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October 4, 2019

Ms. Katherine MacNeil
Project Manager/Engineer
Remedial Action Program
NMED/Petroleum Storage Tank Bureau
121 Tijeras Avenue NE, Suite 1000
Albuquerque, NM 87102

RE: Final Remediation Plan – Revision 1
Former Phillips 66, 401 N. California Street, Socorro, New Mexico
Facility #: 28401 Release ID #: 845 Deliverable ID #: 18371-3

Dear Ms. MacNeil:

On behalf of Three Star Corporation LLC (formerly Greenwald Trust), EA Engineering, Science, and Technology, Inc., PBC (EA) is submitting this revised Final Remediation Plan (FRP) for the former Socorro Phillips 66 (Site) located at 401 California Street, Socorro, New Mexico. NMED PSTB comments have been incorporated and are also included in the Appendix G.

This FRP represents a Deliverable ID 18371-3. Please review and issue a Deliverable Acceptance Letter to allow EA to submit a claim for the completed work.

If you have questions or comments, please feel free to contact us at 505-715-4477 or 505-715-4286.

Thank you.

Sincerely

Vener Mustafin, P.E.
Project Manager/Senior Engineer

Jay Snyder, P.E., P.G., C. Hg
Senior Engineer/Senior Hydrogeologist

Attachment: Final Remediation Plan

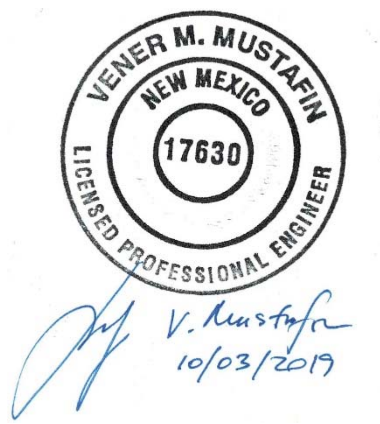
Cc: Ms. Katherine MacNeil, NMED PSTB
Ms. Patricia Jones, Three Star Corp. LLC

EA Engineering, Science, and Technology, Inc.

FINAL REMEDIATION PLAN
REVISION 1
FORMER PHILLIPS 66
401 N. CALIFORNIA STREET, SOCORRO, NM
PSTB FACILITY #28401
RELEASE ID #845
DELIVERABLE ID # 18371-3

Submitted to:
NMED PSTB

Submitted by:
EA Engineering, Science, and Technology, Inc., PBC
320 Gold Avenue SW, Suite 1300
Albuquerque, NM 87102



Distribution:

1 Copy	Ms. Lorena Goerger, NMED PSTB
1 Copy	Ms. Katherine MacNeil, NMED PSTB
1 Copy	Ms. Patricia Jones, Three Star Corp. LLC.

October 2019 EA Project No. 6281002

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1.0 INTRODUCTION

1.1. Contractual

EA Engineering, Science, and Technology, Inc. PBC (EA) has prepared this Final Remediation Plan (FRP) to implement sparging and soil venting to address soil and groundwater contamination at former Phillips 66, Socorro, NM (Figure 1). This FRP has been prepared to satisfy the applicable requirements of the New Mexico Administrative Code (NMAC) 20.5.119.1923 and the Work Plan for Phase 3 Final Remediation Plan (EA 2018).

1.2. Site Description

The site is located at the northwest intersection of California Street and Miguel Street in Socorro, New Mexico (Figure 2). In September 1991, four underground petroleum storage tanks (USTs) consisting of two unleaded gasoline, one regular gasoline and one waste oil tank, were removed from the site. Soil with volatile organic vapor concentrations above action levels and measureable NAPL was present at the time of UST removal. Site investigations defined the extent of contamination but subsequent corrective measures failed to reduce contaminants to below established action levels.

1.3. Site Use

The subject property is currently used as an auto and tire repair shop. Adjoining property use is commercial to the north and east, and a mix of commercial/residential to the west and south. The former Shell station, a listed leaking underground storage tank (LUST) site, is located east of the Phillips 66 Socorro site currently occupied by the feed store (Figure 2).

1.4. Adjacent Supply Wells

Local residences and businesses are connected to the City of Socorro water system; however, there are several domestic wells (RG-727 S3, RG-57666 POD 1, and RG-77518) located within 1,200 feet of the site. The closest well, RG-727 S3, is located approximately 415 feet southwest of the property. The City water is supplied by two springs (Socorro and Sedillo) and three wells (South Industrial, Eagle Pitcher and Evergreen) that are outside the area of contamination attributed to the site.

1.5. Site History

- 1991 – USTs were removed.
- 1995 – 2001 – Initial and secondary investigations and groundwater monitoring were conducted. Benzene, toluene, ethylbenzene, xylenes (BTEX), methyl tertiary butyl ether (MTBE), and total naphthalenes were above standards and NAPL was present in the monitoring well MW-7A.
- 2003 – Approximately 2,600 cubic yards of soil were excavated. However, contaminated soil was left in place along the western edge of the excavation due to limited approved excavation volume (CDM 2003).

- 2014 – Additional soil borings were installed to delineate the extent of the residual contamination and two monitoring wells MW 16 and MW-17 were installed in the median in California Street to determine whether contamination was migrating onto the site from an upgradient source.
- 2018 – Sparge/vent pilot test wells were installed and pre-design baseline groundwater monitoring was performed.
- 2019 – Sparge/vent pilot test was performed.

1.6. Site Hydrogeology

Native subsurface lithology consists predominantly clayey sands, silty sands, fine-grained sands that are interbedded along with clay and silt lenses, and gravely sand. Where soil was excavated, the area was backfilled with clean soil and sand/gravel fill (CDM, 2003). At a depth of 22-23 feet bgs, silt and clay were encountered in several borings. Geologic cross-sections are shown on Figures 6, 7, and 8.

In general, regional groundwater flow within the Upper Santa Fe Group and Quaternary deposits is from the upland areas toward the river and from north to south along the Rio Grande Valley. However, locally groundwater flow direction are strongly affected by groundwater pumping for various municipal and agricultural uses. Nearby surface water, canals and drains that serve as points of recharge and discharge respectively also affect the direction of groundwater flow.

At the site, groundwater is present approximately 11 to 14 feet bgs and moves from northeast to southwest under a hydraulic gradient of approximately 0.004 foot per foot (Figure 3). Water table elevations fluctuate but overall there has been a slight increasing trend since long-term monitoring started at the site. A summary of groundwater levels is provided as Table 1.

1.7. Nature and Extent of Contamination

Soil and groundwater were impacted by the release of petroleum hydrocarbons. BTEX, MTBE, and naphthalenes. In 2018, NAPL was not encountered in the monitoring wells. However, a sheen was observed in the monitoring well MW-15 in 2016 (Table 1).

Based on 2014 Geoprobe investigation 100-ppmv photoionization detector (PID) criterion, vadose soil contamination originated around the NE corner of the canopy (Figure 10, 4 feet bgs) and is centered in the former dispenser island area (Figure 10, 10-feet bgs). Once release reached the groundwater, it spread primarily in northern and southern directions (Figure 10, 12-feet bgs). The greatest extent was noted at 16 feet bgs (Figure 10). Soil impact decreases conically with depth; the deepest reported impact was at 22 feet bgs just north of MW-14. A silt/clay stratum was encountered in several soil borings at approximately 22-23 feet bgs. A summary of soil screening results with PID are shown on Figure 9.

In groundwater, methyl tertiary butyl ether (MTBE) has the greatest extent and originates upgradient of the site across the California Avenue at former Socorro Shell Station (present day

Economy Inn). Within the site, all MTBE concentrations are below the existing conditions represented by a concentration of 260 micrograms per liter (µg/L) in MW-17 located in the median.

Within site boundaries, benzene, toluene, ethylbenzene, xylenes, and naphthalenes (BTEXN) are the contaminants of concern that exceed the associated standards. These contaminants are encountered in area of the former dispenser islands and are represented by benzene extent shown on Figure 4.

1.8. Conceptual Site Model

Based on the data collected to date, EA has developed the following conceptual site model:

- Soil beneath the site consists of clayey sands, silty sands, and fine-grained sands that are interbedded along with clay, silt lenses, and gravelly sands. A significant area has been excavated and backfilled with sandy fill but has been re-contaminated by diffusion and advection of contamination by groundwater.
- The average groundwater level is approximately 12 feet bgs.
- Vadose zone soil contamination remains near the former dispenser island starting at four (4) feet bgs and extending to the water table.
- Soil is impacted below groundwater table, as indicated by elevated PID measurements. The bulk of the contamination was found between 12 and 18 feet bgs extending to 22 feet bgs near MW-14 (soil boring E-4).
- BTEXN are considered to be the contaminants of concern in groundwater. Area of exceedances is represented by the benzene extent that encompasses BTEXN (Figure 4). Within site boundaries, MTBE concentrations are above the regulatory level of 100 µg/L but are below the existing conditions represented by a concentration of 260 µg/L in MW-17.

2.0 REMEDIATION GOALS

Remediation goals include the following:

- Remediation of the source (sorbed-phase) to eliminate the partitioning of contaminants to groundwater and potential for vapor intrusion in the nearby buildings.
- Remediation of groundwater to the NMAC 20.6.2.3103 Human Health Standards.

Remediation goals and cleanup standards will be protective of receptors for the following exposure pathways:

- Groundwater ingestion,
- Worker exposure,
- Soil leaching to groundwater,
- Vapor intrusion

Remediation goals for the various media and pathways are provided in Table 6.

Clean-up times are based on the following remediation milestones:

- Reduction of sorbed-phase soil contaminant concentrations.
- Reduction of groundwater contamination concentrations to below NMAC 20.6.2.3103 standards.

Duration of remediation was estimated at approximately 3 years. Long term monitoring will be required to evaluate the effectiveness and permanence of the implemented remedy. Natural monitored attenuation and/or spot-treatment may be required for areas with recalcitrant concentrations.

3.0 REMEDIATION APPROACH

3.1. Remediation Approach

A combination of sparging and venting (soil vapor extraction [SVE]) will be used at the site to remediate impacted soil and groundwater. The process flow diagram is presented in Appendix A, Drawing P-1.

Sparging will be used to remediate groundwater and saturated soil by the following mechanisms:

- Volatilization of contaminants will be the primary mechanism in the early stages of remediation but will become limited after several months of system operation.
- In-situ bio-degradation is expected to be the main long-term contaminant destruction mechanism. Sparging will supply oxygen to enhance in-situ biological aerobic degradation of petroleum hydrocarbons in the aquifer matrix (mineralization).

SVE will be used to remediate soil in vadose zone and capture sparge gases. The following are the mechanisms:

- Removing of contaminated soil vapors from the vadose zone and vapors produced by sparging of the saturated zone.
- Supplying of atmospheric oxygen into the vadose zone to support in-situ aerobic biodegradation of contaminants (mineralization).

Both SVE and sparging are irreversible processes; captured and degraded contaminants will be permanently removed from the impacted media and/or destroyed in place.

3.2. Basis for Design

The following design parameters were obtained through review of the existing data and results of the pilot testing.

- *Horizontal Extent of the Treatment Zone* – The extent of BTEXN in groundwater, as represented by benzene concentrations.
- *Upper Extent of Saturated Treatment Zone* – Groundwater level, which averaged approximately 12 feet bgs in December 2018.
- *Bottom Extent of Saturated Treatment Zone* – 20 feet bgs represented by contamination extent in soil. The clay stratum encountered at approximately 22 feet bgs confined the contamination on the bottom.
- *Upper Extent of the Vadose Treatment Zone* – Four (4) feet bgs based on 2014 Geoprobe investigation results.
- *Lower Extent of the Vadose Treatment Zone* – Approximately 12 feet bgs that is defined by the water level and capillary fringe.
- *Sparge Radius of Influence (ROI)* – Twenty six (26) feet ROI was directly observed during the pilot testing.

- *<u>Vent ROI</u>* – Thirty (30) feet ROI was observed during the pilot testing. Considering overlapping influences of running two wells, ROI of 40 feet is considered reasonable for design purposes.
- *<u>Sparge Breakthrough Pressure</u>* – Five (5) pounds per square inch, gauge (psig) at the wellhead observed during pilot testing.
- *<u>Vent Vacuum</u>* – 30 inches of water column (inwc) at the wellhead based on pilot testing results.
- *<u>Vent Unit Flowrate</u>* – A rate of approximately one (1) standard cubic foot per minute per foot of well screen (scfm/ft) or less would be reasonable for the application based on pilot testing results.
- *<u>Sparge Flowrate</u>* – Should be less than the vent flowrate in order to capture sparge air.
- *<u>Initial Mass Removal Rate</u>* – The rate should be limited to the emission threshold of 2.282 pounds per hour (lb/hr). The rate is limited by the total mass of contamination and volatilization and is expected to decrease sharply after removing several pore volumes.

3.3. Selected Design Parameters

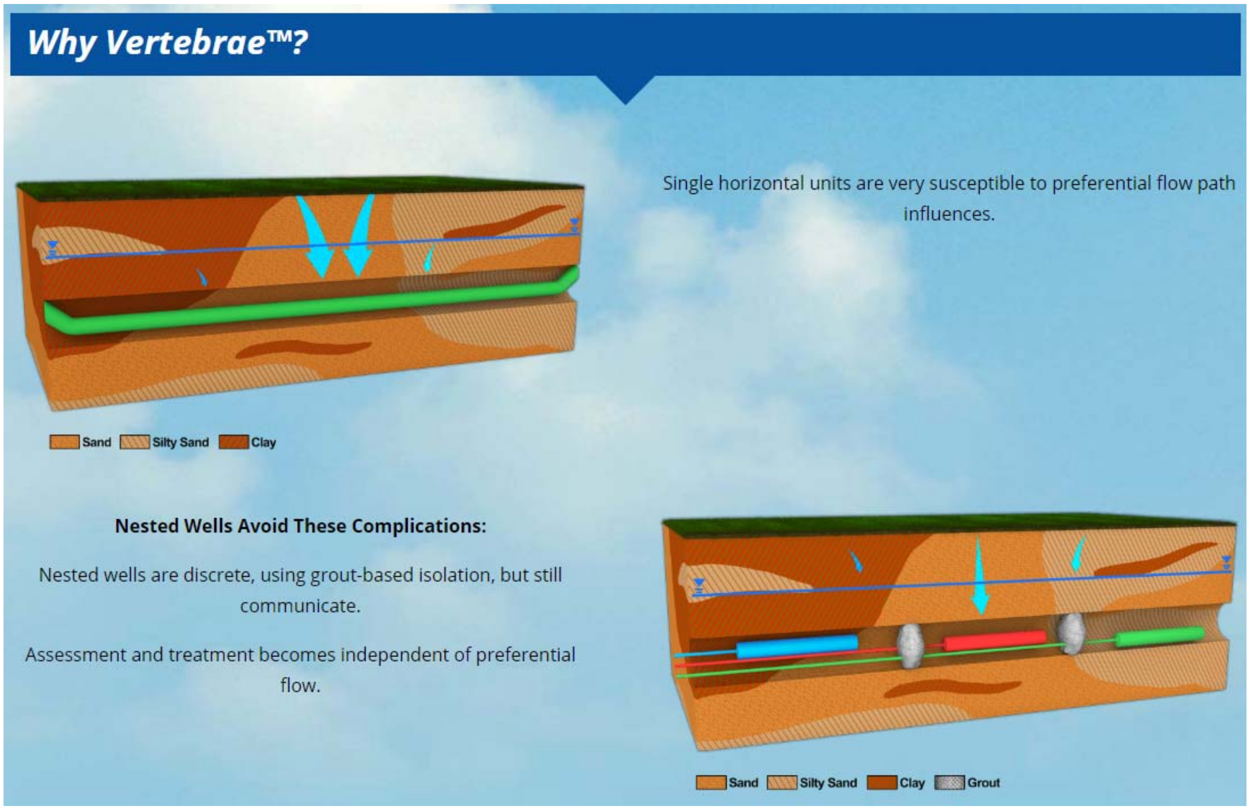
Provided below are the selected design parameters that were based on the site conditions and pilot testing results presented in Section 3.2. The subsequent reuse of the remediation equipment at other sites was also included in the selection of the design system parameters.

Sparge Wells	Twelve Vertebrae™ Wells	Encompass the BTEXN impacted area at ROI of 20 feet. 15-foot screened segments will be separated by 5-foot sections of expandable grout seal. Wells will be installed within three boreholes.
Vent Wells	Two horizontal wells	Encompass the BTEXN impacted area at ROI of 40 feet and capture the sparge area. Continuous uniform screen.
Sparge Blower Pressure Capacity	20 psig	Breakthrough was 5 psig. Extra capacity is allowed for pressure losses and unknown conditions.
Sparge Blower Flow Capacity	50 cfm	Represents approximately 0.25 cfm per foot of screen and has sufficient capacity to deliver sparge air and oxygen to support in-situ aerobic biodegradation and volatilization
Vent Blower Vacuum Capacity	80 inwc	Pilot test vacuum was approximately 30 inwc at the wellhead. The selected vacuum capacity allows for pressure losses and for unknown conditions.
Vent Blower Flow Capacity	100 cfm	Sufficient to capture sparge air and remediate vadose zone.
Enclosure	Modular modified container	To allow easy transport, installation, reuse, and to provide security. The container is pre-plumbed and pre-wired to optimize installation, reduce construction time and cost.

Design of Sparge Wells

Alignment of the sparge wells was based on the extent of BTEXN in groundwater established during the December 2018 baseline-sampling event and results of the January 2019 pilot testing. Therefore, the number of design wells was reduced when compared to the proposed that were developed prior to baseline sampling and pilot testing. Vertebrae™ multi-screen horizontal nested wells were selected in the design for vent wells instead of proposed conventional single-screen horizontal wells. Similarly, to nested vertical wells, Vertebrae™ nested wells are readily constructible, allow for great operational flexibility, targeted application, reduce influence of variations in subsurface preferential flow, reduce duration of remediation, and will result in overall lower remediation costs. Provided below is the comparison of Vertebrae™ and conventional horizontal well technologies.

Criterion	***Conventional Horizontal Wells***	***Vertebrae™ Horizontal Wells***	***Evaluation***
Installation	*Single well in a single borehole*	*Multiple wells in a single borehole*	***Multiple Vertebrae™ wells*** *could be installed in a single borehole*
Site Application	*A total **of three (3)long** air sparge wells could be installed in three boreholes*	*A total of **twelve (12) short** air sparge could be installed in three boreholes*	*For the same borehole footage, **many more Vertebrae™ wells** could be installed.*
Sparging of Less Permeable Zone	*Likely to sparge the most permeable zone within the long screen leaving the less permeable zone unaffected*	*Allows for targeted application within each short screen thus affecting less permeable zones*	***Vertebrae™ wells allows targeted application within less permeable zones***
Constructability	*Constructible by specialized driller and may require off-site access*	*Constructible by a utility driller and does not require off-site access*	***Both are constructible but Vertebrae™ could be installed by a utility driller and does not require off-site access***
Targeted Sparging	*Flow is evenly distributed through **one long well screen***	*Flow is evenly distributed through **several short well screens***	***Vertebrae™ wells allow for targeted sparging/remediation**, while conventional wells do not allow that*
Time to Implement	***Typical time for installation***	***Slightly longer time for installation***	***Vertebrae™** require **slightly more time** to install*
Optimization	***Three wells** could be adjusted to optimize remediation and to target zones of residual contamination*	***Twelve wells** could be adjusted to optimize remediation and to **better target** zones of residual contamination*	***Vertebrae™ wells allow greater flexibility and more effective mass removal***
Areas of residual contamination	*Must sparge the whole length of the well to affect **a small area** of residual contamination*	***Can target discreet zones***	***Vertebrae™ wells have greater ability** to target contamination*
Remediation Time	*Typical for application*	***Will be shortened** due to targeted application and faster remediation of recalcitrant zones*	***Vertebrae™ wells** will shorten remediation time*
Cost	*Typical for application*	*Lower drilling costs due to use of utility driller. Slightly higher well costs. Overall, lower or similar costs. Lower operational cost due to targeted application. Lower O&M and monitoring costs due to shortened remediation duration*	***Vertebrae™ wells** will result in overall lower total cost due to shortened remediation duration, which will result in lower O&M and ground monitoring costs.*



For the same drilled borehole footage, three single-screen wells could be installed using conventional horizontal wells. The proposed design specified installation of twelve (12) 15-foot long Vertebrae^{TM} wells within the same three boreholes; thus minimizing influence of preferential flow.

EN Rx has extensive experience installing the Vertebrae^{TM} well systems. EN Rx has installed the systems at 29 sites in California, Colorado, Florida, Minnesota, Montana, and New York. The installed 97 VertebraeTM wells systems comprised of 566 independent well segments. The application included biosparging, air sparging, ozone sparging, curtain sparging, SVE, vapor mitigation, chemical injection, and chemical recirculation.

Design of Vent Wells

The number of the vents wells in this design was based on sparge wells layout, which in turn were based on baseline sampling BTEXN extent and results of pilot testing. Therefore, the number of SVE wells was reduced to two, as two wells were sufficient to vent the target zone. Alignment was also influenced by the locations of the existing wells and of subsurface utility corridor along California Avenue. Vent wells were maintained as conventional, as the purpose of the wells is to biovent and capture sparge air.

4.0 REMEDIATION SYSTEM ELEMENTS

Major remediation system elements include wells, sparging module, SVE module, electrical service, remediation enclosure, and permits. Design drawing are provided in the Appendix A, specification are provided in the Appendix B, calculations are provided in the Appendix C, and major equipment cut sheets in the Appendix D.

4.1. Remediation Wells

Twelve (12) horizontal air sparge Vertebrae™ wells and two (2) SVE wells were specified as part of the remediation system (Appendix A). To allow for maximal operating flexibility and targeted application, sparge wells will be installed within three boreholes using Vertebrae™ technology. Each sparge well will have a 15-foot long screen section separated by a 5-foot sections of expandable grout seal. SVE wells will have a single screen spanning the full borehole length.

Vertically, sparge wells will be installed at 20 feet bgs horizon, which represents the bottom of the contaminated saturated soil and is approximately 1-2 feet above the clay stratum. SVE wells will be installed at 8.5 feet bgs, approximately 3.5 feet above the water table and are within the contaminated vadose zone.

4.2. Sparging

The total design sparge flowrate is 50 scfm at 20 psi into 12 sparge wells. Each sparge well was designed to carry up to 5 scfm of air and will be controlled by a solenoid valve to allow automatic operation (Appendix A, Drawings P-2 and P-3). Legs will be manifolded inside the remediation enclosure.

4.3. Soil Vapor Extraction

The total design vent flowrate is 100 scfm at a vacuum of 80 inches of water column into two wells (Appendix A, Drawings P-2 and P-3). Each well was designed to carry 50 scfm of air and will be controlled manually at the manifold within the remediation enclosure. Granular activated carbon vessels were included to filter condensate prior to disposal. Extracted air will be vented to the atmosphere, as emissions will be below the thresholds.

4.4. Power Requirements

A 100-Amp 240-Volt 3-Phase electrical service is required to operate the system (Appendix A, Drawing E-1). All equipment will be pre-installed and pre-wired by prior to delivery. Electrical utility company will provide the service and meter and a licensed contractor will connect the service to the main breaker of the remediation enclosure.

4.5. Remediation Enclosure

All equipment will be pre-installed and pre-wired inside an 8-foot wide by 20-foot long by 8.5-foot tall modified cargo steel container with flooring, insulated interior, penetrations for piping, anchor lugs, double rear door, sound-insulated lovers, floor sump, electric heater, ceiling explosion proof lights, wall switch, and fan with thermostat. Electrical wiring will be per National Electrical Code Class I, Division 2, Group D hazardous environment inside enclosure.

4.6. Telemetry

The remediation system will have a telemetry to send and receive alarm condition notifications. In addition, the sparge and vent modules will be interlocked such that sparging module will be shut down in case of SVE module failure.

4.7. Permits

For system construction, the following permits would be required:

- Construction permit
- Electrical permit
- Office of State Engineer well permit

Permits will be obtained once the construction of system is approved and funded under Phase 4 Work Plan.

Air permit will not be required, as emissions are below 10 lb/hr and total mass of contamination was estimated at less than 5,000 pounds (Appendix C, Calculation 1). The majority of contamination will be destroyed in-situ by aerobic biological degradation and emissions rates will decline drastically after a few weeks of system operation.

4.8. Vapor Intrusion Survey

Subsurface soil and groundwater contamination present a potential risk for vapor intrusion (VI) in the onsite mechanic's garage building. To access VI, the following will be completed:

- Subsurface soil vapor concentrations will be collected and compared to the NMED and EPA sub-slab screening levels. For that task, three soil gas samples will be collected from shallow wells placed around the outside perimeter of the building. Wells will be screened at a depth of approximately 5 feet bgs. Soil gas samples will be collected using SUMMA canisters. If soil gas sampling results are below the NMED and EPA sub-slab screening results, the pathway will be considered incomplete and no further evaluation is necessary. If soil gas sampling results exceed the NMED and EPA sub-slab screening levels, sub-slab and indoor soil vapor concentrations will be evaluated.
- If further evaluation is necessary, two temporary sub-slab sampling ports will be installed and sub-slab soil gas samples the indoor air samples will be collected at the same time at

the same locations to differentiate sub-surface soil source from the indoor source. Indoor concentrations may not represent vapor intrusion from subsurface but rather originate with materials used or stored in the building. The results will be compared to the NMED and EPA VI screening levels. If screening levels are below the VI screening levels, the VI pathway will be considered incomplete. If there are exceedances, further indoor air sampling will be conducted in conjunction with O&M of the remediation system until the potential for VI has been eliminated.

5.0 OPERATION, MAINTENANCE, AND MONITORING

Operation and maintenance (O&M), monitoring of the remediation system, troubleshooting, and remediation system performance evaluation are presented in this section.

5.1. Startup

Startup testing will be conducted after system construction. System components will be tested and operating parameters will be evaluated and adjusted for optimal operation. In addition, field parameters will be measured to establish baseline conditions. A system pre-commissioning, functionality, startup, and monitoring items are provided in Tables 7, 8, and 9.

Initially soil vapor concentrations are expected to be elevated but below the threshold for emissions control. Concentrations will subside shortly after start up, as the majority of stagnant soil vapor contamination will be removed within a few pore volume flushes. Process will then become limited by the rate of volatilization.

Right after startup, the system could be operated in SVE-only mode for several weeks, followed by gradual introduction of sparge wells. Vapor concentrations and mass removal rates will be monitored and used to adjust system operation scheme.

If NAPL is present, only SVE will be operated until NAPL is removed. Thereafter, the air sparge wells will be gradually brought online. The exact timing of system initiation will be determined during system operation by assessing presence/absence of NAPL, soil vapor concentrations and mass flow rates and air sparging flow rates. System parameters will be measured periodically throughout the system start up until the system reaches full operation.

5.2. Long Term O&M Plan

Data will be collected during the long term operation and maintenance (O&M) to evaluate the following factors:

- Mass removal and destruction rates
- Cumulative mass removal
- Emission rates
- Operation trends (flow rates, vacuum, etc.)
- Groundwater and soil vapor concentrations
- Progress towards achieving final site cleanup goals

Table 10 lists routine operation and maintenance tasks. Table 11 lists system monitoring requirement. O&M forms are provided in Tables 12 and 13.

A troubleshooting guide will be kept onsite in the equipment compound as well as provided to all field personnel to assist with issues that may arise during O&M, Table 14.

5.3. Monitoring Reports and Performance Assessment

System Operation and Maintenance will be conducted weekly. System performance will be conducted on a quarterly basis. In addition, per NMED PSTB request, monthly system progress reports will be provided. Quarterly monitoring and performance assessment will include the following:

- Groundwater quality data and analysis
- Soil vapor quality data and analysis
- Evaluation of system performance including emission rates, mass removal and destruction rates
- Calculations and graphs of established trends
- A summary of O&M activities performed during the operational period
- Recommendation for improving system performance, if warranted

The system will be maintained in accordance with manufacturer's recommendations and a 90-percent system run time will be used as a performance criterion. The run-time does not include downtime due to force majeure, interruptions in power supply and communication utilities, shutdowns due to scheduled and preventative maintenance and repairs, groundwater monitoring, operational adjustments and shutdowns related to system optimization, regulatory, site owner, tenant, or client-directed shutdown, and other items outside of EA's direct control.

Monitoring scope is presented in Table 11.

6.0 SCHEDULE FOR IMPLEMENTATION

A schedule for implementing the FRP is provided in Appendix E. It is estimated it will take approximately 6 months from the FRP submittal until system startup.

6.1. Implementation

The implementation of the FRP would include the installation of the remediation wells, trenching, piping, backfilling and compaction, installation of the remediation equipment, connecting piping to the manifolds, installation of electrical service, system testing, and system start up. Work will be in accordance with the drawings and specifications provided in this FRP (Appendix A and B).

6.2. Final Site Inspection

Upon completion of the system implementation, a final site inspection will be performed by all involved parties, including NMED PSTB project manager and engineer and EA project manager and engineer. Any deficiencies observed during the site inspection will be noted and corrected.

6.3. As-Built Reporting

After system installation, EA will prepare an As-Built report to document system installation. The report will provide details of the system installation as well as the equipment and materials used. As-built reporting will meet the requirements of NMAC 20.119.1925.D and will include the following:

- Report will be prepared by or under direct supervision of and sealed by Vener Mustafin, NM PE, engineer-of-record.
- Deviations from the drawings and specifications included in the FRP.
- Tabulation of pertinent data including operational parameters, contaminant concentrations, groundwater elevation, soil boring and well construction diagrams.
- Information and documentation regarding major remediation equipment.

6.4. System Optimization

System optimization will be performed in accordance with the results of the system performance and coordinated with the NMED PSTB. As remediation rates change, operational rates will be adjusted to optimize system performance and effectiveness and maximize remediation rates. Optimization actions will be discussed and coordinated with the NMED PSTB. Table 15 summarizes optimization goals, optimum conditions, means of data collection and contingency plan steps. Table 16 summarizes contingency plan measures in case of changed conditions.

The following optimization steps are likely to be performed during system operation:

- Initially, SVE module maybe be operated for several weeks until concentrations decrease to allow sparge module to be started.
- Initially, sparge wells will be operated intermittently and SVE soil vapor concentrations monitored. Duration and a number of wells would be adjusted based on soil vapor concentrations.
- As remediation progresses, sparge flowrate rates and pressure, cycling of various sparge wells may be adjusted based on soil vapor concentrations, groundwater contaminant concentrations, dissolved oxygen concentrations, and groundwater upwelling.
- SVE rates may be adjusted based on soil vapor concentrations and upwelling.
- Shutting of individual remediation wells may be considered when target concentrations decline to below remediation goals for an extended period.
- Intermittent system operation could be considered during asymptotic state of mass removal.
- Monitored natural attenuation could be considered when operation of system becomes impractical relative to mass removal.
- Treatment of recalcitrant zones using other technologies could be considered, if necessary.

7.0 SYSTEM EVALUATION

In accordance with NMAC 20.5.119.1927, the effectiveness of the remediation system will be evaluated annually. The evaluation will contain the following elements

- Analysis of the trend of contaminant concentration in vapor and groundwater phases
- Evaluation of mass of contamination removed and destroyed in-situ
- Estimation of trends for mass removal rates
- Evaluation of the effectiveness of the remediation system based on system performance
- Estimation of time to achieve remediation goals
- Recommendations for system adjustments

8.0 PUBLIC NOTICE

In accordance with NMAC 20.5.119.1923.D.10, a public notice will be publish upon submittal of this FRP, as follows:

- Twice in a paper of general circulation in Socorro County
- Certified copies of the notice mailed to adjacent property owners
- Notice posted at the site and prominently displayed

A copy of the notice is provided in the Appendix F. Notice was published in El Defensor Chieftain of Socorro County on June 20, 2019 and on July 11, 2019. Affidavits of publication are provided in Appendix F.

TABLES

TABLE 1. SUMMARY OF GROUNDWATER GAUGING DATA
FORMER PHILLIPS 66, SOCORRO, NEW MEXICO

Monitor Well	Date Measured	Northing[1]	Easting[1]	Casing Elevation[2]	Depth to Product[3]	Product Thickness[4]	Depth to Water[3]	Groundwater Elevation[2]
MW-1A	3/11/2003	---	---	4596.83	Well Destroyed			
	10/12/2000				---	---	12.77	4584.06
	1/6/2000				---	---	12.78	4584.05
	10/5/1999				---	---	13.13	4583.70
	7/8/1999				---	---	13.15	4583.68
	3/30/1999				---	---	12.84	4583.99
	9/24/1998				---	---	13.02	4583.81
	5/6/1998				---	---	12.75	4584.08
MW-2A	12/18/2018	1,113,994.4	1,445,918.6	4596.97	---	---	12.62	4584.35
	8/17/2016				---	---	12.61	4584.36
	8/9/2016				---	---	14.59	4582.38
	2/2/2016				---	---	12.00	4584.97
	1/18/2015				---	---	12.35	4584.62
	6/12/2014				---	---	12.63	4584.34
	5/18/2012				---	---	12.15	4584.82
	7/6/2011				---	---	12.73	4584.24
	2/16/2011				---	---	12.36	4584.61
	5/13/2010				---	---	12.06	4584.91
	10/20/2009				---	---	12.50	4584.47
	3/5/2008				---	---	12.30	4584.67
	12/27/2007				---	---	12.37	4584.60
	8/21/2007				---	---	13.06	4583.91
	4/10/2007				---	---	12.01	4584.96
	10/25/2006				---	---	12.52	4584.45
	7/5/2006				---	---	13.54	4583.43
	4/21/2006				---	---	13.12	4583.85
	1/11/2006				---	---	12.92	4584.05
	5/25/2005				---	---	12.88	4584.09
	2/17/2005				---	---	12.74	4584.23
	11/19/2004				---	---	13.16	4583.81
	8/5/2004				---	---	13.52	4583.45
	3/11/2003				---	---	12.72	4584.25
	10/12/2000				---	---	12.98	4583.99
	1/6/2000				---	---	12.99	4583.98
	10/5/1999				---	---	13.11	4583.86
	7/8/1999				---	---	13.13	4583.84
	3/30/1999				---	---	12.83	4584.14
	9/24/1998				---	---	13.22	4583.75
	5/6/1998				---	---	12.72	4584.25
MW-3A	12/19/2018	1,114,084.1	1,445,840.7	4597.97	---	---	13.47	4584.50
	8/17/2016				---	---	13.47	4584.50
	8/9/2016				---	---	13.45	4584.52
	2/2/2016				---	---	12.84	4585.13
	1/18/2015				---	---	13.20	4584.77
	6/12/2014				---	---	13.46	4584.51
	5/18/2012				---	---	13.04	4584.93
	7/6/2011				---	---	13.63	4584.34
	2/16/2011				---	---	13.42	4584.55
	5/13/2010				---	---	12.93	4585.04
	10/20/2009				---	---	13.39	4584.58

TABLE 1. SUMMARY OF GROUNDWATER GAUGING DATA
FORMER PHILLIPS 66, SOCORRO, NEW MEXICO

Monitor Well	Date Measured	Northing[1]	Easting[1]	Casing Elevation[2]	Depth to Product[3]	Product Thickness[4]	Depth to Water[3]	Groundwater Elevation[2]
MW-3A	3/5/2008				---	---	13.11	4584.86
	12/27/2007				---	---	13.24	4584.73
	8/21/2007				---	---	13.95	4584.02
	4/10/2007				---	---	12.91	4585.06
	10/25/2006				---	---	13.47	4584.50
	7/5/2006				---	---	14.51	4583.46
	4/21/2006				---	---	14.09	4583.88
	1/11/2006				---	---	13.78	4584.19
	5/25/2005				---	---	13.80	4584.17
	2/17/2005				---	---	13.64	4584.33
	11/19/2004				---	---	14.05	4583.92
	8/5/2004				---	---	14.47	4583.50
	3/11/2003				---	---	13.63	4584.34
	10/12/2000				---	---	14.02	4583.95
	1/6/2000				---	---	13.87	4584.10
	10/5/1999				---	---	14.13	4583.84
	7/8/1999				---	---	14.18	4583.79
	3/30/1999				---	---	13.84	4584.13
	9/24/1998				---	---	14.20	4583.77
	5/6/1998				---	---	13.78	4584.19
MW-4A	12/19/2018	1,114,024.4	1,445,972.8	4,596.56	---	---	12.10	4584.46
	8/17/2016				---	---	12.12	4584.44
	8/9/2016				---	---	12.11	4584.45
	3/3/2016				---	---	11.47	4585.09
	2/2/2016				No Access			
	1/18/2015				---	---	11.82	4584.74
	6/12/2014				---	---	12.11	4584.45
	5/18/2012				---	---	11.62	4584.94
	7/6/2011				---	---	12.23	4584.33
	2/16/2011				---	---	12.68	4583.88
	5/13/2010				No Access			
	10/20/2009				---	---	11.80	4584.76
	3/5/2008				---	---	11.76	4584.80
	12/27/2007				---	---	11.83	4584.73
	8/21/2007				---	---	12.55	4584.01
	4/10/2007				---	---	11.48	4585.08
	10/25/2006				---	---	11.97	4584.59
	7/5/2006				---	---	13.00	4583.56
	4/21/2006				---	---	12.60	4583.96
	1/11/2006				---	---	12.39	4584.17
	5/25/2005				---	---	12.34	4584.22
	2/17/2005				---	---	12.22	4584.34
	11/19/2004				---	---	12.62	4583.94
	8/5/2004				---	---	12.99	4583.57
	3/11/2003				---	---	12.20	4584.36
	10/12/2000				---	---	12.46	4584.10
	1/6/2000				---	---	12.47	4584.09
	10/5/1999				---	---	12.62	4583.94

TABLE 1. SUMMARY OF GROUNDWATER GAUGING DATA
FORMER PHILLIPS 66, SOCORRO, NEW MEXICO

Monitor Well	Date Measured	Northing[1]	Easting[1]	Casing Elevation[2]	Depth to Product[3]	Product Thickness[4]	Depth to Water[3]	Groundwater Elevation[2]
MW-4A	7/8/1999				---	---	12.60	4583.96
	3/30/1999				---	---	12.33	4584.23
	9/24/1998				---	---	12.66	4583.90
	5/6/1998				---	---	12.23	4584.33
MW-5A	8/17/2016	1,114,184.3	1,445,918.2	4596.84	---	---	11.79	4585.05
	8/9/2016				---	---	11.73	4585.11
	2/2/2016				---	---	11.10	4585.74
	1/18/2015				---	---	11.46	4585.38
	6/12/2014				---	---	11.72	4585.12
	7/6/2011				---	---	11.85	4584.99
	5/13/2010				---	---	11.22	4585.62
	10/20/2009				---	---	11.66	4585.18
MW-6A	8/17/2016	1,114,232.1	1,445,906.2	4596.72	---	---	11.57	4585.15
	8/9/2016				---	---	11.47	4585.25
	3/3/2016				---	---	10.93	4585.79
	2/2/2016				---	---	10.99	4585.73
	1/18/2015				---	---	11.24	4585.48
	6/12/2014				---	---	11.29	4585.43
	7/6/2011				---	---	11.54	4585.18
	5/13/2010				---	---	11.00	4585.72
	10/20/2009				---	---	11.52	4585.20
MW-7A	3/11/2003	---	---	4596.71	Well Destroyed			
	10/12/2000				---	---	12.74	4583.97
	1/6/2000				---	---	12.78	4583.93
	10/5/1999				---	NAPL	13.00	4583.71
	7/8/1999				---	NAPL	13.03	4583.68
	3/30/1999				---	NAPL	12.45	4584.26
	9/24/1998				---	---	12.80	4583.91
	5/6/1998				---	---	12.27	4584.44
MW-8	12/19/2018	1,114,058.3	1,445,939.7	4,597.41	---	---	12.95	4584.46
	8/17/2016				---	---	12.95	4584.46
	8/9/2016				---	---	12.94	4584.47
	2/2/2016				---	---	12.31	4585.10
	1/18/2015				---	---	12.66	4584.75
	6/12/2014				---	---	12.91	4584.50
	5/18/2012				---	---	12.42	4584.99
	7/6/2011				---	---	13.06	4584.35
	2/16/2011				---	---	12.72	4584.69
	5/13/2010				---	---	12.37	4585.04
	10/20/2009				---	---	12.83	4584.58
	3/5/2008				---	---	12.58	4584.83
	12/27/2007				---	---	12.68	4584.73
	8/21/2007				---	---	13.39	4584.02
	4/10/2007				---	---	12.33	4585.08
	10/25/2006				---	---	12.83	4584.58
	7/5/2006				---	---	13.87	4583.54
	4/21/2006				---	---	13.46	4583.95
	1/11/2006				---	---	13.21	4584.20

TABLE 1. SUMMARY OF GROUNDWATER GAUGING DATA
FORMER PHILLIPS 66, SOCORRO, NEW MEXICO

Monitor Well	Date Measured	Northing[1]	Easting[1]	Casing Elevation[2]	Depth to Product[3]	Product Thickness[4]	Depth to Water[3]	Groundwater Elevation[2]
MW-8A	5/25/2005				---	---	13.20	4584.21
	2/17/2005				Obstruction in Well			
	11/19/2004				---	---	13.48	4583.93
	8/5/2004				---	---	13.82	4583.59
	3/11/2003				---	---	13.01	4584.40
	10/12/2000				---	---	13.31	4584.10
	1/6/2000				---	---	13.27	4584.14
	10/5/1999				---	---	13.43	4583.98
	7/8/1999				---	---	13.46	4583.95
	3/30/1999				---	---	13.12	4584.29
	9/24/1998				---	---	13.55	4583.86
	5/6/1998				---	---	13.17	4584.24
MW-10A	12/18/2018	1,113,977.8	1,445,797.2	4597.80	---	---	13.72	4584.08
	8/17/2016				---	---	13.78	4584.02
	8/9/2016				---	---	13.74	4584.06
	2/2/2016				---	---	13.09	4584.71
	1/18/2015				---	---	13.57	4584.23
	6/12/2014				---	---	13.66	4584.14
	5/18/2012				---	---	13.35	4584.45
	7/6/2011				---	---	13.91	4583.89
	2/16/2011				---	---	13.49	4584.31
	5/13/2010				---	---	13.15	4584.65
	10/20/2009				---	---	13.71	4584.09
	3/5/2008				---	---	13.42	4584.38
	12/27/2007				---	---	13.56	4584.24
	8/21/2007				---	---	14.24	4583.56
	4/10/2007				---	---	13.17	4584.63
	10/25/2006				---	---	13.89	4583.91
	7/5/2006				---	---	14.95	4582.85
	4/21/2006				---	---	14.48	4583.32
	1/11/2006				---	---	14.10	4583.70
	5/25/2005				---	---	14.22	4583.58
	2/17/2005				---	---	13.98	4583.82
	11/19/2004				---	---	14.43	4583.37
	8/5/2004				---	---	14.94	4582.86
	3/11/2003				---	---	13.99	4583.81
	10/12/2000				---	---	14.38	4583.42
	1/6/2000				---	---	14.22	4583.58
	10/5/1999				---	---	14.57	4583.23
MW-13[5]	12/19/2018	1,114,137.5	1,445,912.9	4,596.51	---	---	11.96	4584.55
	8/17/2016				---	---	11.96	4584.55
	8/9/2016				---	---	11.94	4584.57
	2/2/2016				---	---	11.33	4585.18
	1/18/2015				---	---	11.69	4584.82
	6/12/2014				---	---	11.95	4584.56
	5/18/2012				---	---	11.48	4585.03
	7/6/2011				---	---	12.10	4584.41
	2/16/2011				---	---	11.76	4584.75

TABLE 1. SUMMARY OF GROUNDWATER GAUGING DATA
FORMER PHILLIPS 66, SOCORRO, NEW MEXICO

Monitor Well	Date Measured	Northing[1]	Easting[1]	Casing Elevation[2]	Depth to Product[3]	Product Thickness[4]	Depth to Water[3]	Groundwater Elevation[2]
MW-13[5]	5/13/2010				---	---	12.42	4584.09
	10/20/2009				---	---	11.87	4584.64
	3/5/2008				---	---	11.64	4584.87
	12/27/2007				---	---	11.76	4584.75
	8/21/2007				---	---	12.41	4584.10
	4/10/2007				---	---	11.38	4585.13
	10/25/2006				---	---	11.91	4584.60
	7/5/2006				---	---	12.97	4583.54
	4/21/2006				---	---	12.56	4583.95
	1/11/2006				---	---	12.31	4584.20
	5/25/2005				---	---	12.28	4584.23
	2/17/2005				---	---	11.14	4585.37
	11/19/2004				---	---	12.55	4583.96
	8/5/2004				---	---	12.92	4583.59
	3/12/2003				---	---	12.15	4584.36
MW-14	12/19/2016	1,114,084.2	1,445,941.9	4596.77	---	---	12.30	4584.47
	8/17/2016				---	---	12.30	4584.47
	8/9/2016				---	---	12.32	4584.45
	2/2/2016				---	---	11.67	4585.10
	1/18/2015				---	---	12.02	4584.75
	6/12/2014				---	---	12.29	4584.48
	5/18/2012				---	---	11.81	4584.96
	7/6/2011				---	---	12.44	4584.33
	2/16/2011				---	---	12.09	4584.68
	5/13/2010				---	---	11.75	4585.02
	10/20/2009				---	---	12.21	4584.56
	3/5/2008				---	---	11.97	4584.80
	12/27/2007				No Access			
	8/21/2007				---	---	12.78	4583.99
	4/10/2007				---	---	11.73	4585.04
	10/25/2006				---	---	12.22	4584.55
	7/5/2006				---	---	13.29	4583.48
	4/21/2006				---	---	12.88	4583.89
	1/11/2006				---	---	12.63	4584.14
	5/25/2005				---	---	12.61	4584.16
	2/17/2005				---	---	12.46	4584.31
	11/19/2004				---	---	12.88	4583.89
	8/5/2004				---	---	13.26	4583.51
	3/12/2003				---	---	12.52	4584.25
MW-15[5]	12/19/2018	1,114,064.1	1,445,966.4	4,596.64	---	---	12.19	4584.45
	8/17/2016				---	---	12.21	4584.43
	8/9/2016				---	Sheen	12.21	4584.43
	2/2/2016				---	Sheen	11.57	4585.07
	1/18/2015				---	Light Sheen	11.92	4584.72
	6/12/2014				---	Sheen	12.19	4584.45
	5/18/2012				---	---	11.72	4584.92
	7/6/2011				---	---	12.33	4584.31
	2/16/2011				---	---	11.99	4584.65

TABLE 1. SUMMARY OF GROUNDWATER GAUGING DATA
FORMER PHILLIPS 66, SOCORRO, NEW MEXICO

Monitor Well	Date Measured	Northing[1]	Easting[1]	Casing Elevation[2]	Depth to Product[3]	Product Thickness[4]	Depth to Water[3]	Groundwater Elevation[2]
MW-15[5]	5/13/2010				---	---	11.65	4584.99
	10/20/2009				---	---	12.10	4584.54
	3/5/2008				---	---	11.85	4584.79
	12/27/2007				---	---	11.96	4584.68
	8/21/2007				---	---	12.66	4583.98
	4/10/2007				---	---	11.62	4585.02
	10/25/2006				---	---	12.11	4584.53
	7/5/2006				---	---	13.12	4583.52
	4/21/2006				---	---	12.72	4583.92
	1/11/2006				---	---	12.48	4584.16
	5/25/2005				---	---	12.47	4584.17
	2/17/2005				---	---	12.32	4584.32
	11/19/2004				---	---	12.76	4583.88
	8/5/2004				---	---	13.10	4583.54
	3/12/2003				---	---	12.32	4584.32
MW-16	12/19/2018	1,114,195.3	1,446,012.4	4596.36	---	---	11.24	4585.12
	8/17/2016				---	---	11.17	4585.19
	8/9/2016				---	---	11.06	4585.30
	2/2/2016				---	---	10.53	4585.83
	1/18/2015				---	---	10.92	4585.44
	6/12/2014				---	---	11.14	4585.22
MW-17	12/19/2018	1,114,109.1	1,446,019.3	4596.80	---	---	12.20	4584.60
	8/17/2016				---	---	12.21	4584.59
	8/9/2016				---	---	12.18	4584.62
	2/2/2016				---	---	11.58	4585.22
	1/18/2015				---	---	11.91	4584.89
	6/12/2014				---	---	12.18	4584.62
SVE-1	12/19/2018	---	---	---	---	---	13.60	---
SVE-2	12/19/2018	---	---	---	---	---	12.60	---

NOTES:

[1] Horizontal control to NM State Plane Coordinates Central NAD83 Grid Coordinates (in feet).

[2] Vertical Control to NAVD88 Datum in feet above mean sea level.

[3] Measured in feet below the top of casing at survey point on north side of well.

[4] Measured in feet.

[5] Replacement wells installed (MW-13 for MW-1A; MW-15 for MW-7).

TABLE 2. SUMMARY OF SOIL ANALYTICAL RESULTS
FORMER PHILLIPS 66, SOCORRO, NEW MEXICO

Sample ID	Zone	Sampling Date	Benzene	Toluene	Ethylbenzene	MTBE	EDB	EDC	Xylenes	Total Naphthalenes
SSL DAF 1			***0.0019***	***0.607***	***0.0132***	***0.0277***	***0.0000176***	***0.000407***	***0.148***	***0.00411***
SSL DAF 20			***0.038***	***12.1***	***0.264***	***0.053***	***0.000352***	***0.00814***	***2.97***	***0.0823***
AS-1/SVE-1 4'	Vadose Zone	12/18/2018	<0.017	<0.034	<0.034	<0.034	<0.034	<0.034	<0.068	<0.14
AS-1/SVE-1 15'-17'	Saturated Zone	12/18/2018	**0.42**	<0.14	**8.9**	<0.14	<0.14	<0.14	**15**	**19.9**
SVE-2 10'	Vadose Zone	12/17/2018	<0.014	<0.028	<0.028	<0.028	<0.028	<0.028	<0.055	<0.11
SVE-2 15'	Saturated Zone	12/17/2018	**0.30**	<0.28	**8.6**	<0.28	<0.28	<0.28	<0.56	**7.9**

Notes:
Samples were analyzed by EPA Method 8260B.
Sampling results are reported in milligrams per kilogram.
Soil Screening Levels are tabulated risk-based values for leaching to groundwater "*NMED Risk Assessment Guidelines for Site Investigations and Remediation, Table A-1. March 2017.*"
Bolded red values indicate concentrations above SSLs.
DAF Dilution attenuation factor
SSL Soil Screening Level

TALBE 3. SUMMARY OF SOIL GAS ANALYTICAL RESULTS
FORMER PHILLIPS 66, SOCORRO, NEW MEXICO

		Concentrations, C									
Well ID	**Sampling Date**	**Benzene**	**Toluene**	**Ethylbenzene**	**Xylenes**	**BTEX**	**TPH-G**	**Oxygen**	**Nitrogen**	**Methane**	**Carbon Dioxide**
		μg/L	μg/L	μg/L	μg/L	μg/L	μg/L	%	%	%	%
SVE-1	1/2/2019	130	7.0	7.8	2.6	147	8,700	10	83	0.41	6.2
SVE-2	1/3/2019	340	39	150	31	560	27,000	21	78	0.14	0.42

Notes:
* Total removal mass is limited by the residual mass of contamination.

μg/L micrograms per liter
BTEX benzene, toluene, ethylbenzene, xylenes
TPH-G Total Petroleum Hydrocarbons - Gasoline Range

TABLE 4. SUMMARY OF GROUNDWATER CONTAMINANT ANALYTICAL RESULTS
FORMER PHILLIPS 66, SOCORRO, NEW MEXICO

Well Number	Date Sampled	Benzene	Toluene	Ethyl Benzene	Xylenes	MTBE	EDB	EDC	Total Naphthalenes
Standard		***5***	***1,000***	***700***	***620***	***100***	***0.1***	***10***	***30***
MW-1A	3/11/2003	Well Destroyed							
	10/12/2000	**8.7**	35	7	46	**530**	BD	BD	8.1
	1/6/2000	BD	1.1	BD	2.9	**560**	BD	0.4	NA
	10/5/1999	BD	BD	BD	BD	**580**	BD	0.4	NA
	7/8/1999	BD	BD	BD	BD	**550**	BD	0.3	NA
	3/30/1999	15	58	25	81	**520**	BD	0.5	NA
	5/6/1998	**8.7**	26	14	41	**650**	BD	BD	NA
MW-2A	12/18/2018	<1.0	<1.0	<1.0	<1.5	**100**	<1.0	<1.0	<4.0
	8/9/2016	<1.0	<1.0	<1.0	<1.5	**130**	<1.0	<1.0	<4.0
	2/2/2016	<1.0	<1.0	<1.0	<1.5	**200**	<1.0	<1.0	<4.0
	1/18/2015	<1.0	<1.0	<1.0	<1.5	**180**	<1.0	<1.0	<4.0
	6/10/2014	<1.0	<1.0	<1.0	<1.5	**350**	<1.0	<1.0	<4.0
	5/18/2012	<2.0	<2.0	<2.0	<4.0	**430**	NA	NA	NA
	7/6/2011	<1.0	<1.0	<1.0	<2.0	**260**	NA	NA	NA
	2/16/2011	<1.0	<1.0	<1.0	<2.0	**310**	NA	NA	NA
	5/13/2010	<1.0	<1.0	<1.0	<2.0	**280**	NA	NA	NA
	10/20/2009	<1.0	<1.0	<1.0	<2.0	**230**	NA	NA	NA
	3/5/2008	<0.5	<0.5	<0.5	<2.0	**200**	NA	NA	NA
	12/27/2007	<1.0	<1.0	<1.0	<2.0	**160**	NA	NA	NA
	8/21/2007	<0.5	<0.5	<0.5	<2.0	99	NA	NA	NA
	10/25/2006	<1.0	<1.0	<1.0	<2.0	**160**	<1.0	<1.0	<5.0
	7/5/2006	<1.0	<1.0	<1.0	<2.0	**250**	<1.0	<1.0	<1.0
	4/21/2006	<1.0	<1.0	<1.0	<2.0	84	<1.0	<1.0	<1.0
	1/11/2006	<1.0	<1.0	<1.0	<2.0	57	<1.0	<1.0	<1.0
	5/25/2005	<1.0	<1.0	<1.0	<1.0	99	<1.0	<1.0	<1.0
	2/17/2005	<1.0	<1.0	<1.0	<1.0	81	<1.0	<1.0	<1.0
	11/19/2004	<1.0	<1.0	<1.0	<1.0	**170**	<1.0	<1.0	<1.0
	8/5/2004	<1.0	<1.0	<1.0	<1.0	**290**	<1.0	<1.0	<1.0
	3/11/2003	<1.0	<1.0	<1.0	<1.0	**200**	<1.0	<1.0	<5.0
	10/12/2000	BD	BD	BD	BD	**170**	BD	BD	BD
	1/6/2000	BD	BD	BD	BD	**110**	BD	BD	NA
	10/5/1999	BD	BD	BD	BD	**100**	BD	BD	NA
	7/8/1999	BD	BD	BD	BD	**120**	BD	BD	NA
	3/30/1999	0.6	BD	BD	BD	92	BD	BD	NA
	5/6/1998	BD	BD	BD	BD	BD	BD	BD	NA
MW-3A	12/19/2018	<1.0	<1.0	<1.0	<1.5	**180**	<1.0	<1.0	<4.0
	8/9/2016	<1.0	<1.0	<1.0	<1.5	**130**	<1.0	<1.0	<4.0
	2/2/2016	<1.0	<1.0	<1.0	<1.5	**140**	<1.0	<1.0	<4.0
	1/18/2015	<1.0	<1.0	<1.0	<1.5	**130**	<1.0	<1.0	<4.0
	6/10/2014	<1.0	<1.0	<1.0	<1.5	**140**	<1.0	<1.0	<4.0
	5/18/2012	<2.0	<2.0	<2.0	<4.0	**290**	NA	NA	NA
	7/6/2011	<1.0	<1.0	<1.0	<2.0	**250**	NA	NA	NA
	2/16/2011	1.1	<1.0	<1.0	<2.0	**360**	NA	NA	NA
	5/13/2010	<1.0	<1.0	<1.0	<2.0	**330**	NA	NA	NA
	10/20/2009	<1.0	<1.0	<1.0	<2.0	**400**	NA	NA	NA
	3/5/2008	<0.5	<0.5	<0.5	<2.0	**360**	NA	NA	NA
	12/27/2007	<5.0	<5.0	<5.0	<10.0	**410**	NA	NA	NA
	8/21/2007	<0.5	<0.5	<0.5	<2.0	**410**	NA	NA	NA

TABLE 4. SUMMARY OF GROUNDWATER CONTAMINANT ANALYTICAL RESULTS
FORMER PHILLIPS 66, SOCORRO, NEW MEXICO

Well Number	Date Sampled	Benzene	Toluene	Ethyl Benzene	Xylenes	MTBE	EDB	EDC	Total Naphthalenes
Standard		***5***	***1,000***	***700***	***620***	***100***	***0.1***	***10***	***30***
MW-3A	10/25/2006	<1.0	<1.0	<1.0	<2.0	**350**	<1.0	<1.0	<5.0
	7/5/2006	<1.0	<1.0	<1.0	<2.0	**300**	<1.0	<1.0	<5.0
	4/21/2006	<1.0	<1.0	<1.0	<2.0	**220**	<1.0	<1.0	<5.0
	1/11/2006	<1.0	<1.0	<1.0	<2.0	**400**	<1.0	<1.0	<5.0
	5/25/2005	<1.0	<1.0	<1.0	<1.0	**290**	<1.0	<1.0	<5.0
	2/17/2005	<1.0	<1.0	<1.0	<1.0	**360**	<1.0	<1.0	<5.0
	11/19/2004	<1.0	<1.0	<1.0	<1.0	**290**	<1.0	<1.0	<5.0
	8/5/2004	<1.0	<1.0	<1.0	<1.0	**340**	<1.0	<1.0	<5.0
	3/11/2003	<1.0	<1.0	<1.0	<1.0	**240**	<1.0	<1.0	<5.0
	10/12/2000	BD	BD	BD	BD	**310**	BD	BD	BD
	1/6/2000	BD	BD	BD	BD	**570**	BD	0.4	NA
	10/5/1999	<2.5	<2.5	<2.5	<2.5	**580**	<5.0	<1.0	NA
	7/8/1999	BD	BD	BD	BD	**590**	BD	0.4	NA
	3/30/1999	BD	BD	BD	BD	**580**	BD	0.6	NA
	5/6/1998	BD	BD	BD	BD	**770**	BD	BD	NA
MW-4A	12/19/2018	<1.0	<1.0	<1.0	<1.5	**170**	<1.0	<1.0	<4.0
	8/10/2016	<1.0	<1.0	<1.0	<1.5	**180**	<1.0	<1.0	<4.0
	3/3/2016	**8.9**	<1.0	<1.0	<1.5	**190**	<1.0	<1.0	<4.0
	2/2/2016	No Access							
	1/18/2015	<1.0	<1.0	<1.0	<1.5	**290**	<1.0	<1.0	<4.0
	6/10/2014	1.2	<1.0	<1.0	<1.5	**420**	<1.0	<1.0	<4.0
	5/18/2012	<2.0	3.8	<2.0	<4.0	**430**	NA	NA	NA
	7/6/2011	5.3	<2.0	<2.0	<4.0	**330**	NA	NA	NA
	2/16/2011	<1.0	2.3	1.7	<2.0	**330**	NA	NA	NA
	5/13/2010	<1.0	<1.0	<1.0	<2.0	**240**	NA	NA	NA
	10/20/2009	<10	<10	<10	<20	**270**	NA	NA	NA
	3/5/2008	<5.0	<5.0	<5.0	<20	**230**	NA	NA	NA
	12/27/2007	<5.0	<5.0	<5.0	<10	**240**	NA	NA	NA
	8/21/2007	<0.5	<0.5	<0.5	<2.0	**210**	NA	NA	NA
	10/25/2006	<1.0	<1.0	<1.0	<2.0	**330**	<1.0	<1.0	16.4
	7/5/2006	<1.0	<1.0	<1.0	<2.0	**400**	<1.0	<1.0	<5.0
	4/21/2006	<1.0	<1.0	<1.0	<2.0	**380**	<1.0	<1.0	<5.0
	1/11/2006	<5.0	<5.0	<5.0	<10	**250**	<5.0	<5.0	<25
	5/25/2005	2.3	<1.0	<1.0	<1.0	**270**	<1.0	<1.0	<5.0
	2/17/2005	<1.0	<1.0	<1.0	<1.0	**270**	<1.0	<1.0	<5.0
	11/19/2004	<1.0	<1.0	<1.0	<1.0	**230**	<1.0	<1.0	<5.0
	8/5/2004	<1.0	<1.0	<1.0	<1.0	**320**	<1.0	<1.0	<5.0
	3/11/2003	<1.0	<1.0	<1.0	<1.0	**420**	<1.0	<1.0	<5.0
	10/12/2000	<5.0	<5.0	<5.0	<5.0	**410**	<5.0	<5.0	<30
	3/30/1999	**9.9**	BD	BD	0.6	**340**	BD	1.4	NA
	5/6/1998	**260**	BD	BD	BD	**370**	BD	BD	NA
MW-5A	8/9/2016	<1.0	<1.0	<1.0	<1.5	11	<1.0	<1.0	<4.0
	2/2/2016	<1.0	<1.0	<1.0	<1.5	15	<1.0	<1.0	<4.0
	1/18/2015	<1.0	<1.0	<1.0	<1.5	17	<1.0	<1.0	<4.0
	6/10/2014	<1.0	<1.0	<1.0	<1.5	19	<1.0	<1.0	<4.0
	5/13/2010	<1.0	<1.0	<1.0	<1.5	57	<1.0	<1.0	<4.0
	10/20/2009	<1.0	<1.0	<1.0	<1.5	11	<1.0	<1.0	<4.0
MW-6A	8/9/2016	<1.0	<1.0	<1.0	<1.5	<1.0	<1.0	<1.0	<4.0

TABLE 4. SUMMARY OF GROUNDWATER CONTAMINANT ANALYTICAL RESULTS
FORMER PHILLIPS 66, SOCORRO, NEW MEXICO

Well Number	Date Sampled	Benzene	Toluene	Ethyl Benzene	Xylenes	MTBE	EDB	EDC	Total Naphthalenes
Standard		***5***	***1,000***	***700***	***620***	***100***	***0.1***	***10***	***30***
MW-6A	3/3/2016	<1.0	<1.0	<1.0	<1.5	4.4	<1.0	<1.0	<4.0
	2/2/2016	Not Sampled							
	1/18/2015	Not Sampled							
	6/10/2014	Not Sampled							
	5/13/2010	<1.0	<1.0	<1.0	<1.5	<1.0	<1.0	<1.0	<4.0
	10/20/2009	<1.0	<1.0	<1.0	<1.5	1.2	<1.0	<1.0	<4.0
MW-7A	3/11/2003	Well Destroyed							
	10/12/2000	**6,000**	**7,400**	**2,200**	**8,100**	**250**	<100	<100	**<1,070**
	1/6/2000	NAPL							
	10/5/1999	NAPL							
	7/8/1999	NAPL							
	3/30/1999	NAPL							
	8/1/1994	**4,400**	**26,000**	**6,800**	**30,000**	**9,200**	BD	42	NA
MW-8	12/19/2018	**1,100**	20	34	<15	**110**	<10	<10	**559**
	8/10/2016	**1,900**	29	46	36	**110**	<1.0	<1.0	**611**
	2/2/2016	**1,600**	14	27	17	88	<1.0	<1.0	**294**
	1/18/2015	**3,000**	24	39	53	**160**	<10	<10	**530**
	6/10/2014	**3,600**	25	53	47	**340**	<1.0	<1.0	**532**
	5/18/2012	**3,400**	25	42	44	**200**	<10	<10	**372**
	7/6/2011	**3,300**	26	44	56	**200**	<10	<10	**330**
	2/16/2011	**4,100**	22	33	64	**300**	<10	<10	**270**
	5/13/2010	**3,800**	17	27	44	**250**	<10	<10	**220**
	10/20/2009	**5,600**	32	59	68	**360**	<10	<10	**609**
	3/5/2008	**4,900**	16	46	27	**440**	<5.0	110	**434**
	12/27/2007	**5,100**	15	44	26	**350**	<1.0	<1.0	**204**
	8/21/2007	**94**	<1.0	1.1	3.1	5.8	<1.0	<1.0	6.6
	4/10/2007	**3,500**	<50	<50	<100	**190**	<50	82	**150**
	10/25/2006	**4,000**	34	57	156	**290**	<5.0	120	**561**
	7/5/2006	**3,300**	17	54	31	**280**	<5.0	<5.0	**495**
	4/21/2006	**3,300**	12	33	29	**280**	<5.0	<5.0	**321**
	1/11/2006	**3,300**	11	31	23	**310**	<5.0	<5.0	**592**
	5/25/2005	**3,800**	16	55	63	**290**	<5.0	<5.0	**514**
	2/17/2005	NA	NA	NA	NA	NA	NA	NA	NA
	11/19/2004	**3,400**	11	32	<34	**450**	<5.0	<25	**476**
	8/5/2004	**4,700**	16	53	59	**460**	<5.0	<5.0	**699**
	3/11/2003	**7,500**	35	97	71	**580**	<1.0	<1.0	**619**
	10/12/2000	**6,800**	140	160	120	**360**	<100	<100	**<600**
	1/6/2000	**8,500**	63	120	120	**540**	<40	<8.0	NA
	10/5/1999	**8,000**	34	220	150	**510**	<40	<8.0	NA
	7/8/1999	**7,100**	71	240	160	**570**	<40	<8.0	NA
	3/30/1999	**9,500**	65	330	260	**950**	<20	<4.0	NA
	5/6/1998	**9,500**	BD	490	**720**	**1,400**	BD	BD	NA
	8/1/1994	**740**	35	320	550	**100**	BD	BD	NA
MW-10A	12/18/2018	<1.0	<1.0	<1.0	<1.5	69	<1.0	<1.0	<4.0
	8/9/2016	<1.0	<1.0	<1.0	<1.5	41	<1.0	<1.0	<4.0
	2/2/2016	<1.0	<1.0	<1.0	<1.5	8.9	<1.0	<1.0	<4.0
	1/18/2015	<1.0	<1.0	<1.0	<1.5	9.8	<1.0	<1.0	<4.0
	6/10/2014	<2.0	<2.0	<2.0	<3.0	<2.0	<2.0	<2.0	<8.0

TABLE 4. SUMMARY OF GROUNDWATER CONTAMINANT ANALYTICAL RESULTS
FORMER PHILLIPS 66, SOCORRO, NEW MEXICO

Well Number	Date Sampled	Benzene	Toluene	Ethyl Benzene	Xylenes	MTBE	EDB	EDC	Total Naphthalenes
Standard		***5***	***1,000***	***700***	***620***	***100***	***0.1***	***10***	***30***
MW-10A	5/18/2012	<2.0	,2.0	<2.0	<4.0	49	NA	NA	NA
	7/6/2011	<2.0	,2.0	<2.0	<4.0	29	NA	NA	NA
	2/16/2011	<1.0	<1.0	<1.0	<2.0	55	NA	NA	NA
	5/13/2010	<1.0	<1.0	<1.0	<2.0	9.9	NA	NA	NA
	10/20/2009	<1.0	<1.0	<1.0	<2.0	32	NA	NA	NA
	3/5/2008	<0.5	<0.5	<0.5	<2.0	20	NA	NA	NA
	12/27/2007	<1.0	<1.0	<1.0	<2.0	36	NA	NA	NA
	8/21/2007	<0.5	<0.5	<0.5	<2.0	2.2	NA	NA	NA
	10/25/2006	<1.0	<1.0	<1.0	<2.0	<1.0	<1.0	<1.0	<5.0
	7/5/2006	<1.0	<1.0	<1.0	<2.0	<1.0	<1.0	<1.0	<5.0
	4/21/2006	<1.0	<1.0	<1.0	<2.0	<1.0	<1.0	<1.0	<5.0
	1/11/2006	<1.0	<1.0	<1.0	<2.0	<1.0	<1.0	<1.0	<5.0
	5/25/2005	<1.0	<1.0	<1.0	<2.0	<1.0	<1.0	<1.0	<5.0
	2/17/2005	<1.0	<1.0	<1.0	<2.0	2	<1.0	<1.0	<5.0
	11/19/2004	<1.0	<1.0	<1.0	<2.0	<1.0	<1.0	<1.0	<5.0
	8/5/2004	<1.0	<1.0	<1.0	<2.0	<1.0	<1.0	<1.0	<5.0
	3/11/2003	<1.0	<1.0	<1.0	<2.0	2.2	<1.0	<1.0	<5.0
	10/12/2000	BD	BD	BD	BD	4.3	BD	BD	BD
	9/22/1999	6.1	28	6.5	25	BD	0.07	0.3	NA
MW-13	12/19/2018	1.5	<1.0	<1.0	<1.5	**220**	<1.0	<1.0	<4.0
	8/9/2016	**6.5**	<1.0	3.1	<1.5	**160**	<1.0	<1.0	<4.0
	2/2/2016	4.0	<1.0	<1.0	<1.5	**160**	<1.0	<1.0	<4.0
	1/18/2015	4.1	<1.0	<1.0	<1.5	79	<1.0	<1.0	<4.0
	6/10/2014	**9.5**	<1.0	1.4	<1.5	**130**	<1.0	<1.0	<4.0
	5/18/2012	**28**	<1.0	8.5	4.1	**260**	<1.0	<1.0	<4.0
	7/6/2011	**26**	<2.0	13	7.2	**250**	<2.0	<2.0	<4.0
	2/16/2011	**22**	<1.0	4.1	2.5	**260**	<1.0	<1.0	<4.0
	5/13/2010	**30**	<1.0	4.8	2.7	**320**	<1.0	<1.0	<4.0
	10/20/2009	**56**	<1.0	38	28	**300**	<1.0	<1.0	<4.0
	3/5/2008	**35**	<1.0	2.0	2.5	**380**	<1.0	1.2	<5.0
	12/27/2007	**34**	<5.0	<5.0	<10	**400**	<5.0	<5.0	<25
	8/21/2007	**220**	12	92	75	**560**	<10	<10	<50
	4/10/2007	**77**	<10	<10	<20	**440**	<10	<10	<50
	10/25/2006	**180**	1.1	49	20	**580**	<1.0	5.4	**41**
	7/5/2006	**230**	2.6	97	84	**570**	<1.0	<1.0	5.5
	4/21/2006	**120**	1.9	37	42	**410**	<1.0	3.8	<5.0
	1/11/2006	**140**	1.8	55	52	**470**	<1.0	<1.0	3.5
	5/25/2005	**220**	4.3	71	65	**470**	<1.0	6.1	6.3
	2/17/2005	**120**	2.4	44	27	**490**	<1.0	<1.0	18.6
	11/19/2004	**170**	4.3	67	83	**560**	<1.0	<1.0	29
	8/5/2004	**140**	8.1	69	96	**620**	<1.0	<1.0	12.3
	3/12/2003	**180**	790	**2,200**	**6,000**	430	<5.0	<5.0	**840**
MW-14	12/1/2018	**430**	18	520	92	**160**	<5.0	<5.0	**322**
	8/10/2016	**56**	2.9	64	26	9.7	<1.0	<1.0	**32**
	2/2/2016	**480**	32	**880**	340	**120**	<10	<10	**469**
	1/18/2015	**900**	62	**1,300**	**630**	**100**	<20	<20	**620**
	6/10/2014	**1,100**	<100	**1,000**	**580**	**180**	<100	<100	**300**
	5/18/2012	**4,200**	170	**1,100**	**950**	**350**	<50	<50	**460**

TABLE 4. SUMMARY OF GROUNDWATER CONTAMINANT ANALYTICAL RESULTS
FORMER PHILLIPS 66, SOCORRO, NEW MEXICO

Well Number	Date Sampled	Benzene	Toluene	Ethyl Benzene	Xylenes	MTBE	EDB	EDC	Total Naphthalenes
Standard		***5***	***1,000***	***700***	***620***	***100***	***0.1***	***10***	***30***
MW-14	7/6/2011	**2,600**	**1,000**	**1,800**	**1,900**	**270**	<2.0	2.4	**330**
	2/16/2011	**4,800**	690	**1,800**	**2,000**	**440**	<10	<10	**790**
	5/13/2010	**2,300**	**2,600**	**1,900**	**2,400**	**440**	<10	<10	**642**
	10/20/2009	**4,000**	**2,600**	**1,900**	**2,600**	**520**	<10	<10	**820**
	3/5/2008	**4,600**	**4,200**	**2,100**	**3,220**	**630**	<50	120	**520**
	8/21/2007	**5,500**	**6,200**	**2,200**	**4,300**	**600**	<100	<100	**630**
	4/10/2007	**3,500**	**6,900**	**2,300**	**3,660**	**650**	<100	<20	**510**
	10/25/2006	**2,900**	**7,900**	**2,300**	**3,800**	**810**	<5.0	98	**830**
	7/5/2006	**2,500**	**8,100**	**2,000**	**3,700**	**770**	<10	<10	**800**
	4/21/2006	**3,500**	**9,600**	**2,200**	**4,200**	**730**	<10	94	**840**
	1/11/2006	**4,300**	**11,000**	**2,500**	**4,800**	**660**	<10	<10	**990**
	5/25/2005	**4,500**	**10,000**	**2,500**	**5,400**	**690**	<20	120	**1,070**
	2/17/2005	**3,200**	**7,400**	**1,900**	**3,400**	**720**	<10	<10	**750**
	11/19/2004	**4,600**	**15,000**	**2,500**	**5,600**	**740**	<20	<20	**<760**
	8/5/2004	**4,100**	**11,000**	**2,200**	**4,400**	**800**	<10	120	**870**
	3/12/2003	**1,600**	**5,100**	**1,000**	**3,200**	**470**	<1.0	<1.0	**559**
MW-15	12/19/2018	**430**	4.5	9.1	10	**200**	<2.5	<2.5	**89**
	8/9/2016	Sheen							
	2/2/2016	Sheen							
	1/18/2015	**780**	6.4	21	14	**140**	<2.0	<2.0	**76**
	6/10/2014	NAPL							
	5/18/2012	**6,200**	41	290	170	**210**	<20	<20	**200**
	7/6/2011	**5,400**	37	190	93	**5,400**	<20	<20	**140**
	2/16/2011	**8,900**	240	500	310	**160**	<20	<20	**388**
	5/13/2010	**5,600**	62	280	130	**200**	<10	<10	**204**
	10/20/2009	**7,300**	31	440	110	**190**	<10	<10	**303**
	3/5/2008	**6,900**	49	**890**	**1,517**	**170**	<5.0	140	**227**
	12/27/2007	**6,300**	<50	**850**	**1,300**	96	<50	64	**<250**
	8/21/2007	**8,800**	57	**1,800**	**2,300**	**130**	<50	<50	**270**
	4/10/2007	**4,600**	<25	700	**1,200**	**140**	<25	100	**100**
	10/25/2006	**2,100**	59	260	353	**190**	<5.0	58	**242**
	7/5/2006	**2,900**	69	380	310	**230**	<5.0	<5.0	**84**
	4/21/2006	**2,700**	74	470	470	**190**	<5.0	<5.0	**99**
	1/11/2006	**3,200**	41	330	318	**140**	<5.0	<5.0	**46**
	5/25/2005	**4,800**	360	710	**710**	**150**	<5.0	<5.0	**151**
	2/17/2005	**1,400**	100	190	161	**180**	<1.0	<10	**40.6**
	11/19/2004	**3,400**	310	490	271	**170**	<5.0	<25	**<93**
	8/5/2004	**4,000**	850	550	440	**190**	<5.0	<5.0	**84**
	3/12/2003	**520**	**1,200**	660	**1,160**	**120**	<1.0	19	**273**
MW-16	12/19/2018	<1.0	<1.0	<1.0	<1.5	**140**	<1.0	<1.0	<4.0
	8/9/2016	<1.0	<1.0	<1.0	<1.5	26	<1.0	<1.0	<4.0
	2/2/2016	<1.0	<1.0	<1.0	<1.5	31	<1.0	<1.0	<4.0
	1/18/2015	<1.0	<1.0	<1.0	<1.5	<1.0	<1.0	<1.0	<4.0
	6/10/2014	<1.0	<1.0	<1.0	<1.5	14	<1.0	<1.0	<4.0
MW-17	12/19/2018	<1.0	<1.0	<1.0	<1.5	**260**	<1.0	<1.0	<4.0
	8/9/2016	<1.0	<1.0	<1.0	<1.5	**200**	<1.0	<1.0	<4.0
	2/2/2016	<1.0	<1.0	<1.0	<1.5	**280**	<1.0	<1.0	<4.0
	1/18/2015	<1.0	<1.0	<1.0	<1.5	**320**	<1.0	<1.0	<4.0

TABLE 4. SUMMARY OF GROUNDWATER CONTAMINANT ANALYTICAL RESULTS
FORMER PHILLIPS 66, SOCORRO, NEW MEXICO

Well Number	Date Sampled	Benzene	Toluene	Ethyl Benzene	Xylenes	MTBE	EDB	EDC	Total Naphthalenes
Standard		***5***	***1,000***	***700***	***620***	***100***	***0.1***	***10***	***30***
MW-17	6/10/2014	<5.0	<5.0	<5.0	<7.5	**330**	<5.0	<5.0	<20
SVE-1	12/19/2018	**380**	60	**1,300**	**2,400**	**190**	<10	<10	**1,040**
SVE-2	12/19/2018	**890**	46	**1,300**	100	**190**	<10	<10	**890**

NOTES:
Groundwater concentrations reported in micrograms per liter.
Bold red values indicate concentrations in exceess of standards.

BD	Below laboratory detection limit
EDB	Ethylene dibromide
EDC	Ethylene dicholoride
MTBE	Methyl tertiary butyl ether
NA	Not analyzed
NAPL	Non-aqueous phase liquid

Replacement wells installed (MW-13 for MW-1A; MW-15 for MW-7)

TABLE 5. SUMMARY OF GROUNDWATER GEOCHEMICAL PARAMETERS
FORMER PHILLIPS 66, SOCORRO, NEW MEXICO

Well Number	Date Sampled	pH pH units	SpC µS/cm	Temp ˚C	DO mg/L
MW-2A	12/18/2018	7.18	2,040	23.1	1.04
	8/9/2016	7.27	1,892	23.8	NM
	2/2/2016	7.70	1,270	20.1	1.36
	1/18/2015	7.54	2,500	22.3	1.32
	6/10/2014	7.46	2,430	21.3	0.97
MW-3A	12/19/2018	7.11	2,180	20.5	1.35
	8/9/2016	7.22	2,090	21.5	2.20
	2/2/2016	7.66	1,360	18.0	1.84
	1/18/2015	7.56	2,380	19.7	2.12
	6/10/2014	7.36	2,360	20.0	NM
MW-4A	12/19/2018	7.24	2,050	22.7	1.20
	8/9/2016	7.39	2,480	22.6	1.40
	3/3/2016	7.33	1,260	18.7	0.88
	1/18/2015	7.56	2,430	22.5	1.49
	6/10/2014	7.35	2,320	22.2	NM
MW-5A	8/9/2016	7.20	4,440	23.7	1.16
	2/2/2016	7.61	2,070	19.1	1.42
	1/18/2015	7.61	3,250	21.9	1.67
	6/10/2014	7.47	3,110	22.4	NM
MW-6A	8/9/2016	7.41	6,480	23.8	1.97
	3/3/2016	7.45	2,410	18.8	0.95
	1/18/2015	NM	NM	NM	NM
	6/10/2014	NM	NM	NM	NM
MW-8	12/19/2018	7.14	1,672	22.6	0.79
	8/9/2016	7.12	2,200	22.4	1.03
	2/2/2016	7.69	1,280	19.4	1.18
	1/18/2015	7.43	2,240	21.9	1.12
	6/10/2014	7.23	2,340	21.9	NM
MW-10A	12/18/2018	7.18	2,130	22.5	1.09
	8/9/2016	7.25	2,850	22.5	1.12
	2/2/2016	7.69	1,420	19.1	1.55
	1/18/2015	7.62	3,990	22.0	1.76
	6/10/2014	7.29	5,530	21.1	NM
MW-13	12/19/2018	7.27	2,130	22.9	1.30
	8/9/2016	7.31	2,630	22.6	0.89
	2/2/2016	7.61	1,300	20.0	1.25
	1/18/2015	7.54	2,420	22.6	1.37

TABLE 5. SUMMARY OF GROUNDWATER GEOCHEMICAL PARAMETERS
FORMER PHILLIPS 66, SOCORRO, NEW MEXICO

Well Number	Date Sampled	pH pH units	SpC µS/cm	Temp ˚C	DO mg/L
MW-13	6/10/2014	7.42	2,290	21.5	NM
MW-14	12/19/2018	7.31	1,965	22.6	0.55
	8/9/2016	7.29	2,450	21.7	1.04
	2/2/2016	7.59	1,210	19.8	1.40
	1/18/2015	7.45	2,260	22.0	1.36
	6/10/2014	7.28	2,300	21.6	NM
MW-15	12/19/2018	7.24	2,170	22.8	0.71
	8/9/2016	7.12	2,690	22.2	0.98
	2/2/2016	7.67	1,480	18.5	0.92
	1/18/2015	7.52	2,540	22.8	1.07
	6/10/2014	7.23	2,730	23.0	NM
MW-16	12/19/2018	7.27	2,260	22.1	3.13
	8/9/2016	7.31	2,490	22.6	1.99
	2/2/2016	7.64	1,360	18.7	2.16
	1/18/2015	7.64	2,660	21.1	2.68
	6/10/2014	7.63	2,090	23.8	NM
MW-17	12/19/2018	7.33	2,000	23.2	0.84
	8/9/2016	7.38	2,500	23.2	1.31
	2/2/2016	7.15	NM	18.9	0.91
	1/18/2015	7.67	2,360	20.7	1.58
	6/10/2014	7.37	2,330	25.9	NM
SVE-1	12/19/2018	7.65	2,040	21.4	NM
SVE-2	12/19/2018	7.43	1,943	22.7	1.51
Average	12/19/2018	**7.28**	**2,048**	**22.4**	**1.23**

NOTES:

DO	Dissolved oxygen	mg/L	Milligrams per liter
SpC	Specific conductance	mV	Millivolts
Temp	Temperature	uS/cm	Micro Siemens per centimeter
NM	Not Measured	°C	Degrees Celcius

TABLE 6. REMEDIATION GOALS
FORMER PHILLIPS 66, SOCORRO, NEW MEXICO

Contaminant	**Groundwater Ingestion***
	milligrams per liter
Benzene	0.005
Toluene	1.0
Ethylbenzene	0.7
Xylenes (total)	0.62
Ethylene dibromide	0.00005
Ethylene dichloride	0.005
Methyl tertiary butyl ether	0.1
Total naphthalenes	0.03
Non-Aqueous Phase Liquids	Less than 1/8-inch

** NMAC 20.6.2.3103 Standards for Ground Water of 10,000 mg/L TDS Concentration or Less Human Health Standards (07/12/2019)*

TABLE 7. PRE-COMISSIONING CHECKLIST
FORMER PHILLIPS 66, SOCORRO, NEW MEXICO

Checklist Item	Responsible Person	Initials	Inspection Date
Wells			
Remediation wells installed to specifications			
Trenching			
Utilities have been located			
Trenches installed and backfilled to specifications			
Trench surfaces restored to specifications			
Piping Installation			
Piping complete (including from wells/trenches)			
Appurtenances installed and operation verified			
Pressure test completed			
Equipment Compound			
Enclosure received and installed to specifications			
Remediation Equipment			
Air Sparge Module installed to specifications			
SVE Module installed to specifications			
Manifolds installed to specifications			
Valves, meters, gauges, and appurtenances installed and functional			
Electrical			
Grounding installed/checked			
Lighting functional			
Lockouts/covers/panels in place			
Blower rotation verified			
Disconnects in sight of unit being controlled			
Controls/alarms and interlocks functional			
Other			
Pavement restored to specification			
Asphalt restoration completed to specifications			
Notes			

Modified from USACE 1995

TABLE 8. SYSTEM FUNCTIONALITY CHECKLIST
FORMER PHILLIPS 66, SOCORRO, NEW MEXICO

Checklist Item	Responsible Person	Initials	Inspection Date
Subsurface			
No leaks in piping/downhole equipment			
Air Injection parameters within design range			
SVE extraction parameters within design range			
Field vacuum is observable in monitoring wells			
Remediation Equipment			
All switches and safety interlocks functioning			
Operating points match blower curve specification for flow rate vs. vacuum through start-up			
Current draw and voltage balance match manufacturers specifications			
No excessive vibration/noise/temperature rise			
Monitoring Systems			
Fluid gauges recording within specified range.			
Vacuum gauges recording within specified range			
Pressure gauges recording within specificed range			
PID / LEL / O_2 meters hold calibration			

Notes:
PID = photionization detector
LEL = Lower explosive limit
O_2 = Oxygen
Modified from USACE, 1995

TABLE 9. SYSTEM STARTUP TESTING
FORMER PHILLIPS 66, SOCORRO, NEW MEXICO

SYSTEM STARTUP TESTING			
Monitoring Parameter	**Frequency**	**Monitoring Point**	**Method of Measurement**
SVE Flowrates	Daily	Manifold	Rotameter, Pitot Tube, Anemometer
SVE Vacuum	Daily	Manifold	Gauge, Manometer
SVE Vapor Concentrations	Daily	Manifold	Peristaltic pump / PID or FID and Oxygen Meter
SVE Vapor Concentrations	Last Day of Testing	Manifold Header	1-L SUMMA Canister for BTEX/TPH by TO-15 and Fixed Gases and BTU by ASTM D1945
Sparge Flowrate	Daily	Manifold	Rotameter, Flowmeter
Oxygen Injection Flowrate	Daily	Manifold	Rotameter, Flowmeter
Sparge Pressure	Daily	Manifold	Gauge
Oxygen Injection Pressure	Daily	Manifold	Gauge
Well Field Pressure and Vacuum	Once during testing, end of testing	Well heads	Gauge, Manometer
Fluid Levels	First Day, Middle of Testing, and Last Day of Testing	Wells	Interface Probe or Water Level Meter

TABLE 10. ROUTINE EQUIPMENT OPERATION AND MAINTANANCE TASKS
CANONCITO GROCERY, CANONCITO, NEW MEXICO

Activity	Frequency
Record system process parameters (flow rates, vacuums, pressures, volumes)	Every O&M Event
Visual inspection of system performance	Every O&M Event
Indentify issues and or/problems to be addressed	Every O&M Event
Greasing of blower motor	Every O&M Event
Drain moisture from the knockout vessel, if not transferred automatically	Every O&M Event
General Cleanup and assessment of site security	Every O&M Event
Gauging of fluid levels in monitor and remediation wells to performance assessment and plume control	Quarterly
Inspect, clean, or replace compressor and blower intake air filters	Quarterly
Changing blower oil, air compressor oil, adjusting and lubing of moving parts and replacing of minor parts	Quarterly
Collecting of groundwater samples for performance assessment and plume control	Quarterly
Inspect, clean, or replace level switches and sight glass	Quarterly
Inspect, clean, or replace rotameters	Quarterly
Inspect, clean or replace totalizing flow meters	As Needed
Replace bearings (extraction blower). Every 20,000 hours or as recommended by manufacturer	As Needed
Redevelop remediation wells	As Needed

Note: Tasks may be modified, added, or removed based on equipment manufacturer specifications

TABLE 11. SYSTEM MONITORING REQUIREMENTS
FORMER PHILLIPS 66, SOCORRO, NEW MEXICO

Sampling Medium	Purpose	Location	Analysis	Method	Sampling Container	Sampling Frequency
Groundwater Samples	Remediation Progress and Achievement of Remediation Goals	Source Area Plume Perimeter	VOCs	EPA 8260	3 x 40-mL vaials preserved with $HgCl_2$	Quarterly
Soil Vapor Samples	Mass Removal Emissions Concentration Trends	SVE Header	TPH and VOCs	EPA TO-15	1-Liter SUMMA Canister	Monthly
Soil Vapor Samples	Mass Destroyed by Mineralization Concentration Trends	SVE Header	Fixed Gases and BTU	ASTM D-1945		Monthly

Notes:

ASTM	American Society for Testing Materials
BTU	British Thermal Uni
EPA	United States Environmental Protection Agency
$HgCl_2$	Mercury chloride
mL	Milliliter
SVE	Soil Vapor Extraction
VOCs	Volatile Oranic Compounds

TABLE 12. SYSTEM OPERATING AND MAINTENANCE FORM
FORMER PHILLIPS 66, SOCORRO, NEW MEXICO

Date/Time			
Personnel			
Event Type	Weekly	Monthly	Quarterly Other Emergency
System Running Upon Arrival?	Yes	No	
Component	Value	Units	Notes/Comments
System Security Checked	Yes	No	
General Concerns Regarding System, if any			
Hour Meter - SVE Blower		hours	
Hour Meter - Sparge Blower		hours	
SVE Blower VFD Setting		Hz	
SVE Blower Intake Vacuum		inwc	
SVE Blower Exhaust Pressure		psi	
SVE Blower Exhaust Temperature		F	
SVE Blower Dilution Valve Position			
HSVE-1 Flowrate		cfm	
HSVE-2 Flowrate		cfm	
HSVE-1 PID		ppmv	
HSVE-2 PID		ppmv	
SVE - Vacuum Between Filter and Blower		inwc	
Sparge Compressor Pressure		psig	
Sparge Compressor Flowrate		cfm	
Sparge Compressor Temperature		F	
HAS-1 Flowrate		cfm	
HAS-2 Flowrate		cfm	
HAS-3 Flowrate		cfm	
HAS-4 Flowrate		cfm	
HAS-5 Flowrate		cfm	
HAS-6 Flowrate		cfm	
HAS-7 Flowrate		cfm	
HAS-8 Flowrate		cfm	
HAS-9 Flowrate		cfm	
HAS-10 Flowrate		cfm	
HAS-11 Flowrate		cfm	
HAS-12 Flowrate		cfm	
Moisture Separator Drained?	Yes	No	
SVE Blower Greased?	Yes	No	
SVE Intake Filter Cleaned or Replaced?	Yes	No	
SVE Blower Oil Changed? Type/Quantity	Yes	No	
SVE Blower Belt Tension Checked?	Yes	No	
Sparge Compressor Blower Oil Changed? Type/Quantity	Yes	No	

Notes:

Adjust system parameter entries based on actual instrumentation during startup

TABLE 13. ROUTINE MONITORING DATA FORM
FORMER PHILLIPS 66, SOCORRO, NEW MEXICO

Personnel	
Date	

		MANIFOLD																	
		Header																	
Vacuum																			
Pressure																			
Flowrate																			
Volume																			
Vessel Volume/Time																			
PID/FID																			
Oxygen																			
Temperature																			
LEL																			
Run Time																			
Electric Meter Reading																			

		FIELD																	
Depth to Water																			
Vacuum																			
Pressure																			
Flowrate																			
PID/FID																			
Oxygen																			
Vapor Monitor Reading																			

Notes:

TABLE 14
FIELD TROUBLE SHOOTING GUIDE
FORMER PHILLIPS 66, SOCORRO, NEW MEXICO

Problems	Considerations	Potential Solutions
The zone of influence of vacuum system is not as predicted and may be insufficient for remediation	The soil may be less permeable in some locations or there may be preferential flow	• Apply greater vacuum • Install additional wells • Check wells for silt clogging • Check for preferential pathways, including borehole short-circuiting • Install less permeable surface cover
Vacuum levels are spatially highly variable	There may be preferential flow or heterogeneities	• Further subsurface investigation • Additional Wells • Seal preferential pathways
The VOC vapor concentrations have been reduced in some but not all wells	Treatment may be completed in some areas of the site	• Reduce flows to some wells • Take some wells offline • Check for ongoing sources of contamination • Increase rates in areas of residual contamination
The VOC concentrations remain consistently high despite high mass removal rates	Undiscovered groundwater contamination or free-phase product	• Further investigation • Product recovery • Groundwater remediation • Air sparging
Groundwater VOC concentrations remain high	Large amounts of sorbed contaminants is present beneath the water table	• Increase sparging rates • Dewater the saturated soil, if feasible • Groundwater remediation
Low concentrations of VOCs are extracted during operation, but high concentrations reappear when system is shut off	Diffusion limitation, flow short-circuiting due to preferential flow, soils too moist, airflow rates higher than necessary	• Dual recovery • Pulse venting • Hot gas injection • Excavation of "hot spots" and ex-situ soil treatment
Continued high levels of less volatile components	This is likely to occur when SVE is applied to a contaminant mixture with a large range of volatility	• Bioventing • Pulse Venting • Soil heating
Decreasing air flow rates and/or increasing vacuum levels	Soil became too moist Wells are clogged	• Cover surface to limit infiltration • Increase dewatering • Clean/treat wells
Poor SVE/BV performance following large rain events	The system is sensitive to the effects of soil moisture on air permeability and aeration	• Cover surface to limit infiltration • Dual recovery • Decrease SVE vacuum or shut off system following major rain events
Filters prior to vacuum blower become clogged, leading to excess pressure head loss	Filter needs to be changed Filter type was not properly chosen or sized	• Change filter • Try a different filter • Change filters preventively
Unexpectedly high vapor concentrations at or near explosive levels	Free-phase product: Accumulation of methane or other VOCs	• Dilute intake air • Alter system to be explosion-proof • Check for unknown sources of contamination

TABLE 14
FIELD TROUBLE SHOOTING GUIDE
FORMER PHILLIPS 66, SOCORRO, NEW MEXICO

Problems	Considerations	Potential Solutions
Persistent scale formation in the sparge wells	Scale inhibitor or other type inhibitor can be considered, wells redeveloped, new wells installed, or other technology utilized	• Scale injection pump is not operational – check, repair, and/or replace pump • Scale injection piping is blocked – check the piping • Collect additional groundwater sample as water chemistry may have changed • Consult with engineer to assess if injection rate is appropriate • Consult with engineer to assess if scale inhibitor formulation is still appropriate • Consult with engineer to asses if remediation application warrant reconsideration
Dissolved oxygen concentrations remain low in groundwater matrix	Insufficient air injection, oxygen diffusion, or rapid oxygen utilization	• Increase air injection rates • Pulse air sparging • Verify that well screen is not scaled or bio-fouled
Conveyance line or well bio-fouling	Conducive environment for bio-growth created. Consider well re-development, periodic or consistent bio-inhibition within the well.	• Evaluate changing operational parameters to remove oxygen or electron donor/acceptor • Evaluate use of mechanical means for fouling removal • Evaluate use of biocide • Evaluate alternative technology for remediation if fouling is persistent and does not allow for proper application of technology

Source: Modified from USACE 1995 and USACE 1999.

TABLE 15. OPTIMIZATION AND CONTINGENCY PLAN
FORMER PHILLIPS 66, SOCORRO, NEW MEXICO

Goal	Optimum Condition	Timeframe for Goal Attainment	Means of Data Collection	Contingency Plan
Effective sparging to enhance volatilization and in-situ bio degradation of contaminants within saturated matrix	Maintain design sparge rate	Throughout operation	Dissolved oxygen in groundwater VOCs concentrations in groundwater. PID concentrations in SVE soil vapor. Groundwater levels in sparge, SVE, and monitoring wells.	Verify blower is operational. Adjust flowrates and pressure rates Verify conveyance and appurtenances are not blocked. Adjust injection pressure to make sure flow occurs to all wells. Adjust injection pressure to minimize upwelling.
Effective Capture of Air Sparge Vapors and Contaminant Removal by SVE	Maintain design extraction rate	Throughout operation	TPH and PID concentrations at the SVE manifold header SVE flowrates at the SVE header	Verify extraction blower is operational. Verify extraction conveyances are not blocked. Verify blower intake conveyance is not blocked. Adjust manual dilution valve. Adjust manifold valves. Adjust header valves.
Provide oxygen into vadose zone to support in-situ biodegradation	Maintain design extraction rate	Throughout operation	Soil vapor samples collected at the SVE manifold header	Verify extraction blower is operational. Verify extraction conveyances are not blocked. Screen oxidizer influent vapors with PID/FID and check oxidizer control panel parameters. Adjust manual dilution valve. Adjust manifold valves. Consider carbon adsorption if operation of oxidizer becomes inefficient due to low mass removal rates. Consider uncontrolled emissions, if allowed by regulations.
Sufficient vacuum distributed throughout the vent well field	Minimum of 1% of applied vacuum everywhere within vacuum wellfield	Within first month of operation assuming no flow rate limitations due to mass removal rates	Gauge vacuum at well heads	Verify extraction blower is operational. Verify oxidizer is operational. Verify conveyance line are not blocked. Increase applied vacuum. Adjust extraction rates to achieve full vacuum coverage within target zone.

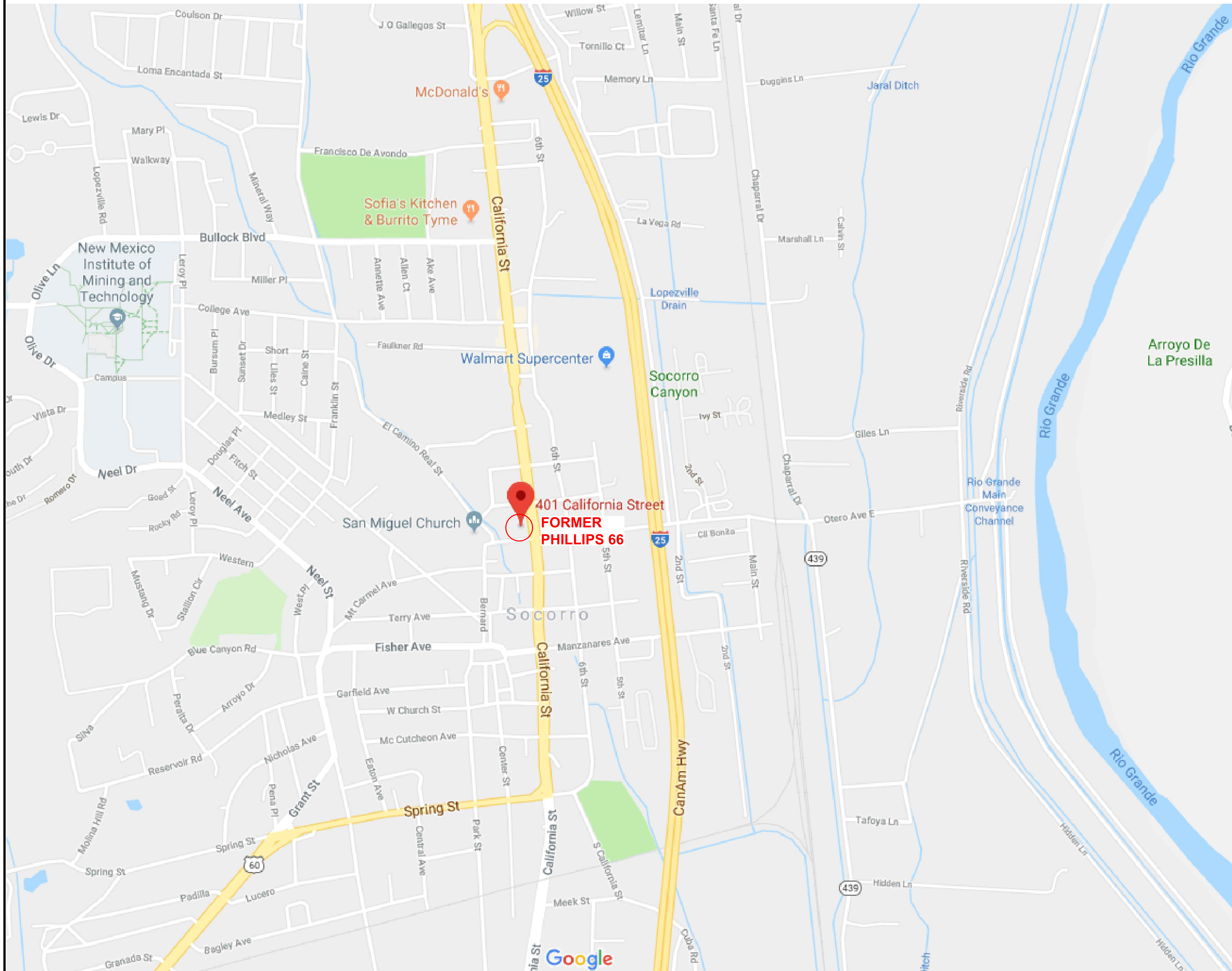
Notes:

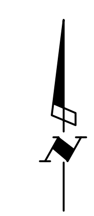
FID photoionization detector
PID photoionization detector
scfm cubic feet per minute
SVE soil vapor extraction
VOC volatile organic compound

TABLE 16. OPTIMIZATION AND CONTINGENCY PLAN FOR CHANGE IN CONDITIONS
FOMER PHILLIPS 66, SOCORRO, NEW MEXICO

Condition	Contingency Plan Actions
High Soil Vapor concentrations during Soil Vapor Extraction (SVE) operation	Decrease total extraction flowrate, Turn off several SVE wells, and/or Open the dilution valve Resume normal operation once concentrations decline
High Soil Vapor concentration during Sparge/Vent operation	Turn off several sparge wells Decrease sparge well run time, and/or Cycle operation of wells Resume normal operation once concentrations decline
Expanding of groundwater plume	Reduce sparging rates Monitor groundwater concentrations Operate system intermittently to allow for groundwater concentrations to attenuate at the periphery
Decreasing mass removal rates	Increase sparging rates Cycle through sparge wells to allow for contaminant desorption Operate system intermittently Consider increasing sparge air temperature to increase volatilization of contaminants

GENERAL DRAWINGS





1,000 500 0 1,000

SCALE IN FEET

IMAGE: GOOGLE MAPS

FORMER PHILLIPS 66
401 CALIFORNIA STREET
SOCORRO, NEW MEXICO

FIGURE 1
LOCATION MAP

PROJECT #: PROPOSAL	PROJECT PHASE:	PROJECT MANAGER: JS

320 Gold Avenue, SW Suite 1300
Albuquerque, NM 87102
Phone: (505) 224-9013
Fax: (505) 224-9016
EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC., PBC

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LEGEND:

MW-3A	MONITORING WELL
AS-1/SVE-1	REMEDIATION WELL (SPARGE/VENT)
(green dashed area)	LIMIT OF EXCAVATION, CIRCA 2003
OHE	OVERHEAD ELECTRIC LINE
UE	UNDERGROUND ELECTRIC LINE
WATER	UNDERGROUND WATER LINE
SEWER	UNDERGROUND SEWER LINE
GAS	UNDERGROUND SEWER LINE

N

40 20 0 40

SCALE IN FEET

IMAGE: GOOGLE EARTH APRIL 2017

FORMER PHILLIPS 66
401 CALIFORNIA STREET
SOCORRO, NEW MEXICO

FIGURE 2
SITE LAYOUT

PROJECT #: PROPOSAL	PROJECT PHASE: __	PROJECT MANAGER: JS

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC., PBC
320 Gold Avenue, SW Suite 1300
Albuquerque, NM 87102
Phone: (505) 224-9013
Fax: (505) 224-9016

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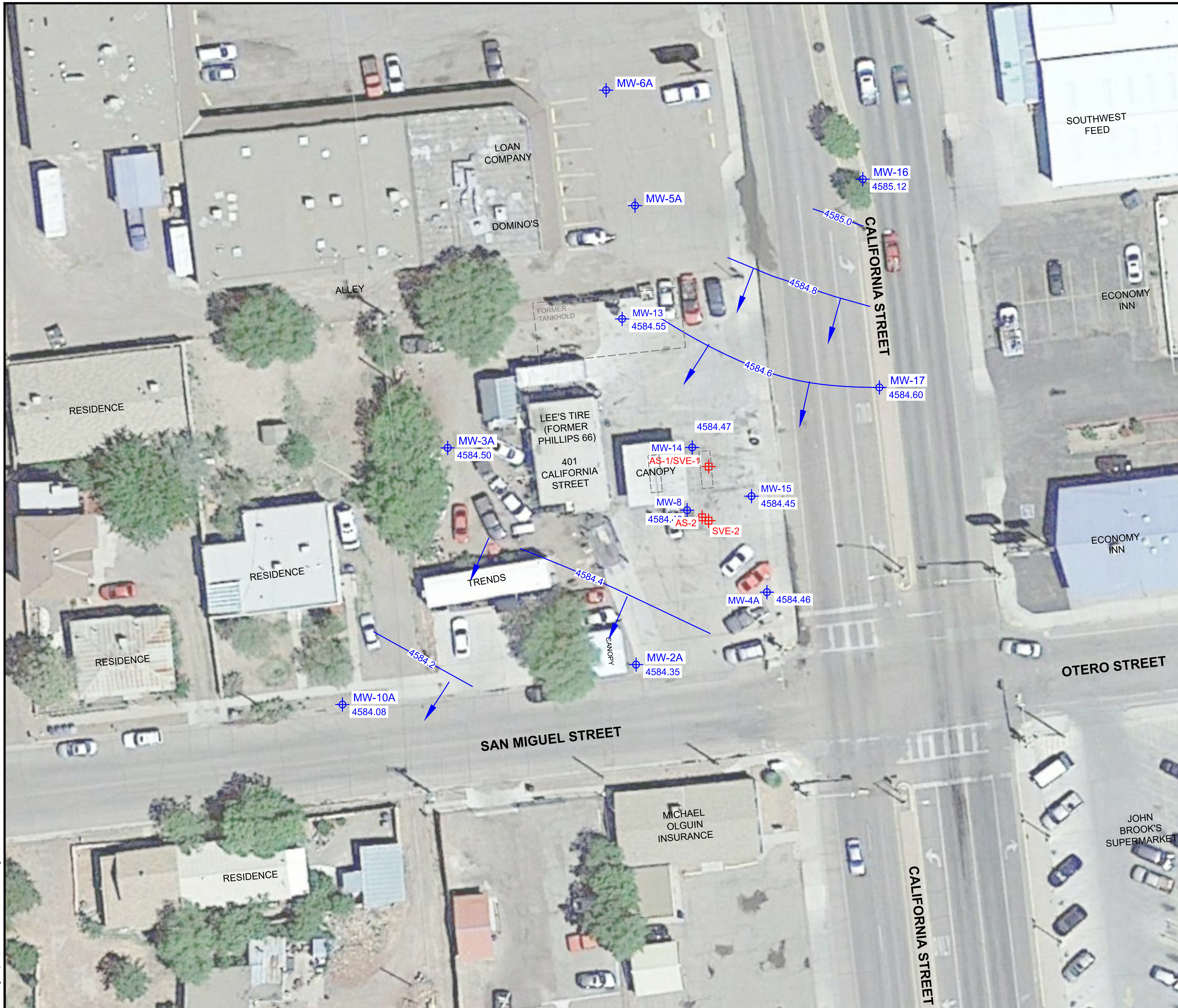

LEGEND:

- MW-3A — MONITORING WELL
- AS-1/SVE-1 — REMEDIATION WELL (SPARGE/VENT)
- DIRECTION OF GROUNDWATER FLOW
- 4585.0 — GROUNDWATER ELEVATION CONTOUR IN FEET ABOVE MEAN SEA LEVEL

N

40 20 0 40

SCALE IN FEET

IMAGE: GOOGLE EARTH APRIL 2017

FORMER PHILLIPS 66
401 CALIFORNIA STREET
SOCORRO, NEW MEXICO

FIGURE 3
GROUNDWATER ELEVATION CONTOUR MAP - DECEMBER 2018

PROJECT #:	6281001	PROJECT PHASE:	03	PROJECT MANAGER:	TM

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B	T	E	X	MTBE	EDB	EDC	N
<1.0	<1.0	<1.0	<1.5	**140**	<1.0	<1.0	<4.0

B	T	E	X	MTBE	EDB	EDC	N
1.5	<1.0	<1.0	<1.5	**220**	<1.0	<1.0	<4.0

B	T	E	X	MTBE	EDB	EDC	N
<1.0	<1.0	<1.0	<1.5	**180**	<1.0	<1.0	<4.0

B	T	E	X	MTBE	EDB	EDC	N
<1.0	<1.0	<1.0	<1.5	**260**	<1.0	<1.0	<4.0

B	T	E	X	MTBE	EDB	EDC	N
430	18	520	92	**160**	<5.0	<5.0	**322**

B	T	E	X	MTBE	EDB	EDC	N
380	60	**1,300**	**2,400**	**190**	<10	<10	**1,040**

B	T	E	X	MTBE	EDB	EDC	N
430	4.5	9.1	10	**200**	<2.5	<2.5	**89**

B	T	E	X	MTBE	EDB	EDC	N
1,100	20	34	<15	**110**	<10	<10	**559**

B	T	E	X	MTBE	EDB	EDC	N
890	46	**1,300**	100	**190**	<10	<10	**890**

B	T	E	X	MTBE	EDB	EDC	N
<1.0	<1.0	<1.0	<1.5	**170**	<1.0	<1.0	<4.0

B	T	E	X	MTBE	EDB	EDC	N
<1.0	<1.0	<1.0	<1.5	69	<1.0	<1.0	<4.0

B	T	E	X	MTBE	EDB	EDC	N
<1.0	<1.0	<1.0	<1.5	**100**	<1.0	<1.0	<4.0

LEGEND:

MW-3A	EXISTING MONITORING WELL
B	BENZENE
T	TOLUENE
E	ETHYLBENZENE
X	XYLENES
N	TOTAL NAPHTHALENES
MTBE	METHYL TERTIARY BUTYL ETHER
EDB	ETHYLENE DICHLORIDE
EDC	ETHYLENE DIBROMIDE
— · —	ESTIMATED EXTENT OF BENZENE 10 ug/L AND NAPHTHALENES 30 ug/L (~4,000 SF)
— — —	ESTIMATED EXTENT OF MBTE (100 ug/L)

NOTES:

1. ALL CONCENTRATIONS ARE IN MICROGRAMS PER LITER (ug/L)
2. BOLD VALUES INDICATE CONCENTRATIONS IN EXCESS OF APPLICABLE STANDARDS.

40 20 0 40

SCALE IN FEET

IMAGE: GOOGLE EARTH APRIL 2017

FORMER PHILLIPS 66
SOCORRO, NEW MEXICO

FIGURE 4. DISTRIBUTION OF ORGANIC CONTAMINANTS IN GROUNDWATER DECEMBER 2018

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LEGEND:

MW-3A	EXISTING MONITORING WELL
F-4	DIRECT PUSH BORING LOCATIONS
	20' X 20' GRID
	ESTIMATED EXTENT OF EXCAVATION
A A'	CROSS-SECTION LOCATION LINE

40 20 0 40

SCALE IN FEET

IMAGE: GOOGLE EARTH APRIL 2017

FORMER PHILLIPS 66
401 CALIFORNIA STREET
SOCORRO, NEW MEXICO

FIGURE 5
2014 GEOPROBE BORING AND CROSS-SECTION LOCATIONS

PROJECT #: 6281001 | PROJECT PHASE: 01 | PROJECT MANAGER: TM

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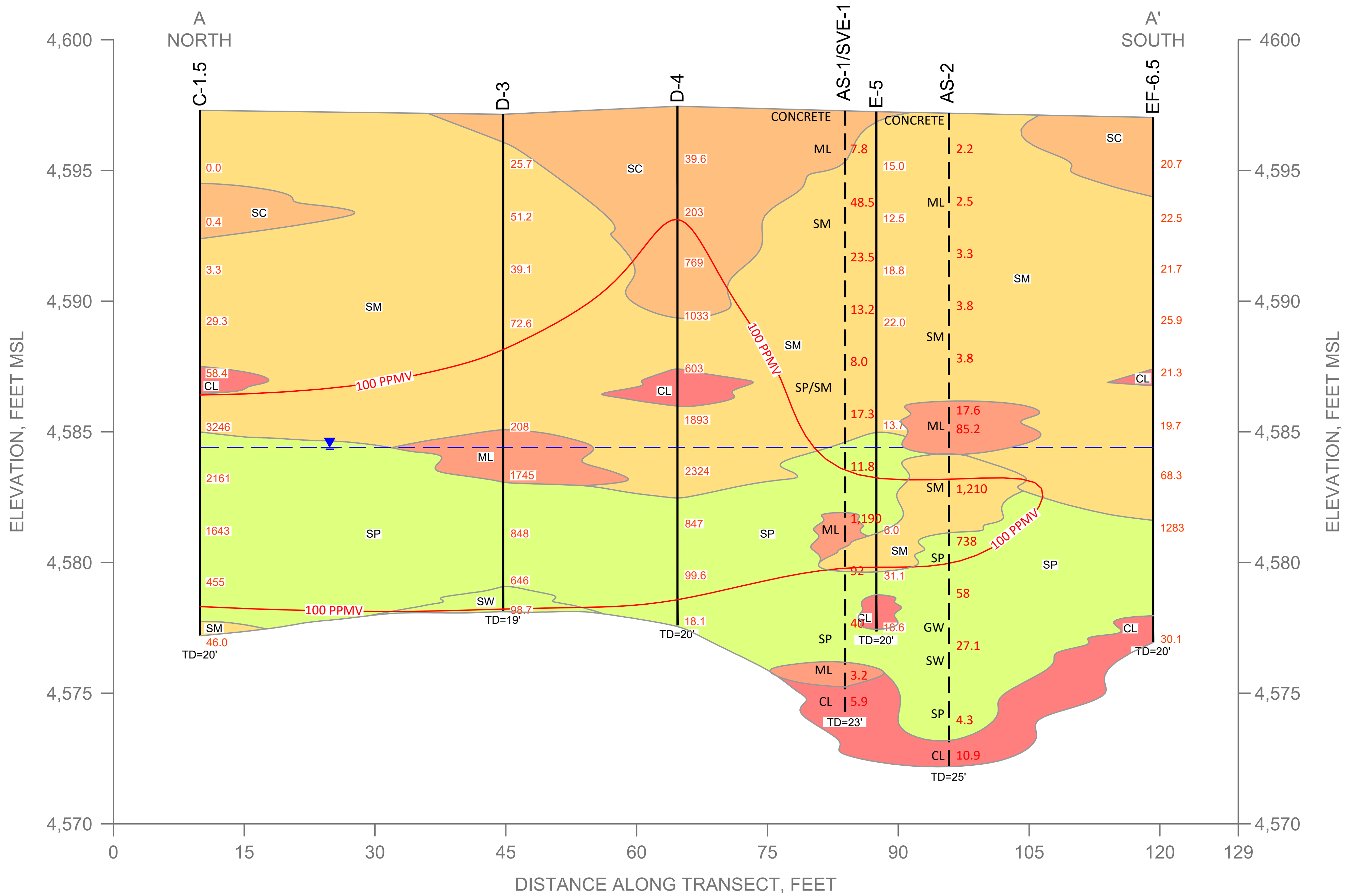
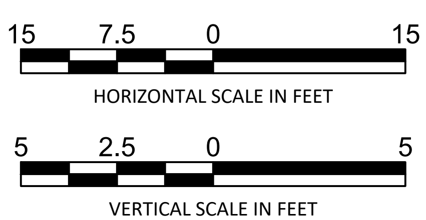


USCS SOIL CLASSIFICATION

- CL - CLAY, BROWN TO DARK BROWN, STIFF
- ML - SILT, BROWN TO BLACK, LOOSE TO DENSE
- SC - CLAYEY SAND, BROWN TO DARK BROWN
- SM - SILTY SAND, BROWN TO VERY DARK GRAY, MEDIUM DENSE TO DENSE
- SP/SW - POORLY GRADED SAND, BROWN TO BLACK, MEDIUM DENSE TO DENSE



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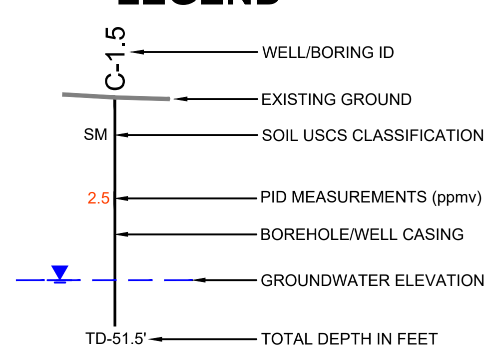

FORMER PHILLIPS 66
SOCORRO, NEW MEXICO

FIGURE 6
GEOLOGIC CROSS-SECTION A-A'

PROJECT #: 6281001	PROJECT PHASE: 01	PROJECT MANAGER: TM

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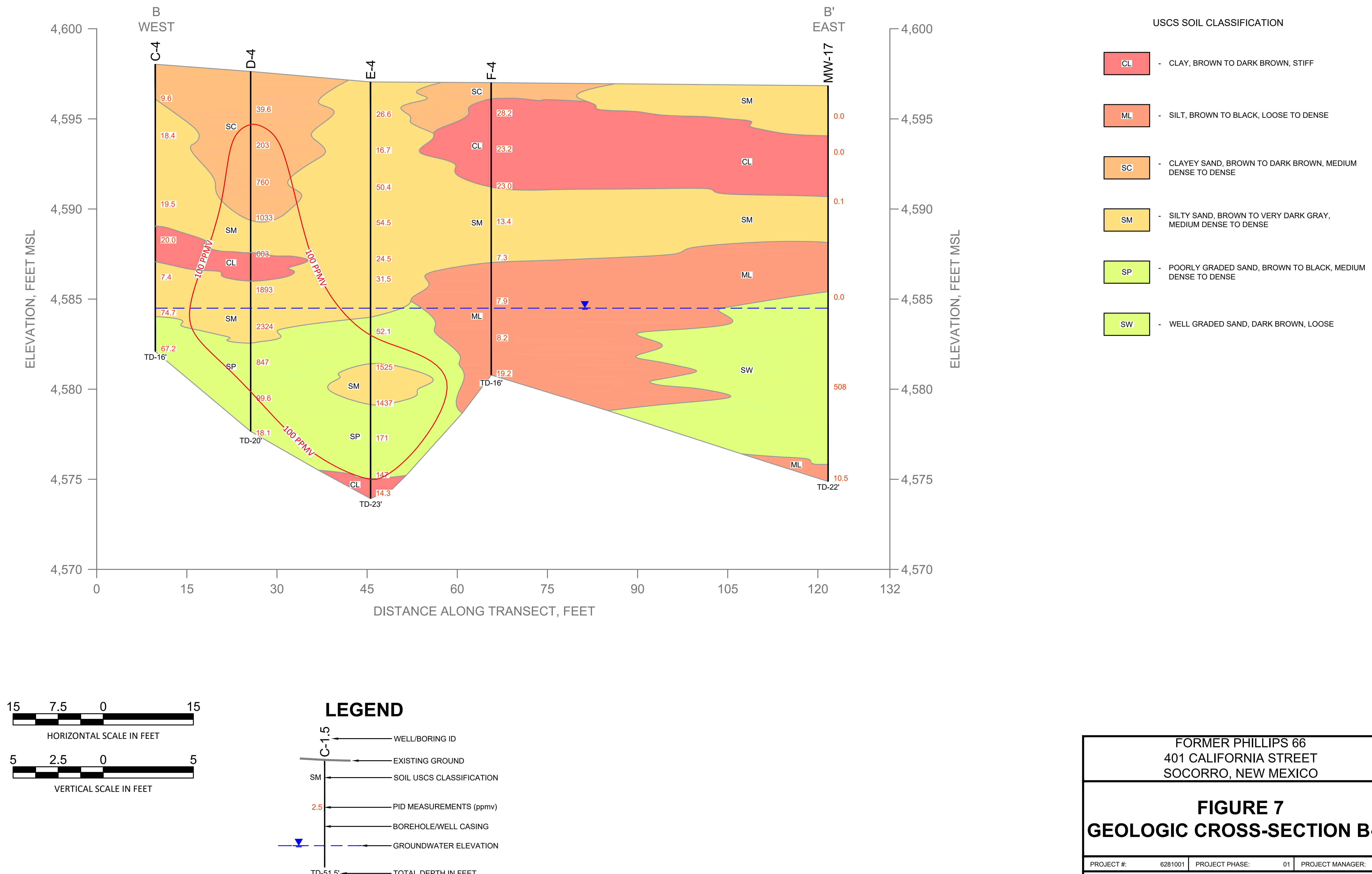

FORMER PHILLIPS 66
401 CALIFORNIA STREET
SOCORRO, NEW MEXICO

FIGURE 7
GEOLOGIC CROSS-SECTION B-B'

PROJECT #: 6281001	PROJECT PHASE: 01	PROJECT MANAGER: TM

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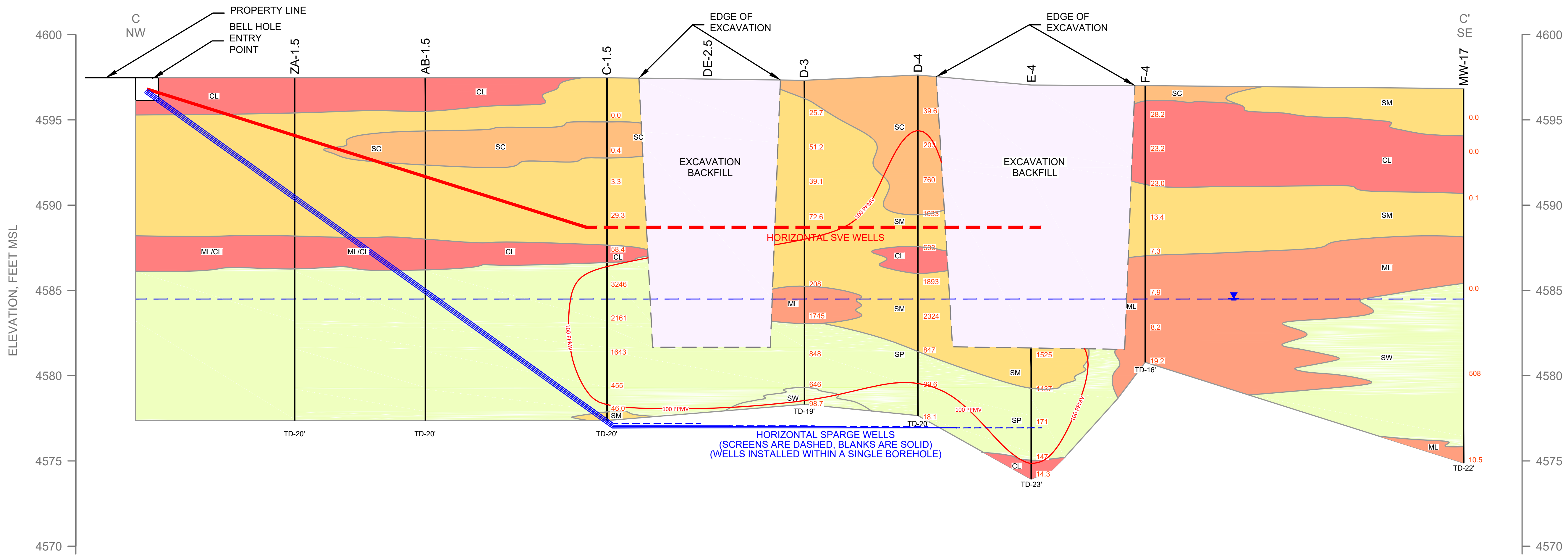

USCS SOIL CLASSIFICATION

CL	CLAY, BROWN TO DARK BROWN, STIFF
ML	SILT, BROWN TO BLACK, LOOSE TO DENSE
SC	CLAYEY SAND, BROWN TO DARK BROWN, MEDIUM DENSE TO DENSE
SM	SILTY SAND, BROWN TO VERY DARK GRAY, MEDIUM DENSE TO DENSE
SP	POORLY GRADED SAND, BROWN TO BLACK, MEDIUM DENSE TO DENSE
SW	WELL GRADED SAND, DARK BROWN, LOOSE

20 10 0 20
HORIZONTAL SCALE IN FEET

6.67 3.33 0 6.67
VERTICAL SCALE IN FEET

LEGEND

- C-1.5 — WELL/BORING ID
- EXISTING GROUND
- SM — SOIL USCS CLASSIFICATION
- 2.5 — PID MEASUREMENTS (ppmv)
- BOREHOLE/WELL CASING
- GROUNDWATER ELEVATION
- TD-51.5' — TOTAL DEPTH IN FEET

FORMER PHILLIPS 66
401 CALIFORNIA STREET
SOCORRO, NEW MEXICO

FIGURE 8
CROSS SECTION C-C' AND VENT/SPARGE SECTION

PROJECT #: 6281001	PROJECT PHASE: 01	PROJECT MANAGER: TM

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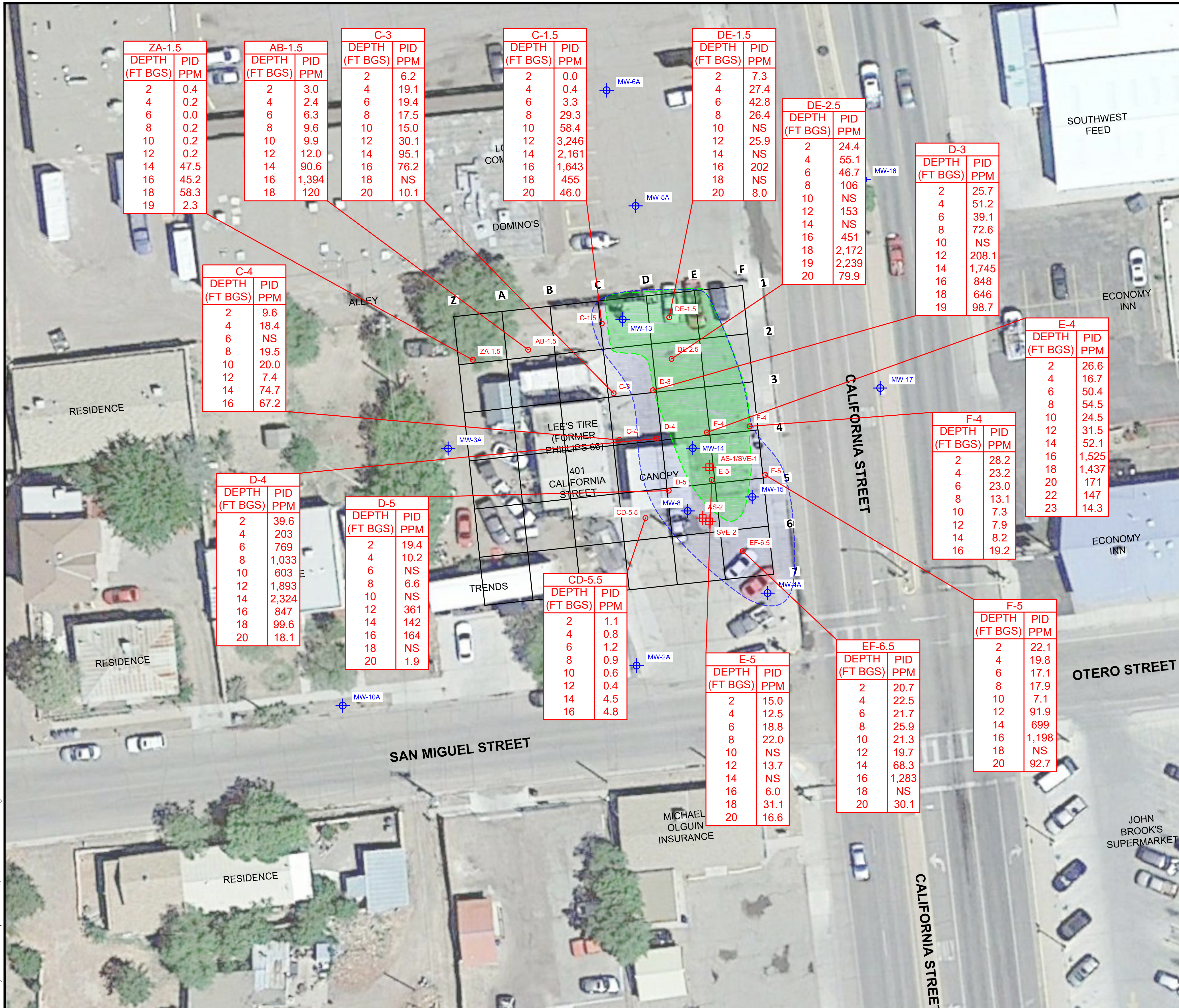

ZA-1.5

DEPTH (FT BGS)	PID PPM
2	0.4
4	0.2
6	0.0
8	0.2
10	0.2
12	0.2
14	47.5
16	45.2
18	58.3
19	2.3

AB-1.5

DEPTH (FT BGS)	PID PPM
2	3.0
4	2.4
6	6.3
8	9.6
10	9.9
12	12.0
14	90.6
16	1,394
18	120

C-3

DEPTH (FT BGS)	PID PPM
2	6.2
4	19.1
6	19.4
8	17.5
10	15.0
12	30.1
14	95.1
16	76.2
18	NS
20	10.1

C-1.5

DEPTH (FT BGS)	PID PPM
2	0.0
4	0.4
6	3.3
8	29.3
10	58.4
12	3,246
14	2,161
16	1,643
18	455
20	46.0

DE-1.5

DEPTH (FT BGS)	PID PPM
2	7.3
4	27.4
6	42.8
8	26.4
10	NS
12	25.9
14	NS
16	202
18	NS
20	8.0

DE-2.5

DEPTH (FT BGS)	PID PPM
2	24.4
4	55.1
6	46.7
8	106
10	NS
12	153
14	NS
16	451
18	2,172
19	2,239
20	79.9

D-3

DEPTH (FT BGS)	PID PPM
2	25.7
4	51.2
6	39.1
8	72.6
10	NS
12	208.1
14	1,745
16	848
18	646
19	98.7

C-4

DEPTH (FT BGS)	PID PPM
2	9.6
4	18.4
6	NS
8	19.5
10	20.0
12	7.4
14	74.7
16	67.2

E-4

DEPTH (FT BGS)	PID PPM
2	26.6
4	16.7
6	50.4
8	54.5
10	24.5
12	31.5
14	52.1
16	1,525
18	1,437
20	171
22	147
23	14.3

F-4

DEPTH (FT BGS)	PID PPM
2	28.2
4	23.2
6	23.0
8	13.1
10	7.3
12	7.9
14	8.2
16	19.2

D-4

DEPTH (FT BGS)	PID PPM
2	39.6
4	203
6	769
8	1,033
10	603
12	1,893
14	2,324
16	847
18	99.6
20	18.1

D-5

DEPTH (FT BGS)	PID PPM
2	19.4
4	10.2
6	NS
8	6.6
10	NS
12	361
14	142
16	164
18	NS
20	1.9

CD-5.5

DEPTH (FT BGS)	PID PPM
2	1.1
4	0.8
6	1.2
8	0.9
10	0.6
12	0.4
14	4.5
16	4.8

E-5

DEPTH (FT BGS)	PID PPM
2	15.0
4	12.5
6	18.8
8	22.0
10	NS
12	13.7
14	NS
16	6.0
18	31.1
20	16.6

EF-6.5

DEPTH (FT BGS)	PID PPM
2	20.7
4	22.5
6	21.7
8	25.9
10	21.3
12	19.7
14	68.3
16	1,283
18	NS
20	30.1

F-5

DEPTH (FT BGS)	PID PPM
2	22.1
4	19.8
6	17.1
8	17.9
10	7.1
12	91.9
14	699
16	1,198
18	NS
20	92.7

LEGEND:

- MW-3A — EXISTING MONITORING WELL
- F-4 — SOIL BORING LOCATIONS
- EDGE OF PAVEMENT
- 20' X 20' GRID
- FT — FEET
- BGS — BELOW GROUND SURFACE
- PID — PHOTOIONIZATION DETECTOR
- PPM — PARTS PER MILLION
- EXTENT OF EXCAVATION
- EXTENT OF PIDs ABOVE 100 PPMV

40 20 0 40
SCALE IN FEET

FORMER PHILLIPS 66
401 CALIFORNIA STREET
SOCORRO, NEW MEXICO

FIGURE 9
2014 GEOPROBE INVESTIGATION PHOTOIONIZATION DETECTOR DATA

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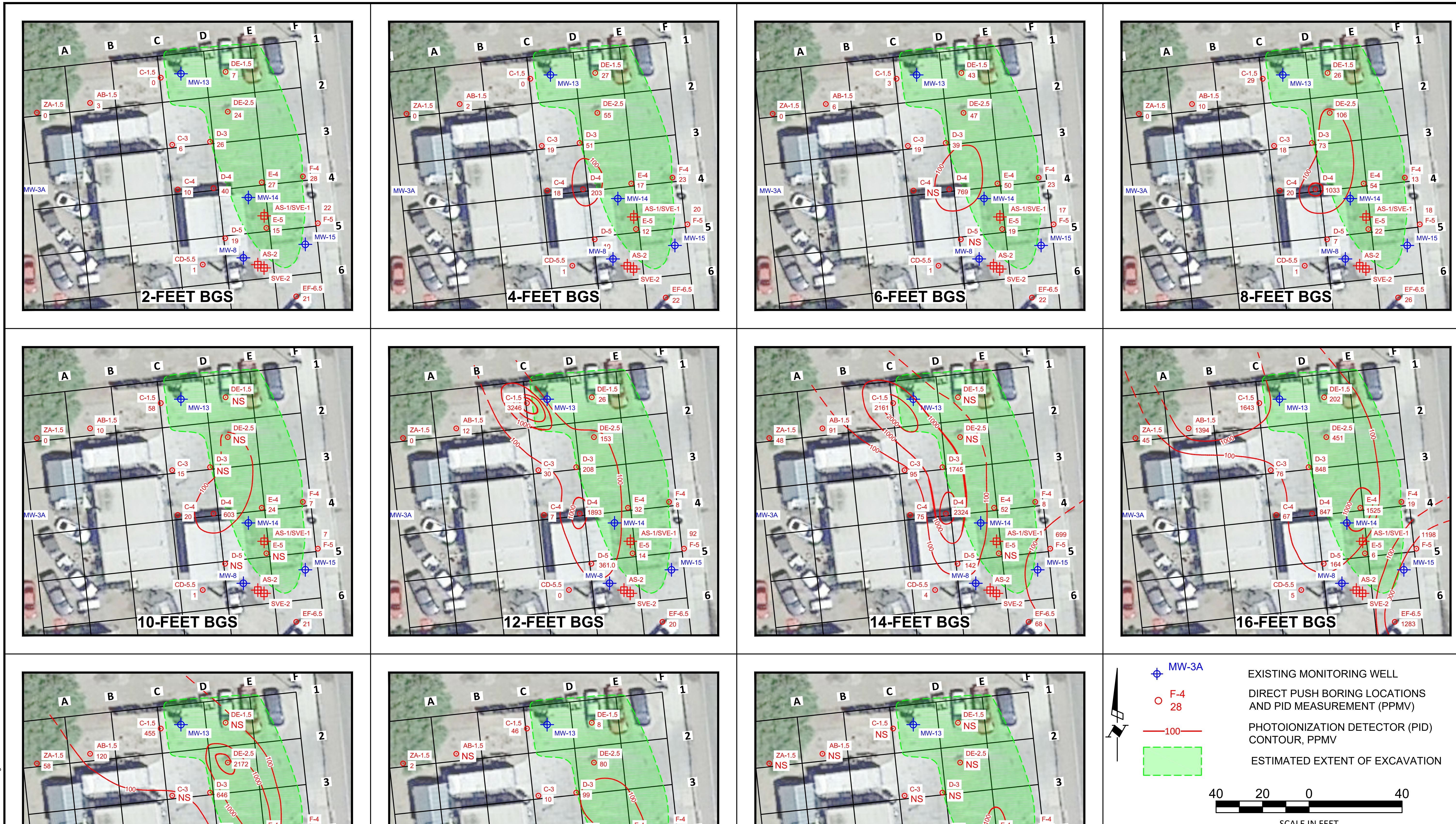

FORMER PHILLIPS 66
401 CALIFORNIA STREET
SOCORRO, NEW MEXICO

FIGURE 10
2014 GEOPROBE SURVEY RESULTS

PROJECT #: 6281001 | PROJECT PHASE: 01 | PROJECT MANAGER: TM

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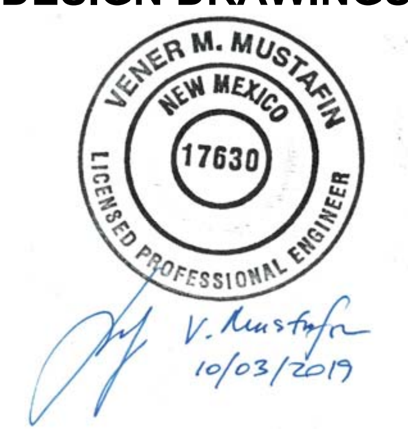
APPENDIX A – DESIGN DRAWINGS



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LEGEND:

MW-3A	EXISTING MONITORING WELL
AS-1/SVE-1	EXISTING REMEDIATION WELL (SPARGE/VENT)
	HORIZONTAL SPARGE WELL, DASHED LINE INDICATES SCREEN
	HORIZONTAL SVE WELL, DASHED LINE INDICATES SCREEN
	EXTENT OF BTEXN IN GROUNDWATER REQUIRING CORRECTIVE ACTION
OHE	OVERHEAD ELECTRIC LINE
UE	UNDERGROUND ELECTRIC LINE
WATER	UNDERGROUND WATER LINE
SEWER	UNDERGROUND SEWER LINE
GAS	UNDERGROUND SEWER LINE
	LIMIT OF EXCAVATION, CIRCA 2003
	SPARGE ZONE OF INFLUENCE ROI OF 20 FEET
	VENT ZONE OF INFLUENCE ROI OF 40 FEET

NOTE: FOR WELL DETAILS AND PROFILE, SEE DRAWING C-2

VENER M. MUSTAFIN
NEW MEXICO
17630
LICENSED PROFESSIONAL ENGINEER

V. Mustafin
06/14/2019

REV	DATE	DRAWN	CHECKED	REMARKS
0	6/14/19	6/14/19	VM	18371-3 FRP

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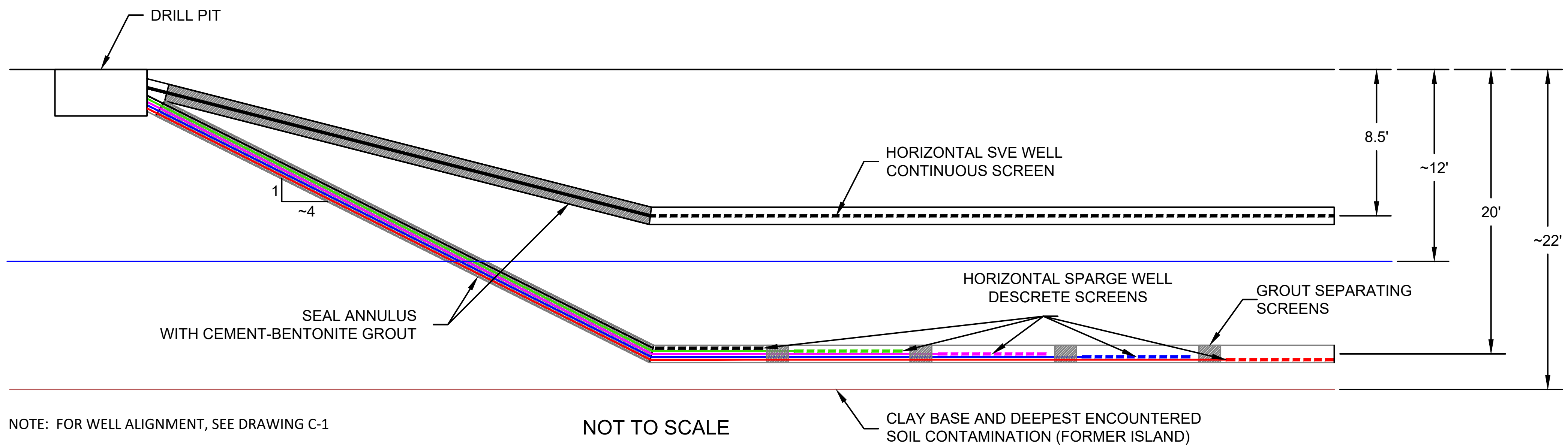
DESIGNED BY: VMM
DRAWN BY: VMM
CHECKED BY: JS

FORMER PHILLIPS 66
401 CALIFORNIA STREET, SOCORRO, NEW MEXICO

HORIZONTAL VENT/SPARGE WELL LAYOUT

PROJECT NUMBER: 6281002

DRAWING NO.: C-1



NOTE: FOR WELL ALIGNMENT, SEE DRAWING C-1

NOT TO SCALE

Horizontal Wells Details

Item	Vent Wells	Air Sparge Wells
Drilling Method	Horizontal Directional Drilling Mud Rotarty	Horizontal Directional Drilling Mud Rotarty
Drilling Fluid	Bio-Degradable Polymer	Bio-Degradable Polymer
Borehole Diameter	6 inches minimum	6 inches minimum
Material	Sch. 80 PVC	Vertebrae™
Diameter	2-inch nominal diameter	1-inch nominal diameter
Well Screen	Four 3-inch 0.020-inch slots per foot (0.24 square inch per foot)	Vertebrae™ 0.060-inch (5 square inch per foot)
Well Screen Wrap	Not Applicable	88-micron geotextile Vertebrae™ screen
Well Blank	2-inch nominal Sch 80 PVC	1-inch nominal HDPE or PVC
Segment Grout	Not Applicable	EN Rx portland/bentonite expands by >30%

Well Length Details

Well ID	Well Blank	Well Screen	Total
HAS-1	85	15	100
HAS-2	105	15	120
HAS-3	125	15	140
HAS-4	93	15	108
HAS-5	113	15	128
HAS-6	133	15	148
HAS-7	153	15	168
HAS-8	97	15	112
HAS-9	117	15	132
HAS-10	137	15	152
HAS-11	157	15	172
HAS-12	177	15	192
Sparge Total	**1,492**	**180**	**1,672**
HSVE-1	90	50	140
HSVE-2	100	75	175
	190	**125**	**315**

Trench and Underground Piping

Item	Air Sparge	Vent
Diameter	1-inch diameter	2-inch diameter
Material	HDPE SDR 13	HDPE or PVC
Burial Depth	18" minimum	18" minimum
Trench Base	3" thick sand	3" thick sand
Backfill Around Pipe	Sand up to 6" above the pipe crow n	Sand up to 6" above the pipe crow n
Tracer	Metal tape w ithin 6-12" below surface	Metal tape w ithin 6-12" below surface
Top Fill	Native fill compacted in 6-inch lifts w ithout testing 5-passes minimum	Native Fill Compacted in 6-inch lifts w ithout testing, 5-passes minimum
Trench Width	36 inches w ide	

Cluster Details

Cluster	Segments	Number of Segments*
Cluster 1	HAS-1, HAS-2, HAS-3	3
Cluster 2	HAS-4, HAS-5, HAS-6, HAS-7	4
Cluster 3	HAS-8, HAS-9, HAS-10, HAS-11, 12	5
Cluster 4	HSVE-1	1
Cluster 5	HSVE-2	1

* w ithin single borehole

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0	6/14/19	6/14/19	VM	VM 18371-3 FRP
1	7/24/19	7/24/19	VM	VM REVISION 1

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Fax: (505) 224-9016

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FORMER PHILLIPS 66
SOCORRO, NEW MEXICO

HORIZONTAL WELL PROFILE AND DETAILS

PROJECT NUMBER: 6281002

DRAWING NO.: C-2

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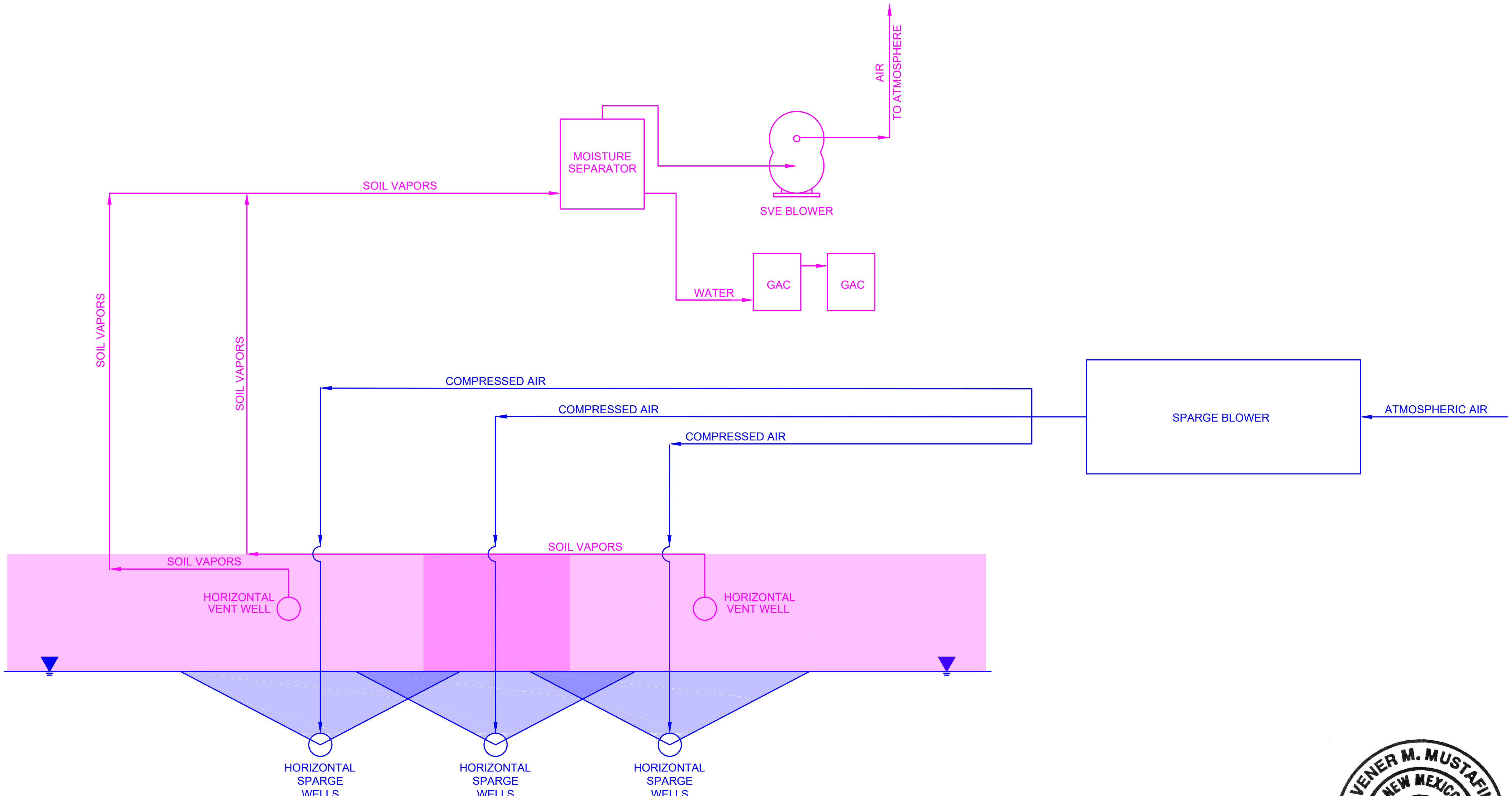

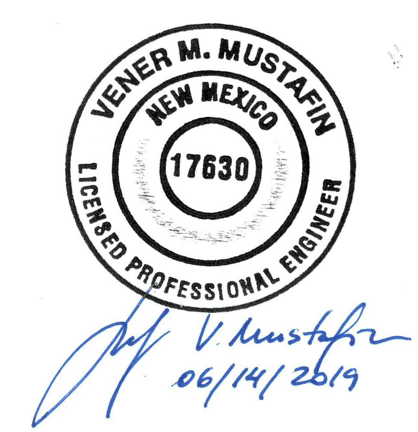

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FORMER PHILLIPS 66
SOCORRO, NEW MEXICO

PROCESS FLOW DIAGRAM

PROJECT NUMBER: 6281002

DRAWING NO.: P-1

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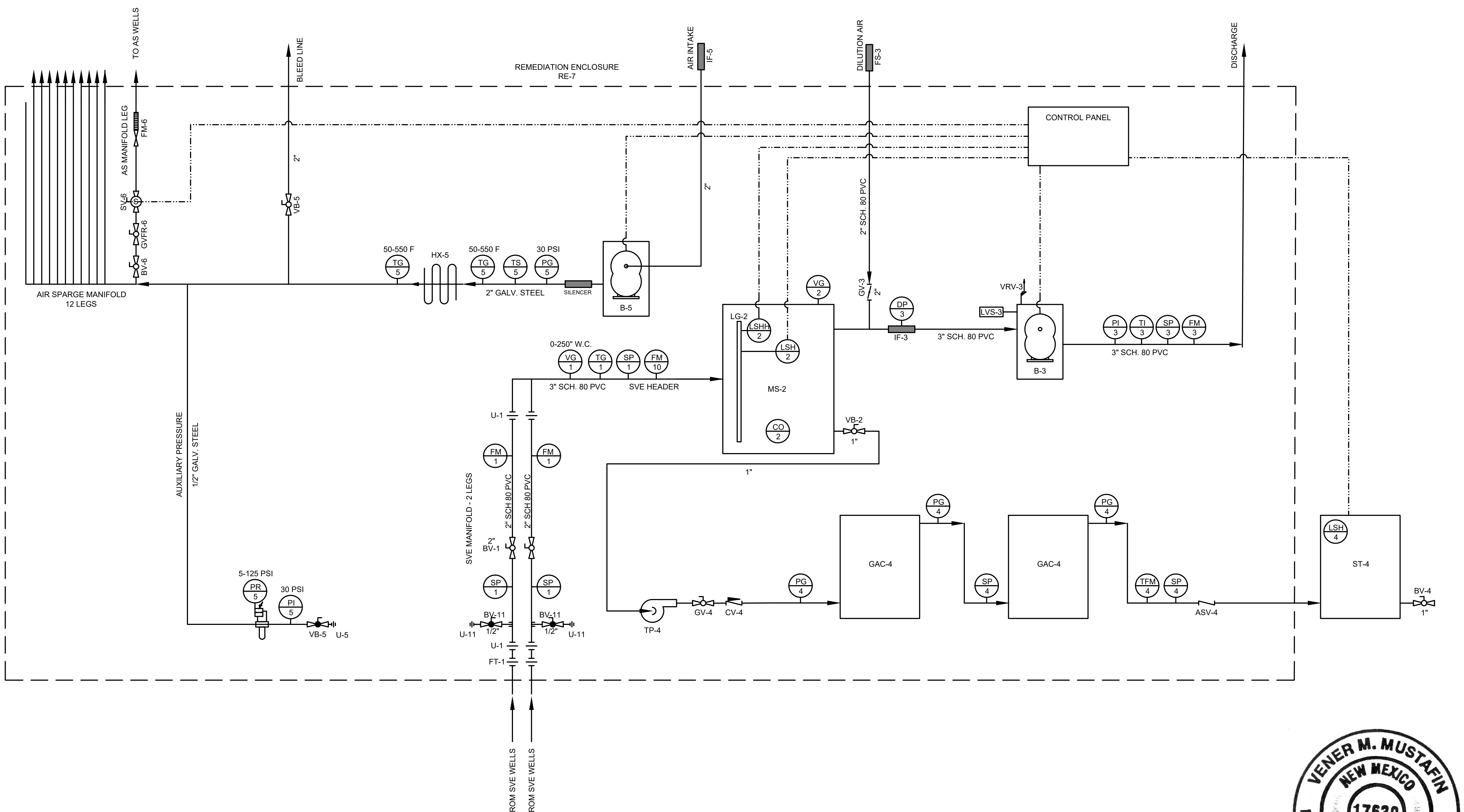

NOTES:

1. THE VENDOR SHALL PRE-PLUMB AND PRE-WIRE ALL EQUIPMENT INSIDE THE ENCLOSURE AND PROVIDE IT AS A "TURN-KEY".
2. ALL EQUIPMENT AND WIRING INSIDE THE ENCLOSURE SHALL CONFORM TO NATIONAL ELECTRICAL CODE DIVISION I CLASS II LOCATION REQUIREMENTS.
3. SPARGE MODULE SHALL BE INTERLOCKED WITH THE SVE MODULE. IF SVE MODULE STOPS, SPARGE MODULE SHALL SHUT DOWN AUTOMATICALLY.

VENER M. MUSTAFIN
NEW MEXICO
17630
LICENSED PROFESSIONAL ENGINEER

06/14/2019

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REV.	DATE	DRAWN	CHECKED	REMARKS
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FORMER PHILLIPS 66
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PIPING AND INSTRUMENTATION DIAGRAM
SHEET 1 OF 2

PROJECT NUMBER: 6281002

DRAWING NO.: P-2

Item	Description
SVE MANIFOLD	
BV-1	2” PVC ball valves
BV-11	Ball valve, 1/2 inch, brass of bronze
FM-1	Rotameter 10-100 scfm
FT-1	Transition Fitting
SP-1	Sample port
U-1	Union, 2"
U-11	Union, 1/2", quick connect
SVE HEADER	
VG-1	Vacuum gauge, 250 inwc, industrial
TG-1	Temperature gauge, 100 degrees F
SP-1	Sampling port
FM-10	3" Dwyer DS-300 pitot tube on blower discharge, w/ differential pressure gauge
MOISTURE SEPARATOR	
MS-2	Moisture Separator, 40 gallon, steel, enamel finish
LG-2	Level glass
VB-2	Dran valve, 1"
LSH-2	Level swithc high
LSHH-2	Lelevl switch high-high
CO-2	Cleanout, 6"
VG-2	Vacuum gauge, 250 inwc, industrial
SVE BLOWER	
B-3	Blower, FPZ model K07-MS-7.5, regenerative blower, 7.5 HP, 230/460 VAC, 3Ø, 60 Hz, TEFC motor with integral inlet & outlet silencers
DP-3	Differential pressure gauge
FM-3	4” Dwyer DS-300 pitot tube on blower discharge, w/ differential pressure gauge
FS-3	2” Filter/silencer, Solberg FS-231P-200
GV-3	2” Gate valve
IF-3	3” inline filter, Solberg model CT-235P-300 with 10 micron replaceable element
LVS-3	Low vacuum switch on blower intake
PI-3	Pressure gauge on blower discharge
SP-3	Sample port on blower discharge
TI-3	Temperature gauge on blower discharge
VRV-3	Vacuum relief valve on blower inlet
TRANSFER PUMPS	
TP-4	Trasnfer pump, AMT 489 centrifugal pump, 3/4-HP, 230/460VAC, 3Ø, TEFC motor
CV-4	Check valve
GV-4	Glove valve, 1"
PG-4	Pressure gauge, SS, liquid-filled
FILTRATION MODULE	
GAC-4	Liquid vessel, 1-20 gpm, 150-psi design rating, 250-lb, 8x30 mesh carbon
PG-4	Pressure gauge, liquid-filled, 50 psi
ST-4	Storage Tank, 250 gallons, plastic
ASV-4	Anti-siphon valve
TFM-4	Totalizing flowmeter
BV-4	Ball valve, 1"
SPARGE MODULE	
B-5	Rotary claw blower, Busch model MM1102BP, 10 HP, 230/460VAC, 3Ø, TEFC motor
	Capable of 70 ICFM at 20 psi discharge pressure (approx. 60 scfm at 4600 ft elevation)
	Silencer on blower discharge, Stoddard
IF-5	2” Inlet air filter with replaceable element, Solberg CSL-851-200HC
PG-5	Pressure gauge, 0-30 psig, liquid-filled
TG-5	Temperature gauge, 50-550°F
TS-5	Temperature switch on blower discharge, Barksdale model M1H
Heat Exchanger	
HX-5	American Industrial model ACA-3302 heat exchanger,
	Aluminum finned plate heat exchanger with steel shroud and stand
	1/2 hp, 230/460 VAC three phase TEFC motor
	30 Degree F approach temperature at 100 cfm
	Ducted in and out of enclosure with louvers and insulated sound cover
	Temperature gauge on discharge, 50-550 F
TG-5	Temperature gauge, 50-550°F
AIR SPARGE MANIFOLD	
BV-6	1” brass ball valve
GVFR-6	1” Brass globe valve flow regulator
SV-6	Solenoid Valve, 120 VAC, brass, NEMA 4
FM-6	Flow meters, Dwyer Series UVC rotameter flow meters
REMEDIATION ENCLOSURE	
RE-7	Modified Cargo box enclosure system, 8’ wide x 20’ long x 8’6” high outside dimension
	Welded steel container with 2” fir decking
	Floor sealed with non-skid bed liner
	R-13 Insulation walls and ceiling with 2x4 furring and plywood interior
	Anchor lugs and lifting eyes
	Double rear doors with cam lock
	Sound insulated louver covers for vent air intake and exhaust louvers
	Spray urethane foam under floor, Min R-13
	Floor sump w/ high level switch
	Wall mounted explosion proof electric convection heater with thermostat, 3600 Watt
	Ceiling mounted explosion proof lights with vapor globe and wall switch
	Explosion proof 16” vent fan with inlet & outlet louvers, wall-mount cabinet, and thermostat

VENER M. MUSTAFIN
NEW MEXICO
17630
LICENSED PROFESSIONAL ENGINEER

V. Mustafin 06/14/2019

DRAWING NO.: P-3
PROJECT NUMBER: 6281002

FORMER PHILLIPS 66
SOCORRO, NEW MEXICO

PIPING AND INSTRUMENTATION DIAGRAM
SHEET 2 OF 2

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC. PBC
320 Gold Avenue, SW Suite 1300
Albuquerque, NM 87102
Phone: (505) 224-9013
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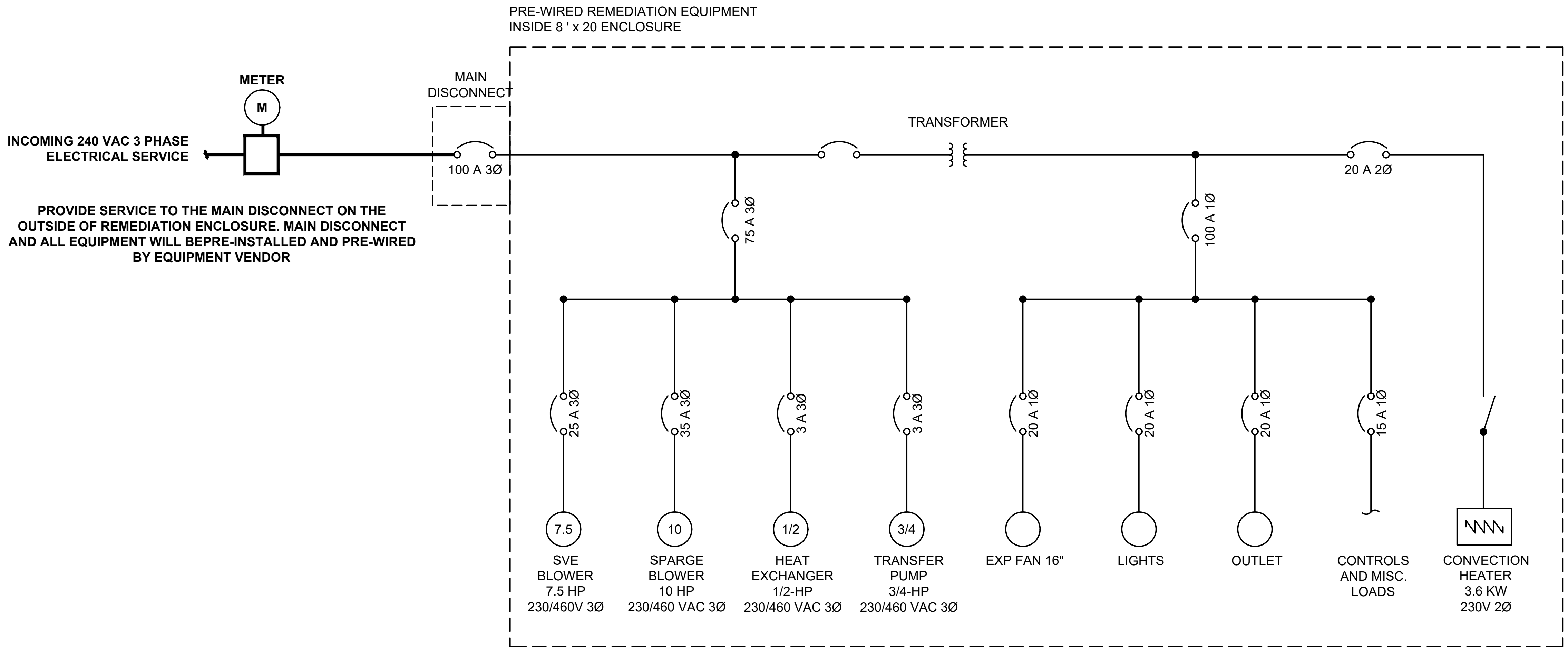
DESIGNED BY: VM
DRAWN BY: VM
CHECKED BY: JS

REV.	DATE	DRAWN	CHECKED	REMARKS
0	06/14/19	06/14/19	VM	18371-3 FRP

REVISIONS



PROVIDE SERVICE TO THE MAIN DISCONNECT ON THE OUTSIDE OF REMEDIATION ENCLOSURE. MAIN DISCONNECT AND ALL EQUIPMENT WILL BEPRE-INSTALLED AND PRE-WIRED BY EQUIPMENT VENDOR

NOTES:
1. ALL EQUIPMENT WILL BE DELIVERED PRE-WIRED BY THE REMEDIATION EQUIPMENT VENDOR
2. WIRING WILL BE PER NATIONAL ELECTRIC CODE FOR CLASS 1, DIVISION 2, GROUP D HAZARDOUS ENVIRONMENT INSIDE ENCLOSURE
3. ALL OUTSIDE WIRING SHALL BE NON-CLASSIFIED BEYOND 3 FEET FROM ANY OPENING
4. ALL WIRING WILL BE INSPECTED AND APPROVED PRIOR TO DELIVERY TO THE SITE

VENER M. MUSTAFIN
NEW MEXICO
17630
LICENSED PROFESSIONAL ENGINEER

V. Mustafin
06/14/2019

REV	DATE	DRAWN	CHECKED	REMARKS
0	6/14/19	6/14/19	VM	18371-3

REVISIONS

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FORMER PHILLIPS 66
SOCORRO, NEW MEXICO

ONE-LINE ELECTRIC DIAGRAM

PROJECT NUMBER: 6281002

DRAWING NO.: E-1

P:\Active Projects\Socorro Phillips 66\Phase 3, 4 and 5\18371-3 - FRP\Drawings

APPENDIX B – SPECIFICATIONS

SPECIFICATION 03 30 00
CONCRETE, FORMS AND REINFORCEMENT

CAST-IN-PLACE CONCRETE

1.1 SUMMARY

A. DEFINITION: This Section includes concrete, forms, and steel reinforcement.

1.2 REFERENCES

A. APPLICABLE STANDARDS

1. American Concrete Institute (ACI)

   a. 304 Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete
   b. 305 Committee Report on Hot Weather Concreting
   c. 306 Committee Report on Cold Weather Concreting
   d. 315 Manual of Standard Practice for Detailing Reinforced Concrete Structures
   e. 318 Building Code Requirements for Reinforced Concrete

2. American National Standards Institute (ANSI)

   a. B18.2.1 Square and Hex Bolts and Screws, Including Askew Head Bolts, Hex Cap Screws, and Lag Screws
   b. B18.2.2 Square and Hex Nuts

3. American Society for Testing and Materials (ASTM)

   a. A36 Structural Steel
   b. A82 Cold Drawn Steel Wire for Concrete Reinforcement
   c. A185 Welded Steel Wire Fabric for Concrete Reinforcement
   d. A307 Low Carbon Steel Externally and Internally Threaded Standard Fasteners
   e. A615 Deformed and Plain Billet Steel Bars for Concrete Reinforcement, Grade 60
   f. C31 Making and Curing Concrete Compression and Flexure Test Specimens in the Field
   g. C33 Concrete Aggregates
   h. C39 Compressive Strength of Cylindrical Concrete Specimens
   i. C94 Ready Mixed Concrete
   j. C143 Slump of Portland Cement Concrete
   k. C150 Portland Cement
   l. C172 Sampling Fresh Concrete
   m. C260 Air Entraining Admixtures for Concrete
   n. C309 Liquid Membrane-Forming Compounds for Curing Concrete
   o. C494 Chemical Admixtures for Concrete
   p. C1116 Fiber-Reinforced Concrete and Shotcrete
   q. C138, C173, or C231 Testing for Air Content

PART 2—PRODUCTS

2.1 CONCRETE MATERIALS

A. CEMENT: Conform to ASTM C150. Portland cement Type I or III.

B. WATER: Clean and free from injurious amounts of oil, acids, alkalies, or other deleterious substances. Any potable water is acceptable.

C. FINE AGGREGATES: Clean natural sand. Manufactured sand may be used upon written approval of ENGINEER. Conform to ASTM C33.

D. COARSE AGGREGATES: Clean crushed stone or processed gravel, not containing organic materials. Conform to ASTM C33.

E. WATER-REDUCING ADMIXTURE: Conform to ASTM C494, Type A.

F. WATER-REDUCING ADMIXTURE: Conform to ASTM C260.

G. FIBER REINFORCEMENT: Conform to ASTM C1116, Type III Synthetic Fiber-Reinforced Concrete.

2.2 CONCRETE MIX PROPORTIONS

A. MIX DESIGN SHALL BE PREPARED WITH THE FOLLOWING PROPORTIONS AND LIMITATIONS:

1. Minimum compressive strength of 3,000 psi at 28 days, unless otherwise specified on the drawings.
2. Minimum cement: 564 pounds per cubic yard
3. Slump: 5 inches maximum
4. Air Entrainment:

Maximum Size Coarse Aggregate (inches)	Air Content (percent by volume)
3/8	6 - 10
1/2	5 - 9
3/4	4 - 8
1	3.5 - 6.5
1.5	3 - 6
2	2.5 - 5.5
3	1.5 - 4.5

B. READYMIXED CONCRETE

1. Concrete shall meet requirements of ASTM C94 and of materials and proportions specified.
2. Ready-mixed concrete plant shall be subject to approval of the ENGINEER.

2.3 FORMS

A. FORM MATERIALS: Use one of the following:

1. Exterior grade 5/8”-inch-thick plywood (use only plywood or steel for all exposed concrete work).
2. Steel.
3. Approved wood fiberboard.
4. Dressed lumber free of loose knots.

B. FORM TIES: Approved break back-type.

2.4 STEEL REINFORCEMENT

A. REINFORCEMENT BARS: Conform to ASTM A615 of A706, Grade 60 for all bars number 4 or larger.

B. TIE ALL BARS, NO. 3 AND LARGER: Conform to ASTM A615, Grade 50.

C. WELDED WIRE FABRIC: Conform to ASTM A185, using bright basic wire conforming to ASTM A82. Wire gauge number 11 or smaller shall be galvanized.

D. BOLSTERS, CHAIRS, AND ACCESSORIES: Conform to ACI 315.

2.5 FIBER REINFORCEMENT

A. 100 percent virgin polypropylene fibrillated fibers containing no reprocessed olefin materials and specifically manufactured for use as concrete secondary reinforcement.

B. Volume per cubic yard shall equal a minimum of 0.1 percent (1.5 pounds).

C. Fibers are for the control of cracking due to drying shrinkage and thermal expansion/contraction, reduction of permeability, increased impact capacity, shatter resistance, abrasion resistance, and added toughness.

2.6 GROUT FOR BONDING

A. One (1) part cement to 1-1/2 parts sand by weight.

B. Keep water to a minimum.

C. Place immediately.

2.7 ANCHOR BOLT

A. Provide all anchor bolts required for complete installation.

B. Anchor bolts and accessories shall conform to ASTM A307 using A36 steel.

C. Use hexagonal bolts and nuts conforming to ANSI B18.2.1 and B18.2.2.

PART 3—EXECUTION

3.1 FIELD TESTING

A. FIELD TESTING OF CONCRETE AND MAKING OF CONCRETE TEST CYLINDERS

1. Test concrete conforming to ASTM C143 and C172.
2. Perform slump tests throughout any placement as required to maintain constant quality of fresh concrete, and as requested by the ENGINEER.
3. Field testing may be void for self-weight bearing structures with ENGINEER's approval. The CONTRACTOR shall provide batch plant mix specification for nominal concrete strength used in construction.
4. Field testing is not required for small structures such as well vaults, small equipment pads, or any other structures less than 10 square feet in area or 2.5 cubic feet in volume.

3.2 PLACING OF CONCRETE

A. PREPARATION

1. Clean bonding surfaces free from foreign materials.
2. Place concrete on properly prepared and unfrozen subgrade and only in dewatered excavations.
3. Do not deposit partially hardened concrete or concrete contaminated by foreign materials.

B. PLACING CONCRETE

1. Conform to ACI 304.
2. Place on prepared subgrade using hand placement methods and screed to final grade.
3. Place within 45 minutes after mixing, unless the ENGINEER extends the period to 90 minutes (maximum) dependent upon weather conditions.
4. Place in horizontal layers not exceeding 18 inches.
5. Vibrate concrete to produce solid mass without honeycomb or surface air bubbles.
6. After initial set, finish and neatly edge concrete.

C. CURING CONCRETE

1. Cure exposed surfaces with liquid membrane-forming compound conforming to ASTM C309, Type I. Apply according to manufacturer's recommendations.
2. Apply curing compound immediately after removing form or after finishing concrete.
3. Keep formwork wet until stripped.

D. COLD WEATHER PLACING: Conform to the practice recommended in ACI 306 when the temperature is below 40 degrees Fahrenheit (F) or is likely to fall below 40 degrees F during 24-hour period after placing.

E. HOT WEATHER PLACING: Conform to practices recommended in ACI 305 when temperature is 90 degrees F or above or is likely to rise above 90 degrees F within 24 hours after placing.

3.4 SURFACE FINISHES

A. FLOAT FINISH

1. Compact, accurately screed and wood float all slabs to a true uniform surface.
2. Test surface with straightedge and eliminate high and low spots of more than 1/8 inch in 10 feet.
3. Use this finish in addition to the finishes specified below for all surfaces as indicated.
4. Use as final finish for slabs not exposed.

B. BURLAP FINISH

1. Apply burlap surface treatment to exposed edges of slabs, curbs, and foundations.
2. Wet and fill all voids using mortar with the same sand-cement ratio as original concrete.
3. In a circular motion, use a burlap or canvas cloth to strike off all excess mortar flush with the surface.
4. Remove all rough spots and rub with cloth to leave a surface of uniform texture and appearance.
5. Finish shall result in a coating of mortar that will fill all small voids and air holes, leaving a smooth surface.
6. Cure as specified under "Curing Concrete".

C. DEFECTIVE SURFACE TREATMENTS

1. After removal of forms, remove all fins, projections, and form ties.
2. Grout and cure all voids, damaged areas, and tie holes.

3.5 FORMS

A. Treat forms with an approved oil or lacquer prior to placing reinforcement.

B. Wet forms with clean, clear water prior to placing concrete.

C. Adequately brace and stiffen forms to prevent deflection and settlement.

3.6 STEEL REINFORCEMENT

A. Place accurately, tie at intersections, and support on chairs. Conform to ACI 318.

B. Tie securely with 16-gauge or larger annealed iron wire.

C. Unless otherwise indicated, the minimum length of lap for tension lap splices shall be as required for Class B splices as defined by ACI 318.

D. Lap-welded wire fabric not less than the length of one (1) mesh.

E. Manual lifting during or after concrete placement is not permitted.

END OF SPECIFICATION 03 30 00

SPECIFICATION 31 00 00

SITE PREPARATION AND EARTHWORK

PART 1—GENERAL

1.1 SUMMARY

A. DEFINITION: This section includes all trenching, excavating, construction, backfilling, compacting, and all related items necessary to complete the work indicated or specified.

1.2 REFERENCES

A. APPLICABLE STANDARDS

1. American Society for Testing and Materials (ASTM)

a. C88—Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
b. D698—Standard Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3)
c. D1241—Materials for Soil-Aggregate Sub-base, Base, and Surface Courses
d. D4253—Maximum Index Density of Soils Using a Vibratory Table
e. D4254—Minimum Index Density of Soils and Calculation of Relative Density
f. ASTM C33 – Standard Specification for Concrete Aggregate
g. ASTM D6938 - 10 Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods

PART 2—MATERIALS

2.1 SUITABLE BACKFILL MATERIAL: Suitable backfill, as defined below, shall be free of debris, roots, organic matter, frozen matter, and stones or solid rubble (brick and/or concrete or asphalt pavement).

A. CLEAN IMPORTED FILL shall have rating of excellent or good by AASHTO classification and shall include Classes A-1-a, A-1-b, A-2-4, A-2-5, and A-3, conforming to the following:

PARAMETER	**AASHTO CLASS**				
	A-1-a	A-1-b	A-2-4	A-2-5	A-3
Sieve Analysis					
% passing					
#10	50 max				
#40	30 max	50 max			51 max
#200	15 max	25 max	35 max	35 max	10 max
Liquid Limit			40 max	41 min	
Plasticity Index	6 max	6 max	10 max	10 max	Non plastic
Usual Type	sand and gravel		silty sand and gravel		fine sand
General Subgrade Rating	excellent to good				

B. SAND BEDDING/FILL shall consist of clean sand (SP, SW, SP-SM, or SW-SM by USCS Soil Classification).

C. BASE COURSE shall consist of crushed stone or screened gravel, caliche, sand, reclaimed asphalt pavement or combination of these material and conform to the following gradation:

Sieve Size	% Passing
1 inch	100
3/4-inch	80-100
No. 4	30-60
No. 10	20-45
No. 200	3-10

D. Excavated overburden in the un-trafficked unpaved areas may be used as backfill with the approval of the ENGINEER. Under pavement, in order to be re-used, excavated overburden must have rating of excellent or good by AASHTO classification.

2.2 UNSUITABLE BACKFILL MATERIAL: Materials unsuitable for use as compacted backfill include all material that contains debris, roots, organic matter, frozen matter, stones (with any dimension greater than 2-inch diameter), or other materials that are determined by the ENGINEER as too wet or otherwise unsuitable for providing a stable subgrade.

2.3 GEOTEXTILE: Geotextile shall be non-woven, have density of not less than 6 ounces per square yard, and minimum grab tensile strength of 160 pounds

2.3 UNDERGROUND LOCATOR TAPE shall be underground utility locating tape, minimum 3” wide, 5-mil with aluminum or ferrous backing.

2.4 REMOVED ASPHALT OR CONCRETE: Asphalt or concrete pavement removed during construction will not be allowed for use as trench backfill. Final disposal and/or recycling of concrete or asphalt pavement rubble will be the responsibility of the CONTRACTOR. The CONTRACTOR must obtain ENGINEER's approval of the intended disposal and/or recycling plan for these materials before hauling any of the material off-site.

2.5 REPLACEMENT CONCRETE: Replacement Concrete shall be in accordance with the specification CAST-IN-PLACE CONCRETE.

2.6 REPLACEMENT ASPHALT. Replacement Asphalt shall be hot plant asphalt mix conforming to Section 423 of the New Mexico Department of Transportation Specifications for Highway and Bridge Construction.

2.7 REINFORCING BAR. Reinforcing Bar shall be Grade 50 minimum deformed steel bar.

PART 3—EXECUTION

3.1 GENERAL

A. The CONTRACTOR shall establish construction exclusion zone by barricading and taping the construction site prior to beginning earthwork.
B. The CONTRACTOR shall request utility clearance prior to excavation. All underground utilities shall be located and clearly marked before any excavation work begins.
C. Open trenches and excavations shall be kept to a minimum to allow access to site facilities. No open trenches or excavations will be allowed at the end of each day or over weekends, unless thoroughly barricaded and protected.
D. Steel plates, fences, barricades and other measures necessary shall be used to maintain access to the site and to protect all site occupants and visitors.
E. Extreme care shall be exercised while operating heavy equipment around the existing structures and overhead electrical lines.

3.2 ASPHALT/CONCRETE REMOVAL. All asphalt and/or concrete cover shall be saw cut to the dimensions and alignment of the trenches and to the extent of asphalt re-pavement shown on the drawings to minimize damage to existing covered areas.

3.3 TRENCHING. Trenching shall be dug to the depths and width specified on the drawings. The dimensions shown on the drawings are the minimum required.

3.4 CROSSING AND PROTECTING EXISTING UTILITIES. The CONTRACTOR shall offset the conveyances at least 6 inches from the existing utilities and shall protect the existing utilities.

3.5 PIPE BENDING RADIUS. The minimum HDPE pipe bending radius shall be 25 times the outside pipe diameter.

3.6 BACKFILLING. Backfilling shall be done in accordance with the design drawings. Piping and conveyance within the portion of the trench designated for backfilling shall be tested prior to backfilling. Backfilling lifts shall not exceed six inches for clean fill. Underground utility locator tape shall be placed within one foot of the surface.

3.7 COMPACTION OF CLEAN IMPORTED FILL UNDER PAVEMENT. Under pavement, clean imported backfill shall be compacted starting six (6) inches above the crown of the pipe. Compaction shall be 95 % maximum density as determined by Standard Proctor (ASTM D698) in six (6-inch) maximum lifts; moisture shall be within ±3% of optimum. Compaction shall be done with vibrating plate or jumping jack. Compaction without testing will be permitted under direct supervision of the ENGINEER or ENGINEER-representative; in such case, compaction shall be done in four (4-inch) lifts with a minimum 8 passes back and forth using vibrating plate or jumping jack.

3.8 COMPACTION OF BASE COURSE IN TRENCHES. Base course shall be compacted to 97% maximum as determined by Standard Proctor (ASTM D698) in six (6-inch) maximum lifts; moisture shall be within ±3% of optimum. Vibratory plate, jumping jack, wheel rolling, or vibratory drum rolling may be used for compaction of the base course in the trenches. Compaction without testing will be permitted under direct supervision of the ENGINEER or ENGINEER-representative; in such case, compaction shall be done in four (4-inch) lifts with a minimum 8 passes back and forth using vibrating plate or jumping jack.

3.9 COMPACTION IN UN-TRAFFICKED AREAS. Native fill may be used for backfill and compaction in un-trafficked areas, if meeting requirements specified in Part 2. Compacting shall be performed in six (6-inch) maximum lifts with 5 passes back and forth using vibrating plate or jumping jack.

3.10 COMPACTION TESTING. When required, compaction testing shall be done by ASTM D6938-10 using field nuclear testing. The contractor shall provide field testing documentation to the ENGINEER before payment for underground construction is issued. The frequency of compaction shall be one a day or every 10 linear feet in areas to be paved, every 25 feet in unpaved areas, whichever is greater.

3.11 REPLACEMENT CONCRETE. Replacement concrete shall be 4 inches thick and have a minimum 28-day compressive strength of 3,000 psi, unless specified otherwise on the drawings. Field testing requirements may be waived by the ENGINEER for structures for which the estimated strength of concrete drastically exceeds the applied load or when replacement concrete area is less than 10 square feet of volume is less than 2.5 cubic feet. In such instances, the CONTRACTOR shall provide to the ENGINEER plant mix documentation or certificate of sack concrete mixture along with a written affidavit by CONTRACTOR’s supervisor that the concrete was mixed, placed, and cured as per manufacturer specifications.

3.12 PREPARATION OF AREA FOR ASPHALT REPLACEMENT. The CONTRACTOR shall prepare and grade the area subject to asphalt replacement to 10 inches below the finish grade. The elevation tolerance shall be within ± ½ inch.

3.13 COMPACTION OF BASE COURSE IN ASPHALT REPLACEMENT AREA. The CONTRACTOR shall compact the base course to 97% maximum as determined by Standard Proctor (ASTM D698) in six (6-inch) lifts; moisture shall be within ±3% of optimum. Vibratory drum roller or pneumatic wheel roller may be used for compaction of the base course in the asphalt replacement area.

3.14 REPLACEMENT ASPHALT. Replacement asphalt course shall be placed in two 2-inch courses over the compacted base course. The material shall be spread in even layer over the entire area and immediately compacted in a 2-inch course using a smooth drum roller the entire area is smooth. Once compaction of the first course is complete, the material shall be placed and spread throughout the area and compacted in a 2-inch finish course using a smooth drum roller until the entire are is smooth. The edges of the finish course shall match the existing grade and the drainage pattern to match the surrounding pattern. The roller speed shall not exceed 2 miles per hour and shall be adjusted to not displace material forward. The roller amplitude and frequency setting shall be adjusted to achieve maximum compaction without de-compaction or reduced density. Each pass shall overlap at least 2 inches.

3.5 CARE AND RESTORATION OF PROPERTY. All surfaces, which would have been disturbed by the CONTRACTOR's operations, shall be restored to a condition at least equal to that in which they were found immediately before work was begun. The restoration of existing property or structures shall be done as promptly as practicable and shall not be left until the end of the construction period.

END OF SPECIFICATION

SPECIFICATION 33 23 01

WELL CONSTRUCTION

PART 1—GENERAL

1.1 DESCRIPTION OF WORK

This specification provides details for installation of remediation wells.

The CONTRACTOR shall provide materials, labor, supervision, equipment, and tools required to install remediation wells in accordance with the applicable codes and regulations, construction drawings provided in the Final Remediation Plan, and as covered in this specification.

1.2 DEFINITIONS

A. CFR—Code of Federal Regulations

B. OSHA—Occupational Health and Safety Administration

C. ENGINEER—Haller and Associates, Inc. and EA Engineering, Science, and Technology, Inc. PBC

D. CONTRACTOR—Party (parties) to be contracted to perform specified work

1.3 REFERENCES

A. 29 CFR 1910.120, OSHA Regulations, Hazardous Waste Operations and Emergency Response

B. ASTM D1785—Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120

C. ASTM D2564—Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings

D. ASTM D2855—Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings

E. ASTM D2619/F2619M – Standard Specification for High-Density Polyethylene (PE) Pipe

F. A53—Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

G. A307—Carbon Steel Externally Threaded Standard Fasteners

1.4 SUBMITTALS

A. Copies of OSHA 40-hour training certificates and current 8-hour annual refresher training course completion certificates for the CONTRACTOR employees or proposed subcontractor employees. These copies will be submitted to the ENGINEER before an employee performs on-site activities. Copies must also be maintained by the CONTRACTOR on site.

B. Copy of Drilling License.

PART 2—PRODUCTS

2.1 Borehole diameter, well materials and sizing shall be as shown on drawings.

PART 3—EXECUTION

3.1 INSTALLATION

A. The CONTRACTOR shall install remediation wells in the locations shown on the design drawings. The ENGINEER may change the locations of the wells. The CONTRACTOR shall not change locations of the well without explicit approval by the ENGINEER.

B. The CONTRACTOR shall provide means of traffic control, if required and shall delineate the work area with barricades, traffic, cones, caution tape, and other means necessary to identify the area and limit unauthorized access.

C. The CONTRACTOR shall request underground utility clearance for the selected drilling locations. All underground utilities will be located and clearly marked by the utility companies. No drilling will be permitted prior to utility clearance. The CONTRACTOR shall stay at least 10 feet away from the overhead electrical lines.

D. All drilling shall be conducted utilizing horizontal directional drilling rig using biodegradable polymer drilling fluids, capable of reaching the target depth and length, and installing the required wells. No other drilling methods are allowed without the explicit approval by the ENGINEER.

E. Borehole size and depth shall be in accordance with the design drawings or as directed by the ENGINEER.

F. Placement of the wells, blanks, separating grout plugs, and cement-bentonite slurry shall be in accordance with the design drawings or as directed by the ENGINEER.

G. Top of well casing shall be terminated 1 foot below ground surface. The CONTRACTOR shall make a neat horizontal even cut using appropriate tools. The CONTRACTOR shall to prevent shavings and debris from entering the well cavity. Well casing shall be capped, borehole backfilled with sand, and covered with a steel plate. Another contractor shall complete well vaults as per details indicated on drawings.

H. The CONTRACTOR shall provide containers and containerize cuttings and drilling fluids. ENGINEER will profile and dispose of cuttings and fluids.

I. The CONTRACTOR shall restore all disturbed surfaces after completion of drilling activities. The restoration will include but not limited to patching asphalt and concrete surfaces, grading and clearing disturbed soils, removing construction waste and debris, removing all tools, equipment, supplies off-site. The CONTRACTOR shall restore site to pre-drilling conditions. ENGINEER's acceptance of restoration will be required to receive full compensation for rendered services.

3.2 WELL DEVELOPMENT

A. The CONTRACTOR shall provide all equipment, parts, and labor necessary to develop wells.

B. Prior to full well development, the CONTRACTOR shall remove drilling fluids and add additive to break down the residual biodegradable polymer.

C. After removing drilling fluids and breaking down the residual biodegradable polymer, the CONTRACTOR shall develop wells by pumping, surging, jetting, and/or backwashing followed by over pumping and/or air lifting, or other suitable technique approved by the ENGINEER. For backwashing, all water shall be potable. The CONTRACTOR shall meet the following criteria for well development :

    a. Extraction of air from SVE wells at 50 cfm at 30 inwc vacuum at well head.

    b. Compressed air injection at 10 cfm at 10 psig at the well head.

   If after sufficient effort, the above stated criteria could not be met, the ENGINEER may revise the criteria after evaluating the development effort.

D. Prior to surging, the CONTRACTOR shall pump the well to make sure water will flow into it. The initial surging shall be gentle to allow fine material to go into suspension. The CONTRACTOR shall remove fines by bailing or over pumping, as fines accumulate due to surging action.

E. The CONTRACTOR shall monitor turbidity, temperature, conductivity, and pH of the extracted fluids.

F. The CONTRACTOR shall provide containers and containerize the development fluids. The ENGINEER will profile and disposed of fluids.

END OF SPECIFICATION

SPECIFICATION 40 10 00
PROCESS PIPING
PART 1—GENERAL

1.1 SUMMARY

A. This Section includes pipe and fittings, strainers, piping specialties, hangers and supports, valves, meters and gauges, and other basic materials.

B. General

1. All special valves, controllers, fittings, and equipment shall meet the following requirements:

   a. Furnished, installed, tested, and put into successful operation.
   b. Be complete with all necessary miscellaneous pipe, valves, unions, fittings, and auxiliaries whether indicated or not, but required.
   c. Be insulated and covered in accordance with the pipe system to which they attach.

2. Furnish and install piping connected to accessories, which may vary from the drawings because of requirements peculiar to the particular equipment furnished, as required to make a complete and workable installation at no additional cost to the ENGINEER. This requirement shall include changes required in the piping systems because of design changes made by the manufacturer between the time of design and the time of installation or because of equipment furnished by a different manufacturer than that specified.

3. Furnish all control valves complete, including pilot lines, solenoid valves, shutoff valves, and operators whether or not specific mention was made of these items.

4. Furnish the necessary pipe and fittings required to install all safety and relief valves vertically. Furnish and route tail pipes to a place where the discharge will not injure personnel, or as indicated.

5. Where spare, replacement, or additional parts are required for the equipment specified herein, deliver these items to the ENGINEER immediately upon receipt at the job site. Parts shall be packaged and sealed for long storage, securely and visibly labeled as to part, function, and name of equipment to which they apply.

1.2 REFERENCES

A. Applicable Standards

1. American National Standards Institute (ANSI)

   a. B2.1—Pipe Threads (Except Dry Seal)

2. American Society of Mechanical Engineers (ASME)

a. B361—Code for Pressure Piping

3. American Society for Testing and Materials (ASTM)

   a. A53—Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
   b. A105—Forgings, Carbon Steel, for Piping Components
   c. A307—Carbon Steel Externally Threaded Standard Fasteners
   d. D1248—Polyethylene Plastic Molding and Extrusion Materials
   e. D1693—Environmental Stress-Cracking of Ethylene Plastic
   f. D1784—Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
   g. D1785—Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120
   h. D2146—Propylene Plastic Molding and Extrusion Materials
   i. D2464—Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
   j. D2466—Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
   k. D2564—Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings
   l. D2657—Heat Joining of Polyolefin Pipe and Fittings
   m. D2855—Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
   n. D3350—Polyethylene Plastic Pipe and Fittings Material
   o. F104—Nonmetallic Gasket Materials

4. National Sanitary Foundation (NSF):

   a. 14—Plastic Piping System Components and Related Materials

5. Pipe Fabrication Institute (PFI)

   a. ES5—Cleaning of Fabricated Piping

PART 2—EQUIPMENT AND MATERIALS

2.1 PIPE AND FITTINGS

A. Pipe furnished under this contract shall conform to ASTM material specifications herein referenced. Magnetic located tape shall be located within 12 inches from the ground surface in each trench containing non-metallic pipes.

B. Fluid, Sparge, and Vapor Extraction, and Groundwater Piping Materials:

   1. Polyvinyl Chloride (PVC) Conduit Pipe:

      a. PVC pipe for underground installation shall be of the type and size designated on the drawings, minimum Schedule 40 with solvent-weld joints, threaded joints with Teflon tape.

b. All fittings shall be of the same material, class, and schedule as the pipe.
c. Solvent cement joints for the pipe shall be made in accordance with the manufacturer's recommendations and ASTM D2855.
d. Applicable System Piping:
    i. All below-grade, non-exposed, conduit piping for electric and control wires.

2. High Density Polyethylene (HDPE) Thermoplastic Pipe:

    a. HDPE pipe for underground installation shall conform to ASTM D3350, PE3406 Type III, Grade P34, minimum SDR11 for low pressure (50 psi) and SDR 9 for medium pressure (100 psi).

3. Galvanized steel Pipe:

    a. Above ground galvanized steel pipe carrying fluids shall be of the size designated on the drawings, minimum Schedule 40, threaded joints with Teflon tape.

C. Natural Gas System Materials (2 inches and smaller):

1. Pipe:

    a. Schedule 40, seamless or electric-resistance welded carbon steel ASTM A53, Grade A.
    b. Pipe underground: Factory-applied plastic-coated pipe, X-TRU-COAT plastic-coated API-5L, welded carbon steel, Schedule 40, line pipe by Republic Steel. All field joints and damaged areas shall be protected by X-TRU-COAT primer and pressure-sensitive tape.
    c. Pipe underground: Where not prohibited by local codes or utilities or by pressure limitations, black polyethylene thermoplastic piping may be used. Pipe shall conform to ASTM D3350, PE3406, Type III, Grade P34.

2. Joints: Screwed or butt-welded for steel pipe. Socket-fusion type as outlined in ASTM D2657 for polyethylene pipe.
3. Fittings: 150-pound, malleable iron screwed fittings and unions or butt-weld carbon-steel fittings for steel pipe. Polyethylene fittings shall be of the same material as the pipe.
4. Stop Valves: Cocks — 125-pound, bronze, threaded ends, square head.

2.2 METERS AND GAUGES

A. Provide all instruments, meters, and gauges complete with interconnecting tubing, piping, valves, for the ranges and as specified on the drawings. All meters and gauges shall be rated for a minimum 150 psig and 150 degrees C or as indicated on the drawings.

2.3 VALVES

A. All valves shall as specified on the drawings and be rated for a minimum 150 psig and 150 degrees C or as indicated on the drawings.

PART 3—PERFORMANCE

3.1 INSTALLATION

A. General:

1. Furnish all labor, materials, and equipment necessary to make a complete installation as indicated and specified.

   a. Provide all necessary supports, brackets, or foundations for properly installing all equipment.
   b. Coordinate with the other trades before installation of materials.
   c. Properly align, adjust, and lubricate all equipment before final acceptance.
   d. Provide vents and drains at high and low points of water systems.
   e. All connections to equipment shall be made with unions or flanges.
   f. Piping indicated on the plans is diagrammatic and not necessarily the exact routing. Provide all necessary bends that may be required to avoid conflicts.
   g. Provide all required openings in walls and floors.
   h. Test, flush, and balance all systems. Install all vents, test tees, test connections and other items required by local practice, codes, and regulations.

B. Piping Installation:

1. General:

   a. Install pipe and fittings in accordance with recognized industry practices, which will achieve permanently leak-proof piping systems, capable of performing each indicated service without piping failure.
   b. Install each run with a minimum of joints and couplings, but with adequate and accessible unions for disassembly and maintenance or replacement of valves and equipment.
   c. Reduce sizes (where indicated) by use of reducing fittings.
   d. Align pipe accurately at connections within 1/16-inch misalignment tolerance.
   e. Comply with ASME B361 Code for Pressure Piping.
   f. Locate piping runs, except as otherwise indicated, vertically and horizontally (pitched to drain) and avoid diagonal runs wherever possible.
   g. Orient horizontal runs parallel with walls and column lines.
   h. Run piping in the shortest route which does not obstruct usable space or block access for servicing the building and its equipment.

i. Hold piping close to walls, overhead construction, columns, and other structural and permanent-enclosure elements of the building.
j. Where possible, locate insulated piping for 1.0-inch clearance outside insulation.

C. Electrical Equipment Spaces:

1. Do not run piping through transformer vaults or other electrical or electronic equipment spaces and enclosures.

D. Piping System Joints:

1. Threaded joints:

a. Thread pipe in accordance with ANSI B2.1.
b. Cut threads full and clean using sharp dies.
c. Ream threaded ends to remove burrs and restore full inside diameter.
d. Apply pipe joint compound or pipe joint tape (Teflon) on male threads at each joint and tighten joint to leave not more than 3 threads exposed.

2. Flanged joints:

a. Match flanges within piping system and at connections with valves and equipment.
b. Clean flange faces and install gaskets.
c. Tighten bolts to provide uniform compression of gaskets.

3. Glued PVC joints:

a. Screen, pipe and fittings will be joined with PVC glue (solvent cement) that meets ASTM D2564 specifications. Interior and exterior surfaces shall clean and free of dirt, grease, oil, and other foreign materials. Surfaces to be glued will be further cleaned with PVC primer and allowed to dry to touch.
b. Pipe gluing will take place at temperatures above 40 degrees. A thin surface of glue will be applied to interior and exterior surfaces. The pipe will then be immediately joined with a ¼-turn twisting motion until the pipe seats completely in the fitting.
c. Joined pipe will be held a minimum of 1 minute. Joined pipe will rest a minimum of 15 minutes before placement in the trenches.

4. HDPE joints:

a. Sections of polyethylene pipe shall be joined into continuous lengths on the job site above ground. The joining method shall be the butt fusion method and shall be performed in strict accordance with the pipe manufacturer’s recommendations. Butt fusion equipment used in the joining procedures shall be capable of meeting all conditions recommended by the pipe manufacturer, including, but not limited to, temperature requirements, alignment, and fusion pressures.

PART 4—EXECUTION

4.1 TRANSPORTATION AND DELIVERY

A. Every precaution shall be taken to prevent injury to the pipe during transportation and delivery to the site and handling prior to and during installation.

B. If in the process of transportation, handling, or laying, any pipe is damaged, such pipe or pipes shall be replaced or repaired by the CONTRACTOR at his own expense.

4.2 PIPE LAYING—GENERAL

A. Pipeline materials shall be as specified or shown. Piping shall be installed where shown or specified.

B. Proper and suitable tools and appliances for the safe and convenient cutting, handling, and laying of the pipe and fitting shall be used.

C. Before being laid, all pipe, fittings, and specials shall be examined for defects, and no piece shall be installed which is known to be defective.

D. Any defective pieces discovered after having been installed shall be removed and replaced.

E. The pipe and fittings shall be thoroughly cleaned before they are laid and shall be kept clean until final acceptance. Care shall be exercised to avoid leaving bits of wood, dirt, and other foreign particles in the pipe. All lines shall be kept clean during construction and shall be capped off with appropriate caps, tape, or wooden bulkheads at the end of each day's work. Exposed ends of uncompleted lines shall be capped or otherwise temporarily sealed at all times when the pipe laying is not in progress.

F. CONTRACTOR shall provide all necessary joint gaskets, lubricants, solvents, cements, and all special tools and accessories that may be required to assemble the pipe or fittings. Pipe jointing materials shall be stored in a cool place and protected from light, sunlight, heat, oil, or grease until installed.

4.2 PIPE LAYING IN TRENCHES

A. Pipeline in trench excavation shall be properly secured against movement and pipe joints shall be made in the excavation as shown, specified, and/or directed by the ENGINEER.

B. Pipe laying will be permitted only in dry trenches having a stable bottom.

C. No pipe shall be laid in water or when weather and trench conditions are unsuitable for pipe laying.

D. Before lowering, and while suspended, the pipe shall be inspected for defects. Any defective, damaged, or unsound pipe shall be rejected. All foreign matter, such as dirt, shall be removed from the inside and outside of the pipe before it is lowered into position in the trench.

E. The cutting of pipe for inserting fittings or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe. In general, pipe shall be laid with bell ends, if applicable, facing in the direction of laying. Whenever necessary to deflect pipe from a straight line, either in the vertical or horizontal plane to avoid obstructions or for other purposes, the maximum degree of deflection shall be as recommended by the manufacturer. Pipes shall be furnished in standard laying lengths. Random short lengths shall be used only as required to connect manholes and cleanouts.

F. Joining shall be accomplished in strict accordance with manufacturers' recommendations. When solvent-weld joints are required, solvent for pipe jointing shall be as recommended by the manufacturer of the pipe.

4.3 ERECTION AND INSTALLATION OF ABOVE-GRADE PIPING

A. General

1. Erect and install all above-grade piping and accessories required to complete the piping systems as indicated on the drawings, as specified, and as required for a proper installation.

B. Installation of above-grade piping

1. CONTRACTOR shall fabricate and erect the above-grade portions of the piping in accordance with the following:

a. Field-route piping in a manner to avoid interference with work by this purchase order and to provide a neat and accessible installation.
b. Piping shall be installed in a rectangular form either perpendicular to, or parallel to the building structure, the floor, or to the major equipment except in cases required or approved by the ENGINEER.
c. Pipe shall be routed to avoid pathways, and equipment maintenance access areas, and shall satisfy the ENGINEER's operation and maintenance requirements which include locating valves, specials, and instruments at a point where they are easily accessible. Improperly located piping shall be removed and rerouted as directed and approved by the ENGINEER with all labor and material furnished by the CONTRACTOR.
d. Pipe routing shall avoid interference with required electrical conduit.
e. Access shall not be blocked around equipment, particularly access to motors.
f. Piping shall not interfere with maintenance access for removal of valves, flow indicators, motors, motor rotors, process instrumentation, or any other device, which may be required to be removed from piping or equipment for maintenance.
g. Provide offsets, fittings, unions, drip pockets, vents, drains, hangers, and supports to make a complete installation.

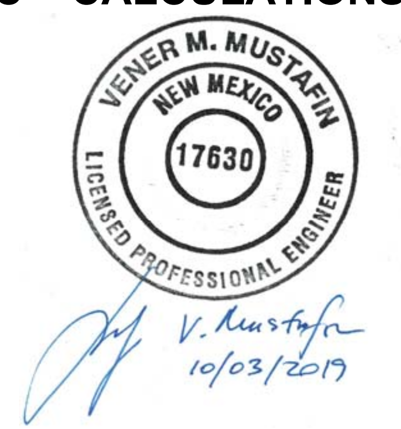
4.4 TESTING

A. All piping shall be pressure tested by the CONTRACTOR prior to acceptance. All below grade pipe must be tested prior to backfill.

1. Pressure Testing: requires that all process piping and hose be isolated as necessary and a minimum pressure of 50 PSI be applied and the pressure source disconnected from the piping. The test pressure is to be monitored for half hour with an appropriate gauge on the piping system. The piping and hose pressure must remain within 2 % of the test pressure to pass the test procedure.
2. The integrity of continuous HDPE piping (e.g., no welded joints) may be determined prior to its use. HDPE that passes may be used without further testing so long as no welded joints will be placed below grade. All strands of pipe with welded joints shall be tested prior to backfilling as described above.
3. The CONTRACTOR shall record all pressure testing events indicating testing personnel, equipment used, pipe tested, initial pressure, final pressure, time and date of testing and testing duration. The CONTRACTOR shall provide all records to the ENGINEER during the system inspections.

END OF SPECIFICATION

APPENDIX C – CALCULATIONS



OBJECTIVE: ESTIMATE MASS OF CONTAMINATION IN SOIL

INPUTS:

$Area := 4000\ ft^2$	Impacted BTEXN Area
$tsat := 10\ ft$	Impacted Saturated Thickness (12-22 feet)
$d := 110\ \frac{lb}{ft^3}$	Soil Bulk Density
$C := 305\ \frac{mg}{kg}$	Average Soil TPH Concentration (AS-1/SVE-1, SVE-2)

CALCULATIONS:

$Vsat := Area \cdot tsat = 40000\ ft^3$	Impacted Saturated Thickness
$Msat := Vsat \cdot d \cdot C = 1342\ lb$	Mass of Contamination in Saturated Soil
$Mvad := Msat \cdot 50\% = 671\ lb$	Mass of Contamination in Vadose Zone - half of saturated
$Mtotal := Msat + Mvad = 2013\ lb$	Total mass of contamination

Mass of dissolved contamination is orders of magnitude less; therefore, it was not calculated

CONCLUSIONS:

Mass of contamination was estimated at ~ 2,000 lbs of TPH.

For the purposes of remediation, mass will be assumed to be 5,000 lbs.

OBJECTIVE: Estimate pipe friction loss in SVE wells

REFERENCE: Environmental Engineering Reference Manual. M. Linderburg. 2001
Section 17. Fluid Dynamics. Friction Losses for Steam and Gases

INPUT:

$p0 := 12.412\ psi$	Pressure at approximately 4,600 ft msl
$vac := \frac{80}{407} \cdot 1\ atm = 2.9\ psi$	Anticipated vacuum at the branch
$p1 := p0 - vac = 9.5\ psi$	SVE Applied Asolute Pressure
$L := 200\ ft$	Well Length
$R' := \frac{0.08206\ atm\ L}{mol\ K}$	Universal Constant
$T := 60\ °F$	Soil vapor average temperature
$D := 2\ in$	Blank SVE Screen Internal Diameter
$MW := 28.98 \frac{g}{mol}$	Air
$Q := \frac{50\ ft^3}{min}$	Design volumetric flowrate - branch
$d := 1.293 \frac{kg}{m^3}$	Density of air at 0 degrees Celcius
$mu := 1.709 \cdot 10^{-5}\ Pa\ s$	Absolute viscosity of air at 0 degrees Celcius
$e := 1.5 \cdot 10^{-6}\ m$	Specific Roughness for Plastic Pipe

CALCULATIONS:

$$Area := \frac{3.14 \cdot D^2}{4} = 0.0218\,ft^2$$ Area of pipe

$$m := Q \cdot d \cdot \frac{p1}{1\,atm} \cdot \frac{32\,°F}{T} = 0.0187\,\frac{kg}{s}$$ Mass flowrate

$$G := \frac{m}{Area} = 9.2343\,\frac{kg}{m^2\,s}$$ Mass flowrate per area

$$Re := \frac{D \cdot G}{mu} = 27449$$ Reynold's Number

$$er := \frac{e}{D} = 2.9528 \cdot 10^{-5}$$ Relative roughness

$$f := \frac{0.25}{\left(\log_{10}\left(\frac{er}{3.7} + \frac{5.74}{Re^{0.9}}\right)\right)^2} = 0.024$$

$$B := \frac{f \cdot L \cdot G^2 \cdot R' \cdot T}{D \cdot MW} = 2.0313 \cdot 10^8\,\frac{kg\,Pa}{m\,s^2}$$

$$p2 := \sqrt{p1^2 - B} = 64095.8076\,Pa$$ Final pressure at discharge

$$dP := p1 - p2 = 1565.458\,Pa$$

$$dP = 0.2271\,psi$$ Pressure loss in pipe

$$inwc := 1 \cdot \frac{atm}{407} = 249\,Pa$$

$$dP = 6.3\,inwc$$ Loss is acceptable, therefore, selected well diameter is appropriate

OBJECTIVE: Estimate pressure loss in sparge wells

REFERENCE: Environmental Engineering Reference Manual. M. Linderburg. 2001
Section 17. Fluid Dynamics. Friction Losses for Steam and Gases

INPUT:

$p1 := 15\,psi + 0.85\,atm = 27\,psi$ — Absolute Air Sparge Applied Pressure

$L := 200\,ft$ — Well Length

$R' := \dfrac{0.08206\,atm\,L}{mol\,K}$ — Universal Constant

$T := 100\,°F$ — Estimated blower discarhge

$D := 0.75\,in$ — Selected pipe diameter

$MW := 28.98\,\dfrac{g}{mol}$ — Molecular Weight of Air

$Q := \dfrac{5\,ft^3}{min}$ — Design volumetric flowrate

$d := 1.293\,\dfrac{kg}{m^3}$ — Density of air at 0 degrees Celcius

$mu := 1.709 \cdot 10^{-5}\,Pa\,s$ — Absolute viscosity of air at 0 degrees Celcius

$e := 1.5 \cdot 10^{-6}\,m$ — Specific Roughness for Plastic Pipe

CALCULATIONS:

1. Area of pipe

$$Area := \frac{3.14 \cdot D^2}{4} = 0.0031\ ft^2$$

2. Mass flowrate

$$m := Q \cdot d \cdot \frac{p1}{1\ atm} \cdot \frac{32\ °F}{T} = 0.005\ \frac{kg}{s}$$

3. Mass flowrate per area

$$G := \frac{m}{Area} = 17.6013\ \frac{kg}{m^2\ s}$$

4. Reynold's Number

$$Re := \frac{D \cdot G}{mu} = 19620$$

5. Relative roughness

$$er := \frac{e}{D} = 7.874 \cdot 10^{-5}$$

6. Friction Factor - Swamee-Jain

$$f := \frac{0.25}{\left(\log_{10}\left(\frac{er}{3.7} + \frac{5.74}{Re^{0.9}}\right)\right)^2} = 0.0261$$

$$B := \frac{f \cdot L \cdot G^2 \cdot R' \cdot T}{D \cdot MW} = 2.3113 \cdot 10^9\ \frac{kg\ Pa}{m\ s^2}$$

Final pressure at discharge

$$p2 := \sqrt{p1^2 - B} = 1.8335 \cdot 10^5\ Pa$$

Pressure loss in pipe

$$dP := p1 - p2 = 6198.2037\ Pa$$

$$dP = 0.899\ psi$$

$$dP\_p := \frac{dP}{p1} = 3.27\ \%$$

Loss is acceptable, therefore the selected pipe diameter is appropriate

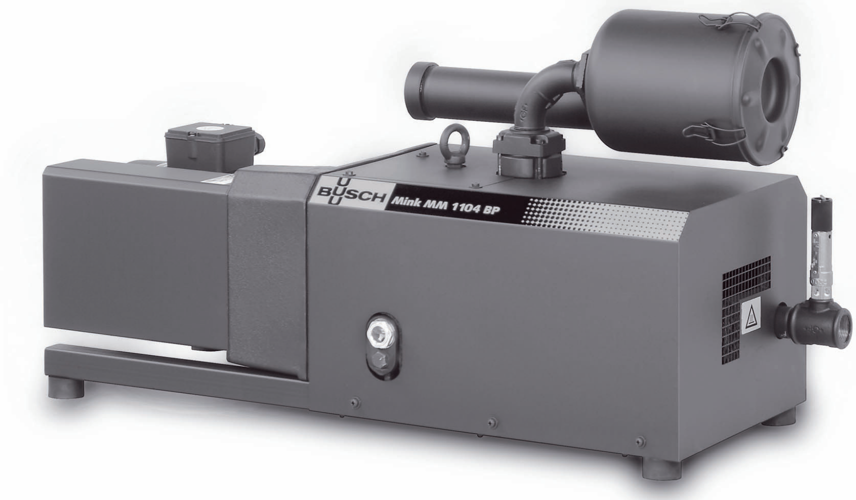
APPENDIX D – CUT SHEETS

Dry Rotary Claw Pressure Pumps

Mink

MM 1102 – 1142 BP

MM 1202 – 1322 AP



MM 1104 BP

Description

The Busch Mink MM Series positive displacement pressure pumps feature a compact rotary claw design that is air cooled, dry-running and non-contacting. These features along with quality construction results in a pump that offers extremely high reliability and a long service life.

Maintenance-Free

Non-contacting Design – eliminates internal wear and parts to replace

Air Cooling – no water levels to check and no cooling system to maintain

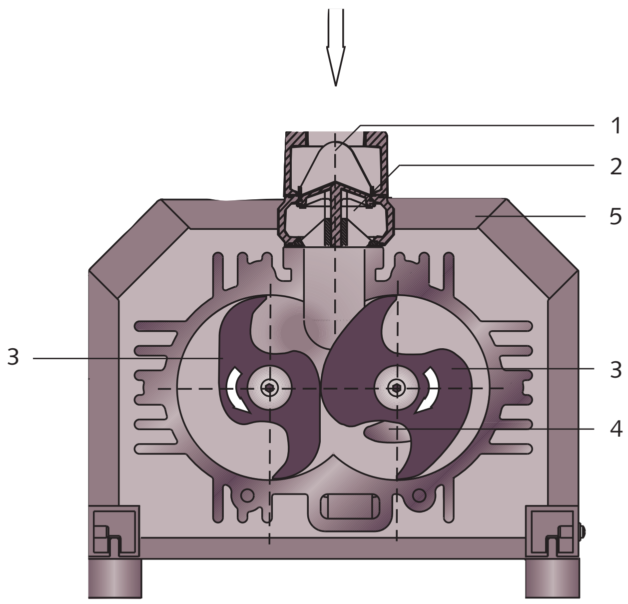
Dry-Running – no sealing or lubricating oil is needed in the pumping chamber, so there is minimal maintenance

Economical

Operating costs are low because of the maintenance-free design and the reduced power requirements made possible by the Mink's high volumetric efficiency along with a non-contacting pumping chamber.

Dry Rotary Claw Pressure Pumps

Operating Principle



1 Gas Inlet
2 Non-return valve
3 Claws
4 Gas outlet
5 Acoustic enclosure

Operating Principle

Inside the pump housing, two claw shaped rotors take in air as they rotate in opposite directions. The air is compressed by the rotors, then discharged through a silencer to atmosphere.
The non-return valve incorporated into the inlet flange prevents air from back flowing through the pump when the pump is turned off. Mink MM dry rotary claw pressure pumps are directly driven by a flanged motor, and the two rotors are synchronized by gears.
A wide range of accessories allows optimum adaptation to many applications.

Applications

Busch Mink MM dry rotary claw pressure pumps are used across a broad range of industries for many different applications and are well suited to applications where dust particles may be present. Mink MM pressure pumps are especially suited to:

Beverage Industry

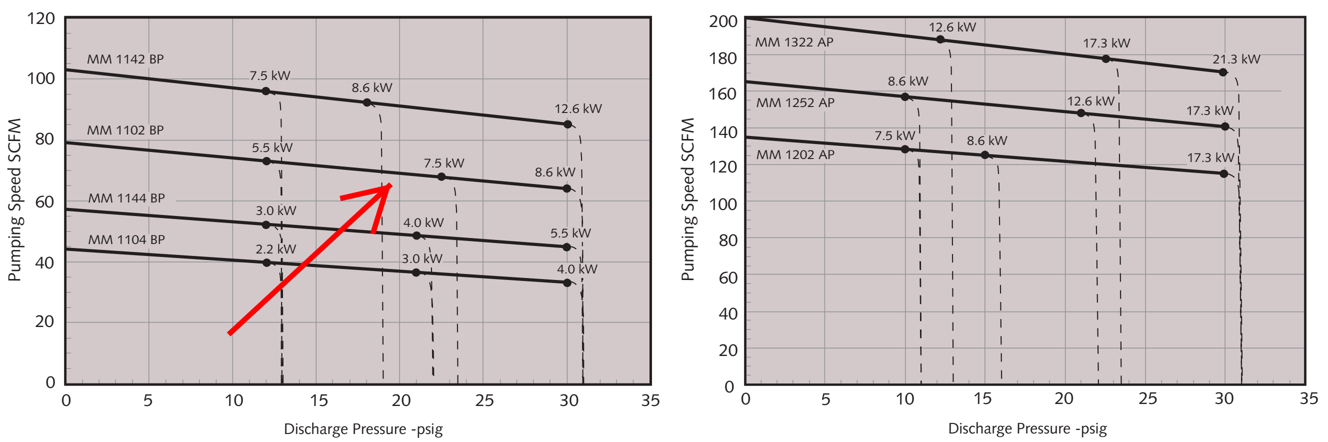
Environmental Technology

Pneumatic Conveying

Printing Industry

Technical Data

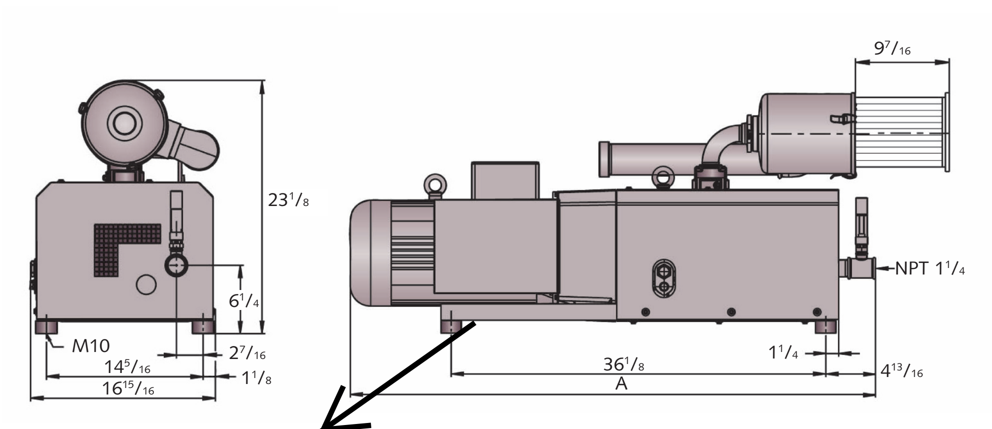
Pumping Speed vs. Discharge Pressure



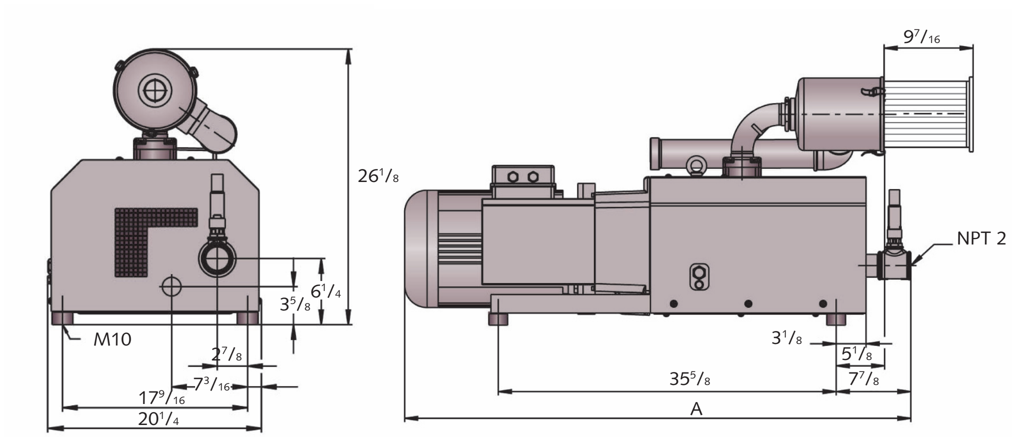
Dashed lines represent pump performance for motor chosen.

Technical Data Mink MM Model	Nominal pumping speed SCFM	Motor Size kW (Hp)	Maximum pressure psig	Relief valve cracking pressure psig	Nominal motor speed RPM	Sound rating dBA	Weight approx. Lbs
1104 BP	44	2.2 (3.0)	13.0	12	1800	73	381
	44	3.0 (4.0)	22.0	21	1800	73	388
	44	4.0 (5.4)	31.0	30	1800	73	396
1144 BP	57	3.0 (4.0)	13.0	12	1800	73	403
	57	4.0 (4.4)	22.0	21	1800	73	411
	57	5.5 (7.5)	31.0	30	1800	73	432
1102 BP	79	5.5 (7.5)	13.0	12	3600	81	425
	79	7.5 (10)	23.5	22.5	3600	81	436
	79	8.6 (11.5)	31.0	30	3600	81	444
1142 BP	103	7.5 (10)	13.0	12	3600	81	448
	103	8.6 (11.5)	19.0	18	3600	81	456
	103	12.6 (17)	31.0	30	3600	81	520
1202 AP	135	7.5 (10.0)	11.0	10	3600	82	519
	135	8.6 (11.5)	16.0	15	3600	82	519
	135	17.3 (23.2)	31.0	30	3600	82	519
1252 AP	165	8.6 (11.5)	11.0	10	3600	83	528
	165	12.6 (16.9)	22.0	21	3600	83	528
	165	17.3 (23.2)	31.0	30	3600	83	528
1322 AP	200	12.6 (16.9)	13.0	12	3600	85	550
	200	17.3 (23.2)	23.5	22.5	3600	85	550
	200	21.3 (28.6)	31.0	30	3600	85	550

Dimensions



Dimensions A	MM 1104 BP	MM 1144 BP	MM 1102 BP	MM 1142 BP
A	$42\frac{1}{2}$	$42\frac{15}{16}$	$45\frac{1}{2}$	$47\frac{1}{16}$



Dimensions A	MM 1202 AP	MM 1252 AP	MM 1322 AP
A	$49\frac{1}{4}$	$53\frac{3}{8}$	$53\frac{15}{16}$

All dimensions in inches unless otherwise noted.

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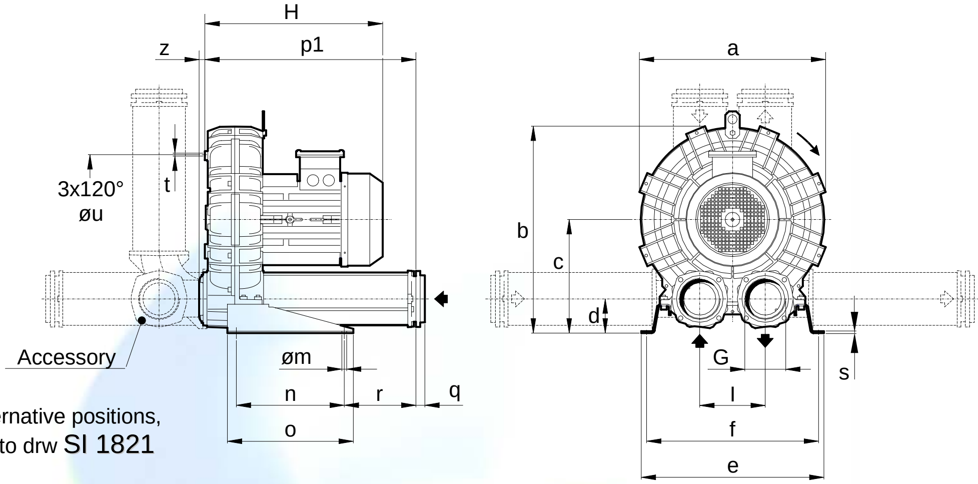
- Smooth operation
- High efficiency impeller
- Maintenance free
- Mountable in any position
- Recognized TEFC - **cURus** motor

OPTIONS
- Special voltages (IEC 38)
- Surface treatments

ACCESSORIES
- Inlet and/or inline filters
- Additional inlet/outlet silencers
- Safety valves
- Flow converting device
- Optional connectors

Dimensions in inches.
Dimension for reference only.



Possible alternative positions, please refer to drw SI 1821

Model	a	b	c	d	e	f	G	l	m	n	o	p1	q	r	s	t	u	z
K07-MS	16.69	18.84	10.59	3.23	18.43	17.24	3" NPT	6.10	0.51	11.81	13.78	20.16	0.98	5.39	0.20	M8	11.61	0.63
K08-MS	17.99	19.61	10.59	3.23	18.82	17.64	3" NPT	6.10	0.51	11.81	13.78	20.16	0.98	5.39	0.20	M8	12.2	0.63
K09-MS	19.37	22.09	12.40	3.78	20.00	18.82	4" NPT	7.17	0.51	11.81	13.78	23.07	0.98	7.83	0.20	M8	14.17	0.63
K10-MS	20.31	22.56	12.40	3.78	20.00	18.82	4" NPT	7.17	0.51	11.81	13.78	23.07	0.98	7.83	0.20	M8	14.17	0.63
K11-MS	21.34	23.74	13.07	3.58	21.26	20.00	4" NPT	7.87	0.51	11.81	13.78	23.46	0.98	8.03	0.20	M8	15.35	0.63
K12-MS	21.57	23.82	13.07	3.58	21.26	20.00	4" NPT	7.87	0.51	11.81	13.78	23.58	0.98	8.03	0.20	M8	15.35	0.51

Model	Maximum flow cfm		Installed power Hp		Maximum differential pressure Dp (In Hg)		Noise level Lp dB (A) (1)		Overall dimensions H	Weight
	60 Hz 3500 rpm	*50 Hz 2900 rpm*	60 Hz 3500 rpm	*50 Hz 2900 rpm*	60 Hz 3500 rpm	*50 Hz 2900 rpm*	60 Hz 3500 rpm	*50 Hz 2900 rpm*	Inches	Lbs
K07-MS	294	*243*	4	*4*	3.7	*4.6*	77.7	*75.7*	15.45	103.00
			5 ½	*5 ½*	5.6	*6.3*	78.0	*76.0*	15.45	107.10
			7 ½	*7 ½*	9.6	*8.9*	78.3	*76.3*	18.37	145.70
			10	-	11.1	-	78.6	-	18.37	154.50
K08-MS	381	*316*	5 ½	*5 ½*	2.9	*3.8*	78.8	*76.8*	15.45	115.70
			7 ½	*7 ½*	5.0	*6.6*	79.1	*77.1*	18.37	154.30
			10	*10*	8.5	*9.2*	79.4	*77.4*	18.37	163.10
			15	-	11.1	-	79.7	-	19.15	184.00
K09-MS	471	*390*	7 ½	*7 ½*	3.7	*4.6*	79.3	*77.3*	18.84	166.50
			10	*10*	5.9	*7.0*	79.6	*77.6*	18.84	175.10
			15	*15*	10.3	*10.4*	80.1	*78.1*	19.63	196.20
			20	-	11.1	-	80.4	-	23.74	269.00
K10-MS	556	*460*	7 ½	*7 ½*	2.7	*3.8*	79.4	*77.4*	18.84	170.90
			10	*10*	4.7	*5.9*	79.7	*77.7*	18.84	179.50
			15	*15*	8.8	*9.9*	80.2	*78.2*	19.63	200.60
			20	-	11.1	-	80.5	-	23.74	273.40
K11-MS	650	*539*	10	*10*	2.9	*3.9*	82.0	*80.0*	19.04	194.90
			15	*15*	6.0	*7.1*	82.5	*80.5*	19.83	216.00
			20	*20*	11.1	*10.4*	83.0	*81.0*	23.94	288.80
K12-MS	726	*602*	15	*15*	3.8	*6.6*	83.5	*81.5*	19.95	223.70
			20	*20*	6.3	*9.6*	84.3	*82.3*	24.06	296.50
			25	-	10.3	-	87.2	-	24.92	320.80

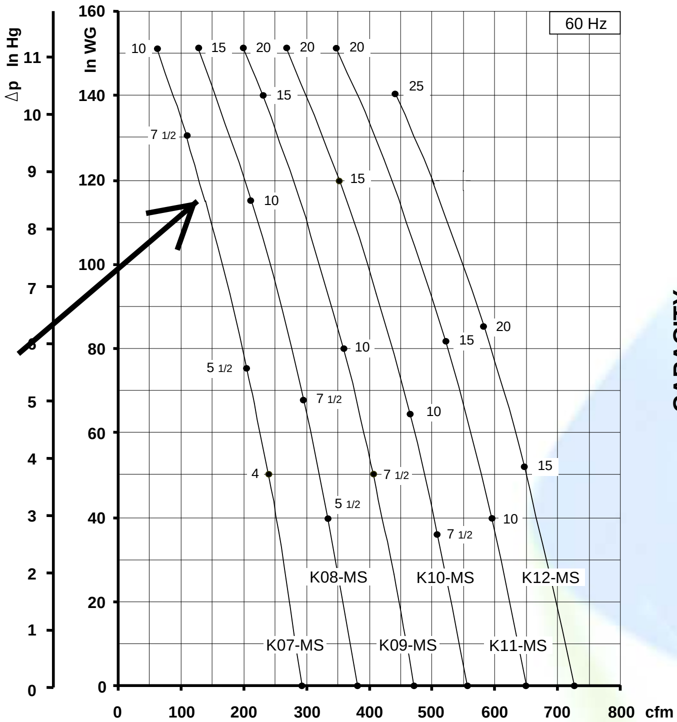
(1) Noise measured at 1 m distance with inlet and outlet ports piped, in accordance to ISO 3744.

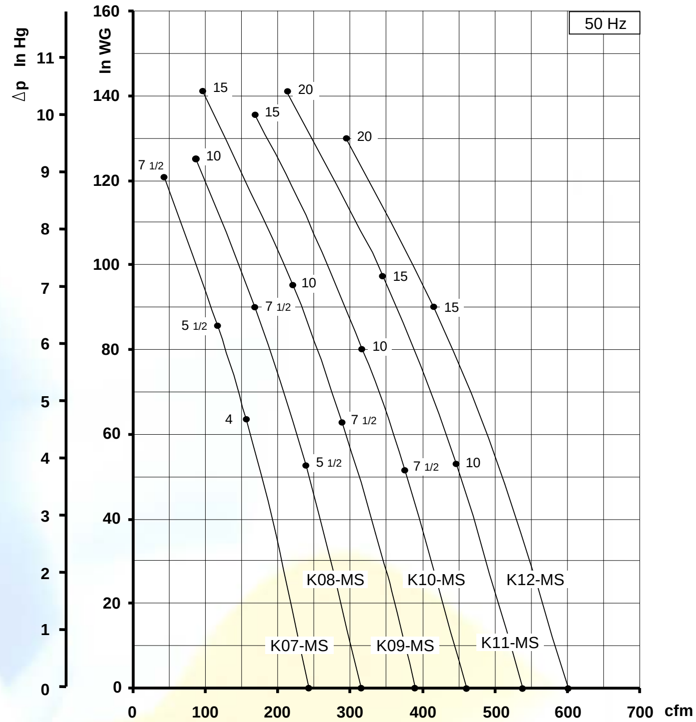
- For proper use, the blower should be equipped with inlet filter and safety valve; other accessories available on request.
- Ambient temperature from +5° to +104°F.
- Specifications subject to change without notice.

SCL K07 / K08 / K09 / K10 / K11 / K12

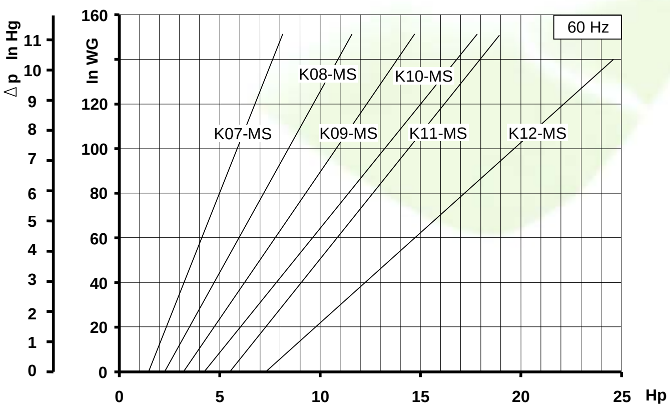
MS SERIES - MOR RANGE

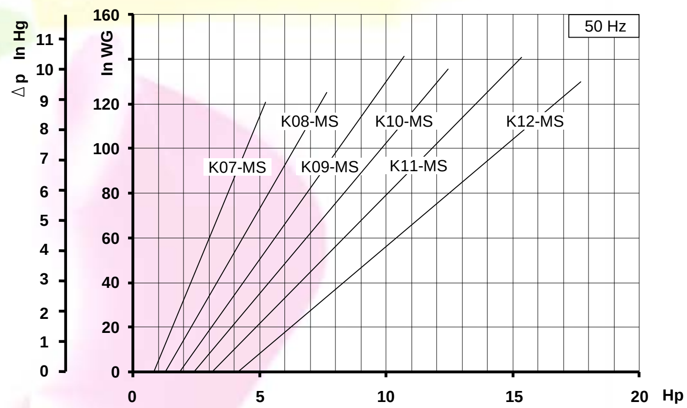
CAPACITY



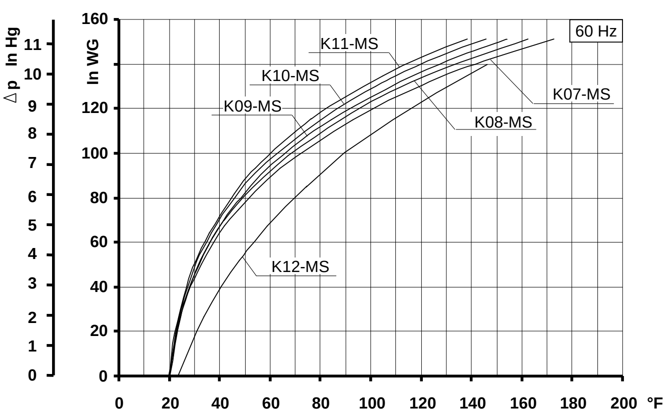


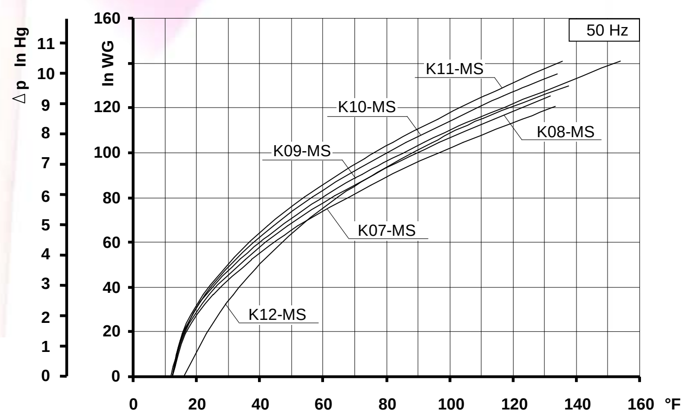
ABSORBED POWER





TEMPERATURE INCRESASE





Curves refer to air at 68° F temperature, measured at inlet port and 29.92 In Hg atmospheric backpressure (abs).
Values for flow, power consumption and temperature rise: +/-10% tolerance.
Data subject to change without notice.

VLS Series
Vapor/Liquid Separators

Features & Specifications

• All Welded Steel construction, ASTM A-36 sheet steel
• 17" Hg vacuum design rating (optional full vacuum design available)
• Polypropylene demister element covering entire separator cross section to minimizes vapor velocity & maximize water coalescing
• Tangential inlet utilizing centrifugal force for gross water/air separation (95%+ By Volume)
• 2" PVC site glass with unions for easy removal
• Steel baffle cover over water holding volume to prevent re-entrainment of water into air stream
• Stainless steel hermetically sealed float rod assembly (single or multiple floats)
• All zinc plated steel hardware
• Enamel external finish (optional internal & external finishes available)
• 99% + moisture removal of 10 micron and larger droplets (due to coalescing)
• Optional air filter with polyester element sized for specific blower, housed in separator (polyester element standard)
• 2" NPT half coupling for pump out or gravity drain, ¼" NPT gage port on inlet
• Neoprene full face top cover gasket

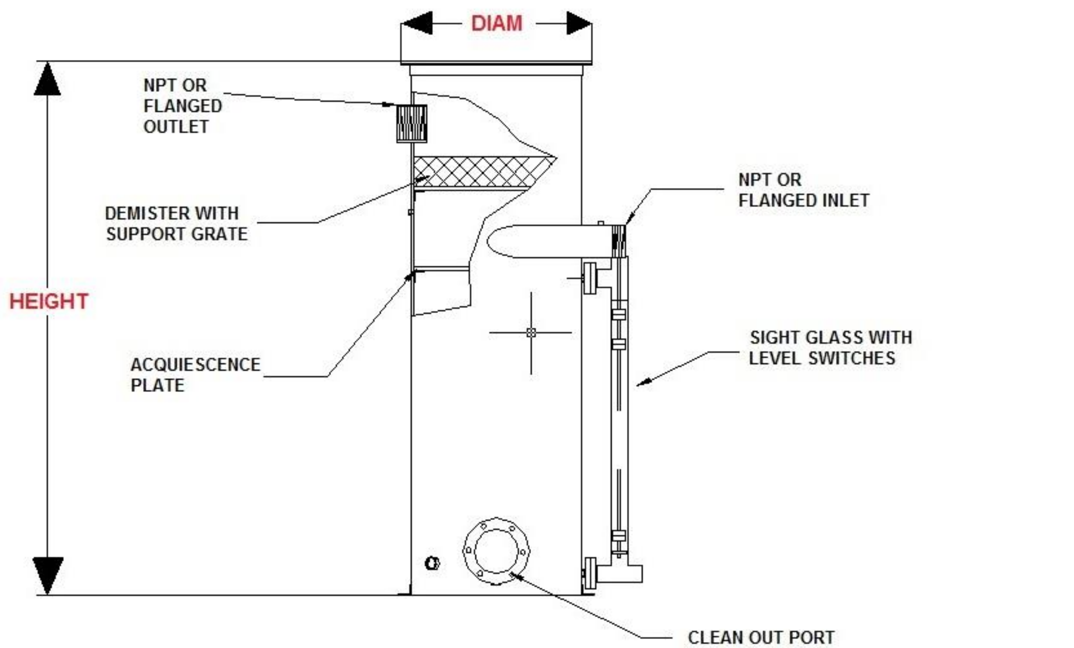
H2K Technologies, Inc.

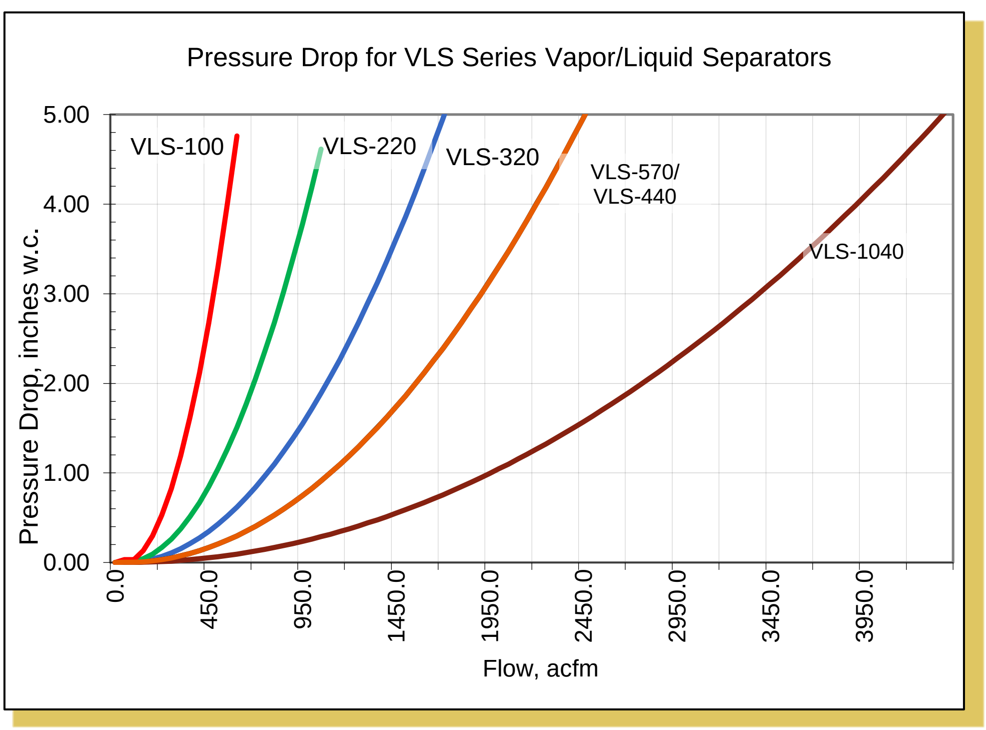
Applications

• Soil vapor extraction
• Dual phase extraction
• Liquid ring pump
•Vacuum or pressure
• Blowers-Side Channel/regenerative,
multi-stage regenerative, positive displacement, and centrifugal
• Industrial industry
• Remediation industry
• Vapor GAC
• Bio venting systems
• Excavation venting

H2K Technologies, Inc.
7550 Commerce St
Corcoran, MN 55340
Phone: 763.746.9900
Fax: 763.746.9903
www.H2KTECH.com
Sales@H2KTech.com

Model Number	Inlet/Outlet Connection	Height In.	Diam. In.	Rated Flow SCFM	Separator Total Volume Gallons	Liquid Holding Volume Gallons	Shipping Weight Lbs.	Operating Weight Lbs.	Vacuum/ Rating, "Hg/PSI
VLS-033	3" FPT	30	18	500	33	10	50	160	17"Hg/9psi
~~VLS-082~~	~~4" FPT~~	~~44~~	~~24~~	~~500~~	~~82~~	~~30~~	~~90~~	~~325~~	~~17"Hg/9psi~~
VLS-100	4"/6" FPT	50	22	650	100	40	140	480	30"Hg/9psi
~~VLS-220~~	~~8"/10" 150 lb flange~~	~~72~~	~~30~~	~~1440~~	~~220~~	~~75~~	~~350~~	~~1,020~~	~~30"Hg/9psi~~
VLS-320	10"/12" 150lb flange	72	36	2100	320	110	450	1,356	30"Hg/9psi
VLS-440	12" 150lb flange	74	42	2600	440	150	625	1,860	17"Hg/9psi
VLS-570	12" 150 lb flange	74	48	3600	570	195	860	2,465	17"Hg/9psi
VLS-1040	16" Duct flange	84	60	4500	1,040	200	1,250	2,978	10"Hg/5psi
VLS-1500	20" Duct flange	85	72	7000	1,500	440	1,525	5,325	10"Hg/5psi
VLS-3055	32" Duct flange	96	96	11,000	3,055	780	1,820	8,532	10"Hg/5psi





Options

- Stainless steel or Fiberglass re-enforced plastic construction (low pressure)
- Stainless steel coalescer media
- ASME designed & stamped for vacuum or pressure
- Full vacuum design
- Immersion heaters, NEMA 4 or NEMA 7 for freeze protection
- 1" recirculation port for pumping under high vacuum
- Air filter material and sizes
- Enamel internal finish, epoxy coatings or hot dipped galvanized finish
- Flanged or NPT inlet and outlet connections
- Flow, pressure, level & temperature gages or transmitters
- Heat trace for classified or non-classified electrical areas for freeze protection
- Clean out Ports
- Internal aeration diffuser for low level stripping or iron oxidation
- DP gage across filter, demister or both
- R-5 insulation with jacket, (steel or aluminum jacket)
- Vacuum relief valve

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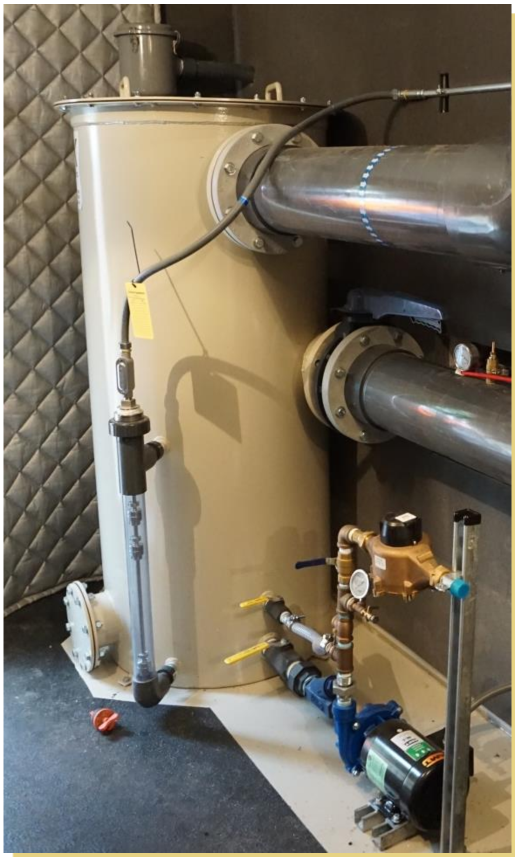
Additional Photos



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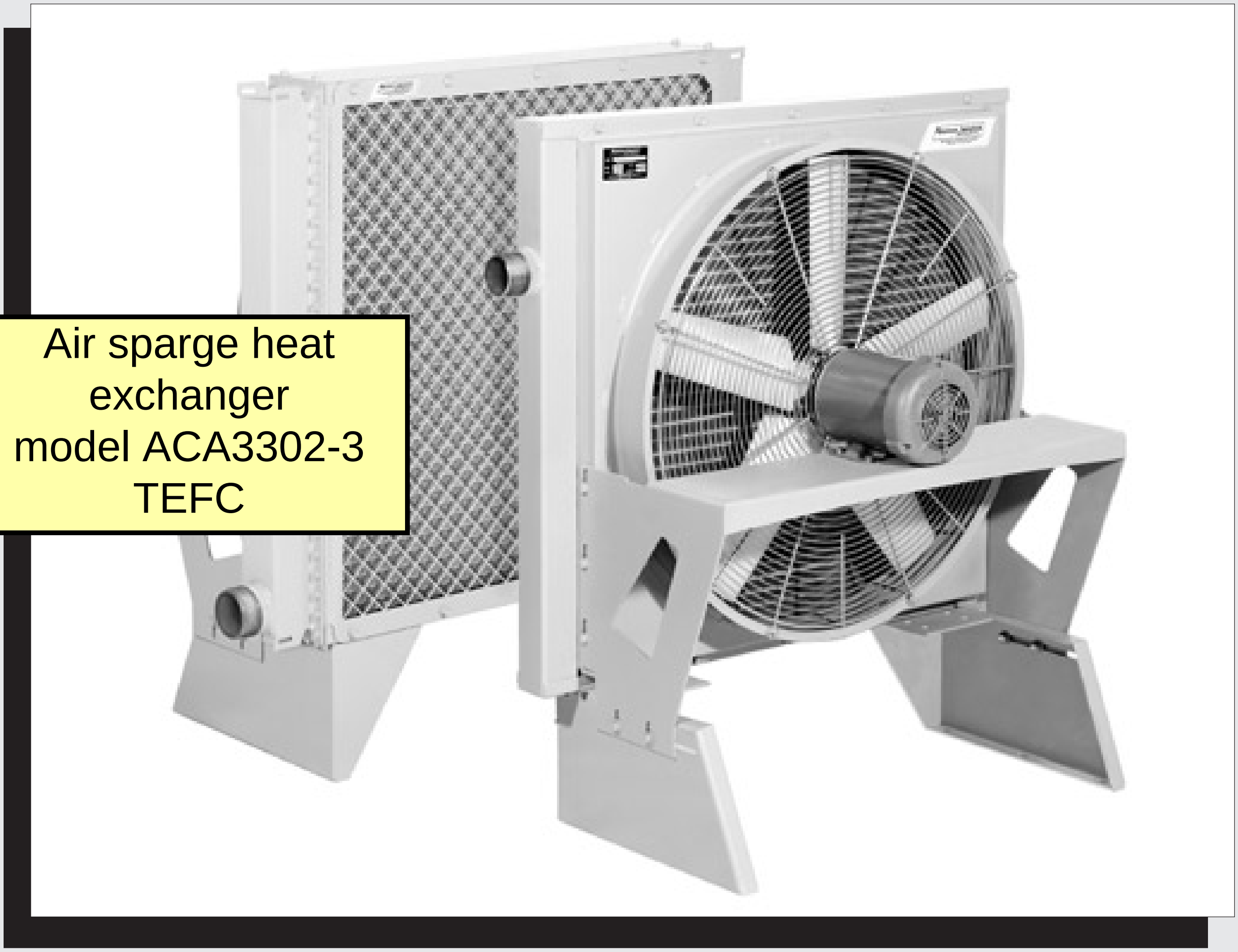

AIR COOLED

AFTERCOOLERS

For Compressed Gas or Vapor

- Computer Selection.
- Low pressure drop available.
- Standard ports NPT, optional ANSI flange.
- Operating temperature of 400° F & pressure of 150PSI.
- Custom designs to fit your needs.
- Cools: Air, Compressors, Blowers, Steam vapors, Pneumatic systems, Vapor recovery systems etc...

note: AIHTI reserves the right to make reasonable design changes without notice.

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ACA - 3181 through ACA - 4362

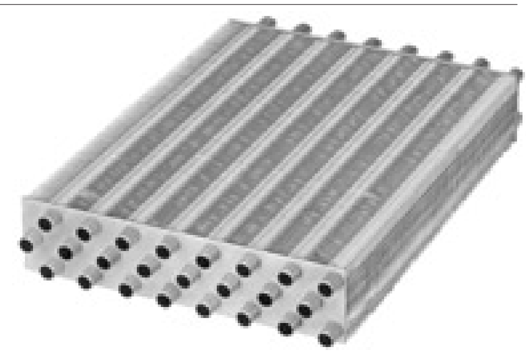
Brazed Core Construction

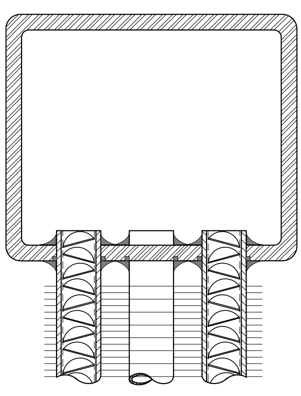
Air coolers are an essential part of any compressed air system, by cooling the air, and condensing water vapor into a liquid state for removal. When air is compressed, the compression induces heat into both the air and the water entrained in the air.

The American Industrial ACA series heat exchanger cools air with air, making it a simple inexpensive way to cool when compared to other water-cooled or refrigerant cooled systems. The unique compact brazed fin/tube design provides efficient cooling and low maintenance under the warmest environmental conditions. By using an ACA series air-cooled after cooler, machine tools will recieve cooler dryer air, provide longer trouble free life, experience less down time, and be cost effective to operate on a continuous basis.

SUPERIOR COOLING FINS

Copper tubes are mechanically bonded to highly efficient aluminum cooling fins. Die-formed fin collars provide a durable precision fit for maximum heat transfer. Custom fin design forces air to become turbulent and carry heat away more efficiently than old flat fin designs.





TANKS

State-of-the-art high temperature brazing method insures permanent bond and positive contact of tube to manifold, eliminating leaks and providing maximum service life.

CONSTRUCTION MATERIALS & RATINGS

Standard Construction Materials		Standard Unit Ratings	
Tubes	Copper	Operating Pressure	150 psig
Fins	Aluminum	Operating Temperature	400 °F
Cabinet & Pipes	Steel	Consult factory for optional materials and ratings.	
Fan Guard	Zinc Plated Steel		
Manifolds	Steel		

note: AIHTI reserves the right to make reasonable design changes without notice.

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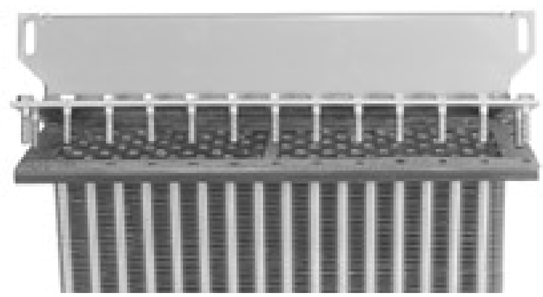
ACA - 6301 through ACA 6602

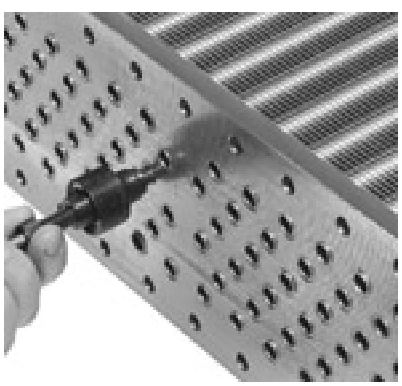
Serviceable Core® Construction

Air coolers are an essential part of any compressed air system, by cooling the air, and condensing water vapor into a liquid state for removal. When air is compressed, the compression induces heat into both the air and the water entrained in the air.
The American Industrial ACA series heat exchanger cools air with air, making it a simple inexpensive way to cool when compared to other water-cooled or refrigerant cooled systems. The unique compact *serviceable core®* design provides efficient cooling and low maintenance under the warmest environmental conditions. By using an ACA series air-cooled after cooler, machine tools will recieve cooler dryer air, provide longer trouble free life, experience less down time, and be cost effective to operate on a continuous basis.

SERVICEABLE CORE®

Core covers disassemble for easy access and cleaning. Repairable design for applications that require limited down time or in the event of a mishap requiring repair. Roller expanded tube to tube-sheet joint. 100% mechanical bond. Positive gasket seal is field replaceable for field maintenance or repair.





SUPERIOR COOLING FINS

Copper tubes are mechanically bonded to highly efficient aluminum cooling fins. Die-formed fin collars provide a durable precision fit for maximum heat transfer. Custom fin design forces air to become turbulent and carry heat away more efficiently than old flat fin designs.

CONSTRUCTION MATERIALS & RATINGS

Standard Construction Materials		Standard Unit Ratings	
Tubes	Copper	Operating Pressure	150 psig
Fins	Aluminum	Operating Temperature	400 °F
Cabinet & Pipes	Steel	Consult factory for optional materials and ratings.	
Fan Guard	Zinc Plated Steel		
Manifolds	Steel		

note: AIHTI reserves the right to make reasonable design changes without notice.

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Compressed Air

Normally air compressors have airflow rates based upon the horsepower. Rotary Screw compressors normally discharge air at 180 ºf - 200 ºf, prior to after-cooling. Reciprocating compressors normally discharge air at 250 ºf - 275 ºf, prior to after-cooling. Compressors are rated in CFM or cubic feet per minute of free air at inlet conditions. For practical purpose we will use sea level at 68 ºf and 36% relative humidity as a norm. Altitude, differing ambient conditions with respect to temperature and humidity will all affect heat exchanger performance to a degree. Moisture content in air actually increases the Btu/hr load requirement for cooling air by adding an additional condensing load to the gas load requirement. As air rapidly cools, moisture in the compressed air stream will condense and separate into droplets, the more humidity present the more condensation will occur.

Sizing

The performance curves provided are for air. However, gases other than air may be applied to this cooler with respect to compatibility by applying a correction factor. Please take time to check the operating specifications thoroughly for material compatibility, pressure, and size before applying an American Industrial heat exchanger into your system.

Terms

Approach Temperature is the desired outlet temperature of the compressed gas minus the inlet ambient air temperature of the external air flowing over the coil.

SCFM (Standard Cubic Feet per Minute)
A cubic foot of air at 68 ºf, 14.696 psia, & 36% relative humidity, per minute.

CFM (Cubic Feet per Minute)
Air at inlet atmospheric conditions.

ACFM (Actual Cubic Feet per Minute)
Air at current pressure, temperature, & humidity conditions without reference to a standard.

To Determine the Heat Load

If the heat load (Btu/hr) is unknown a value can be calculated based upon system operational requirements. To properly calculate the heat load (Btu/hr) to be rejected, several items must be known with certainty (see below).

- Flow rate SCFM (standard cubic feet pr minute)
- Type of gas and its makeup.
- System inlet pressure to the heat exchanger.
- Ambient temperature where the heat exchanger will be located (hotest condition).
- Temperature of the gas at the heat exchanger inlet.
- Temperature of the gas desired at heat exchanger outlet.
- Maximum acceptable pressure loss or cooled gas.

Using The Chart

American Industrial has created a quick reference chart for selecting ACA heat exchangers for Rotary Screw compressors (see page 214) [This chart offers basic information based upon compressor horsepower and average airflow rates. To properly use the chart, select the compressor horsepower at the left or the air flow rate. Next select the approach to ambient that is desired. Where the two columns intersect is shown the proper ACA model number.]

Using The Graphs

American Industrial provides performance graphs for ease of model selection. The following calculation examples (page 213), illustrate formulas to determine model selection sizes. It should be noted that there are some assumptions made when applying the basic principles for calculation in the formula. Altitude, humidity, materials, pressures, etc... all contribute to the final selection. Contact American Industrial for more detailed calculation.

Selection

The selection process is important, many considerations should be made when selecting a heat exchanger. Once the proper Fs requirement is calculated, it is time to apply the data to the graph and make a selection.

1) Find the Flow rate in SCFM located at the bottom of the graph. Follow the graph line up until it matches the calculated Fs from your calculations. If the point falls just above one of the model graphed lines, select the next larger size. If the point is on a line select it as your choice.
2) Check carefully the pressure differential. Units with operating pressures from 70+ psig will have no greater than 2.0 psid within the published flow range. For lower inlet pressure see the pressure drop curves for more detail.
3) Calculate a Nozzle size using the nozzle size calculation to verify your selection has the proper port sizes for your required inlet pressure.

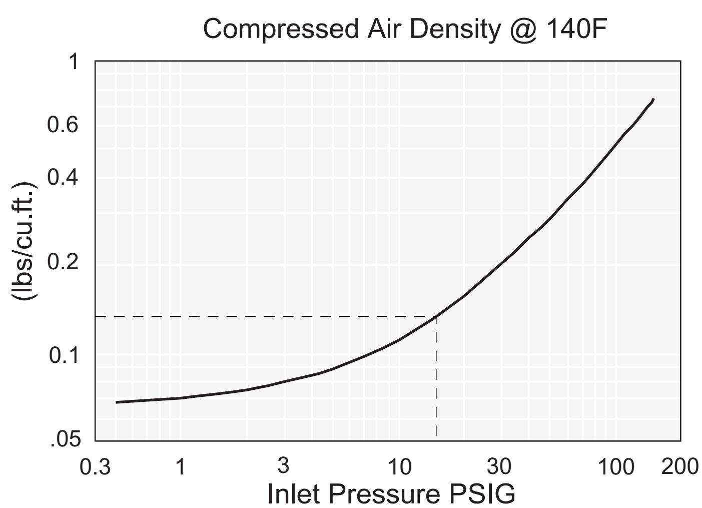
Formula: Nozzle Calculation

$$\text{Nozzle Size} = \sqrt{\frac{\left[\frac{(\text{SCFM} \times 4.512)}{(270{,}000 \times d)} \times 144\right]}{.7854}}$$

All numbers in equation are constants except for SCFM and (d) "density".

Example:
Flow rate = 200 SCFM
Pressure = 15 psig
Density = (d) from Compressed Air Density Graph

$$\sqrt{\frac{\left[\frac{(200 \times 4.512)}{(270{,}000 \times .14)} \times 144\right]}{.7854}} = 2.09\text{" or (2" Nozzle)}$$



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Examples: (Note: All air flow rates must be converted to SCFM)

Application 1 Air Rotary Screw Compressor

Determine the heat load "Q" =Btu/hr

$Q = [SCFM \times CF \times (T_1 - T_2)]$ or $[350 \times 1.13 \times 105^o] = 41{,}528$ Btu/hr

T_1 = Inlet gas temperature: 200°f

T_2 = Outlet gas temperature: Ambient + 10°f= (95°f)

T_a = Ambient temperature: 85°f

Determine the Fs = $\frac{Btu/hr}{T_2 - T_a}$ or $\frac{41{,}528}{10}$ = **4,153 Fs** (Refer to graph example on page 215)

Airflow rate: 350 SCFM

PSIG = Operating Pressure 100 psig

CF = Correction factor: 1.13

CF = (.0753 x S x C x60) or (.0753 x 1.0 x .25 x 60) = 1.13

S = Specific gravity with air being 1.0

C = Specific heat (Btu/Lb °f): .25

Model Selection - ACA-4362

$$\sqrt{\frac{\left[\frac{(350 \times 4.512)}{(270{,}000 \times .50)} \times 144\right]}{.7854}} = 1.46\text{" or (1.5" minimum nozzle)}$$

Application 2 Methane Gas

Determine the heat load "Q" = Btu/hr

$Q = [SCFM \times CF \times (T_1 - T_2)]$ or $[500 \times 1.428 \times 210^o] = 149{,}940$ Btu/hr

T_1 = Inlet gas temperature: 300°f

T_2 = Outlet gas temperature: 90°f

T_a = Ambient temperature: 60°f

Determine the Fs = $\frac{Btu/hr}{T_2 - T_a}$ or $\frac{149{,}940}{30}$ = **4,998 Fs** (Refer to graph example on page 215)

Gas flow rate: 500 SCFM

PSIG = Operating pressure: 150 psig

CF = Correction factor: 1.428

CF = (.0753 x S x C x 60) or (.0753 x .55 x .575 x 60) = 1.428

S = Specific gravity with air being 1.0: .55

C = Specific heat (Btu/Lb °f)

Model Selection - ACA-6421

$$\sqrt{\frac{\left[\frac{(500 \times 4.512)}{(270{,}000 \times .74)} \times 144\right]}{.7854}} = 1.44\text{" or (1.5" minimum nozzle)}$$

Application 3 Low Pressure Blower

Determine the heat load "Q" = Btu/hr

$Q = [SCFM \times CF \times (T_1 - T_2)]$ or $[76 \times 1.13 \times 150^o] = 12{,}882$ Btu/hr

T_1 = Inlet gas temperature: 250°f

T_2 = Outlet gas temperature: 100°f

T_a = Ambient temperature: 90°f

Determine the Fs = $\frac{Btu/hr}{T_2 - T_a}$ or $\frac{12{,}882}{10}$ = **1,288 Fs** (Refer to graph example on page 215)

CF = Correction Factor: 1.13

PSIG = Operating pressure: 2 psig

Airflow rate: 90 ACFM

To Convert ACFM to SCFM = $\frac{ACFM \times (PSIG + 14.7) \times 528}{(T_1 + 460) \times 14.7} = \frac{90 \times 16.7 \times 528}{710 \times 14.7} = 76$ SCFM

S = Specific gravity with air being 1.0

C = Specific heat (Btu/lb °f): .25

△P = 5" water column or less (example pg. 220)

Model Selection - ACA-3302

$$\sqrt{\frac{\left[\frac{(76 \times 4.512)}{(270{,}000 \times .075)} \times 144\right]}{.7854}} = 1.76\text{" or (2.0" minimum nozzle)}$$

Pressure Drop (see page 220 for graphs)

Since gas is compressible the density of the gas changes from one temperature or pressure to the next. While the mass flow rate may not change, the pressure differential across the heat exchanger will change dramatically from high (70-125 psig) to low (1-5 psig) pressure. A low pressure condition requires larger carrying lines to move flow than does the same gas rate under a higher pressure. At lower pressures the differential pressure across the heat exchanger can be quite high compared to the same flow rate at a higher pressure. For that reason it is suggested that the pressure differential graphs on page 220 be consulted prior to making your final selection.

The ACA series heat exchanger is designed to be easily modified to accept larger port sizes in the event your system pressure requires larger nozzles. Consult our engineering department for more exacting information regarding pressure differential issues.

note: AIHTI reserves the right to make reasonable design changes without notice.

ROTARY SCREW COMPRESSORS

(200°F @125 PSI & 36% relative humidity)

Compressor Horse Power (HP)	Average Air Discharge Cubic feet per minute (SCFM)	Model Size Selection			
		*Approach Temperature °F (T_2 - T_a)			
		5°F	10°F	15°F	20°F
15	60	ACA - 3302	ACA - 3242	ACA - 3242	ACA - 3182
20	80	ACA - 3302	ACA - 3242	ACA - 3242	ACA - 3182
30	130	ACA - 3362	ACA - 3302	ACA - 3242	ACA - 3242
40	165	ACA - 3362	ACA - 3302	ACA - 3302	ACA - 3242
60	250	ACA - 4362	ACA - 3362	ACA - 3302	ACA - 3302
75	350	ACA - 6362	ACA - 4362	ACA - 3362	ACA - 3302
100	470	ACA - 6362	ACA - 6362	ACA - 3362	ACA - 3362
125	590	ACA - 6422	ACA - 6362	ACA - 4362	ACA - 3362
150	710	ACA - 6422	ACA - 6362	ACA - 6362	ACA - 4362
200	945	ACA - 6482	ACA - 6422	ACA - 6362	ACA - 6362
250	1160	ACA - 6482	ACA - 6422	ACA - 6362	ACA - 6362
300	1450	ACA - 6542	ACA - 6482	ACA - 6422	ACA - 6362
350	1630	ACA - 6542	ACA - 6482	ACA - 6422	ACA - 6362
400	1830	ACA - 6602	ACA - 6482	ACA - 6422	ACA - 6422
500	2150	ACA - 6602	ACA - 6542	ACA - 6482	ACA - 6422

***Approach Temperature**
the desired outlet temperature of the compressed gas minus the inlet ambient air temperature of the external air flowing over the coil.

T_2 - Outlet gas temperature

T_a - Ambient temperature

Example of a model:

ACA - 3242 - 3 - __ -____ - ____

Model
ACA

Size

Number of Passes
1P = 1 pass
2P = 2 pass

Drive Type
N = no motor
1 = single phase
3 = three phase
1EXP = single phase
3EXP = three phase
5 = 575 Volt

Connections
Blank = NPT
A = ANSI 150#RF Flange

Tubing
Blank = Copper
U = 90/10 Cu Ni
C = Carbon Steel

Coating
Blank = Enamel (standard)
G = Galvanize (cabinet)
T = Heresite (core)
X = Epoxy (core & cabinet)

Using the performance graphs (page 215)

The Flow vs. Fs graph is calculated based upon SCFM units.

To convert volumetric Actual Cubic Feet per Minute (ACFM) into Standard Cubic Feet per Minute (SCFM) see page 213 application 3.

To select a model, locate the flow rate in SCFM located at the bottom of the graph. Proceed upward on the graph until the SCFM flow rate intersects with the calculated Fs. The curve closest, on or above the intersection point is the proper selection.

Using the one pass graph or two-pass graph depends upon pressure differential, flow, and performance requirements. The actual surface area for one or two pass units is the same. However, the airflow velocity in the tubes increases with the number of passes giving slightly higher pressure differentials and better cooling performance.

note: AIHTI reserves the right to make reasonable design changes without notice.

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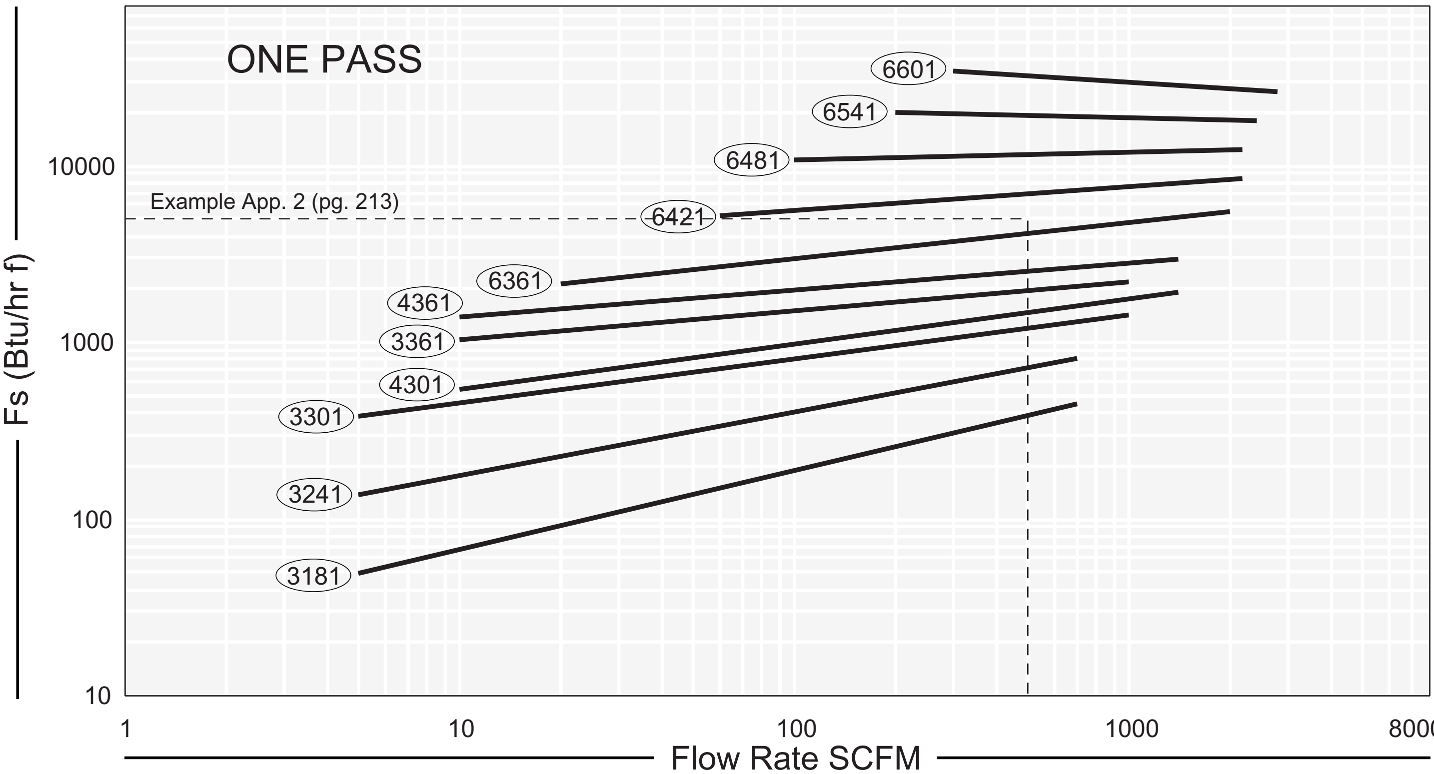
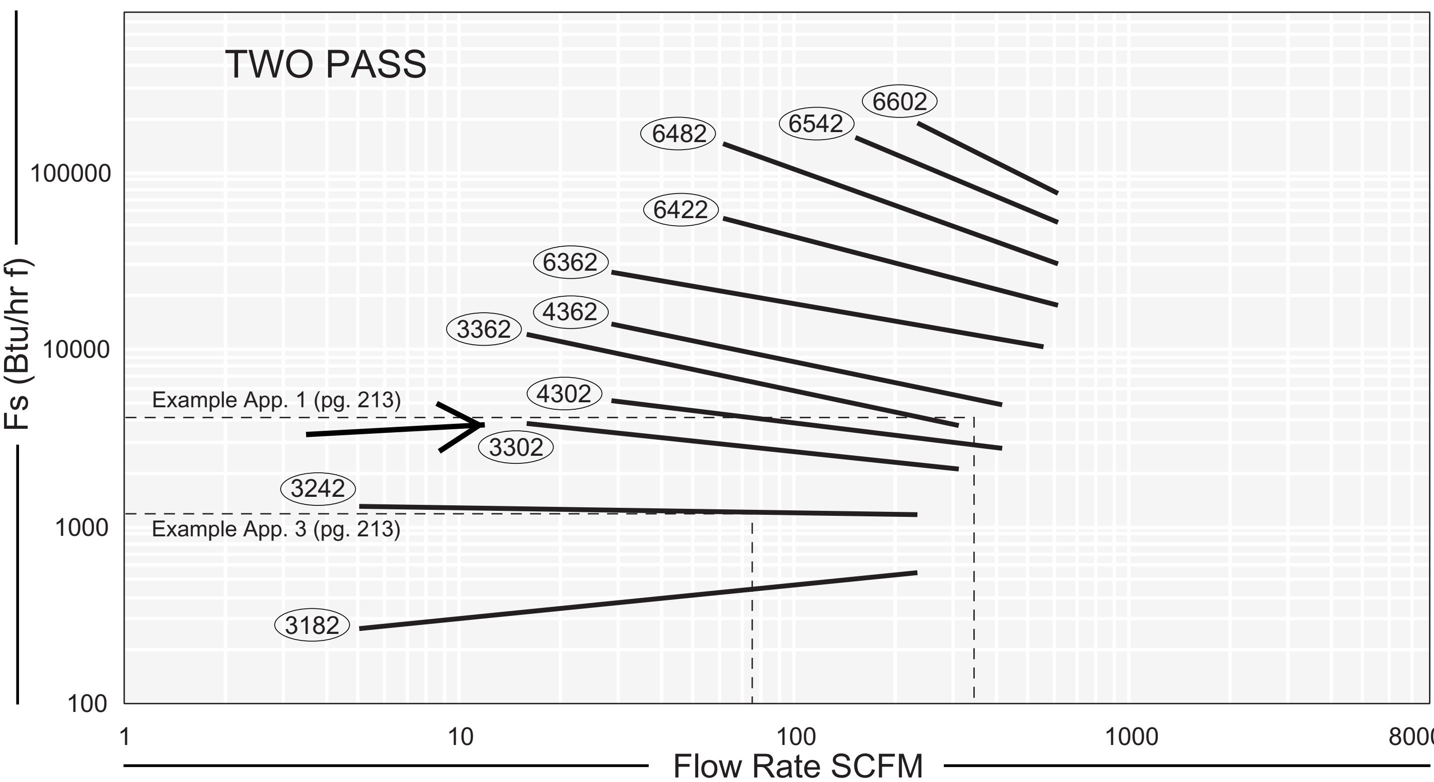




Example

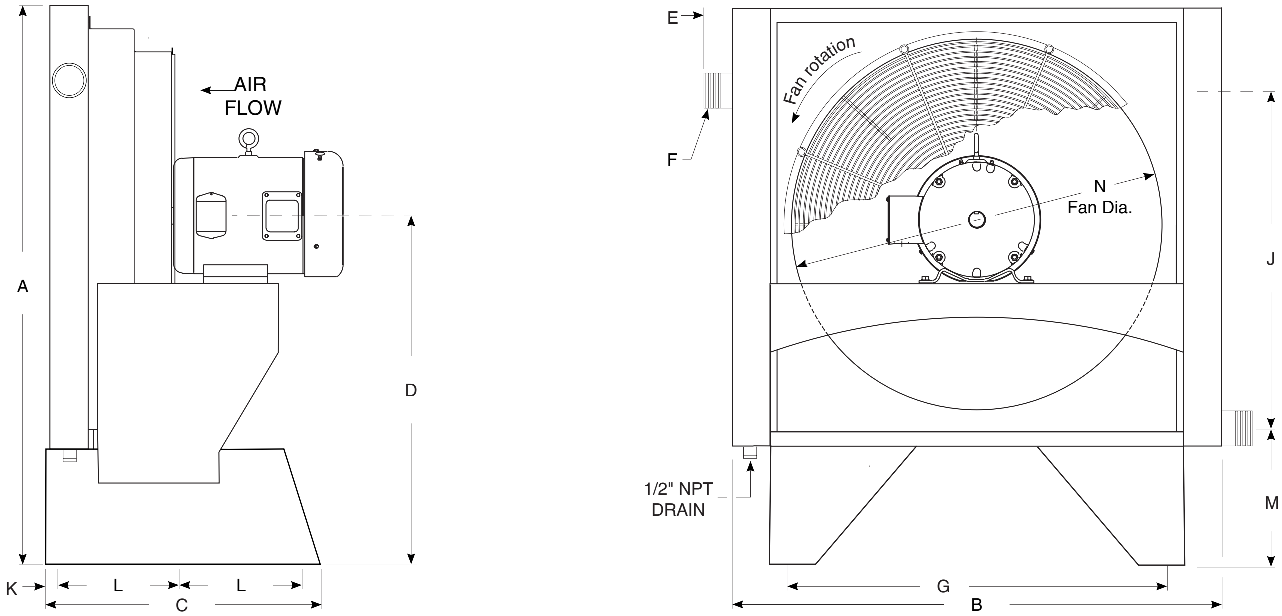
Application #3 (p.5)

$$Fs = \frac{\text{Heat Load (Btu/hr)}}{\text{Process exiting temperature } (T_2) \text{ from cooler} - \text{Ambient air entering the cooler } (T_a)}$$

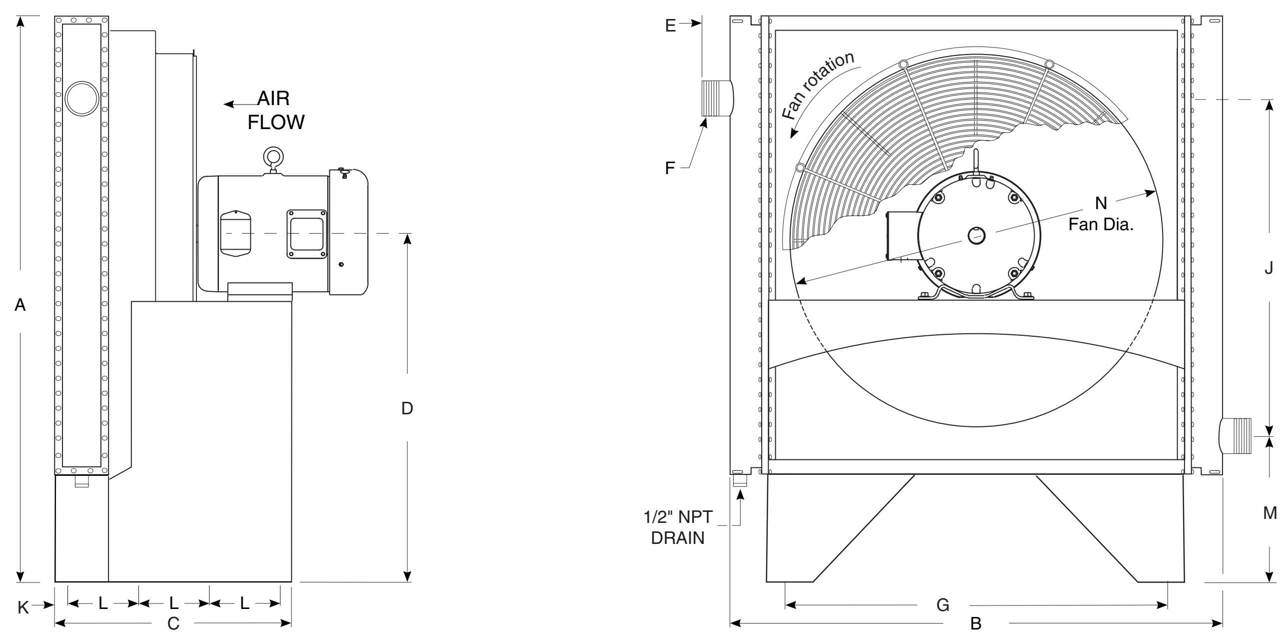
SCFM = 76
ÐPSI required = 5" H2O
Model selection = ACA-6421-3
Fs = 1,288 Nozzle check (p.4) = 3.10 or 3"NPT

note: AIHTI reserves the right to make reasonable design changes without notice.

ACA Series *dimensions*



ACA - 3181 through ACA - 4361



ACA - 6301 through ACA - 6601

DIMENSIONS (inches)												
Model	A	B	C	D	E	F NPT	G	J	K	L	M	N
ACA - 3181	30.6	23.0	19.8	20.25	2.5	1.5	16.3	12.98	1.5	8.38	11.93	14.0
ACA - 3241	36.6	29.0	19.8	23.25	2.5	1.5	22.3	17.48	1.5	8.38	11.93	22.0
ACA - 3301	42.6	35.0	19.8	26.25	2.5	2.0	28.3	21.75	1.5	8.38	12.15	28.0
ACA - 4301	42.6	36.0	19.8	26.25	2.5	2.5	28.3	21.55	1.5	8.38	12.35	28.0
ACA - 6301	42.6	38.8	19.8	26.25	2.5	3.0	28.3	21.07	1.5	8.38	12.98	28.0
ACA - 3361	48.6	41.0	19.8	29.25	2.5	2.0	34.3	26.25	1.5	8.38	12.15	32.0
ACA - 4361	48.6	42.0	19.8	29.25	2.5	2.5	34.4	26.05	1.5	8.38	12.35	32.0
ACA - 6361	48.5	43.9	19.8	29.25	2.5	3.0	34.3	26.0	1.5	8.38	12.7	32.0
ACA - 6421	54.5	50.8	27.36	32.25	2.5	4.0	40.3	29.4	2.0	6.75	13.3	36.0
ACA - 6481	60.6	56.8	27.36	35.25	2.5	4.0	46.3	34.1	2.0	6.75	13.3	42.0
ACA - 6541	66.6	62.8	28.83	38.25	2.5	4.0	52.3	38.6	2.0	6.75	13.3	48.0
ACA - 6601	72.4	67.9	30.6	41.25	2.5	4.0	58.3	43.05	2.0	6.75	13.3	48.0

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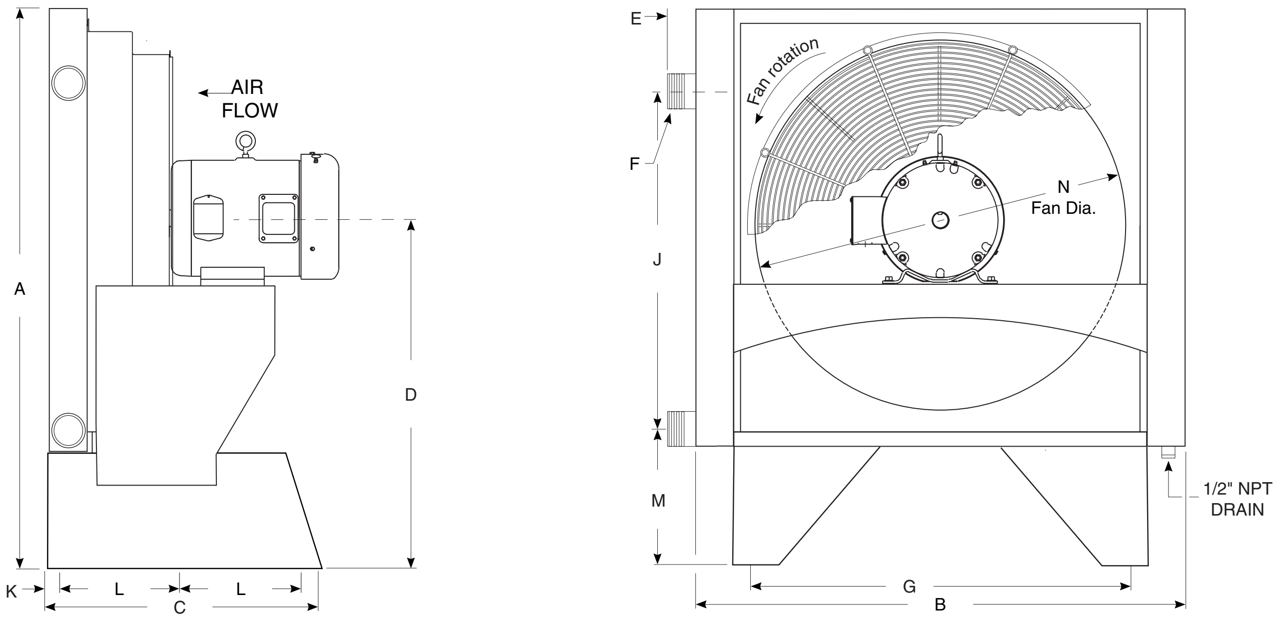
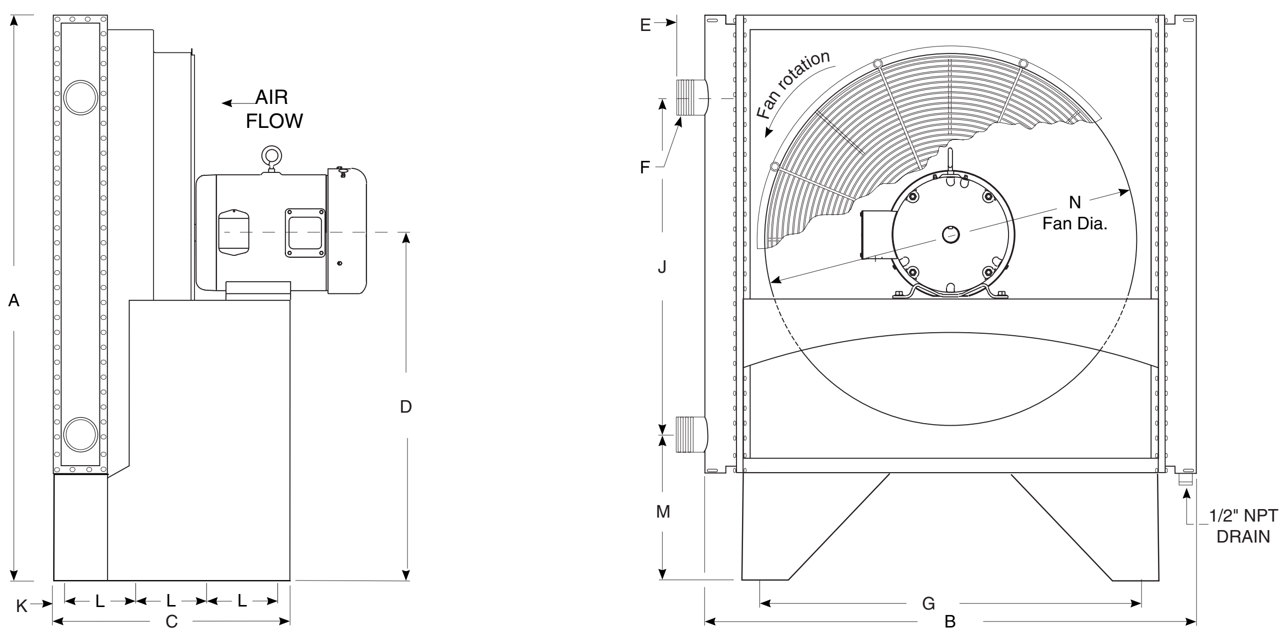


ACA - 3182 through ACA - 4362



ACA - 6302 through ACA - 6602

DIMENSIONS (inches)												
Model	A	B	C	D	E	F NPT	G	J	K	L	M	N
ACA - 3182	30.6	23.0	19.8	20.25	2.5	1.5	16.3	12.98	1.5	8.38	11.93	14.0
ACA - 3242	36.6	29.0	19.8	23.25	2.5	1.5	22.3	17.48	1.5	8.38	11.93	22.0
ACA - 3302	42.6	35.0	19.8	26.25	2.5	2.0	28.3	21.75	1.5	8.38	12.15	28.0
ACA - 4302	42.6	36.0	19.8	26.25	2.5	2.5	28.3	21.55	1.5	8.38	12.35	28.0
ACA - 6302	42.6	38.8	19.8	26.25	2.5	3.0	28.3	21.07	1.5	8.38	12.98	28.0
ACA - 3362	48.6	41.0	19.8	29.25	2.5	2.0	34.3	26.25	1.5	8.38	12.15	32.0
ACA - 4362	48.6	42.0	19.8	29.25	2.5	2.5	34.4	26.05	1.5	8.38	12.35	32.0
ACA - 6362	48.5	43.9	19.8	29.25	2.5	3.0	34.3	26.0	1.5	8.38	12.7	32.0
ACA - 6422	54.5	50.8	27.36	32.25	2.5	4.0	40.3	29.4	2.0	6.75	13.3	36.0
ACA - 6482	60.6	56.8	27.36	35.25	2.5	4.0	46.3	34.1	2.0	6.75	13.3	42.0
ACA - 6542	66.6	62.8	28.83	38.25	2.5	4.0	52.3	38.6	2.0	6.75	13.3	48.0
ACA - 6602	72.4	67.9	30.6	41.25	2.5	4.0	58.3	43.05	2.0	6.75	13.3	48.0

note: AIHTI reserves the right to make reasonable design changes without notice.

ELECTRIC MOTOR DATA

Model	Horse Power	Phase	Hz	Volts	RPM	NEMA Frame	Enclosure Type	Full Load Amperes	Service Factor	Thermal Overload
ACA- 3181/2- 1	.25	1	60-50	115/230 - 90/190	1725-1440	48	TEFC	3.2/1.6/2.8-1.4	1.15	NO
ACA- 3181/2 -3	.25	3	60-50	208 - 230/460 - 190/380	1725-1440	48	TEFC	1.3/.65/1.1-.55	1.15	NO
ACA- 3241/2 -1	.25	1	60-50	115/230 - 90/190	1140-950	56	TEFC	6.8/3.1-3.4	1.15	NO
ACA- 3241/2 -3	.25	3	60-50	208 - 230/460 - 190/380	1140-950	56	TEFC	1.7/2.0/1.0	1.15	NO
ACA- 3301/2 -1	.5	1	60-50	115/230 - 90/190	1140-950	56	TEFC	9.6/4.7-4.8/10.4/5.2	1.15	NO
ACA- 3301/2 -3	.5	3	60-50	208 - 230/460 - 190/380	1140-950	56	TEFC	2.4-2.7/1.35-2.5/1.25	1.15	NO
ACA- 4301/2 -1	.5	1	60-50	115/230 - 90/190	1140-950	56	TEFC	9.6/4.7-4.8/10.4/5.2	1.15	NO
ACA- 4301/2 -3	.5	3	60-50	208 - 230/460 - 190/380	1140-950	56	TEFC	2.4-2.7/1.35-2.5/1.25	1.15	NO
ACA- 6301/2 -3	1.0	3	60-50	208 - 230/460 - 190/380	1140-950	56	TEFC	4/2-3.7/1.85	1.15	NO
ACA- 3361/2 -3	1.0	3	60-50	208 - 230/460 - 190/380	1140-950	56	TEFC	4/2-3.7/1.85	1.15	NO
ACA- 4361/2- 3	1.0	3	60-50	208 - 230/460 - 190/380	1140-950	56	TEFC	4/2-3.7/1.85	1.15	NO
ACA- 6361/2 -3	3.0	3	60-50	208 - 230/460 - 190/380	1725-1440	182T	TEFC	8.4-6.8/3.4	1.15	NO
ACA- 6421/2 -3	5.0	3	60-50	208 - 230/460 - 190/380	1140-950	213T	TEFC	8.2-7.6/3.8	1.15	NO
ACA- 6481/2 -3	5.0	3	60-50	208 - 230/460 - 190/380	1140-950	213T	TEFC	14.0/7.0	1.15	NO
ACA- 6541/2 -3	7.5	3	60-50	208 - 230/460 - 190/380	1140-950	254T	TEFC	20.4/10.2	1.15	NO
ACA- 6601/2 -3	10	3	60-50	208 - 230/460 - 190/380	1140-950	256T	TEFC	28.0/14.0	1.15	NO

ELECTRIC MOTOR NOTES:

1) Motor electrical ratings are an approximate guide and may vary between motor manufacturers. Consult ratings on motor data plate prior to installation and operation.

2) Explosion proof, high temperature, severe duty, chemical, IEC, Canadian Standards Association, and Underwriters Laboratory recognized motors are available upon request.

3) American Industrial reserves the right to enact changes to motor brand, type and ratings regarding horsepower, RPM,FLA,and service factor for standard products without notice. All specific requirements will be honored without change.

4) Fan rotation is clockwise when facing the motor shaft.

5) The above motors contain factory lubricated shielded ball bearings (no additional lubrication is required).

6) **Abbreviation Index**
TEFC...........................Totally Enclosed, Fan Cooled
EXP.............................Explosion Proof

CLASS I,DIV.1, GROUP D or CLASS II,DIV.2, GROUP F & G EXPLOSION PROOF MOTOR DATA

Model	Horse Power	Phase	Hz	Volts	RPM	NEMA Frame	Enclosure Type	Full Load Amperes	Service Factor	Thermal Overload
ACA- 3181/2 -1	.25	1	60	115/230	1725	48	EXP	5.8/2.8	1.0	YES
ACA- 3181/2 -3	.25	3	60	208-230/460	1725	48	EXP	1.4-1.3/.65	1.0	YES
ACA- 3241/2 -3	.33	1	60	115/230	1140	56	EXP	7.8/3.5	1.0	YES
ACA- 3241/2 -1	.33	3	60	208-230/460	1140	56	EXP	1.18-1.6/8	1.0	YES
ACA- 3301/2 -3	.75	1	60	115/230	1140	56	EXP	9.4/4.8	1.0	YES
ACA- 3301/2 -1	.75	3	60	208-230/460	1140	56	EXP	2.5-2.4/1.2	1.0	YES
ACA- 4301/2 -3	.75	1	60	115/230	1140	56	EXP	9.4/4.8	1.0	YES
ACA- 4301/2 -1	.75	3	60	208-230/460	1140	56	EXP	2.5-2.4/1.2	1.0	YES
ACA- 6301/2 -1	1.0	3	60	230/460	1140	56	EXP	3.8/1.9	1.0	YES
ACA- 3361/2 -3	1.0	3	60	230/460	1140	56	EXP	3.8/1.9	1.0	YES
ACA- 4361/2 -3	1.0	3	60	230/460	1140	56	EXP	3.8/1.9	1.15	YES
ACA- 6361/2 -3	3	3	60	230/460	1725	182	EXP	8.8/4.4	1.15	YES
ACA- 6421/2 -3	5	3	60	230/460	1160	215	EXP	15.0-13.8/6.9	1.15	YES
ACA- 6481/2 -3	5	3	60	230/460	1160	215	EXP	15.0-13.8/6.9	1.15	YES
ACA- 6541/2 -3	7.5	3	60	230/460	1160	256	EXP	21.6-20.4/10.2	1.15	YES
ACA- 6601/2 -3	10	3	60	230/460	1160	256	EXP	29-26/13	1.15	YES

NOTE: Basic electric drive units are supplied with one of the corresponding above listed motors.

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575 VOLT ELECTRIC MOTOR DATA

Model	Horse Power	Phase	Hz	Volts	RPM	NEMA Frame	Enclosure Type	Full Load Amperes	Service Factor	Thermal Overload
ACA- 3181/2 -5	1/3	3	60	575	1725	56	TEFC	.52 .56	1.15	NO
ACA- 3241/2 -5	1/3	3	60	575	1140	56	TEFC	.52 .56	1.15	NO
ACA- 3301/2 -5	1/2	3	60	575	1140	56	TEFC	1.08	1.15	NO
ACA- 4301/2 -5	1/2	3	60	575	1140	56	TEFC	1.08	1.15	NO
ACA- 6301/2 -5	1	3	60	575	1140	56	TEFC	1.6	1.15	NO
ACA- 3361/2 -5	1	3	60	575	1140	56	TEFC	1.6	1.15	NO
ACA- 4361/2 -5	1	3	60	575	1140	56	TEFC	1.6	1.15	NO
ACA- 6361/2 -5	3	3	60	575	1725	182T	TEFC	3.3	1.15	NO
ACA- 6421/2 -5	5	3	60	575	1140	213T	TEFC	5.9	1.15	NO
ACA- 6481/2 -5	5	3	60	575	1140	213T	TEFC	5.9	1.15	NO
ACA- 6541/2 -5	7.5	3	60	575	1140	254T	TEFC	8.0	1.15	NO
ACA- 6601/2 -5	10	3	60	575	1140	256T	TEFC	10.5	1.15	NO

COMMON DATA

Model	Air Flow		Sound Level dB(A) @ 7ft	Weight		Serviceable Core
	CFM	m^3/s		w/ motor	w/o motor	
ACA-3181/2	1550	0.731	72	131	111	NO
ACA-3241/2	2900	1.36	76	154	134	NO
ACA-3301/2	4450	2.10	76	184	160	NO
ACA-4301/2	4450	2.10	76	211	187	NO
ACA-6301/2	4450	2.10	76	343	305	YES
ACA-3361/2	6350	2.99	79	243	205	NO
ACA-4361/2	6350	2.99	79	289	251	NO
ACA-6361/2	10500	4.95	91	402	342	YES
ACA-6421/2	14300	6.75	87	636	443	YES
ACA-6481/2	18700	8.82	88	753	560	YES
ACA-6541/2	23350	11.02	91	938	691	YES
ACA-6601/2	29300	13.83	91	1104	835	YES

NOTES:

TEFC = Totally Enclosed, Fan Cooled

To estimate the sound level at distances other than 7 feet (2.1 meters) from the cooler, add 6 db for each halving of distance, or substract 6 db for each doubling of the distance.

Example:
The Sound Level of the ACA-3181/2 is 72 dB at 7ft. At 3.5ft (7ft x 0.5 = 3.5ft) the sound level is 66 dB (72dB - 6dB = 66dB). At 14ft (7ft x 2 = 14ft) the sound level is 78dB (72dB + 6dB = 78dB).

Pressure Drop Graphs (see page 220)

Each graph represents a specific pressure drop at differing flow rates and inlet pressures. The four graphs for each model series size represents the more popular milestone pressure differentials commonly applied.

To use the graphs for selection purposes follw the steps below.

1) Locate the operating pressure at the bottom of the desired pressure drop chart.
2) Locate the flow rate in SCFM at the left end of the chart.
3) Follow the "Pressure" line vertically and the "Flow" line horizontally until they cross, note the location.
4) The curve on, or closest above will be exact or less pressure drop than requested and suitable for the application.
5) There may be several units shown above the intersection point, all of which will produce less than the desired pressure drop at the required flow.

Example: Application 3 Low Pressure Blower

Flow = 76 SCFM
Operating pressure = 2 PSIG
Initial selection from graph page 215 = ACA-3302
Desired pressure drop = 5" H2O or less. (USE the "Pressure Drop 5" H20" curves page 220)
From the pressure drop graph, page 220. Acceptable choice - ACA-3302 is on the line, ACA-3242 is well below the line. The ACA-3302 meets the pressure drop requirement, but exceeds the capacity requirement. However, even though the ACA-3242 exceeds 5" of water pressure drop, other considerations should be made prior to selection such as unit physical size, cost, availability, and port size.

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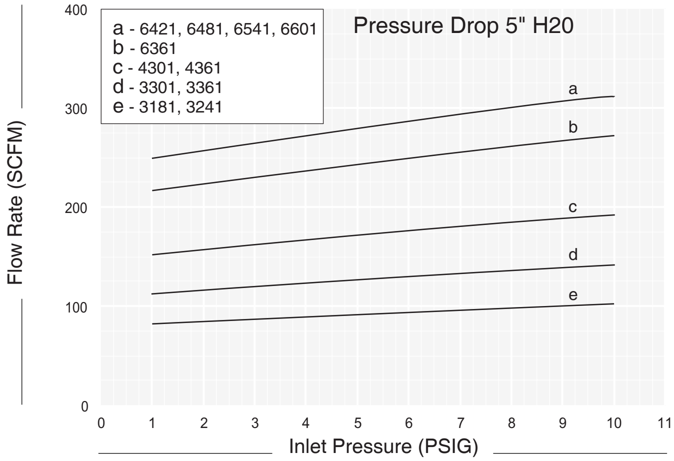
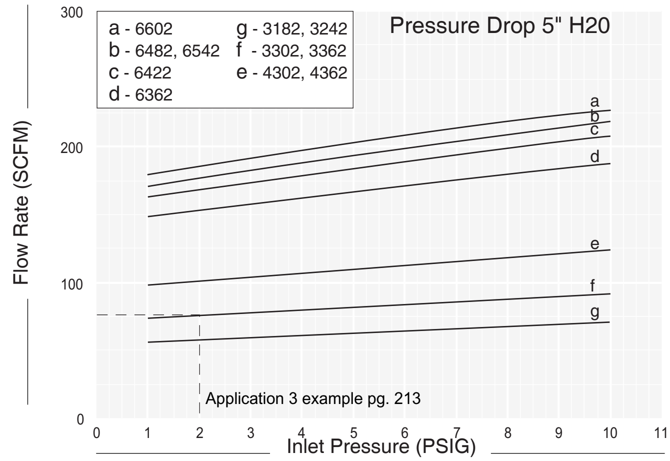
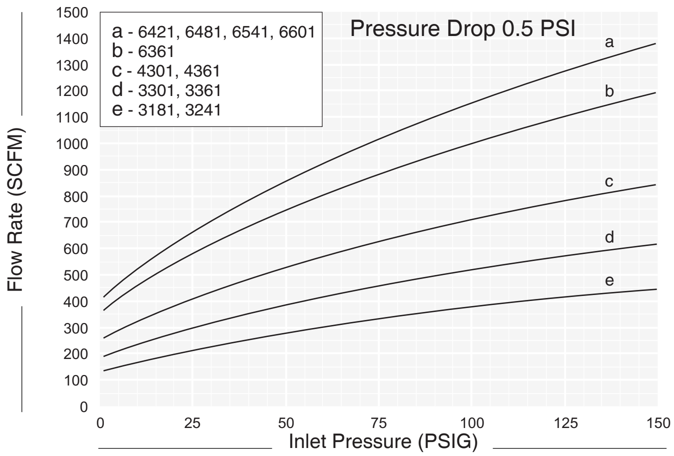
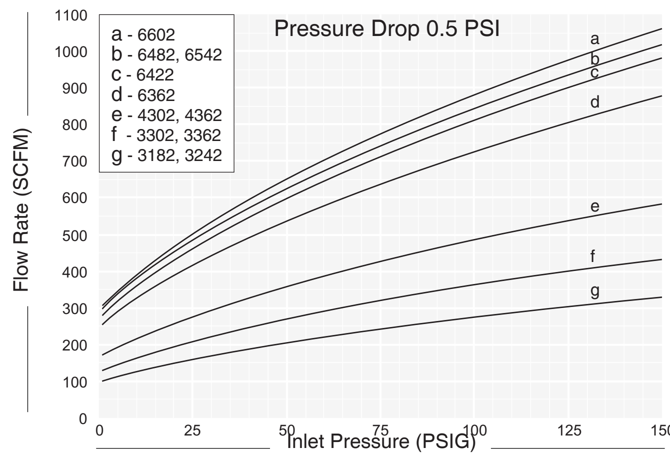
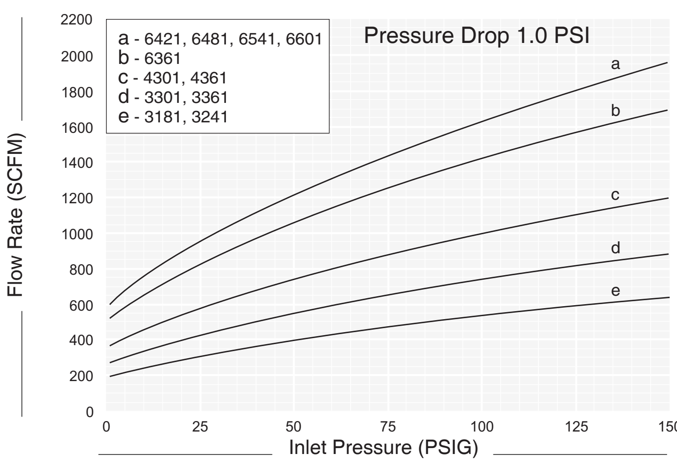
ACA Series *pressure drop graphs*

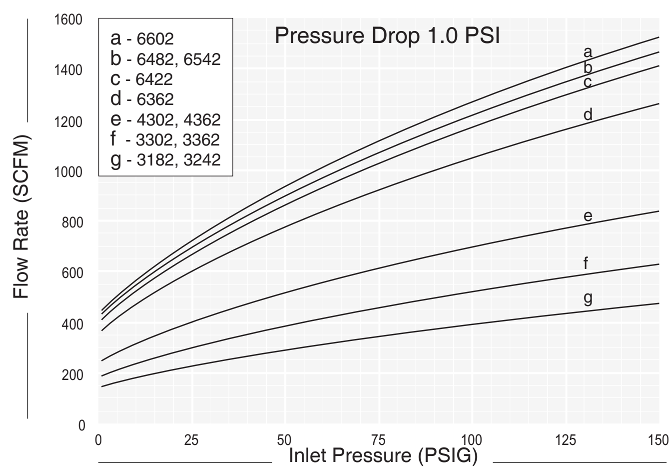


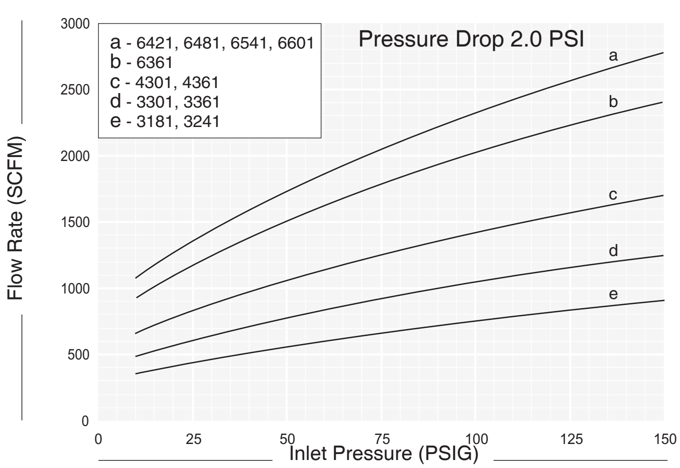


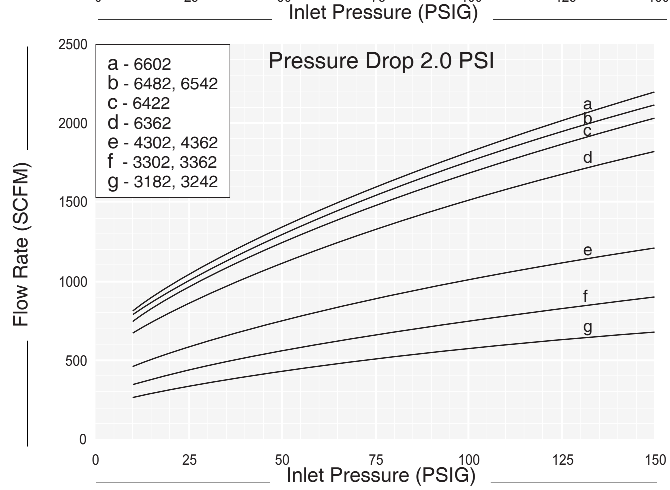












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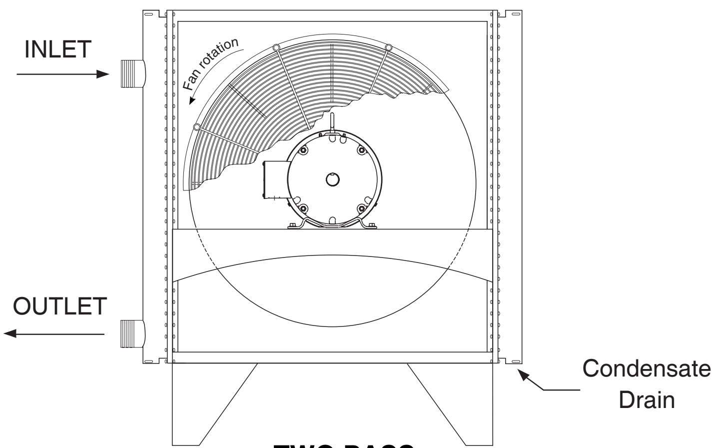
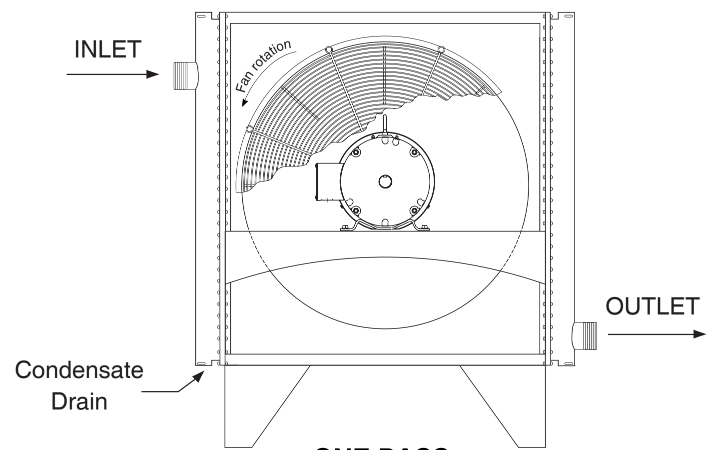
PIPING HOOK UP



TWO PASS



ONE PASS

Receiving:

a) Inspect unit for any shipping damage before uncrating. Indicate all damages to the trucking firms' delivery person and mark it on the receiving bill before accepting the freight. Make sure that the core and fan are not damaged. Rotate the fan blade to make sure that it moves freely. The published weight information located in this brochure is approximate. True shipment weights are determined at the time of shipping and may vary. Approximate weight information published herein is for engineering approximation purposes and should not be used for exact shipping weight. *Since the warranty is based upon the unit date code located on the model identification tag, removal or manipulation of the identification tag will void the manufacturers warranty.*

b) When handling the ACA heat exchanger, special care should be taken to avoid damage to the core and fan. All units are shipped with wood skids for easy forklift handling

c) Standard Enamel Coating: American Industrial provides its standard products with a normal base coat of oil base air cure enamel paint. The enamel paint is applied as a temporary protective and esthetic coating prior to shipment. While the standard enamel coating is durable, American Industrial does not warrantee it as a long-term finish coating. It is strongly suggested that a more durable final coating be applied after installation or prior to long-term storage in a corrosive environment to cover any accidental scratches, enhance esthetics, and further prevent corrosion. It is the responsibility of the customer to provide regular maintenance against chips, scratches, etc... and regular touch up maintenance must be provided for long-term benefits and corrosion prevention.

Installation:

a) American Industrial recommends that the equipment supplied should be installed by qualified personal who have solid understanding of system design, pressure and temperature ratings, and piping assembly. Verify the service conditions of the system prior to applying any ACA series cooler. If the system pressure or temperature does not fall within the parameters on ACA rating tag located on the heat exchanger, contact our factory prior to installation or operation.

b) In order for the heat exchanger to properly function, installation should be made with minimum airflow obstruction distance of not less than twenty (20) inches on both fan intake and exiting side of the heat exchanger.

c) Process piping should be as indicated above with the process flow entering into the upper port and exiting out the lower port (see illustration). This configuration will allow for condensate moisture to drain completely from the equipment. It is recommended that an air separator or automatic drip leg be applied to the outlet side of the heat exchanger to trap any moisture that develops.

d) Flow line sizes should be sized to handle the appropriate flow to meet the system pressure drop requirements. If the nozzle size of the heat exchanger is smaller than the process line size an increased pressure differential at the heat exchanger may occur.

e) ACA series coolers are produced with both brazed ACA-3181 through ACA-4362, and serviceable core® ACA-6301 through ACA-6602 style coils. A brazed construction coil does not allow internal tube access. A serviceable core® will allow full accessibility to the internal tubes for cleaning and maintenance. ACA series coolers are rated for 150 PSIG working pressure, and a 400^{o}f working temperature.

f) Special Coatings: American Industrial offers as customer options, Air-Dry Epoxy, and Heresite (Air-Dry Phenolic) coatings at additional cost. American Industrial offers special coatings upon request, however American Industrial does not warrantee coatings to be a permanent solution for any equipment against corrosion. It is the responsibility of the customer to provide regular maintenance against chips, scratches, etc... and regular touch up maintenance must be provided for long-term benefits and corrosion prevention.

note: AIHTI reserves the right to make reasonable design changes without notice.

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g) Electric motors should be connected only to supply source of the same characteristics as indicated on the electric motor information plate. Prior to starting, verify that the motor and fan spin freely without obstruction. Check carefully that the fan turns in the correct rotation direction normally counter clockwise from the motor side (fan direction arrow). Failure to operate the fan in the proper direction could reduce performance or cause serious damage to the heat exchanger or other components. Fan blades should be rechecked for tightness after the first 100 hours of operation.

Maintenance
Regular maintenance intervals based upon the surrounding and operational conditions should be maintained to verify equipment performance and to prevent premature component failure. Since some of the components such as, motors, fans, load adapters, etc... are not manufactured by American Industrial maintenance requirements provided by the manufacture must be followed.

a) Inspect the entire heat exchanger and motor/fan assembly for loosened bolts, loose connections, broken components, rust spots, corrosion, fin/coil clogging, or external leakage. Make immediate repairs to all affected areas prior to restarting and operating the heat exchanger or its components.

b) Heat exchangers operating in oily or dusty environments will often need to have the coil cooling fins cleaned. Oily or clogged fins should be cleaned by carefully brushing the fins and tubes with water or a non-aggressive degreasing agent mixture (Note: Cleaning agents that are not compatible with copper, brass, aluminum, steel or stainless steel should not be used). A compressed air or a water stream can be used to dislodge dirt and clean the coil further. Any external dirt or oil on the electric motor and fan assembly should be removed. Caution: Be sure to disconnect the electric motor from its power source prior to doing any maintenance.

c) In most cases it is not necessary to internally flush the coil. In circumstances where the coil has become plugged or has a substantial buildup of material, flushing the coil with water or a solvent may be done. Flushing solvents should be non-aggressive suitable for the materials of construction. Serviceable Core® models can be disassembled and inspected or cleaned if required.

d) Most low horsepower electric motors do not require any additional lubrication. However, larger motors must be lubricated with good quality grease as specified by the manufacture at least once every 6-9 months or as directed by the manufacture. T.E.F.C. air ventilation slots should be inspected and cleaned regularly to prevent clogging and starving the motor of cooling air. To maintain the electric motor properly see the manufactures requirements and specifications.

e) Fan blades should be cleaned and inspected for tightness during the regular maintenance schedule when handling a fan blade care must be given to avoid bending or striking any of the blades. Fan blades are factory balanced and will not operate properly if damaged or unbalanced. Damaged fan blades can cause excessive vibration and severe damage to the heat exchanger or drive motor.

Replace any damaged fan with an American industrial suggested replacement.

f) ACA heat exchanger cabinets are constructed using 7ga. through 18ga. steel that may be bent back into position if damaged. Parts that are not repairable can be purchased through American Industrial.

g) Coil fins that become flattened can be combed back into position. This process may require removal of the coil from the cabinet.

h) It is not advisable to attempt repairs to brazed joints of a brazed construction coil unless it will be done by an expert in silver solder brazing. Brazed coils are heated uniformly during the original manufacturing process to prevent weak zones from occurring. Uncontrolled reheating of the coil may result in weakening of the tube joints surrounding the repair area. In many instances brazed units that are repaired will not hold up as well to the rigors of the system as will a new coil. American Industrial will not warranty or be responsible for any repairs done by unauthorized sources. Manipulation in any way other than normal application will void the manufactures warranty.

i) Units containing a Serviceable Core® have bolted manifold covers that can be removed for cleaning or repair purposes.

Servicing Sequence
American Industrial has gone to great lengths to provide components that are repairable. If the ACA unit requires internal cleaning or attention the following steps will explain what must be done to access the internal tubes. Be sure to order gasket kits or repair parts prior to removal and disassembly to minimize down time.

a) To clean the internal tubes first remove all connection pipes from the unit.

b) Be sure the unit is drained of all water etc...

c) Place the ACA unit in an area that it can be accessed from all sides.

d) Remove the manifold cover bolts and hardware and place them into a secure place.

e) The manifold covers are tightly compressed and may need some prying to separate them from the gasket, physically remove the cover assemblies from both sides.

f) The tubes are now accessible for cleaning. We suggest a mild water-soluble degreaser be used with a brush. Tubing I.D. is .325 a plastic bristle brush on a rod will work best for cleaning the tubes. Steel brushes should be avoided since the steel is harder than the copper tubing and may heavily score the tubes if used.

g) If there are any leaking tubes you may plug them be forcing a soft metal plug into the hole and tapping it tight. You may in some cases weld the leaking tube shut however, care should be taken since excessive heat may cause surrounding tube joints to loosen and leak.

note: AIHTI reserves the right to make reasonable design changes without notice.

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3905 Route 173 Zion, IL 60099 tel: 1 (847) 731-1000 fax: 1 (847) 731-1010 www.aihti.com

High Head Straight Centrifugal Pumps

- ***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***
- ***489 Series: 1-1/4" x 1" Ports***
- ***490 Series: 1-1/2" x 1 1/4" Ports***
- ***Max. Working Pressure 150 PSI***
- ***Max. Temperature 200° F***
- ***Max. Flow 118 GPM***
- ***Max. Head 149 Ft. (65 PSI)***
- ***High Efficiency Closed Impeller***
- ***Available with Open Drip Proof (ODP) or Totally Enclosed Fan Cooled (TEFC) 56J Motors***
- ***1/2 HP to 3 HP Single and Three Phase 3450 RPM Motors***

AMT High Head Straight Centrifugal pumps are designed for continuous-duty OEM, Industrial/Commercial and processing applications including circulation, chemical processing, liquid transfer, heating and cooling, sprinkler/fire protection systems and pressure boosting. These heavy duty high pressure pumps are available in a variety of construction and seal materials to meet your specification. The line also features a wide selection of single & three phase ODP or TEFC motors, up to 3 horsepower. All models feature Type 21 mechanical seals and O-rings. Pull-from-the-rear design for easy servicing without disturbing any piping. High efficiency impellers maximize performance.

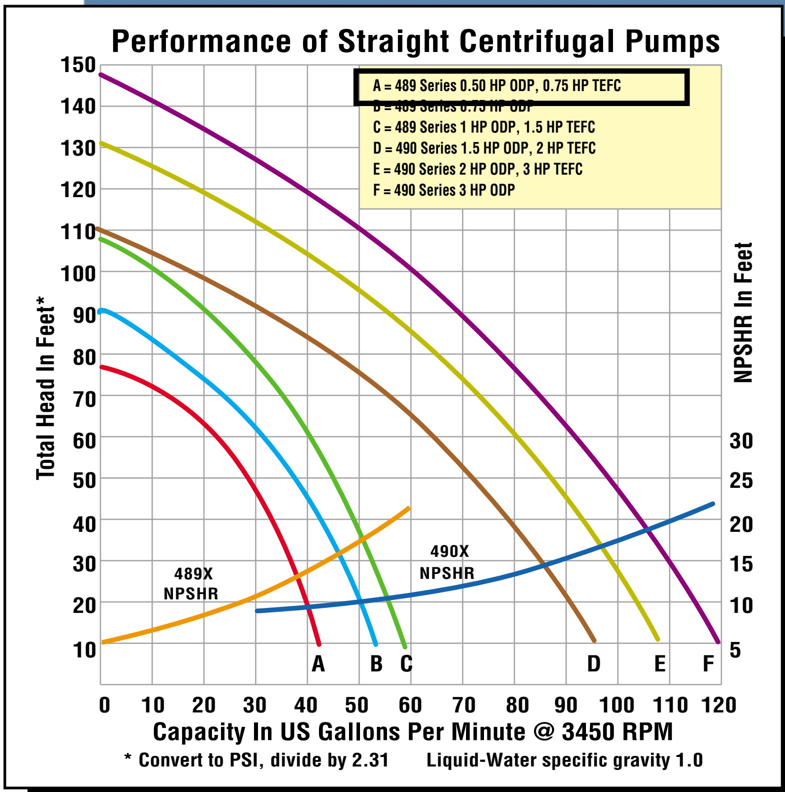
AMT Centrifugal pumps are reliable, cost effective and low maintenance. Many are readily available **"Off-the-Shelf"** for fast 24 hour shipment. For use with non-flammable liquids compatible with pump component materials.

Viton® is a registered trademark of E.I. DuPont

INDUSTRIAL DUTY

Stainless Steel Model 490A-98

Cast Bronze Model 4890-97



High Head Straight Centrifugal Pumps

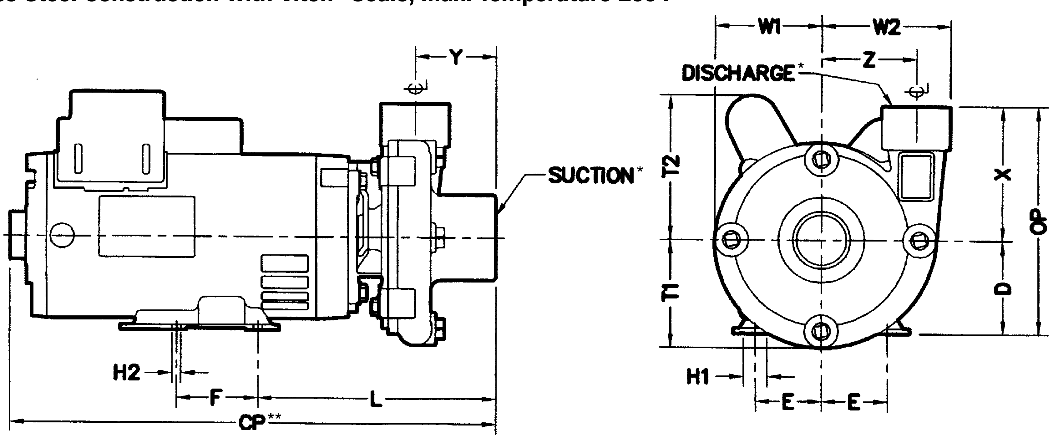
Pump Dimensional & Specification Data

‡ Model	Curve	HP	PH	ENC	VOLTAGE @ 60 Hz+	FULL LOAD AMPS	SUC*	DIS*	CP**	D	E	F	H1	H2	L	OP	T1	T2	W1	W2	X	Y	Z	‡ XCI (-95)	‡ XB (-97)	‡ XSS(-98)
4893	A	1/2	1	ODP	115/230	10/5	1-1/4"	1"	14.8	3.5	2.44	3.00	0.88	0.3	7.3	8.2	3.7	4.7	3.5	4.4	4.7	2.1	3.35	43 lbs.	44 lbs.	43 lbs.
4894	A	1/2	3	ODP	208-230/460	4/2	1-1/4"	1"	13.6	3.5	2.44	3.00	0.88	0.3	7.3	8.2	3.7	4.7	3.5	4.4	4.7	2.1	3.35	43 lbs.	41 lbs.	43 lbs.
489C	A	3/4	1	TEFC	115/230	9/5	1-1/4"	1"	16.3	3.5	2.44	3.00	0.88	0.3	7.3	8.2	3.7	4.7	3.5	4.4	4.7	2.1	3.35	46 lbs.	49 lbs.	46 lbs.
489D	A	3/4	3	TEFC	230/460	3/2	1-1/4"	1"	14.2	3.5	2.44	3.00	0.88	0.3	7.3	8.2	3.7	4.7	3.5	4.4	4.7	2.1	3.35	44 lbs.	47 lbs.	44 lbs.
4895	B	3/4	1	ODP	115/230	13/7	1-1/4"	1"	15.7	3.5	2.44	3.00	0.88	0.3	7.3	8.2	3.7	4.7	3.5	4.4	4.7	2.1	3.35	44 lbs.	45 lbs.	44 lbs.
4896	B	3/4	3	ODP	208-230/460	4/2	1-1/4"	1"	14.0	3.5	2.44	3.00	0.88	0.3	7.3	8.2	3.7	4.7	3.5	4.4	4.7	2.1	3.35	44 lbs.	42 lbs.	44 lbs.
4890	C	1	1	ODP	115/230	17/9	1-1/4"	1"	14.2	3.5	2.44	3.00	0.88	0.3	7.3	8.2	3.7	4.7	3.5	4.4	4.7	2.1	3.35	47 lbs.	48 lbs.	47 lbs.
4891	C	1	3	ODP	208-230/460	5/3	1-1/4"	1"	13.4	3.5	2.44	3.00	0.88	0.3	7.3	8.2	3.7	4.7	3.5	4.4	4.7	2.1	3.35	45 lbs.	46 lbs.	45 lbs.
489A	C	1-1/2	1	TEFC	115/230	18/9	1-1/4"	1"	16.1	3.5	2.44	3.00	0.88	0.3	7.3	8.2	3.7	4.7	3.5	4.4	4.7	2.1	3.35	55 lbs.	58 lbs.	55 lbs.
489B	C	1-1/2	3	TEFC	230/460	5/3	1-1/4"	1"	15.2	3.5	2.44	3.00	0.88	0.3	7.3	8.2	3.7	4.7	3.5	4.4	4.7	2.1	3.35	53 lbs.	56 lbs.	53 lbs.
4902	D	1-1/2	1	ODP	115/230	22/11	1-1/2"	1-1/4"	15.5	3.5	2.44	3.00	0.88	0.3	8.8	8.4	4.0	4.9	3.9	4.7	4.9	3.0	3.49	57 lbs.	64 lbs.	57 lbs.
4903	D	1-1/2	3	ODP	208-230/460	7/4	1-1/2"	1-1/4"	15.7	3.5	2.44	3.00	0.88	0.3	8.8	8.4	4.0	4.9	3.9	4.7	4.9	3.0	3.49	54 lbs.	58 lbs.	54 lbs.
490C	D	2	1	TEFC	115/230	22/11	1-1/2"	1-1/4"	18.0	3.5	2.44	3.00	0.88	0.3	8.8	8.4	4.0	4.9	3.9	4.7	4.9	3.0	3.49	65 lbs.	72 lbs.	62 lbs.
490D	D	2	3	TEFC	230/460	6/3	1-1/2"	1-1/4"	17.5	3.5	2.44	3.00	0.88	0.3	8.8	8.4	4.0	4.9	3.9	4.7	4.9	3.0	3.49	60 lbs.	67 lbs.	63 lbs.
4904	E	2	1	ODP	115/230	28/14	1-1/2"	1-1/4"	16.8	3.5	2.44	3.00	0.88	0.3	8.8	8.4	4.0	4.9	3.9	4.7	4.9	3.0	3.49	63 lbs.	62 lbs.	63 lbs.
4905	E	2	3	ODP	208-230/460	7/4	1-1/2"	1-1/4"	16.5	3.5	2.44	3.00	0.88	0.3	8.8	8.4	4.0	4.9	3.9	4.7	4.9	3.0	3.49	58 lbs.	62 lbs.	58 lbs.
490A	E	3	1	TEFC	230	16	1-1/2"	1-1/4"	17.1	3.5	2.44	3.00	0.88	0.3	8.8	8.4	4.0	4.9	3.9	4.7	4.9	3.0	3.49	74 lbs.	76 lbs.	71 lbs.
490B	E	3	3	TEFC	230/460	8/4	1-1/2"	1-1/4"	16.0	3.5	2.44	3.00	0.88	0.3	8.8	8.4	4.0	4.9	3.9	4.7	4.9	3.0	3.49	66 lbs.	73 lbs.	69 lbs.
4900	F	3	1	ODP	230	18	1-1/2"	1-1/4"	15.0	3.5	2.44	3.00	0.88	0.3	8.8	8.4	4.0	4.9	3.9	4.7	4.9	3.0	3.49	69 lbs.	73 lbs.	69 lbs.
4901	F	3	3	ODP	208-230/460	9/5	1-1/2"	1-1/4"	15.2	3.5	2.44	3.00	0.88	0.3	8.8	8.4	4.0	4.9	3.9	4.7	4.9	3.0	3.49	64 lbs.	68 lbs.	69 lbs.

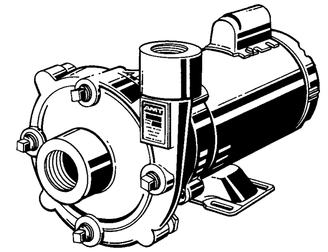
(*) Standard NPT (female) pipe thread.
(**) This dimension may vary due to motor manufacturer's specifications.
(+) 3-Phase motors can also operate on 50 Hz. (This will change Full Load Amps, Service Factor and RPM)
NOTE: Dimensions have a tolerance of ±1/8".
NOTE: Electric supply for ALL motors must 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: 4893-95)*

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



- 300 Series Investment Cast Stainless Steel, Bronze & Cast Iron Construction
- Buna-N or Viton® Mechanical Seal and O-Rings Depending on Model
- Stainless Steel Hardware
- NEMA 56J ODP & TEFC Single and Three Phase 3450 RPM Motors
- Stainless Steel Motor Shaft
- NEMA Base Mounted Motors
- High Efficiency Closed Impeller
- Discharge Rotates in 90° Increments
- Maximum Working Pressure to 150 PSI
- Max. Temperature 200° F (Viton®), 180° F (Buna-N)
- Four Front Drain Plugs, Located 90° Apart
- **"Off-the-Shelf"** Availability for Many Models

Viton® is a registered trademark of E.I. DuPont

See price book pages 32 & 33

The Gorman-Rupp Company reserves the right to discontinue any model or change specifications at any time without incurring any obligation.

CP85-86/0706

LCF Series
Fiberglass Liquid GAC Vessel

Features & Specifications

- Polyethylene inner shell (all wetted surfaces) with continuously wound fiberglass exterior shell
- 150 psi pressure rating with 4;1 safety factor
- Typical 4” NPT top fitting for mating to PVC head
- PVC top head with NPT connections
- ABS skirt or tripod base depending on vessel size
- PVC hub and slotted lateral underdrain for distribution at high and low flow rates

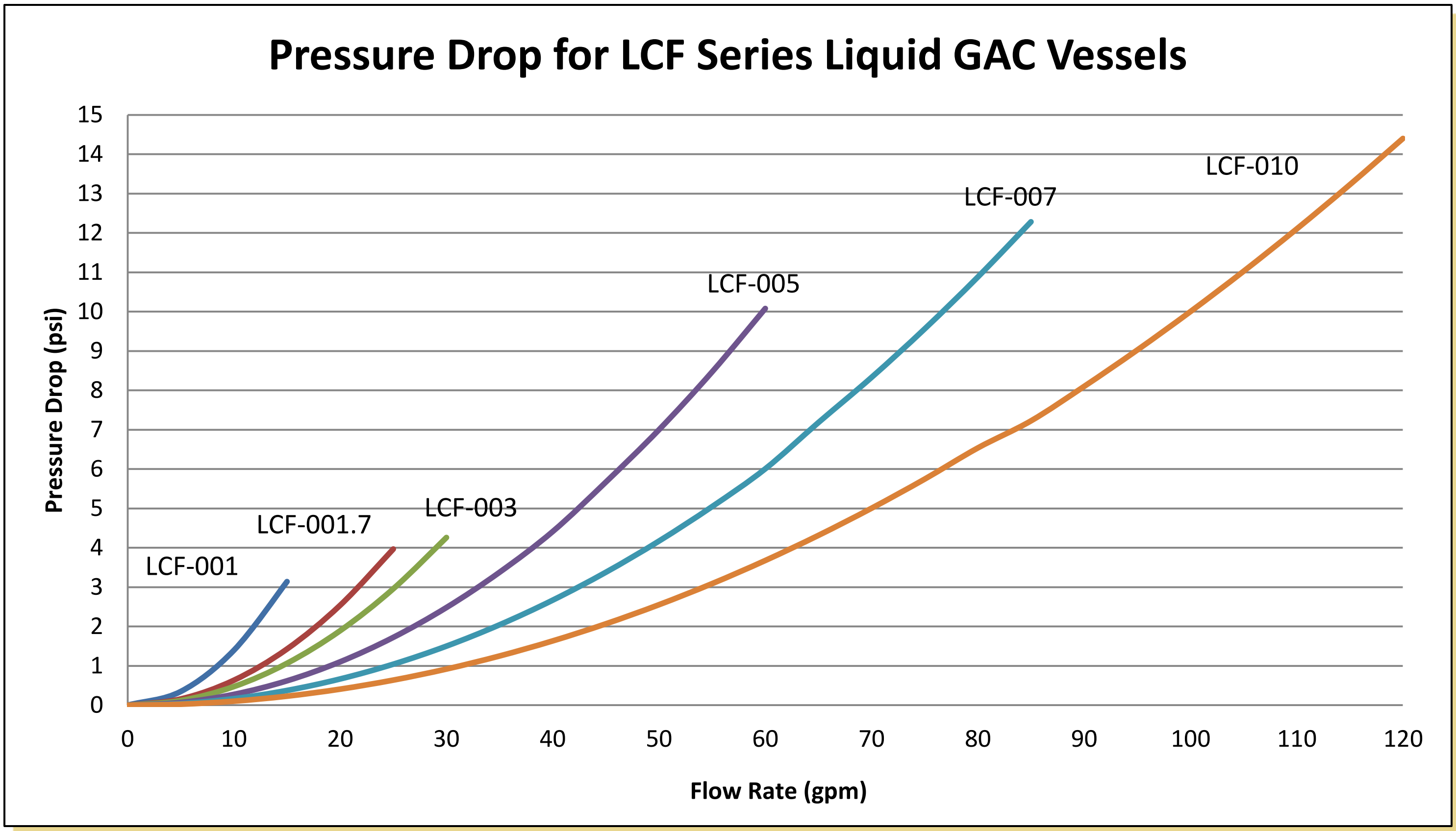
H2K Technologies, Inc.

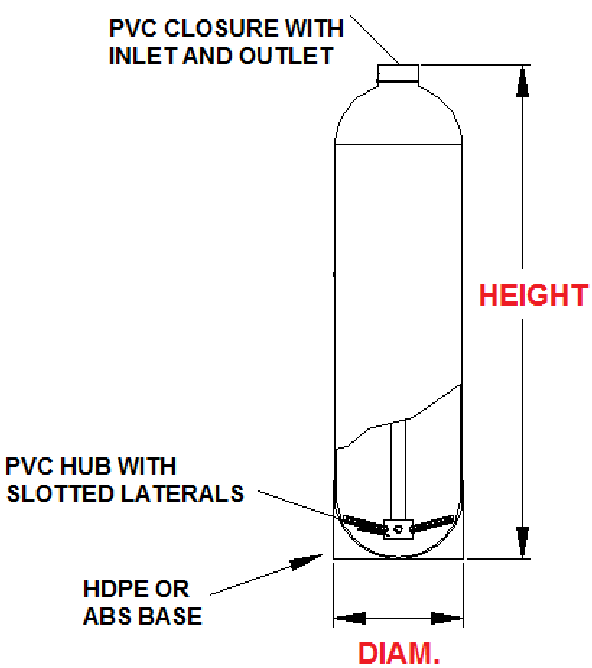
Applications

- Liquid phase granular activated carbon, virgin or reactivated
- Drinking water for dissolved organics
- Impregnated granular activated carbon, clays, and zeolite
- Excavation dewatering
- Removal of dissolved gasoline range organics (BTEX compounds), & other hydrocarbons from water (including MTBE)
- Removal of dissolved chlorinated organic compounds from water
- Liquid phase polymers & resins
- Removal of dissolved pesticides and other semi-volatile organic compounds from water
- Remediation industry
- Industrial waste water

H2K Technologies, Inc.
7550 Commerce St
Corcoran, MN 55340
Phone: 763.746.9900
Fax: 763.746.9903
www.H2KTECH.com
Sales@H2KTech.com

Model Number	Inlet/Outlet Connection	Height In.	Diam. In.	Rated Flow GPM	Carbon Capacity Lbs.	Empty Weight Lbs.	Loaded Weight Lbs.	Operating Weight Lbs.	Spent & Drained Weight Lbs.	Pressure Rating, PSI
LCF-001	1" FNPT	54"	14 "	15	90	25	115	255	180	150 psi
~~LCF-001.7~~	~~1 ½ " FNPT~~	~~69"~~	~~18"~~	~~25~~	~~180~~	~~45~~	~~225~~	~~440~~	~~320~~	~~150 psi~~
LCF-003	1 ½ " FNPT	77"	24"	30	250	65	315	680	480	150 psi
~~LCF-005~~	~~1 ½ " FNPT~~	~~77"~~	~~30"~~	~~60~~	~~500~~	~~150~~	~~650~~	~~1,270~~	~~890~~	~~150 psi~~
LCF-007	2 " FNPT	77"	36"	85	1,000	220	1,220	2,150	1,760	125 psi
LCF-010	2 " FNPT	77"	42"	120	1,250	350	1,650	2,900	2,000	125 psi





Options

- Skid assemblies for single or multiple vessels
- Pressure relief assemblies, PRV or rupture disk
- Flow, pressure, level & temperature gages or Transmitters
- Piping header for series lead/lag, parallel or standby operation of (2), (3), or more vessels

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APPENDIX E – IMPLEMENTATION SCHEDULE

APPENDIX E. IMPLEMENTATION SCHEDULE
FORMER PHILLIPS 66, SOCORRO, NEW MEXICO

Task No.	Task Description	Task Duration	Total Duration
1	Final FRP Approval	30	30
2	Phase 4 Work Plan Preparation and Approval	30	60
3	Public Notice Period	30	90
4	Vendor and Contractor Procurement and Scheduling	30	120
5	Well Installation	30	150
6	Equipment Compound, Piping, Wiring, Plumbing	30	180
7	System Startup	5	185

Note:
The presented schedule is preliminary and may be adjusted based on regulatory approval, property access, equipment, materials, subcontractor availability, and other factors.

APPENDIX F – PUBLIC NOTICE

NOTICE OF SUBMISSION OF REMEDIATION PLAN
Date of Notice: June 15, 2019

Notice is hereby given by EA Engineering, Science, and Technology, Inc. PBC of the submission of a Final Remediation Plan to the Petroleum Storage Tank Bureau (PSTB), New Mexico Environment Department (NMED), in accordance with New Mexico Administrative Code (NMAC) 20.5.119.1923.D.10 as follows:

1. The Remediation Plan has been submitted to the NMED PSTB and proposes actions to remediate a release of petroleum or petroleum products into the environment.

2. The release occurred at the former Socorro 66 Site located at 401 N. California Street, Socorro, New Mexico.

3. The Remediation Plan proposes that sparging of groundwater and soil vapor extraction of soil be used to remediate the impacted soil and groundwater.

4. A copy of the Remediation Plan and all data related to the remediation plan can be viewed by interested parties at the NMED office located at 2905 Rodeo Park Drive East, Building 1, Santa Fe, NM 87505.

5. Comments on the plan may be sent to the PSTB Project Manager at the following address:

   Mr. Jim Gibb
   Geoscientist Supervisor
   New Mexico Environment Department
   Petroleum Storage Tank Bureau
   2905 Rodeo Park Drive East, Building 1
   Santa Fe, NM 87505

6. Public comments must be delivered to the owner, the PSTB Project Manager, or to the Secretary of the Environment Department within 21 days of the publication of this notice.

END OF PUBLIC NOTICE

NOTICE OF SUBMISSION OF REMEDIATION PLAN
Date of Notice: June 15, 2019

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

6. Public comments must be delivered to the owner, the PSTB Project Manager, or to the Secretary of the Environment Department within 21 days of the publication of this notice.

Published by El Defensor Chieftain on June 20, 2019.

AFFIDAVIT of PUBLICATION

Wanda Moeller, being first duly sworn, deposes and says that she is Editor/Publisher of the ***El Defensor Chieftain,*** printed and published each week in the County of Socorro, State of New Mexico, and of general circulation in the city of Socorro, County of Socorro, State of New Mexico and elsewhere, and the hereto attached

TE OF NEW MEXICO)
:SS
JNTY OF SOCORRO)

was printed and published correctly in the regular and entire issue of said ***EL DEFENSOR CHIEFTAIN*** for 1 issue(s), that the first was made on the 20 day of June, 2019 and subsequent publications being:

Request of ***EL DEFENSOR CHIEFTAIN***

By:
Affiant Wanda Moeller

Subscribed and sworn to me this 20 day of June, 2019 in the County of Socorro, State of New Mexico.

Notary Public

Notary Public in and for the County of Socorro, State of New Mexico
My Commission Expires: 3/8/23

Seal

OFFICIAL SEAL
Denise R. Ortega
NOTARY PUBLIC - State of New Mexico
My Commission Expires

Account Number: 1093881 Ad Number: 0000145247

Price: $80.46 (Statement to come at end of month)

NOTICE OF SUBMISSION OF REMEDIATION PLAN
Date of Notice: June 15, 2019

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2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505

6. Public comments must be delivered to the owner, the PSTB Project Manager, or to the Secretary of the Environment Department within 21 days of the publication of this notice.

Published by El Defensor Chieftain on July 11, 2019

AFFIDAVIT of PUBLICATION

Wanda Moeller, being first duly sworn, deposes and says that she is Editor/Publisher of the ***El Defensor Chieftain,*** printed and published each week in the County of Socorro, State of New Mexico, and of general circulation in the city of Socorro, County of Socorro, State of New Mexico and elsewhere, and the hereto attached

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)UNTY OF SOCORRO)

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Request of ***EL DEFENSOR CHIEFTAIN***

By:
Affiant Wanda Moeller

Subscribed and sworn to me this 11 day of July, 2019 in the County of Socorro, State of New Mexico.

Notary Public

Notary Public in and for the County of Socorro, State of New Mexico
My Commission Expires: 3/8/23

Seal

OFFICIAL SEAL
Denise R. Ortega
NOTARY PUBLIC - State of New Mexico
My Commission Expires ____

Account Number: 109381 Ad Number: 000145558

Price: $80.46 (Statement to come at end of month)

APPENDIX G – RESPONSE TO COMMENTS

RESPONSE TO NMED PSTB COMMENTS TO FINAL REMEDIATION PLAN
FORMER PHILLIPS 66, SOCORRO, NEW MEXICO

Question 1. Remediation Goals in FRP differ from those in the proposal. In the proposal, it is stated that soil will be cleaned up to "soil leaching to groundwater" levels provided in NMED's *Risk Assessment Guidance for Site Investigations and Remediation* (March 2017) and that groundwater contamination will be cleaned up to Human Health Standards outline in 20.6.2.3103 NMAC. In the FRP, it is stated that the remediation goal for clean-up of soil is to eliminate the partitioning of contaminants to groundwater and potential for vapor intrusion in the nearby buildings, and for clean-up of groundwater to meet both the Human Health Standards outlined 20.6 3103 NMAC and National Primary Drinking Water Maximum Contaminant Levels outlined in CFR 40.141.61.

Response: *The **NMAC 20.5.119.1929** **Completion of Remediation** regulations are:*

A. The department shall consider remediation complete when all of the following criteria are met:
(1) no layer of NAPL greater than one-eighth inch in thickness is present on the water table or in any of the wells;
(2) the EIB standard of 0.1 mg/L for methyl tertiary butyl ether (MTBE) has been met in groundwater and surface water;
(3) all applicable site-specific target levels or risk-based screening levels in soil and WQCC and EIB standards in groundwater have been achieved;

National Primary Drinking Water Maximum Contaminant Levels were removed.

Vapor intrusion pathway was included due to the existence of on-site mechanic's shop.

Question 2. Why clean up to drinking water standards? Is it due to domestic wells within 1,200 ft of site?

Response: *The groundwater ingestion pathway that is represented by the NMAC 20.6.2.3103 regulations implies drinking of groundwater. Federal MCLs were removed.*

Question 3. There is no discussion in narrative of screening to determine whether there is a potential for Petroleum Vapor Intrusion in nearby buildings. Please include.

Response: *Vapor Intrusion Screening Section 4.8 has been added, as follows:*

4.8 Vapor Intrusion Survey

Subsurface soil and groundwater contamination present a potential risk for vapor intrusion (VI) in the onsite mechanic's garage building. To access VI, the following will be completed:

- *Subsurface soil vapor concentrations will be collected and compared to the NMED and EPA sub-slab screening levels. For that task, three soil gas samples will be collected from shallow wells placed around the outside perimeter of the building. Wells will be screened at a depth of approximately 5 feet bgs. Soil gas samples will be collected using SUMMA canisters. If soil gas sampling results are below the NMED and EPA sub-slab screening results, the pathway will be considered incomplete and no further evaluation is necessary. If soil gas sampling results exceed the NMED and EPA sub-slab screening levels, sub-slab and indoor soil vapor concentrations will be evaluated.*
- *If further evaluation is necessary, two temporary sub-slab sampling ports will be installed and sub-slab soil gas samples the indoor air samples will be collected at the same time at the same locations to differentiate sub-surface soil source from the indoor source. Indoor concentrations may not represent vapor intrusion from subsurface but rather originate with materials used or stored in the building. The results will be compared to the NMED and EPA VI screening levels. If screening levels are below the VI screening levels, the VI pathway will be considered incomplete. If there are exceedances, further indoor air sampling will be conducted in conjunction with O&M of the remediation system until the potential for VI has been eliminated.*

Question 4. Section 1.8 Conceptual Site Model – Please clarify the last sentence of last bullet as to why MTBE isn't one of the contaminants of concern in groundwater. *"MTBE concentrations are below the existing conditions represented by a concentration of 260 µg/L in MW-17.'*

The on-site well MW-14's MTBE concentration at the last sampling in 12/2018 was 160 µg/L, however at the previous sampling event in 07/2011 it was 270 µg/L, and in the 02/2011 event the MTBE concentration at MW-14 was 440 µg/L, which exceeds MW-17's MTBE concentration of 260 µg/L at the 12/2018 sampling event. So please explain why MTBE isn't a contaminant of concern for this site when historical MTBE concentrations at MW-14 fluctuate and have exceeded the 12/2018 MTBE concentrations at MW-17 by as much as 2-3x for several sampling events.

Response: *The NMAC 20.6.2.3109 stipulate the following within the first sentence of the introductory paragraph: The following standards are the allowable pH range and the maximum allowable concentration in ground water for the contaminants specified **unless the existing condition exceeds the standard** or unless otherwise provided in Subsection E of Section 20.6.2.3109 NMAC.*

***MTBE represents the existing condition that exceeds the standard**, as it's occurrence is the result of migration of MTBE from across the California Avenue. In December 2018, the existing condition concentration was represented by 260 µg/L in MW-17. For that sampling event, all MTBE concentration within the site boundary are below the existing condition concentration of 260 µg/L in MW-17. For proper comparison, concentrations collected at the same time must be compared. The comparison indicates the MTBE in MW-17 was always higher than in MW-14. This in concert with the SW direction of groundwater flow indicates that MTBE concentration originated outside the site boundary and therefore is **"the existing condition."** All available comparable data are presented in the table below:*

COMPARISON OF MW-17 AND MW-14 MTBE CONCENTRATIONS		
	MW-17	MW-14
	Existing Condition	On-Site Well
12/19/2018	260	160
8/9/2016	200	9.7
2/2/2016	280	120
1/18/2015	320	100
6/10/2014	330	180

Concentrations are in µg/L

Question 5. Section 5.3 Monitoring Reports and Performance Assessment and Section 6.4 System Optimization – Biweekly or at least monthly site visits is standard for engineered systems. PSTB would like monthly O&M visits and monthly status progress reports. What will be the performance standard? – 90% run time?

Response: *In the proposal, EA included costs for weekly O&M and Quarterly O&M reports. EA will add additional scope and cost for Monthly O&M reports during Work Plan preparation. The system will be maintained in accordance with manufacturer's recommendations. The run-time does not include downtime due to force majeure, interruptions in power supply and communication utilities, shutdowns due to scheduled and preventative maintenance and repairs, groundwater monitoring, operational adjustments and shutdowns related to system optimization, regulatory, site owner, tenant, or client-directed shutdown, and other items outside of EA's direct control.*

Question 6. Will there be telemetry to remote access the system? How will you know if the system has shut down part way through a quarter if you propose to go out only quarterly? Also, optimizing the system operating configuration quarterly isn't often enough.

Response: *Yes, there will be telemetry that will send alarms. Section 4.6 Telemetry was added to the text. Weekly O&M events were included as part of the provided proposal costs. System adjustments and optimization could be conducted during weekly O&M events.*

Question 7. Figure C-1 does not appear to depict nor label the drill pit, nor does the figure indicate trenching from the equipment compound to the Drill pit. Please modify Figure C-1 if appropriate as Figure C-2 implies that there will be trenching with underground piping and provides a table with conveyance piping burial depth, sand bedding, backfill and compaction details.

Response: *Drill Pit is implied at the juncture of the horizontal wells and is a temporary feature that was not depicted for permanent system features shown on Drawing C-1. Trenching is shown in red and blue lines from the convergence of the horizontal well down south towards remediation compound. Trenching is limited to approximately 10 feet and is detailed in Drawing C-2.*

Question 8. Figure C-1 should also show the dissolved phase contaminant iso-contour of NMWQCC standards for Benzene and Total Naphthalenes in relation to the horizontal remediation wells (e.g the dissolved phase contaminant plumes in relation to the remediation system). Please revise Figure to depict this or include another figure depicting this for clarity.

Response: *Drawing C-1 already shows in red dash-dot line the extent of BTEXN in groundwater in relationship to the well alignment and zones of influence. The line is also indicated in the legend.*

Question 9. Figure C-1 shows horizontal SVE ROI of 40' when the vertical SVE pilot testing estimated than an ROI of 30' could be achieved. Why 40'? Why is it assumed that the horizontal SVE ROI exceeds the ROI determined during pilot testing of vertical SVE wells?

Response: *The SVE ROI of 30 feet was observed during a short-duration SVE pilot testing. The SVE ROI was extended to 40 feet during FRP based on the following:*

- *Influence from HSVE-1 and HSVE-2 will overlap, thus extending the zone of influence*
- *SVE system will be operated continuously and the ROI is likely to extend – in contrast to a short duration testing.*
- *Zone of influence in horizontal wells is typically greater than in vertical wells.*

Question 10. Figure C-2, Table entitled 'Vertebrae TM Horizontal Well Details' under Material, shows three material options provided for the SVE/Vent wells and the Air Sparge Wells and also under Well Screen, four different options are provided (vertebrae, HDPE, PVC four 3" 0.020 slots per foot, PVC 0.020 in slot conventional) for the SVE/Vent wells and just the first three for the Air Sparge wells.

As this is the Final Remediation Plan, providing one or two options would seem appropriate, especially if the cost is about the same, however, if there is a significant cost difference between the different options for well materials and well screens, PSTB needs to be made aware of this prior to approval of the Final Remediation Plan. The proposal did not mention Vertebrae wells.

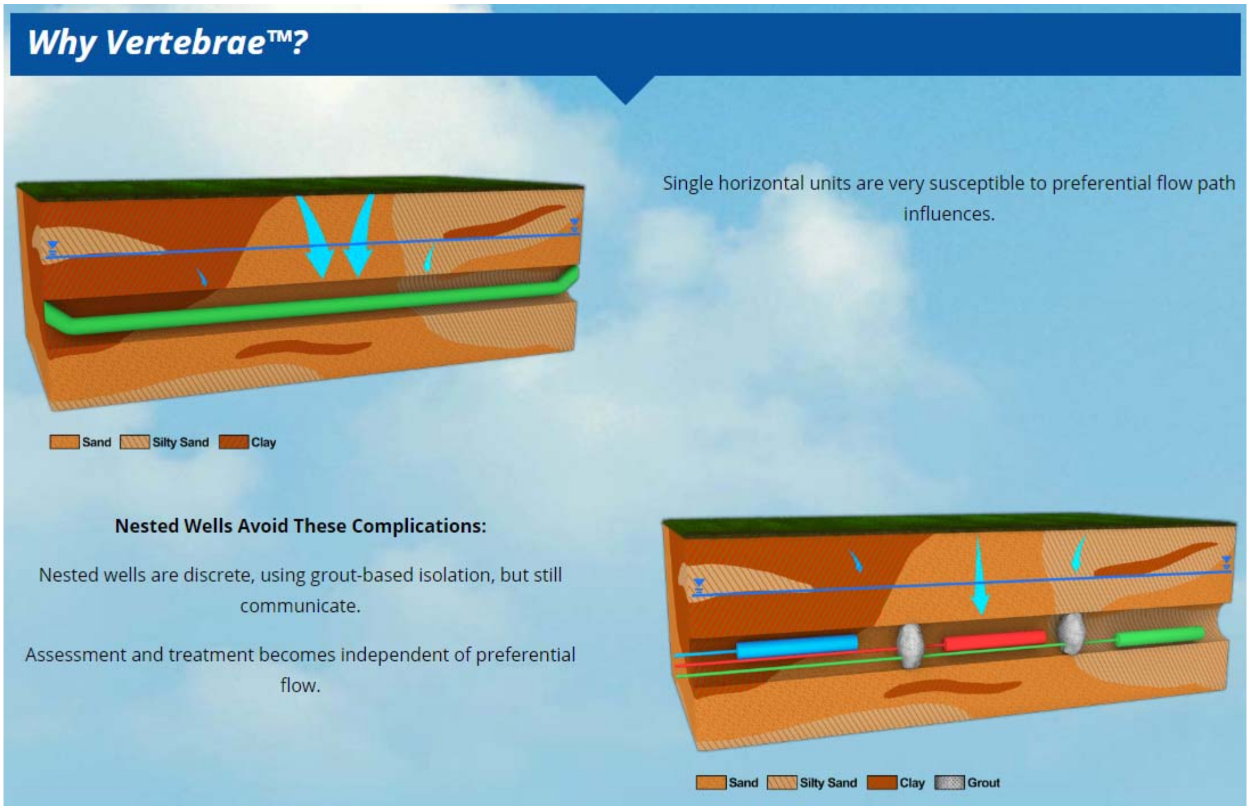
Response: *Drawing C-2 was modified to retain one option for each well type: Sparge wells will be constructed using Vertebrae™ nested horizontal well methodology. Vent wells will be constructed using conventional horizontal well methodology and Sch 80 PVC material.*

- Please include in the narrative why the Vertebrae™ well screens are being proposed for the Air Sparge Wells (e.g. provide pros and cons with regards to efficacy, constructability, time to implement etc versus the other the options presented in Figure C-2).

Also, has a cost vs benefit analysis been done between the Vertebrae well screen and the other options presented?

Response: *Provided below is the comparison of using conventional horizontal wells and Vertebrae wells:*

Criterion	*Conventional Horizontal Wells*	*Vertebrae Horizontal Wells*	*Evaluation*
Installation	*Single well in a single borehole*	*Multiple wells in a single borehole*	***Multiple Vertebrae™ wells** could be installed in a single borehole*
Site Application	*A total **of three (3)long** air sparge wells could be installed in three boreholes*	*A total of **twelve (12) short** air sparge could be installed in three boreholes*	*For the same borehole footage, **many more Vertebrae™ wells** could be installed.*
Sparging of Less Permeable Zone	*Likely to sparge the most permeable zone within the long screen leaving the less permeable zone unaffected*	*Allows for targeted application within each short screen thus affecting less permeable zones*	***Vertebrae™ wells allows targeted application within less permeable zones***
Constructability	*Constructible by specialized driller and may require off-site access*	*Constructible by a utility driller and does not require off-site access*	***Both are constructible but Vertebrae™ could be installed by a utility driller and does not require off-site access***
Targeted Sparging	*Flow is evenly distributed through **one long well screen***	*Flow is evenly distributed through **several short well screens***	***Vertebrae™ wells allow for targeted sparging/remediation**, while conventional wells do not allow that*
Time to Implement	***Typical time for installation***	***Slightly longer time for installation***	***Vertebrae™** require **slightly more time** to install*
Optimization	***Three wells** could be adjusted to optimize remediation and to target zones of residual contamination*	***Twelve wells** could be adjusted to optimize remediation and to **better target** zones of residual contamination*	***Vertebrae™ wells allow greater flexibility and more effective mass removal***
Areas of residual contamination	*Must sparge the whole length of the well to affect **a small area** of residual contamination*	***Can target discreet zones***	***Vertebrae™ wells have greater ability** to target contamination*
Remediation Time	*Typical for application*	***Will be shortened** due to targeted application and faster remediation of recalcitrant zones*	***Vertebrae™ wells** will shorten remediation time*
Cost	*Typical for application*	*Lower drilling costs due to use of utility driller. Slightly higher well costs. Overall, lower or similar costs. Lower operational cost due to targeted application. Lower O&M and monitoring costs due to shortened remediation duration*	***Vertebrae™ wells** will result in overall lower total cost due to shortened remediation duration, which will result in lower O&M and ground monitoring costs.*



Question 11. The FRP narrative should include a brief discussion regarding the impetus to reduce the number of horizontal SVE wells from four to only two and the rationale for going with clusters/nested wells within each of the three Air Sparge boreholes as depicted in Figure C-1, instead of the three conventional single air sparge wells with continuous screen as proposed in EA's proposal. Section 4.1 mentions rationale for utilizing the Vertebrae (cluster/nested wells for the horizontal air sparge wells, but more detail is needed including EA's experience using this technology for horizontal air sparge wells at other sites and their contractor's experience installing vertebrae well screens on horizontal air sparge wells.

Response: *The discussion will be added. In short, the change was based on the following:*

- *December 2018 baseline groundwater monitoring results, which defined the present extent of contamination; hence, the remediation zone*
- *Design parameters obtained during January 2019 vent/sparge pilot testing, which established zones of influence for remediation well spacing*
- *Much better flexibility with remediation, faster remediation time, and overall savings by using Vertebrae™ wells. Vertebrae™ wells are readily constructible onsite by a utility driller.*

A case study for air sparge application is attached.

Provided below is a synopsis of EN Rx VertebraeTM, EA Contractor, experience:

- *Vertebrae well systems installed at 29 sites*
- *Total of 97 Vertebrae well systems*
- *Total of 566 independent well segments*
- *Installed in 6 States: FL, CO, MS, MT, NY & CA*

Remedial Technologies applied to the Vertebrae™ wells include the following:

- *Bio-Sparging*

- *Air Sparging/SVE*
- *Air Sparge curtain*
- *Vapor Mitigation*
- *Ozone Sparging*
- *Chemical Injection*
- *Chemical Recirculation*

Question 12. A review of EA's proposal, did not reveal a specific diameter for the SVE and Air Sparge wells, however, the FRP states that the SVE wells will be 2" diameter and the Air Sparge will be 1" diameter. Please clarify and provide rationale for specifying 2" diameter SVE wells instead of 4" diameter and similarly specifying 1" diameter Air Sparge wells instead of 2" diameter Air Sparge wells.

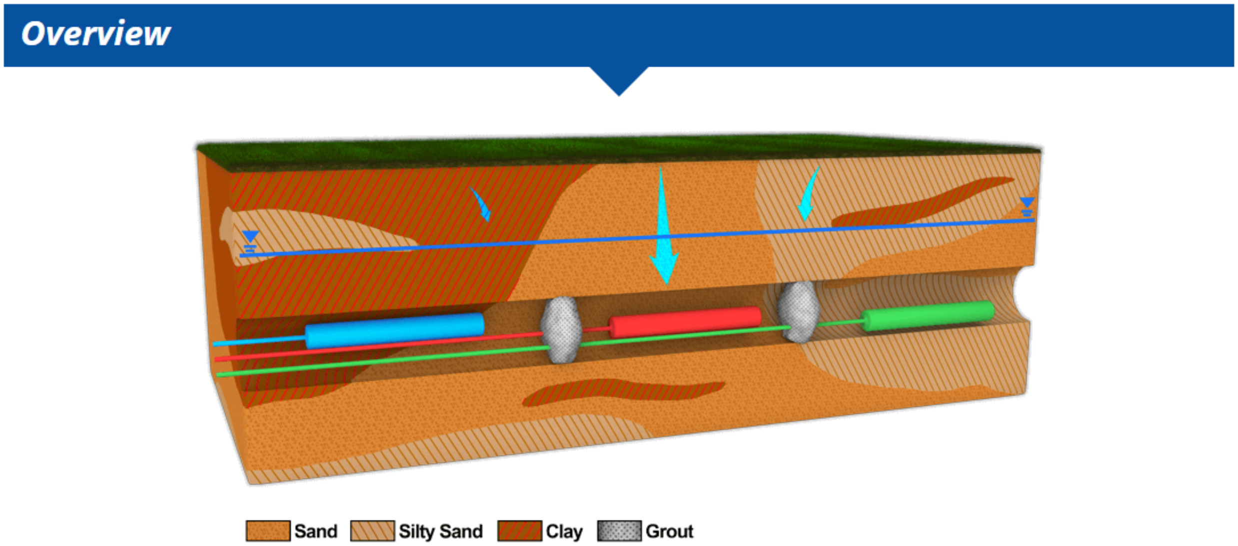
Response: *Section 3.3 of the FRP presented the selected design parameters for SVE and sparge systems. Based on that and number of wells required to affect the target remediation zone, flowrate per well was established. Based on that, well size was determined – please see Calculations 1 and 2.*

Question 13. Please include in the narrative a brief discussion of how the blind horizontal sparge and vent wells will be installed by your contractor including details on placement of blank casing and the 15' screened intervals separated by the 5' of expandable grout seal on the air sparge wells and how the screened intervals are connected to the manifold.

Response: *Wells will be installed using a horizontal rotary drilling methodology using biodegradable polymer as a drilling fluid. The following is a sequence for installation and development.*

1. *Initially, a pilot bore is drilled to the target extent.*
2. *The pilot bit and rods are retrieved.*
3. *The borehole is then over-reamed with a larger diameter bit.*
4. *The wells system that consists of a well and grout pipe enclosed in a protective casing with a plug at the top are pushed into the borehole. Casing protects wells during placement.*
5. *Once casing is placed at the target extent, the drill rod is pulled out. This activates removal of the casing plug and deployment of the well anchor.*
6. *Then the casing is retrieved leaving the well and grout pipe in place.*
7. *Grout pipe located between well screens and is used inject expandable grout that seals the annulus between the wells.*
8. *After placing grout, grout pipes are retrieved.*
9. *Drilling fluids are removed with a diaphragm pump.*
10. *Biodegradable polymer breakdown fluid is pumped into the wells.*
11. *Groundwater is pumped out of the wells until clear.*
12. *For sparge wells, compressed air is applied until design flowrate and pressure are met.*
13. *For SVE wells, drilling fluids will not be returned, as wells are installed in the vadose zone. Therefore, after applying polymer breakdown fluid, wells will be placed under vacuum and air extracted until design flowrate and vacuum are met.*

Each well extends to the surface at the borehole daylight, similarly to the nested vertical wells. Lines will be conveyed in trenches from the borehole to the remediation enclosure and connected to the stub-outs of the manifolds.



Question 14. How will deviation be mitigated with blind directional drilling of these ~ 200' long wells?

Response: *Installation of 200-LF blind horizontal wells is feasible. ENRx, Vertebrae™ proprietor, has recently installed a 2,000-LF blind horizontal well in California and has extensive experience installing horizontal wells. Well alignment and elevation tolerances are the same for the blind and daylighting wells.*

Question 15. Please include a figure depicting manifold elevation detail for the horizontal SVE wells and the horizontal air sparge wells.

Response: *The details provided on the Drawing P-2 and P-3 are sufficient for the vendor to construct manifolds. Similarly, the vendor constructed manifolds for Laguna using P&ID.*

Question 16. The sparge air from the two exterior sparge wells that is injected towards the center Air Sparge well will not be within the ROI of the SVE wells. Therefore, this could result in the injected sparge air not being captured by the SVE wells unless the middle Air Sparge well is always operated simultaneously when one or the other exterior sparge well is operating.

- Is this the operation configuration, or is the physical extraction of vapors desorbed from the aquifer materials not as important as just providing the oxygen necessary for sustained aerobic bioremediation to cleanup groundwater contamination?

Response: *The design sparging and venting rates are conducive to aerobic bioremediation and thus oxygen supply is the primary objective. Injected air will be captured by the HSVE-1 and/or HSVE-2, which will be operated when sparging is conducted. The SVE ROI is shown in blue transparent color on Drawing C-1. Actual zone of SVE influence will be greater due to overlapping influences from HSVE-1 and HSVE-2, which will be increased by the sparging, as zones of vacuum would represent even greater pressure contrast in subsurface.*

Question 17. Provide equipment and appurtenance cut sheets as an Appendix.

Response: *Cut sheets for the major equipment have been added.*

Question 18. Provide site-specific HASP.

Response: *HASP will be developed under Phase 4 Implementation Work Plan.*

Question 19. Table 6 – Remediation Goals are only for groundwater, the table should list all the NMWQCC standards, including MTBE, EDB, and EDC. Also make sure to use the modified standards from Dec 2018. Revise Table as appropriate.

Response: *MTBE, EDB, and EDC are were added to Table 6.*

Question 20. Table 11 – Soil Vapor Samples only quarterly. PSTB would like monthly O&M progress reports and sampling and analysis of vapors monthly so that system optimization can be done more frequently than once a quarter.

Response: *Table 11 was modified to include monthly O&M progress reports and monthly vapor samples. The proposal included quarterly vapor sampling and O&M reports.*

Question 21. Calculation 3: Formula for friction factor has left off the 0.9 exponent. Also, please review the mass flow rate calculation and consequently the mass flow rate per area.

Response: *Exponent was added and calculation updated.*