direct gas fired air burner with combustion air blower and 2hp TEFC motor.
3. Flame Arrestor: A flame arrestor will be supplied and mounted to the inlet of the oxidizer and utilized to prevent flame propagation to the source. A spiral crimped aluminum element shall be removable for inspection and cleaning.
4. Exhaust Stack: The stack for the discharge of cleaned gases shall be self supporting and made of stainless steel. The stack shall terminate at approximately 13’ AGL and is supplied with sampling ports.

E. Control System
1. Main Control System: A Nema 4 control panel shall be completely assembled, wired and mounted at eye level. Control panel components shall include, power distribution circuit with solid state PID temperature controller, flame safety programmer with built in purge timer, Allen Bradley programmable logic controller with Ethernet card, operator and alarm lights and an hour meter to record system run time. The control panel shall be UL 508 approved as an assembly. All wiring shall be consistent with standards set forth in the NEC.
2. Automatic Purge Control: The oxidizer shall be purged with fresh air prior to the introduction of contaminated vapors per NFPA 86. To accomplish this, the combustion air blower will be enabled for a specified time. Once complete, the system shall enable the pre-heat mode.
3. Temperature Control: Combustion chamber temperature shall be continuously monitored via thermocouple. The thermocouple and digital indicating temperature controller enable a 4-20 ma PID loop with the variable frequency tertiary air fan to maintain the combustion chamber set-point temperature.
4. The control panel shall contain an illuminated selector switch indicating power Hand/Off/Auto, status/alarm lights, motor starter, control relays, and terminal blocks factory assembled and tested. The enclosure shall be rated NEMA 4 and constructed of steel.

F. Telemetry
1. A cellular modem will be provided to allow remote access to system controls. The telemetry system will provide data access and the ability to be notified of alarm conditions via text or email.

2.3 ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. Electrical Characteristics: In accordance with the components described above, including all motors and controls.

B. Disconnect Switch: Factory mounted disconnect switches on all individual pieces of equipment.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

3.2 INSTALLATION

A. Contractor to install in accordance with the approved project plans, including all piping and ancillary equipment, and manufacturer's instructions. Contractor shall be responsible for unloading all equipment delivered to the site prior to installation.

3.3 FIELD QUALITY CONTROL

A. All field inspecting, testing, adjusting, and balancing shall be performed by the Supplier for the equipment to function as designed.

3.4 SUPPLIER'S FIELD SERVICES

A. The Contractor is responsible for delivery of all vapor extraction and treatment equipment.

B. Start-up training to include up to 3-days on-site, including inspection of system installation, verification of safety controls, and staff training to optimize the system operation.

END OF SECTION

Appendix E

O&M Data Collection

Site: Shamrock No. 63 **Project No:** BE14.0012

Staff:

Date/Time on site: **off site:**

(use value of no reading (NR) or not active (NA) if applicable for each entry)

SERVICE ELECTRIC METER READING: kWh

SERVICE GAS METER READING: CCF

Oxidizer System Data

INLET TEMP (°F): HOURS:

OUTLET TEMP (°F):

Operator-Recorded System Data

Sample point	Vacuum (in H2O)	Pressure (in Hg)	Temp. (°F)	Differential Pressure (in H2O)	Flow (scfm)	Velocity (ft/min)	HC Conc (ppm-v)	
SVE combined influent		NA		NA				
SVE blower effluent	NA					NA		
Oxidizer discharge	NA	NA		NA	NA	NA		

KNOCKOUT TANK: gallons STORAGE TANK: gallons

SVE Wells

Well	Vacuum (in H2O)	HC Conc (ppm-v)	Flow (scfm)	Velocity (ft/min)	Well	Vacuum (in H2O)	HC Conc (ppm-v)	Flow (scfm)	Velocity (ft/min)
SVE-1S					MW-2				
SVE-2D					MW-5				
SVE-3D					MW-7				
SVE-4S					MW-11				
SVE-5S					MW-16				
MW-1									

NOTES AND LABORATORY SAMPLES COLLECTED:

COMBINED INFLUENT EFFLUENT

Appendix F

Health and Safety Plan

HEALTH AND SAFETY PLAN

Shamrock No. 63
3624 Cerrillos Rd Santa Fe NM

August 15, 2019
PROJECT NO. BE14.0012

PREPARED BY:

Daniel B. Stephens & Associates, Inc., a Geo-Logic Company
6020 Academy NE Suite 100
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(505) 822-9400

Geo-Logic ASSOCIATES

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A Health and Safety Forms
B Emergency Response Plan

Site Health and Safety Plan Summary

This summary provides critical, site-specific health and safety information that all site workers should be familiar with. This summary is an integral part of the site-specific health and safety plan (HASP) and must be attached to the complete plan.

Site Name and Location

Shamrock No. 63

Project Personnel *(refer to Section 3 for description of duties)*

Project Manager (PM): John Casey

Site Safety Officer (SSO):

Site Supervisor:

Emergency Response

Table S-1 lists the Emergency Contacts that might be needed in the event of a site emergency. The complete Emergency Response Plan is provided as Appendix B of this plan.

Site Activities and Hazard Assessment

Table S-2 identifies each of the tasks that will be performed during the field program and the hazards associated with each task. Table S-3 identifies the appropriate personal protective equipment (PPE) to be used for each task, including respiratory protection, and the air monitoring equipment that will be used. Air monitoring is further discussed in Section 7.1 of this plan. In the event that new tasks become necessary or new hazards are encountered, the SSO will update Tables S-2 and S-3 accordingly, and will notify all site workers of the changes.

Contaminants of Concern

Tables S-4 and S-5 identify the contaminants of concern that might reasonably be encountered during site activities and provide summaries of the chemical properties and worker exposure/ health information, respectively. This information is typically summarized from safety data sheets (SDSs) and other sources.

Hospital Route

Figure S-1 depicts the route and provides written instructions from the site to the hospital.

Medical Monitoring *(refer to GLA Policy)*

All site workers must be currently participating in a medical monitoring program that includes baseline and annual medical evaluation and testing.

Site Control Plan *(refer to Section 9 of this plan)*

Site control measures will be implemented during any activity that presents a hazard to workers outside the immediate work area or to unauthorized personnel in the vicinity. These measures can range from erecting barricades or barriers to prevent unauthorized entry, to establishing and enforcing work zones to mitigate the spread of contaminants beyond the work area.

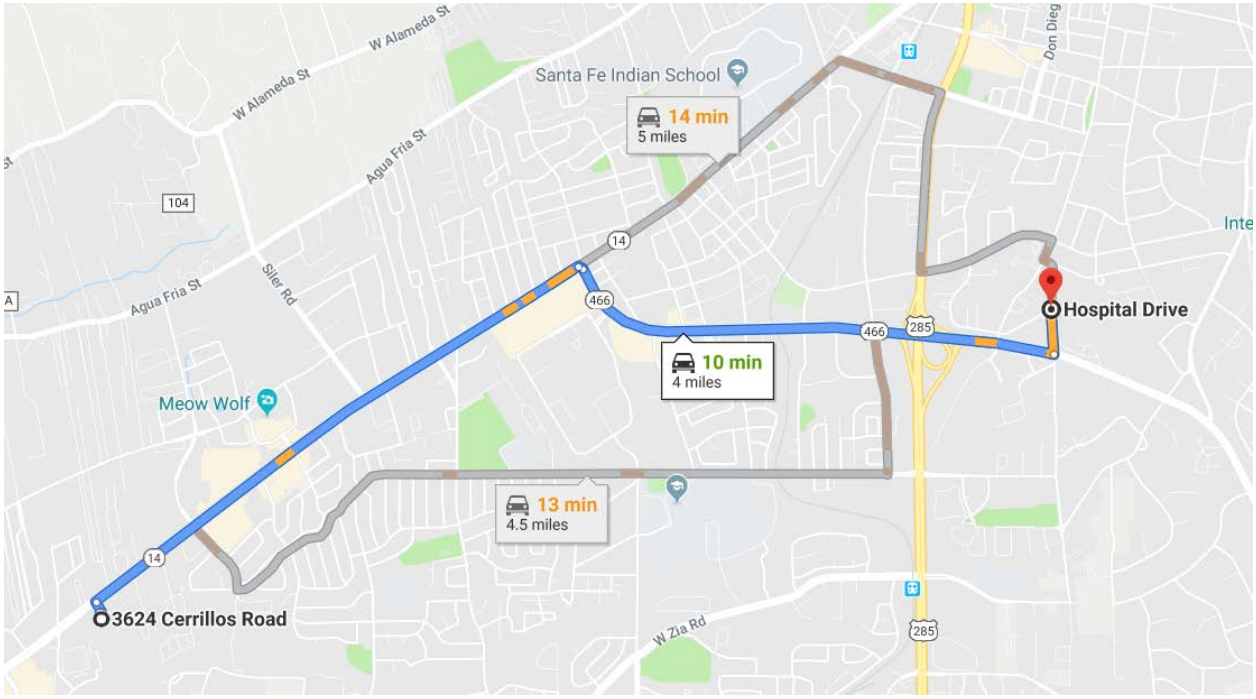
As all work is occurring on private property with minimal truck traffic anticipated, a traffic control plans is not required for this site.

Confined Spaces *(refer to Section 10 of this plan)*

No confined space entries will be performed during this investigation. In the event that confined space entries become necessary, this site-specific HASP will be amended. Confined space entries can only be performed by trained personnel in accordance with the GLA Confined Space Entry Program.

Figure S-1. Hospital Route

The nearest hospital with emergency services is Christus St Vincent Regional Medical Center located at 455 St Michaels Dr, Santa Fe, NM 87505. The map to the hospital is shown on this page, written directions are located on the following page.



3624 Cerrillos Rd
Santa Fe, NM 87507

Head north toward Cerrillos Rd
115 ft

Turn right toward Cerrillos Rd
33 ft

Turn left toward Cerrillos Rd
213 ft

Turn right onto Cerrillos Rd
2.0 mi

Turn right toward St Michaels Dr
98 ft

Slight right onto St Michaels Dr
1.7 mi

Turn left onto Hospital Dr
0.2 mi

Hospital Dr
Santa Fe, NM 87505

Table S-1. Emergency Resources

Location and Number of Nearest Telephone: GLA and Contractor Vehicles

In Case of Fire or Explosion (Telephone Number):

Call Fire Dept: _____ 911

Call Police/Sheriff: _____ 911

In Case of Personal Injury or Exposure (Telephone Number):

Call Hospital: Christus St. Vincent Regional Medical Center, (505) 913-3934 phone

Call Poison Control Center: _____ (800) 432-6866

Call Ambulance: _____ 911

Call Air Ambulance: _____ 911

GLA and Other Contacts

GLA (specific office): _____ Albuquerque (505) 822-9400

GLA Project Manager: _____ John Casey (970) 769-2196

GLA H&S Committee Member: _____ Chad Johannesen (505) 250-4630

GLA Corporate Program Administrator: _____ Russell Granfors (cell) (602) 659-7131

Human Resources Manager: _____ Linda Osdale, Anaheim: (714) 630-5855

Medical Contact: _____ WorkCare, Dr. Peter Greaney (Anaheim, CA) (800) 455-6155

Client Contact: _____ Susan von Gonten (505) 476-4389

Regulatory Contact (if appropriate): _____ Susan von Gonten (505) 476-4389

Emergency Response Telephone Numbers

Local Chemical Emergency Response Team: _____ 911

National Response Center, Oil & Toxic Chemical Spills: _____ (800) 424-8802

CHEMTREC (24-hour): _____ (800) 424-9300

Other Contacts: _____

_____

_____

Table S-2. Proposed Tasks and Hazard Assessment

Potential Hazards	*Proposed Tasks*				
	Drilling, Well Installation, and Development	Soil Sampling	Groundwater Sampling	SVE System Installation and Operation	Trenching and Excavations
Heavy equipment	X			X	X
Hazardous energy	X			X	X
Pinch points	X			X	X
Unstable ground					X
Noise hazards (>85 dbA)	X			X	X
Eye hazards	X	X	X	X	X
Head hazards	X				X
Dermal contact	X	X	X	X	X
Slips, trips, and/or falls	X	X	X	X	X
Heavy lifting	X	X	X	X	
Vehicle traffic	X	X	X	X	
Unauthorized site entry	X			X	X
Buried utilities	X	X		X	X
Overhead utilities	X			X	X
Respiratory Concerns					
Particulates	X	X			X
Vapors and/or gases	X	X	X	X	X
Oxygen depletion					
Asbestos					
Contaminated soil or liquids	X	X	X	X	X
Explosive atmospheres					
Heat/cold stress	X	X	X	X	X
Sunburn	X	X	X	X	X
Electrical hazards				X	
Compressed air or gases	X		X		
Fire hazards (hot work)	X			X	
Chemical hazards (other than COCs)			X		
Insects and vermin	X	X	X	X	X
Confined spaces					
Ionizing Radiation					
Unexploded Ordnance/Munitions					
HAZARD RANKING (Low, Medium, High)	Medium	Low	Low	Low-Medium	Medium

dBA = A-weighted decibels
COCs = Contaminants of concern

Table S-3. Requirements for Personal Protective Equipment and Air Monitoring

Personal Protective Equipment	*Proposed Tasks*				
	Drilling, Well Installation, and Development	Soil Sampling	Groundwater Sampling	SVE System Installation and Operation	Trenching and Excavations
Level D (Long pants, shirt, steel-toed boots, and safety glasses)	Minimum required for all site activities				
Hard hat	X			X	X
Hearing protection	X			X	X
Faceshield	X (decon)				
Respiratory Protection	(Selection matrix and cartridge change schedule in Project Files)				
Half-mask with organic vapor/HEPA cartridge	X				X
Full-face with organic vapor/HEPA cartridge					
Cartridge change schedule	Breakthrough, 8 hours, or end of shift				Breakthrough, 8 hours, or end of shift
Air Monitoring Equipment					
Particulate monitor	X				X
Photoionization detector	X	X		X	X
Flame-ionization detector					
Combustible gas indicator	X				
O_2 monitor					
Colorimetric tubes	X				
H_2S detector					
Methane gas monitor					
Other _____					

HEPA = High-efficiency particulate air
O_2 = Oxygen
H_2S = Hydrogen sulfide

Table S-4. Chemical and Physical Properties for Primary Contaminants of Concern

Compound	Vapor Pressure (mm Hg)	Vapor Density [a] (air=1)	Specific Gravity	Odor Threshold [b] (ppm)	LEL-UEL (%)	Ionization Potential (eV)	Physical Description
Ethylene dibromide (EDB) **[Ca]**	12	6.5	2.17	NA	NA	9.45	Colorless liquid or solid (below 50°F) with a sweet odor.
Ethylene dichloride (EDC) **[Ca]**	64	3.42	1.24	6-10	6.2-16	11.05	Colorless liquid with a pleasant, chloroform-like odor.
Silica, crystalline as respirable dust **[Ca]**	NA	NA	2.66	NA	Unknown	NA	Colorless, odorless solid - a component of many mineral dusts.
Benzene **[Ca]**	75	2.7	0.88	24–119 (P)	1.2–7.8	9.24	Colorless to light yellow liquid with aromatic odor
Toluene	21	3.18	0.87	1.6 (G)	1.1–7.1	8.82	Colorless liquid with a sweet, pungent, benzene-like odor
Ethylbenzene	7	3.66	0.87	0.092–0.6 (G)	0.8–6.7	8.76	Colorless liquid with an aromatic odor
Xylene (o-, m-, p-isomers)	7–9	3.66	0.86–0.88	0.62–20 (G)	0.9–1.1	8.44–8.56	Colorless liquid with an aromatic odor (p-Xylene is a solid below 56°F)
Methyl tertiary butyl ether (MTBE) **[Ca]**	8.5–10	3.1	0.74	0.053 (G)	NA	NA	Clear, colorless, low viscosity liquid with a terpene-like odor
Gasoline **[Ca]**	38–300	NA	0.72–0.76	0.3 (G)	1.4–7.6	NA	Clear liquid with a characteristic odor
Diesel fuel	NA	<1	0.81	NA	0.7 [a]	NA	Clear white liquid with kerosene odor

Sources: NIOSH *Pocket Guide to Chemical Hazards* (2013 - accessed online).
[a] Vapor density data from *Groundwater Chemicals Desk Reference* (Montgomery, 2000) and product material safety data sheets.
[b] Odor threshold data from (1) MSA *RESPONSE® Guide*, on-line at http://webapps.msanet.com/responseguide/ChemicalDatabase.aspx, and (2) 3M *Respirator Selection Guide* (2012).

mm Hg = Millimeters of mercury
ppm = Parts per million
LEL/UEL = Lower explosive limit/Upper explosive limit
eV = Electron volts
NA = Not available or unknown
[Ca] = Known or suspected carcinogen

Table S-5. Exposure Limit, Hazard, and First Aid Information for Primary Contaminants of Concern

Compound	Applicable Exposure Limit	IDLH	Primary Acute Symptoms from Inhalation and Dermal Exposures	Target Organs	First Aid
Ethylene dibromide (EDB) **[Ca]**	0.045 ppm [b]	100 ppm	Irritates eyes, skin, and respiratory system; dermatitis	Eyes, skin, respiratory system, liver, kidneys, reproductive system	*Eye:* Irrigate immediately *Skin:* Soap wash immediately *Breathing:* Respiratory support *Ingestion:* Medical attention immediately
Ethylene dichloride (EDC) **[Ca]**	1 ppm [b]	50 ppm	Irritates eyes, skin, and nose; causes nausea and vomiting; dermatitis	Eyes, skin, kidneys, liver, central nervous system, cardiovascular system	*Eye:* Irrigate immediately *Skin:* Soap wash immediately *Breathing:* Respiratory support *Ingestion:* Medical attention immediately
Silica, crystalline as respirable dust **[Ca]**	0.05 mg/m^3 [a]	50 mg/m^3	Cough, dyspnea (breathing difficulty), wheezing; decreased pulmonary function, progressive respiratory symptoms (silicosis); irritation eyes	Eyes, respiratory system	*Eyes:* irrigate immediately; *Skin:* no recommendation; *Breathing:* remove to fresh air; *Ingestion:* no recommendation
Benzene **[Ca]**	0.1 ppm [a] 1.0 ppm [b]	500 ppm	Irritates eyes, skin, and nose; causes headache, nausea, giddiness, staggered gait, weakness, exhaustion; dermatitis	Eyes, skin, respiratory system, blood, CNS, bone marrow	*Eyes:* irrigate immediately; *Skin:* soap wash immediately; *Breathing:* remove to fresh air, provide respiratory support; *Ingestion:* medical attention immediately
Toluene	100 ppm [a] 150 ppm [b]	500 ppm	Irritates eyes and nose; causes headache, weakness, fatigue	Eyes, skin, respiratory system, CNS, liver, kidneys	As above
Ethylbenzene	100 ppm [a,c] 125 ppm [b]	800 ppm	Irritates eyes, skin and mucous membranes	Eyes, skin, respiratory system, CNS	As above

Table S-5. Exposure Limit, Hazard, and First Aid Information for Primary Contaminants of Concern

Compound	Applicable Exposure Limit	IDLH	Primary Acute Symptoms from Inhalation and Dermal Exposures	Target Organs	First Aid
Xylene, o-, m-, p-	100 ppm [a,c] 150 ppm [b]	900	Irritates eyes, skin, nose and throat; causes dizziness, excitement	Eyes, skin, respiratory system, CNS, GI tract, blood, liver, kidneys (o-, m- and p-Xylene)	As above
Methyl tertiary butyl ether (MTBE) **[Ca]**	50 ppm [d]	NE	Irritates eyes, skin, and respiratory tract	Eyes, skin, respiratory system, CNS	As above
Gasoline **[Ca]**	300 ppm [a]	NE.	Irritates eyes, skin, mucous membrane; causes dermatitis, headache, weakness, exhaustion, blurred vision, dizziness, slurred speech, confusion, convulsions; possible liver, kidney damage	Eyes, skin, respiratory system, CNS, liver, kidneys	As above
Diesel fuel	10 ppm [a,c,e] 15 ppm [b,e]	NE	Irritates eyes, skin, and upper respiratory tract; CNS depression	Eyes, skin, respiratory system	As above

Sources: NIOSH *Pocket Guide to Chemical Hazards* (2013- accessed on-line) and manufacturer's safety data sheets (SDS); MSA *Response®* Guide (2013 - accessed on-line)

[a] National Institute of Safety and Health recommended exposure limit (NIOSH REL) - 10-hour time-weighted average (TWA)

[b] NIOSH short-term exposure limit (STEL) - 15 minute TWA - not to be exceeded

[c] Occupational Safety and Health Administration permissible exposure limit (OSHA PEL) - 8-hour TWA

[d] American Conference for Governmental Industrial Hygienists (ACGIH) - 8-hr TWA

[e] No exposure limit established; limits for naphthalene presented as a guide only

mg/m^3 = Milligrams per cubic meter
ppm = Parts per million
[Ca] = Known or suspected carcinogen
CNS = Central nervous system
CVS = Cardiovascular system
NE = None established

Site-Specific Health and Safety Plan

Project Name: Shamrock No. 63 FRP Implementation
Project Location: 3624 Cerrillos Rd Santa Fe NM
GLA Project Manager: John Casey

1. INTRODUCTION

This Health and Safety Plan (HASP) establishes the responsibilities, requirements, and procedures for Geo-Logic Associates (GLA) personnel while performing surface and subsurface investigations at the above-named site. The HASP summary is an integral part of this HASP and must be attached for the plan to be considered complete.

The objective of this HASP is to establish a safe work environment for all site personnel, provide a uniform and concise plan of action in an emergency, and furnish the necessary guidance to adhere to these policies. This HASP meets the requirements set forth by the Occupational Safety and Health Administration (OSHA) in Title 29 of the Code of Federal Regulations (CFR), Part 1910.120 (Hazardous Waste Operations and Emergency Response) and 29 CFR, Part 1926 (Safety and Health Regulations for Construction). This HASP is designed to augment the health and safety policies and procedures established in the GLA Health and Safety Program Manual (H&S Manual).

Safety is considered a priority during all field activities. Field personnel will not perform any task for which they have not received adequate training, or which they personally feel is unsafe.

2. DESCRIPTION OF SITE ACTIVITIES

The project will include DBS&A observation of the following activities: drilling and installing new wells, trenching and installation of buried and above ground conveyance pipelines, and installation of treatment equipment; and DBS&A performance of groundwater sampling and remediation system sampling.

Table S-2 in the HASP summary identifies the tasks that will be performed during the field program and the hazards associated with those tasks. The measures that will be employed to protect worker safety are described in Table S-3 and Sections 4 and 5 of this plan. Assuming that the site tasks do not change and that data from follow-up testing do not change the hazard assessment, this HASP will also apply to any subsequent field events. This HASP must be revised to address activities beyond those described above and listed in Tables S-2 and S-3.

The specific field activities are described in detail in the scope of work and the related sampling and analysis plan. The site-specific field methods and procedures are based on standard procedures established by GLA and applicable regulatory agency guidance.

The site is considered an uncontrolled hazardous waste site. All workers and visitors are subject to the OSHA requirements for hazardous waste workers in 29 CFR 1910.120.

The site is an active hotel and car sales location. Workers must be aware of traffic and pedestrians entering and exiting the site.

Nearest telephone:	GLA and Contractor personnel
Nearest water:	Potable water will be supplied
Nearest bathroom facilities:	Best Western Hotel
Nearest fire extinguisher:	GLA and Contractor vehicles
Nearest first aid kit:	GLA and Contractor vehicles
Warning/method signal for site evacuation:	Verbal

3. PROJECT PERSONNEL

The H&S manual establishes the roles and responsibilities for health and safety at various levels within the company. The GLA personnel responsible for the activities at the site are listed in the HASP summary. Their roles are described in the following subsections.

3.1 Project Manager

The Project Manager (PM) is responsible for implementing the GLA H&S Program at the site and designating the Site Safety Officer (SSO). The PM will oversee the preparation of this site-specific HASP, ensuring that the hazards associated with each task have been identified and that appropriate protective measures have been established. The PM will approve the final HASP.

3.2 Site Safety Officer

The SSO will be responsible for ensuring that all personnel entering an active work area comply with this HASP, meet appropriate OSHA medical and safety training requirements, and use the required level of personal protective equipment (PPE). The SSO will conduct site safety meetings prior to the start of work and before the start of each new activity. Workers will acknowledge their attendance by signing the tailgate safety meeting form (Appendix A). Accidents or incidents at the job site that affect or could potentially affect worker safety will be documented using the GLA I Illnesses, Injury, and Unusual Occurrence Report.

In accordance with the Hazard Communication standard (29 CFR 1910.1200), the SSO will coordinate with contractor representatives to identify hazardous materials being used on the site and to ensure that safety data sheets (SDSs [formerly referred to as material safety data sheets, or MSDSs]) are available for each material. Site workers will be briefed on hazardous

materials at the job site. The SSO will maintain SDSs for the hazardous chemicals routinely used at the site; the contractor will maintain SDSs for the hazardous chemicals they bring to the site.

To maintain a safe job site, all potentially dangerous conditions or practices must be corrected before proceeding with field work. The SSO will notify contractors and the PM of any unsafe work practices, and will stop all work on DBS&A projects if contractors do not abide by this plan.

The SSO will establish the initial level of PPE and respiratory protection and will upgrade or downgrade levels of protection in response to field conditions. Information and guidance concerning the PPE Program and the Respiratory Protection Program are found in the H&S manual.

The SSO will establish the physical limits of the work areas at the site and will instruct all personnel and visitors on the boundaries of the exclusion zones. Only authorized personnel will be allowed in active work areas. It is also the responsibility of the SSO to ensure that all personnel enter and leave active work areas through the decontamination station, if necessary. Specific site control measures are addressed in Section 9 of this plan.

3.3 Site Supervisor

The Site Supervisor is responsible for directing all field activities at the site and ensuring that the scope of work is completed. The Site Supervisor will serve as the SSO in his/her absence.

3.4 Site Workers and Visitors

Additional workers and visitors may be authorized to enter the site under the direction of the PM or the SSO. All workers must be properly trained in their assigned duties, including standard safety procedures. All workers and visitors entering the work zone will be familiar with the contents of this site-specific HASP and will sign the plan acceptance form (Appendix A). Constructive comments regarding the HASP should be directed to the PM, the SSO, or the GLA H&S Program Coordinator.

3.5 Contractors

Contractors to GLA are obligated to comply with OSHA regulations and standard industry safety practices for their profession. If a contractor proposes changes in the HASP, the SSO will obtain permission from the H&S Program Coordinator and the PM, and this authorization will be documented in the project site log. A modification to the HASP will be issued reflecting the changes. Additional contractor responsibilities are described in Section 14 of the H&S manual.

4. GENERAL HAZARD REVIEW AND ASSESSMENT

The hazard review for the site is based on GLA's experience conducting similar field operations at similar sites. Table S-2 in the HASP summary identifies the hazards associated with each task and provides a hazard ranking (from low to high) for each task. The controls (elimination, substitution, engineering, administrative, or PPE) that will be employed to protect worker safety are described in Sections 4 and 5 of this plan. Table S-3 in the HASP summary lists the PPE required to protect workers during each task and identifies the air monitoring equipment that will be used on site.

Tables S-4 and S-5 in the site HASP summary provide information on the physical and chemical characteristics, symptoms of exposure, and first aid procedures for each of the contaminants known or suspected to be present at the site. The OSHA permissible exposure limits (PELs) or the National Institute of Occupational Safety and Health (NIOSH) recommended exposure limits (RELs) for each contaminant of concern are also presented in Table S-5. The PEL and REL are levels to which one may be exposed for 8 hours per day, 5 days per week for one's working lifetime without resulting in adverse health effects.

4.1 Sunburn and Temperature Hazards

Sunburn is perhaps the most common hazard for field site workers. Sunburn is caused by overexposure to ultraviolet (UV) radiation from the sun. Chronic overexposure to sunlight, especially the UV-B component, accelerates skin aging and increases the risk of skin cancer. The following guidelines can be used to avoid overexposure to UV rays from the sun:

- Wear protective clothing (long sleeves, hats with protective brims, and long pants) that provides the most coverage, and is consistent with the job to be performed.
- Protect eyes with UV-absorbing sunglasses or tinted safety glasses.
- Use a commercial sunscreen with a skin protection factor (SPF) of at least 30 and protection against both UV-A and UV-B rays. Sunscreen should be applied 15 to 30 minutes before exposure and reapplied at 60- to 90-minute intervals. If possible, avoid exposure to the sun between 10:00 a.m. and 2:00 p.m., as rays are the most powerful during this period.

Heat stress is often the most critical hazard for field site workers. The effects can range from transient heat fatigue to serious illness and even death. Heat stress is caused by a number of interacting factors including environmental conditions, clothing, workload, and the individual characteristics of the worker. Because heat stress is fairly common during the summer and fall, preventive measures and alertness are especially important during these seasons.

Protective clothing and equipment affect the way the body controls its temperature. A previous heat injury (including sunburn) can also increase an individual's susceptibility to

further heat injury. Workers who have suffered a previous heat injury or who have sunburn must be especially vigilant in preventing heat stress and injury.

In order to ensure against heat stress-related problems, personnel should take frequent breaks in shaded areas. Workers should wear loose fitting clothing (except around rotating equipment) and will unzip or remove coveralls during breaks. Cool drinking water with added electrolytes will be made available and sufficient amounts of fluids should be consumed to avoid dehydration.

During hot weather, heat stress monitoring will be part of the daily regimen. GLA personnel will count their pulse rate for 30 seconds as early as possible in the rest period. If the pulse rate exceeds 110 beats per minute (bpm), the length of the next work period will be reduced by 20 minutes and the heat stress parameters will be observed again at that time. If the pulse rate at the beginning of the next test period exceeds 100 bpm and the last reading was over 110 bpm, the work cycle will be reduced by one-third. Whenever the pulse rate is elevated, work should not be resumed until the pulse rate is below 100 beats per minute. These heat stress indicators shall be observed at least once every hour.

During cold weather, GLA personnel should wear multilayer, wind-resistant outfits and drink warm fluids. Warm shelter will be available during breaks.

4.2 Weather Hazards

In addition to the hazards of UV radiation from the sun and extreme ambient temperatures, general weather conditions may present a hazard to field workers. Rain and snow may result in muddy, slippery conditions that make foot and vehicle travel hazardous. Lightning and tornadoes, common summertime phenomena, can be extremely hazardous. In the event of adverse weather (e.g., high wind and airborne dust, lightning, extreme cold or heat, or rain) that could compromise worker's health and safety during outdoor activities, the SSO will shut down operations. Additional safety measures for weather-related hazards are described in the H&S manual.

If lightning is visible and the sound of thunder is heard less than 30 seconds after lightning is observed, stop field operations and move to a sturdy, completely enclosed building. If a sturdy shelter is not available, get inside a hardtop automobile and keep the windows up. Automobiles offer excellent lightning protection.

In the event of a tornado, move to a pre-designated shelter. If an underground shelter is not available, move to an interior room or hallway on the lowest floor and get under a sturdy piece of furniture. Stay away from windows. If caught outside or in a vehicle, do not try to outrun a tornado in your car; instead, lie flat in a nearby ditch or depression. Remember that flying debris from tornadoes causes most deaths and injuries.

4.3 Biological Hazards

Venomous snakes and arthropods (e.g., insects, spiders, ticks, scorpions, and centipedes) create a hazard when their habitats are disturbed. Awareness and avoidance are the best defenses. Fieldwork shall be performed in a manner that minimizes disturbances of these creatures. Should a bite or sting occur, first aid shall be immediately applied and medical treatment sought as soon as possible.

The feces and urine of some desert rodents may be carriers of the hantavirus, and fleas on living or dead animals may carry bubonic plague. Both hantavirus and bubonic plague occur in New Mexico and the southwestern United States. Field workers should avoid all contact with rodent nests, droppings, or bodies. Professional medical treatment should be sought immediately if a worker suffers an animal bite of any kind.

Important Note: Any individual with a known allergy to wasps and bees must notify the SSO and/or PM/task leader prior to working at the project site. If an individual has a history of allergic reactions to insect bites or is subject to attacks of hay fever or asthma, or if they are not promptly relieved of symptoms after first aid is administered, a physician will be called or immediate emergency medical treatment will be sought. In a highly sensitive person, do not wait for symptoms to appear, as delay can be fatal.

4.4 Emergency Response

Table S-1 in the HASP summary lists the names and telephone numbers of people and agencies that might be contacted in the event of an emergency. The emergency response (ER) plan is included as Appendix B. The ER plan includes instructions and procedures for emergency vehicular access, evacuation procedures for personnel, methods of containing a fire, and instructions on how to handle a variety of specific medical emergencies.

5. TASK-SPECIFIC SAFETY GUIDELINES

Table S-2 in the HASP summary identifies each of the tasks that will be performed during the field investigation and the physical and chemical hazards associated with each task. Table S-3 in the site HASP summary identifies the requirements for PPE, and the air monitoring that will be performed. This section identifies the measures that will be taken to eliminate or minimize potential exposures to site workers for each task listed in Tables S-2 and S-3.

5.1 Drilling and Well Installation

Drilling and well installation will be conducted using hollow stem auger drilling methods. All workers should be aware that dust-size particles are easily inhaled and can lead to serious diseases like silicosis and cancer.

It is anticipated that the hazards associated with drilling operations at this site will be primarily physical (e.g., slips, trips, falls, etc.), as identified in Table S-2. Attention to site conditions, good housekeeping, and use of standard safety procedures will help to control or minimize the physical hazards.

Chemical hazards associated with drilling and monitoring well installation include potential inhalation of dusts and possibly organic vapors, and skin and eye contact with contaminated material. The discharge of dust can be nearly eliminated by using direct-push methods and can be controlled somewhat by other drilling technologies, such as reverse circulation, where long blooey lines can be used to discharge cuttings away from the work area. Injecting small amounts of water during the drilling process can suppress the amount of airborne dust. Direct-reading personal dust monitors (e.g., Thermo Scientific pDR-1500 personal DataRAM) can be used to identify and quantify airborne dust concentrations that a worker is exposed to while working. A photoionization detector (PID) will be used to screen for organic contaminants during both drilling and monitoring well installation activities. Appropriate PPE for these activities, including respiratory protection, is described in Table S-3.

The following safety guidelines and practices can be used to mitigate some of the hazards associated with drilling activities.

- The state one-call utility notification center (dial 811) must be contacted at least 48 hours before starting work so that local utility owners can be contacted to identify and mark the locations of any underground cables, pipes, or utility installations in the area of the proposed excavation. The locations of utilities should be discussed with the property owner to identify private utilities.
- Before starting work, a tailgate safety meeting will be held with all site workers. The GLA PM or Site Supervisor should thoroughly instruct the equipment operator as to the nature of the work to be performed and point out any special safety hazards. The SSO should ask the operator to identify and discuss any hazards associated with his particular equipment. All kill switches and safety devices on the drill rig shall be located and tested prior to drilling. Drilling shall not commence without a properly operating kill switch.
- A 15-foot radius work area shall be established around the drill rig. All GLA field personnel are to maintain a safe distance from the immediate area of the drill rig, and shall enter this work zone only when absolutely necessary for the performance of the task at hand.
- Appropriate and adequate barricades and/or warning lights shall be used to prevent accidental entry by workers and unauthorized persons, animals, or vehicles.
- Under no circumstance shall GLA personnel become directly involved in drilling operations, other than those immediately required for sample collection and for the performance of vapor monitoring and geologic logging.

- When appropriate, the contractor will provide an operator's assistant to help watch for safety hazards, such as buried lines, overhead hazards, ditches, or posts.
- All equipment should maintain at least 20 feet of clearance from overhead power lines. Working within less than 20 feet of overhead utilities must be coordinated with the utility.
- Be aware of and monitor for potentially hazardous levels of toxic vapors that can be displaced from the borehole during installation of the monitor well materials.

Additional safety guidelines to be considered when working around heavy equipment are provided in the H&S manual.

5.2 Soil Sampling

Soil samples will be collected using the drilling rig and a modified split-spoon sampler or Shelby tube. Physical hazards may include any of those identified in Table S-2 and Section 5.1 regarding drilling and monitoring well installation. Chemical hazards associated with soil sampling include potential inhalation of dusts and possibly organic vapors, and skin and eye contact with contaminated material. Attention to site conditions, good housekeeping, and use of standard safety procedures will help to control or minimize the physical hazards. A PID will be used to screen for organic contaminants during soil sampling activities. Appropriate PPE for soil sampling is described in Table S-3.

5.3 Well Development and Groundwater Sampling

Groundwater samples will be collected from groundwater monitoring wells. Prior to sampling, water level measurements will be collected using a water level indicator. Physical hazards may include any of those identified in Table S-2. Chemical hazards associated with well development and groundwater sampling include potential skin and eye contact with contaminated groundwater and sample preservatives. Attention to site conditions, good housekeeping, and use of standard safety procedures will help to control or minimize the physical and chemical hazards. Appropriate PPE for well development and groundwater sampling will include that described in Table S-3.

5.4 Installation and Operation of SVE System

Site activities will include installation and operation of a full scale SVE system. Chemical hazards associated with this work include inhalation of organic vapors. Physical hazards may include typical construction hazards due to work with and around heavy equipment; heat stress; trips, falls, and slips; and electrical hazards when working in and around open electrical panels. Use caution when working around blower discharge piping; it is insulated but may be hot. Blowers have sound attenuating enclosures, but ear protection may be needed when working around equipment. Remediation well vaults are located in an active hotel parking lot and car sales lot so utilize reflective safety vests and traffic cones when working in well vaults.

Appropriate PPE will include safety glasses or goggles, steel-toed boots, and long-legged pants. Air monitoring will be conducted using a PID to monitor organic vapors in the breathing zones of workers and around piping joints. Diligent air monitoring and the use of appropriate PPE and standard safety procedures will minimize the risk of exposure and physical injury. Work in and around electrical panels shall be conducted by qualified professionals and shall include locking and tagging of affected equipment.

5.5 Excavating and Trenching Activities

Excavating and trenching operations will be conducted using a backhoe or a larger excavator (trackhoe). The hazards associated with excavating operations at this site will be primarily physical (e.g., slips, trips, falls, etc.), as identified in Table S-2. Chemical hazards associated with excavating and trenching activities include potential skin and eye contact with airborne particulates and contaminated soil. Attention to site conditions, good housekeeping, and use of standard safety procedures will help to control or minimize the physical and chemical hazards. Appropriate PPE for well development and groundwater sampling will include that described in Table S-3.

Any excavation/trenching operations will be performed in accordance with OSHA regulations in 29 CFR 1926, Subpart P (Excavations). Properly trained contractor personnel will operate excavating equipment; at no time will an employee of GLA operate excavating equipment. Personnel should be sure they have eye contact with equipment operators before approaching heavy equipment. Never approach equipment from or work within an operator's blind spots. GLA employees will be familiar with and avoid hazards associated with work near or in trenches.

A “competent person” trained to interpret soil conditions and to identify the proper safety protection devices or procedures needed for each particular situation shall be in charge of all excavation and trenching activities at the job site. “Competent person” means one who is capable of identifying existing and predictable hazards in the surroundings, or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them. The GLA competent person shall be designated by the PM and will be familiar with their role and responsibilities (refer to the H&S manual). All site workers should be familiar with basic soil mechanics related to excavations (refer to the H&S manual) and pay particular attention to identify evidences of distress in the excavation.

The following safety guidelines and practices can be used to mitigate some of the hazards associated with excavation activities:

- Contact the local utility locator to identify and mark the locations of any underground cables, pipes, or utility installations in the area of the proposed excavation. Discuss the locations of utilities with the property owner to identify private utilities.

- Take additional precautions when excavating a backfilled trench, or when working near railroads, highways, or other sources of vibrations.
- Provide appropriate and adequate barricades and warning lights to prevent accidental entry by workers and unauthorized persons, animals, or vehicles.
- Do not leave a hazard unguarded. Secure the site or surround the excavation with plastic high-visibility fencing to prevent accidental entry.
- If personnel are required to enter a trench or excavation that is greater than 5 feet in depth or excavated in soft or unstable materials, the sides of the excavation will be shored or sloped in accordance with OSHA regulations in 29 CFR Part 1926.652.
- If the excavation cannot be sloped adequately (usually at 1.5 horizontal to 1 vertical), trench boxes, shoring, sheeting, bracing, or other equivalent methods are required to keep the trench wall from collapsing.
- When workers are required to enter trenches that are 4 feet or greater in depth, an adequate means of exit, such as ladders or steps, shall be provided. Exit points shall be spaced no more than 50 feet apart.
- If the trench is 4 feet or more in depth and hazardous atmospheres exist or could reasonably be expected to exist, the trench shall be considered a confined space. Workers entering the trench shall be properly trained in confined space entries, and atmospheric testing for oxygen content, flammability, and organic or other vapors shall be performed before entering the trench. For additional information on the GLA Confined Space Program, refer to the H&S manual or contact the H&S Program Coordinator.

6. STANDARD SAFE WORK PRACTICES

The following guidelines are meant to cover operations by GLA field staff and GLA contractors (e.g., the drill crew and support personnel) during field activities at the site. GLA contractors may choose to establish and enforce more stringent safety guidelines for personnel under their employ. Health and safety issues for other personnel working or visiting at the site *and not involved in the site activities* are the responsibility of the Client and their respective contractors, not GLA.

Prior to the initiation of any on-site activities, the SSO will conduct a safety meeting to discuss the contents of this site-specific HASP, describe the field activities, identify any high-risk activities, and familiarize personnel with emergency procedures, including the route to the hospital. The GLA field supervisor will establish that all equipment is in good condition. The GLA supervisor should properly and thoroughly instruct the contractor on exactly what results are to be accomplished and point out all known safety hazards.

During the field activities, all participants will be expected to follow standard safe work practices as outlined below:

- Do not eat, drink, smoke, or chew tobacco in the work area.
- Avoid contact with potentially contaminated substances.
- Report any unsafe conditions to the SSO.
- Be aware of the physical characteristics of investigations, including:
  - Wind direction in relation to the contaminated area
  - Accessibility to associates, equipment, vehicles, etc.
  - Communication
  - Areas of known or suspected contamination
  - Site access
  - Nearest water sources
- Dispose of all wastes generated during field activities in accordance with applicable regulatory guidelines.

7. AIR AND NOISE MONITORING

This section describes the measures that will be taken to protect workers from exposures to hazardous atmospheres and noise during the site activities.

7.1 Air Monitoring

This site is contaminated with fuel-related petroleum hydrocarbons (gasoline, diesel) and the potential exists for the development of toxic or explosive atmospheres in or near the borehole, monitor well, or excavation. Drilling and excavating activities also have the potential to create hazardous levels of dust and airborne particulates. Respiratory protection will be used if air monitoring shows the presence of a hazardous atmosphere at concentrations above occupational exposure limits.

Respiratory protection will be used in accordance with OSHA regulations in 29 CFR 1910.134 and the GLA Respiratory Protection Program Plan. All persons using respiratory protection must be medically cleared to do so and should be aware of the following important definitions:

- Assigned protection factor (APF) is the level of protection that a respirator or class of respirators is expected to provide to employees and is used to select the appropriate class of respirators. Level C PPE includes an air-purifying respirator (APR). A half-face APR has an APF of 10; a full-facepiece APR has an APF of 50.
- Maximum use concentration (MUC) is the maximum atmospheric concentration of a hazardous substance from which an employee can expect to be protected when wearing a respirator. The MUC is calculated by multiplying the occupational exposure limit by

the APF. For example, in the case of benzene, OSHA has established a permissible exposure level (PEL) of 1 ppm (for an 8-hour time-weighted average [TWA)]), and a short-term exposure limit (STEL) of 5 ppm. Therefore, the MUC for benzene is 10 ppm for a half-face APR and 50 ppm for a full-facepiece APR. The half-face and full-facepiece APRs may be used for short periods of time (up to 15 minutes) in benzene concentrations up to 50 and 250 ppm, respectively (STEL x APF).

Table S-3 in the HASP summary identifies each of the tasks to be performed at the site and the air monitoring requirements for each task. Targets of such monitoring may include organic vapors, particulates, combustible gases, and oxygen. Table S-4 lists each of the contaminants of concern for the site. Table 1 lists the types of hazardous atmospheres that could be present at a site, the air monitoring equipment used for each, and the action levels to be used at this site. When in use, all meters will be calibrated daily in accordance with manufacturer's instructions.

Table 1. Air Monitoring Equipment, Action Levels, and Protective Measures

Hazard	Equipment	Action Levels in BZ	Action Response
Organic Vapors	PID, FID	Background	Level D PPE
		OEL of most toxic contaminant sustained for 5 minutes	Use Level C respiratory protection; evaluate specific compounds.
		MUC for respiratory protection in use.	Stop work; upgrade to Level B
	Colorimetric (Drager) Tubes	Chemical specific: >1 ppm for benzene >1 ppm for vinyl chloride >1 ppm for 1,1-DCE	Use Level C respiratory protection if compounds exceed OELs.
Particulates	Dust Monitor	Visible dust	Suppress with water
		<5 mg/m3	Level D PPE
		>5 mg/m3	Use Level C respiratory protection
Flammable/explosive Atmosphere	Explosimeter	<10% scale reading	Proceed with work
		10 - 15% scale reading	Stop work
		>15% scale reading	Evacuate site
Oxygen-deficient Atmosphere	Oxygen Meter	19.5 -- 23.5%	Normal - continue work
		<19.5%	Evacuate - oxygen deficient
		>23.5%	Evacuate - fire hazard
Ionizing radiation	Gamma radiation meter	>0.1 millirem/hr	Radiation sources may be present
		>1 millirem/hr	Evacuate - radiation hazard

BZ = Breathing zone
PID = Photoionization detector
FID = Flame ionization detector
PPE = Personal protective equipment
MUC = Maximum use concentration
ppm = Parts per million
mg/m^3 = Milligrams per cubic meter
1,1-DCE = 1,1-Dichloroethene

OEL = Occupational exposure limit

The SSO or his/her designee will obtain PID readings of organic vapor concentrations in the breathing zone of the workers. Readings will be made after each section of drill pipe is advanced and at the working face of the excavation as the excavation progresses. The person making the PID measurements will determine the extent of the affected area, record the readings, and advise workers of the results.

7.1.1 Organic Vapors

The need for respiratory protection from toxic vapors is based on the most hazardous constituent that is likely to be present or known to be present, based on soil, soil gas, and/or groundwater sampling. Table S-4 lists each of the volatile contaminants of concern for the site.

A release of gasoline has occurred at this site. Gasoline is a complex mixture of petroleum hydrocarbons, additives, and blending agents, whose composition varies widely. The most hazardous constituent is benzene, a known human carcinogen. A PID will be used to monitor organic vapor concentrations; in the absence of other data, the PID readings are assumed to be due to benzene. If testing shows that benzene is not present or does not occur at significant concentrations, toluene, the next most volatile aromatic hydrocarbon in gasoline would be considered the most hazardous constituent. The OSHA PEL and STEL for benzene are 1 ppm and 5 ppm, respectively. The OSHA PEL for toluene is 200 ppm.

Assuming the presence of benzene, work will stop and workers in the affected area will upgrade to Level C respiratory protection if PID readings exceed 1 meter unit (usually parts per million by volume or ppmv) above background in the breathing zone for 5 minutes, or if unusual or unpleasant odors are detected. Workers will leave the work zone when PID readings exceed the MUC for the respiratory protection being used (10 ppm for a half-face APR; 50 ppm for a full-face APR). All personnel within the work zone will continue to wear respiratory protection until vapor levels dissipate below 1 meter unit. APRs will be equipped with organic vapor cartridges that will be changed at the end of each 8-hour shift.

A benzene-specific colorimetric tube (e.g., Draeger) can be used to determine whether benzene is present and at what concentration. If the colorimetric tube indicates that benzene concentration exceeds 1 ppm, all personnel within the affected area must use respiratory protection. If the colorimetric tube indicates that benzene is not present, exposure levels for toluene will be used to determine the need for respiratory protection. The SSO will periodically check for the presence of benzene using a colorimetric tube.

All personnel should be aware that the detection capabilities of PIDs may be enhanced or dampened by high humidity or by the presence of certain gases, such as methane. Direct evidence of contamination, such as visible staining of soils or strong odors, should be used to further evaluate these quantitative instrument readings.

7.1.2 Combustible and Oxygen-Deficient Atmospheres

An instrument or instruments capable of detecting combustible gases and oxygen levels will be used during drilling, monitoring well installation, and excavation activities. The instrument(s) shall be placed as close to drill, open borehole, or working face of the excavation, as possible. The lower explosive limit (LEL) and the upper explosive limit (UEL) for benzene are 1.2 percent and 7.8 percent, respectively. Similar values are published for gasoline (NIOSH Pocket Guide). Drilling or excavating operations will be suspended when combustible gas measurements are at or between the LEL and the UEL.

Normal atmosphere contains between 20.8 and 21 percent oxygen. The atmosphere is oxygen-deficient if it contains less than 19.5 percent oxygen, and oxygen-enriched if it contains more than 22 percent oxygen. Oxygen-deficient atmospheres may be created when oxygen is displaced by other gases, or consumed by bacterial activities. Oxygen-enriched atmospheres can be created by certain chemical reactions and present a significant fire and explosion risk. Drilling or excavating operations will be suspended when readings indicate oxygen levels at or below 19.5 percent and at or above 22 percent.

7.1.3 Particulates

When respirable dust is considered a potential hazard (e.g., drilling or excavating operations), direct-reading personal dust monitors (e.g., Thermo Scientific pDR-1500 personal DataRAM) should be used to identify and quantify airborne dust concentrations that a worker is exposed to while working. NIOSH has established a recommended exposure limit (REL) for crystalline silica as respirable dust of 0.05 milligrams per cubic meter (mg/m^3). This value is 10-hour TWA concentration for a 40-hour workweek. NIOSH recommends the use of N95 or more efficient filters for protection against respirable dust. The MUC for crystalline silica as respirable dust is 0.5 mg/m^3 for a half-face APR and 2.5 mg/m^3 for a full-face APR. Supplied air respirators must be used if airborne concentrations of crystalline silica exceed 2.5 mg/m^3 (NIOSH Pocket Guide, 2013). Respirator cartridges and filters will be changed each day.

7.2 Noise Monitoring

All site personnel who are exposed to average noise levels of 85 A-weighted decibels (dBA) or greater during an 8-hour workday must participate in their company's Hearing Protection Program. Workers must use appropriate hearing protection whenever noise levels exceed 90 dBA. The GLA H&S Program Coordinator has used a noise meter to survey a variety of equipment that may be used during the site activities and found that work around heavy equipment is most likely to require hearing protection. Noise levels are highest near the engines and compressors, but generally do not exceed 85 dBA in the typical operator locations (e.g., behind the drill rig). However, impact noise, such as the tripping of a pneumatic or hydraulic hammer on a direct-push rig or driving casing on a dual-tube drill rig, can be considerably higher. When a noise meter is not available, the following rule of thumb should

be used: if it seems loud or you cannot carry on a normal conversation, hearing protection should be worn.

8. PROTECTIVE EQUIPMENT

PPE requirements for each task are described in Table S-3. At a minimum, the following PPE shall be used by personnel while working at the site:

- Steel-toed/steel-shanked work boots
- Long pants
- Protective eyewear
- Hard hat (when needed)
- Chemical-resistant gloves (when needed)
- Hearing protection (when needed)

Level C PPE will include Level D equipment plus a full- or half-face air-purifying respirator with appropriate cartridges and prefilters. Workers using respiratory protection should be familiar with guidelines to determine that the equipment being used for respiratory protection is providing adequate protection, as discussed in Section 7.1. Chemical-resistant coveralls and/or gloves will be worn whenever conditions require GLA field personnel to come in direct contact with potentially contaminated materials.

GLA will supply employees with PPE that meets requirements established by NIOSH or the American National Standards Institute (ANSI), and that meet current OSHA criteria. Employees will be trained in the selection, care, and use of PPE, as described in the H&S manual.

8.1 Disposal of Contaminated Clothing or Equipment

All potentially contaminated clothing, Tyvek coveralls, gloves, paper towels, and other expendable items will be placed in garbage bags for disposal. Fresh Tyvek coveralls and work gloves should be donned at the start of each workday or when otherwise required.

8.2 Decontamination Procedures

Specific personnel decontamination procedures are based on the personal level of protection. When using Level D protection, a personnel decontamination system (PDS) is not required. However, because project personnel wearing Level D protection may need to upgrade to Level C if site conditions change, a PDS may be established based on specific site characteristics.

The decontamination stations for Level C decontamination may include (1) a segregated equipment drop for hand tools and monitoring equipment, (2) a wash and rinse for gloves and disposable booties (if worn), (3) a removal station for gloves and disposable booties (if worn), (4) a removal station for respiratory protection, hard hat, safety glasses, and Tyvek suits, and (5) a station to wash and rinse hands and face. Specific procedures and the sequence of events

will be determined based on the potential hazards identified at the site. The stations listed are a guide to the selection of adequate decontamination procedures.

When a PDS is set up, the SSO or his/her designee has the responsibility for operating the decontamination station. This person will make sure that all personnel enter and leave active work areas through the PDS, that all personnel decontaminate properly, and that disposable items are bagged. The SSO will assist on-site workers in changing cartridges, masks, gloves, or other pieces of safety equipment, and monitor the length of work periods. Disposable items will be placed in plastic bags and properly disposed of. Non-disposable items will be properly cleaned and dried according to manufacturer's specifications and stored for future use.

Decontamination procedures, which are based on guidelines appropriate for low-level contamination, will be required for all reusable equipment used for drilling, sampling, personal protection, and field monitoring. Drilling equipment will be decontaminated between each borehole. Sampling equipment will be decontaminated between each sample. High-pressure steam cleaners, alconox detergent solution, and deionized water rinses may be used. If necessary, personnel will decontaminate equipment at a specified decontamination area between boreholes and before leaving the site. Field monitoring equipment will be cleaned daily; additional cleaning and recalibration will be performed if contamination affects operation.

9. SITE CONTROL

Barricades, caution tape, or other necessary means shall be used when necessary to prevent unauthorized access into the work area. The SSO will establish the physical limits of the work areas at the site and instruct all personnel and visitors concerning the boundaries of the exclusion zones.

At a minimum, a 15-foot-wide primary exclusion area will be established around the perimeter of the drill rig or other active machinery. GLA personnel will enter the primary exclusion zone only when absolutely necessary for the performance of the task at hand. A secondary exclusion zone will be established around the general work area. If necessary, the work area will be marked off with temporary barriers and caution tape. Only authorized personnel will be allowed in active work areas.

Traffic control plans may be required for all sites where work activities may impact traffic flow on adjacent roadways. These plans must be submitted to and approved by the local traffic control authority. The PM or their designee will be responsible for ensuring that the necessary site control measures and plans are prepared and implemented.

10. CONFINED SPACE ENTRY

No confined spaces have been identified at the site and no confined space entries are anticipated during the field activities. However, any confined spaces identified as the work

progresses shall be properly marked and managed accordingly. GLA has developed and implemented a Confined Space Entry Program Plan that provides policies and procedures to be followed for confined space entries, including air monitoring, participant training and duties, and authorizing and permitting confined space entries.

If confined space entries become necessary, the SSO will contact the PM and this site-specific HASP will be amended accordingly. The SSO will ensure that entries are performed in accordance with the GLA Confined Space Entry Program Plan. If necessary, the SSO will contact the local fire department to coordinate the entry and rescue requirements.

11. SPILL PREVENTION

Minor spills of potentially contaminated soil, residual free product, or groundwater may occur during site work. The area beneath drill rig may be lined with plastic sheeting to control fluid leaks from the equipment. If a spill occurs, site personnel will use best judgment and available materials to contain and prevent it from spreading. All contained soil and liquids will be disposed of in compliance with federal, state, and local requirements.

12. SAFETY MEETINGS

A site safety or "tailgate" safety meeting will be held before the start of work for the project and before the start of each new activity. All personnel directly involved in the work are required to attend. This HASP and all pertinent health and safety issues will be discussed during the initial briefing or meetings. The tailgate meeting will also address specific issues regarding on-site health and safety, such as the proposed work and associated hazards, recent problems, and any accidents or incidents. All personnel will acknowledge their attendance by signing the safety meeting form (Appendix A).

13. TRAINING REQUIREMENTS

Before entering the site, workers will have received the necessary training required by OSHA for workers at potentially hazardous waste sites [29 CFR 1910.120(e)], including 40 hours of formal instruction and a minimum of 3 days of field experience under the supervision of a trained and experienced worker. Additionally, site supervisors will have completed an 8-hour health and safety supervisor training course. Before starting work, each worker will receive site-specific hazard recognition and emergency response training.

In the event that organic vapor concentrations in the work zone require an upgrade to Level C PPE, only workers who are trained and medically cleared to wear a respirator will be allowed in the work zone.

GLA's contractors will certify, by name, that each of their employees who will perform field work at a hazardous waste project site has received the applicable health and safety training listed above.

14. MEDICAL MONITORING REQUIREMENTS

All medical monitoring will be performed in accordance with 29 CFR 1910.120(f), 29 CFR 1910.134 (Respiratory Protection), and 29 CFR 1910.95 (Occupational Noise Exposure). The PM must identify any chemicals of concern that might require monitoring (e.g., lead or PCBs) before and after the site activities.

The GLA medical monitoring program is directed by WorkCare in Anaheim, California. In the event of a chemical exposure resulting in symptoms or illness, the SSO may contact Dr. Peter Greaney at WorkCare (800-455-6155) to obtain guidance for recommended testing protocols.

15. HOSPITAL AND EVACUATION ROUTE

If a medical emergency occurs during work at the site, the Christus St. Vincent Regional Medical Center in Santa Fe, NM is the closest emergency room facility. Figure S-1 in the HASP summary provides a computer-generated route map from the site to the hospital, with driving directions. All workers should be familiar with the location of this facility. The SSO will perform a pre-activity physical route check to determine any planning modifications required. If the evacuation route needs to be modified, this HASP will be corrected, and all workers will be notified of the changes. All workers should be familiar with the location of this facility.

Appendix A

Health and Safety Forms

Geo-Logic ASSOCIATES

Health and Safety Plan Acceptance Form

Instructions: This form is to be completed by each person prior to beginning work at the subject hazardous waste site. THIS FORM IS TO BE MAINTAINED IN THE PROJECT FILES.

Project _____

Job No. _____

Location _____

By my signature below, I acknowledge that I have read and understand the contents of the Health & Safety Plan for this project. I agree to perform my work in accordance with the plan.

Signature	Print Name	Company	Date

Geo-Logic ASSOCIATES

Tailgate Safety Meeting

Project ID:_____ Day: _____

Location:_____ Date: _____

Project Manager:_____ Team Leader: _____

Health & Safety Officer:_____ No. of Personnel Present: _____

Check Topics Discussed

Scheduled Activities:_____

Chemical/Physical Hazards
- Contaminants of Concern
- Safety Data Sheets
- Overhead & Underground Utilities
- Extraordinary Site Conditions
- Lifting/Slips/Trips/Falls
- Heat/Cold Stress (Inc. Sunburn)
- Other:_____

First Aid
- Facilities/Kits/Eyewashes

Personal Protective Equipment - Level D
- Hard Hats/Hearing Protection
- Steel-Toed Boots
- Glasses/Goggles/Shields
- Gloves
- Contingency: Level C
- Respirators & Tyvek/Saranex

Emergency Procedures/Site Safety
- "Buddy System"
- Communication
- Facility-Specific Regulations
- Rally Point

Vehicle/Heavy Equipment
- Drill Rig "KILL" Switches
- Operation & Inspection
- Preventive Maintenance
- Rotating Augers/Moving Parts

Sanitation & Hygiene
- Drinking Water/Fluids
- Restrooms
- Personal Cleanliness

Housekeeping
- Waste Containers
- Waste Materials
- Waste Water/Decon. Water

Fire Prevention
- Locations of Extinguishers
- Smoking
- Hot Work
- Explosive & Flammable Liquids
- Other:_____

Emergency Facilities (and Directions)
- Name:_____
- Address:_____
- Tel. No.:_____

Safety Meeting Attendees:

Name	Signature	Name	Signature

Geo-Logic ASSOCIATES

Illnesses, Injury, and Unusual Occurrence Report

Date of Event: _____ Report Number: _____

1. Name of the Site: _____

2. Name of individual(s) injured, ill, or exposed:

_____

_____

3. Provide a brief, but concise description of the event:

_____

_____

4. Damaged Property:

_____

_____

5. Damage to equipment and the type of equipment:

_____

_____

6. Did this accident involve a motor vehicle? Yes _____ No _____

Any motor vehicle accident, regardless of fault, which involves a company vehicle, rental vehicle, or personal vehicle, while the employee is acting in the course of employment must be accompanied by a police report, unless the police refuse to respond to the scene of the accident. In addition, draw a simple illustration of the scene on the reverse side of this form.

7. Action taken/additional employee training:

_____

8. Name and Signature: _____ Name (print)

_____ Signature

_____ Date Completed

Diagram 1:



Diagram 2:



Geo-Logic ASSOCIATES

Daily Site Safety Checklist

Job Name and Number: _____

Person Completing Form: _____ **Date(s):** _____

Instructions: Use form for up to five consecutive days. Write in date, place checkmark to indicate item has been completed. Deficiencies must be corrected. Completed form to be maintained with the Project files with copy to H&S Program Coordinator.

Checklist Item	Date				
The HASP (including emergency phone numbers) has been reviewed and signed by GLA staff, subcontractors, & visitors and is available on site					
Hazardous chemicals have been discussed and SDSs are available for each hazardous chemical on site.					
Tailgate Safety Meeting has been conducted for all site workers and visitors (and updated as necessary)					
Copies of Hospital Route map and emergency phone numbers are available in all vehicles					
DBS&A personnel and subcontractors have discussed hazards associated with Site-specific work					
Potential slips, trips, or fall hazards have been identified and mitigated where possible					
Site control measures have been established for present conditions (e.g., safety cones or caution tape)					
Proper PPE has been identified and is being used for present conditions					
Personnel monitoring is being conducted for present conditions					
An operating, fully-charged cell phone is available on site					
A fully-stocked first aid kit and eye wash bottle are readily available					
Fully-charged fire extinguishers are available for use.					
All workers and visitors have training appropriate for assigned tasks					
Equipment on-site has been inspected and is in safe working order					
Electrical power operated tools are properly grounded and used with a GFCI					
Excavated soils are properly stored and labeled					
Excavations are properly shored/sloped and barricaded					
Used disposable PPE and garbage are bagged for proper disposal					
All Health and Safety concerns have been communicated to the Site H&S Officer and the Project Manager					

Geo-Logic ASSOCIATES

Project Health and Safety Checklist

The Project Manager and their designated site supervisors and safety officers are responsible for the implementation of the company health and safety program. This form has been designed to help the Project Manager meet the health and safety guidelines established by the company in accordance with OSHA regulations and accepted protocols. If you have any questions, contact the H&S Program Coordinator.

Project Planning

_ Do all of the workers at the site have the required or appropriate level of safety training for the site and the assigned tasks (e.g., current 40-hour training, 8-hour Supervisor training, 3-day supervised training)?

_ Has an OSHA-trained Supervisor been designated for the site?

_ Has a Safety Officer been designated for the site?

_ Has a Competent Person been designated for the site (required at construction/excavation sites)?

_ Do field personnel have current first aid/CPR training?

_ Are there any health hazards at the site that require workers to be medically monitored (e.g., excessive noise, possible respirator use, or potential for exposure to hazardous contaminants)?

_ Are there any special health hazards at the site that require baseline testing before and follow-up testing after field activities (e.g., cadmium or PCBs)?

Site H&S Plans

_ Has a site-specific H&S Plan been prepared? *[Required for all Hazwoper sites; Company policy requires completion of the H&S Plan Summary at a minimum.]*

_ Has the site H&S Plan been reviewed and approved by the PM?

_ Have all site workers been briefed on the contents of the site H&S Plan and signed-off on the Plan?

_ Have Tailgate Safety Meetings been held as necessary (e.g., prior to the start of activities, when activities or conditions change, or when new workers come on site) and have those present signed the attendance sheet?

_ Do site workers understand the site hazards and know the route to the hospital?

_ Have clearances been obtained for underground utilities?

Documentation

The following documentation should be available at the field site or in the office for inspection:

_ Site-specific H&S Plan signed by site workers **(must be available at the field site)**

_ Utility Clearance Form **(must be available at the field site)**

_ MSDSs for hazardous chemicals used on-site **(must be available at the field site)**

_ Tailgate Safety Meeting forms signed by site workers (current one in the field and completed forms in the project file)

_ Records of excavation inspections by Competent Person (current one in the field and completed forms in the project file)

_ Copies of Accident/Incident or Chemical Exposure reports (submitted to H&S Program)

_ Results of any safety inspections (project and/or program files)

Appendix B

Emergency Response Plan

Emergency Response Plan

PURPOSE AND SCOPE

The following Emergency Response Plan has been developed to include instruction and procedures for emergency vehicular access, evacuation procedures for personnel, methods of containing a fire, and medical emergencies. All extraordinary conditions that require concise and timely action must be dealt with in a manner that minimizes the health and safety risks to the immediate site personnel and the general public.

GENERAL RESPONSE CONSIDERATIONS

All on-site personnel shall be familiar with the Emergency Response Plan described herein. This section will be maintained in the field office.

Due to the nature of the site, the emergencies or extraordinary conditions that may arise are more than likely limited to personnel accidents requiring first aid, exposure to contaminated sediments, and potential fire near mechanical equipment. The following procedures shall be implemented in the event of an emergency:

- First aid or other appropriate initial action will be administered by those closest to the accident/event. This assistance will be coordinated by the Site Safety Officer (SSO) and will be conducted in a manner so that those rendering assistance are not placed in a situation of unacceptable risk. The primary concern is to avoid placing a greater number of workers in jeopardy.
- Personnel shall report all accidents and unusual events to the SSO, the subcontractor Health and Safety representative, and the Project Manager (PM).

The SSO and other on-site personnel are responsible for conducting the emergency response in an efficient, rapid, and safe manner. The SSO will decide if off-site assistance and/or medical treatment is required and shall be responsible for alerting off-site authorities and arranging for their assistance. The SSO, in coordination with the contractor Health and Safety representative, will provide an Accident/Incident Report to the PM that includes the following:

- A description of the emergency (including date, time and duration)
- Date, time and names of all persons/agencies notified and their response
- A description of corrective actions implemented or other resolution of the incident

All workers at the site are responsible for conducting themselves in a mature, calm manner in the event of an accident/unusual event. All personnel must conduct themselves in a manner to avoid spreading the danger to themselves and to surrounding workers.

RESPONSIBILITIES

The SSO shall have responsibility for directing response activities in the event of an emergency. He/she will:

- Assess the situation
- Determine required response measures
- Notify appropriate response teams
- Determine and direct on-site personnel during the emergency

The SSO shall coordinate the response activities of on-site personnel with those of public agencies.

PUBLIC RESPONSE AGENCIES

The site-specific HASP includes a list of public response agencies to be contacted and who may, depending on the nature of the situation, assume authority for emergency response. The HASP presents local emergency numbers, including local hospitals (which includes the poison control center), ambulance service, fire and police departments, and others. In addition, nationwide hotline numbers for emergency assistance are listed. These phone lists should be retained by all field personnel and posted by the phone in all field trailers.

The hospital location is outlined in the HASP. The SSO will provide directions and/or maps to these facilities to all field personnel.

Prior to the initiation of all on-site work, the local police and fire department will be notified, if deemed necessary. This notification will take the form of a letter describing both on-site and off-site activities. If requested, a briefing will be held to further explain the type of activities and equipment that are associated with each project. Emergency procedures also will be discussed.

ACCIDENTS AND NON-ROUTINE EVENTS

Several types of emergencies are outlined in the following subsections. These are not intended to cover all potential situations, and the corresponding response procedures should be followed using common sense. Every accident is a unique event that must be dealt with by trained personnel working in a calm, controlled manner. In the event of an accident/unusual event, the prime consideration is to provide the appropriate initial response to assist those in jeopardy without placing additional personnel at an unnecessary risk. Employees shall be instructed to report all injuries and illnesses to the SSO.

Worker Injury

If a person working on the site is physically injured, appropriate first aid procedures shall be followed. Depending on the severity of the injury, emergency medical response may be sought. If the employee can be moved, he/she will be taken to the edge of the work area where contaminated clothing (if any) will be removed, and emergency first aid administered. If necessary, transportation to local emergency medical facility will be provided as soon as possible.

If a worker can only be moved by emergency medical personnel, the SSO will decide what protective equipment, if any, is required to be worn by emergency personnel. Each work area will have extra equipment available for emergencies.

If the injury to the worker involves chemical exposure, the first aid procedures summarized in Table S-5 should generally be initiated as soon as possible, including the following:

- **Eye Exposure:** If contaminated solid or liquid gets into the eyes, wash eyes immediately at the emergency eyewash station using water and lifting the lower and upper lids occasionally. Obtain medical attention immediately if symptoms warrant.

- **Skin Exposure:** If contaminated solid or liquid gets on the skin, wash skin immediately at the decontamination station using soap and water. Obtain medical attention immediately if symptoms warrant.

- **Inhalation:** If a person inhales large amounts of organic vapor, move him/her to fresh air at once. If breathing has stopped, perform cardiopulmonary resuscitation (CPR), as per American Red Cross standard first aid instruction. Keep the affected person warm and at rest. Obtain medical attention as soon as possible.

- **Ingestion:** If contaminated solid or liquid is swallowed, medical attention shall be obtained immediately by consulting the Poison Control Center as outlined in the site-specific HASP.

Temperature-Related Problems

Adverse weather conditions are important considerations in planning and conducting site operations. Hot or cold weather can cause physical discomfort, loss of efficiency, and personal injury. One or more of the following control measures shall be employed to help control heat stress:

- Provide adequate non-alcoholic liquids to replace lost body fluids. Employees must replace water and salt lost through perspiration. Employees will be encouraged to drink more than the amount required to satisfy thirst, as thirst satisfaction is not an accurate indicator of adequate salt and fluid replacement.

- Replacement fluids can be a 0.1 percent salt solution, commercial mixes such as GatoradeTM or Quick KickTM, or a combination of these with fresh water.
- Establish a work regimen that will provide adequate rest periods for cooling down.
- Take rest breaks in a cool, shaded area during hot periods.
- Employees shall not be assigned other tasks during rest periods.
- Inform all employees of the importance of adequate rest, acclimation, and proper diet in the prevention of heat stress.

Adverse Weather

In addition to the hazards of UV radiation from the sun and extreme ambient temperatures, general weather conditions may present a hazard to field workers. Rain may result in muddy, slippery conditions that make foot and vehicle travel hazardous. Lightning and tornadoes, common summertime phenomena, can be extremely hazardous. In the event of adverse weather (e.g., high wind and airborne dust, lightning, extreme cold or heat, or rain) that could compromise worker's health and safety during outdoor activities, the SSO will shut down operations. Safety precautions for lightning and tornadoes can be found in the H&S manual.

Fires

The potential for fires involving hazardous chemicals must be addressed during the preliminary site-specific evaluation of all hazards. Personnel in each work group will be knowledgeable in fire extinguishing techniques. They shall be instructed in proper use and maintenance of the appropriate fire extinguishers supplied at the work site.

Vehicle Accidents

Posted speed limits will be observed. All vehicles will be required to meet applicable state inspection standards. All drivers will be required to have a good driving record and must have all necessary licenses to operate their vehicle.

The phone numbers of the SSO, the field office, and subcontractor Health and Safety representative will be carried in each vehicle at the site. These numbers may also be provided to all police, fire, rescue, and emergency agencies in the area.

Upon notification of an accident, the PM will make available any personnel and equipment at his or her disposal to aid in the cleanup. For example, the following equipment may be supplied:

- Sorbent materials to contain/control liquids
- Front-end loaders to pick up solids
- Dust-suppression materials to control dust

- Trucks to haul collected material
- Appropriate protective gear for cleanup workers

The supervision and operation of all emergency response personnel and equipment will be coordinated through the authorities at the scene of the accident.

Appendix G

Permits

Air

August 30, 2019

New Mexico Environment Department
Air Quality Bureau
Minor Source Permitting – NPR Determination
525 Camino de los Marquez, Suite 1
Santa Fe, New Mexico, 87505-1816

Re: No Permit Required Determination
Shamrock No. 63 PSTB Site

Please find attached the documentation for a No Permit Required (NPR) Determination for the Shamrock No. 63 Petroleum Storage Tank Bureau (PSTB) site. A soil vapor extraction (SVE) system is planned for installation to clean up subsurface volatile organic compounds (VOCs). Located at 3624 Cerrillos Road, Santa Fe, New Mexico, the site is currently operating as an automobile car lot. Previously, the site dispensed gasoline products, which was the source of the current contamination.

Daniel B Stephens & Associates (DBS&A), under contract to the New Mexico Environment Department (NMED) PSTB, plans to install five new SVE vertical wells and convert six existing monitor wells to SVE wells. These wells will be connected via underground piping to a new natural gas thermal oxidizer. The SVE system will extract subsurface contamination in the form of soil vapor and treat the contamination using thermal oxidation with a 99% efficiency. DBS&A is currently under contract to run the system for twelve months, but may operate longer based on effectiveness of the remediation system.

Please let me know if you have questions or need additional information. I can be reached by phone (505-353-9075) or email (tgolden@dbstephens.com).

Sincerely,

DANIEL B. STEPHENS & ASSOCIATES, INC.

Thomas Golden, P.E.
Project Engineer

Daniel B. Stephens & Associates, Inc.
6020 Academy Rd. NE, Suite 100 505-822-9400
Albuquerque, NM 87109 FAX 505-822-8877

Mail Application To:		**For Department use only:**
New Mexico Environment Department Air Quality Bureau Permits Section 525 Camino de los Marquez, Suite 1 Santa Fe, New Mexico, 87505 Phone: (505) 476-4300 Fax: (505) 476-4375 www.env.nm.gov/aqb		AIRS No.:

Universal Air Quality Permit Application

Use this application for NOI, NSR, or Title V sources.

Use this application for: the initial application, modifications, technical revisions, and renewals. For technical revisions, complete Sections, 1-A, 1-B, 2-E, 3, 9 and any other sections that are relevant to the requested action; coordination with the Air Quality Bureau permit staff prior to submittal is encouraged to clarify submittal requirements and to determine if more or less than these sections of the application are needed. Use this application for streamline permits as well. See Section 1-I for submittal instructions.

This application is submitted as (check all that apply)**:** ☒ Request for a No Permit Required Determination (no fee)
☐ **Updating** an application currently under NMED review. Include this page and all pages that are being updated (no fee required).
Construction Status: ☒Not Constructed ☐ Existing Permitted (or NOI) Facility ☐ Existing Non-permitted (or NOI) Facility
Minor Source: ☐ a NOI 20.2.73 NMAC ☐ 20.2.72 NMAC application or revision ☐ 20.2.72.300 NMAC Streamline application
Title V Source: ☐ Title V (new) ☐ Title V renewal ☐ TV minor mod. ☐ TV significant mod. TV Acid Rain: ☐ New ☐ Renewal
PSD Major Source: ☐ PSD major source (new) ☐ minor modification to a PSD source ☐ a PSD major modification

Acknowledgements:

☒ I acknowledge that a pre-application meeting is available to me upon request. ☐ Title V Operating, Title IV Acid Rain, and NPR applications have no fees.

☐ $500 NSR application Filing Fee enclosed OR ☐ The full permit fee associated with 10 fee points (required w/ streamline applications).

☐ Check No.: in the amount of

☒I acknowledge the required submittal format for the hard copy application is printed double sided 'head-to-toe', 2-hole punched (except the Sect. 2 landscape tables is printed 'head-to-head'), numbered tab separators. Incl. a copy of the check on a separate page.

☐ This facility qualifies to receive assistance from the Small Business Environmental Assistance program (SBEAP) and qualifies for 50% of the normal application and permit fees. Enclosed is a check for 50% of the normal application fee which will be verified with the Small Business Certification Form for your company.

☐ This facility qualifies to receive assistance from the Small Business Environmental Assistance Program (SBEAP) but does not qualify for 50% of the normal application and permit fees. To see if you qualify for SBEAP assistance and for the small business certification form go to https://www.env.nm.gov/aqb/sbap/small_business_criteria.html).

Citation: Please provide the **low level citation** under which this application is being submitted: **20.2.72.200.A.1 NMAC**

Section 1 – Facility Information

Section 1-A: Company Information

		AI # if known (see 1st 3 to 5 #s of permit IDEA ID No.):	Updating Permit/NOI #:
1	Facility Name: Former Shamrock No. 63	Plant primary SIC Code (4 digits):	
		Plant NAIC code (6 digits):	
a	Facility Street Address (If no facility street address, provide directions from a prominent landmark): 3624 Cerrillos Rd., Santa Fe, NM		
2	Plant Operator Company Name: Daniel B. Stephens & Associates, Inc.	Phone/Fax: 505-822-9400/505-822-8877	
a	Plant Operator Address: 6020 Academy NE, Suite 100, Albuquerque, NM 87109		
b	Plant Operator's New Mexico Corporate ID or Tax ID: 85-0341157		
3	Plant Owner(s) name(s): New Mexico Environment Department,	Phone/Fax: 505-476-4397	

	Petroleum Storage Tank Bureau	
a	Plant Owner(s) Mailing Address(s): 2905 Rodeo Park Drive East, Building 1, Santa Fe, NM 87505	
4	Bill To (Company): Daniel B. Stephens & Associates, Inc.	Phone/Fax: 505-822-9400/505-822-8877
a	Mailing Address: 6020 Academy NE, Suite 100, Albuquerque, NM 87109	E-mail:tgolden@geo-logic.com
5	☐ Preparer: ☒ Consultant: Daniel B. Stephens & Associates, Inc.	Phone/Fax: 505-822-9400/505-822-8877
a	Mailing Address: 6020 Academy NE, Suite 100, Albuquerque, NM 87109	E-mail: tgolden@geo-logic.com
6	Plant Operator Contact: Tom Golden	Phone/Fax: 505-822-9400/505-822-8877
a	Address: 6020 Academy NE, Suite 100, Albuquerque, NM 87109	E-mail: tgolden@geo-logic.com
7	Air Permit Contact: Tom Golden	Title: Project Engineer
a	E-mail: tgolden@geo-logic.com	Phone/Fax: 505-822-9400/505-822-8877
b	Mailing Address: 6020 Academy NE, Suite 100, Albuquerque, NM 87109	
c	The designated Air permit Contact will receive all official correspondence (i.e. letters, permits) from the Air Quality Bureau.	

Section 1-B: Current Facility Status

1.a	Has this facility already been constructed? ☐ Yes ☒ No	1.b If yes to question 1.a, is it currently operating in New Mexico? ☐ Yes ☐ No
2	If yes to question 1.a, was the existing facility subject to a Notice of Intent (NOI) (20.2.73 NMAC) before submittal of this application? ☐ Yes ☐ No	If yes to question 1.a, was the existing facility subject to a construction permit (20.2.72 NMAC) before submittal of this application? ☐ Yes ☐ No
3	Is the facility currently shut down? ☐ Yes ☐ No	If yes, give month and year of shut down (MM/YY):
4	Was this facility constructed before 8/31/1972 and continuously operated since 1972? ☐ Yes ☒ No	
5	If Yes to question 3, has this facility been modified (see 20.2.72.7.P NMAC) or the capacity increased since 8/31/1972? ☐Yes ☐No ☒N/A	
6	Does this facility have a Title V operating permit (20.2.70 NMAC)? ☐ Yes ☒ No	If yes, the permit No. is: P-
7	Has this facility been issued a No Permit Required (NPR)? ☐ Yes ☒ No	If yes, the NPR No. is:
8	Has this facility been issued a Notice of Intent (NOI)? ☐ Yes ☒ No	If yes, the NOI No. is:
9	Does this facility have a construction permit (20.2.72/20.2.74 NMAC)? ☐ Yes ☒ No	If yes, the permit No. is:
10	Is this facility registered under a General permit (GCP-1, GCP-2, etc.)? ☐ Yes ☒ No	If yes, the register No. is:

Section 1-C: Facility Input Capacity & Production Rate

1	What is the facility's maximum input capacity, specify units (reference here and list capacities in Section 20, if more room is required)			
a	Current	Hourly: N/A	Daily: N/A	Annually: N/A
b	Proposed	Hourly: N/A	Daily: N/A	Annually: N/A
2	What is the facility's maximum production rate, specify units (reference here and list capacities in Section 20, if more room is required)			
a	Current	Hourly: N/A	Daily: N/A	Annually: N/A
b	Proposed	Hourly: N/A	Daily: N/A	Annually: N/A

Section 1-D: Facility Location Information

1	Section: S05	Range: 09E	Township: T16N	County: Santa Fe	Elevation (ft): 6635
2	UTM Zone: ☐ 12 or ☒ 13			Datum: ☐ NAD 27 ☐ NAD 83 ☒ WGS 84	
a	UTM E (in meters, to nearest 10 meters): 408863.06			UTM N (in meters, to nearest 10 meters): 3945033.15	
b	**AND** Latitude (deg., min., sec.): 35° 38'41.68"			Longitude (deg., min., sec.): -106°00'24.08"	
3	Name and zip code of nearest New Mexico town: Santa Fe, NM 87507				
4	Detailed Driving Instructions from nearest NM town (attach a road map if necessary): Exit I-25 onto Cerrillos Road, 3624 Cerrillos Rd is 3.32 miles on the right.				
5	The facility is 0 miles from of Santa Fe (it is within the town of Santa Fe).				
6	Status of land at facility (check one): ☒ Private ☐ Indian/Pueblo ☐ Federal BLM ☐ Federal Forest Service ☐ Other (specify)				
7	List all municipalities, Indian tribes, and counties within a ten (10) mile radius (20.2.72.203.B.2 NMAC) of the property on which the facility is proposed to be constructed or operated: City of Santa Fe, Santa Fe County				
8	**20.2.72** NMAC applications **only**: Will the property on which the facility is proposed to be constructed or operated be closer than 50 km (31 miles) to other states, Bernalillo County, or a Class I area (see www.env.nm.gov/aqb/modeling/class1areas.html)? ☒ Yes ☐ No (20.2.72.206.A.7 NMAC) If yes, list all with corresponding distances in kilometers: Pecos Wilderness, 15km; Bandelier Wilderness 25 km				
9	Name nearest Class I area: Pecos Wilderness				
10	Shortest distance (in km) from facility boundary to the boundary of the nearest Class I area (to the nearest 10 meters): 15				
11	Distance (meters) from the perimeter of the Area of Operations (AO is defined as the plant site inclusive of all disturbed lands, including mining overburden removal areas) to nearest residence, school or occupied structure: 15				
12	Method(s) used to delineate the Restricted Area: Continuous Chain Link Fence "**Restricted Area**" is an area to which public entry is effectively precluded. Effective barriers include continuous fencing, continuous walls, or other continuous barriers approved by the Department, such as rugged physical terrain with steep grade that would require special equipment to traverse. If a large property is completely enclosed by fencing, a restricted area within the property may be identified with signage only. Public roads cannot be part of a Restricted Area.				
13	Does the owner/operator intend to operate this source as a portable stationary source as defined in 20.2.72.7.X NMAC? ☒ Yes ☐ No A portable stationary source is not a mobile source, such as an automobile, but a source that can be installed permanently at one location or that can be re-installed at various locations, such as a hot mix asphalt plant that is moved to different job sites.				
14	Will this facility operate in conjunction with other air regulated parties on the same property? ☒ No ☐ Yes If yes, what is the name and permit number (if known) of the other facility?				

Section 1-E: Proposed Operating Schedule (The 1-E.1 & 1-E.2 operating schedules may become conditions in the permit.)

1	Facility **maximum** operating ($\frac{\text{hours}}{\text{day}}$): 24	($\frac{\text{days}}{\text{week}}$): 7	($\frac{\text{weeks}}{\text{year}}$): 52	($\frac{\text{hours}}{\text{year}}$): 8736		
2	Facility's maximum daily operating schedule (if less than 24 $\frac{\text{hours}}{\text{day}}$)? Start:	☐AM ☐PM	End:	☐AM ☐PM		
3	Month and year of anticipated start of construction: March 2020					
4	Month and year of anticipated construction completion: April 2020					
5	Month and year of anticipated startup of new or modified facility: April 2020					
6	Will this facility operate at this site for more than one year? ☒ Yes ☐ No					

Section 1-F: Other Facility Information

1	Are there any current Notice of Violations (NOV), compliance orders, or any other compliance or enforcement issues related to this facility? ☐ Yes ☒ No If yes, specify:		
a	If yes, NOV date or description of issue:		NOV Tracking No:
b	Is this application in response to any issue listed in 1-F, 1 or 1a above? ☐ Yes ☐ No If Yes, provide the 1c & 1d info below:		
c	Document Title:	Date:	Requirement # (or page # and paragraph #):
d	Provide the required text to be inserted in this permit:		
2	Is air quality dispersion modeling or modeling waiver being submitted with this application? ☐ Yes ☒ No		
3	Does this facility require an "Air Toxics" permit under 20.2.72.400 NMAC & 20.2.72.502, Tables A and/or B? ☐ Yes ☒ No		
4	Will this facility be a source of federal Hazardous Air Pollutants (HAP)? ☒ Yes ☐ No		
a	If Yes, what type of source? ☐ **Major** (☐ ≥10 tpy of any single HAP **OR** ☐ ≥25 tpy of any combination of HAPS) **OR** ☒ **Minor** (☐ <10 tpy of any single HAP **AND** ☐ <25 tpy of any combination of HAPS)		
5	Is any unit exempt under 20.2.72.202.B.3 NMAC? ☐ Yes ☒ No		
a	If yes, include the name of company providing commercial electric power to the facility: _____ Commercial power is purchased from a commercial utility company, which specifically does not include power generated on site for the sole purpose of the user.		

Section 1-G: Streamline Application **(This section applies to 20.2.72.300 NMAC Streamline applications only)**

1	☐ I have filled out Section 18, "Addendum for Streamline Applications." ☒ N/A (This is not a Streamline application.)

Section 1-H: Current Title V Information - Required for all applications from TV Sources

(Title V-source required information for all applications submitted pursuant to 20.2.72 NMAC (Minor Construction Permits), or 20.2.74/20.2.79 NMAC (Major PSD/NNSR applications), and/or 20.2.70 NMAC (Title V))

1	Responsible Official (R.O.) (20.2.70.300.D.2 NMAC):		Phone:
a	R.O. Title:	R.O. e-mail:	
b	R. O. Address:		
2	Alternate Responsible Official (20.2.70.300.D.2 NMAC):		Phone:
a	A. R.O. Title:	A. R.O. e-mail:	
b	A. R. O. Address:		
3	Company's Corporate or Partnership Relationship to any other Air Quality Permittee (List the names of any companies that have operating (20.2.70 NMAC) permits and with whom the applicant for this permit has a corporate or partnership relationship):		
4	Name of Parent Company ("Parent Company" means the primary name of the organization that owns the company to be permitted wholly or in part.):		
a	Address of Parent Company:		
5	Names of Subsidiary Companies ("Subsidiary Companies" means organizations, branches, divisions or subsidiaries, which are owned, wholly or in part, by the company to be permitted.):		
6	Telephone numbers & names of the owners' agents and site contacts familiar with plant operations:		

7	Affected Programs to include Other States, local air pollution control programs (i.e. Bernalillo) and Indian tribes: Will the property on which the facility is proposed to be constructed or operated be closer than 80 km (50 miles) from other states, local pollution control programs, and Indian tribes and pueblos (20.2.70.402.A.2 and 20.2.70.7.B)? If yes, state which ones and provide the distances in kilometers:

Section 1-I – Submittal Requirements

Each 20.2.73 NMAC (**NOI**), a 20.2.70 NMAC (**Title V**), a 20.2.72 NMAC (**NSR** minor source), or 20.2.74 NMAC (**PSD**) application package shall consist of the following:

Hard Copy Submittal Requirements:

1) One hard copy **original signed and notarized application package** **printed double sided** **'head-to-toe'** **2-hole punched** as we bind the document on top, not on the side; except Section 2 (landscape tables), which should be head-to-head. Please use **numbered tab separators** in the hard copy submittal(s) as this facilitates the review process. For NOI submittals only, hard copies of UA1, Tables 2A, 2D & 2F, Section 3 and the signed Certification Page are required. Please include a copy of the check on a separate page.

2) If the application is for a minor NSR, PSD, NNSR, or Title V application, include one working hard **copy** for Department use. This copy should be printed in book form, 3-hole punched, and **must be double sided**. Note that this is in addition to the head-to-to 2-hole punched copy required in 1) above. Minor NSR Technical Permit revisions (20.2.72.219.B NMAC) only need to fill out Sections 1-A, 1-B, 3, and should fill out those portions of other Section(s) relevant to the technical permit revision. TV Minor Modifications need only fill out Sections 1-A, 1-B, 1-H, 3, and those portions of other Section(s) relevant to the minor modification. NMED may require additional portions of the application to be submitted, as needed.

3) The entire NOI or Permit application package, including the full modeling study, should be submitted electronically. Upon receipt of the application fee, the Bureau will email the applicant with instructions for submitting the electronic files through a secure file transfer service. Optionally, the applicant may submit the files with the application on compact disk (CD) or digital versatile disc (DVD).

4) If **air dispersion modeling** is required by the application type, include the **NMED Modeling Waiver** and/or electronic air dispersion modeling report, input, and output files. The dispersion modeling ***summary report only*** should be submitted as hard copy(ies) unless otherwise indicated by the Bureau.

5) If the applicant submits the electronic files on CD and the application is subject to PSD review under 20.2.74 NMAC (PSD) or NNSR under 20.2.79 NMC include,
   a. one additional CD copy for US EPA,
   b. one additional CD copy for each federal land manager affected (NPS, USFS, FWS, USDI) and,
   c. one additional CD copy for each affected regulatory agency other than the Air Quality Bureau.
   If the application is submitted electronically through the secure file transfer service, these extra CDs do not need to be submitted.

Electronic Submittal Requirements [in addition to the required hard copy(ies)]:

1) All required electronic documents shall be submitted. Submit a single PDF document of the entire application as submitted and the individual documents comprising the application.

2) The documents should also be submitted in Microsoft Office compatible file format (Word, Excel, etc.) allowing us to access the text and formulas in the documents (copy & paste). Any documents that cannot be submitted in a Microsoft Office compatible format shall be saved as a PDF file from within the electronic document that created the file. If you are unable to provide Microsoft office compatible electronic files or internally generated PDF files of files (items that were not created electronically: i.e. brochures, maps, graphics, etc,), submit these items in hard copy format. We must be able to review the formulas and inputs that calculated the emissions.

3) It is preferred that this application form be submitted as 4 electronic files (3 MSWord docs: Universal Application section 1, Universal Application section 3-19, and Universal Application 4, the modeling report) and 1 Excel file of the tables (Universal Application section 2). Please include as many of the 3-19 Sections as practical in a single MS Word electronic document. Create separate electronic file(s) if a single file becomes too large or if portions must be saved in a file format other than MS Word.

4) The electronic file names shall be a maximum of 25 characters long (including spaces, if any). The format of the electronic Universal Application shall be in the format: "A-3423-FacilityName". The "A" distinguishes the file as an application submittal, as opposed to other documents the Department itself puts into the database. Thus, all electronic application submittals should begin with "A-". Modifications to existing facilities should use the core permit number (i.e. '3423') the Department assigned to the facility as the next 4 digits. Use 'XXXX' for new facility applications. The format of any separate electronic submittals (additional submittals such as non-Word attachments, re-submittals, application updates) and Section document shall be in the format: "A-3423-9-description", where "9" stands for the section # (in this case Section 9-Public Notice). Please refrain, as much as possible, from submitting any scanned documents as this file format is extremely large, which uses up too much storage capacity in our database. Please take the time to fill out the header information throughout all submittals as this will identify any loose pages, including the Application Date (date submitted) & Revision # (0 for original, 1, 2, etc.; which will help keep track of subsequent partial update(s) to the original submittal. The footer information should not be modified by the applicant.

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Table 2-A: Regulated Emission Sources

Unit and stack numbering must correspond throughout the application package. If applying for a NOI under 20.2.73 NMAC, equipment exemptions under 2.72.202 NMAC do not apply.

Unit Number[1]	Source Description	Make	Model #	Serial #	Manufacturer's Rated Capacity[3] (Specify Units)	Requested Permitted Capacity[3] (Specify Units)	Date of Manufacture[2] / Date of Construction/ Reconstruction[2]	Controlled by Unit # / Emissions vented to Stack #	Source Classification Code (SCC)	For Each Piece of Equipment, Check One	RICE Ignition Type (CI, SI, 4SLB, 4SRB, 2SLB)[4]	Replacing Unit No.
1	250 CFM Catalytic oxidizer	Intellishare	N/A	N/A	250 CFM	250 CFM	Dec-19 / Mar-20			☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	SI	
										☐ Existing (unchanged) ☐ To be Removed ☐ New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced		
										☐ Existing (unchanged) ☐ To be Removed ☐ New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced		
										☐ Existing (unchanged) ☐ To be Removed ☐ New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced		
										☐ Existing (unchanged) ☐ To be Removed ☐ New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced		
										☐ Existing (unchanged) ☐ To be Removed ☐ New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced		
										☐ Existing (unchanged) ☐ To be Removed ☐ New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced		
										☐ Existing (unchanged) ☐ To be Removed ☐ New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced		
										☐ Existing (unchanged) ☐ To be Removed ☐ New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced		
										☐ Existing (unchanged) ☐ To be Removed ☐ New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced		
										☐ Existing (unchanged) ☐ To be Removed ☐ New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced		
										☐ Existing (unchanged) ☐ To be Removed ☐ New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced		
										☐ Existing (unchanged) ☐ To be Removed ☐ New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced		
										☐ Existing (unchanged) ☐ To be Removed ☐ New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced		

[1] Unit numbers must correspond to unit numbers in the previous permit unless a complete cross reference table of all units in both permits is provided.
[2] Specify dates required to determine regulatory applicability.
[3] To properly account for power conversion efficiencies, generator set rated capacity shall be reported as the rated capacity of the engine in horsepower, not the kilowatt capacity of the generator set.
[4] "4SLB" means four stroke lean burn engine, "4SRB" means four stroke rich burn engine, "2SLB" means two stroke lean burn engine, "CI" means compression ignition, and "SI" means spark ignition

Table 2-D: Maximum Emissions (under normal operating conditions)

☐ **This Table was intentionally left blank because it would be identical to Table 2-E.**

Maximum Emissions are the emissions at maximum capacity and prior to (in the absence of) pollution control, emission-reducing process equipment, or any other emission reduction. Calculate the hourly emissions using the worst case hourly emissions for each pollutant. For each pollutant, calculate the annual emissions as if the facility were operating at maximum plant capacity without pollution controls for 8760 hours per year, unless otherwise approved by the Department. List Hazardous Air Pollutants (HAP) & Toxic Air Pollutants (TAPs) in Table 2-I. Unit & stack numbering must be consistent throughout the application package. Fill all cells in this table with the emission numbers or a "-" symbol. A "-" symbol indicates that emissions of this pollutant are not expected. Numbers shall be expressed to at least 2 decimal points (e.g. 0.41, 1.41, or 1.41E-4).

Unit No.	NOx		CO		VOC		SOx		PM[1]		PM10[1]		PM2.5[1]		H_2S		Lead	
	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr
1	0	0	0	0	0.0128	0.056	0	0	0	0	0	0	0	0	0	0	0	0
Totals																		

[1]**Condensable Particulate Matter:** Include condensable particulate matter emissions for PM10 and PM2.5 if the source is a combustion source. Do not include condensable particulate matter for PM unless PM is set equal to PM10 and PM2.5. Particulate matter (PM) is not subject to an ambient air quality standard, but PM is a regulated air pollutant under PSD (20.2.74 NMAC) and Title V (20.2.70 NMAC).

Table 2-F: Additional Emissions during Startup, Shutdown, and Routine Maintenance (SSM)

☐ This table is intentionally left blank since all emissions at this facility due to routine or predictable startup, shutdown, or scehduled maintenance are no higher than those listed in Table 2-E and a malfunction emission limit is not already permitted or requested. If you are required to report GHG emissions as described in Section 6a, include any GHG emissions during Startup, Shutdown, and/or Scheduled Maintenance (SSM) in Table 2-P. Provide an explanations of SSM emissions in Section 6 and 6a.

All applications for facilities that have emissions during routine our predictable startup, shutdown or scheduled maintenance (SSM)[1], including NOI applications, must include in this table the Maximum Emissions during routine or predictable startup, shutdown and scheduled maintenance (20.2.7 NMAC, 20.2.72.203.A.3 NMAC, 20.2.73.200.D.2 NMAC). In Section 6 and 6a, provide emissions calculations for all SSM emissions reported in this table. Refer to "Guidance for Submittal of Startup, Shutdown, Maintenance Emissions in Permit Applications (https://www.env.nm.gov/aqb/permit/aqb_pol.html) for more detailed instructions. Numbers shall be expressed to at least 2 decimal points (e.g. 0.41, 1.41, or 1.41E-4).

Unit No.	NOx		CO		VOC		SOx		PM[2]		PM10[2]		PM2.5[2]		H_2S		Lead	
	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr
Totals																		

[1] **For instance**, if the short term steady-state Table 2-E emissions are 5 lb/hr and the SSM rate is 12 lb/hr, enter 7 lb/hr in this table. If the annual steady-state Table 2-E emissions are 21.9 TPY, and the number of scheduled SSM events result in annual emissions of 31.9 TPY, enter 10.0 TPY in the table below.

[2] **Condensable Particulate Matter:** Include condensable particulate matter emissions for PM10 and PM2.5 if the source is a combustion source. Do not include condensable particulate matter for PM unless PM is set equal to PM10 and PM2.5. Particulate matter (PM) is not subject to an ambient air quality standard, but it is a regulated air pollutant under PSD (20.2.74 NMAC) and Title V (20.2.70 NMAC).

Section 3

Application Summary

The **Application Summary** shall include a brief description of the facility and its process, the type of permit application, the applicable regulation (i.e. 20.2.72.200.A.X, or 20.2.73 NMAC) under which the application is being submitted, and any air quality permit numbers associated with this site. If this facility is to be collocated with another facility, provide details of the other facility including permit number(s). In case of a revision or modification to a facility, provide the lowest level regulatory citation (i.e. 20.2.72.219.B.1.d NMAC) under which the revision or modification is being requested. Also describe the proposed changes from the original permit, how the proposed modification will affect the facility's operations and emissions, de-bottlenecking impacts, and changes to the facility's major/minor status (both PSD & Title V).

The **Process Summary** shall include a brief description of the facility and its processes.

Startup, Shutdown, and Maintenance (SSM) routine or predictable emissions: Provide an overview of how SSM emissions are accounted for in this application. Refer to "Guidance for Submittal of Startup, Shutdown, Maintenance Emissions in Permit Applications (http://www.env.nm.gov/aqb/permit/app_form.html) for more detailed instructions on SSM emissions.

This is an application for a No Permit Required (NPR) determination. The application is for a new, minor source (NMAC 20.272.200.A), which will discharge a maximum of 1 tons per year of volatile organic compounds (VOCs).

This facility is a soil vapor mitigation system used to remove subsurface VOCs at a former gasoline station facility. The VOCs are in liquid and vapor phases in the subsurface. In-line blowers apply a slight vacuum to the subsurface through extraction wells to mobilize VOC impacted soil vapor and to volatilize liquid hydrocarbons. The vapor is then treated with a gas thermal oxidizer which is rated to remove 99% of emissions, before being discharged to the atmosphere.

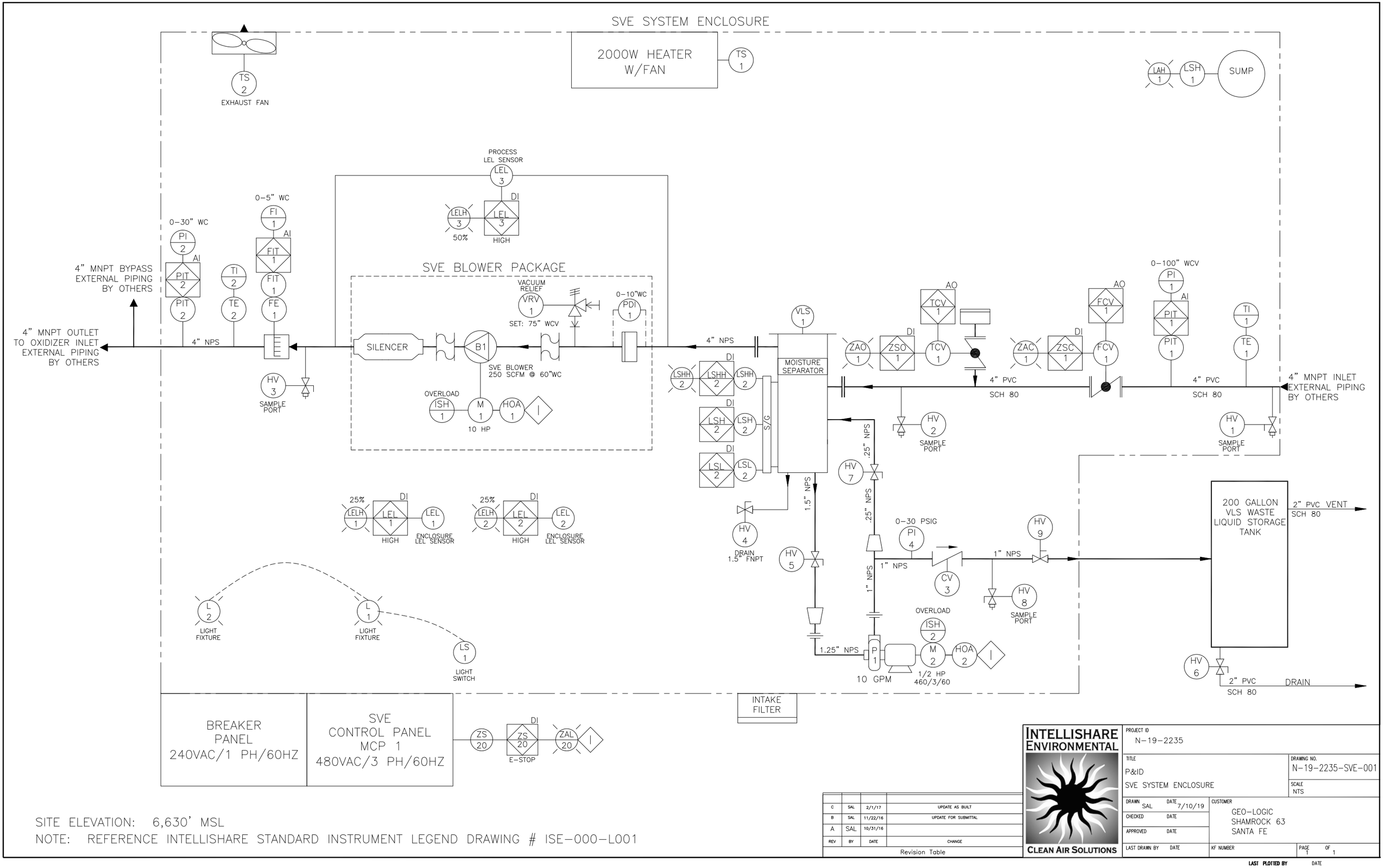
SSM emissions are not accounted for in this application as the system design prevents the possibility of SSM emissions because a blower is required for removal of the VOCs. If the blowers stop functioning, the whole system shuts down and ceases to emit.

Section 4

Process Flow Sheet

A **process flow sheet** and/or block diagram indicating the individual equipment, all emission points and types of control applied to those points. The unit numbering system should be consistent throughout this application.

Please see attached drawings titled “Process Flow Sheet” and General System Arrangement.



SITE ELEVATION: 6,630' MSL

NOTE: REFERENCE INTELLISHARE STANDARD INSTRUMENT LEGEND DRAWING # ISE–000–L001

REV	BY	DATE	CHANGE
C	SAL	2/1/17	UPDATE AS BUILT
B	SAL	11/22/16	UPDATE FOR SUBMITTAL
A	SAL	10/31/16	

Revision Table

INTELLISHARE ENVIRONMENTAL
CLEAN AIR SOLUTIONS

PROJECT ID: N–19–2235

TITLE: P&ID
SVE SYSTEM ENCLOSURE

DRAWING NO.: N–19–2235–SVE–001

SCALE: NTS

DRAWN: SAL DATE: 7/10/19

CHECKED: DATE

APPROVED: DATE

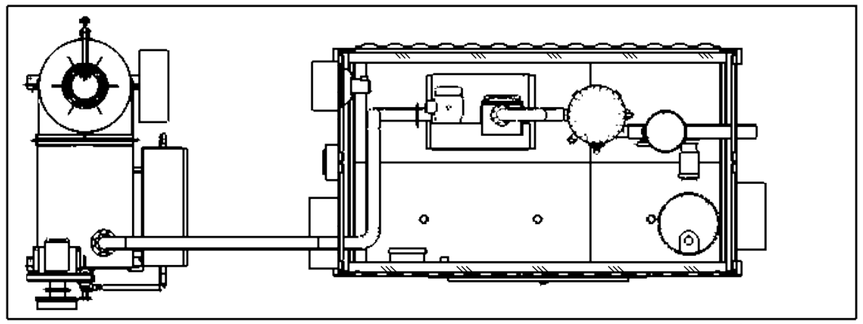
LAST DRAWN BY: DATE

CUSTOMER: GEO–LOGIC SHAMROCK 63 SANTA FE

KF NUMBER:

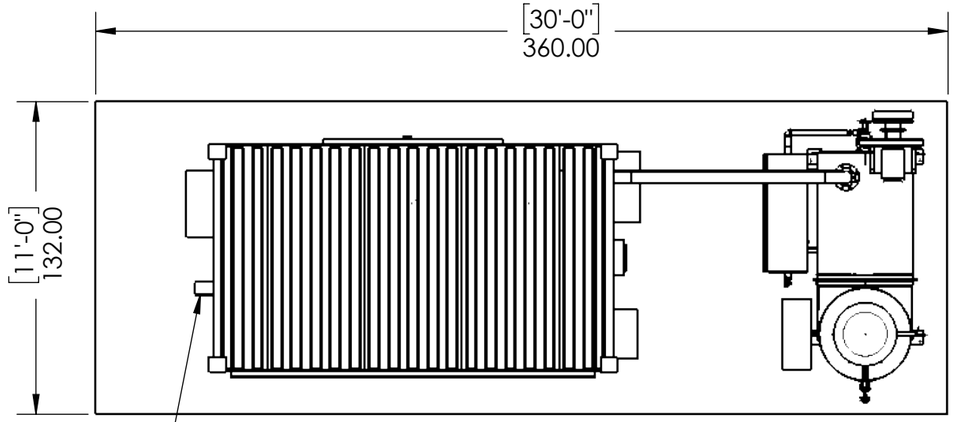
PAGE 1 OF 1

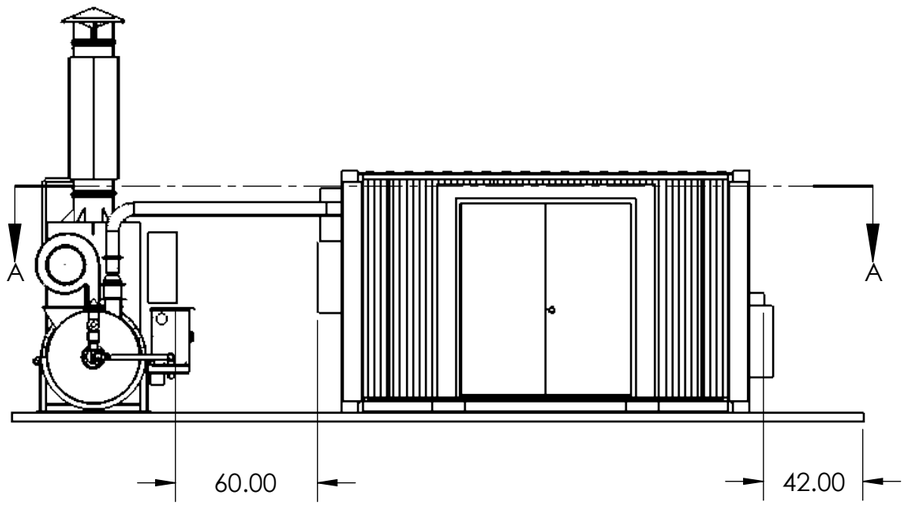
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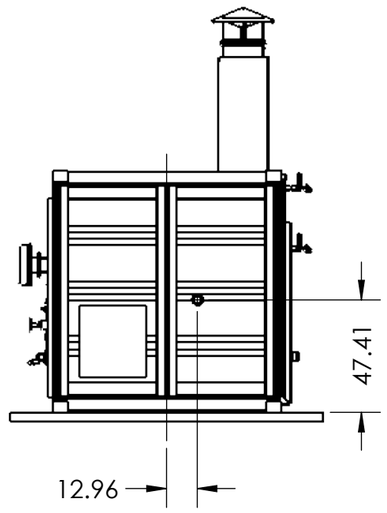


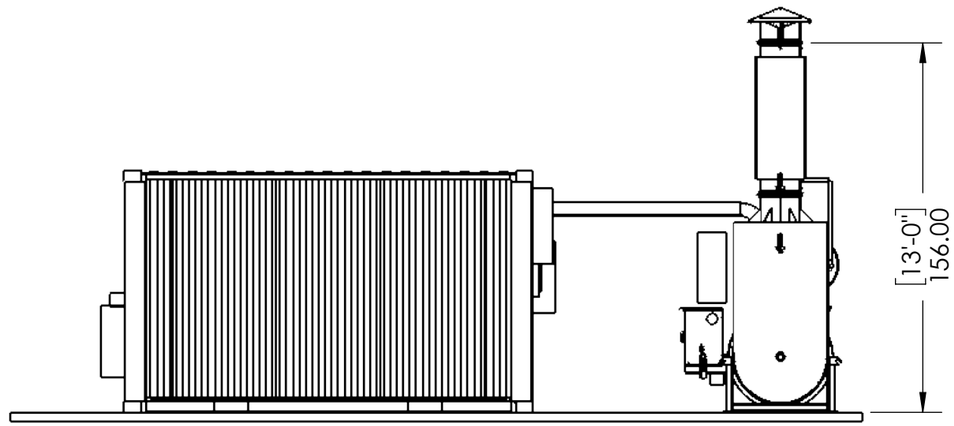
SECTION A-A

48.00









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INTELLISHARE ENVIRONMENTAL
CLEAN AIR SOLUTIONS

N-19-2235-003

TITLE: GENERAL ARRANGEMENT TO250 WITH SVE ENCLOSURE	TEMPLATE REFERENCE: N-19-2235-003 SCALE: 1:64
DRAWN: DATE 8/7/2019	CUSTOMER: GEO-LOGIC REV: --
CHECKED: DATE	
APPROVED: DATE	
LAST DRAWN BY: SAL DATE 8/9/2019	SOURCE PAGE 1 OF 1
LAST PLOTTED BY: XXX DATE: XXX	FILE PATH

PIPING & VALVES

- VALVE NORMALLY OPEN or UNSPECIFIED
- VALVE NORMALLY CLOSED
- BALL
- BUTTERFLY
- CHECK
- GATE
- ORIFICE VALVE
- 3 WAY
- VACUUM RELIEF
- PRESSURE RELIEF
- PRESSURE REGULATOR EXTERNAL BACKLOAD
- PRESSURE REGULATOR SELF CONTAINED
- REDUCER
- Y–STRAINER
- SAMPLE/TEST PORT
- SCREW/CAP PORT
- FLANGE
- UNION
- ORFICE PLATE
- TRAVERSE PORT PRESSURE TAP SAMPLE PORT TRAP

OPERATORS

- M — ELECTRIC MOTOR
- S — SOLENOID
- MANUAL
- DOUBLE–ACTING PNEUMATIC ACTUATOR
- SPRING–RETURN SINGLE–ACTING PNEUMATIC ACTUATOR
- MECHANICAL LINK

LINE LEGEND

- PIPING
- PROCESS DUCTWORK
- ELECTRICAL SIGNAL OTHER
- INSTRUMENT TUBING
- NON CONNECTING LINES
- CONNECTING LINES

MATERIAL ABBREVIATIONS

BCS	BLACK CARBON STEEL
CI	CAST IRON
CPVC	CLORINATED POLYVINYL CHLORIDE
CS	CARBON STEEL
CU	COPPER
DI	DUCTILE IRON
FRP	FIBERGLASS REINFORCED PLASTIC
GS	GALVANIZED STEEL
HDPE	HIGH DENSITY POLYETHYLENE
PE	POLYETHYLENE
PVC	POLYVINYL CHLORIDE
SCH	SCHEDULE
SS	STAINLESS STEEL
STL	STEEL

EQUIPMENT

- FAN / BLOWER
- PUMP
- HEAT EXCHANGER
- CATALYST — CATALYST REACTOR
- SILENCER
- GAS BURNER
- ELECTRIC HEATER
- GROUND
- FLEX HOSE
- FLEXIBLE CONNECTOR
- SIGHT GLASS OBSERVATION VIEW PORT
- INLINE LIQUID FILTER
- PITOT STATIC
- PITOT AVERAGING
- FILTER
- FLAME ARRESTOR
- OTHERS — ISE

NOTE:

THIS IS A STANDARD LEGEND, THEREFORE, NOT ALL OF THIS INFORMATION MAY BE USED ON THIS PROJECT.

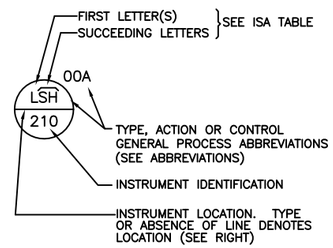
TRANSDUCERS

EXAMPLE: FY I/P — CURRENT TO PNEUMATIC TRANSDUCER (PANEL MOUNTED)

A	ANALOG
D	DIGITAL
E	VOLTAGE
F	FREQUENCY
I	CURRENT
P	PNEUMATIC
PF	PULSE FREQUENCY
PD	PULSE DURATION

INSTRUMENT IDENTIFICATION

BUBBLE SYMBOL



INSTRUMENT LOCATION SYMBOL

- FIELD MOUNTED INSTRUMENT
- PANEL MOUNTED INSTRUMENT
- GREEN — PILOT LIGHT/ALARM LIGHT (LIGHT COLOR)
- PROGRAMMABLE LOGIC CONTROLS

SPECIAL CASES

- HS 4 OO — ON AND OFF EVENT LIGHTS
- HS 4 OC — OPENED AND CLOSED POSITION LIGHTS
- HS 4 OC — OPENED AND CLOSED POSITION SWITCHES
- I — HARD WIRED INTERLOCKS
- R — RESET

TYPE, ACTION OR CONTROL ABBREVIATIONS

AC	ALTERNATING CURRENT
AI	ANALOG INPUT
AO	ANALOG OUTPUT
AM	AUTO–MANUAL
AS	ADJUSTABLE SPEED
DC	DIRECT CURRENT
DI	DIGITAL INPUT
DO	DIGITAL OUTPUT
FAR	FORWARD–AUTO–REVERSE
FR	FORWARD–REVERSE
HOA	HAND–OFF–AUTO
HOR	HAND–OFF–REMOTE
HLO	HIGH–LOW–OFF
HLOA	HIGH–LOW–OFF–AUTO
LCP	LOCAL CONTROL PANEL
LEL	LOWER EXPLOSIVE LIMIT
LOS	LOCKOUT STOP
LR	LOCAL–REMOTE
M	MANUAL
MA	MANUAL–AUTO
MCP	MAIN CONTROL PANEL
OA	OFF–AUTO
OC	OPEN–CLOSE
OCA	OPEN–CLOSE–AUTO
OO	ON–OFF
OOA	ON–OFF–AUTO
OOR	ON–OFF–REMOTE
PLC	PROGRAMMABLE LOGIC CONTROLLER
R	RESET
SS	START–STOP
VAC	VOLTS ALTERNATING CURRENT
VFD	VARIABLE FREQUENCY DRIVE

INSTRUMENT SOCIETY OF AMERICA (ISA) TABLE

LETTER	FIRST LETTER(S) MEASURED OR INITIATING VARIABLE	FIRST LETTER(S) MODIFIER	SUCCEEDING LETTERS READOUT OR PASSIVE FUNCTION	SUCCEEDING LETTERS OUTPUT FUNCTION	SUCCEEDING LETTERS MODIFIER
A	ANALYSIS (+)	AUXILLARY	ALARM		
B	BURNER, COMBUSTION	BLOWER	USERS CHOICE (+)	USERS CHOICE (+)	USERS CHOICE (+)
C	CONDUCTIVITY	CHECK		CONTROL	CONTROLLER
D	DENSITY	DISCONNECT	DIFFERENTIAL		
E	VOLTAGE		SENSOR(PRIMARY ELEMENT)		
F	FLOW RATE	FILTER/FLAME			
G	GAUGE		GLASS		
H	HAND (MANUAL)				HIGH
I	CURRENT		INDICATOR		
J	POWER	SCAN			
K	TIME OR SCHEDULE	CHANGE RATE		CONTROL STATION	
L	LEVEL		LIGHT (PILOT)		LOW
M	MOTION	MOTOR			MIDDLE
N	USERS CHOICE (+)		USERS CHOICE (+)	USERS CHOICE (+)	USERS CHOICE (+)
O	USERS CHOICE (+)		ORIFICE, RESTRICTION		
P	PRESSURE (OR VACUUM)	PUMP	POINT (TEST CONNECTION)	PORT	
Q	QUANTITY	INTEGRATE	INTEGRATE		
R	RADIATION	RELEIF	RECORD OR PRINT		
S	SPEED OR FREQUENCY	SOLENOID		SWITCH	STRAINER/SILENCER
T	TEMPERATURE			TRANSMIT	
U	MULTIVARIABLE (+)		MULTIFUNCTION (+)	MULTIFUNCTION (+)	MULTIFUNCTION (+)
V	VIBRATION			VALVE OR DAMPER	
W	WEIGHT OR FORCE		WELL		
X	UNCLASSIFIED (+)		UNCLASSIFIED (+)	UNCLASSIFIED (+)	UNCLASSIFIED (+)
Y	EVENT OR STATE	Y–STRAINER		RELAY OR COMPUTE (+)	
Z	POSITION, DIMENSION			DRIVE OR ACTUATE	UNCLASSIFIED FINAL CONTROL ELEMENT

(+) WHEN USED, EXPLANATION IS SHOWN ADJACENT TO INSTRUMENT SYMBOL. SEE ABBREVIATIONS.

GENERAL PROCESS ABBREVIATIONS

NPS	NATIONAL PIPE STANDARD SIZE	HP	HORSE POWER	BOM	BILL OF MATERIAL REFERENCE
AGL	ABOVE GROUND LEVEL	LB	POUND WEIGHT	ACFM	ACTUAL CUBIC FEET PER MINUTE
BTU	BRITISH THERMAL UNIT	LEL	LOWER EXPLOSIVE LIMIT	SCFM	STANDARD CUBIC FEET PER MINUTE
DRE	DESTRUCTION AND REMOVAL EFFICIENCY	MSL	MEAN SEA LEVEL	GPM	GALLONS PER MINUTE
FA	FLAME ARRESTOR	PH	PHASE	SCFH	STANDARD CUBIC FEET PER HOUR
FLA	FULL LOAD AMPS	RPM	REVOLUTIONS PER MINUTE	"WC	INCHES OF WATER COLUMN
FSP	FLAME SAFETY PROGRAMMER			YS	Y STRAINER

REV	BY	DATE	CHANGE
C	SAL	5/1/17	ADDED INFORMATION TO ISA TABLE
B	SAL	2/12/15	ADDED INFORMATION TO ISA TABLE
A	SAL	12/5/13	Initial Release

Revision Table

INTELLISHARE ENVIRONMENTAL — CLEAN AIR SOLUTIONS

PROJECT ID: STANDARD INSTRUMENT LEGEND

TITLE: PROCESS & INSTRUMENTATION DIAGRAM LEGEND SHEET

DRAWING NO.: ISE–000–L001

SCALE: NONE

DRAWN: SAL DATE: 12/5/13

CHECKED: DATE:

APPROVED: DATE:

LAST DRAWN BY: SAL DATE: –

CUSTOMER: Intellishare Environmental, Inc. Menomonie, WI USA

KF NUMBER:

PAGE 1 OF 1

LAST PLOTTED BY SAL DATE –

Section 5

Plot Plan Drawn To Scale

A **plot plan drawn to scale** showing emissions points, roads, structures, tanks, and fences of property owned, leased, or under direct control of the applicant. This plot plan must clearly designate the restricted area as defined in UA1, Section 1-D.12. The unit numbering system should be consistent throughout this application.

Please see attached DBS&A drawing titled Remediation System Site Plan.



EXPLANATION

- EXISTING MONITOR WELL
- POWER POLE
- PROPOSED SVE RECOVERY WELL
- PROPOSED MONITOR WELL
- PROPOSED SVE CONVEYANCE LINE
- PROPOSED CHAIN LINK FENCE
- EXISTING CHAIN LINK FENCE
- EXISTING ROD IRON FENCE

REV. NO.	DATE	DESCRIPTION	APPROVED BY

DATE OF ISSUE: 8/25/19
DESIGNED BY: TG,JS,KJ
DRAWN BY: RT
CHECKED BY: JS
APPROVED BY: TG

DBS&A
Daniel B. Stephens & Associates, Inc.
6020 Academy Rd. NE, Suite 100
Albuquerque, NM 87109-3315

NEW MEXICO ENVIRONMENT DEPARTMENT
PETROLEUM STORAGE TANK BUREAU
2905 RODEO PARK DRIVE EAST
SANTA FE, NEW MEXICO 57505

SHAMROCK NO. 63 SITE
SVE SYSTEM INSTALLATION
SANTA FE, NEW MEXICO

GENERAL SITE PLAN

SHT. 3 OF 8
DWG NO. G-2

JOB NO. BE14.0012

S:\PROJECTS\BE14.0012_SHAMROCK_63\CAD\PRODUCTION\G-2 GENERAL SITE PLAN.DWG August 19, 2019 - 2:14 PM BY: SAMSON, JEFFREY

Section 6

All Calculations

Show all calculations used to determine both the hourly and annual controlled and uncontrolled emission rates. All calculations shall be performed keeping a minimum of three significant figures. Document the source of each emission factor used (if an emission rate is carried forward and not revised, then a statement to that effect is required). If identical units are being permitted and will be subject to the same operating conditions, submit calculations for only one unit and a note specifying what other units to which the calculations apply. All formulas and calculations used to calculate emissions must be submitted. The "Calculations" tab in the UA2 has been provided to allow calculations to be linked to the emissions tables. Add additional "Calc" tabs as needed. If the UA2 or other spread sheets are used, all calculation spread sheet(s) shall be submitted electronically in Microsoft Excel compatible format so that formulas and input values can be checked. Format all spread sheets and calculations such that the reviewer can follow the logic and verify the input values. Define all variables. If calculation spread sheets are not used, provide the original formulas with defined variables. Additionally, provide subsequent formulas showing the input values for each variable in the formula. All calculations, including those calculations are imbedded in the Calc tab of the UA2 portion of the application, the printed Calc tab(s), should be submitted under this section.

Tank Flashing Calculations: The information provided to the AQB shall include a discussion of the method used to estimate tank-flashing emissions, relative thresholds (i.e., NOI, permit, or major source (NSPS, PSD or Title V)), accuracy of the model, the input and output from simulation models and software, all calculations, documentation of any assumptions used, descriptions of sampling methods and conditions, copies of any lab sample analysis. If Hysis is used, all relevant input parameters shall be reported, including separator pressure, gas throughput, and all other relevant parameters necessary for flashing calculation.

SSM Calculations: It is the applicant's responsibility to provide an estimate of SSM emissions or to provide justification for not doing so. In this Section, provide emissions calculations for Startup, Shutdown, and Routine Maintenance (SSM) emissions listed in the Section 2 SSM and/or Section 22 GHG Tables and the rational for why the others are reported as zero (or left blank in the SSM/GHG Tables). Refer to "Guidance for Submittal of Startup, Shutdown, Maintenance Emissions in Permit Applications (http://www.env.nm.gov/aqb/permit/app_form.html) for more detailed instructions on calculating SSM emissions. If SSM emissions are greater than those reported in the Section 2, Requested Allowables Table, modeling may be required to ensure compliance with the standards whether the application is NSR or Title V. Refer to the Modeling Section of this application for more guidance on modeling requirements.

Glycol Dehydrator Calculations: The information provided to the AQB shall include the manufacturer's maximum design recirculation rate for the glycol pump. If GRI-Glycalc is used, the full input summary report shall be included as well as a copy of the gas analysis that was used.

Road Calculations: Calculate fugitive particulate emissions and enter haul road fugitives in Tables 2-A, 2-D and 2-E for:

1. If you transport raw material, process material and/or product into or out of or within the facility and have PER emissions greater than 0.5 tpy.
2. If you transport raw material, process material and/or product into or out of the facility more frequently than one round trip per day.

Significant Figures:

A. All emissions standards are deemed to have at least two significant figures, but not more than three significant figures.

B. At least 5 significant figures shall be retained in all intermediate calculations.

C. In calculating emissions to determine compliance with an emission standard, the following rounding off procedures shall be used:

(1) If the first digit to be discarded is less than the number 5, the last digit retained shall not be changed;

(2) If the first digit discarded is greater than the number 5, or if it is the number 5 followed by at least one digit other than the number zero, the last figure retained shall be increased by one unit; **and**

(3) If the first digit discarded is exactly the number 5, followed only by zeros, the last digit retained shall be rounded upward if it is an odd number, but no adjustment shall be made if it is an even number.

(4) The final result of the calculation shall be expressed in the units of the standard.

Control Devices: In accordance with 20.2.72.203.A(3) and (8) NMAC, 20.2.70.300.D(5)(b) and (e) NMAC, and 20.2.73.200.B(7) NMAC, the permittee shall report all control devices and list each pollutant controlled by the control device

regardless if the applicant takes credit for the reduction in emissions. The applicant can indicate in this section of the application if they chose to not take credit for the reduction in emission rates. For notices of intent submitted under 20.2.73 NMAC, only uncontrolled emission rates can be considered to determine applicability unless the state or federal Acts require the control. This information is necessary to determine if federally enforceable conditions are necessary for the control device, and/or if the control device produces its own regulated pollutants or increases emission rates of other pollutants.

Please see attached calculations beginning on the next page. All VOC emissions are less than 1 ton/yr.

Tank flashing and SSM calculations are not required for this project.

Calculation Cover Sheet

Daniel B. Stephens & Associates, Inc.

Project Name Shamrock #63 Project Number BE14.0012.00

Calculation Number BE14.0012.00-01 Discipline Engineering No. of Sheets 2

PROJECT: Shamrock #63

SITE: 3624 Cerrillos Rd, Santa Fe, New Mexico

SUBJECT: Estimated Hydrocarbon Emissions from SVE Treatment Equipment

SOURCES OF DATA:
A. SVE pilot test data, AcuVac, October 2017
B. Natural gas thermal oxidizer equipment specifications, Intellishare Environmental, August 2019
C. Department of Health and Human Services (2007). NIOSH Pocket Guide to Chemical Hazards. DHHS Publication No. 2005-149.

SOURCES OF FORMULAE & REFERENCES:

☐ Preliminary Calculation ☒ Final Calculation Supersedes Calculation No. _____

Rev. No.	Revision	Calculation By	Date	Checked By	Date	Approved By	Date
0	Final Remediation Plan	TH	8/16/19	KJ	8/21/19		

Project No. BE14.0012.00 Date 8/16/18

Subject Emissions calculation Sheet 1 of 2

By TH Checked By KJ Calculation No. BE14.0012.00-01

1.0 OBJECTIVE

Calculate the estimated hydrocarbon emission rates for a future soil vapor extraction (SVE) system at the site in Santa Fe, New Mexico, based on SVE pilot test data[A].

2.0 GIVEN

Laboratory results for influent soil vapor samples from SVE pilot test data[A]. The estimated destruction efficiency for the soil vapor treatment equipment is 99%[B].

3.0 METHOD

Hydrocarbon emission rates are calculated based on the estimated effluent hydrocarbon constituent concentrations and proposed air flow rates. Effluent concentrations were estimated based on measured influent concentrations from SVE pilot testing and the minimum equipment destruction efficiency, DE, provided by the manufacturer using equation 1.

$$C_{eff} = C_{\text{inf}} \cdot (1 - DE) \qquad \text{eqn. 1}$$

The effluent concentration is converted to a volume of air under standard conditions using equation 2.

$$C_{std} = C_{eff} \cdot \left(\frac{P_{std}}{P_{lab}} \cdot \frac{T_{lab}}{T_{std}} \right) \qquad \text{eqn. 2}$$

The anticipated vapor treatment equipment is estimated to operate with a flow rate of approximately 750 standard cubic feet per minute (scfm).

4.0 SOLUTION

A sample calculation for estimating emission rates of total xylenes is provided below for samples collected during SVE pilot testing. Full results are provided on attached spreadsheets. The average concentration from three wells for total xylenes, C_{inf}, was 163 micrograms per liter (µg/L). This value represents a concentration prior to vapor treatment. Assume that effluent concentrations, C_{eff}, would be reduced by 99 percent following vapor treatment (the minimum destruction efficiency reported by the oxidizer manufacturer).

$$C_{eff} = C_{inf} * (1 - 0.99) = 163\ \mu\frac{g}{L} * 0.01 = 1.63 \mu g/L$$

Project No. BE14.0012.00 Date 8/16/18

Subject Emissions calculation Sheet 2 of 2

By TH Checked By KJ Calculation No. BE14.0012.00-01

Calculate the total xylenes concentration under standard conditions, C_{std}, using equation 2 and assuming the absolute pressure and temperature at the laboratory (5000 feet above mean sea level) are 12.23 pounds per square inch (psi) and 70 degrees Fahrenheit (°F), respectively, using the total xylenes effluent concentration calculated above:

$$C_{std} = C_{lab} \times \left(\frac{P_{std}}{P_{lab}} \times \frac{T_{lab}}{T_{std}}\right) = 1.63\ \mu g/L \times \left(\frac{14.7\ psi}{12.23 psi} \times \frac{530\ R}{530\ R}\right) = 1.96\ \mu g/L$$

Calculate emissions rates in pounds per hour (lb/hr) and tons per year (ton/yr) assuming a discharge air flow rate, Q_{out}, of 250 scfm:

Emissions = Q_{out} * C_{std} = 250 scfm * 1.96 µg/L * (28.317 L/ft^3) * (60 min/hr) *

(pound/ 454 grams) * (gram / 10^6 µg) = 0.0018 lb/hr

Emissions = 0.00184 lb/hr * 8760 hr/yr * ton/2000 lb = 0.008 ton/yr

The above calculation assumes the system will be run continuously (24-hours per day). The individual well concentrations also represent what would be taken in by the system during initial operations. Over time with consistent system operation, concentrations typically drop significantly.

Emissions Summary
Based on SVE Pilot Test Analytical Organic Chemistry Data for Soil Vapor
Shamrock#63, Santa Fe, New Mexico

	Benzene	Toluene	Ethylbenzene	Total Xylenes
Average Influent Laboratory Analytical Results (µg/L)	655	363	31	163
Estimated Effluent Analytical Results (µg/L)	6.55	3.63	0.31	1.63
Estimated Effluent Analytical Results at STP (µg/L)	7.87	4.36	0.38	1.96
Average from Pilot Test Data (lb/hr)	0.0074	0.0041	0.0004	0.0018
Average from Pilot Test Data (ton/yr)	0.032	0.018	0.002	0.008

Estimated Flow (SCFM)
250

Estimated Flow (ACFM)
300

Minimum Vapor Treatment Equipment Destruction Efficiency (Thermal Mode)
99%

Conversions

453.59	gram / lb
1000000	ug / gram
60	min / hr
28.3	liter / cubic foot
8760	hr/yr
2000	lb/ton

Flow Conversions

12.2	absolute air pressure at 5000 ft msl
14.7	absolute air pressure at 0 ft msl
70	°F, standard temperature
70	°F, assumed lab temperature
460	°R

Section 6.a

Green House Gas Emissions

(Submitting under 20.2.70, 20.2.72 20.2.74 NMAC)

Title V (20.2.70 NMAC), Minor NSR (20.2.72 NMAC), and PSD (20.2.74 NMAC) applicants must estimate and report greenhouse gas (GHG) emissions to verify the emission rates reported in the public notice, determine applicability to 40 CFR 60 Subparts, and to evaluate Prevention of Significant Deterioration (PSD) applicability. GHG emissions that are subject to air permit regulations consist of the sum of an aggregate group of these six greenhouse gases: carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6).

Calculating GHG Emissions:

1. Calculate the ton per year (tpy) GHG mass emissions and GHG CO_2e emissions from your facility.
2. GHG mass emissions are the sum of the total annual tons of greenhouse gases without adjusting with the global warming potentials (GWPs). GHG CO_2e emissions are the sum of the mass emissions of each individual GHG multiplied by its GWP found in Table A-1 in 40 CFR 98 Mandatory Greenhouse Gas Reporting.
3. Emissions from routine or predictable start up, shut down, and maintenance must be included.
4. Report GHG mass and GHG CO_2e emissions in Table 2-P of this application. Emissions are reported in **short** tons per year and represent each emission unit's Potential to Emit (PTE).
5. All Title V major sources, PSD major sources, and all power plants, whether major or not, must calculate and report GHG mass and CO2e emissions for each unit in Table 2-P.
6. For minor source facilities that are not power plants, are not Title V, and are not PSD there are three options for reporting GHGs in Table 2-P: 1) report GHGs for each individual piece of equipment; 2) report all GHGs from a group of unit types, for example report all combustion source GHGs as a single unit and all venting GHGs as a second separate unit; 3) or check the following ☒ By checking this box, the applicant acknowledges the total CO2e emissions are less than 75,000 tons per year.

Sources for Calculating GHG Emissions:

- Manufacturer's Data
- AP-42 Compilation of Air Pollutant Emission Factors at http://www.epa.gov/ttn/chief/ap42/index.html
- EPA's Internet emission factor database WebFIRE at http://cfpub.epa.gov/webfire/
- 40 CFR 98 Mandatory Green House Gas Reporting except that tons should be reported in short tons rather than in metric tons for the purpose of PSD applicability.
- API Compendium of Greenhouse Gas Emissions Methodologies for the Oil and Natural Gas Industry. August 2009 or most recent version.
- Sources listed on EPA's NSR Resources for Estimating GHG Emissions at http://www.epa.gov/nsr/clean-air-act-permitting-greenhouse-gases:

Global Warming Potentials (GWP):
Applicants must use the Global Warming Potentials codified in Table A-1 of the most recent version of 40 CFR 98 Mandatory Greenhouse Gas Reporting. The GWP for a particular GHG is the ratio of heat trapped by one unit mass of the GHG to that of one unit mass of CO_2 over a specified time period.

"Greenhouse gas" for the purpose of air permit regulations is defined as the aggregate group of the following six gases: carbon dioxide, nitrous oxide, methane, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. **(20.2.70.7 NMAC, 20.2.74.7 NMAC).** You may also find GHGs defined in 40 CFR 86.1818-12(a).

Metric to Short Ton Conversion:
Short tons for GHGs and other regulated pollutants are the standard unit of measure for PSD and title V permitting programs. 40 CFR 98 Mandatory Greenhouse Reporting requires metric tons.
1 metric ton = 1.10231 short tons (per Table A-2 to Subpart A of Part 98 – Units of Measure Conversions)

The proposal from Intellishare Environmental states maximum gas pre-heater input is 750,000 BTU/Hr (Reference #1 in Section 7). The
EPA estimates 117.00 pounds of CO_2 per million BTU (Reference #3 in Section 7). Under continual operation, the total BTU per year would be as follows:

750,000 BTU/Hour X 8,760 Hour/year = 6570 million BTU.

This would produce the follow weight of CO_2.

6570 million BTU X 117.00 lbs./million BTU X 0.0005 tons/lbs. = 384 tons of CO_2 per year.

This is less than 75,000 tons per year.

Section 7

Information Used To Determine Emissions

Information Used to Determine Emissions shall include the following:

- If manufacturer data are used, include specifications for emissions units and control equipment, including control efficiencies specifications and sufficient engineering data for verification of control equipment operation, including design drawings, test reports, and design parameters that affect normal operation.
- If test data are used, include a copy of the complete test report. If the test data are for an emissions unit other than the one being permitted, the emission units must be identical. Test data may not be used if any difference in operating conditions of the unit being permitted and the unit represented in the test report significantly effect emission rates.
- If the most current copy of AP-42 is used, reference the section and date located at the bottom of the page. Include a copy of the page containing the emissions factors, and clearly mark the factors used in the calculations.
- If an older version of AP-42 is used, include a complete copy of the section.
- If an EPA document or other material is referenced, include a complete copy.
- Fuel specifications sheet.
- If computer models are used to estimate emissions, include an input summary (if available) and a detailed report, and a disk containing the input file(s) used to run the model. For tank-flashing emissions, include a discussion of the method used to estimate tank-flashing emissions, relative thresholds (i.e., permit or major source (NSPS, PSD or Title V)), accuracy of the model, the input and output from simulation models and software, all calculations, documentation of any assumptions used, descriptions of sampling methods and conditions, copies of any lab sample analysis.

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1. Intellishare Environmental proposal dated August 9, 2019
2. SVE Pilot Test Sampling Lab Results, Hall Environmental Lab dated November 2017
3. US EIA Carbon Dioxide Emission Coefficients https://www.eia.gov/environment/emissions/co2_vol_mass.php, Accessed August 2019

INTELLISHARE ENVIRONMENTAL

CLEAN AIR SOLUTIONS

1422 Indianhead Drive E
Menomonie, WI 54751 USA
Phone: 715-233-6115
Fax: 715-232-0669
E-Mail: jstrey@intellishare-env.com
Website: www.intellishare-env.com

Date:	8/9/19
ISE Proposal No:	N-19-2235R1
Client Project ID:	Shamrock 63, Sante Fe, NM
Proposal For:	Jeffrey Samson, P.E. Geo-Locic 6020 Academy Road NE, Suite 100 Albuquerque, NM 87109
Phone:	505-353-9071
Fax:	
E-Mail:	jsamson@geologic.com
Application:	Remediation
Proposed Solution:	250 CFM Thermal Oxidizer w/SVE Building System

Intellishare Environmental specializes in the engineering and manufacturing of clean air solutions for the environmental remediation industry. We offer new, used, rental and lease programs to fit any budget or application.

Thank you for the opportunity to provide the following proposal for your project. At Intellishare Environmental, every client is important. Please contact me with any additional questions you may have regarding this information.

Kind Regards,

John Strey
Principal

Oxidizer Process Information

- Design Air Flow Capacity: 250 SCFM
- Maximum Air Flow: 250 SCFM
- Minimum Air Flow: 100 SCFM
- Max Gas Pre-Heater Input: 750,000 BTUH
- Minimum Thermal Operating Temperature: 1400 degrees F.
- Maximum Thermal Operating Temperature: 1750 degrees F.
- Minimum Catalyst Inlet Temperature: 650 degrees F.
- Average Catalyst Operating Temperature: 750 degrees F.
- Maximum Catalyst Operating Temperature: 1100 degrees F.
- Catalyst Volume: .48 cubic feet
- Catalyst Gas Hourly Space Velocity: 39,000 $GHSV^{-1}$
- Destruction Efficiency:
  - 99% thermal
  - 98% catalytic
- Maximum LEL Throughput: 25%
- Time to Reach Operating Temperature: 15 minutes from cold start
- Inlet Connection: 4 Flanged
- Outlet Connection: 12” Flanged
- Foot Print: W=6’, L=10’, H=8’
- Weight: 3,500 lbs
- Available Voltages: 460/3/60

SVE Process Information

- Design Air Flow Capacity: 250 SCFM
- SVE Design Vacuum: 70” W.C.
- SVE Design pressure: 15” W.C.
- VLS Liquid Capacity: 50 Gallon
- Liquid Pump Out: 10 GPM
- Estimated Noise Level Outside of Building: < 70 dBA at a distance of 10’
- Inlet Connection: 4” Flanged
- Outlet Connection: 4” Flanged
- Foot Print: W=6’, L=6’, H=4’
- Estimated Weight: 1500 lbs
- Power Input: 480/3/60
- Horsepower: 10hp

Oxidizer Equipment Specification

Reactor: The reactor housing will be constructed of 7 gauge rolled steel. The Inlet and outlet connections are flanged. The reactor will be painted ISE standard grey two component paint.

High Temperature Refractory: All internal reactor surfaces are completely insulated with a ceramic insulation media rated for 2200 deg F. A coating is applied to the insulation to increase the mechanical integrity and extend the life of the insulation.

Gas Pre-Heater: The unit will come equipped as standard with a direct gas fired air burner with combustion air blower and 2hp TEFC motor..

Fuel Gas Piping Assembly: The fuel gas piping assembly is pre-piped. The gas train will meet all code requirements and is suitable for FM approval. All components are rated for outdoor operation and continuous use. Fuel train enclosure provided to protect fuel train from elements.

Main Control Panel: The main control panel shall be NEMA 4 construction and shall be pre-wired to all components. The control panel features alarm detection and an hour meter to record run time. Temperature control will be provided with approved temperature control devices and 4-20ma temperature retransmit and limit switches. The control panel shall be UL labeled and listed as an assembly.

Flame Arrestor: A flame arrestor will be supplied and mounted to the inlet of the oxidizer and utilized to prevent flame propagation to the source. A spiral crimped aluminum element shall be removable for inspection and cleaning.

Optional Exhaust Stack Silencer: An exhaust gas silencer can be placed on the discharge of the thermal oxidizer, which will reduce any oxidizer noise to very low levels. The silencer internals are manufactured from 309SS. The silencer is a chamber type.

Optional Catalyst Module: The oxidizer can be furnished with a monolith catalyst, specifically designed for the destruction of petroleum hydrocarbons. The catalyst module is easily field inserted with minimal requirements and typically takes 2 hours for complete conversion.

Optional Temperature Chart Recorder: The oxidizer can be furnished with digital chart recorder to record the inlet and outlet temperatures of the oxidizer.

SVE Equipment Specification

SVE Blower: 250 CFM @ 70" W.C. vacuum at 6630' msl. Sutorbuilt 4007 Positive Displacement (PD) Blower with 10 HP TEFC motor, belt drive. Discharge Silencer, automatic belt tensioner, vacuum relief valve. A blower inlet filter will be provided.

Moisture Separator: The vapor liquid separator (VLS) is welded steel construction with external enamel finish. The separator is 100 gallon total capacity with 50 gallon liquid holding capacity. Internal to the separator is a moisture/filter demister. The separator is equipped with PVC site glass and three point liquid level control. The separator will be equipped with 1" drain valve.

Condensate Removal Pump: Goulds NPE 1ST to provide 10 GPM at 80' TDH, stainless steel impeller and volute. 1/2hp TEFC motor. Check valve, throttle valve and sample port on pump discharge.

Condensate Tank: A poly tank with 70 gallon capacity will be installed within the building. A two point level sensor (warning and high level shutdown) will be installed in the tank. A vent will be plumbed outside the enclosure.

Automatic Purge/Dilution Control: An automatic valve will be installed on the inlet of the SVE blower. Once the fresh air purge of the oxidizer is complete, the valve is automatically switched to dilution control and works on a PID loop with the catalyst exit temperature thermocouple.

Automatic Inlet Isolation Valve: An automatic valve with modulating actuator will be installed on the inlet of the SVE system.

SVE Control Panel: The NEMA 3R control panel will be completely assembled, wired and mounted at eye level. Control panel includes power disconnect The control panel is PLC based with operator touch screen terminal. An hour meter is provided to record system run time. HOA function for blower and transfer pump will be through the operator touchscreen. Oxidizer interlocks will be provided. The control panel will be UL 508 approved as an assembly. All wiring will be consistent with standards set forth in the NEC.

Telemetry: A telemetry system consists of a modem to allow remote access to the system controls. The operator can view data and will also receive an email for any alarm events. The telemetry system is real time and also allows Intellishare the ability to log in and make any PLC program changes or modifications and remote support over the course of the project duration. The telemetry system will consist of a cellular modem with Verizon data plan by others.
Remote display will include the below:
1. Oxidizer inlet temperature
2. Oxidizer outlet temperature
3. SVE discharge pressure
4. SVE discharge flow
5. SVE inlet & discharge temperature
6. SVE wellfield vacuum and soil gas LEL

SVE Instrumentation: Pitot tube flow sensor with DP transmitter w/display installed on SVE blower outlet (flow to oxidizer). Vacuum transmitter w/display on blower inlet. Pressure transmitter w/display on SVE discharge. A thermocouple will be installed on the SVE inlet & discharge. LEL sensor piped around the SVE blower to indicate LEL.

Spare Parts (estimate for 1st year of operation):
(1) Oxidizer thermocouple
(1) Oxidizer pressure switch
(4) Oxidizer Combustion air filter element
(1) Oxidizer UV scanner & amplifier
(2) SVE blower belts
(12) Synthetic blower oil
(4) SVE inlet filter elements
(1) SVE inlet dilution filter element
(1) LEL Sensor Module

SVE Equipment Specification

Modified Cargo Box enclosure;
-8’ wide x 10’ long x 8’6” high outside dimension
-Welded sea container
-Used container with be like new condition
-Container will be repainted after modifications to match existing beige color
-Floor sealed with non-skid bed liner
-R-13 Insulation walls and ceiling with 2 x 4 furring and painted plywood interior
-(2) 36” x 6’-8” insulated steel access doors on side
-Sound insulated louver covers for vent air intake and exhaust louvers
-1800 W wall mounted electric fan forced heater with thermostat
-(2) Ceiling mounted incandescent lights with vapor globe and wall switch
-(1) 14” vent fan with inlet and outlet louvers and thermostat
-Spray foam urethane insulation under floor for sound and heat retention
-Floor sump and high level sensor

Equipment Mounted and Wired:
-The container will have;
-Wall penetrations for the inlet and outlet SVE/VLS pump piping and tank vent
-(2) LEL meters to detect explosive environment
-SVE, VLS and Pump mounted and wired
-SVE control panel and breaker box mounted to exterior

Equipment Pricing

Thermal Oxidizer Model 250…….…….……	$	56,000
Oxidizer Exhaust Gas Silencer……..	$	6,500
Oxidizer Temperature 2 channel chart recorder.. ..……	$	3,000
Oxidizer Catalyst Module (Crated)……	$	4,500
Soil Vapor Extraction Building……	$	78,750
Modify Extraction Building to 10' Length…….	$	4,200
Spare parts……..……	$	4,950
Start up and Training (3 days includes expenses)..……	$	5,500
Freight all equipment to Sante Fe, NM……	$	5,700
Total	$	169,100

Please note: The above pricing is based upon the client issuing a state and local sales tax exemption certificate, pollution control exemption certificate, or any other tax exemption certificate to Intellishare Environmental. If client is unable to provide such a certificate, then sales tax must be added to the total contract price.

Payment Terms

30% with order placement
30% 8 weeks after order placement
30% prior to shipment
10% net 30 days upon shipment

Delivery

Schedule

Approximately 10-12 weeks from submittal approval. Submittals can be provided in 10-15 working days after receipt of order.

Terms

F.O.B. factory prepaid and added.

Reference #2

Hall Environmental Analysis Laboratory
4901 Hawkins NE
Albuquerque, NM 87109
TEL: 505-345-3975 FAX: 505-345-4107
Website: www.hallenvironmental.com

November 08, 2017

John Casey

Daniel B. Stephens & Assoc.
6020 Academy NE Suite 100
Albuquerque, NM 87109
TEL: (505) 822-9400
FAX (505) 822-8877

RE: Shamrock 63 OrderNo.: 1710C22

Dear John Casey:

Hall Environmental Analysis Laboratory received 6 sample(s) on 10/23/2017 for the analyses presented in the following report.

These were analyzed according to EPA procedures or equivalent. To access our accredited tests please go to www.hallenvironmental.com or the state specific web sites. In order to properly interpret your results, it is imperative that you review this report in its entirety. See the sample checklist and/or the Chain of Custody for information regarding the sample receipt temperature and preservation. Data qualifiers or a narrative will be provided if the sample analysis or analytical quality control parameters require a flag. When necessary, data qualifiers are provided on both the sample analysis report and the QC summary report, both sections should be reviewed. All samples are reported, as received, unless otherwise indicated. Lab measurement of analytes considered field parameters that require analysis within 15 minutes of sampling such as pH and residual chlorine are qualified as being analyzed outside of the recommended holding time.

Please don't hesitate to contact HEAL for any additional information or clarifications.

ADHS Cert #AZ0682 -- NMED-DWB Cert #NM9425 -- NMED-Micro Cert #NM0190

Sincerely,

Andy Freeman
Laboratory Manager
4901 Hawkins NE
Albuquerque, NM 87109

Analytical Report
Lab Order **1710C22**
Date Reported: **11/8/2017**

Hall Environmental Analysis Laboratory, Inc.

CLIENT: Daniel B. Stephens & Assoc.
Client Sample ID: MW-17 SVE Pilot Quick Test
Project: Shamrock 63
Collection Date: 10/21/2017 8:15:00 AM
Lab ID: 1710C22-001 **Matrix:** AIR **Received Date:** 10/23/2017 4:20:00 PM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 8015D: GASOLINE RANGE						Analyst: **NSB**	
Gasoline Range Organics (GRO)	28000	1000		µg/L	200	11/1/2017 11:45:17 AM	D46792
Surr: BFB	106	80.2-145		%Rec	200	11/1/2017 11:45:17 AM	D46792
EPA METHOD 8021B: VOLATILES						Analyst: **NSB**	
Methyl tert-butyl ether (MTBE)	ND	50		µg/L	200	11/1/2017 11:45:17 AM	B46792
Benzene	58	20		µg/L	200	11/1/2017 11:45:17 AM	B46792
Toluene	14	10		µg/L	200	11/1/2017 11:45:17 AM	B46792
Ethylbenzene	ND	10		µg/L	200	11/1/2017 11:45:17 AM	B46792
Xylenes, Total	ND	20		µg/L	200	11/1/2017 11:45:17 AM	B46792
Surr: 4-Bromofluorobenzene	110	81.9-144		%Rec	200	11/1/2017 11:45:17 AM	B46792

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
PQL	Practical Quanitative Limit	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

CLIENT: Daniel B. Stephens & Assoc.
Client Sample ID: MW-11 SVE Pilot Quick Test
Project: Shamrock 63
Collection Date: 10/21/2017 9:15:00 AM
Lab ID: 1710C22-002 **Matrix:** AIR **Received Date:** 10/23/2017 4:20:00 PM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 8015D: GASOLINE RANGE						Analyst: **NSB**	
Gasoline Range Organics (GRO)	200000	2500		µg/L	500	11/2/2017 8:52:03 AM	G46838
Surr: BFB	110	80.2-145		%Rec	500	11/2/2017 8:52:03 AM	G46838
EPA METHOD 8021B: VOLATILES						Analyst: **NSB**	
Methyl tert-butyl ether (MTBE)	ND	50		µg/L	200	11/1/2017 12:07:55 PM	B46792
Benzene	890	20		µg/L	200	11/1/2017 12:07:55 PM	B46792
Toluene	300	20		µg/L	200	11/1/2017 12:07:55 PM	B46792
Ethylbenzene	34	20		µg/L	200	11/1/2017 12:07:55 PM	B46792
Xylenes, Total	260	40		µg/L	200	11/1/2017 12:07:55 PM	B46792
Surr: 4-Bromofluorobenzene	114	81.9-144		%Rec	200	11/1/2017 12:07:55 PM	B46792

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
PQL	Practical Quanitative Limit	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

CLIENT: Daniel B. Stephens & Assoc.
Client Sample ID: MW-5 SVE Pilot Quick Test
Project: Shamrock 63
Collection Date: 10/21/2017 10:45:00 AM
Lab ID: 1710C22-003 **Matrix:** AIR **Received Date:** 10/23/2017 4:20:00 PM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 8015D: GASOLINE RANGE						Analyst: **NSB**	
Gasoline Range Organics (GRO)	79000	1000		µg/L	200	11/2/2017 8:29:27 AM	G46838
Surr: BFB	107	80.2-145		%Rec	200	11/2/2017 8:29:27 AM	G46838
EPA METHOD 8021B: VOLATILES						Analyst: **NSB**	
Methyl tert-butyl ether (MTBE)	ND	50		µg/L	200	11/2/2017 8:29:27 AM	B46838
Benzene	340	20		µg/L	200	11/2/2017 8:29:27 AM	B46838
Toluene	130	20		µg/L	200	11/2/2017 8:29:27 AM	B46838
Ethylbenzene	12	10		µg/L	200	11/2/2017 8:29:27 AM	B46838
Xylenes, Total	63	40		µg/L	200	11/2/2017 8:29:27 AM	B46838
Surr: 4-Bromofluorobenzene	113	81.9-144		%Rec	200	11/2/2017 8:29:27 AM	B46838

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
PQL	Practical Quanitative Limit	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

CLIENT: Daniel B. Stephens & Assoc.
Client Sample ID: MW-1 SVE Pilot Quick Test
Project: Shamrock 63
Collection Date: 10/21/2017 11:45:00 AM
Lab ID: 1710C22-004 **Matrix:** AIR **Received Date:** 10/23/2017 4:20:00 PM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 8015D: GASOLINE RANGE						Analyst: **NSB**	
Gasoline Range Organics (GRO)	130000	1000		µg/L	200	11/2/2017 9:37:04 AM	G46838
Surr: BFB	132	80.2-145		%Rec	200	11/2/2017 9:37:04 AM	G46838
EPA METHOD 8021B: VOLATILES						Analyst: **NSB**	
Methyl tert-butyl ether (MTBE)	ND	50		µg/L	200	11/2/2017 9:37:04 AM	B46838
Benzene	430	20		µg/L	200	11/2/2017 9:37:04 AM	B46838
Toluene	76	20		µg/L	200	11/2/2017 9:37:04 AM	B46838
Ethylbenzene	20	20		µg/L	200	11/2/2017 9:37:04 AM	B46838
Xylenes, Total	120	40		µg/L	200	11/2/2017 9:37:04 AM	B46838
Surr: 4-Bromofluorobenzene	115	81.9-144		%Rec	200	11/2/2017 9:37:04 AM	B46838

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
PQL	Practical Quanitative Limit	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

CLIENT: Daniel B. Stephens & Assoc.
Client Sample ID: MW-7 SVE Pilot Quick Test
Project: Shamrock 63
Collection Date: 10/21/2017 12:45:00 PM
Lab ID: 1710C22-005 **Matrix:** AIR **Received Date:** 10/23/2017 4:20:00 PM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 8015D: GASOLINE RANGE						Analyst: **NSB**	
Gasoline Range Organics (GRO)	120000	1000		µg/L	200	11/2/2017 9:59:22 AM	G46838
Surr: BFB	113	80.2-145		%Rec	200	11/2/2017 9:59:22 AM	G46838
EPA METHOD 8021B: VOLATILES						Analyst: **NSB**	
Methyl tert-butyl ether (MTBE)	ND	50		µg/L	200	11/2/2017 9:59:22 AM	B46838
Benzene	380	20		µg/L	200	11/2/2017 9:59:22 AM	B46838
Toluene	50	20		µg/L	200	11/2/2017 9:59:22 AM	B46838
Ethylbenzene	13	10		µg/L	200	11/2/2017 9:59:22 AM	B46838
Xylenes, Total	40	40		µg/L	200	11/2/2017 9:59:22 AM	B46838
Surr: 4-Bromofluorobenzene	115	81.9-144		%Rec	200	11/2/2017 9:59:22 AM	B46838

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
PQL	Practical Quanitative Limit	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

CLIENT: Daniel B. Stephens & Assoc.
Client Sample ID: MW-2 SVE Pilot Quick Test
Project: Shamrock 63
Collection Date: 10/21/2017 2:30:00 PM
Lab ID: 1710C22-006
Matrix: AIR
Received Date: 10/23/2017 4:20:00 PM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 8015D: GASOLINE RANGE						Analyst: **NSB**	
Gasoline Range Organics (GRO)	77000	1000		µg/L	200	11/2/2017 10:21:41 AM	G46838
Surr: BFB	106	80.2-145		%Rec	200	11/2/2017 10:21:41 AM	G46838
EPA METHOD 8021B: VOLATILES						Analyst: **NSB**	
Methyl tert-butyl ether (MTBE)	ND	50		µg/L	200	11/2/2017 10:21:41 AM	B46838
Benzene	220	20		µg/L	200	11/2/2017 10:21:41 AM	B46838
Toluene	15	10		µg/L	200	11/2/2017 10:21:41 AM	B46838
Ethylbenzene	ND	10		µg/L	200	11/2/2017 10:21:41 AM	B46838
Xylenes, Total	ND	20		µg/L	200	11/2/2017 10:21:41 AM	B46838
Surr: 4-Bromofluorobenzene	112	81.9-144		%Rec	200	11/2/2017 10:21:41 AM	B46838

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
PQL	Practical Quanitative Limit	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

QC SUMMARY REPORT
Hall Environmental Analysis Laboratory, Inc.

WO#: **1710C22**
08-Nov-17

Client: Daniel B. Stephens & Assoc.
Project: Shamrock 63

Sample ID **1710C22-003ADUP** SampType: **DUP** TestCode: **EPA Method 8015D: Gasoline Range**
Client ID: **MW-5 SVE Pilot Qui** Batch ID: **G46838** RunNo: **46838**
Prep Date: Analysis Date: **11/2/2017** SeqNo: **1493886** Units: **µg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Gasoline Range Organics (GRO)	77000	1000						2.80	20	
Surr: BFB	430000		400000		107	80.2	145	0	0	

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
PQL	Practical Quanitative Limit	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1710C22**

08-Nov-17

Client: Daniel B. Stephens & Assoc.

Project: Shamrock 63

Sample ID	**1710C22-003ADUP**	SampType:	**DUP**	TestCode:	**EPA Method 8021B: Volatiles**
Client ID:	**MW-5 SVE Pilot Qui**	Batch ID:	**B46838**	RunNo:	**46838**
Prep Date:		Analysis Date:	**11/2/2017**	SeqNo:	**1493921** Units: **µg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Methyl tert-butyl ether (MTBE)	ND	50						0	20	
Benzene	330	20						2.63	20	
Toluene	120	20						3.25	20	
Ethylbenzene	11	10						5.78	20	
Xylenes, Total	61	40						3.19	20	
Surr: 4-Bromofluorobenzene	450		400.0		113	81.9	144	0	0	

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
PQL	Practical Quanitative Limit	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

HALL ENVIRONMENTAL ANALYSIS LABORATORY

Hall Environmental Analysis Laboratory
4901 Hawkins NE
Albuquerque, NM 87109
TEL: 505-345-3975 FAX: 505-345-4107
Website: www.hallenvironmental.com

Sample Log-In Check List

Client Name: DBS | Work Order Number: 1710C22 | RcptNo: 1

Received By: Erin Melendrez 10/23/2017 4:20:00 PM

Completed By: Ashley Gallegos 10/24/2017 8:06:55 AM

Reviewed By: 10/24/17

Chain of Custody

1. Custody seals intact on sample bottles?	Yes ☐	No ☐	Not Present ☑
2. Is Chain of Custody complete?	Yes ☑	No ☐	Not Present ☐
3. How was the sample delivered?	Client		

Log In

4. Was an attempt made to cool the samples?	Yes ☑	No ☐	NA ☐
5. Were all samples received at a temperature of >0° C to 6.0°C	Yes ☑	No ☐	NA ☐
6. Sample(s) in proper container(s)?	Yes ☑	No ☐	
7. Sufficient sample volume for indicated test(s)?	Yes ☑	No ☐	
8. Are samples (except VOA and ONG) properly preserved?	Yes ☑	No ☐	
9. Was preservative added to bottles?	Yes ☐	No ☑	NA ☐
10. VOA vials have zero headspace?	Yes ☐	No ☐	No VOA Vials ☑
11. Were any sample containers received broken?	Yes ☐	No ☑	
12. Does paperwork match bottle labels? (Note discrepancies on chain of custody)	Yes ☑	No ☐	
13. Are matrices correctly identified on Chain of Custody?	Yes ☑	No ☐	
14. Is it clear what analyses were requested?	Yes ☑	No ☐	
15. Were all holding times able to be met? (If no, notify customer for authorization.)	Yes ☑	No ☐	

# of preserved bottles checked for pH: _____ (<2 or >12 unless noted)

Adjusted? _____

Checked by: _____

Special Handling (if applicable)

16. Was client notified of all discrepancies with this order? Yes ☐ No ☐ NA ☑

Person Notified: _____ Date _____

By Whom: _____ Via: ☐ eMail ☐ Phone ☐ Fax ☐ In Person

Regarding: _____

Client Instructions: _____

17. Additional remarks:

18. **Cooler Information**

Cooler No	Temp °C	Condition	Seal Intact	Seal No	Seal Date	Signed By
1	NA	Good	Not Present			

Chain-of-Custody Record

Client: DBS&A

Mailing Address: 6020 Academy Rd NE ABQ 87109

Phone #: 505-822-9400

email or Fax#: tgolden@dbstephens.com

QA/QC Package:
☒ Standard ☐ Level 4 (Full Validation)

Accreditation
☐ NELAP ☐ Other _____

☐ EDD (Type) _____

Turn-Around Time:
☒ Standard ☐ Rush _____

Project Name: Shamrock #63

Project #: BE14.0021.00.00005.0005

Project Manager: J. Casey

Sampler: T. Golden

On Ice: ☐ Yes ☐ No

Sample Temperature: N/A

HALL ENVIRONMENTAL ANALYSIS LABORATORY

www.hallenvironmental.com

4901 Hawkins NE - Albuquerque, NM 87109

Tel. 505-345-3975 Fax 505-345-4107

Analysis Request

Date	Time	Matrix	Sample Request ID	Container Type and #	Preservative Type	HEAL No. 1710622	BTEX + MTBE + TMB's (8021)	BTEX + MTBE + TPH (Gas only)	TPH 8015B (GRO / DRO / MRO)	TPH (Method 418.1)	EDB (Method 504.1)	PAH's (8310 or 8270 SIMS)	RCRA 8 Metals	Anions (F,Cl,NO_3,NO_2,PO_4,SO_4)	8081 Pesticides / 8082 PCB's	8260B (VOA)	8270 (Semi-VOA)					Air Bubbles (Y or N)
10/21/17	8:15	AIR	MW-17 SVE PILOT QUICK TEST	1L Teflar	None	-001		X	X													
	9:15		MW-11 SVE PILOT QUICK TEST			-002																
	10:45		MW-5 SVE PILOT QUICK TEST			-003																
	11:45		MW-1 SVE PILOT QUICK TEST			-004																
	12:45		MW-7 SVE PILOT QUICK TEST			-005																
	14:30		MW-2 SVE PILOT QUICK TEST			-006																

Date	Time	Relinquished by:	Received by:	Date	Time
10/23/17	4:20			10/23/17	1620
Date:	Time:	Relinquished by:	Received by:	Date	Time

Remarks:

If necessary, samples submitted to Hall Environmental may be subcontracted to other accredited laboratories. This serves as notice of this possibility. Any sub-contracted data will be clearly notated on the analytical report.

HALL ENVIRONMENTAL ANALYSIS LABORATORY

Hall Environmental Analysis Laboratory
4901 Hawkins NE
Albuquerque, NM 87109
TEL: 505-345-3975 FAX: 505-345-4107
Website: www.hallenvironmental.com

November 08, 2017

John Casey

Daniel B. Stephens & Assoc.
6020 Academy NE Suite 100
Albuquerque, NM 87109
TEL: (505) 822-9400
FAX (505) 822-8877

RE: Shamrock 63 OrderNo.: 1710C23

Dear John Casey:

Hall Environmental Analysis Laboratory received 9 sample(s) on 10/23/2017 for the analyses presented in the following report.

These were analyzed according to EPA procedures or equivalent. To access our accredited tests please go to www.hallenvironmental.com or the state specific web sites. In order to properly interpret your results, it is imperative that you review this report in its entirety. See the sample checklist and/or the Chain of Custody for information regarding the sample receipt temperature and preservation. Data qualifiers or a narrative will be provided if the sample analysis or analytical quality control parameters require a flag. When necessary, data qualifiers are provided on both the sample analysis report and the QC summary report, both sections should be reviewed. All samples are reported, as received, unless otherwise indicated. Lab measurement of analytes considered field parameters that require analysis within 15 minutes of sampling such as pH and residual chlorine are qualified as being analyzed outside of the recommended holding time.

Please don't hesitate to contact HEAL for any additional information or clarifications.

ADHS Cert #AZ0682 -- NMED-DWB Cert #NM9425 -- NMED-Micro Cert #NM0190

Sincerely,



Andy Freeman
Laboratory Manager
4901 Hawkins NE
Albuquerque, NM 87109

Hall Environmental Analysis Laboratory, Inc.

Analytical Report
Lab Order **1710C23**
Date Reported: **11/8/2017**

CLIENT: Daniel B. Stephens & Assoc.
Client Sample ID: MW-9 SVE Pilot
Project: Shamrock 63
Collection Date: 10/20/2017 9:30:00 AM
Lab ID: 1710C23-001 **Matrix:** AIR **Received Date:** 10/23/2017 4:15:00 PM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 8015D: GASOLINE RANGE						Analyst: **NSB**	
Gasoline Range Organics (GRO)	180000	2500		µg/L	500	11/1/2017 8:44:37 AM	D46792
Surr: BFB	108	80.2-145		%Rec	500	11/1/2017 8:44:37 AM	D46792
EPA METHOD 8021B: VOLATILES						Analyst: **NSB**	
Methyl tert-butyl ether (MTBE)	ND	120		µg/L	500	11/1/2017 8:44:37 AM	B46792
Benzene	980	50		µg/L	500	11/1/2017 8:44:37 AM	B46792
Toluene	260	50		µg/L	500	11/1/2017 8:44:37 AM	B46792
Ethylbenzene	42	25		µg/L	500	11/1/2017 8:44:37 AM	B46792
Xylenes, Total	190	100		µg/L	500	11/1/2017 8:44:37 AM	B46792
Surr: 4-Bromofluorobenzene	110	81.9-144		%Rec	500	11/1/2017 8:44:37 AM	B46792

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
PQL	Practical Quanitative Limit	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

CLIENT: Daniel B. Stephens & Assoc.
Client Sample ID: MW-9 SVE Pilot
Project: Shamrock 63
Collection Date: 10/20/2017 12:30:00 PM
Lab ID: 1710C23-002 **Matrix:** AIR **Received Date:** 10/23/2017 4:15:00 PM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 8015D: GASOLINE RANGE						Analyst: **NSB**	
Gasoline Range Organics (GRO)	140000	1000		µg/L	200	11/1/2017 10:59:59 AM	D46792
Surr: BFB	112	80.2-145		%Rec	200	11/1/2017 10:59:59 AM	D46792
EPA METHOD 8021B: VOLATILES						Analyst: **NSB**	
Methyl tert-butyl ether (MTBE)	ND	50		µg/L	200	11/1/2017 10:59:59 AM	B46792
Benzene	760	20		µg/L	200	11/1/2017 10:59:59 AM	B46792
Toluene	230	20		µg/L	200	11/1/2017 10:59:59 AM	B46792
Ethylbenzene	36	20		µg/L	200	11/1/2017 10:59:59 AM	B46792
Xylenes, Total	200	40		µg/L	200	11/1/2017 10:59:59 AM	B46792
Surr: 4-Bromofluorobenzene	115	81.9-144		%Rec	200	11/1/2017 10:59:59 AM	B46792

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
PQL	Practical Quanitative Limit	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

CLIENT: Daniel B. Stephens & Assoc.
Client Sample ID: MW-9 SVE Pilot
Project: Shamrock 63
Collection Date: 10/20/2017 3:30:00 PM
Lab ID: 1710C23-003 **Matrix:** AIR **Received Date:** 10/23/2017 4:15:00 PM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 8015D: GASOLINE RANGE						Analyst: **NSB**	
Gasoline Range Organics (GRO)	150000	1000		µg/L	200	11/1/2017 11:22:37 AM	D46792
Surr: BFB	109	80.2-145		%Rec	200	11/1/2017 11:22:37 AM	D46792
EPA METHOD 8021B: VOLATILES						Analyst: **NSB**	
Methyl tert-butyl ether (MTBE)	ND	50		µg/L	200	11/1/2017 11:22:37 AM	B46792
Benzene	800	20		µg/L	200	11/1/2017 11:22:37 AM	B46792
Toluene	230	20		µg/L	200	11/1/2017 11:22:37 AM	B46792
Ethylbenzene	26	20		µg/L	200	11/1/2017 11:22:37 AM	B46792
Xylenes, Total	140	40		µg/L	200	11/1/2017 11:22:37 AM	B46792
Surr: 4-Bromofluorobenzene	112	81.9-144		%Rec	200	11/1/2017 11:22:37 AM	B46792

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
PQL	Practical Quanitative Limit	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

CLIENT: Daniel B. Stephens & Assoc.
Client Sample ID: MW-10 SVE Pilot
Project: Shamrock 63
Collection Date: 10/22/2017 9:30:00 AM
Lab ID: 1710C23-004 **Matrix:** AIR **Received Date:** 10/23/2017 4:15:00 PM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 8015D: GASOLINE RANGE						Analyst: **NSB**	
Gasoline Range Organics (GRO)	200000	2500		µg/L	500	11/3/2017 9:03:58 AM	G46868
Surr: BFB	110	80.2-145		%Rec	500	11/3/2017 9:03:58 AM	G46868
EPA METHOD 8021B: VOLATILES						Analyst: **NSB**	
Methyl tert-butyl ether (MTBE)	ND	50		µg/L	200	11/2/2017 10:44:00 AM	B46838
Benzene	980	20		µg/L	200	11/2/2017 10:44:00 AM	B46838
Toluene	970	20		µg/L	200	11/2/2017 10:44:00 AM	B46838
Ethylbenzene	56	20		µg/L	200	11/2/2017 10:44:00 AM	B46838
Xylenes, Total	260	40		µg/L	200	11/2/2017 10:44:00 AM	B46838
Surr: 4-Bromofluorobenzene	113	81.9-144		%Rec	200	11/2/2017 10:44:00 AM	B46838

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
PQL	Practical Quanitative Limit	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

CLIENT: Daniel B. Stephens & Assoc.
Client Sample ID: MW-10 SVE Pilot
Project: Shamrock 63
Collection Date: 10/22/2017 12:30:00 PM
Lab ID: 1710C23-005 **Matrix:** AIR **Received Date:** 10/23/2017 4:15:00 PM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 8015D: GASOLINE RANGE						Analyst: **NSB**	
Gasoline Range Organics (GRO)	220000	2500		µg/L	500	11/3/2017 9:28:23 AM	G46868
Surr: BFB	113	80.2-145		%Rec	500	11/3/2017 9:28:23 AM	G46868
EPA METHOD 8021B: VOLATILES						Analyst: **NSB**	
Methyl tert-butyl ether (MTBE)	ND	50		µg/L	200	11/2/2017 11:28:42 AM	B46838
Benzene	880	20		µg/L	200	11/2/2017 11:28:42 AM	B46838
Toluene	930	20		µg/L	200	11/2/2017 11:28:42 AM	B46838
Ethylbenzene	69	20		µg/L	200	11/2/2017 11:28:42 AM	B46838
Xylenes, Total	370	40		µg/L	200	11/2/2017 11:28:42 AM	B46838
Surr: 4-Bromofluorobenzene	116	81.9-144		%Rec	200	11/2/2017 11:28:42 AM	B46838

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
PQL	Practical Quanitative Limit	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

CLIENT: Daniel B. Stephens & Assoc.
Client Sample ID: MW-10 SVE Pilot
Project: Shamrock 63
Collection Date: 10/22/2017 3:30:00 PM
Lab ID: 1710C23-006 **Matrix:** AIR **Received Date:** 10/23/2017 4:15:00 PM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 8015D: GASOLINE RANGE						Analyst: **NSB**	
Gasoline Range Organics (GRO)	230000	2500		µg/L	500	11/3/2017 9:50:58 AM	G46868
Surr: BFB	112	80.2-145		%Rec	500	11/3/2017 9:50:58 AM	G46868
EPA METHOD 8021B: VOLATILES						Analyst: **NSB**	
Methyl tert-butyl ether (MTBE)	ND	50		µg/L	200	11/2/2017 11:51:02 AM	B46838
Benzene	860	20		µg/L	200	11/2/2017 11:51:02 AM	B46838
Toluene	840	20		µg/L	200	11/2/2017 11:51:02 AM	B46838
Ethylbenzene	56	20		µg/L	200	11/2/2017 11:51:02 AM	B46838
Xylenes, Total	300	40		µg/L	200	11/2/2017 11:51:02 AM	B46838
Surr: 4-Bromofluorobenzene	113	81.9-144		%Rec	200	11/2/2017 11:51:02 AM	B46838

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
PQL	Practical Quanitative Limit	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

CLIENT: Daniel B. Stephens & Assoc.
Client Sample ID: MW-6 SVE Pilot
Project: Shamrock 63
Collection Date: 10/23/2017 7:30:00 AM
Lab ID: 1710C23-007 **Matrix:** AIR **Received Date:** 10/23/2017 4:15:00 PM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 8015D: GASOLINE RANGE						Analyst: **NSB**	
Gasoline Range Organics (GRO)	150000	1000		µg/L	200	11/2/2017 12:13:24 PM	G46838
Surr: BFB	112	80.2-145		%Rec	200	11/2/2017 12:13:24 PM	G46838
EPA METHOD 8021B: VOLATILES						Analyst: **NSB**	
Methyl tert-butyl ether (MTBE)	ND	50		µg/L	200	11/2/2017 12:13:24 PM	B46838
Benzene	830	20		µg/L	200	11/2/2017 12:13:24 PM	B46838
Toluene	670	20		µg/L	200	11/2/2017 12:13:24 PM	B46838
Ethylbenzene	39	20		µg/L	200	11/2/2017 12:13:24 PM	B46838
Xylenes, Total	190	40		µg/L	200	11/2/2017 12:13:24 PM	B46838
Surr: 4-Bromofluorobenzene	113	81.9-144		%Rec	200	11/2/2017 12:13:24 PM	B46838

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
PQL	Practical Quanitative Limit	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

CLIENT: Daniel B. Stephens & Assoc.
Client Sample ID: MW-6 SVE Pilot
Project: Shamrock 63
Collection Date: 10/23/2017 10:30:00 AM
Lab ID: 1710C23-008 **Matrix:** AIR **Received Date:** 10/23/2017 4:15:00 PM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 8015D: GASOLINE RANGE						Analyst: **NSB**	
Gasoline Range Organics (GRO)	120000	1000		µg/L	200	11/3/2017 8:41:27 AM	G46868
Surr: BFB	113	80.2-145		%Rec	200	11/3/2017 8:41:27 AM	G46868
EPA METHOD 8021B: VOLATILES						Analyst: **NSB**	
Methyl tert-butyl ether (MTBE)	ND	50		µg/L	200	11/3/2017 8:41:27 AM	B46868
Benzene	670	20		µg/L	200	11/3/2017 8:41:27 AM	B46868
Toluene	390	20		µg/L	200	11/3/2017 8:41:27 AM	B46868
Ethylbenzene	37	20		µg/L	200	11/3/2017 8:41:27 AM	B46868
Xylenes, Total	200	40		µg/L	200	11/3/2017 8:41:27 AM	B46868
Surr: 4-Bromofluorobenzene	115	81.9-144		%Rec	200	11/3/2017 8:41:27 AM	B46868

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
PQL	Practical Quanitative Limit	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

CLIENT: Daniel B. Stephens & Assoc.
Client Sample ID: MW-6 SVE Pilot
Project: Shamrock 63
Collection Date: 10/23/2017 1:30:00 PM
Lab ID: 1710C23-009 **Matrix:** AIR **Received Date:** 10/23/2017 4:15:00 PM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 8015D: GASOLINE RANGE						Analyst: **NSB**	
Gasoline Range Organics (GRO)	130000	1000		µg/L	200	11/3/2017 10:35:57 AM	G46868
Surr: BFB	110	80.2-145		%Rec	200	11/3/2017 10:35:57 AM	G46868
EPA METHOD 8021B: VOLATILES						Analyst: **NSB**	
Methyl tert-butyl ether (MTBE)	ND	50		µg/L	200	11/3/2017 10:35:57 AM	B46868
Benzene	740	20		µg/L	200	11/3/2017 10:35:57 AM	B46868
Toluene	340	20		µg/L	200	11/3/2017 10:35:57 AM	B46868
Ethylbenzene	19	10		µg/L	200	11/3/2017 10:35:57 AM	B46868
Xylenes, Total	99	40		µg/L	200	11/3/2017 10:35:57 AM	B46868
Surr: 4-Bromofluorobenzene	113	81.9-144		%Rec	200	11/3/2017 10:35:57 AM	B46868

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
PQL	Practical Quanitative Limit	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1710C23**

08-Nov-17

Client: Daniel B. Stephens & Assoc.

Project: Shamrock 63

Sample ID	**1710C23-001ADUP**	SampType:	**DUP**		TestCode:	**EPA Method 8015D: Gasoline Range**				
Client ID:	**MW-9 SVE Pilot**	Batch ID:	**D46792**		RunNo:	**46792**				
Prep Date:		Analysis Date:	**11/1/2017**		SeqNo:	**1492582**	Units:	**µg/L**		
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Gasoline Range Organics (GRO)	150000	2500						16.7	20	
Surr: BFB	1100000		1000000		107	80.2	145	0	0	

Sample ID	**1710C23-008ADUP**	SampType:	**DUP**		TestCode:	**EPA Method 8015D: Gasoline Range**				
Client ID:	**MW-6 SVE Pilot**	Batch ID:	**G46868**		RunNo:	**46868**				
Prep Date:		Analysis Date:	**11/3/2017**		SeqNo:	**1495152**	Units:	**µg/L**		
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Gasoline Range Organics (GRO)	150000	1000						19.5	20	
Surr: BFB	460000		400000		115	80.2	145	0	0	

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
PQL	Practical Quanitative Limit	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1710C23**

08-Nov-17

Client: Daniel B. Stephens & Assoc.

Project: Shamrock 63

Sample ID	**1710C23-001ADUP**	SampType:	**DUP**	TestCode:	**EPA Method 8021B: Volatiles**
Client ID:	**MW-9 SVE Pilot**	Batch ID:	**B46792**	RunNo:	**46792**
Prep Date:		Analysis Date:	**11/1/2017**	SeqNo:	**1492623** Units: **µg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Methyl tert-butyl ether (MTBE)	ND	120						0	20	
Benzene	830	50						16.4	20	
Toluene	250	50						3.71	20	
Ethylbenzene	45	25						7.32	20	
Xylenes, Total	220	100						13.2	20	
Surr: 4-Bromofluorobenzene	1100		1000		111	81.9	144	0	0	

Sample ID	**1710C23-008ADUP**	SampType:	**DUP**	TestCode:	**EPA Method 8021B: Volatiles**
Client ID:	**MW-6 SVE Pilot**	Batch ID:	**B46868**	RunNo:	**46868**
Prep Date:		Analysis Date:	**11/3/2017**	SeqNo:	**1495168** Units: **µg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Methyl tert-butyl ether (MTBE)	ND	50						0	20	
Benzene	830	20						21.7	20	R
Toluene	500	20						24.4	20	R
Ethylbenzene	39	20						4.44	20	
Xylenes, Total	220	40						10.1	20	
Surr: 4-Bromofluorobenzene	460		400.0		115	81.9	144	0	0	

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
PQL	Practical Quanitative Limit	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

HALL ENVIRONMENTAL ANALYSIS LABORATORY

Hall Environmental Analysis Laboratory
4901 Hawkins NE
Albuquerque, NM 87109
TEL: 505-345-3975 FAX: 505-345-4107
Website: www.hallenvironmental.com

Sample Log-In Check List

Client Name: DBS | Work Order Number: 1710C23 | RcptNo: 1

Received By: Erin Melendrez 10/23/2017 4:15:00 PM

Completed By: Ashley Gallegos 10/24/2017 8:14:20 AM

Reviewed By: 10/24/17

Chain of Custody

1. Custody seals intact on sample bottles?	Yes ☐	No ☐	Not Present ☑
2. Is Chain of Custody complete?	Yes ☑	No ☐	Not Present ☐
3. How was the sample delivered?	Client		

Log In

4. Was an attempt made to cool the samples?	Yes ☑	No ☐	NA ☐
5. Were all samples received at a temperature of >0° C to 6.0°C	Yes ☑	No ☐	NA ☐
6. Sample(s) in proper container(s)?	Yes ☑	No ☐	
7. Sufficient sample volume for indicated test(s)?	Yes ☑	No ☐	
8. Are samples (except VOA and ONG) properly preserved?	Yes ☑	No ☐	
9. Was preservative added to bottles?	Yes ☐	No ☑	NA ☐
10. VOA vials have zero headspace?	Yes ☐	No ☐	No VOA Vials ☑
11. Were any sample containers received broken?	Yes ☐	No ☑	
12. Does paperwork match bottle labels? (Note discrepancies on chain of custody)	Yes ☑	No ☐	
13. Are matrices correctly identified on Chain of Custody?	Yes ☑	No ☐	
14. Is it clear what analyses were requested?	Yes ☑	No ☐	
15. Were all holding times able to be met? (If no, notify customer for authorization.)	Yes ☑	No ☐	

# of preserved bottles checked for pH: _____ (<2 or >12 unless noted)

Adjusted? _____

Checked by: _____

Special Handling (if applicable)

16. Was client notified of all discrepancies with this order? Yes ☐ No ☐ NA ☑

Person Notified: _____ Date _____

By Whom: _____ Via: ☐ eMail ☐ Phone ☐ Fax ☐ In Person

Regarding: _____

Client Instructions: _____

17. Additional remarks:

18. **Cooler Information**

Cooler No	Temp °C	Condition	Seal Intact	Seal No	Seal Date	Signed By
1	NA	Good	Not Present			

Chain-of-Custody Record

Client: DBS&A

Mailing Address: 6020 Academy Rd NE ABQ 87109

Phone #: 505-822-9400

email or Fax#: tgolden@dbstephens.com

QA/QC Package:
☒ Standard ☐ Level 4 (Full Validation)

Accreditation
☐ NELAP ☐ Other _____

☐ EDD (Type) _____

Turn-Around Time:
☒ Standard ☐ Rush _____

Project Name: ~~Hot~~ Shamrock #63

Project #: BE14.0021.00.00005.0003

Project Manager: J. Casey

Sampler: T. Golden

On Ice: ☒ Yes ☐ No

Sample Temperature: N/A

HALL ENVIRONMENTAL ANALYSIS LABORATORY

www.hallenvironmental.com

4901 Hawkins NE - Albuquerque, NM 87109

Tel. 505-345-3975 Fax 505-345-4107

Date	Time	Matrix	Sample Request ID	Container Type and #	Preservative Type	HEAL No. 1710C23	BTEX + MTBE + TMB's (8021)	BTEX + MTBE + TPH (Gas only)	TPH 8015B (GRO / DRO / MRO)	TPH (Method 418.1)	EDB (Method 504.1)	PAH's (8310 or 8270 SIMS)	RCRA 8 Metals	Anions (F,Cl,NO_3,NO_2,PO_4,SO_4)	8081 Pesticides / 8082 PCB's	8260B (VOA)	8270 (Semi-VOA)	Air Bubbles (Y or N)
10/20/17	9:30	AIR	MW-9 SVE PILOT	1L Tedlar	None	-001		X	X									
"	12:30	"	MW-9 SVE PILOT	"	"	-002		"	"									
"	15:30	"	MW-9 SVE PILOT	"	"	-003		"	"									
10/22/17	9:30	"	MW-10 SVE PILOT	"	"	-004		"	"									
"	12:30	"	MW-10 SVE PILOT	"	"	-005		"	"									
"	15:30	"	MW-10 SVE PILOT	"	"	-006		"	"									
10/23/17	7:30	"	MW-6 SVE PILOT	"	"	-007		"	"									
"	10:30	"	MW-6 SVE PILOT	"	"	-008		"	"									
"	13:30	"	MW-6 SVE PILOT	"	"	-009		"	"									

Analysis Request

Date	Time	Relinquished by:	Received by:	Date	Time
10/23/17	4:15			10/23/17	1615
Date:	Time:	Relinquished by:	Received by:	Date	Time

Remarks:

If necessary, samples submitted to Hall Environmental may be subcontracted to other accredited laboratories. This serves as notice of this possibility. Any sub-contracted data will be clearly notated on the analytical report.

U.S. Energy Information Administration

Reference #3

Environment

Carbon Dioxide Emissions Coefficients

Release Date: February 2, 2016 | Also available in spreadsheet

Carbon Dioxide Emissions Coefficients by Fuel

Carbon Dioxide (CO_2) Factors:	Pounds CO_2 Per Unit of Volume or Mass	Kilograms CO_2 Volume or Mass	Pounds CO_2 Million Btu	Kilograms CO_2 Million Btu
For homes and businesses				
Propane	12.70/gallon	5.76/gallon	139.05	63.07
Butane	14.80/gallon	6.71/gallon	143.20	64.95
Butane/Propane Mix	13.70/gallon	6.21/gallon	141.12	64.01
Home Heating and Diesel Fuel (Distillate)	22.40/gallon	10.16/gallon	161.30	73.16
Kerosene	21.50/gallon	9.75/gallon	159.40	72.30
Coal (All types)	4,631.50/short ton	2,100.82/short ton	210.20	95.35
Natural Gas	117.10/thousand cubic feet	53.12/thousand cubic feet	117.00	53.07
Gasoline	19.60/gallon	8.89/gallon	157.20	71.30
Residual Heating Fuel (Businesses only)	26.00/gallon	11.79/gallon	173.70	78.79
Other transportation fuels				
Jet Fuel	21.10/gallon	9.57/gallon	156.30	70.90
Aviation Gas	18.40/gallon	8.35/gallon	152.60	69.20
Industrial fuels and others not listed above				
Flared natural gas	120.70/thousand cubic feet	54.75/thousand cubic feet	120.60	54.70
Petroleum coke	32.40/gallon	14.70/gallon	225.10	102.10
Other petroleum & miscellaneous	22.09/gallon	10.02/gallon	160.10	72.62
Nonfuel uses				
Asphalt and Road Oil	26.34/gallon	11.95/gallon	166.70	75.61
Lubricants	23.62/gallon	10.72/gallon	163.60	74.21
Petrochemical Feedstocks	24.74/gallon	11.22/gallon	156.60	71.03
Special Naphthas (solvents)	20.05/gallon	9.10/gallon	160.50	72.80
Waxes	21.11/gallon	9.57/gallon	160.10	72.62
Coal by type				
Anthracite	5,685.00/short ton	2,578.68/short ton	228.60	103.70
Bituminous	4,931.30/short ton	2,236.80/short ton	205.70	93.30

Source: U.S. Energy Information Administration estimates.

Note: To convert to carbon equivalents multiply by 12/44. Coefficients may vary slightly with estimation method and across time.

Carbon Dioxide (CO_2) Factors:	Pounds CO_2 Per Unit of Volume or Mass	Kilograms CO_2 Volume or Mass	Pounds CO_2 Million Btu	Kilograms CO_2 Million Btu
Subbituminous	3,715.90/short ton	1,685.51/short ton	214.30	97.20
Lignite	2,791.60/short ton	1,266.25/short ton	215.40	97.70
Coke	6,239.68/short ton	2,830.27/short ton	251.60	114.12
Other fuels				
Geothermal (average all generation)	NA	NA	16.99	7.71
Municipal Solid Waste	5,771.00/short ton	2,617.68/short ton	91.90	41.69
Tire-derived fuel	6,160.00/short ton	2,794.13/short ton	189.54	85.97
Waste oil	924.0/barrel	419.12/barrel	210.00	95.25

Source: U.S. Energy Information Administration estimates.

Note: To convert to carbon equivalents multiply by 12/44. Coefficients may vary slightly with estimation method and across time.

Detailed factors (discontinued)

Section 8

Map(s)

A map such as a 7.5 minute topographic quadrangle showing the exact location of the source. The map shall also include the following:

The UTM or Longitudinal coordinate system on both axes	An indicator showing which direction is north
A minimum radius around the plant of 0.8km (0.5 miles)	Access and haul roads
Topographic features of the area	Facility property boundaries
The name of the map	The area which will be restricted to public access
A graphical scale	

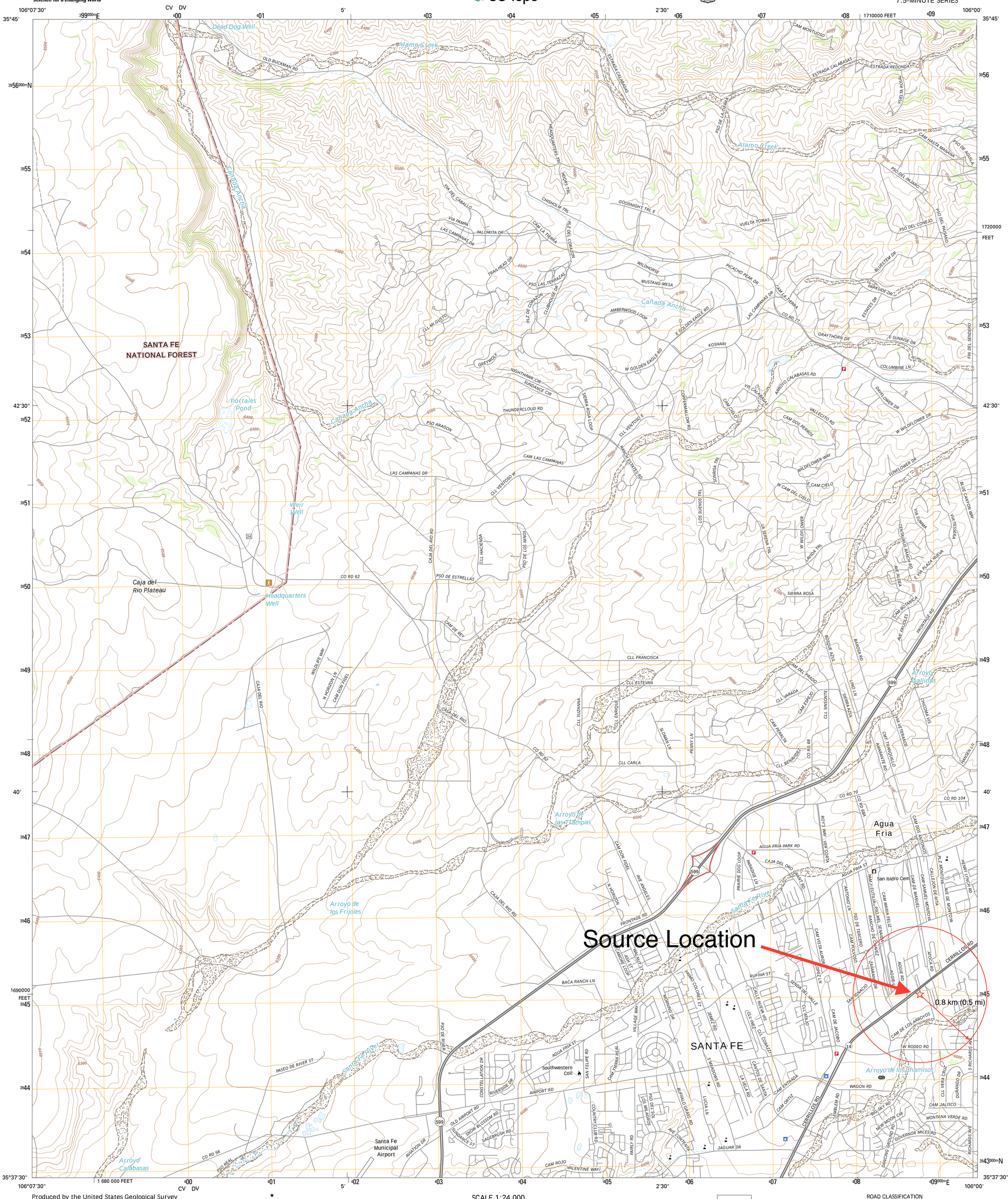
Please see the topographic map included as Figure 1. The facility property boundaries and area restricted to public access are too small to appear at the map scale. Please see the included area map (Figure 1), as well as the site plan provided in Section 5 to get a close up view of the site location (Figure 1) and the restricted areas (Section 5).

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

USGS science for a changing world

The National Map US Topo

AGUA FRIA QUADRANGLE
NEW MEXICO-SANTA FE CO.
7.5-MINUTE SERIES



Produced by the United States Geological Survey
North American Datum of 1983 (NAD83)
World Geodetic System of 1984 (WGS84). Projection and
1 000-meter grid: Universal Transverse Mercator, Zone 13S
10 000-foot ticks: New Mexico Coordinate System of 1983
(central zone)

This map is not a legal document. Boundaries may be generalized for this map scale. Private lands within government reservations may not be shown. Obtain permission before entering private lands.

Imagery.....NAIP, October 2014
Roads..... U.S. Census Bureau, 2015 - 2016
Roads within US Forest Service Lands.....FSTopo Data with limited Forest Service updates, 2012 - 2016
Names.....GNIS, 2016
Hydrography.....National Hydrography Dataset, 2014
Contours.....National Elevation Dataset, 1999
Boundaries.....Multiple sources; see metadata file 1972 - 2016
Public Land Survey System.....BLM, 2016
Wetlands.....FWS National Wetlands Inventory 1977 - 2014

MN 8° 28´ 150 MILS
GN 0° 37´ 11 MILS
UTM GRID AND 2017 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

U.S. National Grid
100,000-m Square ID
^{4}00
CV DV
Grid Zone Designation
13S

SCALE 1:24 000
1 0.5 0 KILOMETERS 1 2
1000 500 0 METERS 1000 2000
1 0.5 0 1
MILES
1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000
FEET

CONTOUR INTERVAL 20 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

This map was produced to conform with the National Geospatial Program US Topo Product Standard, 2011.
A metadata file associated with this product is draft version 0.6.19

NEW MEXICO
QUADRANGLE LOCATION

1	2	3
4		5
6	7	8

1 White Rock
2 Horcado Ranch
3 Tesuque
4 Montoso Peak
5 Santa Fe
6 Tetilla Peak
7 Turquoise Hill
8 Seton Village
ADJOINING QUADRANGLES

ROAD CLASSIFICATION
Expressway
Secondary Hwy
Ramp
Local Connector
Local Road
4WD
Interstate Route
US Route
State Route
FS Primary Route
FS Passenger Route
FS High Clearance Route

Check with local Forest Service unit for current travel conditions and restrictions.

AGUA FRIA, NM
2017

NSN 7643016382502
NGA REF NO. USGSX24K279



Image source: ESRI ArcGIS Online and data partners, including imagery from agencies supplied via the Content Sharing Program.

N

0 250 500
Feet

T:\Marketing\Proposals in Progress\DB18.xxxx.PR_NMED Shamrock 63\GIS\MXDs\F01_Area_map.mxd

Daniel B. Stephens & Associates, Inc.
6/14/2018
JN BE14.0012

SHAMROCK NO. 63
3624 CERRILLOS ROAD
SANTA FE, NEW MEXICO
Area Map

Figure 1



Image source: ESRI ArcGIS Online and data partners, including imagery from agencies supplied via the Content Sharing Program.

N

0 250 500
Feet

T:\Marketing\Proposals in Progress\DB18.xxxx.PR_NMED Shamrock 63\GIS\MXDs\F01_Area_map.mxd

Daniel B. Stephens & Associates, Inc.
6/14/2018
JN BE14.0012

SHAMROCK NO. 63
3624 CERRILLOS ROAD
SANTA FE, NEW MEXICO
Area Map

Figure 1

Section 9

Proof of Public Notice

(for NSR applications submitting under 20.2.72 or 20.2.74 NMAC)
(This proof is required by: 20.2.72.203.A.14 NMAC "Documentary Proof of applicant's public notice")

☒ **I have read the AQB "Guidelines for Public Notification for Air Quality Permit Applications"**
This document provides detailed instructions about public notice requirements for various permitting actions. It also provides public notice examples and certification forms. Material mistakes in the public notice will require a re-notice before issuance of the permit.

Unless otherwise allowed elsewhere in this document, the following items document proof of the applicant's Public Notification. Please include this page in your proof of public notice submittal with checkmarks indicating which documents are being submitted with the application.

New Permit and **Significant Permit Revision** public notices must include all items in this list.

Technical Revision public notices require only items 1, 5, 9, and 10.

Per the Guidelines for Public Notification document mentioned above, include:

1. ☐ A copy of the certified letter receipts with post marks (20.2.72.203.B NMAC)
2. ☐ A list of the places where the public notice has been posted in at least four publicly accessible and conspicuous places, including the proposed or existing facility entrance. (e.g: post office, library, grocery, etc.)
3. ☐ A copy of the property tax record (20.2.72.203.B NMAC).
4. ☐ A sample of the letters sent to the owners of record.
5. ☐ A sample of the letters sent to counties, municipalities, and Indian tribes.
6. ☐ A sample of the public notice posted and a verification of the local postings.
7. ☐ A table of the noticed citizens, counties, municipalities and tribes and to whom the notices were sent in each group.
8. ☐ A copy of the public service announcement (PSA) sent to a local radio station and documentary proof of submittal.
9. ☐ A copy of the classified or legal ad including the page header (date and newspaper title) or its affidavit of publication stating the ad date, and a copy of the ad. When appropriate, this ad shall be printed in both English and Spanish.
10. ☐ A copy of the display ad including the page header (date and newspaper title) or its affidavit of publication stating the ad date, and a copy of the ad. When appropriate, this ad shall be printed in both English and Spanish.
11. ☐ A map with a graphic scale showing the facility boundary and the surrounding area in which owners of record were notified by mail. This is necessary for verification that the correct facility boundary was used in determining distance for notifying land owners of record.

Section 10

Written Description of the Routine Operations of the Facility

---

A written description of the routine operations of the facility. Include a description of how each piece of equipment will be operated, how controls will be used, and the fate of both the products and waste generated. For modifications and/or revisions, explain how the changes will affect the existing process. In a separate paragraph describe the major process bottlenecks that limit production. The purpose of this description is to provide sufficient information about plant operations for the permit writer to determine appropriate emission sources.

The SVE system will be operated for a minimum duration of at least twelve months. The system startup will require daily site visits for the first two to three days of operation to document system performance and hydrocarbon recovery rates. During this initial startup period the SVE system will be adjusted to obtain optimum performance. The system is expected to run 24 hours a day 7 days a week.

After the initial startup period, Operation and Mainenance (O&M) will be performed regularly. This includes weekly site visits for the first month, followed by bi-weekly site visits (every two weeks) for subsequent months. The following O&M activities will be performed during vapor monitoring events:

- Record SVE well flow rates, vapor concentrations, and other pertinent operations data
- Adjust and maintain applied well vacuums within design specifications
- Adjust flow rates to maximize mass removal rates

The following equipment maintenance issues will be addressed as required:

- Perform routine preventive maintenance on equipment and motors
- Respond to system shutdowns
- Conduct other miscellaneous activities necessary to ensure efficient and effective system performance
- Empty condensate storage tank and dispose of condensate
- Evaluate the efficacy of filters and replace those materials that exhibit a significant decrease in performance
- Calculate system extraction and emission rates and destruction efficiency

If needed, this facility will remain in operation until subsurface VOC concentrations diminish, which may be longer than twelve months. O&M activities will continue as described for any operational time past twelve months.

Section 11
Source Determination

Source submitting under 20.2.70, 20.2.72, 20.2.73, and 20.2.74 NMAC

Sources applying for a construction permit, PSD permit, or operating permit shall evaluate surrounding and/or associated sources (including those sources directly connected to this source for business reasons) and complete this section. Responses to the following questions shall be consistent with the Air Quality Bureau's permitting guidance, Single Source Determination Guidance, which may be found on the Applications Page in the Permitting Section of the Air Quality Bureau website.

Typically, buildings, structures, installations, or facilities that have the same SIC code, that are under common ownership or control, and that are contiguous or adjacent constitute a single stationary source for 20.2.70, 20.2.72, 20.2.73, and 20.2.74 NMAC applicability purposes. Submission of your analysis of these factors in support of the responses below is optional, unless requested by NMED.

A. Identify the emission sources evaluated in this section (list and describe)**:**

B. Apply the 3 criteria for determining a single source:

SIC Code: Surrounding or associated sources belong to the same 2-digit industrial grouping (2-digit SIC code) as this facility, OR surrounding or associated sources that belong to different 2-digit SIC codes are support facilities for this source.

☒ **Yes** ☐ **No**

Common Ownership or Control: Surrounding or associated sources are under common ownership or control as this source.

☒ **Yes** ☐ **No**

Contiguous or Adjacent: Surrounding or associated sources are contiguous or adjacent with this source.

☒ **Yes** ☐ **No**

C. Make a determination:

☒ The source, as described in this application, constitutes the entire source for 20.2.70, 20.2.72, 20.2.73, or 20.2.74 NMAC applicability purposes. If in "A" above you evaluated only the source that is the subject of this application, all "**YES**" boxes should be checked. If in "A" above you evaluated other sources as well, you must check **AT LEAST ONE** of the boxes "**NO**" to conclude that the source, as described in the application, is the entire source for 20.2.70, 20.2.72, 20.2.73, and 20.2.74 NMAC applicability purposes.

☐ The source, as described in this application, **does not** constitute the entire source for 20.2.70, 20.2.72, 20.2.73, or 20.2.74 NMAC applicability purposes (A permit may be issued for a portion of a source). The entire source consists of the following facilities or emissions sources (list and describe):

Section 12

Section 12.A
PSD Applicability Determination for All Sources

(Submitting under 20.2.72, 20.2.74 NMAC)

A PSD applicability determination for all sources. For sources applying for a significant permit revision, apply the applicable requirements of 20.2.74.AG and 20.2.74.200 NMAC and to determine whether this facility is a major or minor PSD source, and whether this modification is a major or a minor PSD modification. It may be helpful to refer to the procedures for Determining the Net Emissions Change at a Source as specified by Table A-5 (Page A.45) of the EPA New Source Review Workshop Manual to determine if the revision is subject to PSD review.

A. This facility is:

- ☒ **a minor PSD source before and after this modification (if so, delete C and D below).**
- ☐ **a major PSD source before this modification. This modification will make this a PSD minor source.**
- ☐ **an existing PSD Major Source that has never had a major modification requiring a BACT analysis.**
- ☐ **an existing PSD Major Source that has had a major modification requiring a BACT analysis**
- ☐ **a new PSD Major Source after this modification.**

B. **This facility is not one of the listed 20.2.74.501 Table I – PSD Source Categories. The "project" emissions** for this modification are not significant because they are less than 1 ton/year. **The "project" emissions listed below only result from changes described in this permit application, thus no emissions from other than this facility. Also, specifically discuss whether this project results in "de-bottlenecking", or other associated emissions resulting in higher emissions. The project emissions (before netting) for this project are as follows [see Table 2 in 20.2.74.502 NMAC for a complete list of significance levels]:**

a. **NOx: 0 TPY**
b. **CO: 0 TPY**
c. **VOC: <1 TPY**
d. **SOx: 0 TPY**
e. **TSP (PM): 0 TPY**
f. **PM10: 0 TPY**
g. **PM2.5: 0 TPY**
h. **Fluorides: 0 TPY**
i. **Lead: 0 TPY**
j. **Sulfur compounds (listed in Table 2): 0 TPY**
k. **GHG: 384 TPY (CO_2)**

Section 13

Determination of State & Federal Air Quality Regulations

This section lists each state and federal air quality regulation that may apply to your facility and/or equipment that are stationary sources of regulated air pollutants.

Not all state and federal air quality regulations are included in this list. Go to the Code of Federal Regulations (CFR) or to the Air Quality Bureau's regulation page to see the full set of air quality regulations.

Required Information for Specific Equipment:
For regulations that apply to specific source types, in the 'Justification' column **provide any information needed to determine if the regulation does or does not apply**. **For example**, to determine if emissions standards at 40 CFR 60, Subpart IIII apply to your three identical stationary engines, we need to know the construction date as defined in that regulation; the manufacturer date; the date of reconstruction or modification, if any; if they are or are not fire pump engines; if they are or are not emergency engines as defined in that regulation; their site ratings; and the cylinder displacement.

Required Information for Regulations that Apply to the Entire Facility:
See instructions in the 'Justification' column for the information that is needed to determine if an 'Entire Facility' type of regulation applies (e.g. 20.2.70 or 20.2.73 NMAC).

Regulatory Citations for Regulations That Do Not, but Could Apply:
If there is a state or federal air quality regulation that does not apply, but you have a piece of equipment in a source category for which a regulation has been promulgated, you must **provide the low level regulatory citation showing why your piece of equipment is not subject to or exempt from the regulation. For example** if you have a stationary internal combustion engine that is not subject to 40 CFR 63, Subpart ZZZZ because it is an existing 2 stroke lean burn stationary RICE with a site rating of more than 500 brake HP located at a major source of HAP emissions, your citation would be 40 CFR 63.6590(b)(3)(i). **We don't want a discussion of every non-applicable regulation, but if it is possible a regulation could apply, explain why it does not. For example,** if your facility is a power plant, you do not need to include a citation to show that 40 CFR 60, Subpart OOO does not apply to your non-existent rock crusher.

Regulatory Citations for Emission Standards:
For each unit that is subject to an emission standard in a source specific regulation, such as 40 CFR 60, Subpart OOO or 40 CFR 63, Subpart HH, include the low level regulatory citation of that emission standard. Emission standards can be numerical emission limits, work practice standards, or other requirements such as maintenance. **Here are examples:** a glycol dehydrator is subject to the general standards at 63.764C(1)(i) through (iii); an engine is subject to 63.6601, Tables 2a and 2b; a crusher is subject to 60.672(b), Table 3 and all transfer points are subject to 60.672(e)(1)

Federally Enforceable Conditions:
All federal regulations are federally enforceable. All Air Quality Bureau State regulations are federally enforceable except for the following: affirmative defense portions at 20.2.7.6.B, 20.2.7.110(B)(15), 20.2.7.11 through 20.2.7.113, 20.2.7.115, and 20.2.7.116; 20.2.37; 20.2.42; 20.2.43; 20.2.62; 20.2.63; 20.2.86; 20.2.89; and 20.2.90 NMAC. Federally enforceable means that EPA can enforce the regulation as well as the Air Quality Bureau and federally enforceable regulations can count toward determining a facility's potential to emit (PTE) for the Title V, PSD, and nonattainment permit regulations.

INCLUDE ANY OTHER INFORMATION NEEDED TO COMPLETE AN APPLICABILITY DETERMINATION OR THAT IS RELEVENT TO YOUR FACILITY'S NOTICE OF INTENT OR PERMIT.

EPA Applicability Determination Index for 40 CFR 60, 61, 63, etc: http://cfpub.epa.gov/adi/

Table for STATE REGULATIONS:

STATE REGU-LATIONS CITATION	Title	Applies? Enter Yes or No	Unit(s) or Facility	JUSTIFICATION: (You may delete instructions or statements that do not apply in the justification column to shorten the document.)
20.2.1 NMAC	General Provisions	Yes	Facility	General Provisions apply to Notice of Intent, Construction, and Title V permit applications.
20.2.3 NMAC	Ambient Air Quality Standards NMAAQS	Yes	Facility	This facility emits small volumes of low concentration VOCs with little potential to impact overall site ambient air quality.
20.2.7 NMAC	Excess Emissions	No	Facility	This facility is a minor source, not a Title V source.
20.2.23 NMAC	Fugitive Dust Control	No	Facility	This facility will not generate fugitive during operation.
20.2.33 NMAC	Gas Burning Equipment - Nitrogen Dioxide	No	Facility	**Choose all that apply:** This facility has new gas burning equipment **(a thermal oxidizer)** having a heat input of less than 1,000,000 million British Thermal Units per year.
20.2.34 NMAC	Oil Burning Equipment: NO_2	No	Facility	This facility does not burn oil.
20.2.35 NMAC	Natural Gas Processing Plant – Sulfur	No	Facility	This facility does not process natural gas.
20.2.37 and 20.2.36 NMAC	Petroleum Processing Facilities and Petroleum Refineries	No	Facility	This facility does not process or refine petroleum.
20.2.38 NMAC	Hydrocarbon Storage Facility	No	Facility	This facility does not store hydrocarbons.
20.2.39 NMAC	Sulfur Recovery Plant - Sulfur	No	Facility	This facility does not recover Sulfur.
20.2.61.109 NMAC	Smoke & Visible Emissions	No	Facility	The emissions from this facility will not be visible. This facility is not subject because it qualifies for exemption D under 20.2.61.111 NMAC.
20.2.70 NMAC	Operating Permits	No	Facility	This facility is not subject because it qualifies for exemption B under 20.2.70.202 NMAC (non-major source).
20.2.71 NMAC	Operating Permit Fees	No	Facility	This facility is not subject because it qualifies for exemption B under 20.2.70.202 NMAC (non-major source).
20.2.72 NMAC	Construction Permits	No	Facility	This facility is not subject to 20.2.72 NMAC because it does not meet any of the permit requirements.
20.2.73 NMAC	NOI & Emissions Inventory Requirements	No	Facility	The emissions from this facility are low enough that an NOI is not required.
20.2.74 NMAC	Permits – Prevention of Significant Deterioration (PSD)	No	Facility	This facility is not a PSD major as defined by any of the following: **(1)** Any stationary source listed in Table 1 of this Part (20.2.74.501 NMAC) which emits, or has the potential to emit, emissions equal to or greater than one hundred (100) tons per year of any regulated pollutant; or **(2)** Any stationary source not listed in Table 1 of this Part (20.2.74.501 NMAC) and which emits or has the potential to emit two hundred fifty (250) tons per year or more of any regulated pollutant; or **(3)** Any physical change that would occur at a stationary source not otherwise qualifying under paragraphs (1) or (2) of subsection Z of 20.2.74.7 NMAC if the change would constitute a major stationary source by itself; **(4)** A major source that is major for volatile organic compounds shall be considered major for ozone; **(5)** The fugitive emissions of a stationary source shall not be included in

STATE REGU-LATIONS CITATION	Title	Applies? Enter Yes or No	Unit(s) or Facility	JUSTIFICATION: (You may delete instructions or statements that do not apply in the justification column to shorten the document.)
				determining for any of the purposes of this section whether it is a major stationary source, unless the source belongs to one of the stationary source categories found in Table 1 of this Part (20.2.74.501 NMAC) or any other stationary source category which, as of August 7, 1980, is being regulated under section 111 or 112 of the Act.
20.2.75 NMAC	Construction Permit Fees	No	Facility	This facility is not subject to 20.2.72 NMAC because it does not meet any of the permit requirements.
20.2.77 NMAC	New Source Performance	No	Facility	This facility is a Clean Air Act designated area source which is not regulated by the EPA under 40 CFR 60.
20.2.78 NMAC	Emission Standards for HAPS	No	Facility	This facility is a Clean Air Act designated area source which is not regulated by the EPA under 40 CFR 61 or by the Urban Air Toxics Strategy.
20.2.79 NMAC	Permits – Nonattainment Areas	No	Facility	This facility is a minor stationary source.
20.2.80 NMAC	Stack Heights	No	Facility	This facility has one stack approximately 13’ high primarily for odor mitigation.
20.2.82 NMAC	MACT Standards for source categories of HAPS	No	Facility	This facility is a Clean Air Act designated area source which is not regulated by the EPA under 40 CFR 61 or by the Urban Air Toxics Strategy.

Example of a Table for Applicable FEDERAL REGULATIONS (Note: This is not an exhaustive list):

FEDERAL REGU-LATIONS CITATION	Title	Applies? Enter Yes or No	Unit(s) or Facility	JUSTIFICATION:
40 CFR 50	NAAQS	No	Facility	This facility emits small volumes of low concentration VOCs with little potential to impact overall site ambient air quality.
NSPS 40 CFR 60, Subpart A	General Provisions	No	Facility	This facility is a Clean Air Act designated area source which is not regulated by the EPA under 40 CFR 63 or by the Urban Air Toxics Strategy.
NSPS 40 CFR60.40a, Subpart Da	Subpart Da, Performance Standards for **Electric Utility Steam Generating Units**	No	Facility	This facility is not an Electric Utility Steam Generating Unit.
NSPS 40 CFR60.40b Subpart Db	**Electric Utility Steam Generating Units**	No	Facility	This facility is not an Electric Utility Steam Generating Unit.

FEDERAL REGU-LATIONS CITATION	Title	Applies? Enter Yes or No	Unit(s) or Facility	JUSTIFICATION:
40 CFR 60.40c, Subpart Dc	Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units	No	Facility	This facility is not an Electric Utility Steam Generating Unit.
NSPS 40 CFR 60, Subpart Ka	Standards of Performance for **Storage Vessels for Petroleum Liquids** for which Construction, Reconstruction, or Modification Commenced After May 18, 1978, and **Prior** to July 23, 1984	No	Facility	This facility does not have any Storage Vessels for Petroleum Liquids
NSPS 40 CFR 60, Subpart Kb	Standards of Performance for **Volatile Organic Liquid Storage Vessels** (Including Petroleum Liquid Storage Vessels) for Which Construction, Reconstruction, or Modification Commenced **After** July 23, 1984	No	Facility	This facility does not have any Storage Vessels for Petroleum Liquids.
NSPS 40 CFR 60.330 Subpart GG	**Stationary Gas Turbines**	No	Facility	This facility does not have any Stationary Gas Turbines.
NSPS 40 CFR 60, Subpart KKK	Leaks of VOC from **Onshore Gas Plants**	No	Facility	This facility is not an Onshore Gas Plant.
NSPS 40 CFR Part 60 Subpart LLL	Standards of Performance for **Onshore Natural Gas Processing**: SO_2 Emissions	No	Facility	This facility is not an Onshore Gas Plant.
NSPS 40 CFR Part 60 Subpart OOOO	Standards of Performance for Crude Oil and Natural Gas Production, Transmission, and Distribution for which construction, modification or reconstruction commenced after August 23, 2011 and before September 18,	No	Facility	This facility is not involved in the Production, Transmission or Distribution of Crude Oil or Natural Gas.

FEDERAL REGU-LATIONS CITATION	Title	Applies? Enter Yes or No	Unit(s) or Facility	JUSTIFICATION:
	2015			
NSPS 40 CFR Part 60 Subpart OOOOa	Standards of Performance for Crude Oil and Natural Gas Facilities for which Construction, Modification or Reconstruction Commenced After September 18, 2015	No	Facility	This facility is not involved in the Production, Transmission or Distribution of Crude Oil or Natural Gas.
NSPS 40 CFR 60 Subpart IIII	Standards of performance for Stationary Compression Ignition Internal Combustion Engines	No	Facility	This facility does not have a combustion engine.
NSPS 40 CFR Part 60 Subpart JJJJ	Standards of Performance for Stationary Spark Ignition Internal Combustion Engines	No	Facility	This facility does not have a combustion engine.
NSPS 40 CFR 60 Subpart TTTT	Standards of Performance for Greenhouse Gas Emissions for Electric Generating Units	No	Facility	This facility does not generate electricity.
NSPS 40 CFR 60 Subpart UUUU	Emissions Guidelines for Greenhouse Gas Emissions and Compliance Times for Electric Utility Generating Units	No	Facility	This facility does not generate electricity.
NSPS 40 CFR 60, Subparts WWW, XXX, Cc, and Cf	Standards of performance for Municipal Solid Waste (MSW) Landfills	No	Facility	This facility is not a landfill.
NESHAP 40 CFR 61 Subpart A	General Provisions	No	Facility	This facility is not regulated under 40 CFR 61.
NESHAP 40 CFR 61 Subpart E	National Emission Standards for **Mercury**	No	Facility	This facility does not emit mercury.
NESHAP 40 CFR 61 Subpart V	National Emission Standards for **Equipment Leaks** (Fugitive Emission Sources)	No	Facility	This facility does not have any sources that are intended to operate in volatile hazardous air pollutant (VHAP) service: pumps, compressors, pressure relief devices, sampling connection systems, open-ended valves or lines, valves, connectors, surge control vessels, bottoms receivers, and control devices or systems required by this subpart
MACT	General Provisions	No	Facility	This facility is a Clean Air Act designated area source which is not regulated by

FEDERAL REGU-LATIONS CITATION	Title	Applies? Enter Yes or No	Unit(s) or Facility	JUSTIFICATION:
40 CFR 63, Subpart A				the EPA under 40 CFR 63 or by the Urban Air Toxics Strategy.
MACT 40 CFR 63.760 Subpart HH	**Oil and Natural Gas Production Facilities**	No	Facility	This facility is not an Oil and Gas Production Facility and is not subject to the requirements of 40 CFR 63 Subpart HH
MACT 40 CFR 63 Subpart HHH		No	Facility	This facility is not subject to 40 CFR 63 Subpart HHH
MACT 40 CFR 63 Subpart DDDDD	National Emission Standards for Hazardous Air Pollutants for Major Industrial, Commercial, and Institutional Boilers & Process Heaters	No	Facility	This facility is not subject to 40 CFR 63 Subpart DDDDD
MACT 40 CFR 63 Subpart UUUUU	National Emission Standards for Hazardous Air Pollutants Coal & Oil Fire Electric Utility Steam Generating Unit	No	Facility	This facility is not subject to 40 CFR 63 Subpart UUUUU
MACT 40 CFR 63 Subpart ZZZZ	National Emissions Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines (**RICE MACT**)	No	Facility	See 63.6580 and EPA Region 1's Reciprocating Internal Combustion Guidance website.
40 CFR 64	**Compliance Assurance Monitoring**	No	Facility	This facility is not a major source; therefore Compliance Assurance Monitoring does not apply.
40 CFR 68	**Chemical**	No	Facility	This facility is not a stationary source that has more than a threshold quantity of a

FEDERAL REGU-LATIONS CITATION	Title	Applies? Enter Yes or No	Unit(s) or Facility	JUSTIFICATION:
	Accident Prevention			regulated substance in a process, as determined under §68.115, 40 CFR 68.
Title IV – Acid Rain 40 CFR 72	**Acid Rain**	No	Facility	This facility is not an electricity generation facility, therefore 40 CFR 72 does not apply.
Title IV – Acid Rain 40 CFR 73	**Sulfur Dioxide** Allowance Emissions	No	Facility	This facility is not an electricity generation facility, therefore 40 CFR 73 does not apply.
Title IV-Acid Rain 40 CFR 75	**Continuous Emissions Monitoring**	No	Facility	This facility is not an electricity generation facility, therefore 40 CFR 75 does not apply.
Title IV – Acid Rain 40 CFR 76	**Acid Rain** Nitrogen Oxides **Emission Reduction Program**	No	Facility	This facility is not an electricity generation facility, therefore 40 CFR 76 does not apply.
Title VI – 40 CFR 82	Protection of **Stratospheric Ozone**	No	Facility	Not Applicable –facility does not “service”, “maintain” or “repair” class I or class II appliances nor “disposes” of the appliances.

Section 14

Operational Plan to Mitigate Emissions

(Submitting under 20.2.70, 20.2.72, 20.2.74 NMAC)

☐ **Title V Sources** (20.2.70 NMAC)**:** By checking this box and certifying this application the permittee certifies that it has developed an **Operational Plan to Mitigate Emissions During Startups, Shutdowns, and Emergencies** defining the measures to be taken to mitigate source emissions during startups, shutdowns, and emergencies as required by 20.2.70.300.D.5(f) and (g) NMAC. This plan shall be kept on site to be made available to the Department upon request. This plan should not be submitted with this application.

☐ **NSR** (20.2.72 NMAC)**, PSD** (20.2.74 NMAC) **& Nonattainment** (20.2.79 NMAC) **Sources:** By checking this box and certifying this application the permittee certifies that it has developed an **Operational Plan to Mitigate Source Emissions During Malfunction, Startup, or Shutdown** defining the measures to be taken to mitigate source emissions during malfunction, startup, or shutdown as required by 20.2.72.203.A.5 NMAC. This plan shall be kept on site to be made available to the Department upon request. This plan should not be submitted with this application.

☐ **Title V** (20.2.70 NMAC)**, NSR** (20.2.72 NMAC)**, PSD** (20.2.74 NMAC) **& Nonattainment** (20.2.79 NMAC) **Sources:** By checking this box and certifying this application the permittee certifies that it has established and implemented a Plan to Minimize Emissions During Routine or Predictable Startup, Shutdown, and Scheduled Maintenance through work practice standards and good air pollution control practices as required by 20.2.7.14.A and B NMAC. This plan shall be kept on site or at the nearest field office to be made available to the Department upon request. This plan should not be submitted with this application.

The emissions from this facility are below permitting standards. If sampling determines the potential for emissions above any standard, the system will be shut down and operations will only continue on a schedule that will prevent exceedance of any permitting standard.

Section 15

Alternative Operating Scenarios

(Submitting under 20.2.70, 20.2.72, 20.2.74 NMAC)

Alternative Operating Scenarios: Provide all information required by the department to define alternative operating scenarios. This includes process, material and product changes; facility emissions information; air pollution control equipment requirements; any applicable requirements; monitoring, recordkeeping, and reporting requirements; and compliance certification requirements. Please ensure applicable Tables in this application are clearly marked to show alternative operating scenario.

Construction Scenarios: When a permit is modified authorizing new construction to an existing facility, NMED includes a condition to clearly address which permit condition(s) (from the previous permit and the new permit) govern during the interval between the date of issuance of the modification permit and the completion of construction of the modification(s). There are many possible variables that need to be addressed such as: Is simultaneous operation of the old and new units permitted and, if so for example, for how long and under what restraints? In general, these types of requirements will be addressed in Section A100 of the permit, but additional requirements may be added elsewhere. Look in A100 of our NSR and/or TV permit template for sample language dealing with these requirements. Find these permit templates at: https://www.env.nm.gov/aqb/permit/aqb_pol.html. Compliance with standards must be maintained during construction, which should not usually be a problem unless simultaneous operation of old and new equipment is requested.

In this section, under the bolded title "Construction Scenarios", specify any information necessary to write these conditions, such as: conservative-realistic estimated time for completion of construction of the various units, whether simultaneous operation of old and new units is being requested (and, if so, modeled), whether the old units will be removed or decommissioned, any PSD ramifications, any temporary limits requested during phased construction, whether any increase in emissions is being requested as SSM emissions or will instead be handled as a separate Construction Scenario (with corresponding emission limits and conditions, etc.

There are no alternative operating scenarios for this facility.

Section 16

Air Dispersion Modeling

1) Minor Source Construction (20.2.72 NMAC) and Prevention of Significant Deterioration (PSD) (20.2.74 NMAC) ambient impact analysis (modeling): Provide an ambient impact analysis as required at 20.2.72.203.A(4) and/or 20.2.74.303 NMAC and as outlined in the Air Quality Bureau's Dispersion Modeling Guidelines found on the Planning Section's modeling website. If air dispersion modeling has been waived for one or more pollutants, attach the AQB Modeling Section modeling waiver approval documentation.
2) SSM Modeling: Applicants must conduct dispersion modeling for the total short term emissions during routine or predictable startup, shutdown, or maintenance (SSM) using realistic worst case scenarios following guidance from the Air Quality Bureau's dispersion modeling section. Refer to "Guidance for Submittal of Startup, Shutdown, Maintenance Emissions in Permit Applications (http://www.env.nm.gov/aqb/permit/app_form.html) for more detailed instructions on SSM emissions modeling requirements.
3) Title V (20.2.70 NMAC) ambient impact analysis: Title V applications must specify the construction permit and/or Title V Permit number(s) for which air quality dispersion modeling was last approved. Facilities that have only a Title V permit, such as landfills and air curtain incinerators, are subject to the same modeling required for preconstruction permits required by 20.2.72 and 20.2.74 NMAC.

What is the purpose of this application?	Enter an X for each purpose that applies
New PSD major source or PSD major modification (20.2.74 NMAC). See #1 above.	
New Minor Source or significant permit revision under 20.2.72 NMAC (20.2.72.219.D NMAC). See #1 above. **Note:** Neither modeling nor a modeling waiver is required for VOC emissions.	
Reporting existing pollutants that were not previously reported.	
Reporting existing pollutants where the ambient impact is being addressed for the first time.	
Title V application (new, renewal, significant, or minor modification. 20.2.70 NMAC). See #3 above.	
Relocation (20.2.72.202.B.4 or 72.202.D.3.c NMAC)	
Minor Source Technical Permit Revision 20.2.72.219.B.1.d.vi NMAC for like-kind unit replacements.	
Other: i.e. SSM modeling. See #2 above.	
This application does not require modeling since this is a No Permit Required (NPR) application.	
This application does not require modeling since this is a Notice of Intent (NOI) application (20.2.73 NMAC).	
This application does not require modeling according to 20.2.70.7.E(11), 20.2.72.203.A(4), 20.2.74.303, 20.2.79.109.D NMAC and in accordance with the Air Quality Bureau's Modeling Guidelines.	

Check each box that applies:

☐ See attached, approved modeling **waiver for all** pollutants from the facility.
☐ See attached, approved modeling **waiver for some** pollutants from the facility.
☐ Attached in Universal Application Form 4 (UA4) is a **modeling report for all** pollutants from the facility.
☐ Attached in UA4 is a **modeling report for some** pollutants from the facility.
☒ No modeling is required.

Section 17

Compliance Test History

(Submitting under 20.2.70, 20.2.72, 20.2.74 NMAC)

To show compliance with existing NSR permits conditions, you must submit a compliance test history. The table below provides an example.

This facility does not have any existing NSR permits.

Section 20

Other Relevant Information

Other relevant information. Use this attachment to clarify any part in the application that you think needs explaining. Reference the section, table, column, and/or field. Include any additional text, tables, calculations or clarifying information.

Additionally, the applicant may propose specific permit language for AQB consideration. In the case of a revision to an existing permit, the applicant should provide the old language and the new language in track changes format to highlight the proposed changes. If proposing language for a new facility or language for a new unit, submit the proposed operating condition(s), along with the associated monitoring, recordkeeping, and reporting conditions. In either case, please limit the proposed language to the affected portion of the permit.

There is no additional information that needs to be included for this application.

Section 22: Certification

Company Name: _____

I, _____, hereby certify that the information and data submitted in this application are true and as accurate as possible, to the best of my knowledge and professional expertise and experience.

Signed this ____ day of _____, _____, upon my oath or affirmation, before a notary of the State of _____.

_____ _____
*Signature Date

_____ _____
Printed Name Title

Scribed and sworn before me on this ____ day of _____, _____.

My authorization as a notary of the State of _____ expires on the

_____ day of _____, _____.

_____ _____
Notary's Signature Date

_____
Notary's Printed Name

*For Title V applications, the signature must be of the Responsible Official as defined in 20.2.70.7.AE NMAC.

Wells

August 21, 2019

New Mexico Office of the State Engineer
District VI
P.O. Box 25102
Santa Fe, NM 87504-5102

Re: Application for Permit to Drill a Well with No Consumptive Use of Water

To Whom It May Concern:

Please find enclosed three (3) copies of Application for Permit to Drill a Well with No Consumptive Use of Water and a check for the appropriate permit fees. Daniel B. Stephens & Associates, Inc. (DBS&A) has been contracted by the New Mexico Environment Department (NMED) to drill one (1) groundwater monitoring well and two (2) soil vapor extraction wells (which may intersect the water table) for an Underground Storage Tank (UST) site in Santa Fe, New Mexico for the purpose of monitoring and remediating groundwater petroleum contaminants.

Please call me at (505) 822-9400 should you have any questions or need additional paperwork.

Sincerely,

DANIEL B. STEPHENS & ASSOCIATES, INC.

Tom Golden
Project Engineer

Enclosures

Daniel B. Stephens & Associates, Inc.
6020 Academy Rd. NE, Suite 100 505-822-9400
Albuquerque, NM 87109 FAX 505-822-8877

File No.

NEW MEXICO OFFICE OF THE STATE ENGINEER

WR-07 APPLICATION FOR PERMIT TO DRILL

A WELL WITH NO WATER RIGHT

(check applicable box):

For fees, see State Engineer website: http://www.ose.state.nm.us/

Purpose:	☐ Pollution Control And/Or Recovery	☐ Ground Source Heat Pump
☐ Exploratory Well (Pump test)	☐ Construction Site/Public Works Dewatering	☐ Other(Describe):
☒ Monitoring Well	☐ Mine Dewatering	

A separate permit will be required to apply water to beneficial use regardless if use is consumptive or nonconsumptive.

☒ Temporary Request - Requested Start Date: April 2020 Requested End Date: Unknown

Plugging Plan of Operations Submitted? ☐ Yes ☒ No

1. APPLICANT(S)

Name: Polk Oil Company	Name: Daniel B. Stephens & Associates, Inc.
Contact or Agent: check here if Agent ☐ Jim Polk	Contact or Agent: check here if Agent ☒ John Casey
Mailing Address: 1221 N. Paseo de Onate	Mailing Address: 6020 Academy NE, Suite 100
City: Espanola	City: Albuquerque
State: Zip Code: NM 87532	State: Zip Code: NM 87109
Phone: ☐ Home ☐ Cell Phone (Work):	Phone: 970-385-4812 ☐ Home ☒ Cell Phone (Work):
E-mail (optional):	E-mail (optional): jcasey@geo-logic.com

FOR OSE INTERNAL USE Application for Permit, Form WR-07, Rev 11/17/16

File No.:	Trn. No.:	Receipt No.:
Trans Description (optional):		
Sub-Basin:	PCW/LOG Due Date:	

2. WELL(S) Describe the well(s) applicable to this application.

Location Required: Coordinate location must be reported in NM State Plane (NAD 83), UTM (NAD 83), or Latitude/Longitude (Lat/Long - WGS84).
District II (Roswell) and District VII (Cimarron) customers, provide a PLSS location in addition to above.

■ NM State Plane (NAD83) (Feet)
☐ NM West Zone
☐ NM East Zone
☐ NM Central Zone

☐ UTM (NAD83) (Meters)
☐ Zone 12N
☐ Zone 13N

■ Lat/Long (WGS84) (to the nearest 1/10th of second)

Well Number (if known):	X or Easting or Longitude:	Y or Northing or Latitude:	Provide if known: -Public Land Survey System (PLSS) (*Quarters or Halves , Section, Township, Range)* OR - Hydrographic Survey Map & Tract; OR - Lot, Block & Subdivision; OR - Land Grant Name
MW-20			See attached table
SVE-2D			See attached table
SVE-3D			See attached table

NOTE: If more well locations need to be described, complete form WR-08 (Attachment 1 – POD Descriptions)
Additional well descriptions are attached: ☐ Yes ■ No If yes, how many_____

Other description relating well to common landmarks, streets, or other:

Well is on land owned by: Manuel Miramontez, Kelly Santa Fe Ventures Limited Partnershipp, and The Lofts

Well Information: NOTE: If more than one (1) well needs to be described, provide attachment. Attached? ■ Yes ☐ No
If yes, how many 3

Approximate depth of well (feet): see attached table	Outside diameter of well casing (inches): see attached table
Driller Name: National Exploration	Driller License Number: WD-1210

3. ADDITIONAL STATEMENTS OR EXPLANATIONS

Daniel B. Stephens & Associates is contracted by New Mexico Environment Department Petroleum Storage Tank Bureau (NMED PSTB) to install a new monitor well (MW-20) to assess the vertical extent of contamination within the vadose zone within contaminated site perimeters. Additionally, two new soil vapor extraction wells for remediation will be installed that may intersect the water table.

The duration of the monitoring is indeterminate. Well will be P&A'd once site is determined by NMED PSTB that no further action is required.
Additional PODs under RG-93132.

FOR OSE INTERNAL USE

Application for Permit, Form WR-07

File No.:	Trn No.:

4. SPECIFIC REQUIREMENTS: The applicant must include the following, as applicable to each well type. Please check the appropriate boxes, to indicate the information has been included and/or attached to this application:

Exploratory:	**Pollution Control and/or Recovery:**	**Construction De-Watering:**	**Mine De-Watering:**
☐ Include a description of any proposed pump test, if applicable.	☐ Include a plan for pollution control/recovery, that includes the following: ☐ A description of the need for the pollution control or recovery operation. ☐ The estimated maximum period of time for completion of the operation. ☐ The annual diversion amount. ☐ The annual consumptive use amount. ☐ The maximum amount of water to be diverted and injected for the duration of the operation. ☐ The method and place of discharge.	☐ Include a description of the proposed dewatering operation, ☐ The estimated duration of the operation, ☐ The maximum amount of water to be diverted, ☐ A description of the need for the dewatering operation, and, ☐ A description of how the diverted water will be disposed of.	☐ Include a plan for pollution control/recovery, that includes the following: ☐ A description of the need for mine dewatering. ☐ The estimated maximum period of time for completion of the operation. ☐ The source(s) of the water to be diverted. ☐The geohydrologic characteristics of the aquifer(s). ☐The maximum amount of water to be diverted per annum. ☐The maximum amount of water to be diverted for the duration of the operation. ☐The quality of the water. ☐The method of measurement of water diverted. ☐The recharge of water to the aquifer. ☐Description of the estimated area of hydrologic effect of the project. ☐The method and place of discharge. ☐An estimation of the effects on surface water rights and underground water rights from the mine dewatering project. ☐A description of the methods employed to estimate effects on surface water rights and underground water rights. ☐Information on existing wells, rivers, springs, and wetlands within the area of hydrologic effect.
Monitoring: ■ Include the reason for the monitoring well, and, ■ The duration of the planned monitoring.	☐ The method of measurement of water produced and discharged. ☐ The source of water to be injected. ☐ The method of measurement of water injected. ☐ The characteristics of the aquifer. ☐ The method of determining the resulting annual consumptive use of water and depletion from any related stream system. ☐ Proof of any permit required from the New Mexico Environment Department. ☐ An access agreement if the applicant is not the owner of the land on which the pollution plume control or recovery well is to be located.	**Ground Source Heat Pump:** ☐ Include a description of the geothermal heat exchange project, ☐ The number of boreholes for the completed project and required depths. ☐ The time frame for constructing the geothermal heat exchange project, and, ☐ The duration of the project. ☐ Preliminary surveys, design data, and additional information shall be included to provide all essential facts relating to the request.	

ACKNOWLEDGEMENT

I, We (name of applicant(s)), John Casey on behalf of Polk Oil Company
Print Name(s)

affirm that the foregoing statements are true to the best of (my, our) knowledge and belief.

John E. Casey

Applicant Signature

Applicant Signature

ACTION OF THE STATE ENGINEER

This application is:

☐ approved ☐ partially approved ☐ denied

provided it is not exercised to the detriment of any others having existing rights, and is not contrary to the conservation of water in New Mexico nor detrimental to the public welfare and further subject to the attached conditions of approval.

Witness my hand and seal this _____ day of _____ 20 _____ , for the State Engineer,

_____, State Engineer

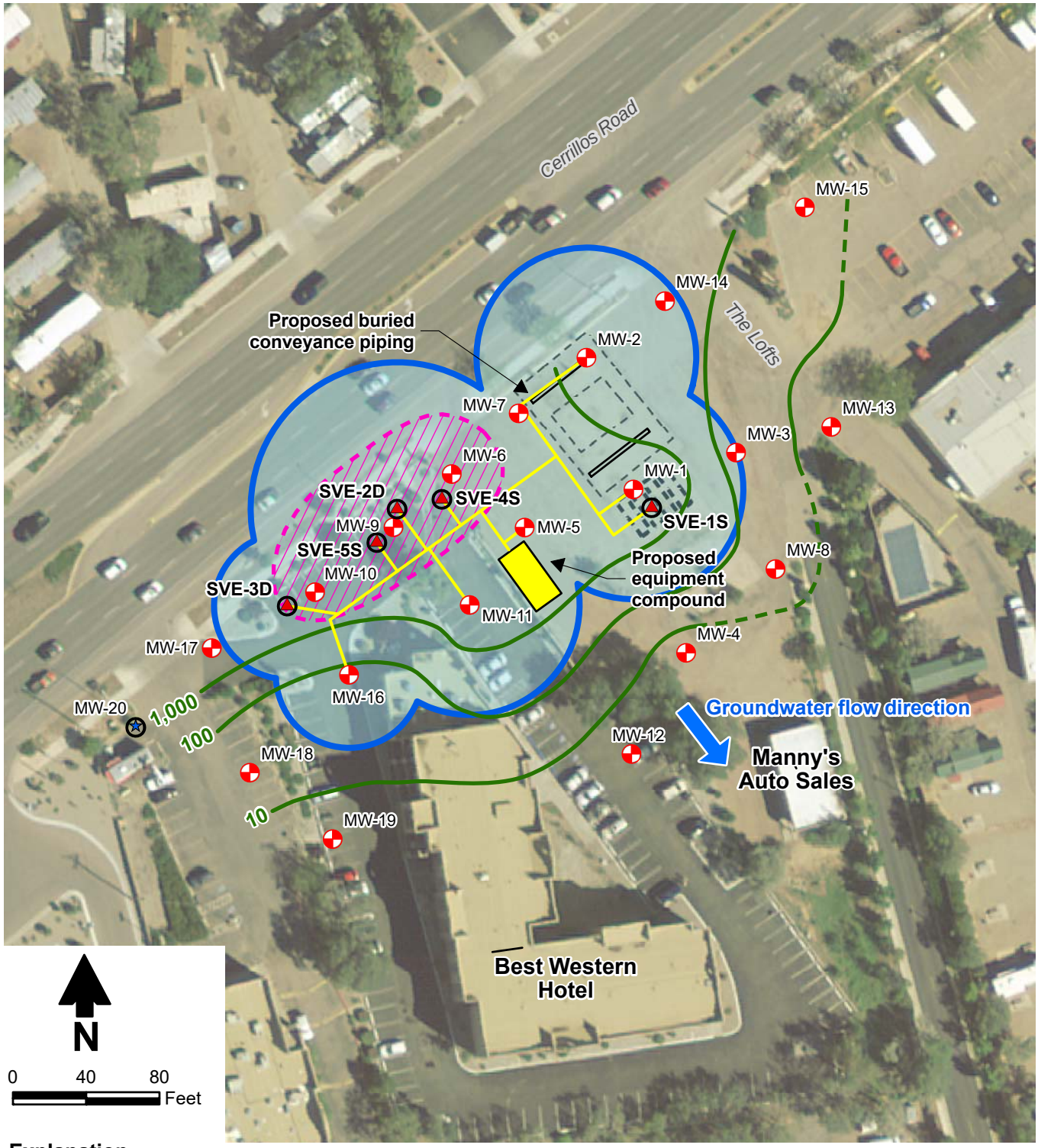
By: _____ _____
Signature Print

Title: _____
Print

FOR OSE INTERNAL USE

Application for Permit, Form WR-07

File No.:	Trn No.:



Explanation

- Proposed monitor well
- Proposed SVE well
- Monitor well
- Proposed SVE conveyance line
- Benzene isoconcentration contour (µg/L) (dashed where inferred)
- Former fuel dispenser infrastructure
- Approximate SVE ROI (radius varies)
- Approximate extent of LNAPL
- Proposed equipment compound

Source: 1. USGS imagery of the Santa Fe metropolitan area.
2. Fuel dispenser and AST locations detemined in consultation with NMED-PSTB.

SHAMROCK NO. 63
3624 CERRILLOS ROAD
SANTA FE, NEW MEXICO

Proposed Technical Approach

Daniel B. Stephens & Associates, Inc.
8/20/2019
JN BE14.0012

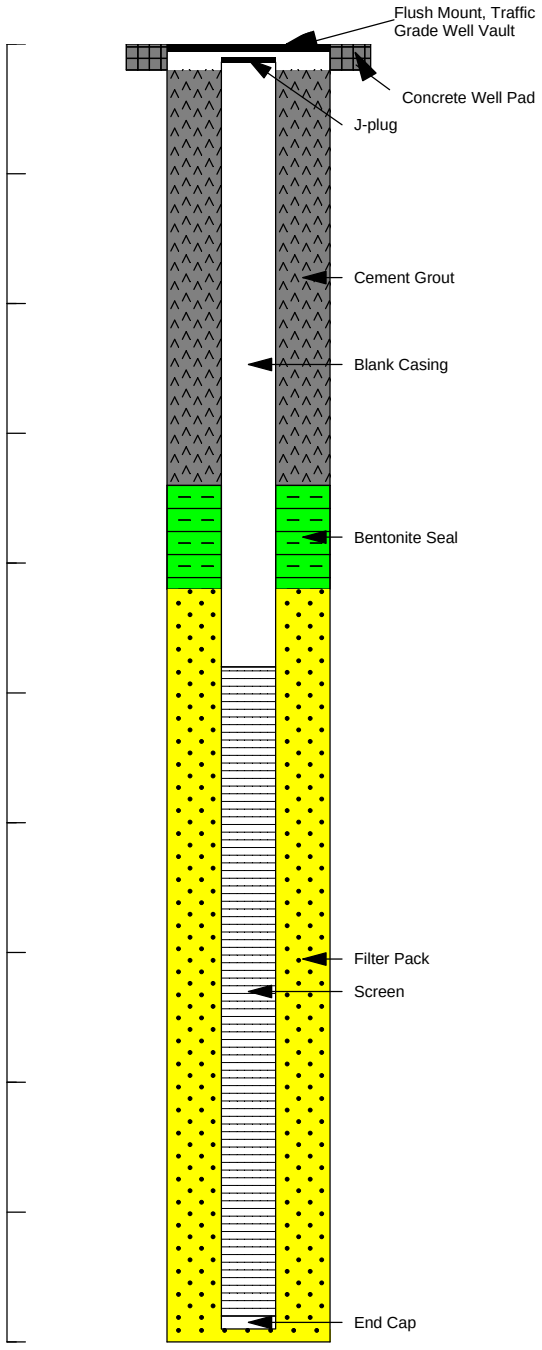
Figure 11

S:\Projects\BE14.0012_Shamrock_63\GIS\MXDs\Location_maps\F11_Proposed_Tech Approach.mxd

Well Locations - Shamrock No. 63 FRP Implementation

Well	X_Coord	Y_Coord	TRS	Approximate Well Depth (ft)	Outside Diameter of Well Casing (inch)
SVE-2	1712488.95	1690240.899	S05; T16N.R09E	75	4
SVE-3	1712428.061	1690188.591	S05; T16N.R09E	75	4
MW-20	1712347.557	1690123.207	S05; T16N.R09E	90	2

Typical Monitoring Well Design



Depths to be determined by onsite personnel

NEW MEXICO
ENVIRONMENT DEPARTMENT

2905 Rodeo Park Drive East
Building 1
Santa Fe, NM 87505-6313
Telephone (505) 476-4397 Fax (505) 476-4374
www.env.nm.gov

Michelle Lujan Grisham
Governor

Howie C. Morales
Lt. Governor

James C. Kenney
Cabinet Secretary

Jennifer J. Pruett
Deputy Secretary

June 25, 2019

Mr. Jim Polk
Polk Oil Company
1221 N Paseo de Oñate
Española, New Mexico 87532

Re: Approval of Phase 3 Fixed-Price Workplan for Shamrock No. 63, 3624 Cerrillos Road, Santa Fe, New Mexico

Facility #: 29206 Release ID #: 4509 WPID #: 18604

Dear Mr. Polk:

The New Mexico Environment Department (Department) approves the fixed-price workplan dated December 4, 2018, which was submitted on your behalf by Daniel B. Stephens & Associates, Inc. (DBS&A). This workplan is for Phase 3 activities consisting of preparation of a conceptual remediation plan (CRP) and a final remediation plan (FRP) at the Shamrock No. 63 site. Work shall be performed in accordance with the workplan and current Contractor Fee Schedule.

The total budget approved for this workplan shall not exceed $56,168.36, including New Mexico Gross Receipts Tax. Please refer to the following table for a breakdown of the expected deliverables and dates of completion. The dates listed in the table are the current deadlines in the applicable portion of the corrective action timeline for the subject site. These deliverables document completion of individual performance criteria.

Deliverable Name	$ Approved	Estimated Date of Deliverable	Deliverable ID
CRP Development & Project Planning and submittal	$14,379.74	07/31/2019	18604-1
FRP Development and submittal	$41,788.62	08/30/2019	18604-2

Please be reminded that Section 74-6B-7.F (NMSA 1978) of the Ground Water Protection Act does not allow the Department to authorize payments in excess of the funds available. This means that approval of the workplan does not guarantee reimbursement from the Corrective Action Fun(Fund).

Furthermore, the Department must receive all claims for reimbursement within 90 days of the date of notice of deliverable approval.

To facilitate reimbursement, if a deliverable represents a reduced scope of work that requires a reduction in the amount to be claimed, the notification of the modified costs must be submitted to the Department with the deliverable.

The Department has reviewed the current statement of qualifications of DBS&A's authorized representative, the project professional engineer, and the individual with direct, responsible supervisory control of this workplan. In accordance with 20.5.122.2201 NMAC, the Department has determined that DBS&A is currently a qualified firm to perform the scope of work as described in the approved workplan. The work was awarded through a competitive contractor selection process.

Substantial compliance is required for reimbursement and will be determined on a site-by-site basis prior to disbursement from the Fund. In accordance with 20.5.123.2303 NMAC, the owner or operator shall request a compliance determination before submitting the initial request for payment of the costs of corrective action, other than the costs of a Minimum Site Assessment (MSA). Please submit a request for compliance determination, if you have not already done so, to the Petroleum Storage Tank Bureau, 2905 Rodeo Park Drive East, Building 1, Santa Fe, New Mexico 87505. It is in your best interest to submit your request as soon as possible to ensure that any work that you undertake is reimbursable.

You may begin work immediately. Approval of this workplan is contingent upon all work being performed on this site in accordance with all local, state and federal regulations, including 29 CFR 1910 governing occupation health and safety. The Department expects DBS&A to complete the work as outlined within the approved budget. All change orders must be approved in writing prior to the work being performed.

If you have any questions, please contact the project manager, Susan von Gonten at (505) 476-4389. Thank you for your continued voluntary cooperation.

Sincerely,

Dana Bahar
Bureau Chief
Petroleum Storage Tank Bureau

DB:SvG:as

cc: Thomas Golden, P.E., DBS&A (via email)
John Casey, P.E., DBS&A (via email)
Lorena Goerger, Manager, Remedial Action Program (via email)
Jim Gibb, Geoscientist Supervisor (via email)
Susan von Gonten, Project Manager (via email)
Katherine MacNeil, P.E. (via email)
Casey Stavert, Inspector, Prevention and Inspection Program (via email)

cc w/encl: PSTB Master File Santa Fe

CONSENT FOR ACCESS TO PROPERTY

Name of Property Owner: Kelly Santa Fe Ventures Limited Partnership

Location of Property: 3650 Cerrillos Road, Santa Fe, New Mexico, 87507

This is my consent to Daniel B. Stephens and Associates, Inc. (DBS&A), and its authorized officers, employees, contractors, and representatives for access to the above-described Property for the following purposes:

- Monitor well installation
- Well survey
- Short-term (three days duration) monitoring of the wellhead(s) during soil vapor extraction (SVE) pilot testing.
- Collection of groundwater samples on a quarterly or semi-annual basis

This work is conducted by DBS&A on behalf of Polk Oil Company, responsible party (RP) for the former Shamrock 63 site located at 3624 Cerrillos Road, and in cooperation with the New Mexico Environment Department, Petroleum Storage Tank Bureau (NMED-PSTB).

DBS&A will provide the Property Owner verbal notice 96 hours prior to entrance onto the Property. This notice shall be given to:

Name:	Mr. John Nygaard
Mailing Address:	3650 Cerrillos Road Santa Fe, NM 87507
Phone Number:	(505)438-3822
Email:	jnygaard@kellyinns.com

Field activities will be conducted so as to minimize interference with the movement of vehicles and regular activities on the Property. Following completion of the project, DBS&A or its representative will remove equipment and other associated items. DBS&A or its representative will otherwise return the property as close as possible to the pre-entrance condition.

This permission is given by me voluntarily with knowledge of my right to refuse and without coercion. I have had an opportunity to ask questions and all my questions have been answered to my satisfaction.

John Nygaard — 8/9/17

Signature-Property Owner — Date

CONSENT FOR ACCESS TO PROPERTY

Name of Property Owner: Surf Thru, Inc.

Location of Property: 3570 Cerrillos Road, Santa Fe, New Mexico, 87507

This is my consent to Daniel B. Stephens and Associates, Inc. (DBS&A), and its authorized officers, employees, contractors, and representatives for access to the above-described Property for the following purposes:

- Monitor well installation
- Well survey
- Collection of groundwater samples on a quarterly or semi-annual basis

This work is conducted by DBS&A on behalf of Polk Oil Company, responsible party (RP) for the former Shamrock No. 63 site located at 3624 Cerrillos Road, and in cooperation with the New Mexico Environment Department, Petroleum Storage Tank Bureau (NMED-PSTB).

DBS&A will provide the Property Owner verbal notice 96 hours prior to entrance onto the Property. This notice shall be given to:

Name:	Mr. Todd Gall
Mailing Address:	2701 Brighton Park Dr. Bakersfield, CA 93311
Phone Number:	(559) 978-9495
Email:	surftag@surfthruexpress.com

Field activities will be conducted so as to minimize interference with the movement of vehicles and regular activities on the Property. Following completion of the project, DBS&A or its representative will remove equipment and other associated items. DBS&A or its representative will otherwise return the property as close as possible to the pre-entrance condition.

This permission is given by me voluntarily with knowledge of my right to refuse and without coercion. I have had an opportunity to ask questions and all my questions have been answered to my satisfaction.

Signature-Property Owner

8/21/17
Date

CONSENT FOR ACCESS TO PROPERTY

Name of Property Owner: Joel S. Marks

Location of Property: 3668 Cerrillos Road, Santa Fe, New Mexico, 87507

This is my consent to Daniel B. Stephens and Associates, Inc. (DBS&A), and its authorized officers, employees, contractors, and representatives for access to the above-described Property for the following purposes:

- Monitor well installation
- Well survey
- Short-term (two to three days duration) monitoring of the wellhead(s) during soil vapor extraction (SVE) pilot testing to be conducted on the adjacent Best Western property.
- Collection of groundwater samples on a quarterly or semi-annual basis

This work is conducted by DBS&A on behalf of Polk Oil Company, responsible party (RP) for the former Shamrock 63 site located at 3624 Cerrillos Road, and in cooperation with the New Mexico Environment Department, Petroleum Storage Tank Bureau (NMED-PSTB).

DBS&A will provide the Property Owner verbal notice 96 hours prior to entrance onto the Property. This notice shall be given to:

Name:	Mr. Joel S. Marks
Mailing Address:	5645 4th St. NW Albuquerque, NM 87107
Phone Number:	(505)876-7331
Email:	joepawn@aol.com

Field activities will be conducted so as to minimize interference with the movement of vehicles and regular activities on the Property. Following completion of the project, DBS&A or its representative will remove equipment and other associated items. DBS&A or its representative will otherwise return the property as close as possible to the pre-entrance condition.

This permission is given by me voluntarily with knowledge of my right to refuse and without coercion. I have had an opportunity to ask questions and all my questions have been answered to my satisfaction.

Signature/Property Owner

9.6.17
Date

Appendix H

Legal Notice Publication

NOTICE OF SUBMISSION OF
FINAL REMEDIATION PLAN

Date of Notice: August 29, 2019 and September 5, 2019

Notice is hereby given by Daniel B. Stephens & Associates, Inc. of the submission of a Final Remediation Plan to the New Mexico Environment Department (NMED) Petroleum Storage Tank Bureau (PSTB), as follows:

1. The Final Remediation Plan proposes actions to remediate a release of petroleum or petroleum products into the environment.

2. The release occurred at the Shamrock No. 63 Site, 3624 Cerrillos Rd, Santa Fe, New Mexico. The remediation equipment will be located at this address.

3. The Final Remediation Plan proposes to remove gasoline contamination through the use of soil vapor extraction technology. The vapors will be treated using thermal and/or catalytic oxidation technology and discharged to the atmosphere.

4. A copy of the Final Remediation Plan can be viewed by interested parties at the NMED PSTB office located at 2905 Rodeo Park Drive East, Building 1, Santa Fe, New Mexico, 87505. In addition, the Final Remediation Plan and all applicable data may be viewed at the following website: http://dbsa-client-access.com/PSTB/file_access.htm. Services may be arranged for translation of documents, for interpreters, and for obtaining services for persons with disabilities by contacting the PSTB Project Manager.

5. Comments on the plan may be sent to the PSTB Project Manager: by mail at New Mexico Environment Department Petroleum Storage Tank Bureau, Attn: Susan von Gonten, 2905 Rodeo Park Drive East, Building 1, Santa Fe, New Mexico, 87505; by telephone at 505-476-4397; or e-mailed to: susan.vongonten@state.nm.us. Comments may also be submitted to the Secretary of the Environment Department. Comments must be delivered by September 26, 2019. Please include the name of the site “Shamrock No. 63 Site, 3624 Cerrillos Rd, Santa Fe, New Mexico” to ensure comments are correctly assigned to the site.

AVISO DE PRESENTACIÓN DEL
PLAN DE REMEDIACIÓN FINAL

Fecha de aviso: 29 de agosto de 2019 y 5 de septiembre de 2019

Por el presente documento, Daniel B. Stephens & Associates, Inc., en nombre de Polk Oil Company da aviso de la presentación de un Plan de Remediación Final a la Oficina de Tanques de Almacenamiento de Petróleo (PSTB, por sus siglas en inglés) del Departamento de Medio Ambiente de Nuevo México (NMED, por sus siglas en inglés), de la siguiente manera:

1. El Plan de Remediación Final propone medidas para remediar una liberación de petróleo o de productos petrolíferos en el medio ambiente.

2. La liberación ocurrió en el sitio Shamrock Núm. 63, 3624 Cerrillos Rd, Santa Fe, Nuevo México. El equipo de remediación se ubicará en esta dirección.

3. El Plan de Remediación Final propone eliminar la contaminación por gasolina mediante el uso de tecnología de extracción de vapor de suelo. Los vapores serán tratados utilizando tecnología de oxidación térmica y/o catalítica y descargados a la atmósfera.

4. Las partes interesadas pueden ver una copia del Plan de Remediación Final en la oficina de PSTB de NMED ubicada en 2905 Rodeo Park Drive East, Edificio 1, Santa Fe, Nuevo México, 87505. Además, el Plan de Remediación Final y todos los datos aplicables pueden ser vistos en el siguiente sitio web: http://dbsa-client-access.com/PSTB/file_access.htm. Pueden organizarse servicios para traducción de documentos, para intérpretes y para obtener servicios para personas con discapacidades poniéndose en contacto con la gerente de proyectos de PSTB. Los usuarios de TDD o TTY, pueden acceder a los números de teléfono utilizando la Red de Retransmisión de Nuevo México, 1-800-659-1779 (voz) y 1-800-659-8331 (usuarios de TTY).

5. Los comentarios sobre el plan pueden enviarse a la gerente de proyectos de PSTB: por correo a la Oficina de Tanques de Almacenamiento de Petróleo del Departamento de Medio Ambiente de Nuevo México, a la atención de: Susan von Gonten, 2905 Rodeo Park Drive East, Edificio 1, Santa Fe, Nuevo México, 87505; por teléfono al 505-476-4397; o por correo electrónico a: susan.vongonten@state.nm.us. Los comentarios deben entregarse a más tardar el 26 de septiembre de 2019. Los comentarios enviados a la gerente de proyectos también deben enviarse por correo al secretario de NMED al Departamento de Medio Ambiente de Nuevo México, a la atención de: Secretary Kenney, P.O. Box 5469, Santa Fe, NM 87502-5469. Por favor incluya el nombre del sitio "Shamrock Núm. 63, 3624 Cerrillos Rd, Santa Fe, Nuevo México" para asegurarse que los comentarios se asignen correctamente al sitio.

Parcel Number	Map Code	Property Use	Owner Name	Property Address
10685402	1.0501E+18	COMM	MARQUEZ, JESUS J & ETAL	3624 CERRILLOS RD, SANTA FE, NM 87507
11746730	1.0501E+18	COMM	MONTOYA, JOE S	3565 TO 3579 CERRILLOS RD, SANTA FE, NM 87507
12568150	1.0501E+18	COMM	SANTA FE HOTEL GROUP LLC	3625 CERRILLOS RD, SANTA FE, NM 87507
13240617	13240617	MH	GARCIA, RICHARD L	403 A W PUEBLO ST, SANTA FE, NM 87507
13241180	13241180	MH	GUEVARA-FUENTES, CANDIDA	3665 CERRILLOS RD # 39, SANTA FE, NM 87507
13241789	13241789	MH	TOOTLE, KATHLEEN &	3665 CERRILLOS RD # 9, SANTA FE, NM 87507
14126464	1.0501E+18	COMM	SURF THRU, INC	3570 CERRILLOS RD, SANTA FE, NM 87507
14126989	14126989	MH	COLLECTIVE COMMUNITIES-VAGABOND MCH, LLC	3665 CERRILLOS RD # 21, SANTA FE, NM 87507
16001286	1.0501E+18	MRES	COLLECTIVE COMMUNITIES-VAGABOND MCH, LLC	3665 CERRILLOS RD, SANTA FE, NM 87507
16005265	16005265	MH	THOMPSON, PATRICK	3665 CERRILLOS RD # 25, SANTA FE, NM 87507
16005800	16005800	MH	SOTELO-FLORES, SANJUANA	3665 CERRILLOS RD # 7, SANTA FE, NM 87507
16007376	16007376	MH	TRUJILLO, HAROLD OR VELMA OR TARA L	3665 CERRILLOS RD # 17, SANTA FE, NM 87507
16007405	16007405	MH	ORTIZ-QUEZADA, MANUEL	3665 CERRILLOS RD # 3, SANTA FE, NM 87507
18311187	1.0501E+18	COMM	JM GILLIAM PROPERTIES LLC	3675 CERRILLOS RD, SANTA FE, NM 87507
18403302	18403302	MH	PACHECO-GUEVARA, OTIS L & OLIVARES-ANDRADE, ROSAL	3665 CERRILLOS RD # 22, SANTA FE, NM 87507
18601975	18601975	MH	MADRID, JOSEPH J	3665 CERRILLOS RD # 29, SANTA FE, NM 87507
18701343	18701343	MH	GONZALES-ESCARSEGA, MERARY	3665 CERRILLOS RD # 23, SANTA FE, NM 87507
18701616	18701616	MH	SANCHEZ, HURTADO ROGELIO	3665 CERRILLOS RD # 11, SANTA FE, NM 87507
18900107	18900107	MH	GONZALEZ, GLORIA	3665 CERRILLOS RD # 30, SANTA FE, NM 87507
19000101	19000101	MH	JACQUEZ-LOZANO, JUAN M	3665 CERRILLOS RD # 14, SANTA FE, NM 87507
19100528	1.0501E+18	COMM	KELLY SANTA FE VENTURES LIMTD PRTNRSHP	3650 CERRILLOS RD, SANTA FE, NM 87507
19102532	1.0501E+18	COMM	SANTA FE CHALET RV RESORTS LLC	3574 CERRILLOS RD, SANTA FE, NM 87507
19105471	19105471	MH	PEREZ DE CALLES, ODILIA N	3665 CERRILLOS RD # 5, SANTA FE, NM 87507
19205141	19205141	MH	NEVAREZ, YOLANDA & SERGIO	3665 CERRILLOS RD # 33, SANTA FE, NM 87507
23475483	23475483	MH	REYES, MERCEDES A	3665 CERRILLOS RD # 31, SANTA FE, NM 87507
54188416	1.0501E+18	COMM	OH HI MARK LLC	3668 CERRILLOS RD, SANTA FE, NM 87507
55252137	55252137	MH	CHAPARRO, MARIA G	3665 CERRILLOS RD # 1, SANTA FE, NM 87507
55253135	55253135	MH	ESPARZA-CERVANTES, MARCO	3665 CERRILLOS RD 16, SANTA FE, NM 87507
58000189	1050096350158CA000(	COMA	LOFTS, THE	3600 CERRILLOS RD, SANTA FE, NM 87507
58207059	58207059	MH	PEREZ ORTIZ, MARBRISA	3665 CERRILLOS RD # 28, SANTA FE, NM 87507
58312444	58312444	MH	VELETA, CRISTOBAL C	3665 CERRILLOS RD 25, SANTA FE, NM 87507
58501247	1.0501E+18	COMM	BESSER, BRUCE R	3658 -3662 CERRILLOS RD, SANTA FE, NM 87507
58605442	58605442	MH	ALDANA-LOPEZ, TOMAS	3665 CERILLOS RD 35, SANTA FE, NM 87507
66003639	66003639	MH	ALCALA MONTES, KESIA NOHEMI	3665 CERRILLOS RD 6, SANTA FE, NM 87507
66008723	66008723	MH	VEGA, OCTAVIO	3665 CERRILLOS RD # 34, SANTA FE, NM 87507
68104167	68104167	MH	FLORES-MARQUEZ, GRICELDA	3665 CERRILLOS RD # 20, SANTA FE, NM 87507
68902173	68902173	MH	CHAVEZ-GARCIA, ARMANDO	3665 CERRILLOS RD # 15, SANTA FE, NM 87507
99309298	1.0501E+18	VAC	SPARE LLC	3672 CERRILLOS RD, SANTA FE, NM 87507
110001280		MH	MONTIJO-ORTIZ, MAURILIO	3665 CERRILLOS RD, SANTA FE, NM 87507

Parcel Number	Map Code		Property Use	Owner Name	Property Address
500001045		500001045	MH	LOPEZ, PAZ MARIA	3665 CERRILLOS RD # 8, SANTA FE, NM 87507
940001597		940001597	MH	SANCHEZ, MARTIN	3665 CERRILLOS RD # 12, SANTA FE, NM 87507
940001613		940001613	MH	MONTIJO, BLANCA	3665 CERRILLOS RD # 32, SANTA FE, NM 87507
940001627		940001627	MH	NAVA JUAN GABRIEL	3665 CERRILLOS RD # 24, SANTA FE, NM 87507
940001657		940001657	MH	CERVANTES-RODRIGUEZ, JOSE	3665 CERRILLOS RD # 37, SANTA FE, NM 87507-2954
940001682		940001682	MH	LOVATO, MARIE E	3665 CERRILLOS RD # 27, SANTA FE, NM 87507
960000364		960000364	MH	TRUJILLO, JAY	3665 CERRILLOS RD # 2, SANTA FE, NM 87507
990006691		990006691	MH	MARQUEZ, MARIO & SYLVIA	3665 CERRILLOS RD # 13, SANTA FE, NM 87507
990007703		990007703	MH	MONTIJO, JESUS	3665 CERRILLOS RD # 38, SANTA FE, NM 87507
990007890		990007890	MH	QUEZADA, SALOMON	3665 CERRILLOS RD 19, SANTA FE, NM 87507
992203573			IPBP	THE HAMPTON INN	3625 CERRILLOS RD, SANTA FE, NM 87507
992203651			IPBP	PENSKE TRUCK RENTALS	3572 CERRILLOS RD, SANTA FE, NM 87507
992203764			IPBP	PUTNAM-PRITCHARD INTERIORS	3600 CERRILLOS RD #101, SANTA FE, NM 87507
992203939			IPBP	AARON SALES & LEASE C1368	3675 CERRILOS RD, SANTA FE, NM 87507
992207352			IPBP	BEST WESTERN SANTA FE	3650 CERRILLOS RD, SANTA FE, NM 87507
992231792			IPBP	TAOS ICEHOUSE LLC	3668 CERRILLOS RD, SANTA FE, NM 87507
992231796			IPBP	TECHBIVVY LLC	3668 CERRILLOS RD, SANTA FE, NM 87507

Santa Fe County : Assessor

Parcel Number	Map Code	Property Use	Owner Name	Property Address
10685402	1050096341237000000	COMM	MARQUEZ, JESUS J & ETAL	3624 CERRILLOS RD, SANTA FE, NM 87507
12568150	1050096328289000000	COMM	SANTA FE HOTEL GROUP LLC	3625 CERRILLOS RD, SANTA FE, NM 87507
13240617	13240617	MH	GARCIA, RICHARD L	403 A W PUEBLO ST, SANTA FE, NM 87507
13241180	13241180	MH	GUEVARA-FUENTES, CANDIDA	3665 CERRILLOS RD # 39, SANTA FE, NM 87507
13241789	13241789	MH	TOOTLE, KATHLEEN &	3665 CERRILLOS RD # 9, SANTA FE, NM 87507
14126464	1050096359240000000	COMM	SURF THRU, INC	3570 CERRILLOS RD, SANTA FE, NM 87507
14126989	14126989	MH	COLLECTIVE COMMUNITIES-VAGABOND MCH, LLC	3665 CERRILLOS RD # 21, SANTA FE, NM 87507
16001286	1050096306279000000	MRES	COLLECTIVE COMMUNITIES-VAGABOND MCH, LLC	3665 CERRILLOS RD, SANTA FE, NM 87507
16005265	16005265	MH	THOMPSON, PATRICK	3665 CERRILLOS RD # 25, SANTA FE, NM 87507

Parcel Number	Map Code	Property Use	Owner Name	Property Address
16005800	16005800	MH	SOTELO-FLORES, SANJUANA	3665 CERRILLOS RD # 7, SANTA FE, NM 87507
16007376	16007376	MH	TRUJILLO, HAROLD OR VELMA OR TARA L	3665 CERRILLOS RD # 17, SANTA FE, NM 87507
16007405	16007405	MH	ORTIZ-QUEZADA, MANUEL	3665 CERRILLOS RD # 3, SANTA FE, NM 87507
18403302	18403302	MH	PACHECO-GUEVARA, OTIS L & OLIVARES-ANDRADE, ROSALIA	3665 CERRILLOS RD # 22, SANTA FE, NM 87507
18601975	18601975	MH	MADRID, JOSEPH J	3665 CERRILLOS RD # 29, SANTA FE, NM 87507
18701343	18701343	MH	GONZALES-ESCARSEGA, MERARY	3665 CERRILLOS RD # 23, SANTA FE, NM 87507
18701616	18701616	MH	SANCHEZ, HURTADO ROGELIO	3665 CERRILLOS RD # 11, SANTA FE, NM 87507
18900107	18900107	MH	GONZALEZ, GLORIA	3665 CERRILLOS RD # 30, SANTA FE, NM 87507
19000101	19000101	MH	JACQUEZ-LOZANO, JUAN M	3665 CERRILLOS RD # 14, SANTA FE, NM 87507
19100528	1050096331219000000	COMM	KELLY SANTA FE VENTURES LIMTD PRTNRSHP	3650 CERRILLOS RD, SANTA FE, NM 87507

Parcel Number	Map Code	Property Use	Owner Name	Property Address
19102532	1050096376178000000	COMM	SANTA FE CHALET RV RESORTS LLC	3574 CERRILLOS RD, SANTA FE, NM 87507
19105471	19105471	MH	PEREZ DE CALLES, ODILIA N	3665 CERRILLOS RD # 5, SANTA FE, NM 87507
19205141	19205141	MH	NEVAREZ, YOLANDA & SERGIO	3665 CERRILLOS RD # 33, SANTA FE, NM 87507
23475483	23475483	MH	REYES, MERCEDES A	3665 CERRILLOS RD # 31, SANTA FE, NM 87507
54188416	1050096315216000000	COMM	OH HI MARK LLC	3668 CERRILLOS RD, SANTA FE, NM 87507
55252137	55252137	MH	CHAPARRO, MARIA G	3665 CERRILLOS RD # 1, SANTA FE, NM 87507
55253135	55253135	MH	ESPARZA-CERVANTES, MARCO	3665 CERRILLOS RD 16, SANTA FE, NM 87507
58000189	1050096350158CA0000	COMA	LOFTS, THE	3600 CERRILLOS RD, SANTA FE, NM 87507
58207059	58207059	MH	PEREZ ORTIZ, MARBRISA	3665 CERRILLOS RD # 28, SANTA FE, NM 87507
58312444	58312444	MH	VELETA, CRISTOBAL C	3665 CERRILLOS RD 25, SANTA FE, NM 87507

Parcel Number	Map Code	Property Use	Owner Name	Property Address
58501247	1050096335197000000	COMM	BESSER, BRUCE R	3658 -3662 CERRILLOS RD, SANTA FE, NM 87507
58605442	58605442	MH	ALDANA-LOPEZ, TOMAS	3665 CERILLOS RD 35, SANTA FE, NM 87507
66003639	66003639	MH	ALCALA MONTES, KESIA NOHEMI	3665 CERRILLOS RD 6, SANTA FE, NM 87507
66008723	66008723	MH	VEGA, OCTAVIO	3665 CERRILLOS RD # 34, SANTA FE, NM 87507
68104167	68104167	MH	FLORES-MARQUEZ, GRICELDA	3665 CERRILLOS RD # 20, SANTA FE, NM 87507
68902173	68902173	MH	CHAVEZ-GARCIA, ARMANDO	3665 CERRILLOS RD # 15, SANTA FE, NM 87507
99309298	1050096309208000000	VAC	SPARE LLC	3672 CERRILLOS RD, SANTA FE, NM 87507
110001280		MH	MONTIJO-ORTIZ, MAURILIO	3665 CERRILLOS RD, SANTA FE, NM 87507
500001045	500001045	MH	LOPEZ, PAZ MARIA	3665 CERRILLOS RD # 8, SANTA FE, NM 87507
940001597	940001597	MH	SANCHEZ, MARTIN	3665 CERRILLOS RD # 12, SANTA FE, NM 87507

Parcel Number	Map Code	Property Use	Owner Name	Property Address
940001613	940001613	MH	MONTIJO, BLANCA	3665 CERRILLOS RD # 32, SANTA FE, NM 87507
940001627	940001627	MH	NAVA JUAN GABRIEL	3665 CERRILLOS RD # 24, SANTA FE, NM 87507
940001657	940001657	MH	CERVANTES-RODRIGUEZ, JOSE	3665 CERRILLOS RD # 37, SANTA FE, NM 87507-2954
940001682	940001682	MH	LOVATO, MARIE E	3665 CERRILLOS RD # 27, SANTA FE, NM 87507
960000364	960000364	MH	TRUJILLO, JAY	3665 CERRILLOS RD # 2, SANTA FE, NM 87507
990006691	990006691	MH	MARQUEZ, MARIO & SYLVIA	3665 CERRILLOS RD # 13, SANTA FE, NM 87507
990007703	990007703	MH	MONTIJO, JESUS	3665 CERRILLOS RD # 38, SANTA FE, NM 87507
990007890	990007890	MH	QUEZADA, SALOMON	3665 CERRILLOS RD 19, SANTA FE, NM 87507
992203573		IPBP	THE HAMPTON INN	3625 CERRILLOS RD, SANTA FE, NM 87507
992203651		IPBP	PENSKE TRUCK RENTALS	3572 CERRILLOS RD, SANTA FE, NM 87507

Parcel Number	Map Code	Property Use	Owner Name	Property Address
992203764		IPBP	PUTNAM-PRITCHARD INTERIORS	3600 CERRILLOS RD #101, SANTA FE, NM 87507
992207352		IPBP	BEST WESTERN SANTA FE	3650 CERRILLOS RD, SANTA FE, NM 87507
992231792		IPBP	TAOS ICEHOUSE LLC	3668 CERRILLOS RD, SANTA FE, NM 87507
992231796		IPBP	TECHBIVVY LLC	3668 CERRILLOS RD, SANTA FE, NM 87507

SANTA FE NEW MEXICAN

Ad Proof / Order Confirmation / Invoice

Account Number
16795

Ad Order Number
0000263025

DANIEL B. STEPHENS AND ASSOCIATES, INC

LEGAL # 86183

NOTICE OF SUBMISSION OF FINAL REMEDIATION PLAN

Date of Notice: August 29, 2019 and September 5, 2019

Notice is hereby given by Daniel B. Stephens & Associates, Inc. on behalf of Polk Oil Company of the submission of a Final Remediation Plan to the New Mexico Environment Department (NMED) Petroleum Storage Tank Bureau (PSTB), as follows:

1. The Final Remediation Plan proposes actions to remediate a release of petroleum or petroleum products into the environment.

2. The release occurred at the Shamrock No. 63 Site, 3624 Cerrillos Rd, Santa Fe, New Mexico. The remediation equipment will be located at this address.

3. The Final Remediation Plan proposes to remove gasoline contamination through the use of soil vapor extraction technology. The vapors will be treated using thermal and/or catalytic oxidation technology and discharged to the atmosphere.

4. A copy of the Final Remediation Plan can be viewed by interested parties at the NMED PSTB office located at 2905 Rodeo Park Drive East, Building 1, Santa Fe, New Mexico, 87505. In addition, the Final Remediation Plan and all applicable data may be viewed at the following website: http://dbsa-client-access.com/PSTB/file_access.htm. Services may be arranged for translation of documents, for interpreters, and for obtaining services for persons with disabilities by contacting the PSTB Project Manager. TDD or TTY users, please access phone numbers using the New Mexico Relay Network, 1-800-659-1779 (voice) and 1-800-659-8331 (TTY users).

5. Comments on the plan may be sent to

the PSTB Project Manager: by mail at New Mexico Environment Department Petroleum Storage Tank Bureau, Attn: Susan von Gonten, 2905 Rodeo Park Drive East, Building 1, Santa Fe, New Mexico, 87505; by telephone at 505-476-4397; or e-mailed to: susan.vongonten@state.nm.us. Comments must be delivered by September 26, 2019. Comments sent to the project manager must also be mailed to the NMED Secretary at New Mexico Environment Department, Attn: Secretary Kenney, PO Box 5469, Santa Fe, NM 87502-5469. Please include the name of the site "Shamrock No. 63 Site, 3624 Cerrillos Rd, Santa Fe, New Mexico" to ensure comments are correctly assigned to the site.

Pub.: Aub. 29, Sep. 5, 2019

SANTA FE NEW MEXICAN

Ad Proof / Order Confirmation / Invoice

Account Number
16795

Ad Order Number
0000263028

DANIEL B. STEPHENS AND ASSOCIATES, INC

LEGAL # 86184

AVISO DE PRESENTACIÓN DEL PLAN DE REMEDIACIÓN FINAL

Fecha de aviso: 29 de agosto de 2019 y 5 de septiembre de 2019

Por el presente documento, Daniel B. Stephens & Associates, Inc., en nombre de Polk Oil Company da aviso de la presentación de un Plan de Remediación Final a la Oficina de Tanques de Almacenamiento de Petróleo (PSTB, por sus siglas en inglés) del Departamento de Medio Ambiente de Nuevo México (NMED, por sus siglas en inglés), de la siguiente manera:

1. El Plan de Remediación Final propone medidas para remediar una liberación de petróleo o de productos petrolíferos en el medio ambiente.

2. La liberación ocurrió en el sitio Shamrock Núm. 63, 3624 Cerrillos Rd, Santa Fe, Nuevo México. El equipo de remediación se ubicará en esta dirección.

3. El Plan de Remediación Final propone eliminar la contaminación por gasolina mediante el uso de tecnología de extracción de vapor de suelo. Los vapores serán tratados utilizando tecnología de oxidación térmica y/o catalítica y descargados a la atmósfera.

4. Las partes interesadas pueden ver una copia del Plan de Remediación Final en la oficina de PSTB de NMED ubicada en 2905 Rodeo Park Drive East, Edificio 1, Santa Fe, Nuevo México, 87505. Además, el Plan de Remediación Final y todos los datos aplicables pueden ser vistos en el siguiente sitio web: http://dbsa-client-access.com/PSTB/file_access.htm. Pueden organizarse servicios para traducción de documentos, para intérpretes y para obtener servicios para personas con

discapacidades poniéndose en contacto con la gerente de proyectos de PSTB. Los usuarios de TDD o TTY, pueden acceder a los números de teléfono utilizando la Red de Retransmisión de Nuevo México, 1-800-659-1779 (voz) y 1-800-659-8331 (usuarios de TTY).

5. Los comentarios sobre el plan pueden enviarse a la gerente de proyectos de PSTB: por correo a la Oficina de Tanques de Almacenamiento de Petróleo del Departamento de Medio Ambiente de Nuevo México, a la atención de: Susan von Gonten, 2905 Rodeo Park Drive East, Edificio 1, Santa Fe, Nuevo México, 87505; por teléfono al 505-476-4397; o por correo electrónico a: susan.vongonten@state.nm.us. Los comentarios deben entregarse a más tardar el 26 de septiembre de 2019. Los comentarios enviados a la gerente de proyectos también deben enviarse por correo al secretario de NMED al Departamento de Medio Ambiente de Nuevo México, a la atención de: Secretary Kenney, P.O. Box 5469, Santa Fe, NM 87502-5469. Por favor incluya el nombre del sitio "Shamrock Núm. 63, 3624 Cerrillos Rd, Santa Fe, Nuevo México" para asegurarse que los comentarios se asignen correctamente al sitio.

Pub.: Aug. 29, Sep. 5, 2019

Appendix I

Schedule for Implementation of Final Remediation Plan

Shamrock No. 63 Remedial Action Schedule

Task	Calendar Days	Start Date	End Date
Final FRP Submittal			8/30/2019
Address PSTB and Public Comments	45	8/30/2019	10/14/2019
FRP Approval	7	10/14/2019	10/21/2019
Work Plan for FRP Implementation	14	10/21/2019	11/4/2019
Work Plan Approval	60	11/4/2019	1/3/2020
Equipment Procurement	84	1/3/2020	3/27/2020
Well Installation	14	3/27/2020	4/10/2020
Trenching/Piping	14	4/10/2020	4/24/2020
Equipment Installation	14	4/24/2020	5/8/2020
Startup	5	5/8/2020	5/13/2020
First Year System Operations	365	5/13/2020	5/13/2021