DEPARTMENT OF THE AIR FORCE ENTERED
HEADQUARTERS 377TH AIR BASE WING (AFMC)

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DEC 03 2012

Mr. John Kieling, Manager
RCRA Permits Management Program
Hazardous Waste Bureau (HWB)
New Mexico Environment Department (NMED)
2905 Rodeo Park Road
Santa Fe New Mexico 87505

Dear Mr. Kieling

Attached please find the report titled, *Phase II Remediation Interim Measures Plan, Soil Vapor Extraction Treatment System Design; Bulk Fuels Facility Spill, SWMUs ST-106 & SS-111, November 2012*. The report details the higher capacity SVE treatment system which, upon approval, will be put in place as an interim measure remediation process for the Bulk Fuels Facility Spill remediation site.

Please contact Mr. L. Wayne Bitner at (505) 853-3484 or at ludie.bitner@kirtland .af.mil or Ms. Victoria R. Martinez at (505) 846-6362 or at victoria.martinez@kirtland.af.mil if you have any questions.

Sincerely

JOHN C. KUBINEC, Colonel USAF
Commander

Attachment:
Phase II Remediation Interim Measures Plan, Soil Vapor Extraction Treatment System Design; Bulk Fuels Facility Spill, SWMUs ST-106 & SS-111, November 2012

cc:
NMED-RPD (Davis), w/out attach
NMED-HWB (Moats, McDonald, Salem, Brandwein), w/ attach
NMED-GWQB (J. Schoeppner), w/ attach
NMED-OGC w/out attach

EPA Region 6 (L. King), w/out attach
AFCEE/CMSE (Mr. Oyelowo), w/out attach
/EXEC (Mr. Urrutia), w/out attach
Public Info Repository (Central New Mexico), w/ attach
Administrative Record/Information Repository (AR/IR), w/ attach
File, w/ attach

KIRTLAND AIR FORCE BASE
ALBUQUERQUE, NEW MEXICO

Phase II Remediation Interim Measures Plan
Soil-Vapor Extraction Treatment System Design

Bulk Fuels Facility Spill
Solid Waste Management Units ST-106 and SS-111

December 2012

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2050 Wyoming Blvd. SE
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KIRTLAND AIR FORCE BASE
ALBUQUERQUE, NEW MEXICO

PHASE II REMEDIATION INTERIM MEASURES PLAN
SOIL-VAPOR EXTRACTION TREATMENT SYSTEM DESIGN

BULK FUELS FACILITY SPILL
SOLID WASTE MANAGEMENT UNITS ST-106 AND SS-111
KIRTLAND AIR FORCE BASE, NEW MEXICO

December 2012

Prepared for
U.S. Army Corps of Engineers
Albuquerque District
Albuquerque, New Mexico 87109

USACE Contract No. W912DY-10-D-0014
Delivery Order 0002

Prepared by
Shaw Environmental & Infrastructure, Inc.
9201 East Dry Creek Road
Centennial, Colorado 80112

NOTICE

This report was prepared for the U.S. Army Corps of Engineers by Shaw Environmental & Infrastructure, Inc. for the purpose of aiding in the implementation of a final remedial action plan under the U.S. Air Force Environmental Restoration Program. As the report relates to actual or possible releases of potentially hazardous substances, its release prior to a final decision on remedial action may be in the public's interest. The limited objectives of this report and the ongoing nature of the Environmental Restoration Program, along with the evolving knowledge of site conditions and chemical effects on the environment and health, must be considered when evaluating this report, since subsequent facts may become known which may make this report premature or inaccurate.

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13. ABSTRACT (Maximum 200 words)

This Plan describes the Phase II interim measures remediation activities for the final design and operation of a catalytic oxidation soil vapor treatment system. Quarterly monitoring data from previous quarters were used to optimize the system design, and follow-on quarters of monitoring will be used to inform system operation and optimization. Additionally, data collected during the operation of this system will be used to inform any future remediation operations at the project site. The system will be installed in accordance with applicable state and local requirements and the approved engineering drawings included in this report.

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JOHN C. KUBINEC, Colonel, USAF
Commander, 377th Air Base Wing

This document has been approved for public release.

KIRTLAND AIR FORCE BASE
377th Air Base Wing Public Affairs

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PREFACE

This Phase II Remediation Interim Measures Plan for Soil-Vapor Extraction Treatment System Design has been prepared by Shaw Environmental & Infrastructure, Inc. (Shaw) for the U.S. Army Corps of Engineers (USACE), under Contract W912DY-10-D-0014, Delivery Order 0002. It pertains to the Kirtland Air Force Base Bulk Fuels Facility Spill, Solid Waste Management Units ST-106 and SS-111, located in Albuquerque, New Mexico. This report was prepared in accordance with all applicable federal, state, and local laws and regulations, including the New Mexico Hazardous Waste Act, New Mexico Statutes Annotated 1978, New Mexico Hazardous Waste Management Regulations, Resource Conservation and Recovery Act, and regulatory correspondence between the New Mexico Environment Department Hazardous Waste Bureau and the U.S. Air Force, dated April 2, June 4, August 6, and December 10, 2010.

This work will be performed under the authority of USACE Contract No. W912DY-10-D-0014, Delivery Order 0002. Mr. Walter Migdal is the USACE Albuquerque District Project Manager; Mr. Wayne Bitner, Jr. is the Kirtland Air Force Base Restoration Section Chief; and Mr. Thomas Cooper is the Shaw Project Manager. This report was prepared by Diane Agnew.

Thomas Cooper, PG, PMP
Shaw Environmental & Infrastructure, Inc.
Project Manager

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ACRONYMS AND ABBREVIATIONS

°F	degrees Fahrenheit
μg/L	microgram per liter
3D	three-dimensional
AFB	Air Force Base
AST	aboveground storage tank
AVGAS	aviation gasoline
BFF	Bulk Fuels Facility
bgs	below ground surface
CATOX	catalytic oxidizer
CME	Corrective Measures Evaluation
COC	constituent of concern
CQAP	Construction Quality Assurance Plan
EDB	1,2-dibromoethane/ethylene dibromide
EPA	U.S. Environmental Protection Agency
FFOR	Former Fuel Off-Loading Rack
GRO	gasoline range organic
GWM	groundwater monitoring
HWB	Hazardous Waste Bureau (NMED)
ICE	Internal Combustion Engine
JP-8	jet propellant-8 fuel
KAFB	Kirtland AFB
LEL	lower explosive limit
mg/kg	milligram per kilogram
NAPL	non-aqueous phase liquid
NMED	New Mexico Environment Department
PG	Professional Geologist
PMP	Project Management Professional
ppmv	parts per million by volume
Praxis	Praxis Environmental Technologies, Inc.
PSH	phase-separated hydrocarbons

ACRONYMS AND ABBREVIATIONS (concluded)

QA	quality assurance
QC	quality control
ROI	radius of influence
RSI	Remediation Service International
SCFM	standard cubic feet per minute
Shaw	Shaw Environmental & Infrastructure, Inc.
SM	Standard Method
SVE	soil-vapor extraction
SVEW	soil-vapor extraction well
SVMW	soil-vapor monitoring well
THC	total hydrocarbons
TMB	trimethylbenzene
TPH	total petroleum hydrocarbons
USACE	U.S. Army Corps of Engineers
USF	Upper Santa Fe
VFD	Variable Frequency Drive
VOC	volatile organic compound

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EXECUTIVE SUMMARY

This report details the Phase II Remediation Interim Measures Plan for the Soil-Vapor Extraction (SVE) System at Solid Waste Management Units ST-106 and SS-111, Bulk Fuels Facility (BFF) Spill site, Kirtland Air Force Base (AFB), New Mexico (U.S. Environmental Protection Agency Identification Number NM9570024423/HWB-KAFB-10-004).

The purpose of the Phase II Remediation Interim Measure is to replace the current internal combustion engine unit-based SVE action with a system designed for longer-term operation. The primary element of the Phase II Remediation Interim Measure is the installation of an SVE system to increase hydrocarbon removal from the BFF vadose zone soil. The SVE system includes two SVE wells (Kirtland AFB [KAFB]-106161 and KAFB-106160), an aboveground piping manifold that runs the vapors to a blower skid, and a catalytic oxidation unit to destroy the hydrocarbon vapors in the air extracted from the wells.

The Phase II Remediation Interim Measure system is not designed to complete remediation at the BFF. This system is designed to continue the interim measures remediation process and will then be incorporated into the corrective measures evaluation for the site, which will be submitted at a later date.

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1. INTRODUCTION

The Bulk Fuels Facility (BFF) Spill site is located within the western portion of Kirtland Air Force Base (AFB), New Mexico (Figure 1-1) and is comprised of two solid waste management units, designated as ST-106 and SS-111. The component of the BFF Spill project related to investigation and remediation of the vadose zone near the Former Fuel Off-Loading Rack (FFOR) is designated as ST-106. The phase-separated hydrocarbon (PSH)-impacted groundwater component of the project is designated as SS-111.

On April 2, 2010, regulatory control of the BFF Spill site was transferred from the New Mexico Environment Department (NMED) Ground Water Quality Bureau to the NMED-Hazardous Waste Bureau (HWB) (NMED, 2010b). Historically, semiannual reports have presented data regarding ongoing remediation of ST-106 vadose zone contamination associated with the FFOR, and ongoing characterization and interim remediation instituted to begin recovery of PSH in groundwater at SS-111. Activities and data related to ST-106 were conducted as the Stage 2 abatement action under the NMED-Ground Water Quality Bureau–approved *Stage 2 Abatement Plan for the Bulk Fuels Facility (ST-106)* (U.S. Air Force, 2002). This plan identified soil-vapor extraction (SVE) as the preferred abatement option to be implemented at ST-106 to attain abatement standards and requirements set forth in Section 4103 of Title 20, New Mexico Administrative Code, Chapter 6, Part 2. ST-106 remediation was initiated before the discovery of PSH impacts to groundwater. Following the discovery of SS-111, Kirtland AFB instituted PSH recovery directly from the aquifer surface at three well locations by using the same SVE technology approved for the Stage 2 abatement action for ST-106. These actions were conducted as interim measures while site characterization activities continued.

This report details the Phase II Remediation Interim Measures Plan for the SVE System at Solid Waste Management Units ST-106 and SS-111, BFF Spill site, Kirtland AFB, New Mexico (U.S. Environmental Protection Agency [EPA] Identification Number NM9570024423/HWB-KAFB-10-004).

1.1 Site Background

The BFF Spill site is located in the northwestern portion of Kirtland AFB (Figure 1-1). Historical aerial photography has revealed that the area was used for fuel storage and processing as early as 1951 (CH2M HILL, 2001). At that time, the fueling area was separated into a distinct tank-holding area where bulk shipments of fuel were received (near the location of existing well Kirtland AFB (KAFB)-1066 and a separate fuel-loading area where individual fuels trucks were filled. The truck-loading area appears to have been approximately 250 feet north of the tank area.

Subsequent aerial photographs indicate that construction of the facility and associated infrastructure took place from 1951 until 1953. The facility operated until it was removed from service in 1999, due to a below-grade line leakage along the off-loading rack (CH2M HILL, 2001). Bulk storage for jet propellant-8 fuel (JP-8), diesel fuel, and aviation gasoline (AVGAS) was managed in the eastern portion of the facility. A 250-gallon underground storage tank was located near the Pump House, Building 1033 (CH2M HILL, 2001). The three types of fuel handled by the BFF were AVGAS, jet propellant-4 fuel, and JP-8. The use of AVGAS and jet propellant grade 4 at Kirtland AFB was phased out in 1975 and 1993, respectively. JP-8 was handled through the FFOR until the leak was discovered in 1999.

The exact history of releases is unknown. Conceptually, releases could have occurred when fuel was transferred from railcars, through the FFOR, to the Pump House, and then to the bulk fuel storage containers on the south end of the site (aboveground storage tanks [ASTs] 2420 and 2422). The probable release points were investigated and are summarized in subsequent sections. Fuel transfer from the railcars to the Pump House was done under vacuum transfers. Transfer of fuel from the Pump House to the bulk storage containers was performed under pressurized conditions. Fuel-transfer infrastructure for vacuum transfers was exempt from pressure testing, whereas fuel infrastructure for pressurized transfer did undergo regular pressure testing. Only when the vacuum portion of the fuel system underwent pressure testing in 1999 was any problem noted in the fueling system.

At present, jet fuel is stored in two ASTs (1.7 million gallons each). The site currently has one temporary JP-8 off-loading rack located in the southwest corner of the facility, west of the fuel-loading structure at Building 2404. This rack was placed into service following the piping failure at the FFOR (ST-106). A second small off-loading rack (Building 2401) is used for the delivery of diesel and unleaded gasoline motor vehicle fuels.

Fuel delivered to the temporary JP-8 off-loading rack is conveyed to the Pump House (Building 1033) via subsurface transfer lines. The fuel is then pumped to the JP-8 ASTs by piping of varying sizes that runs aboveground for approximately 750 feet and runs belowground for approximately 300 feet.

1.1.1 Current Remediation Activities

There are currently four SVE and treatment systems in use at the BFF which consist of trailer-mounted units that include specialized on-board computer controllers, sensors, and a pair of 460-cubic-inch displacement Ford Model LSG-875 internal combustion engines (ICE). These ICEs have been modified and remanufactured to the specifications of Remediation Service International (RSI). Within each SVE system, the programmable logic controller (PLC) uses the engines as the vacuum pump to extract vapor from the vadose zone, and the internal combustion process along with the catalytic converters on each engine provide treatment of the hydrocarbon vapors.

The ST-106 FFOR SVE unit (RSI Unit 249) was installed in April 2003 (fully operational in July 2003), the KAFB-1065 unit (RSI Unit 335) was installed in August 2008, and the KAFB-1066 (RSI Unit 345) and KAFB-1068 (RSI Unit 344) units were installed in March 2009. Based on an evaluation of system performance during operations in 2011, the four units were re-located in order to increase system performance. During April 2012, RSI Unit 335 was moved to KAFB-106149-484, RSI Unit 344 was moved to KAFB-106161, and RSI Unit 345 was moved to KAFB-106160. The ST-106 unit is connected through manifold piping to nine SVE wells (SVEWs), SVEW-01 through SVEW-09, shown on Figure 1-3.

The ST-106 SVE System (Unit 249) has extracted approximately 223,960 gallons of non-aqueous phase liquid (NAPL) from the vadose zone from July 2003 through June 2012. Based on the system computer PLC recorder, the KAFB-106149 SVE system (Unit 335) has extracted approximately 91,800 gallons of NAPL from the vadose zone from August 2008 through June 2012. The KAFB-106160 SVE system (Unit 345) has extracted approximately 66,300 gallons of NAPL from the vadose zone from March 2009 through June 2012. The KAFB-106161 SVE system (Unit 344) has extracted approximately 58,100 gallons of NAPL from the vadose zone from March 2009 through June 2012 (Shaw, 2012).

1.2 Previous Investigation Activities

As previously mentioned, in November 1999, three known discharges occurred as a result of pressure testing of the lines that transfer fuel from the JP-8 off-loading rack (Building 2405) to the Pump House at the facility. Subsequent investigations were conducted, and the results are provided in the following reports:

- *Stage 1 Abatement Plan Report for the Bulk Fuels Facility (ST-106)* (CH2M HILL, 2001)
- *Stage 2 Abatement Plan Report for the Soil Vapor Extraction and Treatment System, Bulk Fuels Facility (ST-106),* (CH2M HILL, 2006a)
- *Stage 1 Abatement Plan Report, East Side of the Kirtland AFB Bulk Fuels Facility* (CH2M HILL, 2006b)
- *Semi-Annual Summary and Performance Report, October 2007 through March 2008, Bulk Fuels Facility* (CH2M HILL, 2008)
- *Remediation and Site Investigation Report for the Bulk Fuels Facility, April 2009– September 2009* (CH2M HILL, 2009)

The conclusions of these reports are summarized below. Soil data collected during the BFF Spill investigations are compared to the NMED total petroleum hydrocarbons (TPH) screening guidelines to aid in defining the extent of contamination (NMED, 2012a).

1.2.1 Stage 1 Abatement Plan Report

In the soil investigations initiated immediately after the 1999 discovery of the fuel line leak, contamination was detected along the JP-8 off-loading rack that supplies the 300-foot-long belowground pipeline. The horizontal extent of shallow contamination less than 40 feet below ground surface (bgs) was delineated during the June 2000 direct-push investigation portion of the Stage 1 investigation. This contamination appeared to be limited to within 50 feet lateral to the location where the pipelines went below ground.

Site investigations conducted during 2000 also included soil characterization at depth, extending down to the water table at select locations. Contamination was identified in two deep soil borings (SB-25 and SB 26) installed during July 2000 by using hollow-stem auger drilling. These two borings were located on the eastern and western ends of the off-loading rack. The maximum concentration detected in soil from boring SB-25 was 81,000 parts per million by volume (ppmv) of TPH in the sample from 105 feet bgs, which is just below the Transition Zone between Upper Santa Fe (USF)-1 and USF-2. The maximum concentration detected in boring SB-26 was 114,000 ppmv of TPH in the sample from 270 feet bgs, which is just above the clay zone that divides the USF-2 hydrostratigraphic unit.

Additional borings were installed to determine the horizontal extent of the soil that had TPH concentrations greater than 100 milligrams per kilogram (mg/kg). Based on data from the additional borings, soil contaminated in excess of the NMED TPH Screening Guidelines (NMED, 2012a) is limited to within approximately 310 feet of the surface; and within the area 65 feet south (SB-29A), 280 feet north (SB-34), 400 feet east (SB-32), and 175 feet west (SB-33) of the FFOR. The total area of soil affected by the petroleum hydrocarbon contamination is estimated to be 6.5 acres, with depths of contamination extending to 310 feet bgs (CH2M HILL, 2001).

1.2.2 Stage 2 Abatement Plan Report

Four additional soil borings were advanced in 2003 as part of a pilot test for SVE. All four soil-vapor monitoring wells included both soil and vapor sampling capabilities and were completed to a depth of approximately 450 feet bgs. In addition to the anticipated intervals of petroleum-related contamination, two locations were found to have detections at the shallowest sampling depth of 60 feet bgs (CH2M HILL, 2006a).

1.2.3 Stage 1 Abatement Plan Report, East Side of the Kirtland Air Force Base Bulk Fuels Facility

In 2005, a shallow soil investigation of potential source areas on the east side of the BFF was conducted. Soil samples were collected from the following areas:

- Former Wash Rack Drainfield
- Three fuel-storage ASTs
- Former Fuel/Water Evaporation Pond
- Recovered Liquid Fuel Collector Tank
- Primary fuel-storage ASTs and tank bottom water-holding tanks

The investigation included excavating test pits (TP-07, TP-08, and TP-09) and advancing direct-push borehole (SB-04) to 50 feet bgs. Additionally, a temporary soil-vapor monitoring point was installed in the direct-push borehole and monitored for hydrocarbon concentrations with field-monitoring equipment for several quarters. Based on visual observations, analysis of soil samples from the test pit and shallow soil sampling at this location, and soil-vapor samples, substantial hydrocarbon impacts were not identified in the interval from the ground surface to 50 feet bgs. The only area where the NMED TPH guideline (NMED, 2012a) was exceeded was in the vicinity of the primary fuel storage ASTs and tank bottom water-holding tanks. The maximum petroleum hydrocarbon concentration was 2,400 mg/kg detected in the 15-foot bgs sample. None of the detections suggested the area was a contributor to the soil-vapor profile at the BFF Spill (CH2M HILL, 2006b).

1.2.4 Semi-Annual Summary and Performance Report

In 2007, groundwater monitoring (GWM) well KAFB-1066 was installed in the general vicinity of the east side of the BFF. This monitoring well was installed between the presumed area of the storage tank associated with the 1951 rack operations and the location of the filling rack itself where tanker trucks would have been fueled. Well KAFB-1066 is roughly 75 feet north of the storage tank area associated with the 1951 operations. Additionally, 15 GWM wells were installed between 2007 and 2008. These monitoring well installations are reported on the Semi-Annual Summary and Performance Reports (CH2M HILL, 2008). Soil sampling was conducted at 20-foot intervals during advancement of the KAFB-1066 borehole from 20 to 480 feet bgs. Soil sample results did not suggest the presence of a large surface release of fuel in this area. However, there were detections of limited petroleum hydrocarbon concentrations (less than 100 mg/kg) throughout much of the borehole length, and isolated, higher concentration detections of other fuel compounds, such as toluene, benzene, xylenes, etc., at individual shallower depths of 40 and 140 feet bgs in the borehole. While the individual fuel-related detections in the borehole were not extremely high, the pattern of detections may be indicative of a predominantly stair-step lateral and vertical migration of near surface releases of fuel through the vadose zone (CH2M HILL, 2008).

1.2.5 Remediation and Site Investigation Report

In 2009, soil boring investigations were conducted, and four additional GWM wells were installed at the BFF Spill to further evaluate other potential source areas. Soil data were consistent with previous sampling results, and the effectiveness of the SVE system was indicated. NAPL was not detected in samples collected from any of the newly installed wells (CH2M HILL, 2009).

1.2.6 Current Investigation

1.2.6.1 Groundwater Monitoring Wells

During the first three quarters of 2011, GWM wells were completed by the subcontractor drilling companies, WDC Exploration and Wells (69 wells) and Yellow Jacket Drilling (9 wells). The GWM wells were installed at all 28 NMED-prescribed locations at depths specified for these locations in the Groundwater Investigation Work Plan (USACE, 2011a) and in accordance with Table 4 of the NMED-HWB August 6, 2010 letter (NMED, 2010c). A summary of well installation, as well as the soil boring logs and well construction diagrams, are included in the Quarterly Pre-Remedy Monitoring and Site Investigation Report for April – June 2012 (Shaw, 2012). The goal for the installation of the well clusters was to fully characterize the nature and extent of the jet fuel plume and its degradation constituents such as 1,2-dibromoethane/ethylene dibromide (EDB). The number and types of wells installed and surveyed are as follows:

- 22 water table wells – Shallow Zone
- 28 intermediate wells – Intermediate Zone (see discussion at end of this section)
- 28 deep wells – Deep Zone

An additional three monitoring well clusters were installed during August through October 2012 and will be included in the Fourth Quarter 2012 sampling event. These clusters were installed northeast of the previously installed wells to delineate the northern edge of the EDB plume. The monitoring well clusters and individual wells are shown on Figure 1-2; the wells associated with clusters are detailed in Table 1-1.

1.2.6.2 Soil Vapor Monitoring Wells

A total of 35 soil-vapor monitoring well (SVMW) clusters has been installed during the current investigation; previous contractors installed 41 individual soil vapor monitoring wells. All SVMW locations are shown on Figure 1-3. Each nested well location consists of six individual (one 3-inch-diameter and five 3/4-inch-diameter), Schedule 80, polyvinyl chloride SVMWs that were installed in the same borehole. Nested wells included a 10-foot length of machine-slotted (0.050-inch) screen. Planned depths for the bottom of the nested well screens were 25, 50, 150, 250, 350, and 450 feet bgs. In some cases, the screened intervals were adjusted based on lithology observed during borehole advancement (e.g., screens were placed in transmissive zones). If proposed vapor-monitoring screened intervals were observed to be within fine-grained lithologic intervals (clay or silt), screened intervals were adjusted up or down to the nearest coarser-grained unit. Screens separated by 100 feet (150, 250, 350, and 450 feet bgs) were adjusted by no more than 25 feet, and screens separated by 25 feet (25 and 50 feet bgs) were adjusted by no more than 5 feet. The soil classification logs and completion diagrams for these wells can be found in the Quarterly Pre-Remedy Monitoring and Site Investigation Report for April – June 2012 (Shaw, 2012).

1.2.6.3 PneuLog® Wells

Nine PneuLog® well clusters have been installed as part of the current investigation. All PneuLog® well clusters are shown on Figure 1-3. Each well cluster consists of three "nested" 3-inch-diameter well casings with three screened intervals at approximately 500 to 355, 350 to 205, and 200 to 25 feet bgs. All nine well clusters were surveyed during Fourth Quarter 2011. The soil classification logs and completion diagrams for these wells can be found in the Quarterly Pre-Remedy Monitoring and Site Investigation Report for April – June 2012 (Shaw, 2012).

1.3 Remediation Design Data-Gathering Activities

The following activities were performed in a effort to characterize the different plumes as well as optimize the design for the remediation system.

- PneuLog® Testing
- SVE Radius of Influence (ROI) Testing
- Contaminant Fate and Transport Conceptual Modeling for the vadose zone and groundwater

The results of these activities are presented in greater detail in the Interim Measures Work Plan (Shaw, 2011a).

1.3.1 PneuLog® Testing

During Second Quarter 2012, PneuLog® wells KAFB-106148, KAFB-106149, and KAFB-106150 were analyzed using PneuLog® technology developed by Praxis Environmental Technologies, Inc. (Praxis). Praxis' technology utilizes pneumatic well logging to measure the vertical air permeability and chemical concentration profiles in wells screened for SVE. Down-hole instruments simultaneously measure cumulative air flow and chemical vapor concentrations along the depth of the well screen.
Praxis personnel performed the testing with oversight provided by on-site Shaw Environmental & Infrastructure, Inc. (Shaw) personnel.

The PneuLog® vadose zone testing generated distinctive permeability and vapor concentration profiles that will be used in the design of the overall vadose zone remediation system. In general, the permeability increases with depth, which is consistent with the lithologic data where the upper 250 feet of the vadose zone is finer-grained than the deeper intervals. In addition, the results for two of the three PneuLog® tests (KAFB-106149 and KAFB-106150) show increasing vapor hydrocarbon concentrations with depth, which is consistent with the conceptual model in terms of a declining water table creating a large NAPL "smear" zone extending from 250 feet bgs to the top of the current water table. The concentration profile for well KAFB-106148 shows higher concentrations in the upper 350 feet compared to the bottom 100 feet. This profile is consistent with the location of this well, which is closer to the initial FFOR release locations than the other two wells. Results of the PneuLog® testing are below, and a full description and report for the testing are presented in the Quarterly Pre-Remedy Monitoring and Site Investigation Report for April – June 2012 (Shaw, 2012).

1.3.2 SVE Radius of Influence Testing

The following sections summarize the SVE ROI testing conducted during Fourth Quarter 2011 and describe the data analysis that took place during First and Second Quarters 2012. SVE ROI testing commenced on November 2, 2011, and was completed on December 16, 2011. Five single-well tests and three 5-day tests were performed to provide detailed, site-specific information to aid in the quantitative assessment and modeling of SVE vadose zone remediation and subsequent optimization of the existing system. Extraction and monitoring wells used for each 5 day ROI test are presented in Figure 1-4. The five single-well tests were conducted to determine the extraction wells for the three 5-day tests. The 5-day tests were conducted to determine the extent of the area impacted by SVE at the BFF. Following the analysis of the 5-day tests, it was clear that additional data was needed to clarify the ROI of SVE at the BFF. Consequently, when the RSI SVE engines resumed operation on April 30, 2012, an SVE monitoring program began and is ongoing.

Data were collected to be incorporated into the three-dimensional (3D) analysis of remediation prospects for the vadose zone contamination using existing SVE wells and RSI SVE units. This analysis involves vapor concentration distribution, lithology, and 3D numerical modeling of vapor flow. The ongoing quarterly field and analytical vapor concentration monitoring data for existing SVMWs and soil-vapor extraction wells (SVEWs) are used as chemical data input for the analysis. Results of the ROI testing are described below, and a full description and report for the testing are presented in the Quarterly Pre-Remedy Monitoring and Site Investigation Report for April – June 2012 (Shaw, 2012). Full details for operations of the RSI SVE units are presented in the Soil-Vapor Extraction Optimization Plan (Shaw, 2011b), and the Pre-Remedy Monitoring and Soil-Vapor Extraction

System Operation and Maintenance Work Plan (Shaw, 2011c).

1.3.2.1 Procedure

Monitoring wells were selected for each 5 day test (Figure 1-4). Each period during which vacuum pressure on all monitoring wells was obtained once is referred to as a monitoring round. On the first day of tests 5DTKAFB106121-450 and 5DTSVEW-05, monitoring rounds were conducted hourly. On the first day of test 5DTKAFB-106149-484 monitoring rounds were conducted approximately every 90 minutes, as there were more wells than could be monitored in an hour. On the second and third days, monitoring rounds were conducted twice daily, and on the fourth and fifth days, monitoring round were conducted once daily.

The ongoing SVE monitoring program at the BFF includes measuring vacuum pressure on all depths at all 9 PneuLog® wells. Since April 30, 2012, SVE is occurring at wells KAFB-106149-484, KAFB-106160, KAFB-106161, and SVEW-01. SVE was also occurring at SVEW-05 from April 30, 2012 through October 23, 2012. The results below include data taken through September 30, 2012 and consequently assume extraction from SVEW-05. Initially, an attempt was made to have both engines running on each SVE unit. However, several units frequently had at least one engine down for repairs. At the end of June 2012, a decision was made to run only one engine on each RSI SVE unit for consistency.

1.3.2.2 Results

Results from the two of the three 5-day ROI tests were useful for establishing a horizontal ROI for the individual extraction wells, while results from the SVE monitoring were useful for establishing a 3D ROI in the BFF as a whole.

Because vacuum pressure at the BFF is strongly influenced by changes in barometric pressure, the difference between vacuum pressures measured at each well and vacuum pressure at a selected background monitoring well was calculated. This effectively removes the influence of barometric pressure from the data.

Test 1 - Test 5DTKAFB106121-450 Results

ROI test 5DTKAFB106121-450 used well KAFB-106121-450, screened from 430 to 440 ft bgs, as the extraction well. RSI SVE Unit 335, running both engines, was used to extract soil vapor from KAFB-106121-450. Well KAFB-106131-450, which is 381 ft from the extraction well, was used as the background monitoring well, as it was the most distant well monitored during the test.

Only the data from wells screened in the same interval as the extraction well were used for analysis. Three monitoring wells, KAFB-106120-450, KAFB-106122-450, and KAFB-106123-450, are screened from approximately 430 to 440 ft bgs, while two monitoring wells, KAFB-106113-450 and KAFB-106114-450, are screened from 440 to 450 ft bgs. Data from these 5 wells were used in the analysis of this test.

Based on the results, only wells KAFB-106123-450 and KAFB-106122-450, located respectively 61 and 75 ft from the extraction well, show an observable response to SVE. This indicates that the ROI for this five-day test is at least 75 ft but, most likely, is less than 95 ft, as the results for well KAFB-106120-450, located 95 ft from the extraction well, show no observable response to the SVE (Figure 1-4).

Test 2 - Test 5DTSVEW-05 Results

ROI test 5DTSVEW-05 used well SVEW-05, screened from 445 to 460 ft bgs, as the extraction well. RSI SVE Unit 249, running both engines, was used to extract soil vapor from SVEW-05. Well KAFB-106121-450, located 964 ft from the extraction well, was used as the background monitoring well. KAFB-106121-450 was monitored only once per day during this test. Consequently, only the first monitoring round per day was used in this analysis.

Only data for wells screened in the same portion of the vadose zone as the extraction well were used in this analysis. KAFB-106148-484 is screened from 354 to 484 ft bgs; SVEW-09 is screened from 445 to 460 ft bgs; and KAFB-106119-450 is screened from 440 to 450 ft bgs (Figure 1-4). Data from these 3 wells were used in the analysis of this test.

Because data from only the first monitoring round per day was used and only data from wells screened in the same portion of the vadose zone as the extraction well were used, there was very little usable data available for analysis. No meaningful conclusions about the ROI for extraction well SVEW-05 could be determined based on the analysis of data from only 5 monitoring rounds and 3 monitoring wells.

Test 3 - Test 5DTKAFB106149-484 Results

ROI test 5DTKAFB106149-484 used well KAFB-106149-484, screened from 354 to 484 ft bgs, as the extraction well. RSI SVE Unit 335, running both engines, was used to extract soil vapor from KAFB-106149-484. Well KAFB-106121-450, located 643 ft from the extraction well, was used as the background monitoring well.

Only data for wells screened within the same interval as the extraction well were used in this analysis. Nine monitoring wells, KAFB-106111-450, KAFB-106112-450, KAFB-106113-450, KAFB-106114-450, KAFB-106116-450, KAFB-106117-450, KAFB-106119-450, KAFB-106128-450, and KAFB-106129-450 are screened from 440 to 450 ft bgs, and SVMW-15 is screened from 450 to 452.5 ft bgs. Data from these 10 monitoring wells was used in the analysis of this test.

Wells KAFB-106117-450, located 29 ft from the extraction well, KAFB-106116-450, located 161 ft from the extraction well, KAFB-106119-450, located 201 ft from the extraction well, KAFB-106128-450, located 205 ft from the extraction well, and SVMW-15, located 227 ft from the extraction well, all showed an observable response to SVE (Figure 1-4). Vacuum pressure for KAFB-106112-450, located

221 ft from the extraction well, was greater than average for approximately half of the monitoring rounds. It was, however, greater than average for four of the six monitoring rounds that occurred after the first day, indicating that it may have been weakly experiencing the effects of SVE.

Wells SVMW-15 and KAFB-106112-450 are located at very similar distances from the extraction well, though on different radii extending from the extraction well, with SVMW-15 being only 6 ft farther away. SVMW-15 shows a definite response to SVE, while KAFB-106112-450 possibly shows a weak response, indicating that these two wells are on the edge of the ROI for SVE from KAFB-106149-484. This places the horizontal ROI at approximately 220 to 230 ft for a five-day period of extraction. Vacuum pressure for KAFB-106114-450 was greater than average on the last two days of testing, which could be a result of the ROI extending over 300 ft after four days of extraction. However, additional data would be necessary to make a conclusive statement.

SVE Monitoring Results

On April 30, 2012 RSI SVE units began extracting from wells KAFB-106149-484, KAFB-106160, KAFB-106161, SVEW-01 and SVEW-05. Because results from ROI tests were not sufficient to determine the 3D ROI at the BFF, it was determined that vacuum pressure across the BFF should be monitored during SVE and the data used to clarify the 3D ROI at the BFF. All wells in each of the 9 PneuLog® clusters were selected as the monitoring wells. Each cluster contains wells screened across three intervals: approximately 354 to 484, 205 to 350, and 25 to 200 ft bgs. Data for all depth intervals were used in this analysis to help determine the 3D ROI of the system. Well KAFB-106121-450 is used as the background monitoring well for the 484-ft bgs PneuLog® wells; KAFB-106121-350 is used as the background monitoring well for the 350-ft bgs PneuLog® wells; and KAFB-106121-145 is used as the background monitoring well for the 200-ft bgs PneuLog® wells.

484-ft bgs Wells

Wells KAFB-106154-484, located 176 ft from the nearest extraction well (KAFB-106149-484), KAFB106150-484, located 68 ft from the nearest extraction well (KAFB-106160) and KAFB-106148-484, located 96 ft from the nearest extraction well (SVEW-05) all show an observable response to SVE. These wells are also the three closest to an extraction well; the next closest, KAFB-106151-484, located 205 ft from the nearest extraction well (KAFB-106160), does not show an observable response to SVE. This indicates that the horizontal ROI for the RSI SVE units running one engine at the Kirtland AFB BFF Spill site is at least 176 ft, but less than 205 ft.

350-ft bgs Wells

Wells KAFB-106150-350, located 79 ft from the nearest extraction well (KAFB-106160), KAFB-106149-349, located 5 ft from the nearest extraction well (KAFB-106149-484), KAFB-106148-349, located 84 ft from the nearest extraction well (SVEW-01) and KAFB-106154-350, located 176 ft from the nearest extraction well (KAFB-106149-484) all show an observable response to SVE, though the responses of wells KAFB-106148-349 and KAFB-106154-350 are not as strong as those for the 484-ft bgs wells in the same clusters. These wells are also the four closest to an extraction well; the next closest, KAFB-106151-350, located 209 ft from the closest extraction well (KAFB-106160) does not show an observable response to SVE. This indicates that the ROI for RSI SVE units running one engine is between 176 and 209 ft, which is consistent with the results for the 484-ft bgs wells.

200-ft bgs Wells

Well KAFB-106148-194, located 98 ft from the closest extraction well (SVEW-01), shows an observable response to SVE. Well KAFB-106149-194, located 205 ft above the nearest extraction well (KAFB-106149-484), may be showing a slight response to SVE. These results indicate that the vertical ROI for RSI SVE units running one engine at the Kirtland AFB BFF Spill site is approximately 200 ft, which is consistent with the horizontal ROI shown in the response of the 484-ft bgs monitoring wells.

Based on the data gathered thus far, it appears that the ROI for RSI SVE units running one engine at the Kirtland AFB BFF Spill site is isotropic and between 176 and 205 ft in all directions. Data obtained during the ROI testing indicate that the ROI may extend up to an additional 100 ft when RSI SVE units are running both engines.

1.3.3 Contaminant Fate and Transport Conceptual Model

Conceptual site models were developed for both the vadose zone and for groundwater. The results of these models are explained below. Full details of the conceptual site models are presented in the Quarterly Pre-Remedy Monitoring and Site Investigation Report for April – June 2012 (Shaw, 2012).

1.3.3.1 Vadose Zone

Based on the 3D distribution of soil and vapor concentration data in the vadose zone, a relatively simple vadose zone NAPL and vapor migration model becomes apparent:

- Based on historical analysis of water level data for water supply well KAFB-3, in the 1940s through most of the 1970s, the groundwater table was at a depth approximately 100 feet higher than the current 2012 water table. Beginning in 2009, the water table started rising in response to water conservation practices and municipal use of surface water resources. Water-table changes have had a profound impact on the distribution of and future prognosis for vadose zone contamination.
- The definitive indicators that NAPL did not spread out substantially as it migrated through the vadose zone until it encountered the historical capillary fringe and water table, where it spread out in horizontal directions, includes the following: 1) the low TPH and benzene soil concentrations, 2) the constant contaminant footprint at elevations of 5,000 feet above mean sea level (350 feet bgs) and above, and 3) the expansion of the aerial extent and increase in concentrations at the elevation of 4,900 feet above mean sea level (450 feet bgs). If the vertical NAPL migration occurred over a widespread area or had spread out along vadose zone capillary barriers, it would be expected that higher soil and vapor concentrations would be observed at shallower elevations.
- As surface or near-surface releases of NAPL occurred at the facility, the NAPL essentially migrated vertically downward with some minor horizontal movement related to the heterogeneities in the lithologic intervals. Once the NAPL encountered the historical capillary fringe above the water table at a nominal depth of 400 feet bgs, the NAPL spread out horizontally away from the release areas. The NAPL then accumulated on the water table and started migrating in a northeasterly direction following the downgradient groundwater flow direction.

- As the water table declined as a result of regional groundwater extraction, the NAPL from the initial and subsequent releases followed the falling water table downward. Over time, this had the effect of creating a residual NAPL smear zone from nominal depths of 400 to 500 feet bgs. The recently acquired PneuLog® data indicate that the water table was at approximately 350 feet when the NAPL releases started.

- As the water table started rising in 2009, the NAPL that could flow into monitoring wells (i.e., NAPL not already at residual saturation) became trapped below the water table. The reason is that the NAPL buoyancy force resulting from a density difference of 0.2 gram per cubic centimeter is not sufficient to overcome the entry pressures and generate the upward hydraulic gradient required for the NAPL to rise along with the rising water table.

- Because vapor can migrate in the vadose zone, the vapor concentrations define the overall volume of the vadose zone that is affected by residual NAPL contamination in the soil. To a lesser extent, the vapor concentrations do define the areas of highest vadose zone contamination.

- Based on the 3D distribution of soil and vapor concentrations, the majority of the vadose zone contaminant mass is located within 100 to 150 feet above the present-day water table at depths of 350 to 500 feet bgs (Figure 1-5).

- Based on a screening process that accounts for frequency of detection, the following compounds are determined to be constituents of concern (COCs): 1,2,4-trimethylbenzene (TMB); 1,3,5-TMB; 2-butanone; acetone; benzene; C5-C8 aliphatic hydrocarbons; C9-C10 aromatic hydrocarbons; C9-C12 aliphatic hydrocarbons; cyclohexane; ethylbenzene; heptane; isopropanol; m,p,o-xylenes; methylene chloride; n-hexane; propene; propylene; toluene; and total xylenes (in lieu of quantifying individual m,p,o-xylene isomers).

- The ROI testing of SVE wells conducted in November and December 2011 shows that the ROI of SVE within the BFF Spill site is most likely between 220 and 300 horizontal feet. This estimate is based on the analysis of ROI test 5DTKAFB106149-484. A vertical ROI has not yet been determined.

1.3.3.2 Groundwater

As with the vadose zone model, the groundwater contamination conceptual site model is relatively straightforward:

- Current groundwater flow directions are toward the Ridgecrest water supply wells (Ridgecrest-5 and Ridgecrest-3) with average groundwater velocity of 95 feet/year and a range of 18 to over 300 feet/year to the northeast at a direction of North 25° to 35° East. Overall, vertical groundwater flow direction is down - a downward flow velocity has not been determined at this time. As previously discussed in the Fourth Quarter 2011 report (USACE, 2012c), EDB and TPH-gasoline range organic (GRO) plume maps confirm this plume migration direction and general velocity. The EDB plume is moving at least 50 feet/year to the northeast simply based on plume extent (Figure 1-6).

- As previously discussed in the Fourth Quarter 2011 report (USACE, 2012c), the NAPL viscosity is such that NAPL should be able to flow to groundwater wells. However, the rising water table has resulted in much of the NAPL being trapped below the water table, and remediation NAPL recovery is likely to be problematic. NAPL chemistry defines the source strength for groundwater contamination. For example, the benzene concentration in the KAFB-1066 NAPL, similar to gasoline, is 2,200,000 micrograms per liter (µg/L); the benzene concentration in KAFB-106076 NAPL, similar to jet fuel, is 400,000 µg/L. While EDB was not detected in either NAPL sample, the detection limit was 1,000 µg/L.

- Concentrations for KAFB-1065 (the contaminated well with the longest data record) and the NAPL chemical composition, i.e., the NAPL on top of and below the water table, will act as a persistent source of groundwater contamination for the indefinite future.

- Microbial degradation of organic compounds has fundamentally limited the downward gradient of the vast majority of the individual compounds in the NAPL as well as the TPH-diesel range organic compounds. Furthermore, there is sufficient organic carbon in the aquifer (average concentration of 230 mg/kg) to retard the migration of organic compounds that will partition onto carbon. The compounds that are currently being actively degraded and/or retarded include benzene, ethylbenzene, toluene, xylene; 1,2,4-TMB; and naphthalene. Other NAPL compounds are almost certainly being degraded and retarded; more definitive analysis will be conducted and presented in future monitoring reports.

- Based on a screening process that accounts for frequency of detection (5 percent) and comparison between maximum detected concentrations and NMED and EPA regulatory screening levels, the following analytes are determined to be groundwater COCs:

  - Shallow Zone—EDB, 1,2-dichloroethane, benzene, bis (2-ethylhexyl) phthalate, dibenzo(a,h)anthracene, ethylbenzene, iron, manganese, methylene chloride, naphthalene, nitrogen (nitrate as N), phenol, sulfate, tetrachloroethene, toluene, trichloroethene, and xylenes (total).

  - Intermediate Zone—EDB, benzene, ethylbenzene, iron, manganese, and naphthalene.

  - Deep Zone—EDB, bis (2-ethylhexyl) phthalate, and manganese.

- Additional screening will be conducted over the next year to determine which, if any, of these inorganic analytes in this COC list are related to background concentrations. Those constituents determined to be related to background will be deleted from the COC list.

- EDB has migrated the full length of the monitoring network and was detected above the EPA maximum contaminant level (0.05 µg/L) in samples from 30 of 51 shallow wells, 11 of 27 intermediate wells, and 3 of 28 deep wells during the Second Quarter 2012 monitoring event. EDB is the one compound that was detected in the Shallow, Intermediate, and Deep Zones in the farthest downgradient well cluster (GWM 10; KAFB-106055, KAFB-106057, and KAFB-106058) for the last three quarters (Figure 1-6).

- The concentration patterns of both EDB and TPH-GRO indicate two release periods of NAPL containing EDB. EDB concentrations (Shallow Zone) in the immediate vicinity of the NAPL plume mostly range from 1 to 10 µg/L, with hot spots of up to 320 µg/L (Figure 1-6). Approximately 500 feet downgradient of the northern edge of the NAPL plume, the concentrations decline to less than 1 µg/L, followed by concentration increases to greater than 1 µg/L at the downgradient edge of the monitoring well network. TPH-GRO (Intermediate Zone) has a similar pattern with high concentrations in the NAPL area, a low concentration area approximately 500 feet downgradient of the northern edge of the NAPL plume, and higher concentrations in the downgradient monitoring wells.
- The extent of EDB groundwater contamination is not defined at this time.

2. REMEDIATION SYSTEM DESIGN AND INSTALLATION

2.1 Phase II Remediation Interim Measure

The purpose of the Phase II Remediation Interim Measure is to replace the current ICE unit-based SVE action with a system designed for longer-term operation. The primary element of the Phase II Remediation Interim Measure is the installation of a SVE system to increase hydrocarbon removal from the BFF vadose zone soil. The increased hydrocarbon removal will not only increase treatment of contaminated soil in the vadose zone, but will also allow additional ROI and other tests to be performed. As the SVE system operates, data gathered from the system and the surrounding monitoring wells will provide more information for characterization and evaluation of the contamination, which will provide feedback for the Corrective Measures Evaluation (CME) final remediation system design.

The SVE system includes two SVE wells (KAFB-106161 and KAFB-106160), an aboveground piping manifold that transports the vapors to a blower skid, and a catalytic oxidation unit to destroy the hydrocarbon vapors in the extracted well gas. The SVE system is designed to extract up to 1600 standard cubic feet per minute (SCFM) of air, containing up to 3450 ppmv total hydrocarbons (THC) from the two SVE wells; which results in removal of over 2200 lb/day of hydrocarbon from the soil. Initially the well gas is expected to contain roughly 6800 ppmv THC and the flow rate of the well gas will be reduced to around 800 SCFM. This is necessary to limit the hydrocarbon mass removal rate to the catalytic oxidizer (CATOX) design capacity of 2200 lb/day. Over time the THC in the well gas is expected to decrease and the flow rate will be increased to maximize hydrocarbon removal.

The SVE wells are installed at locations with the highest measured and estimated concentrations of COCs to maximize remediation potential. The aboveground manifold is roughly 200 feet of 8-inch-diameter and 600 feet of 6-inch-diameter polyethylene pipe mounted on sleepers. The SVE blower skid includes a knock-out pot for removing and collecting entrained NAPL and condensate, and a positive displacement blower fitted with silencers and inlet filters. The CATOX is a natural gas-fired unit designed for 98 percent minimum destruction of hydrocarbons. It includes an inlet system fan burner and burner control systems, a catalyst bed, a heat-recovery exchanger, and an exhaust stack. With the high hydrocarbon content of the SVE well gas and the heat recovery exchanger, the CATOX will require very little natural gas until THC concentrations in the SVE well gas drop below 1500 ppmv. Condensate generated from system operation will be collected in a standard, aboveground fuel storage tank that is equipped with gages and alarms that are tied into the system control panel. The tank will be maintained in accordance with Resource Conservation and Recovery Act and NMED requirements, specifically 40 CFR parts 264 and 265 (U.S. EPA, 2012), and NMAC 20.5 (NMED, 2012b). Figure 2-2 shows the layout of the system, Figure 2-3 provides a closer detail of the system at the pad, and Figure 2-4 details the flow process.

2.2 Monitoring Well Network

Monitoring wells for the remediation system will include all of the groundwater, soil vapor, and PneuLog® wells that have been installed as part of the current and past investigations (Figures 1-2 and 1-3). These wells will be monitored on a quarterly basis, and their results will be presented in the Quarterly Pre-Remedy Monitoring and Site Investigation Report. Monitoring well sample procedure and details are presented in the Pre-Remedy Monitoring and Soil-Vapor Extraction System Operation and Maintenance Work Plan (Shaw, 2011c).

2.3 System Friction Loss Estimates

The piping network for the vapor extraction pipeline was modeled to determine frictional head losses. Using the vacuum blower performance data and pipeline friction losses, an evaluation was conducted to determine the available vacuum for the system. For a normal operating case at low vacuum, the piping manifold provides an absolute pressure at the wells of 10.7 pounds per square inch absolute pressure (2.8 inches of mercury vacuum, relative to normal atmospheric pressure in Albuquerque). This will be sufficient for vapor extraction to the treatment system. A detailed calculation is provided in Appendix F.

2.4 Remediation System Installation

2.4.1 Permitting

The following permits will be necessary in order to comply with State and Kirtland AFB regulations:

- Albuquerque Environmental Health Department Air Quality Authority-To-Construct Permit #1984
  - This Permit will be modified to include the planned SVE system's catalytic oxidation exhaust. A full description of the system's specifications and exhaust will be included in the permit modification.
- Kirtland AFB Dig Permit
  - This Permit clears or marks all AFB utilities at the proposed SVE system and associated utility locations.
- Kirtland AFB Request for Environmental Impact Analysis
  - This form has been submitted and approved. This form gives approval for the installation of natural gas and electrical lines that supply the SVE system.
  - This form also provides a checklist that ensures that all other necessary forms and permits have been or will be obtained for operating the system.

2.4.2 System Installation

The SVE system will be installed and operated at the BFF and will run off of two wells that have been previously installed, as shown in red on Figure 2-1. Soil Classification Logs and Well Construction Diagrams for the two wells are presented in Appendix A. The well casing is 6-inch, stainless steel with stainless steel centralizers. The well screen is 6-inch, 0.050-slot wire-wrapped stainless steel set in a 50-foot section and a 40-foot section separated by 10 feet of casing. From the bottom of the 40-foot section of the 6-inch, 0.050-slot screen, a 6-inch, 0.030-slot wire-wrapped stainless steel screen is continued to 525 feet bgs. The bottom of the sump is set at 530 feet bgs and is 5 feet in length. The SVEW design was constructed for multi-purpose applications and, as such, was screened across the water table to provide an option to adapt the well for future groundwater extraction if required.

The SVE blower and CATOX skids will be installed and anchored on a 50-foot by 18-foot concrete pad, and the steel stack will be placed on a 6-foot by 6-foot concrete pad adjoining the larger pad. The entire system will be surrounded by a secured fence. The complete system layout is presented on Figure 2-2, with further detail presented in Appendix B.

Piping will run from the individual vacuum recovery wellheads and will join into a single high-density polyethylene pipe that will run to the SVE system. The SVE process is designed to maximize the volatilization of low-molecular weight compounds by pulling air from the vadose zone of the soil layer. The air is extracted using a motor-driven vacuum blower built by Global Technologies, which creates vacuum on the influent lines, and at low pressure, discharges the air to the treatment system. Upstream of the vacuum blower, a demister system is installed that separates entrained water in the system. A knock-out tank and demister filter condense water, which can then be collected and pumped to a collection/treatment system. Inlet filters to the vacuum blower reduce particulate in the blower, while also lowering sound levels created by suction. Silencers are installed at the discharge of the blower to reduce sound output of the unit. Vapor will then move from the blower skid to the Aguil Model 20 CATOX adjoined to the 30-foot steel stack. A CATOX was chosen for the system because of the close proximity to the BFF, and in order to comply with regulations dictating the lower explosive limit (LEL) on Kirtland AFB. A detailed description of both the blower skid and CATOX are presented in Appendix B. The units will be constructed off site and delivered to the BFF after the concrete pad has been poured and set.

Approved and licensed electrical and plumbing contractors will be employed for the installation of the SVE remediation system. The construction quality assurance (QA)/quality control (QC) program will use testing and inspection methods that are standard to the specific electrical or plumbing work. The QA/QC requirements will be detailed in the engineering specification and drawings/details. The Site Construction Manager, at a minimum, will be present on site for critical junctures in the system installation such as groundbreaking, piping assembly and leak testing, natural gas installation and connection, electrical wiring, and system start-up.

The site property and vegetation will be restored after completion of the installation. An as-built report will also be prepared and submitted, and it will document any changes and modifications to the drawings and specifications that may occur during installation of the remediation system. Photo documentation of the SVE remediation system will be included in the as-built report. The as-built report will be reviewed, signed, and stamped by a Professional Engineer licensed and registered in the State of New Mexico.

2.4.3 Key Personnel

An identification and description of the qualifications of key persons, consultants, and contractors that will be implementing the SVE system installation is presented in Appendix C.

2.4.4 Construction Quality Assurance Plan

The purpose of the Construction Quality Assurance Plan (CQAP) is to define the methodology and practices to control construction work quality during the performance of work. The CQAP provides the description of the general construction work QC measures to be implemented for SVE system installation. The CQAP provides the framework and criteria to plan, monitor, verify, and assess quality-related services to assure construction and related tasks are of the highest standard. The CQAP is presented in Appendix D.

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3. PHASE V: OPERATION, MAINTENANCE, AND MONITORING

3.1 SVE Operational Approach

The SVE system will be operated 24 hours a day, 7 days a week. The primary goals of system operation are to maximize the removal of THC from the vadose zone soil and to aid in data gathering activities to further characterize and evaluate the contamination. Data gathered from operation of the SVE system will contribute to the CME and final remedy design. The amount of hydrocarbon in the soils should be high enough that the SVE system is expected to operate at near maximum capacity. Procedures for system startup and normal operation are found in the O&M manual in Appendix E.

The thermal capacity of the CATOX unit is limited to a mass removal rate of approximately 2,200 pounds of hydrocarbons per day. This is based on the design capacity of 1,600 SCFM of air at 3,450 ppmv of hydrocarbon (25 percent of LEL). In order to achieve this mass removal rate for hydrocarbons, the inlet air flow to the CATOX unit should be close to 2,500 SCFM, and the inlet hydrocarbon should be close to 2,100 ppmv (as measured by the instruments on the CATOX unit). These conditions mean that the CATOX unit is running at near maximum thermal capacity and maximum hydrocarbon removal from the vadose zone soil.

To maintain these conditions the system operators will have to periodically optimize the flows of well gas from the two wells and the dilution air. This requires manually adjusting the SVE blower speed (using the Variable Frequency Drive [VFD]) and the position of the dilution air valves at the blower inlet and at the two well heads. As the hydrocarbon content of the well gas changes, the operating settings will have to be adjusted. During the first 8 weeks of operation, the system should be optimized on a weekly basis. After several weeks of operation, the rate of change in THC concentrations in the wells should decrease and the system will require less frequent optimization. Optimizing the system flows will require a tradeoff between maximizing hydrocarbon removal (high well gas flow and high THC concentrations) and preventing CATOX unit shutdown due to high catalyst outlet temperature caused by hydrocarbon removal rates over the designed limit.

Figure 2-4 illustrates the process flow diagram for the SVE system and expected operation based on current conditions where the soil gas from both wells contains 6,800 ppmv hydrocarbons. Typically after starting the SVE system, the hydrocarbon content of the soil gas will decline, and the operators will cut back on the dilution air flow to pull higher volume of air from the wells. The dilution air that is let into the system at the wellheads helps reduce water condensation in the SVE manifold during the colder months and therefore, it is preferable to first cut back on the dilution air let in to the inlet of the SVE blower. If the hydrocarbon content of one of the SVE wells is consistently higher than the other, the operators may increase the amount of air extracted from that well by adjusting the position of the wellhead valves (partially closing the low-hydrocarbon well to restrict flow). Routine optimization of flow rates between the two wells will be conducted using the Horiba instruments or equivalent.

3.2 Performance Based Criteria

The SVE system is expected to operate at near maximum capacity while being monitored and optimized until such time as the CME final remedy is put in place. Data collected from the system and surrounding monitoring wells during SVE system operation will aid in creating performance based criteria. The performance based criteria will be addressed in the CME to be submitted at a later date.

3.3 System Maintenance and Monitoring

Maintenance for the SVE and thermal CATOX system will include preventative maintenance, corrective maintenance, and shut-down inspection and maintenance. The systems will be inspected and maintained monthly, quarterly, and annually. Activities will include observance, documentation, servicing, repair, or replacement (if necessary). Any defects will be reported as soon as possible to Shaw environmental, health, and safety personnel. The air/water knock-out pump, SVE vacuum blower, filters, CATOX fan, burner, catalyst, and instruments will be inspected regularly to ensure proper operation. Appendix E contains the Operations and Maintenance manuals for the SVE blower skid and the CATOX unit. These manuals describe the preventative maintenance and periodic inspection practices for the SVE System.

For routine weekly optimization of the SVE system for THC removal, Shaw will use the Horiba THC monitors or equivalent. In addition, Shaw will collect SUMMA canister samples to monitor, track, and report mass removal of benzene, toluene, ethylbenzene, xylenes and EDB every quarter. Shaw will also measure pressure and take vapor samples in the SVE monitoring wells on a quarterly basis, and their results will be presented in the Quarterly report. SVE monitoring wells for the remediation system will include all of the groundwater, soil vapor and PneuLog® wells that have been installed as part of the current and past investigations (Figures 1-2 and 1-3).

The PLC in the CATOX unit will record flow rate and THC so that data can be used to calculate gross THC removal. The PLC also records temperature to ensure that the system is operating at conditions that result in 98% organic destruction. The flow, pressure, and temperature of air entering the SVE system will be measured and recorded to calculate removal rates from vapor recovery wells and to indicate the efficiency of the system. Vapor samples will be taken from sample ports throughout the system using vacuum or SUMMA canisters. Laboratory tests will be conducted from the extracted vapors before and after the treatment process to determine volatile organic compound (VOC) concentrations. This will allow the system to be optimized to increase the overall effectiveness. An air emission monitoring report will be prepared for the client. The report will present the progress of the system from start-up, and will consist of maintenance and monitoring descriptions, system effectiveness, lessons learned, emission data, calculations of volume of contaminants removed, and analytical laboratory certificates of analysis. The report will also describe any system problems and reasons for down time.

3.4 Quarterly Groundwater Monitoring

Quarterly groundwater monitoring is currently being performed according to the Pre-Remedy Monitoring and Soil-Vapor Extraction System Operation and Maintenance Work Plan (Shaw, 2011c) and results are presented in the Quarterly Pre-Remedy Monitoring and Site Investigation Report for April – June 2012 (Shaw, 2012). Groundwater monitoring consists of collecting liquid level groundwater elevation and light nonaqueous phase liquid measurement data quarterly, and performing quarterly groundwater sampling for field chemical parameters and off-site laboratory analysis. In the following discussions, the aquifer beneath the Kirtland AFB BFF Spill site has been classified into the following four zones for purposes of data analysis:

- **Shallow Zone—**This is the monitored zone that intersects the water table and extends 5 to 15 feet below the 2011 measured water table. As the water table has continued to rise, a number of these wells have become flooded to where the water level is now above the top of the screens. Based on ongoing water conservation practices in the Albuquerque area, additional wells will become flooded over the next several years.
- **Intermediate Zone—**This is the aquifer zone that is monitored by wells that extend 15 to 30 feet below the 2011 measured water table elevation. As the water table continues to rise, this zone will become deeper in the aquifer.
- **Deep Zone—**This is the aquifer zone that is monitored by wells that extend 30 to 100 feet below the 2011 measured water table elevation. As the water table continues to rise, this zone will become deeper in the aquifer.
- **Regional Aquifer—**This is the aquifer zone where most of the water supply wells in the area are completed. Generally, these wells are completed 500 feet or more below the 2009 water table elevation (typically greater than 1,000 feet bgs).

3.4.1 Quarterly Pre-Remedy Groundwater Monitoring

The groundwater investigation and monitoring program currently includes collecting quarterly groundwater elevation and light nonaqueous phase liquid measurement data, and conducting quarterly groundwater sampling at BFF Spill site monitoring wells and nearby production wells. This data will also be used to evaluate the success and production of the SVE system.

Groundwater sampling includes purging one well boring volume and monitoring field parameters for stabilization of temperature, pH, and specific conductance to within an estimated 10 percent prior to collecting water quality measurements. Field parameters that were recorded prior to collecting groundwater samples for laboratory analysis were pH, conductivity, temperature, alkalinity, dissolved oxygen, turbidity, oxidation-reduction potential, and alkalinity.

After collection of water quality measurements, the wells will be purged at an approximate rate of 1.0 liter per minute. Prior to sample collection, the Kirtland AFB production wells and the Veterans Affairs Medical Center groundwater production well will be purged by flushing the dedicated sample line and then collecting the samples. Samples will be collected through non-chlorinated taps from the production wells. Groundwater samples collected will be analyzed for the following list of parameters:

- VOCs – EPA SW8026B
- EDB – EPA SW8011
- Semivolatile organic compounds – EPA SW8270C
- TPH-GRO and TPH-diesel range organics – EPA SW8015B
- Polycyclic aromatic hydrocarbons – EPA SW8270C low-level method (VA-2 well only)
- Lead and major cations – EPA SW6010C
- Dissolved iron and manganese – EPA SW6010C
- Anions (chloride and sulfate) – EPA 300.0
- Nitrate/nitrite as nitrogen – EPA 353.2
- Ammonia nitrogen – Standard Method (SM) 4500NHB
- Total sulfide – SM 4500 S-2CF
- Carbonate/bicarbonate alkalinity – SM 2320B

Field QC samples will be collected in accordance with the BFF Spill Quality Assurance Project Plan (USACE, 2011g), and will include trip and ambient field blanks for VOCs, field duplicate and equipment rinse blank samples, and extra sample volume collected and submitted for laboratory matrix spike and matrix spike duplicate QC measurements.

Groundwater analytical data are validated for precision, accuracy, representativeness, comparability, and completeness in accordance with the BFF Spill Quality Assurance Project Plan (USACE, 2011g), and appropriate data qualifiers are appended to the analytical data in the project database.

3.5 Status and Quarterly Reporting

All data and summaries for the SVE system will be included in the current Quarterly Pre-Remedy Monitoring and Site Investigation Report. The SVE system section of the report will include results of system monitoring along with field activities for that quarter. The following information will also be included in the quarterly report:

- Charts and tables of the remediation system operation monitoring parameters, including flow rate, vapor screening results, analytical laboratory results for air, and a summary of operating conditions
- The volume of extracted hydrocarbons, recovery rate, and effective radius and efficiency for vapor treatment
- Graphic representation of photoionization detector vapor screening concentrations, VOC vapor extraction removal rates, and system electrical and natural gas consumption
- The modeled horizontal and vertical extent and magnitude of contamination
- Maps illustrating the extent and concentration of contamination

Groundwater sampling results with plume maps and tables of historic and recent analytical results and gauging are already included in the Quarterly Pre-Remedy Monitoring and Site Investigation Reports.

3.6 Completion of Remediation

The Phase II Remediation Interim Measure system is not designed to complete remediation at the BFF; this system is designed to continue the interim measures remediation process and will then be incorporated into CME for the project site, which will be submitted at a later date.

4. SCHEDULE

Appendix G contains the project schedule for system permitting and construction. The schedule contains major milestones and work elements related to construction and initiation of system operation. The project schedule is specific to this phase of work and does not include contract milestones.

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5. WASTE MANAGEMENT

Investigation-derived waste generated may include nonregulated or recyclable materials associated with routine, scheduled engine maintenance including used air filters, used oil filters, spark plugs, motor oil, and anti-freeze. Additionally, during periods of cold temperatures, the system may generate condensate from the extracted soil vapor, which will be captured in integrated knock-out system drums and manifested as hazardous waste. Soil-vapor condensate generated by the SVE remediation system will be disposed of off site as hazardous waste. All drums of condensate will be manifested as hazardous waste for flammable liquids, unless otherwise specified, and contain benzene and water.

During operations, scheduled maintenance of the SVE remediation system will occur regularly and consist of oil and filter changes at a minimum, and additional maintenance tasks performed at monthly, quarterly, semiannual, and annual intervals. Waste oil and waste anti-freeze will be stored in 55-gallon, U.S. Department of Transportation, closed-top, steel drums at a pre-approved location. Once full, the drums will be picked up for recycling by a vendor providing the service to Kirtland AFB.

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FIGURES

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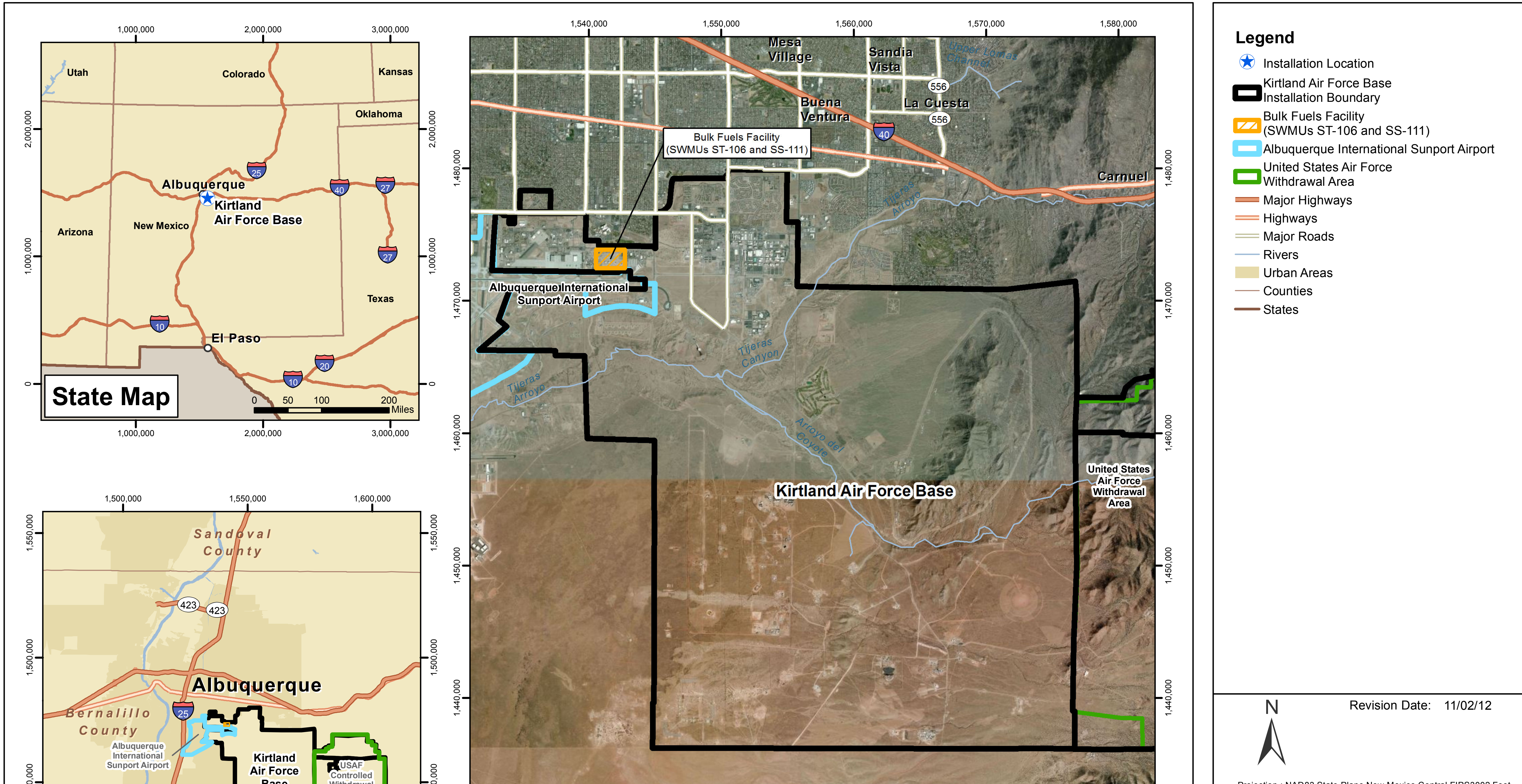

PHASE II REMEDIATION INTERIM MEASURES PLAN
BULK FUELS FACILITY
KIRTLAND AIR FORCE BASE, NEW MEXICO

FIGURE 1-1

SITE LOCATION MAP

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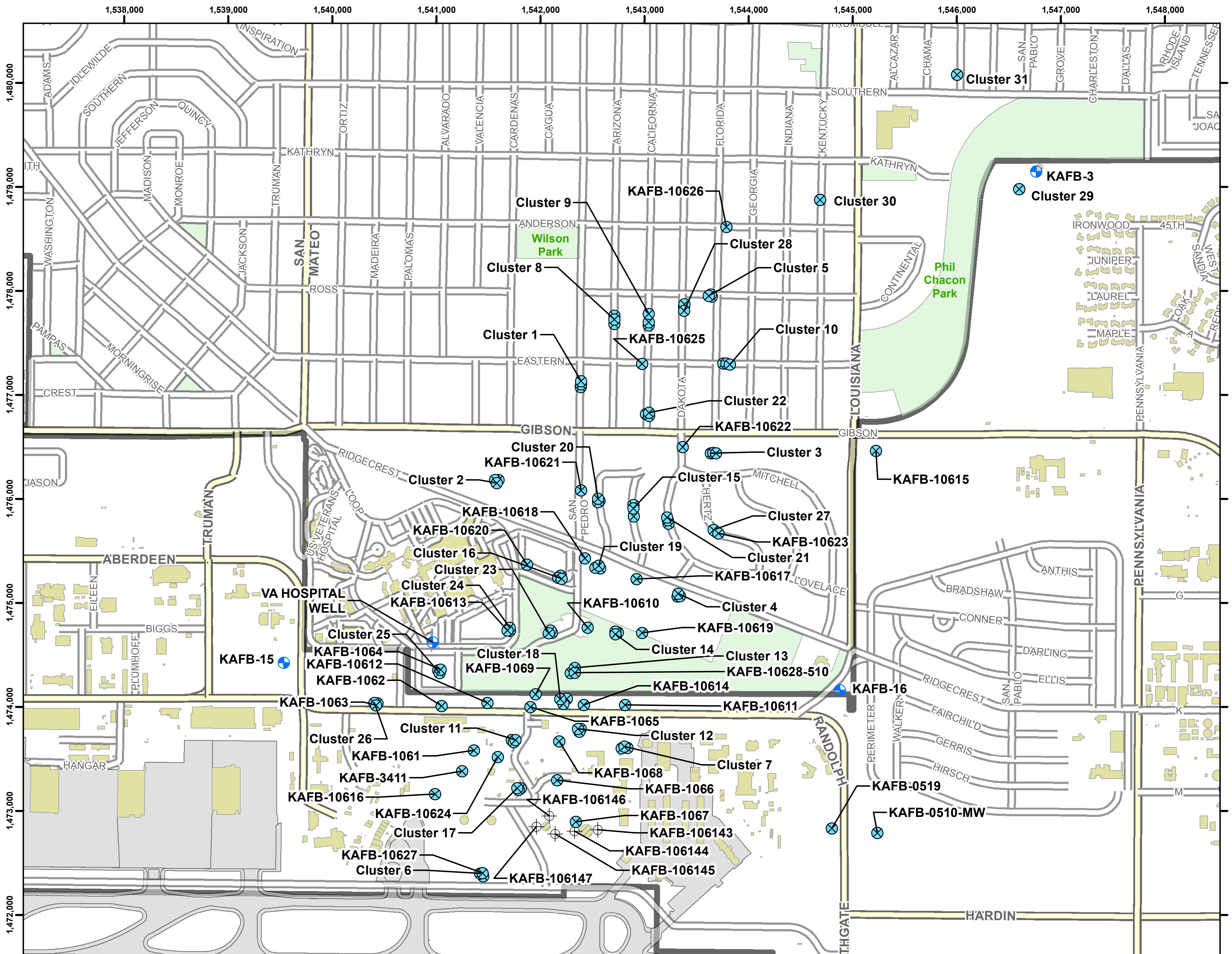

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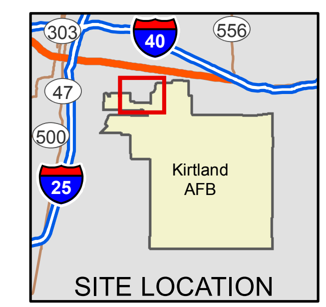
Legend

- Monitor Well
- Water Supply Well
- Borehole



Revision Date: 11/02/12

N

0 400 800 1,600

Feet

1 inch = 1,000 feet

Projection : NAD83 State Plane New Mexico Central FIPS3002 Feet

PHASE II REMEDIATION INTERIM MEASURES PLAN
BULK FUELS FACILITY
KIRTLAND AIR FORCE BASE, NEW MEXICO

FIGURE 1-2

GROUNDWATER MONITORING WELL AND SOIL BORING LOCATIONS

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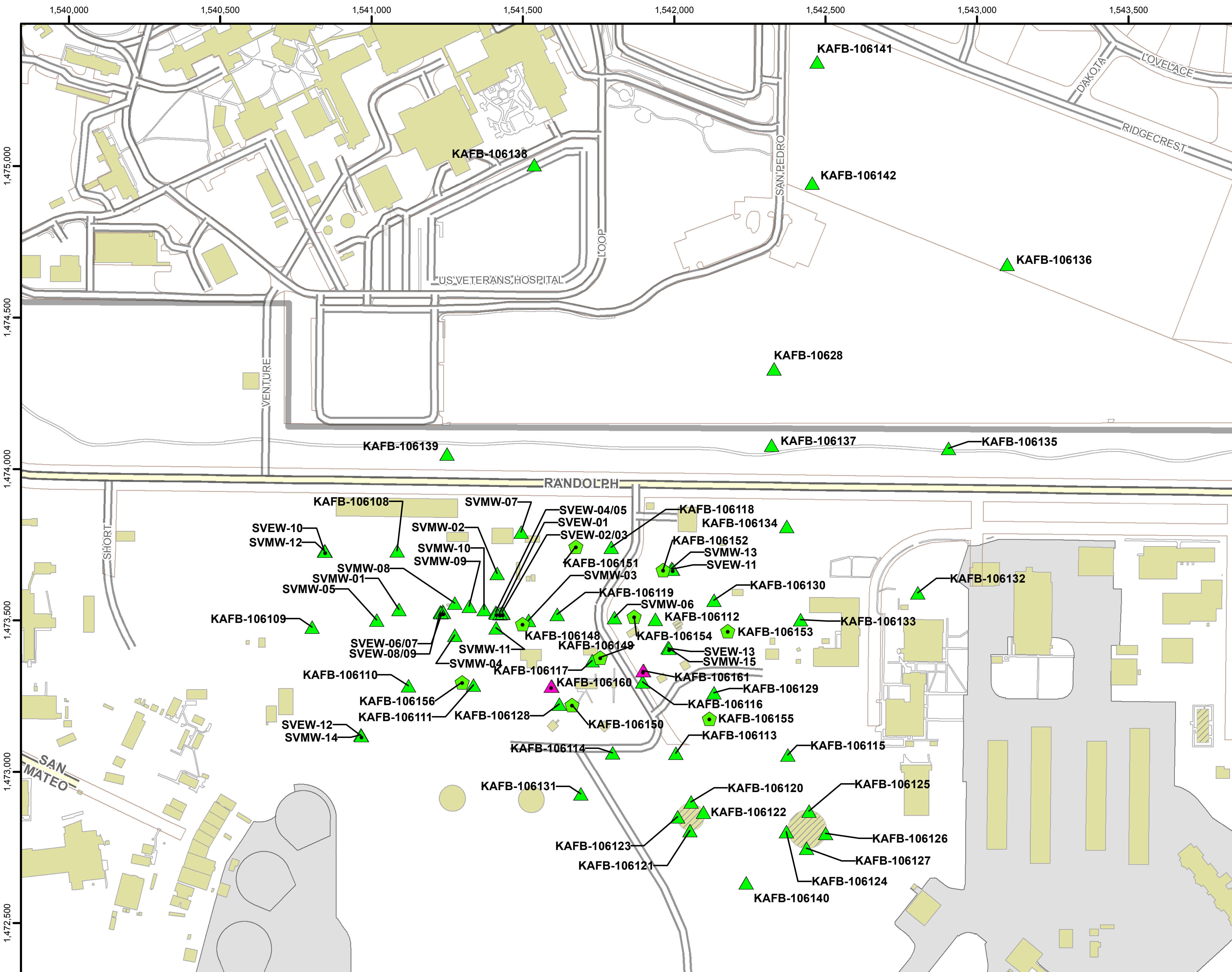

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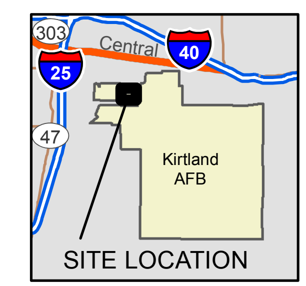
Legend

- SVE Remediation Well
- Pneulog Cluster
- SVE Extraction Well
- SVM Cluster



Revision Date: 11/02/12

N

0 175 350 700

Feet

1 inch = 350 feet

Projection : NAD83 State Plane New Mexico Central FIPS3002 Feet

PHASE II REMEDIATION INTERIM MEASURES PLAN
BULK FUELS FACILITY
KIRTLAND AIR FORCE BASE, NEW MEXICO

FIGURE 1-3

SOIL VAPOR MONITORING LOCATIONS

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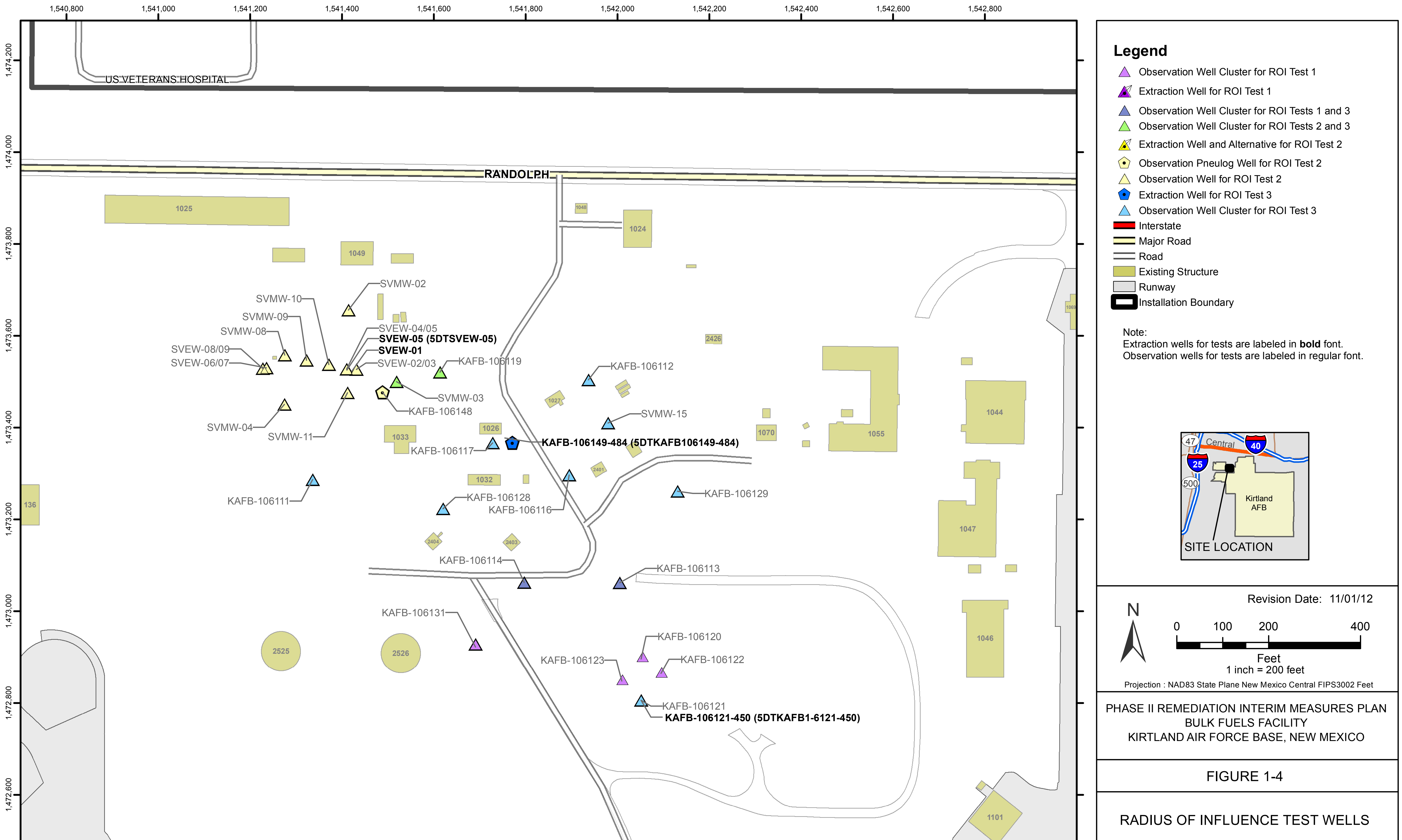

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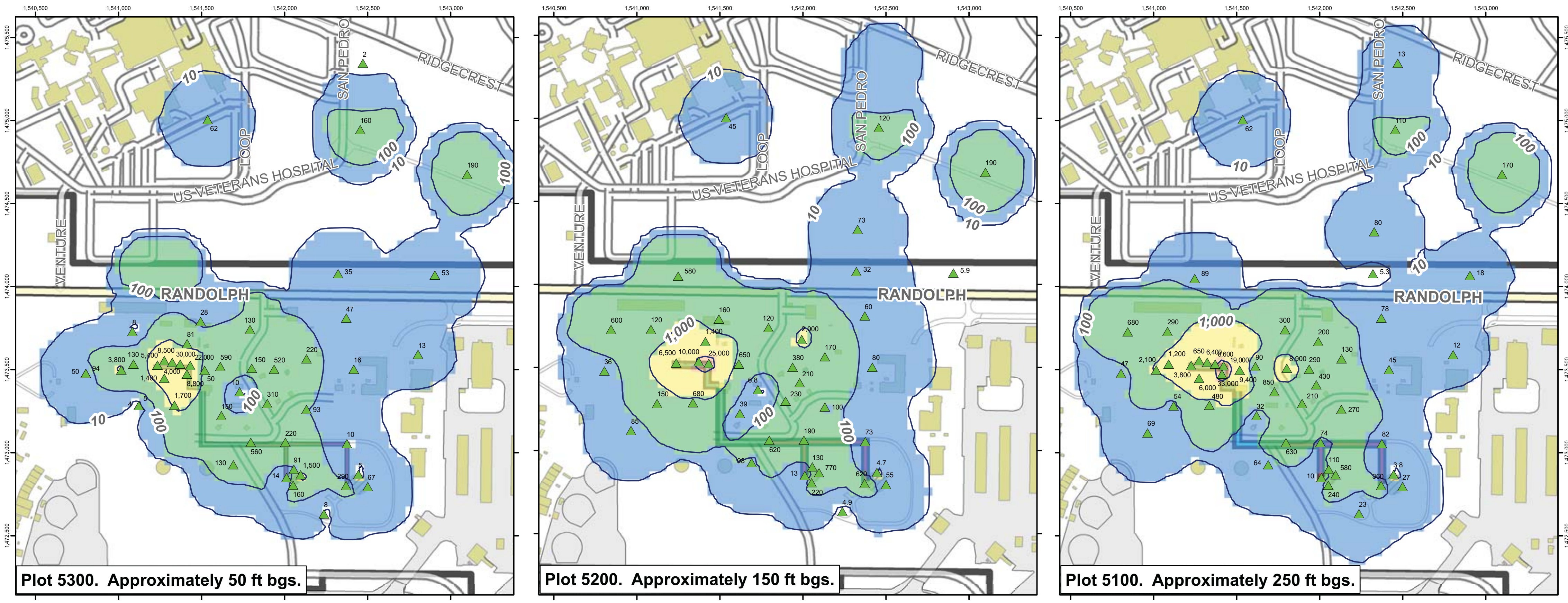
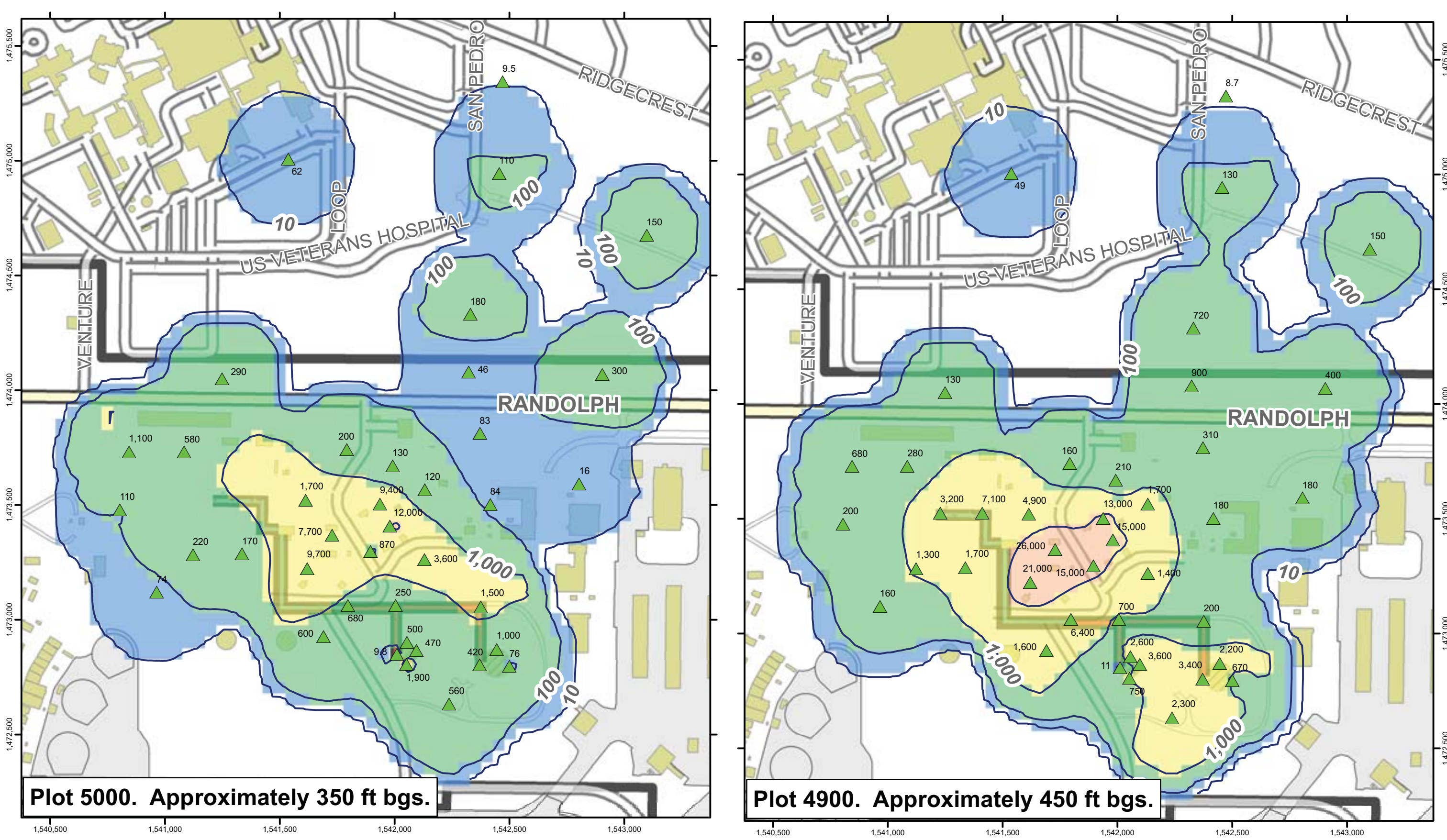




Note:
The vadose zone VOC plume was gridded in three dimensions using inverse distance weighting in RockWorks and then concentration plan-view maps were "cut" at respective elevations. Ground elevations range from 5314 to 5364 ft above mean sea level across the ST-106/SS-111 investigation area.

SVE well locations are presented with the total vapor VOC concentration in ppmv for each elevation. Sample results within 25 ft of the elevation are posted. For example, plot 5000 includes sample results within the 5025 to 4075 ft interval. Locations are not shown at elevations where there is no sample result for the elevation interval.

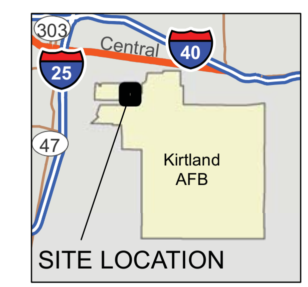
See Figure 4-2 for SVE well locations with ID numbers.

Legend

- SVE/SVM Well with Vapor VOC Concentration (ppmv)
- VOC Concentration Contours (ppmv)

VOC Concentration (ppmv)

- 1 - 10
- 11 - 100
- 110 - 1,000
- 1,100 - 10,000
- 11,000 - 41,000



Revision Date: 11/02/12

N

0 400 800 1,600

Feet

1 inch = 400 feet

Projection : NAD83 State Plane New Mexico Central FIPS3002 Feet

PHASE II REMEDIATION INTERIM MEASURES PLAN
BULK FUELS FACILITY
KIRTLAND AIR FORCE BASE, NEW MEXICO

FIGURE 1-5

TOTAL VOC VAPOR PLUME
FOOTPRINTS BY ELEVATION
JUNE 2012

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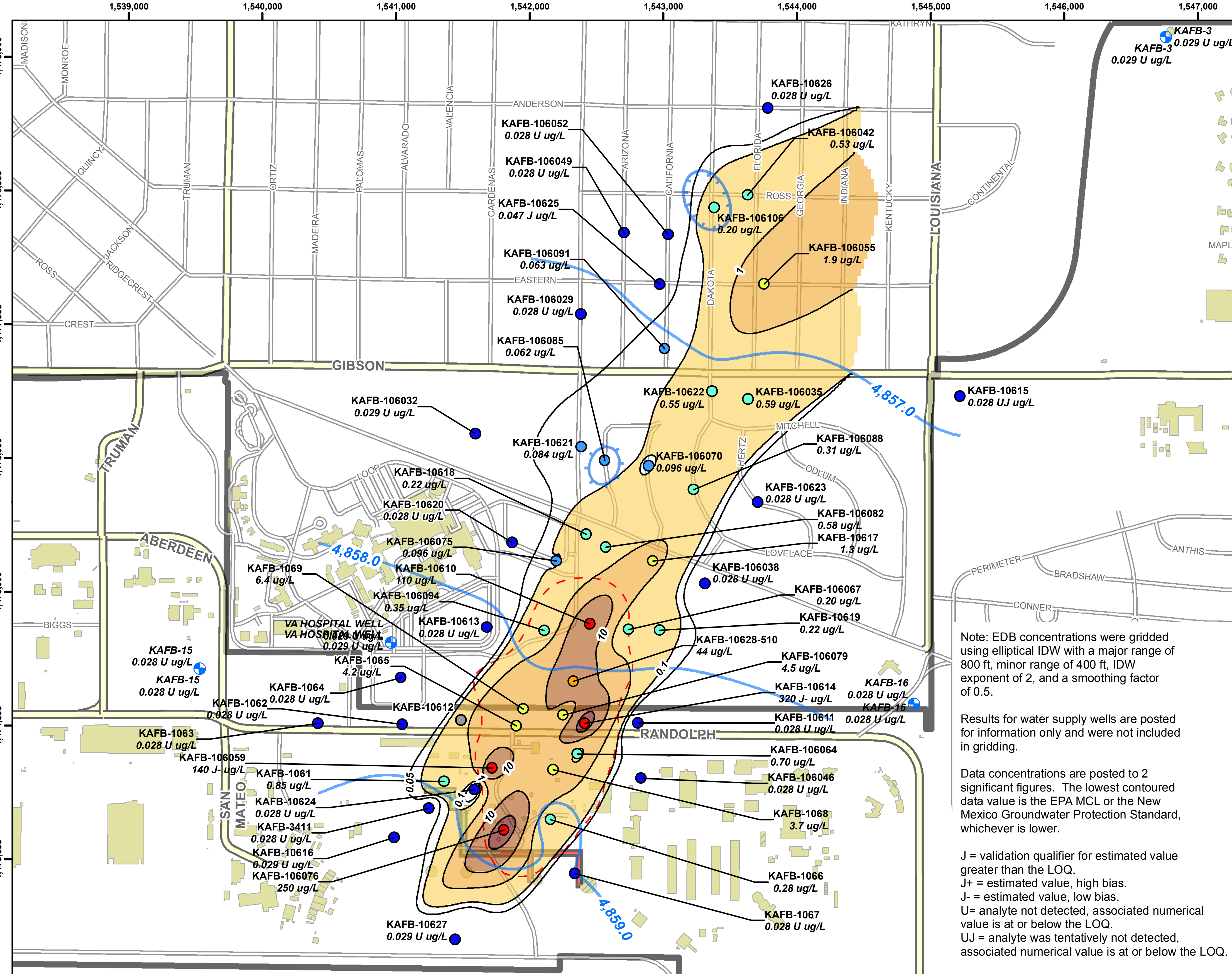


Legend

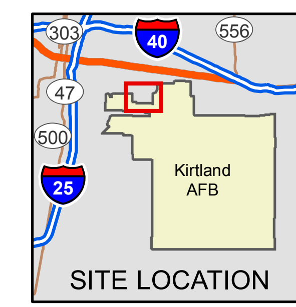
- Water Supply Well

EDB Result (ug/L)

- 0.028 - 0.050
- 0.051 - 0.10
- 0.11 - 1.0
- 1.1 - 10
- 11 - 100
- 110 - 320
- Not Sampled
- Groundwater Level Contour (ft msl)
- Groundwater High
- Groundwater Depression
- EDB Concentration Contour (ug/L)

EDB Concentration (ug/L)

- 0.014 - 0.1
- 0.11 - 1
- 1.1 - 10
- 11 - 100
- 110 - 310
- Historical Area of Observed NAPL (July 2009)



Note: EDB concentrations were gridded using elliptical IDW with a major range of 800 ft, minor range of 400 ft, IDW exponent of 2, and a smoothing factor of 0.5.

Results for water supply wells are posted for information only and were not included in gridding.

Data concentrations are posted to 2 significant figures. The lowest contoured data value is the EPA MCL or the New Mexico Groundwater Protection Standard, whichever is lower.

J = validation qualifier for estimated value greater than the LOQ.
J+ = estimated value, high bias.
J- = estimated value, low bias.
U= analyte not detected, associated numerical value is at or below the LOQ.
UJ = analyte was tentatively not detected, associated numerical value is at or below the LOQ.

Revision Date: 11/02/12

N

0 400 800 1,600
Feet
1 inch = 800 feet

Projection : NAD83 State Plane New Mexico Central FIPS3002 Feet

PHASE II REMEDIATION INTERIM MEASURES PLAN
BULK FUELS FACILITY
KIRTLAND AIR FORCE BASE, NEW MEXICO

FIGURE 1-6

1,2-DIBROMOETHANE (EDB) CONCENTRATIONS IN SHALLOW GROUNDWATER

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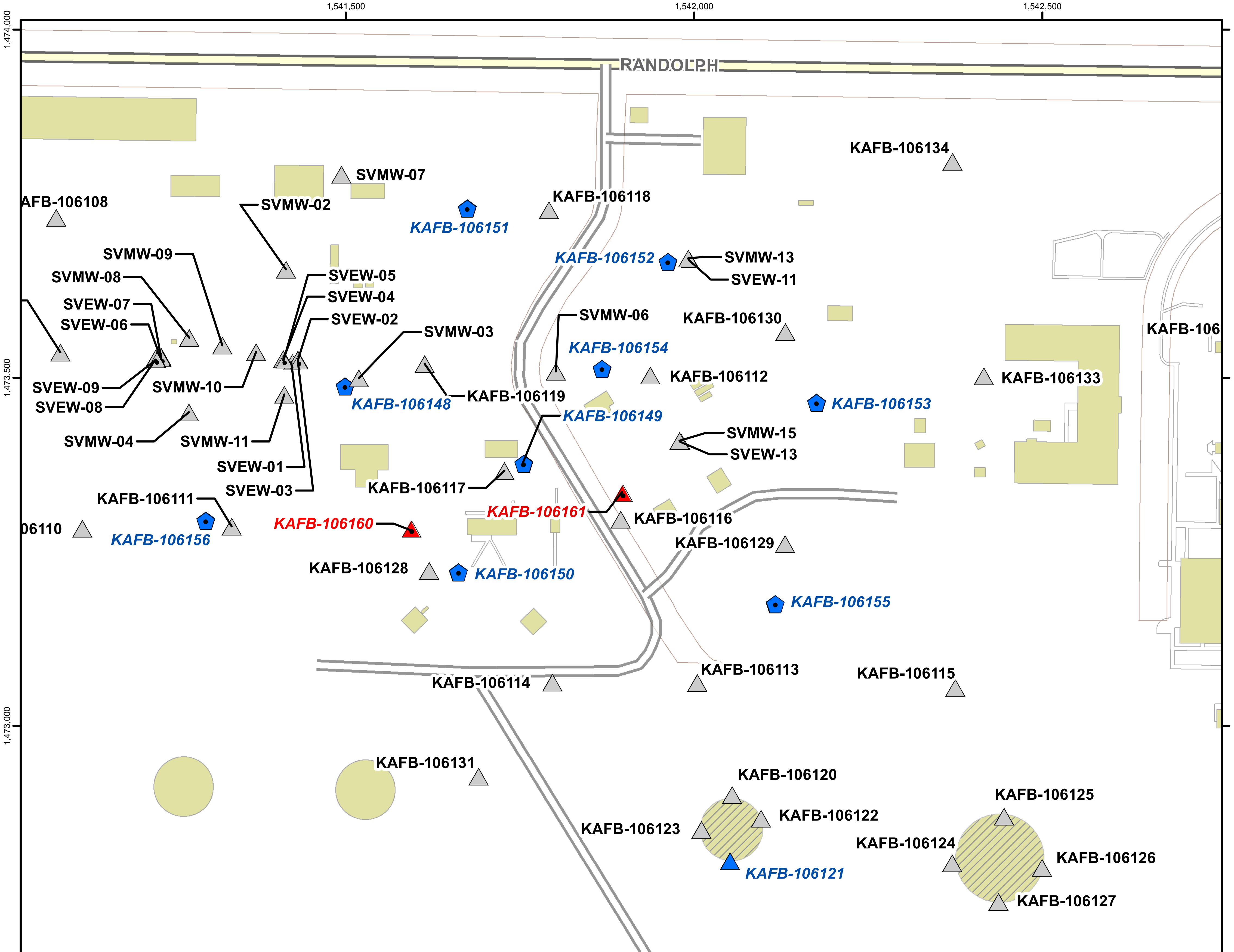

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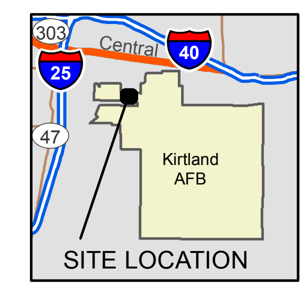
Legend

- Active SVE Extraction Well
- Primary SVM Cluster
- Pneu Log
- SVE Extraction Well
- SVM Cluster
- Removed Fuel Storage Tanks



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Revision Date: 11/02/12

0 75 150 300

Feet

1 inch = 150 feet

Projection : NAD83 State Plane New Mexico Central FIPS3002 Feet

PHASE II REMEDIATION INTERIM MEASURES PLAN
BULK FUELS FACILITY
KIRTLAND AIR FORCE BASE, NEW MEXICO

FIGURE 2-1

SVE REMEDIATION
MONITORING SYSTEM

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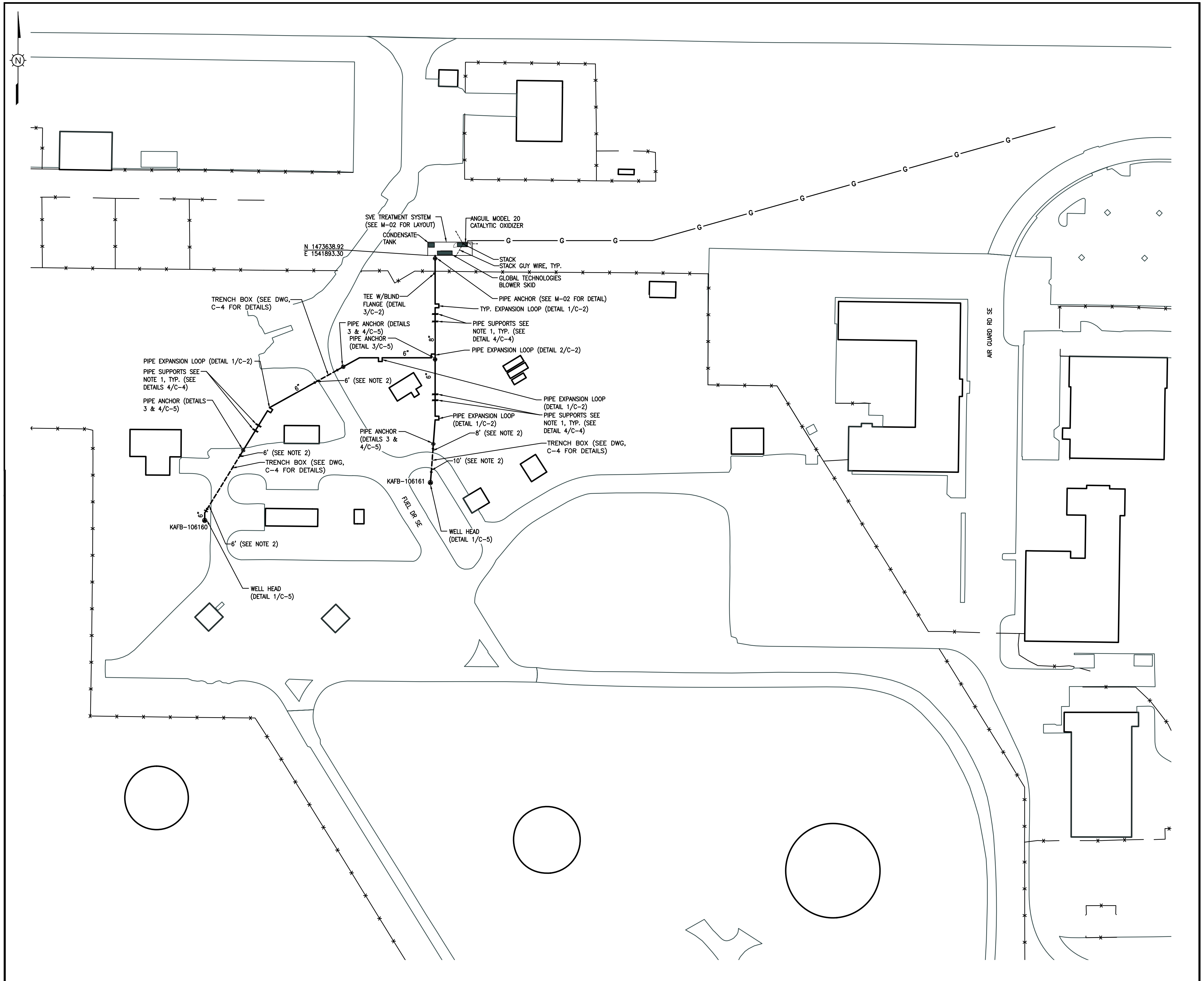
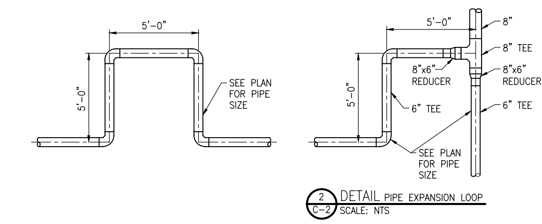


LEGEND:

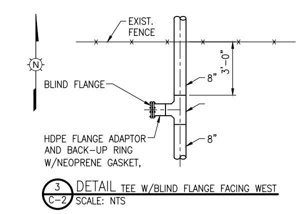
EXISTING		NEW	
	BUILDING		SVE TREATMENT SYSTEM
	ROAD	KAFB-106161	EXTRACTION WELLS
	FENCE		EXTRACTION WELL PIPING IN TRENCH BOX
5350	MAJOR CONTOURS		EXTRACTION WELL ABOVE GRADE PIPING
	MINOR CONTOUR	G	GAS LINE
G	GAS LINE		PIPE SUPPORTS
ST	STORM SEWER		PIPE ANCHOR
WW	WASTE WATER LINE	OR	EXPANSION LOOP
W	WATER LINE		
E	ELECTRICAL CABLE		
F	FUEL LINE		
(F)	FORMER FUEL LINE		
IW	INDUSTRIAL WASTE LINE		
T1049 (3)-25 kVA	TRANSFORMER		
	LIGHT POLE		
	POWER POLE		

NOTES:

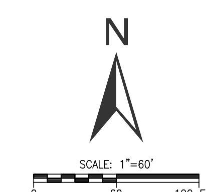
1. VACUUM PIPING WILL BE SUPPORTED BY 4"x4" PRESSURE TREATED POSTS LAID HORIZONTALLY ON GRADE EXCEPT WHERE NOTED BY PIPE ANCHORS. 6"ø PIPING SHALL BE SUPPORTED EVERY 8'-0" OC. 8"ø PIPING SHALL BE SUPPORTED EVERY 10'-0" OC.
2. MINIMUM DISTANCE REQUIRED FROM EDGE OF PAVED ROAD TO OUTSIDE DIAMETER OF PIPE.

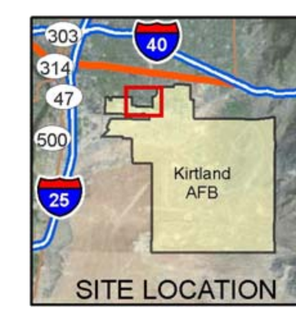


2 C-2 DETAIL PIPE EXPANSION LOOP
SCALE: NTS



3 C-2 DETAIL TEE W/BLIND FLANGE FACING WEST
SCALE: NTS





PHASE II REMEDIATION INTERIM MEASURES PLAN
BULK FUELS FACILITY
KIRTLAND AIR FORCE BASE, NEW MEXICO

FIGURE 2-2

SOIL VAPOR EXTRACTION AND THERMAL TREATMENT SYSTEM SITE PLAN

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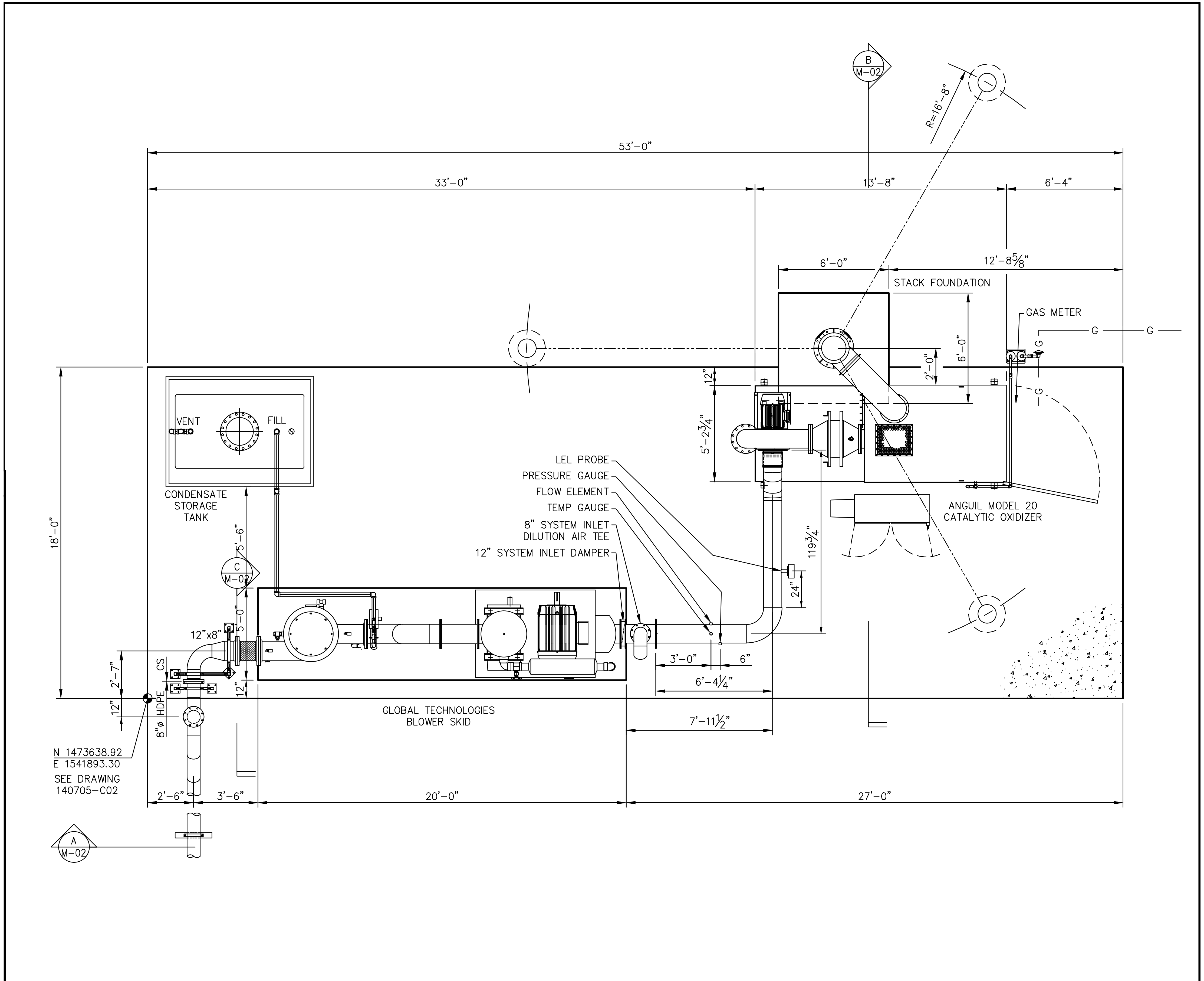

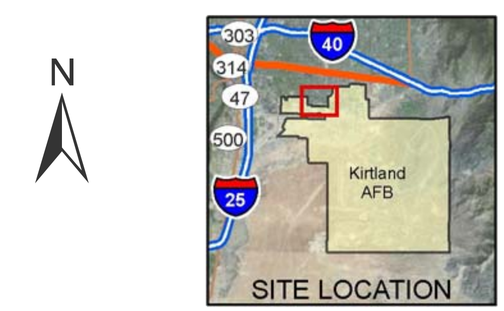

PHASE II REMEDIATION INTERIM MEASURES PLAN
BULK FUELS FACILITY
KIRTLAND AIR FORCE BASE, NEW MEXICO

FIGURE 2-3

SOIL VAPOR EXTRACTION AND THERMAL TREATMENT SYSTEM MECHANICAL - GENERAL ARRANGEMENT

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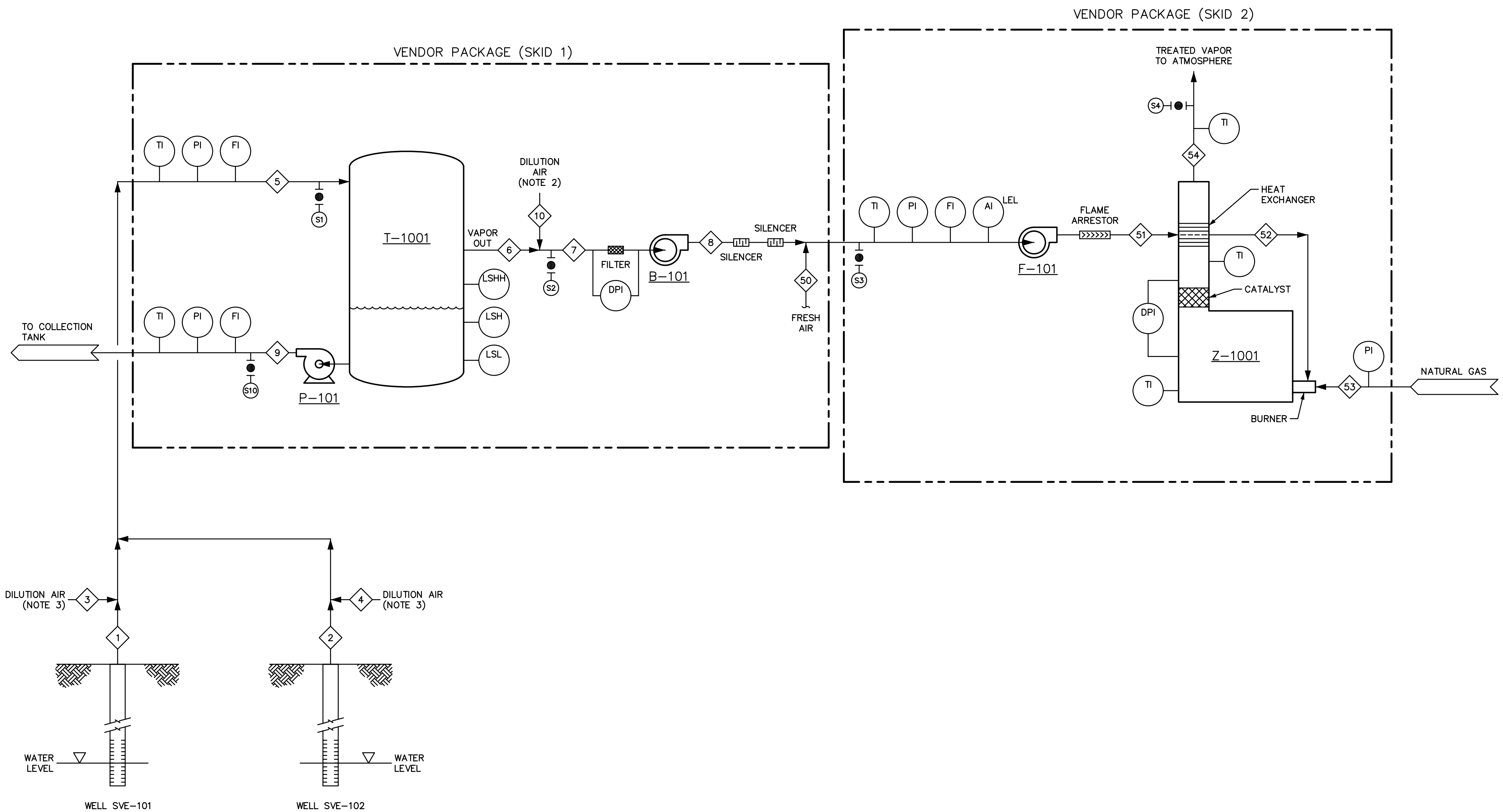


B-101
SVE-1 VACUUM/BLOWER SYSTEM
1,200 SCFM
-12" Hg VACUUM
125 HP

F-101
SYSTEM FAN
2,500 SCFM

P-101
SVE-1 LIQUID PUMP
5 GPM

T-1001
SVE-1
AIR/WATER SEPARATOR
600 GALLON
48" DIA x 6' H

Z-1001
THERMAL CATALYTIC OXIDIZER

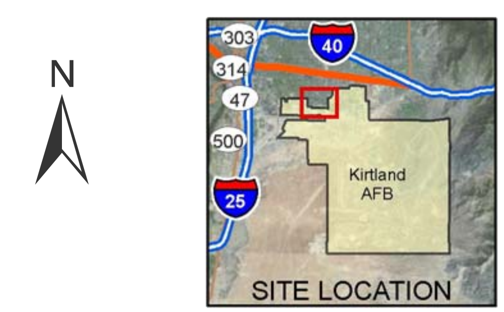
COMPONENT / STREAM NO.		1	2	3	4	5	6	7	8	9	10	50	51	52	53	54
		AIR FLOW FROM SVE-101	AIR FLOW FROM SVE-102	DILUTION AIR FROM SVE-101	DILUTION AIR FROM SVE-102	VAPOR FROM WELLS	SEPARATOR VAPOR	DILUTED INLET VAPOR	BLOWER VAPOR	CONDENSATE	DILUTION AIR	FRESH AIR	EXTRACTED VAPOR	COMBUSTION AIR	NATURAL GAS	STACK GAS
WATER FLOW (average)	lb/hr															
AIR FLOW (average)	lb/hr	1,800	1,800	900	900	5,400	5,400	7,200	7,200	(NOTE 4)	1,800	4,050	11,250	11,250		11,340
LIQUID FLOW (maximum)	gpm															
LIQUID FLOW (average)	gpm															
AIR FLOW	acfm	529	529			1,633	1,633	2,177	2,105		479	1,078	3,104	5,529		6,153
AIR FLOW	scfm	400	400	200	200	1,200	1,200	1,600	1,600		400	900	2,500	2,500		2,520
TOTAL HYDROCARBONS	lb/hr	45	45			90	90	90	90				90	90		1.8
TOTAL HYDROCARBONS	ppmv	6,800	6,800			4,533	4,533	3,400	3,400				2,176	2,176		44
GAS FLOW	lb/hr (scfh)														6 (162)	
TEMPERATURE	°F	50	50	60	60	60	60	60	111	60	60	60	95	500		600
PRESSURE	psia	10.7	10.7	10.7	10.7	10.6	10.6	10.6	12.04		12.04	12.04	12.40	12.04		12.04
AIR DENSITY (AT 70°F)	lb/ft^3	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075		0.075	0.075	0.075	0.075		0.075
WATER DENSITY	lb/gal									8.340						

NOTES:

1. VENDOR TO SUPPLY ITEMS MARK WITH AN ASTERICK (*).
2. DILUTION AIR MANUALLY ADJUSTED TO LIMIT LEL IN VAPORS TO THERMAL TREATMENT SYSTEM.
3. DILUTION AIR TO REDUCE CONDENSATION IN PIPELINE.
4. CONDENSATE RATE WILL DEPEND ON OUTSIDE TEMPERATURE. DURING WINTER UP TO 112 GALLONS PER DAY OF CONDENSATE CAN BE PRODUCED.

LEGEND:

LEL – LOWER EXPLOSION LIMIT
S2 – SAMPLE PORT



PHASE II REMEDIATION INTERIM MEASURES PLAN
BULK FUELS FACILITY
KIRTLAND AIR FORCE BASE, NEW MEXICO

FIGURE 2-4

SOIL VAPOR EXTRACTION (SVE) SYSTEM PROCESS FLOW DIAGRAM

140705_FDNB0002_B3

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TABLES

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Table 1-1. Groundwater Monitoring Well Clusters and Associated Wells

NMED Cluster	Location
Cluster 1	KAFB-106029
	KAFB-106030
	KAFB-106031
Cluster 2	KAFB-106032
	KAFB-106033
	KAFB-106034
Cluster 3	KAFB-106035
	KAFB-106036
	KAFB-106037
Cluster 4	KAFB-106038
	KAFB-106039
	KAFB-106040
Cluster 5	KAFB-106041
	KAFB-106042
	KAFB-106043
Cluster 6	KAFB-106044
	KAFB-106045
Cluster 7	KAFB-106046
	KAFB-106047
	KAFB-106048
Cluster 8	KAFB-106049
	KAFB-106050
	KAFB-106051
Cluster 9	KAFB-106052
	KAFB-106053
	KAFB-106054
Cluster 10	KAFB-106055
	KAFB-106057
	KAFB-106058
Cluster 11	KAFB-106059
	KAFB-106060
	KAFB-106061
Cluster 12	KAFB-106062
	KAFB-106063
	KAFB-106064
Cluster 13	KAFB-106065
	KAFB-106066
Cluster 14	KAFB-106067
	KAFB-106068
	KAFB-106069
Cluster 15	KAFB-106070
	KAFB-106071
	KAFB-106072
Cluster 16	KAFB-106073
	KAFB-106074
	KAFB-106075
Cluster 17	KAFB-106076
	KAFB-106077
	KAFB-106078
Cluster 18	KAFB-106079
	KAFB-106080
	KAFB-106081

Table 1-1. Groundwater Monitoring Well Clusters and Associated Wells (concluded)

NMED Cluster	Location
Cluster 19	KAFB-106082
	KAFB-106083
	KAFB-106084
Cluster 20	KAFB-106085
	KAFB-106086
	KAFB-106087
Cluster 21	KAFB-106088
	KAFB-106089
	KAFB-106090
Cluster 22	KAFB-106091
	KAFB-106092
	KAFB-106093
Cluster 23	KAFB-106094
	KAFB-106095
	KAFB-106096
Cluster 24	KAFB-106097
	KAFB-106098
Cluster 25	KAFB-106099
	KAFB-106100
Cluster 26	KAFB-106101
	KAFB-106102
Cluster 27	KAFB-106103
	KAFB-106104
Cluster 28	KAFB-106105
	KAFB-106106
	KAFB-106107

NMED New Mexico Environment Department

APPENDIX A

Soil Classification Logs and Well Construction Diagrams

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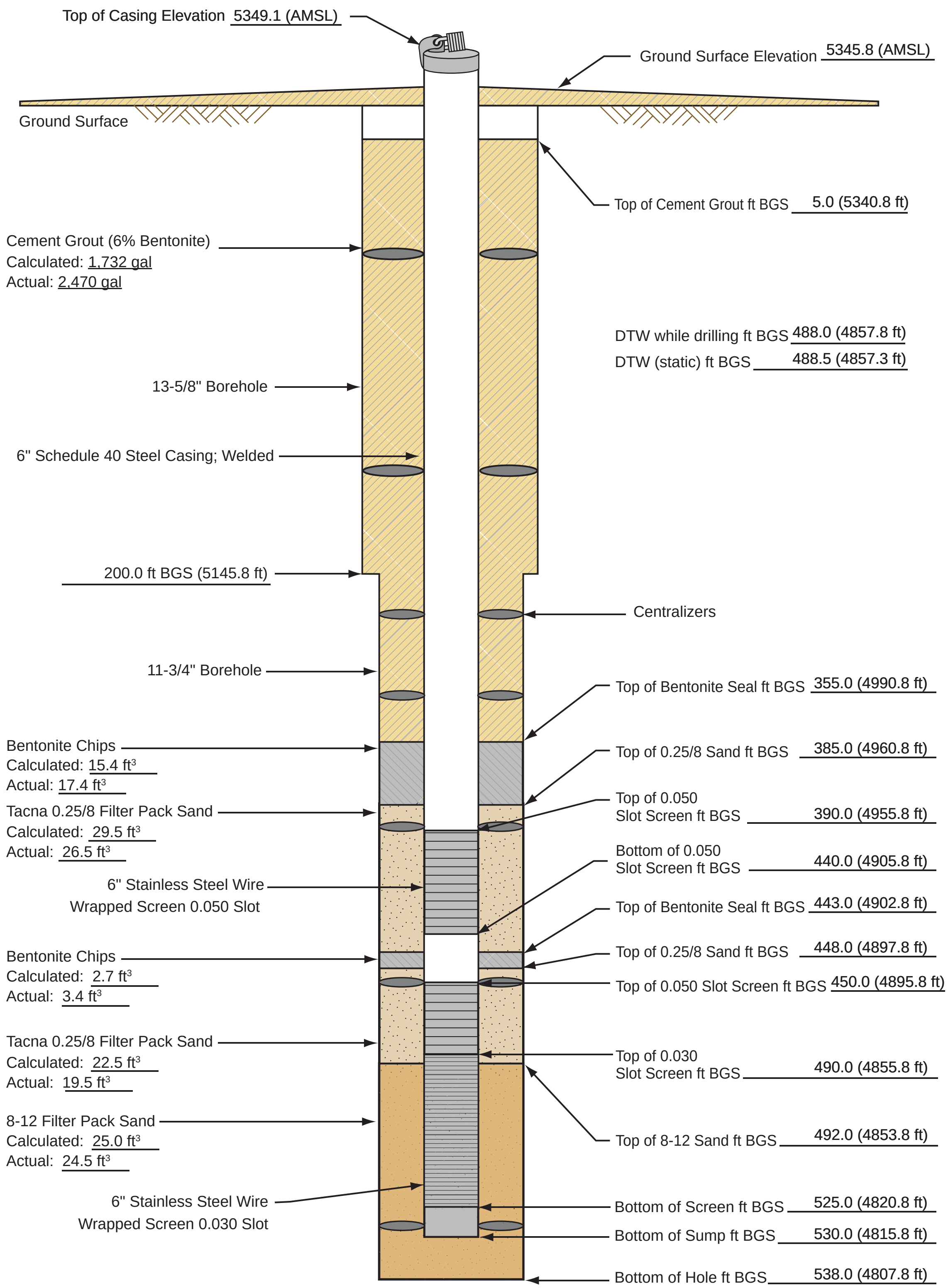
Soil Vapor Extraction Well KAFB-106161

Installation Start Date/Time: 2/13/2012 @ 0915
Installation End Date/Time: 2/23/2012 @ 1720



(4,816.90) = *Elevations are NAVD 88 Datum values based on NGS Control Station "Hanger", Elevation = 5,343.43 ft. GPS/RTK methods and GEO1D99 model were used to determine elevations of all surveyed points.*

Not to Scale
BGS = Below Ground Surface

140705.FB010010_SVE_KAFB_106161

Borehole ID: KAFB-106161

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB BFF SWMU ST-106 and SS-111
Project Number: 140705

Date Started: 2/6/2012
Date TD Reached: 2/9/2012
Date Completed: 2/23/2012

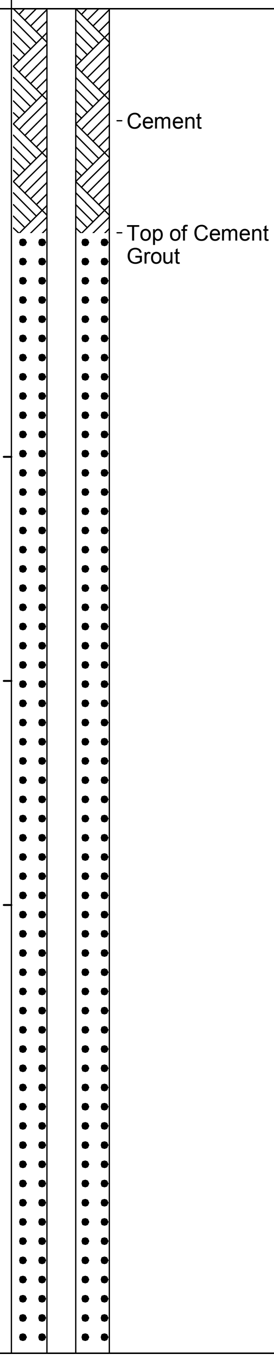
Ground Elevation AMSL (ft): 5345.8
Y Coordinate: 1473334.69
X Coordinate: 1541896.31

Hole Diameter Upper (in.): 13-5/8
Hole Diameter Lower (in.): 11-3/4
Surface Completion Type: Stick-up

Groundwater Levels BGS (ft):
At Time of Drilling: 488.00
At End of Drilling: Not Recorded
After Drilling: 488.50

Drillling Contractor: WDC Drilling
Drilling Method: Air Rotary Casing Hammer
Logged By: Patrick Ostrye

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
0					No description recorded.			Hand augered.
5					No description recorded.			Began drilling @ 1500 on 2/6/12.
10					Silty SAND (SM); reddish brown (2.5YR 4/4); moist; loose; 82% fine to coarse sand; 3% gravel to 10mm; subangular to subrounded; 15% silt.	SM		
15					Clayey SAND (SC); dark reddish brown (2.5YR 3/4); moist; loose; 70% fine to medium sand; 20% clay; 10% silt; nonplastic.	SC		New 20' connection @ 1510. Resumed drilling @ 1530.
20					Silty SAND (SM); red (2.5YR 4/6); moist; loose; 70% fine to medium sand; 10% coarse sand; 15% silt; 5% clay; nonplastic.	SM		
25					Same as above (20 ft).	SM		
30								



Borehole ID: KAFB-106161

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB BFF SWMU ST-106 and SS-111
Project Number: 140705

Date Started: 2/6/2012
Date TD Reached: 2/9/2012
Date Completed: 2/23/2012

Ground Elevation AMSL (ft): 5345.8
Y Coordinate: 1473334.69
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Hole Diameter Upper (in.): 13-5/8
Hole Diameter Lower (in.): 11-3/4
Surface Completion Type: Stick-up

Groundwater Levels BGS (ft):
▽ At Time of Drilling: 488.00
▼ At End of Drilling: Not Recorded
▼ After Drilling: 488.50

Drillling Contractor: WDC Drilling
Drilling Method: Air Rotary Casing Hammer
Logged By: Patrick Ostrye

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
30					Silty SAND (SM); red (2.5YR 4/6); moist; loose; 70% very fine to medium sand; 20% silt; 10% clay; nonplastic.	SM		
35					Silty SAND (SM); red (2.5YR 4/6); moist; loose; 75% fine to medium sand; 5% coarse sand; 5% gravel to 10mm; angular to subangular; 15% silt.			New 20' connection @ 1547. Resumed drilling @ 1602.
40					Silty SAND (SM); red (2.5YR 4/6); moist; loose; 65% fine to medium sand; 5% coarse to very coarse sand; 5% gravel to 10mm; angular to subrounded; 20% silt; 5% clay.			
45					Poorly graded SAND with Silt (SP-SM); red (2.5YR 4/8); moist; loose; 75% fine to medium sand; 10% coarse to very coarse sand; 5% gravel to 10mm; angular; 10% silt.	SP-SM	Cement Grout	
50					No description recorded.			
55					Silty SAND (SM); red (2.5YR 4/8); moist; loose; 70% fine to medium sand; 10% coarse to very coarse sand; 20% silt.	SM		New 20' connection @ 1615. Resumed drilling.
60								

Borehole ID: KAFB-106161

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB BFF SWMU ST-106 and SS-111
Project Number: 140705

Date Started: 2/6/2012
Date TD Reached: 2/9/2012
Date Completed: 2/23/2012

Ground Elevation AMSL (ft): 5345.8
Y Coordinate: 1473334.69
X Coordinate: 1541896.31

Hole Diameter Upper (in.): 13-5/8
Hole Diameter Lower (in.): 11-3/4
Surface Completion Type: Stick-up

Groundwater Levels BGS (ft):
∇ At Time of Drilling: 488.00
▼ At End of Drilling: Not Recorded
▼ After Drilling: 488.50

Drillling Contractor: WDC Drilling
Drilling Method: Air Rotary Casing Hammer
Logged By: Patrick Ostrye

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
60					Silty SAND (SM); red (2.5YR 4/6); moist; loose; 70% fine to medium sand; 10% coarse to very coarse sand; 20% silt.			
65					Silty SAND (SM); red (2.5YR 4/8); moist; loose; 65% very fine to medium sand; 5% coarse sand; 30% silt.			
70					Silty SAND (SM); red (2.5YR 4/6); moist; loose; 65% very fine to medium sand; 5% coarse to very coarse sand; 5% gravel to 4mm; angular; 25% silt.			
75					Silty SAND (SM); red (2.5YR 4/8); moist; loose; 67% very fine to medium sand; 3% coarse sand; 30% silt.	SM	Cement Grout	End of 2/6/12. Resumed drilling on 2/7/12.
80					Silty SAND (SM); red (2.5YR 4/6); moist; loose; 55% very fine to medium sand; 10% coarse sand; 35% silt.			
85					Same as above (80 ft).			
90								

Borehole ID: KAFB-106161

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB BFF SWMU ST-106 and SS-111
Project Number: 140705

Date Started: 2/6/2012
Date TD Reached: 2/9/2012
Date Completed: 2/23/2012

Ground Elevation AMSL (ft): 5345.8
Y Coordinate: 1473334.69
X Coordinate: 1541896.31

Hole Diameter Upper (in.): 13-5/8
Hole Diameter Lower (in.): 11-3/4
Surface Completion Type: Stick-up

Groundwater Levels BGS (ft):
∇ At Time of Drilling: 488.00
▼ At End of Drilling: Not Recorded
▼ After Drilling: 488.50

Drillling Contractor: WDC Drilling
Drilling Method: Air Rotary Casing Hammer
Logged By: Patrick Ostrye

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
90					Silty SAND (SM); red (2.5YR 4/6); moist; loose; 65% fine to medium sand; 5% coarse to very coarse sand; 30% silt.	SM		
95					Silty SAND (SM); red (2.5YR 4/6); moist; loose; 80% very fine to medium sand; 20% silt.			New 20' connection @ 0917. Resumed drilling @ 0930.
100					Poorly graded SAND (SP); reddish brown (5YR 5/4); moist; loose; 95% fine to coarse sand; 5% silt and clay.	SP		
105					Poorly graded SAND (SP); reddish brown (5YR 4/4); moist; loose; 95% fine to coarse sand; 5% silt and clay.		Cement Grout	
110					Silty SAND (SM); red (2.5YR 4/6); moist; loose; 65% very fine to medium sand; 5% coarse sand; 30% silt.	SM		
115					Silty SAND (SM); yellowish red (5YR 5/6); moist; loose; 85% very fine to medium sand; 15% silt.			New 20' connection @ 0954. Cleaned out cyclone. Resumed drilling @ 1030.
120								

Borehole ID: KAFB-106161

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB BFF SWMU ST-106 and SS-111
Project Number: 140705

Date Started: 2/6/2012
Date TD Reached: 2/9/2012
Date Completed: 2/23/2012

Ground Elevation AMSL (ft): 5345.8
Y Coordinate: 1473334.69
X Coordinate: 1541896.31

Hole Diameter Upper (in.): 13-5/8
Hole Diameter Lower (in.): 11-3/4
Surface Completion Type: Stick-up

Groundwater Levels BGS (ft):
At Time of Drilling: 488.00
At End of Drilling: Not Recorded
After Drilling: 488.50

Drillling Contractor: WDC Drilling
Drilling Method: Air Rotary Casing Hammer
Logged By: Patrick Ostrye

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
120					Silty SAND (SM); yellowish brown (5YR 5/6); moist; loose; 60% very fine to medium sand; 5% coarse to very coarse sand; 35% silt.	SM		
125					Same as above (120 ft).	SM		
130					Silty SAND (SM); yellowish brown (5YR 5/6); moist; loose; 70% very fine to medium sand; trace coarse sand; 30% silt.	SM		
					Poorly graded SAND (SP); brown (7.5YR 5/3); dry; loose; 95% very fine to medium sand; 5% clay; non to low plasticity.	SP	Cement Grout	New 20' connection @ 1105. Resumed drilling @ 1130.
135								
140					Poorly graded SAND (SP); brown (7.5YR 5/3); dry; loose; 92% fine to medium sand; 3% coarse to very coarse sand; 5% clay; non to low plasticity.	SP		
145					Poorly graded SAND (SP); brown (7.5YR 5/3); dry; loose; 100% fine to coarse sand.	SP		
150								

Borehole ID: KAFB-106161

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB BFF SWMU ST-106 and SS-111
Project Number: 140705

Date Started: 2/6/2012
Date TD Reached: 2/9/2012
Date Completed: 2/23/2012

Ground Elevation AMSL (ft): 5345.8
Y Coordinate: 1473334.69
X Coordinate: 1541896.31

Hole Diameter Upper (in.): 13-5/8
Hole Diameter Lower (in.): 11-3/4
Surface Completion Type: Stick-up

Groundwater Levels BGS (ft):
At Time of Drilling: 488.00
At End of Drilling: Not Recorded
After Drilling: 488.50

Drillling Contractor: WDC Drilling
Drilling Method: Air Rotary Casing Hammer
Logged By: Patrick Ostrye

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
150					Silty SAND (SM); red (5YR 4/6); moist; loose; 80% very fine to coarse sand; 5% very coarse sand; trace gravel; 15% silt.	SM		
155					Poorly graded SAND with Silt (SP-SM); reddish brown (5YR 5/4); moist; loose; 85% very fine to medium sand; 5% coarse to very coarse sand; 10% silt.	SP-SM		New 20' connection @ 1150. Resumed drilling @ 1245.
160					Poorly graded SAND (SP); reddish brown (5YR 5/3); dry; loose; 95% very fine to very coarse sand; 5% silt and clay.	SP		
165					Poorly graded SAND (SP); reddish brown (5YR 5/4); moist; loose; 90% very fine to very coarse sand; 10% gravel to 15mm; angular to subrounded. Note: pumice fragments to 6mm; rounded.	SP	Cement Grout	
170					Poorly graded SAND (SP); light brown (7.5YR 6/3); dry; loose; 100% very fine to medium sand.	SP		
175					Poorly graded SAND (SP); reddish brown (5YR 5/4); moist; loose; 85% very fine to medium sand; 5% coarse to very coarse sand; 5% gravel to 4mm; subrounded to rounded; 5% silt and clay. Note: pumice fragments to 4mm; rounded.	SP		New 20' connection @ 1315. Resumed drilling @ 1325.
180								

Borehole ID: KAFB-106161

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB BFF SWMU ST-106 and SS-111
Project Number: 140705

Date Started: 2/6/2012
Date TD Reached: 2/9/2012
Date Completed: 2/23/2012

Ground Elevation AMSL (ft): 5345.8
Y Coordinate: 1473334.69
X Coordinate: 1541896.31

Hole Diameter Upper (in.): 13-5/8
Hole Diameter Lower (in.): 11-3/4
Surface Completion Type: Stick-up

Groundwater Levels BGS (ft):
▽ At Time of Drilling: 488.00
▼ At End of Drilling: Not Recorded
▼ After Drilling: 488.50

Drillling Contractor: WDC Drilling
Drilling Method: Air Rotary Casing Hammer
Logged By: Patrick Ostrye

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
180					Poorly graded SAND (SP); light brown (7.5YR 6/3); dry; loose; 95% very fine to medium sand; 5% silt and clay.			
185					Poorly graded SAND (SP); brown (7.5YR 5/3); dry; loose; 90% very fine to medium sand; 5% coarse to very coarse sand; 5% silt and clay.			
190					Poorly graded SAND (SP); brown (7.5YR 5/3); dry; loose; 95% very fine to medium sand; 5% silt and clay.	SP		
195					Same as above (190 ft).		Cement Grout	New 5' connection @ 1353. Resumed drilling @ 1405.
200					Same as above (190 ft).			New 20' connection @ 1410. Resumed drilling @ 1705.
205					No cuttings returned.			
					Poorly graded SAND with Gravel (SP); reddish brown (5YR 4/4); damp; loose; 75% fine to medium sand; 10% coarse	SP		
210								

Borehole ID: KAFB-106161

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB BFF SWMU ST-106 and SS-111
Project Number: 140705

Date Started: 2/6/2012
Date TD Reached: 2/9/2012
Date Completed: 2/23/2012

Ground Elevation AMSL (ft): 5345.8
Y Coordinate: 1473334.69
X Coordinate: 1541896.31

Hole Diameter Upper (in.): 13-5/8
Hole Diameter Lower (in.): 11-3/4
Surface Completion Type: Stick-up

Groundwater Levels BGS (ft):
▽ At Time of Drilling: 488.00
▼ At End of Drilling: Not Recorded
▼ After Drilling: 488.50

Drillling Contractor: WDC Drilling
Drilling Method: Air Rotary Casing Hammer
Logged By: Patrick Ostrye

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
210					to very coarse sand; 15% gravel to 13mm; subangular to rounded.			Possible perched water table; cuttings were very damp. End of 2/7/12. Resumed drilling @ 0820 on 2/8/12.
215					Poorly graded SAND (SP); reddish brown (5YR 5/4); moist; loose; 90% fine to coarse sand; 5% very coarse sand; 5% gravel to 8mm; subrounded.			New 20' connection @ 0825. Resumed drilling @ 0852.
220					Poorly graded SAND with Gravel (SP); brown (7.5YR 5/4); moist; loose; 80% fine to very coarse sand; 20% gravel to 10mm; subangular to subrounded.			
225					Poorly graded SAND (SP); brown (7.5YR 5/4); moist; loose; 93% fine to coarse sand; 5% very coarse sand; 3% gravel to 5mm; subangular to subrounded.	SP	Cement Grout	
230					Poorly graded SAND (SP); brown (7.5YR 5/3); moist; loose; 97% fine to coarse sand; 3% gravel to 10mm; subrounded. Note: pumice fragments to 5mm; rounded.			
235					Poorly graded SAND (SP); brown (7.5YR 5/3); moist; loose; 100% fine to coarse sand.			New 20' connection @ 0903. Resumed drilling @ 0912.
240								

Borehole ID: KAFB-106161

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB BFF SWMU ST-106 and SS-111
Project Number: 140705

Date Started: 2/6/2012
Date TD Reached: 2/9/2012
Date Completed: 2/23/2012

Ground Elevation AMSL (ft): 5345.8
Y Coordinate: 1473334.69
X Coordinate: 1541896.31

Hole Diameter Upper (in.): 13-5/8
Hole Diameter Lower (in.): 11-3/4
Surface Completion Type: Stick-up

Groundwater Levels BGS (ft):
At Time of Drilling: 488.00
At End of Drilling: Not Recorded
After Drilling: 488.50

Drillling Contractor: WDC Drilling
Drilling Method: Air Rotary Casing Hammer
Logged By: Patrick Ostrye

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
240					Poorly graded SAND (SP); brown (7.5YR 5/3); moist; loose; 100% fine to coarse sand.	SP		
245					Well graded SAND (SW); reddish brown (7.5YR 5/4); moist; loose; 85% sand; 10% gravel to 5mm; angular to subangular; 5% silt and clay.	SW		
250					Silty SAND (SM); reddish brown (5YR 5/4); moist; medium dense; 64% very fine to medium sand; 1% gravel to 8mm; rounded; 35% silt.			
255					Silty SAND (SM); light reddish brown (5YR 6/3); moist; medium dense; 64% very fine to medium sand; 1% gravel to 20mm; rounded; 35% silt.	SM	Cement Grout	New 20' connection @ 0930. Resumed drilling @ 1053.
260					Silty SAND (SM); reddish brown (5YR 6/3); moist; loose; 60% fine to coarse sand; 5% very coarse sand; 30% silt. Note: gravel is composed of pumice.			
265					Sandy SILT (ML); brown (7.5YR 5/4); moist; firm; 60% silt; 40% very fine to fine sand.	ML		
270					Silty SAND (SM); brown (7.5YR 5/4); moist; medium dense; 80% very fine to medium sand; 5% coarse sand; 15% silt.	SM		

Borehole ID: KAFB-106161

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB BFF SWMU ST-106 and SS-111
Project Number: 140705

Date Started: 2/6/2012
Date TD Reached: 2/9/2012
Date Completed: 2/23/2012

Ground Elevation AMSL (ft): 5345.8
Y Coordinate: 1473334.69
X Coordinate: 1541896.31

Hole Diameter Upper (in.): 13-5/8
Hole Diameter Lower (in.): 11-3/4
Surface Completion Type: Stick-up

Groundwater Levels BGS (ft):
At Time of Drilling: 488.00
At End of Drilling: Not Recorded
After Drilling: 488.50

Drillling Contractor: WDC Drilling
Drilling Method: Air Rotary Casing Hammer
Logged By: Patrick Ostrye

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
270					Silty SAND (SM); brown (7.5YR 5/4); moist; medium dense; 80% very fine to medium sand; 5% coarse sand; 15% silt.	SM		
275					Poorly graded SAND (SP); brown (7.5YR 5/4); moist; medium dense; 85% very fine to medium sand; 10% coarse sand; 5% silt and clay.	SP		New 20' connection @ 1110. Resumed drilling @ 1120.
280					Clayey SAND (SC); reddish brown (5YR 5/4); moist; medium dense; 70% very fine to fine sand; 20% clay; 10% silt; nonplastic.	SC		
285					Poorly graded SAND (SP); brown (7.5YR 5/4); moist; medium dense; 95% fine to medium sand; 5% silt and clay.		Cement Grout	
290					Poorly graded SAND (SP); brown (7.5YR 5/4); dry; medium dense; 100% fine to coarse sand.	SP		
295					Poorly graded SAND (SP); brown (7.5YR 5/4); dry; medium dense; 100% fine to coarse sand.			New 20' connection @ 1135. Resumed drilling @ 1150.
300								

Borehole ID: KAFB-106161

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB BFF SWMU ST-106 and SS-111
Project Number: 140705

Date Started: 2/6/2012
Date TD Reached: 2/9/2012
Date Completed: 2/23/2012

Ground Elevation AMSL (ft): 5345.8
Y Coordinate: 1473334.69
X Coordinate: 1541896.31

Hole Diameter Upper (in.): 13-5/8
Hole Diameter Lower (in.): 11-3/4
Surface Completion Type: Stick-up

Groundwater Levels BGS (ft):
At Time of Drilling: 488.00
At End of Drilling: Not Recorded
After Drilling: 488.50

Drillling Contractor: WDC Drilling
Drilling Method: Air Rotary Casing Hammer
Logged By: Patrick Ostrye

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
300					Clayey GRAVEL (GC); gravel lense with clay.	GC		Possible perched layer.
					Well graded SAND with Gravel (SW); reddish brown (5YR 4/4); moist; medium dense; 75% sand; 20% gravel to 10mm; angular to subangular; 5% silt and clay.	SW		
305					Poorly graded SAND (SP); reddish brown (5YR 4/4); moist; medium dense; 95% fine to medium sand; 5% very coarse sand.	SP		
310					Poorly graded SAND (SP); reddish brown (5YR 5/4); dry; medium dense; 85% very fine to medium sand; 10% coarse to very coarse sand; 5% silt and clay.			
					Well graded SAND with Gravel (SW); reddish brown (5YR 5/4); dry; medium dense to dense; 70% sand; 30% gravel to 12mm; angular to subangular.	SW	Cement Grout	Heavy bit chatter.
315								New 20' connection @ 1230. Resumed drilling @ 1445. Heavy bit chatter; added water to cyclone for dust suppression.
320					Well graded SAND with Gravel (SW); reddish brown (5YR 5/4); dry; medium dense to dense; 70% sand; 30% gravel to 15mm; angular to subangular.			
					Poorly graded SAND (SP); light reddish brown (5YR 6/3); dry; loose; 95% fine to medium sand; 5% coarse sand.	SP		
325								
330								

Borehole ID: KAFB-106161

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB BFF SWMU ST-106 and SS-111
Project Number: 140705

Date Started: 2/6/2012
Date TD Reached: 2/9/2012
Date Completed: 2/23/2012

Ground Elevation AMSL (ft): 5345.8
Y Coordinate: 1473334.69
X Coordinate: 1541896.31

Hole Diameter Upper (in.): 13-5/8
Hole Diameter Lower (in.): 11-3/4
Surface Completion Type: Stick-up

Groundwater Levels BGS (ft):
▽ At Time of Drilling: 488.00
▼ At End of Drilling: Not Recorded
▼ After Drilling: 488.50

Drillling Contractor: WDC Drilling
Drilling Method: Air Rotary Casing Hammer
Logged By: Patrick Ostrye

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
330					Poorly graded SAND (SP); reddish brown (5YR 5/4); dry; medium dense; 100% fine to very coarse sand.	SP		Heavy bit chatter.
335					Poorly graded SAND (SP); reddish brown (5YR 5/4); dry; medium dense; 97% fine to coarse sand; 3% very coarse sand.			New 20' connection @ 1505. Resumed drilling @ 1530. Heavy bit chatter; added water to cyclone for dust suppression.
340					Clayey SAND (SC); yellowish red (5YR 4/6); damp; medium dense; 60% very fine to very coarse sand; 40% clay; plastic.	SC	Cement Grout	
345					Poorly graded SAND (SP); light reddish brown (5YR 6/3); dry; loose; 80% very fine to medium sand; 15% coarse to very coarse sand; 5% gravel to 10mm; subrounded.	SP		
					Poorly graded GRAVEL (GP); lense; gravel to 20mm; subangular to rounded.	GP		
350					Poorly graded SAND (SP); reddish brown (5YR 4/4); dry; loose; 95% very fine to very coarse sand; 5% silt and clay.	SP		
355					Well graded SAND (SW); brown (7.5YR 4/3); dry; loose; 95% sand; 5% silt and clay.	SW	Top of Bentonite Seal	New 20' connection @ 1550. Resumed drilling @ 1600.
360								

Borehole ID: KAFB-106161

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB BFF SWMU ST-106 and SS-111
Project Number: 140705

Date Started: 2/6/2012
Date TD Reached: 2/9/2012
Date Completed: 2/23/2012

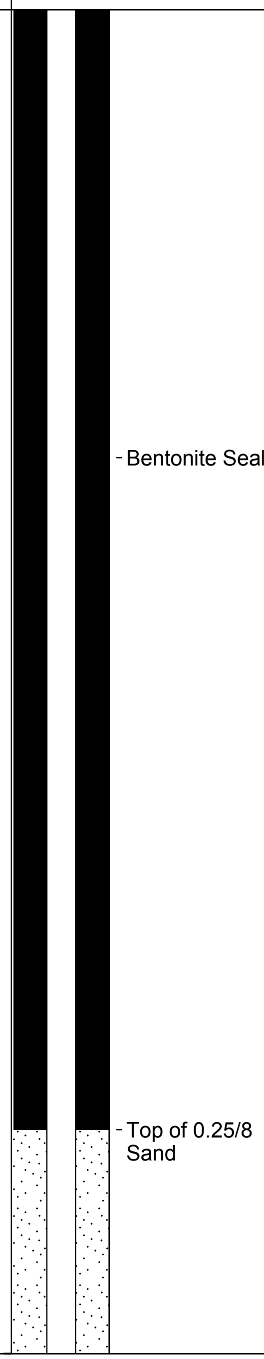
Ground Elevation AMSL (ft): 5345.8
Y Coordinate: 1473334.69
X Coordinate: 1541896.31

Hole Diameter Upper (in.): 13-5/8
Hole Diameter Lower (in.): 11-3/4
Surface Completion Type: Stick-up

Groundwater Levels BGS (ft):
▽ At Time of Drilling: 488.00
▼ At End of Drilling: Not Recorded
▼ After Drilling: 488.50

Drillling Contractor: WDC Drilling
Drilling Method: Air Rotary Casing Hammer
Logged By: Patrick Ostrye

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
360					Poorly graded SAND (SP); reddish brown (5YR 4/4); dry; medium dense; 95% fine to coarse sand; 5% silt and clay.			
365					Poorly graded SAND with Gravel (SP); brown (7.5YR 4/4); dry; dense; 60% fine to very coarse sand; 40% gravel to 12mm; subangular to subrounded.			
370					Poorly graded SAND (SP); brown (7.5YR 5/4); dry; medium dense; 90% medium to very coarse sand; 10% gravel to 10mm; subrounded to rounded.		Bentonite Seal	
375					Poorly graded SAND (SP); brown (7.5YR 5/4); dry; medium dense; 95% fine to coarse sand; 5% very coarse sand.	SP		New 20' connection @ 1632. Resumed drilling @ 1645. Added water to cyclone for dust suppression.
380					Poorly graded SAND (SP); wet; medium dense; 100% fine to coarse sand.			
385					Poorly graded SAND (SP); wet; medium dense; 100% medium to very coarse sand.		Top of 0.25/8 Sand	
390								



Borehole ID: KAFB-106161

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB BFF SWMU ST-106 and SS-111
Project Number: 140705

Date Started: 2/6/2012
Date TD Reached: 2/9/2012
Date Completed: 2/23/2012

Ground Elevation AMSL (ft): 5345.8
Y Coordinate: 1473334.69
X Coordinate: 1541896.31

Hole Diameter Upper (in.): 13-5/8
Hole Diameter Lower (in.): 11-3/4
Surface Completion Type: Stick-up

Groundwater Levels BGS (ft):
At Time of Drilling: 488.00
At End of Drilling: Not Recorded
After Drilling: 488.50

Drillling Contractor: WDC Drilling
Drilling Method: Air Rotary Casing Hammer
Logged By: Patrick Ostrye

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
390					Poorly graded SAND (SP); brown (7.5YR 5/4); damp; medium dense; 95% fine to medium sand; 5% coarse sand.	SP	Top of 0.050 Slot Screen	Added water to cyclone for dust suppression.
395					Poorly graded SAND with Gravel (SP); brown (7.5YR 5/4); wet; medium dense; 85% fine to very coarse sand; 15% gravel to 5mm; subangular to subrounded.	SP		End of 2/8/12. Resumed drilling @ 0815 on 2/9/12.
400					Well graded SAND (SW); brown (7.5YR 5/4); dry; medium dense; 100% sand.	SW		
405					Poorly graded SAND (SP); brown (7.5YR 5/4); dry; medium sand; 100% fine to coarse sand. Note: gravel lense at 408 ft; 1 ft thick.	SP		
410					Poorly graded SAND (SP); brown (7.5YR 5/4); dry; medium sand; 100% medium to coarse sand.	SP		
415					Poorly graded SAND (SP); brown (7.5YR 5/4); moist; medium dense; 80% fine to coarse sand; 10% very coarse sand; 10% gravel to 10mm; subangular to subrounded.	SP		New 20' connection @ 0837. Resumed drilling @ 0913.
420								

Borehole ID: KAFB-106161

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB BFF SWMU ST-106 and SS-111
Project Number: 140705

Date Started: 2/6/2012
Date TD Reached: 2/9/2012
Date Completed: 2/23/2012

Ground Elevation AMSL (ft): 5345.8
Y Coordinate: 1473334.69
X Coordinate: 1541896.31

Hole Diameter Upper (in.): 13-5/8
Hole Diameter Lower (in.): 11-3/4
Surface Completion Type: Stick-up

Groundwater Levels BGS (ft):
∇ At Time of Drilling: 488.00
▼ At End of Drilling: Not Recorded
▼ After Drilling: 488.50

Drillling Contractor: WDC Drilling
Drilling Method: Air Rotary Casing Hammer
Logged By: Patrick Ostrye

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
420					Poorly graded SAND (SP); brown (7.5YR 4/4); damp; medium dense; 90% fine to coarse sand; 10% very coarse sand.	SP		
425					Poorly graded SAND (SP); brown (7.5YR 4/4); damp; medium dense; 94% fine to coarse sand; 3% very coarse sand; 3% gravel to 5mm; subrounded to rounded.		0.050 Slot Screen	
430					Poorly graded SAND with Gravel (SP); brown (7.5YR 4/4); moist; medium dense; 85% very fine to very coarse sand; 15% gravel to 10mm; subangular to subrounded.			
435					Well graded SAND with Gravel (SW); brown (7.5YR 4/4); moist; medium dense; 85% sand; 15% gravel to 15mm; angular to subrounded.	SW		New 20' connection @ 0935. Resumed drilling @ 0943.
440					Poorly graded SAND (SP); brown (7.5YR 4/4); moist; medium dense; 92% fine to coarse sand; 5% very coarse sand; 3% gravel to 5mm; angular to subrounded.	SP	Bottom of Screen; Top of Bentonite Seal	
445					Poorly graded SAND (SP); strong brown (7.5YR 4/6); moist; medium dense; 91% very fine to medium sand; 3% coarse to very coarse sand; 1% gravel to 10mm; angular to rounded; 5% silt and clay.		Top of 0.25/8 Sand	Petroleum odor from cyclone; breathing zone 0.0 ppm.
450								

Borehole ID: KAFB-106161

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB BFF SWMU ST-106 and SS-111
Project Number: 140705

Date Started: 2/6/2012
Date TD Reached: 2/9/2012
Date Completed: 2/23/2012

Ground Elevation AMSL (ft): 5345.8
Y Coordinate: 1473334.69
X Coordinate: 1541896.31

Hole Diameter Upper (in.): 13-5/8
Hole Diameter Lower (in.): 11-3/4
Surface Completion Type: Stick-up

Groundwater Levels BGS (ft):
At Time of Drilling: 488.00
At End of Drilling: Not Recorded
After Drilling: 488.50

Drillling Contractor: WDC Drilling
Drilling Method: Air Rotary Casing Hammer
Logged By: Patrick Ostrye

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
450					Poorly graded SAND (SP); brown (7.5YR 5/4); moist; medium dense; 97% very fine to medium sand; 3% coarse to very coarse sand; odor.	SP	Top of 0.050 Slot Screen	
455					Poorly graded SAND (SP); brown (7.5YR 5/4); moist; medium dense; 94% very fine to medium sand; 5% coarse to very coarse sand; 1% gravel to 10mm; angular to subrounded; odor.	SP		New 20' connection @ 1007. Resumed drilling @ 1020.
460					Well graded SAND (SW); brown (7.5YR 5/4); moist; medium dense; 90% sand; 10% gravel to 5mm; angular to subrounded; odor.	SW		
465					Poorly graded SAND (SP); strong brown (7.5YR 4/6); moist; medium dense; 94% very fine to medium sand; 5% coarse to very coarse sand; 1% gravel to 8mm; angular to subangular; odor.	SP		
470					Poorly graded SAND (SP); brown (7.5YR 5/4); dry; medium dense; 100% very fine to very coarse sand; odor.	SP		
475					Poorly graded SAND (SP); brown (7.5YR 5/4); dry; medium dense to dense; 95% very fine to medium sand; 5% coarse sand; odor.	SP		New 20' connection @ 1040. Resumed drilling @ 1057.
480								

Borehole ID: KAFB-106161

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB BFF SWMU ST-106 and SS-111
Project Number: 140705

Date Started: 2/6/2012
Date TD Reached: 2/9/2012
Date Completed: 2/23/2012

Ground Elevation AMSL (ft): 5345.8
Y Coordinate: 1473334.69
X Coordinate: 1541896.31

Hole Diameter Upper (in.): 13-5/8
Hole Diameter Lower (in.): 11-3/4
Surface Completion Type: Stick-up

Groundwater Levels BGS (ft):
At Time of Drilling: 488.00
At End of Drilling: Not Recorded
After Drilling: 488.50

Drillling Contractor: WDC Drilling
Drilling Method: Air Rotary Casing Hammer
Logged By: Patrick Ostrye

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
480–485					Poorly graded SAND (SP); light brown (7.5YR 6/3); dry; medium dense; 100% coarse to very coarse sand.	SP		
485–488					Well graded SAND with Gravel (SW); light brown (7.5YR 6/3); dry; medium dense to dense; 80% sand; 20% gravel to 12mm; angular to subangular.	SW		
488–500					Poorly graded SAND with Gravel (SP); brown (7.5YR 4/4); damp; dense; 75% medium to fine sand; 10% coarse to very coarse sand; 15% gravel to 15mm; subangular to subrounded.	SP	Bottom of 0.050 Slot Screen / Top of 0.030 Slot Screen	
					Poorly graded SAND (SP); brown (7.5YR 4/3); damp; dense; 90% fine to very coarse sand; 10% gravel to 10mm; subangular to subrounded.			New 20' connection @ 1140. Resumed drilling @ 1255.
500–505					No cuttings returned.			
505–510					No cuttings returned.			

Borehole ID: KAFB-106161

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB BFF SWMU ST-106 and SS-111
Project Number: 140705

Date Started: 2/6/2012
Date TD Reached: 2/9/2012
Date Completed: 2/23/2012

Ground Elevation AMSL (ft): 5345.8
Y Coordinate: 1473334.69
X Coordinate: 1541896.31

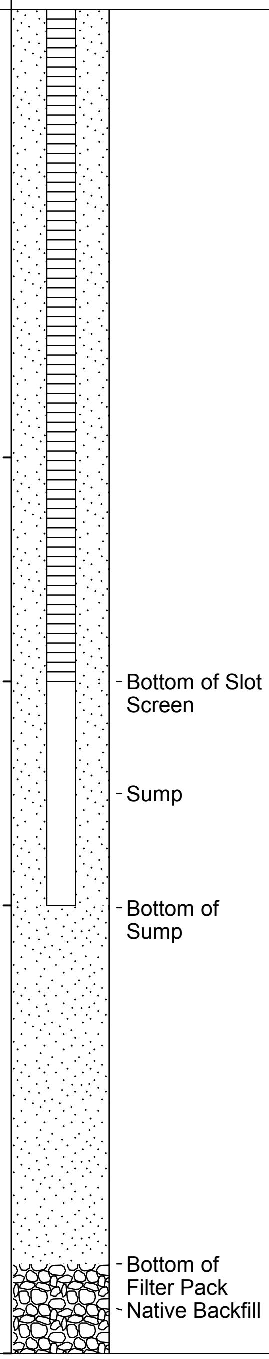
Hole Diameter Upper (in.): 13-5/8
Hole Diameter Lower (in.): 11-3/4
Surface Completion Type: Stick-up

Groundwater Levels BGS (ft):
At Time of Drilling: 488.00
At End of Drilling: Not Recorded
After Drilling: 488.50

Drillling Contractor: WDC Drilling
Drilling Method: Air Rotary Casing Hammer
Logged By: Patrick Ostrye

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Remarks
510					No cuttings returned.		
515					No cuttings returned.		New 20' connection @ 1340. Resumed drilling @ 1355.
520					Well graded SAND with Gravel (SW); saturated; dense; 75% sand; 20% gravel to 20mm; subangular to subrounded; 5% silt and clay.	SW	
525					Poorly graded GRAVEL with Sand (GP); saturated; dense; 80% gravel to 20mm; angular to rounded; 20% medium to very coarse sand. Note: gravel is composed of quartz, chert, limestone, and granite.	GP	
530					Silty SAND (SM); saturated; dense; 72% very fine to medium sand; 10% coarse to very coarse sand; 3% gravel to 10mm; angular to subangular; 15% silt.	SM	
535					Silty SAND (SM); saturated; dense; 79% very fine to medium sand; 5% coarse to very coarse sand; 1% gravel to 5mm; subangular; 15% silt.	SM	
540							

Well Diagram



Borehole ID: KAFB-106161

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB BFF SWMU ST-106 and SS-111
Project Number: 140705

Date Started: 2/6/2012
Date TD Reached: 2/9/2012
Date Completed: 2/23/2012

Ground Elevation AMSL (ft): 5345.8
Y Coordinate: 1473334.69
X Coordinate: 1541896.31

Hole Diameter Upper (in.): 13-5/8
Hole Diameter Lower (in.): 11-3/4
Surface Completion Type: Stick-up

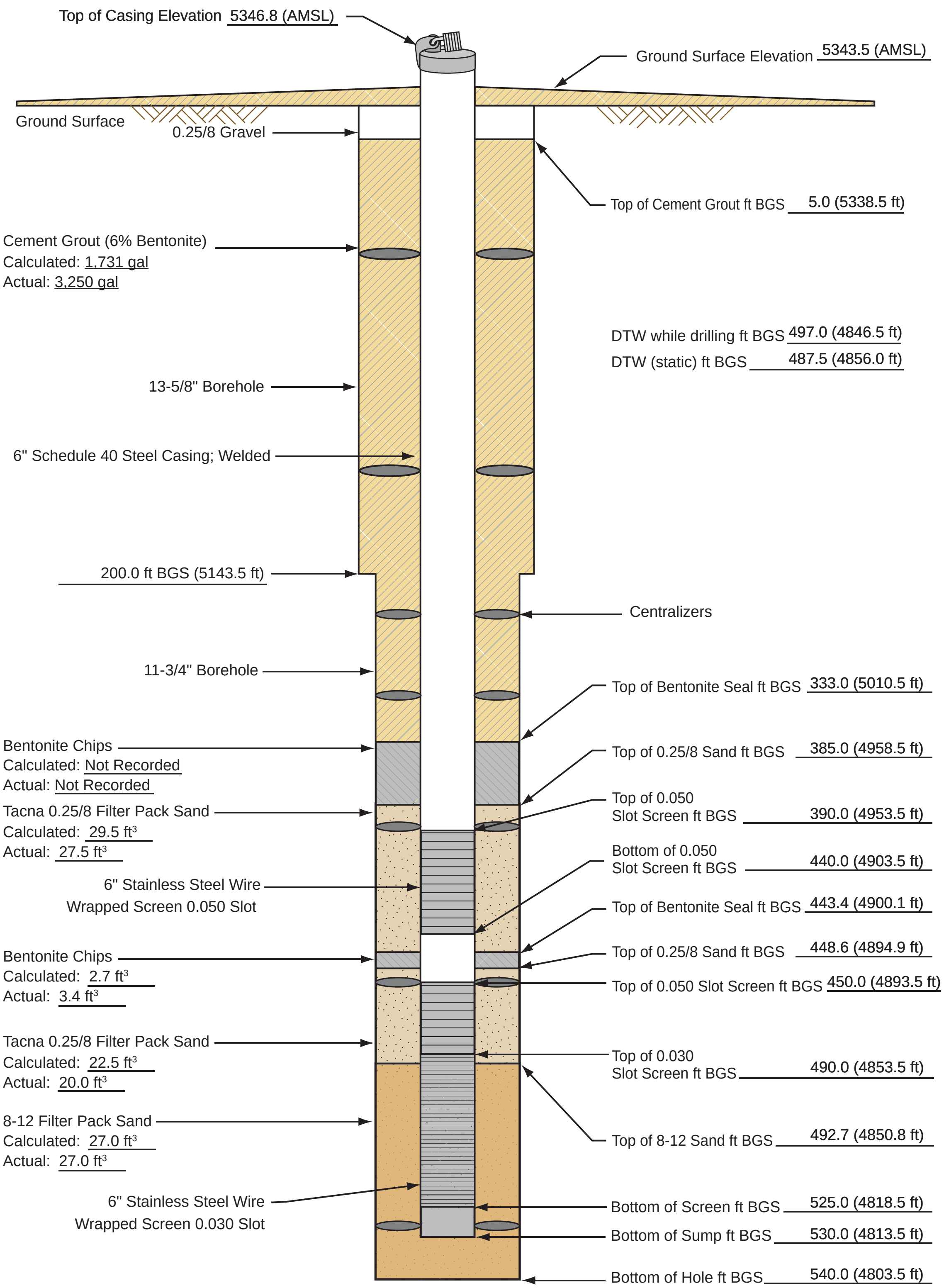
Groundwater Levels BGS (ft):
At Time of Drilling: 488.00
At End of Drilling: Not Recorded
After Drilling: 488.50

Drillling Contractor: WDC Drilling
Drilling Method: Air Rotary Casing Hammer
Logged By: Patrick Ostrye

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
540					Silty SAND (SM); saturated; dense; 80% very fine to medium sand; 20% silt.	SM	Native Backfill	
545					Same as above (540 ft).			
548								Total Depth = 548 ft. Reached @ 1513 on 2/9/12. Water added during drilling (gallons) = 0 Water added after drilling (gallons) = 550
550								
555								
560								
565								
570								

Soil Vapor Extraction Well KAFB-106160

Installation Start Date/Time: 2/29/2012 @ 0930
Installation End Date/Time: 3/5/2012 @ 1700



(4,816.90) = *Elevations are NAVD 88 Datum values based on NGS Control Station "Hanger", Elevation = 5,343.43 ft. GPS/RTK methods and GEO1D99 model were used to determine elevations of all surveyed points.*

Not to Scale
BGS = Below Ground Surface

140705.FB010010_SVE_KAFB_106160

Borehole ID: KAFB-106160

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB BFF SWMU ST-106 and SS-111
Project Number: 140705

Date Started: 2/23/2012
Date TD Reached: 2/27/2012
Date Completed: 3/5/2012

Ground Elevation AMSL (ft): 5343.5
Y Coordinate: 1473283.34
X Coordinate: 1541593.17

Hole Diameter Upper (in.): 13-5/8
Hole Diameter Lower (in.): 11-3/4
Surface Completion Type: Stick-up

Groundwater Levels BGS (ft):
∇ At Time of Drilling: 497.00
▼ At End of Drilling: Not Recorded
▼ After Drilling: 487.50

Drillling Contractor: WDC Drilling
Drilling Method: Air Rotary Casing Hammer
Logged By: Patrick Ostrye

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
0					No description recorded.		Cement	Hand augered.
5					No description recorded.		Top of Cement Grout	Began drilling @ 1405 on 2/23/12.
8					Silty SAND (SM); red (2.5YR 4/6); moist; very loose; 65% very fine to medium sand; 5% coarse to very coarse sand; 10% gravel to 10mm; angular to rounded; 20% silt.	SM		Larger clasts are caliche coated.
15					Silty SAND (SM); red (2.5YR 4/8); moist; very loose; 67% very fine to medium sand; 3% coarse sand; 5% gravel to 12mm; angular to subrounded; 20% silt; 5% clay.	SM		New 20' connection @ 1418. Resumed drilling @ 1427.
20					Silty SAND (SM); red (2.5YR 4/6); dry; very loose; 66% very fine to medium sand; 3% coarse to very coarse sand; 1% gravel to 8mm; angular to subrounded; 30% silt.	SM		
25					Silty SAND (SM); red (2.5YR 4/8); moist; very loose; 65% very fine to medium sand; 5% coarse to very coarse sand; 30% silt.	SM		
30								

Borehole ID: KAFB-106160

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB BFF SWMU ST-106 and SS-111
Project Number: 140705

Date Started: 2/23/2012
Date TD Reached: 2/27/2012
Date Completed: 3/5/2012

Ground Elevation AMSL (ft): 5343.5
Y Coordinate: 1473283.34
X Coordinate: 1541593.17

Hole Diameter Upper (in.): 13-5/8
Hole Diameter Lower (in.): 11-3/4
Surface Completion Type: Stick-up

Groundwater Levels BGS (ft):
▽ At Time of Drilling: 497.00
▼ At End of Drilling: Not Recorded
▼ After Drilling: 487.50

Drillling Contractor: WDC Drilling
Drilling Method: Air Rotary Casing Hammer
Logged By: Patrick Ostrye

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
30					Silty SAND (SM); red (2.5YR 4/8); moist; very loose; 70% very fine to medium sand; 30% silt.			
35					Silty SAND (SM); red (2.5YR 4/6); moist; very loose; 66% very fine to medium sand; 3% coarse to very coarse sand; 1% gravel to 8mm; subangular to subrounded; 30% silt.			New 20' connection @ 1438. Resumed drilling @ 1446.
40					Silty SAND (SM); red (2.5YR 4/6); moist; very loose; 64% very fine to medium sand; 5% coarse to very coarse sand; 1% gravel to 5mm; angular to subangular; 30% silt.			
45					Silty SAND (SM); red (2.5YR 4/8); moist; loose; 60% very fine to medium sand; 10% coarse to very coarse sand; 5% gravel to 15mm; subangular to subrounded; 25% silt.	SM	Cement Grout	
50					Silty SAND (SM); red (2.5YR 4/6); moist; loose; 64% very fine to medium sand; 10% coarse to very coarse sand; 1% gravel to 8mm; angular; 25% silt.			
55					Silty SAND (SM); yellowish red (5YR 4/6); moist; loose; 80% very fine to coarse sand; 5% very coarse sand; 15% silt.			New 20' connection @ 1504. Cleaned out cyclone. Resumed drilling @ 1520.
60								

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 4/30/12 13:38 - Z:\KAFB BFF\GINT\KAFB_PROJECT\KAFB_BFF.GPJ

Borehole ID: KAFB-106160

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB BFF SWMU ST-106 and SS-111
Project Number: 140705

Date Started: 2/23/2012
Date TD Reached: 2/27/2012
Date Completed: 3/5/2012

Ground Elevation AMSL (ft): 5343.5
Y Coordinate: 1473283.34
X Coordinate: 1541593.17

Hole Diameter Upper (in.): 13-5/8
Hole Diameter Lower (in.): 11-3/4
Surface Completion Type: Stick-up

Groundwater Levels BGS (ft):
At Time of Drilling: 497.00
At End of Drilling: Not Recorded
After Drilling: 487.50

Drillling Contractor: WDC Drilling
Drilling Method: Air Rotary Casing Hammer
Logged By: Patrick Ostrye

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
60					Silty SAND (SM); red (2.5YR 4/6); moist; loose; 73% very fine to medium sand; 1% coarse to very coarse sand; 1% gravel to 10mm; subangular to subrounded; 25% silt.			
65					Silty SAND (SM); red (2.5YR 4/6); moist; loose; 70% very fine to medium sand; 5% coarse to very coarse sand; 25% silt.			
70					Silty SAND (SM); red (2.5YR 4/8); moist; loose; 62% very fine to medium sand; 3% gravel to 20mm; angular to subangular; 25% silt; 10% clay; nonplastic.			
75					Silty SAND (SM); red (2.5YR 4/6); moist; loose; 60% very fine to medium sand; 40% silt.	SM	Cement Grout	New 20' connection @ 1530. Resumed drilling @ 1540.
80					Silty SAND (SM); red (2.5YR 4/6); moist; loose; 62% very fine to medium sand; 3% coarse sand; 35% silt.			
85					Silty SAND (SM); red (2.5YR 4/6); moist; loose; 65% very fine to medium sand; 5% coarse sand; 25% silt; 5% clay.			
90								

Borehole ID: KAFB-106160

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB BFF SWMU ST-106 and SS-111
Project Number: 140705

Date Started: 2/23/2012
Date TD Reached: 2/27/2012
Date Completed: 3/5/2012

Ground Elevation AMSL (ft): 5343.5
Y Coordinate: 1473283.34
X Coordinate: 1541593.17

Hole Diameter Upper (in.): 13-5/8
Hole Diameter Lower (in.): 11-3/4
Surface Completion Type: Stick-up

Groundwater Levels BGS (ft):
At Time of Drilling: 497.00
At End of Drilling: Not Recorded
After Drilling: 487.50

Drillling Contractor: WDC Drilling
Drilling Method: Air Rotary Casing Hammer
Logged By: Patrick Ostrye

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
90–95					Silty SAND (SM); reddish brown (2.5YR 4/4); moist; loose; 60% very fine to medium sand; 40% silt.	SM		
95–100					Poorly graded SAND (SP); reddish brown (5YR 5/4); moist; loose; 95% very fine to medium sand; 5% silt.	SP		New 20' connection @ 1600. Resumed drilling @ 1610.
100					Silty SAND (SM); red (2.5YR 4/6); moist; loose; 62% very fine to medium sand; 3% coarse to very coarse sand; 35% silt.	SM		
105					Silty SAND (SM); red (2.5YR 4/8); moist; loose; 64% very fine to medium sand; 1% coarse sand; 25% silt; 10% clay; nonplastic.	SM	Cement Grout	
110					Silty SAND (SM); red (2.5YR 4/6); moist; loose; 65% very fine to medium sand; 5% coarse to very coarse sand; 30% silt.	SM		
115–120					Silty SAND (SM); red (2.5YR 4/6); moist; loose; 55% very fine to medium sand; 35% silt; 10% clay; nonplastic.	SM		New 20' connection @ 1623. Cleaned out cyclone. Resumed drilling @ 1645.

Borehole ID: KAFB-106160

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB BFF SWMU ST-106 and SS-111
Project Number: 140705

Date Started: 2/23/2012
Date TD Reached: 2/27/2012
Date Completed: 3/5/2012

Ground Elevation AMSL (ft): 5343.5
Y Coordinate: 1473283.34
X Coordinate: 1541593.17

Hole Diameter Upper (in.): 13-5/8
Hole Diameter Lower (in.): 11-3/4
Surface Completion Type: Stick-up

Groundwater Levels BGS (ft):
At Time of Drilling: 497.00
At End of Drilling: Not Recorded
After Drilling: 487.50

Drillling Contractor: WDC Drilling
Drilling Method: Air Rotary Casing Hammer
Logged By: Patrick Ostrye

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
120					Silty SAND (SM); red (2.5YR 4/6); moist; loose; 55% very fine to medium sand; 35% silt; 10% clay; nonplastic.	SM		
					No cuttings returned.			Clay clogged discharge hose.
125					Clayey SAND (SC); reddish brown (5YR 4/4); moist; loose; 50% very fine to fine sand; 10% medium sand; 30% clay; 10% silt; nonplastic.	SC		
130					Silty SAND (SM); yellowish red (5YR 4/6); damp; loose; 70% very fine to medium sand; 30% silt.			Cuttings stuck in hose.
135					Same as above (130 ft).	SM	Cement Grout	End of 2/23/12. Resumed drilling @ 0745 on 2/24/12.
140					Poorly graded SAND (SP); reddish brown (5YR 4/4); damp to wet; loose; 95% fine to medium sand; 5% coarse sand; pumice.	SP		Possible perched water table. No odor.
145					No cuttings returned.			
150								

Borehole ID: KAFB-106160

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At End of Drilling: Not Recorded
After Drilling: 487.50

Drillling Contractor: WDC Drilling
Drilling Method: Air Rotary Casing Hammer
Logged By: Patrick Ostrye

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
150					Poorly graded SAND with Silt (SP-SM); reddish brown (5YR 4/4); damp; loose; 84% fine to medium sand; 5% coarse sand; 1% gravel to 10mm; subangular to rounded; 10% silt; no odor. Note: pumice.	SP-SM		
155					Poorly graded SAND (SP); reddish brown (5YR 4/4); damp; loose; 100% fine to medium sand; no odor.	SP		New 20' connection @ 0817. Cleaned out cyclone. Resumed drilling @ 0850.
160					Poorly graded SAND (SP); reddish brown (5YR 4/4); damp; loose; 99% fine to very coarse sand; 1% gravel to 5mm; angular to subrounded. Note: gravel is composed of pumice.			
165					Poorly graded SAND (SP); reddish brown (5YR 4/4); damp; loose; 85% fine to coarse sand; 10% very coarse sand; 5% gravel to 8mm; subrounded to rounded.		Cement Grout	
170					Poorly graded SAND (SP); reddish brown (5YR 4/4); damp; loose; 100% fine to coarse sand.			
175					Poorly graded SAND (SP); reddish brown (5YR 4/4); moist; loose; 95% fine to coarse sand; 5% very coarse sand.			New 20' connection @ 0920. Resumed drilling @ 0932.
180								

Borehole ID: KAFB-106160

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Hole Diameter Lower (in.): 11-3/4
Surface Completion Type: Stick-up

Groundwater Levels BGS (ft):
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▼ At End of Drilling: Not Recorded
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Drillling Contractor: WDC Drilling
Drilling Method: Air Rotary Casing Hammer
Logged By: Patrick Ostrye

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
180					Poorly graded SAND (SP); reddish brown (5YR 5/4); moist; loose; 90% very fine to medium sand; 5% coarse to very coarse sand; 5% silt and clay.			
185					Poorly graded SAND (SP); reddish brown (5YR 4/4); moist; loose; 85% very fine to coarse sand; 5% very coarse sand; 5% gravel to 8mm; subrounded to rounded; 5% silt and clay.			
190					Poorly graded SAND (SP); reddish brown (5YR 4/4); moist; loose; 100% fine to coarse sand.			
195					Poorly graded SAND with Gravel (SP); reddish brown (5YR 4/4); moist; loose; 85% fine to very coarse sand; 15% gravel to 10mm; angular to subrounded.	SP	Cement Grout	New 5' connection @ 0950. Resumed drilling @ 1002.
200					Poorly graded SAND (SP); reddish brown (5YR 4/4); damp; loose; 90% fine to medium sand; 10% coarse sand.			New connection @ 1010. Resumed drilling @ 1400.
205					Poorly graded SAND (SP); brown (7.5YR 5/4); dry; loose; 95% very fine to coarse sand; 5% silt and clay.			
210								

Borehole ID: KAFB-106160

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Hole Diameter Lower (in.): 11-3/4
Surface Completion Type: Stick-up

Groundwater Levels BGS (ft):
At Time of Drilling: 497.00
At End of Drilling: Not Recorded
After Drilling: 487.50

Drillling Contractor: WDC Drilling
Drilling Method: Air Rotary Casing Hammer
Logged By: Patrick Ostrye

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
210–215					Poorly graded GRAVEL with Sand (GP); reddish brown (5YR 4/4); moist; loose; 60% gravel to 20mm; subangular to rounded; 40% fine to very coarse sand. Note: gravel is composed of limestone, quartz, chert, and granite.	GP		
215–220					Poorly graded SAND with Gravel (SP); reddish brown (5YR 4/4); moist; loose; 75% fine to coarse sand; 10% very coarse sand; 15% gravel to 20mm; subangular to subrounded.	SP		New 20' connection @ 1411. Resumed drilling @ 1419.
220–230					Well graded SAND with Gravel (SW); reddish brown (5YR 4/4); moist; loose; 80% sand; 20% gravel to 10mm; angular to subrounded. Well graded SAND with Gravel (SW); reddish brown (5YR 5/4); moist; loose; 70% sand; 30% gravel to 15mm; subangular to rounded.	SW	Cement Grout	
230–240					Poorly graded SAND (SP); reddish brown (5YR 4/3); moist; loose; 85% fine to coarse sand; 5% very coarse sand; 10% gravel to 10mm; subrounded to rounded. Poorly graded SAND with Gravel (SP); reddish brown (5YR 4/3); moist; loose; 75% fine to coarse sand; 10% very coarse sand; 15% gravel to 20mm; subangular to rounded.	SP		New 20' connection @ 1436. Resumed drilling @ 1449.

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Hole Diameter Upper (in.): 13-5/8
Hole Diameter Lower (in.): 11-3/4
Surface Completion Type: Stick-up

Groundwater Levels BGS (ft):
∇ At Time of Drilling: 497.00
▼ At End of Drilling: Not Recorded
▼ After Drilling: 487.50

Drillling Contractor: WDC Drilling
Drilling Method: Air Rotary Casing Hammer
Logged By: Patrick Ostrye

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
240					Poorly graded SAND with Gravel (SP); brown (7.5YR 4/4); moist; loose; 75% fine to coarse sand; 5% very coarse sand; 20% gravel to 12mm; subangular to rounded.			
245					Poorly graded SAND (SP); brown (7.5YR 5/4); moist; loose; 99% fine to coarse sand; 1% gravel to 25mm; subrounded to rounded.			
250					Poorly graded SAND (SP); brown (7.5YR 5/4); moist; loose; 100% fine to coarse sand.			
255					Poorly graded SAND (SP); brown (7.5YR 5/4); moist; loose; 100% medium to very coarse sand. Note: some pumice.	SP	Cement Grout	New 20' connection @ 1503. Resumed drilling @ 1510.
260					Poorly graded SAND (SP); brown (7.5YR 5/4); moist; loose; 100% fine to coarse sand.			
265					Poorly graded SAND (SP); brown (7.5YR 4/4); damp; loose; 100% very fine to medium sand; no odor.			
270								

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 4/30/12 13:38 - Z:\KAFB BFF\GINT\KAFB_PROJECT\KAFB_BFF.GPJ

Borehole ID: KAFB-106160

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB BFF SWMU ST-106 and SS-111
Project Number: 140705

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At End of Drilling: Not Recorded
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Drilling Contractor: WDC Drilling
Drilling Method: Air Rotary Casing Hammer
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Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
270					Poorly graded SAND (SP); brown (7.5YR 4/4); damp; loose; 100% fine to coarse sand; strong odor.	SP		
275					Silty SAND (SM); brown (7.5YR 4/4); moist; loose; 70% very fine to fine sand; 20% silt; 10% clay; strong odor.	SM		New 20' connection @ 1525. Resumed drilling @ 1535. Breeze at drillers back.
280					Same as above (275 ft).	SM		
285					Well graded SAND (SW); brown (7.5YR 5/4); moist; loose; 95% sand; 5% silt and clay; slight odor.	SW	Cement Grout	
290					Same as above (285 ft); odor.	SW		
295					Same as above (285 ft); odor	SW		New 20' connection @ 1557 Resumed drilling @ 1605.
300								

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Y Coordinate: 1473283.34
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Hole Diameter Upper (in.): 13-5/8
Hole Diameter Lower (in.): 11-3/4
Surface Completion Type: Stick-up

Groundwater Levels BGS (ft):
At Time of Drilling: 497.00
At End of Drilling: Not Recorded
After Drilling: 487.50

Drillling Contractor: WDC Drilling
Drilling Method: Air Rotary Casing Hammer
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Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
300–305					Well graded SAND (SW); brown (7.5YR 5/4); dry; loose; 100% sand.	SW		Gravel lense.
305–310					Poorly graded SAND with Gravel (SP); brown (7.5YR 4/4); dry; medium dense; 75% fine to medium sand; 10% coarse to very coarse sand; 15% gravel to 10mm; angular to subrounded.	SP		
310–315					Well graded GRAVEL with Sand (GW); dry; medium dense; 70% gravel to 25mm; angular; 30% sand; well graded sand.	GW		
315–320					Poorly graded SAND (SP); brown (7.5YR 5/3); dry; medium dense; 97% very fine to coarse sand; 3% very coarse sand.	SP	Cement Grout	New 20' connection and resumed drilling @ 1644.
320–325					Poorly graded SAND (SP); brown (7.5YR 5/2); dry; medium dense; 100% fine to medium sand.	SP		
325–330					Poorly graded SAND (SP); brown (7.5YR 5/2); dry; medium dense; 90% fine to medium sand; 10% coarse to very coarse sand.	SP		

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Hole Diameter Upper (in.): 13-5/8
Hole Diameter Lower (in.): 11-3/4
Surface Completion Type: Stick-up

Groundwater Levels BGS (ft):
▽ At Time of Drilling: 497.00
▼ At End of Drilling: Not Recorded
▼ After Drilling: 487.50

Drillling Contractor: WDC Drilling
Drilling Method: Air Rotary Casing Hammer
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Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
330					Poorly graded SAND (SP); brown (7.5YR 5/2); dry; medium dense; 85% fine to medium sand; 15% coarse to very coarse sand.		Cement Grout; Top of Bentonite Seal	
335					Same as above (330 ft).			End of 2/24/12. Resumed drilling @ 0800 on 2/27/12.
340					Poorly graded SAND with Gravel (SP); brown (7.5YR 5/2); dry; medium dense; 75% fine to coarse sand; 10% very coarse sand; 15% gravel to 10mm; angular to subrounded.			
345					Poorly graded SAND (SP); brown (7.5YR 5/2); dry; medium dense; 100% fine to very coarse sand.	SP		
350					Poorly graded SAND (SP); brown (7.5YR 5/3); moist; medium dense; 90% fine to medium sand; 10% coarse to very coarse sand.			
355					Poorly graded SAND (SP); brown (7.5YR 5/3); dry; medium dense; 100% fine to coarse sand.			New 20' connection @ 0820. Resumed drilling @ 0920.
360								

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Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
360					Poorly graded SAND (SP); brown (7.5YR 5/3); dry; medium dense; 95% fine to very coarse sand; 5% gravel to 8mm; angular to subangular.			
365					Same as above (360 ft).			
370					Poorly graded SAND (SP); brown (7.5YR 5/3); dry; medium dense; 95% fine to coarse sand; 5% very coarse sand.		Bentonite Seal	
375					Same as above (370 ft).	SP		New 20' connection @ 0955. Resumed drilling @ 1015.
380					Poorly graded SAND (SP); brown (7.5YR 5/3); dry; medium dense; 100% fine to medium sand.			
385					Poorly graded SAND with Gravel (SP); brown (7.5YR 5/3); dry; medium dense; 75% fine to medium sand; 10% coarse to very coarse sand; 15% gravel to 15mm; angular to subangular.		Top of 0.25/8 Sand	
390								

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Logged By: Patrick Ostrye

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
390					Well graded SAND (SW); brown (7.5YR 4/4); dry; medium dense; 90% sand; 5% gravel to 5mm; angular to subrounded; 5% silt and clay.	SW	Top of 0.050 Slot Screen	
395					Silty SAND (SM); yellowish red (5YR 4/6); moist; medium dense; 70% very fine to medium sand; 10% coarse to very coarse sand; 20% silt.	SM		New 20' connection @ 1032. Resumed drilling @ 1043.
400					Poorly graded SAND (SP); light brown (7.5YR 6/4); moist; medium dense; 95% very fine to medium sand; 5% silt and clay.	SP		
405					Poorly graded SAND (SP); light brown (7.5YR 6/4); moist; medium dense; 95% very fine to fine sand; 5% silt and clay.			
410					Poorly graded SAND (SP); brown (7.5YR 5/3); dry; medium dense; 95% fine to coarse sand; 5% very coarse sand.			
415					Same as above (410 ft).			New 20' connection @ 1107. Resumed drilling @ 1120.
420								

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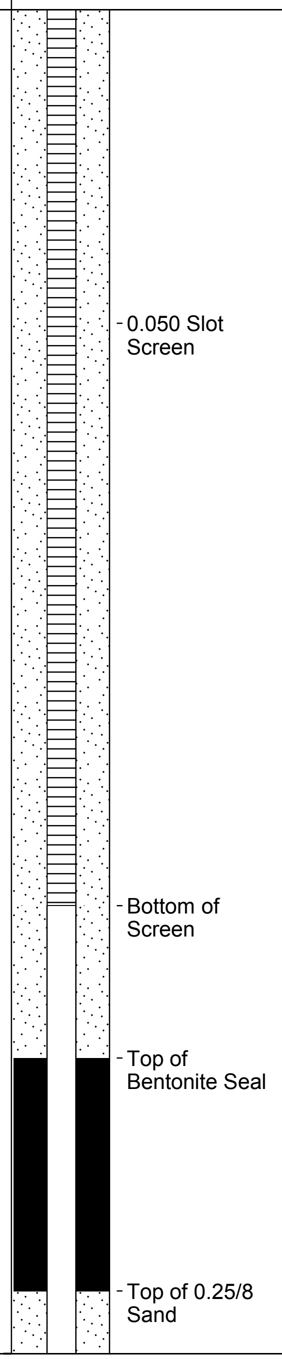
Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Remarks
420					Poorly graded SAND (SP); brown (7.5YR 5/3); dry; medium dense; 100% fine to coarse sand.		
425					Poorly graded SAND (SP); brown (7.5YR 5/3); dry; medium dense; 100% fine to medium sand.		
430					Poorly graded SAND (SP); brown (7.5YR 4/3); dry; medium dense; 80% very fine to medium sand; 10% coarse to very coarse sand; 5% gravel to 5mm; angular; 5% silt and clay.		
435					Poorly graded SAND with Gravel (SP); brown (7.5YR 4/4); moist; medium dense; 75% very fine to medium sand; 5% coarse to very coarse sand; 15% gravel to 12mm; angular to rounded; 5% silt and clay.	SP	New 20' connection @ 1145. Resumed drilling @ 1245.
440					Poorly graded SAND (SP); brown (7.5YR 5/4); moist; medium dense; 90% fine to medium sand; 10% coarse sand; slight odor.		
445					Same as above (440 ft); 15% coarse sand; slight odor.		
450							

Well Diagram



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Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
450					Poorly graded SAND (SP); brown (7.5YR 5/4); dry; medium dense; 100% fine to medium sand.		Top of 0.050 Slot Screen	
455					Poorly graded SAND (SP); brown (7.5YR 4/3); moist; medium dense; 85% fine to medium sand; 10% coarse sand; 5% silt and clay.			New 20' connection @ 1313. Resumed drilling @ 1322.
460					Poorly graded SAND (SP); brown (7.5YR 5/3); moist; medium dense; 100% fine to coarse sand.			
					Poorly graded SAND with Gravel (SP); light brown (7.5YR 6/3); dry; medium dense; 85% fine to very coarse sand; 15% gravel to 10mm; angular to subrounded.	SP		
465								
470					Poorly graded SAND (SP); brown (7.5YR 5/3); dry; medium dense; 90% fine to coarse sand; 10% very coarse sand.			
475					Poorly graded SAND with Gravel (SP); light brown (7.5YR 6/3); dry; medium dense; 70% very fine to very coarse sand; 25% gravel to 10mm; angular to subrounded; 5% silt and clay.			New 20' connection @ 1350. Resumed drilling @ 1400.
480								

Borehole ID: KAFB-106160

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Drilling Method: Air Rotary Casing Hammer
Logged By: Patrick Ostrye

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
480					Poorly graded SAND (SP); brown (7.5YR 4/4); damp; medium dense; 100% fine to coarse sand; strong odor.	SP		
485					Poorly graded SAND (SP); brown (7.5YR 4/4); dry to moist; medium dense; 85% very fine to medium sand; ▼15% coarse sand.			
490					Well graded SAND (SW); brown (7.5YR 4/4); moist; medium dense; 95% sand; 5% silt and clay.	SW	Bottom of 0.050 Slot Screen / Top of 0.030 Slot Screen	
495					Poorly graded SAND (SP); brown (7.5YR 4/4); moist; medium dense; 95% ▽very fine to coarse sand; 5% silt and clay.	SP		New 20' connection @ 1439. Resumed drilling @ 1445.
500					Clayey SAND with Gravel (SC); dark brown (7.5YR 3/4); damp; dense; 60% fine to very coarse sand; 25% gravel to 24mm; subangular to subrounded; 15% clay; nonplastic.	SC		
505					Poorly graded SAND (SP); brown (7.5YR 4/4); damp; dense; 90% fine to very coarse sand; 5% gravel to 10mm; angular to subrounded; 5% silt and clay.	SP		
510								

Borehole ID: KAFB-106160

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB BFF SWMU ST-106 and SS-111
Project Number: 140705

Date Started: 2/23/2012
Date TD Reached: 2/27/2012
Date Completed: 3/5/2012

Ground Elevation AMSL (ft): 5343.5
Y Coordinate: 1473283.34
X Coordinate: 1541593.17

Hole Diameter Upper (in.): 13-5/8
Hole Diameter Lower (in.): 11-3/4
Surface Completion Type: Stick-up

Groundwater Levels BGS (ft):
At Time of Drilling: 497.00
At End of Drilling: Not Recorded
After Drilling: 487.50

Drillling Contractor: WDC Drilling
Drilling Method: Air Rotary Casing Hammer
Logged By: Patrick Ostrye

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
510–515					Poorly graded SAND (SP); brown (7.5YR 4/4); damp; dense; 99% medium to very coarse sand; 1% gravel to 8mm; angular to subangular.	SP		Heavy bit chatter. Drive casing locked @ 1510. Unlocked @ 1525.
515–520					Silty SAND with Gravel (SM); brown (7.5YR 4/3); saturated; dense; 65% very fine to very coarse sand; 15% gravel to 10mm; subangular to subrounded; 20% silt.	SM		New 20' connection @ 1531. Resumed drilling @ 1540.
520					No cuttings returned.			
525					No cuttings returned.		Bottom of Slot Screen	
							Sump	
530					No cuttings returned.		Bottom of Sump	
535					No cuttings returned.		Filter Pack	New connection @ 1630. Resumed drilling @ 1636.
540								

Borehole ID: KAFB-106160

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB BFF SWMU ST-106 and SS-111
Project Number: 140705

Date Started: 2/23/2012
Date TD Reached: 2/27/2012
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Ground Elevation AMSL (ft): 5343.5
Y Coordinate: 1473283.34
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Hole Diameter Upper (in.): 13-5/8
Hole Diameter Lower (in.): 11-3/4
Surface Completion Type: Stick-up

Groundwater Levels BGS (ft):
▽ At Time of Drilling: 497.00
▼ At End of Drilling: Not Recorded
▼ After Drilling: 487.50

Drillling Contractor: WDC Drilling
Drilling Method: Air Rotary Casing Hammer
Logged By: Patrick Ostrye

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
540					No description recorded; cuttings saturated.		Bottom of Filter Pack; Native Backfill	
545								Total Depth = 544. Reached @ 1650 on 2/27/12. Water added after drilling = 700 gallons.
550								
555								
560								
565								
570								

APPENDIX B

Project Specifications and Drawings

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Normal Operation of SVE System

A detailed layout of the SVE blower skid and CATOX system is presented on Figure 2-3, and the process flow diagram for the system is shown on Figure 2-4.

SVE is the process of pulling fresh air through the subsurface soil to volatilize THC. The air/water knock-out tank will separate entrained water that is in the air stream. A lobed vacuum blower pulls the vapors from the individual recovery wells through the knock-out tank and to the blower, and then discharges at low pressure. The air will then be pushed through the CATOX for treatment. THC-laden air is drawn into the CATOX's fan and is discharged into the system's heat exchanger. The air passes through the tube side of the heat exchanger and into the burner, where the contaminated air is raised to the catalyst operating temperature of 600 degrees Fahrenheit (°F) (Figure 2-4). When the THC-laden air passes through the catalyst, an exothermic reaction takes place. The THC in the air stream are converted to carbon dioxide and water vapor. The unit is designed for 98 percent destruction of hydrocarbons.

On initial start-up and after any shutdown, the oxidizer must be started and heated up using an air stream of fresh air only because the oxidizer cannot destroy the THC until it reaches adequate temperatures, thus, the process stream cannot be passed through the unit during heat-up. The fresh air inlet is maintained open as a default position, and is always open during start-up. Moreover, during startup, there is a system valve at the inlet of the SVE blower (during the heatup cycle, this valve is shut), that isolates the CATOX unit from the SVE manifold and contaminated soil gas. During on-line operation, the system valve is opened, and the fresh air (dilution air) inlet is open to a greater or lesser degree depending on operating conditions.

The vacuum blower system can be started to pull vacuum from the wells. Upon start-up, all dilution air valves will be open, and using the VFD, the blower will be set at about 80 percent of maximum speed. SVE wells will be brought on-line by opening the valve for that well. Once preliminary readings of LEL are attained, dilution air at the SVE can be reduced. As new wells are brought on-line, the dilution valves at wellheads can be closed slightly without risking production of excessive liquid. The VFD on the blower motor can be used to adjust the vacuum applied to the well field. Higher speeds will increase the vacuum if all valve positions remain the same. Based on the expected initial conditions for the SVE wells, a blower speed of 80 percent of the maximum should give adequate flow and vacuum to the wells. The vacuum blower is interlocked with the high-high temperature on the discharge side of the vacuum blower. The blower system also will have a pumping oiler system. If the oil level reaches a low condition, it will shut down the vacuum blower.

As hydrocarbon loadings increase in the CATOX, the temperature of the air stream exiting the catalyst rises. The fresh air inlet, in turn, opens proportionally to dilute the THC level in the process stream to keep the catalyst outlet temperature from climbing to the safety shut-down point of 1,000 °F. As THC loadings decrease, the fresh air inlet, conversely, proportionally closes to lessen the amount of dilution to help maintain operating efficiency.

The CATOX system fan, with associated drive mechanism and controls, induces a negative pressure upstream of the oxidizer to serve as the major source of air into the system. It is sized to provide suitable flow through the system under all design conditions.

The oxidizer is equipped with an air heat-type burner that delivers up to 1,000,000-British Thermal Units-per-hour output from a natural gas source. Pilot gas feeds from the same ports as main gas to immediately merge, thus forming a common fire envelope.

The burner and its associated controls combust a fuel air mixture to provide the initial driving heat to the system. The controls include a modulating firing rate valve and temperature loop controller to modulate the volume of fuel going to the burner and the dilution air coming in through the system fan. The reactor vessel holding the catalyst modules has an inner liner constructed entirely of stainless steel. The inner liner is covered with 6 inches of high-temperature mineral wool insulation. It has an outer cabinet of 14-gauge, aluminized steel with a structural framework. The temperature set point for heating the process stream to catalyzing temperature is achieved by a loop control that governs the burner firing rate by sending a 4-20 milliamp control signal to the actuator, which modulates the gas inlet to the burner. It receives a thermo-couple input signal from the catalyst inlet area.

When the catalyst inlet temperature tends to decrease below the field-adjustable set point, the temperature-control loop drives the firing rate valve open to deliver more fuel to the burner to maintain the set point. Once the burner is lit, if at any time during burner operation the flame controller senses the lack of a flame or an unacceptably weak flame, the controller automatically and immediately closes the main fuel valves, thus turning off the burner. The control then locks out, thus requiring a manual reset before further burner operation is allowed. This safety feature prevents a buildup in the combustion chamber of uncombusted fuel.

As the THC pass through the catalyst, heat is given off, and a portion of this heat is passed to the inlet stream via the heat exchanger. If high THC loadings are present, the amount of heat given off by oxidation of the THC may alone be enough to maintain the catalyst inlet set point. Under this condition, the temperature-control loop moves the firing rate actuator to fully closed, since no additional heat is required. If the catalyst outlet temperature continues to rise, a separate controller begins opening the fresh air valve in order to keep this temperature below 1,000 °F.

The catalyst within the CATOX oxidizes the THC if the catalyst is at the minimum oxidizing temperature. The primary function of the control system of the catalyst is to bring it up to and maintain it at proper oxidizing temperature. This will limit the heat the catalyst receives to avoid damage to the catalyst, and to recover, to a certain extent, the heat given off by the catalytic reaction for use in maintaining catalyst operating temperature. The catalyst is a noble metal type; it is a class of precious metal catalyst consisting of special-purpose compositions of highly dispersed platinum and rhodium for performance and durability in catalyzed reactions. The catalyst breaks down the hydrocarbons into carbon dioxide and water in a range of 500 °F to 1,000 °F.

During normal operation, the liquid-transfer pump from the air/water knock-out drum should cycle on and off as liquids collect in the knock-out tank. During automatic operation, the transfer pump will start when water level in the knock-out tank rises above the high level. The pump will continue to operate until the water level in the knock-out tank drops below the low-level set point. If water level reaches high-high level in the knock-out tank, an interlock will trigger automatic shutdown of the vacuum blower. The vacuum blower cannot be started until the liquid level in the knock-out tank is reduced by pumping out.

SECTION 400513

PIPELINES, PROCESS PIPING

PART 1 GENERAL

1.1 SUMMARY

Section Includes:

1. Carbon steel piping system
2. Plastic piping system.
3. High-density polyethylene (HDPE).
4. Trench systems

1.2 SYSTEM DESCRIPTION

This specification covers the requirements for above grade process pipe, pipe supports, fittings, equipment and accessories from the Soil Vapor Extraction (SVE) well heads to the treatment system at Kirtland Air Force Base (AFB), Albuquerque, New Mexico.

Performance Requirements

The pressure ratings and materials specified represent minimum acceptable standards for piping systems. The piping systems shall be suitable for the services specified and intended. Each piping system shall be coordinated to function as a unit. Flanges, valves, fittings and appurtenances shall have a pressure rating no less than that required for the system in which they are installed.

Above Grade Piping Systems

Piping systems shall be suitable for design conditions, considering the piping both with and without internal pressure, and installation factors such as insulation, support spans, and ambient temperatures. Consideration shall be given to all operating and service conditions both internal and external to the piping systems.

1.3 QUALITY ASSURANCE

1.3.1 Jointing of Polyethylene Piping

a. Join piping by performance qualified PE joiners, qualified by a person who has been trained and certified by the manufacturer of the pipe, using manufacturer's pre-qualified joining procedures. Inspect joints by an inspector qualified in the joining procedures being used. Welders training, qualifications and procedures, (metal and PE) includes use of equipment, explanation of the procedure, and successfully making joints which pass testing.

b. Submit a certificate of qualified jointing procedures, training procedures, qualifications of trainer, and training test results for joiners and inspectors. Notify the Contracting Officer at least 24 hours in advance of the date to qualify joiners and inspectors

1.4 DELIVERY, STORAGE, AND HANDLING

Materials delivered and placed in storage shall be stored with protection from the weather, excessive humidity variation, excessive temperature variation, dirt, dust and/or other contaminants. Proper protection and care of material before, during and after installation is the Contractor's responsibility. Any material found to be damaged shall be replaced at the Contractor's expense. During installation, piping shall be capped to keep out dirt and other foreign matter. A material safety data sheet in conformance with 29 CFR 1910 Section 1200(g) shall accompany each chemical delivered for use in pipe installation. At a minimum, this includes all solvents, solvent cements, glues and other materials that may contain hazardous compounds. Handling shall be in accordance with ASTM F 402. Storage facilities shall be classified and marked in accordance with NFPA 704. Materials shall be stored with protection from puncture, dirt, grease, moisture, mechanical abrasions, excessive heat, ultraviolet (UV) radiation damage, or other damage. Pipe and fittings shall be handled and stored in accordance with the manufacturer's recommendation. Plastic pipe shall be packed, packaged and marked in accordance with ASTM D 3892.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Provide piping materials and appurtenances as specified and as shown on the drawings, and suitable for the service intended. Piping materials, appurtenances, and equipment supplied as part of this contract shall be of equal material and ratings as the connecting pipe, new and unused except for testing equipment. Components that serve the same function and are the same size shall be identical products of the same manufacturer. The general materials to be used for the piping systems shall be in accordance with the mechanical piping drawings. Pipe fittings shall be compatible with the applicable pipe materials.

2.1.1 Standard Products

Provide material and equipment which are the standard products of a manufacturer regularly engaged in the manufacturing of the products and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Nominal sizes for standardized products shall be used. Pipe, valves, fittings and appurtenances shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

2.2 CARBON STEEL PIPING SYSTEM

2.2.1 Carbon Steel Pipe

2.2.1.1 General Service

Carbon steel pipe shall meet the requirements of ASTM A 53/A 53M seamless, Grade A, Schedule 40, galvanized.

2.2.2 Carbon Steel Joints

Carbon steel piping 3” and smaller shall be joined by taper-threaded couplings. Carbon steel piping larger than 3” shall be joined by welding. Dielectric fittings or isolation joints shall be provided between all dissimilar metals.

2.2.3 Carbon Steel Fittings

Fittings shall be carbon steel, galvanized.

2.2.3.1 Threaded Fittings

Threaded fittings shall be Class 150, malleable iron, ASTM A 47/A 47M, conforming to ASME B16.3, black, banded, and threaded in accordance with ASME B1.20.2MASME B1.20.1. Threaded, rigid couplings shall be seamless, Type II (electrogalvanized) carbon steel in accordance with ASTM A 865/A 865M and threaded in accordance with ASME B1.20.2MASME B1.20.1. Polytetrafluoroethylene (PTFE) pipe-thread tape conforming to ASTM D 3308 shall be used for lubricant/sealant.

2.2.3.2 Welding Fittings

Welding fittings shall be butt-welding. Welding fittings shall be forged steel, Class 150 low-carbon steel, ASTM A234/ A234M seamless conforming to ASME B16.9.

2.2.3.3 Flanged Fittings

The internal diameter bores of flanges and flanged fittings shall be the same as that of the associated pipe. The flanges shall be slip-on type. Flanges and flanged fittings shall be forged steel, ASTM A 105/A 105M, faced and drilled to ASME B16.5 Class 150 with a 0.0625 inch raised face. Cast steel backing flanges, ASTM A 216/A 216M Grade WCA Bolting shall be alloy-steel ASTM A 193/A 193M Grade B5 hex head bolts and ASTM A 194/A 194M Grade 8 hex head nuts. When mating flange on valves or equipment is cast iron, ASTM A 193/A 193M Grade B8 Class 1bolts and ASTM A 194/A 194M Grade 8 heavy hex head nuts shall be used. Bolts shall be provided with washers of the same material as the bolts. Gaskets shall meet the requirements of ASME B16.5. Nonmetallic gaskets shall conform to ASME B16.21 and be a 0.125 inch thick chloroprene rubber, durometer hardness No.80, 1,500 psi minimum tensile strength, 125 percent minimum elongation, flat ring type for use with raised face flanges.

2.3 PLASTIC PIPING SYSTEM

Plastic piping and fittings shall conform to the following, unless otherwise indicated on mechanical piping drawings:

2.3.1 PVC Pipe

PVC, ASTM D 1784, minimum cell classification 12545-C, pipe shall be Schedule 80 conforming to ASTM D 1785 manufactured to an SDR rating in accordance with ASTM D 2241, so that the pressure rating of the pipe is consistent for all pipe sizes.

2.3.2 PVC Joints

The piping system shall be joined by socket-weld connections except where connecting to unions, valves, and equipment with that may require future disassembly. Connections at those points with piping diameter less than 4” shall be threaded and back-welded, and diameters larger than 4” shall be flanged. Tubing connections shall use compression fittings.

2.3.3 PVC Fittings

The schedule rating for the fittings shall not be less than that for the associated pipe. Fittings shall be ASTM D 1784, minimum cell classification, PVC conforming to the requirements of ASTM D 2467, socket type.

2.3.4 PVC Solvent Cement

Socket connections shall be joined with PVC solvent cement conforming toASTM D 2564. Manufacture and viscosity shall be as recommended by the pipe and fitting manufacturer to assure compatibility. Joints shall be prepared with primers conforming to ASTM F 656 prior to cementing and assembly.

2.4 HIGH-DENSITY POLYETHYLENE (HDPE)

HDPE piping and fittings shall conform to the following, unless otherwise indicated on mechanical piping drawings:

2.4.1 HDPE Pipe

PE, AWWA Pipe: AWWA C906, DR No. 17, Iron Pipe Sizes (IPS) with PE compound number 3408 required to give pressure rating not less than 200 psig.

2.4.2 PE Joints

PE pipe shall be joined by thermal butt-fusion, except where connecting to valves and equipment that may require future disassembly, then joints shall be flanged.

2.4.3 PE Fittings

AWWA Fittings: AWWA C906, molded butt-fusion type, with DR number matching pipe and PE compound number required to give pressure rating not less than 200 psig.

2.4.3.1 Couplings

Couplings and saddle joints shall be joined by electrofusion in accordance with ASTM F 1055.

2.4.3.2 Flanged Fittings

AWWA Fittings: AWWA C906, molded butt-fusion type, with DR number matching pipe and PE compound number required to give pressure rating not less than 200 psig.

2.5 ISOLATION JOINTS AND COUPLINGS

2.5.1 Dielectric Fittings

Dielectric fittings shall be provided between threaded ferrous and nonferrous metallic pipe, fittings and valves. Dielectric fittings shall prevent metal-to-metal contact of dissimilar metallic piping elements and shall be suitable for the required working pressure, temperature and corrosive application.

2.5.2 Isolation Joints

Isolation joints shall be provided between non-threaded ferrous and nonferrous metallic pipe fittings and valves. Isolation joints shall consist of an isolation gasket of the dielectric type, isolation washers and isolation sleeves for flange bolts. Isolation gaskets shall be full faced with an outside diameter equal to the flange outside diameter. Bolt isolation sleeves shall be full length. Units shall be of a shape to prevent metal-to-metal contact of dissimilar metallic piping elements.

2.5.3 Metallic Piping Couplings

Thrust ties shall be provided where shown on the contract drawings and where required to restrain the force developed by 1.5 times the maximum allowable operating pressures specified. For metallic pipe other than ductile iron, thrust ties shall be attached with fabricated lugs. For ductile iron pipe, thrust ties shall be attached with socket clamps against a grooved joint coupling or flange. For exposed installations, zinc-plated nuts and bolts shall be used. However, high-strength, low-alloy steel, in accordance with AWWA C111/A21.11, may be substituted for use on cast iron and ductile iron couplings.

2.5.4 Couplings for Nonmetallic Piping

2.5.4.1 Bellows Coupling

A bellows coupling shall have a minimum of two polytetrafluoroethylene (PTFE) convolutions unless otherwise shown, with ductile iron flanged, faced and drilled to ASME B16.5 Class 125 end connections, and metal reinforcing bands. The maximum allowable working pressure shall be 140 psig 120 degrees F. Bolting shall be limited to restrain the force developed by 1.5 times the specified maximum allowable operating pressure. The coupling shall be sized to match the associated piping.

2.5.4.2 Compression Coupling

A compression coupling shall consist of one steel middle section, two steel mechanical nuts, two elastomeric gaskets and two machined steel lock rings. The coupling shall use ethylene propylene diene monomer (EPDM) wedge gaskets. The maximum allowable working pressure shall be 150 psig 120 degrees F. The coupling shall be sized to match the associated piping.

2.6 VALVES

2.6.1 General Requirements For Valves

Valves shall include operator, actuator, hand wheel, chain wheel, extension stem, floor stand, worm and gear operator, operating nut, chain, wrench, and all other accessories required for a complete operation. The valves shall be suitable for the intended service. Renewable parts are not to be of a lower quality than those specified. Valves shall be the same size as adjoining pipe unless otherwise indicated on drawings. Valve ends shall be compatible with adjacent piping system. An operator shall be sized to operate the associated valve for the full range of pressures and velocities. Valves will open by turning counterclockwise. Operators, actuators, and accessories shall be factory mounted. Valves in main water distribution piping shall have the ability to except locks for lockout tag, out requirements.

2.6.2 Factory Finishing

Valves shall have an epoxy lining and coating in accordance with AWWA C550 unless otherwise specified. The epoxy shall be either a two-part liquid material or a heat-activated (fusion) material except that only a heat-activated material shall apply if a valve coating is specified as "fusion" or "fusion bonded" epoxy. The epoxy lining and coating shall have a minimum of 7.0 mils dry film thickness except where it is limited by valve operating tolerances. Exposed valves shall be finished in accordance with Section 099000 Painting. Safety isolation valves and lockout valves with handles, handwheels, or chain wheels shall be painted "safety yellow."

2.6.3 Ball Valves

2.6.3.1 General Purpose Ball Valves

General purpose ball valves shall conform to the following unless otherwise specified on the mechanical piping drawings:

a. Ball valves, shall be end entry type with bronze bodies and threaded, in accordance with ASME B1.20.2MASME B1.20.1 regular ports. Valves shall have polytetrafluoroethylene (PTFE) seats and packing, stainless steel balls and hand lever operators. Valves shall be rated for 200 psig service at 150 degrees F.

2.6.3.2 Thermoplastic Ball Valve

Thermoplastic ball valves, 6 inch and smaller, shall be rated for 150 psig service at 120 degrees F, and have ASTM D 1784, polyvinyl chloride (PVC) bodies, balls, and stems. Valves shall be end entry, double union design, with solvent-weld socket ends connections, a ethylene propylene diene monomer (EPDM) seat, and ethylene propylene diene monomer (EPDM) O-ring stem seals. Valves shall have hand lever operators.

2.7 DRAINS AND SAMPLE PORTS

Valved drains and sample ports shall follow the requirements below unless otherwise specified on the mechanical piping drawings.

2.7.1 Locations

All pipeline low points shall be drained. A sample port shall be located immediately downstream of a treatment process. The sample ports shall be located in easily accessible locations, and shall avoid potential stagnant points and/or areas where material could collect.

2.7.2 Sizes

For pipelines 2.5 inch and larger, drains shall be 0.5 inch and equipped with ball valves.

2.8 MISCELLANEOUS PIPING COMPONENTS

The following requirements shall be followed unless otherwise indicated on the mechanical piping drawings.

2.9.1 Vacuum Breakers

Vacuum breakers shall be located as indicated on the mechanical piping drawings. Vacuum breakers 2 inch and smaller shall be an angle type with all cast iron bodies and bonnets, and shall be installed at least 6 inches above the flood line of associated equipment.

2.9.2 Strainers

Strainers shall be installed at start-up and then removed after the system is in normal operation.

2.9.3 Pipe Expansion

2.9.3.1 Expansion Joints

Provide all structural work and equipment required to control expansion and contraction of piping. Verify that the anchors, guides, and expansion joints provided, adequately protect the piping systems. Locations of expansion joints are located on the contract drawings.

2.9.3.2 Expansion Loops

Expansion shall be accommodated by loops and bends as indicated on the drawings. Pipe in the loops and bends shall accommodate expansion while maintaining required insulation clearance from floors, walls, tops, and other pipes and sturctures to avoid damage to pipe. Expansion loops may be designed around obstacles such as utility manholes, structures, or trees to avoid construction conflicts. Slopes of pipe and trench bottoms shall be maintained. Contractor shall have the option to adjust the loop dimensions around obstacles based on final field measurements, if approved by Shaw. Submit dimensions to Shaw for verification of loop and bend sizes before proceeding with that segment of work. Allowable pipe stresses shall be in accordance with ASME B31.1.

2.9.4 Pressure Relief Devices

Pressure relief devices shall conform to the requirements of ASME B31.3.

2.10 PIPE SUPPORTS

Provide auxiliary steel where the support of piping systems and equipment is required between building structural elements. Light gauge and structural steel shapes shall conform to the requirements of ASTM A 36/A 36M. The Contractor has the option to use pre-engineered support systems of electrogalvanized steel products. However, a mixture of support system manufacturers products is not permitted. Details of pipe supports are located on the contract drawings.

2.11 CONCRETE TRENCH SYSTEMS

A pre-cast concrete trench system at road crossings shall be provided and installed with a removable top as shown on the drawings.

2.11.1 Joint Sealants

Concrete joints shall be sealed as indicated. Type II sealant (nonsagging) shall be used for vertical joints. Type I sealant shall be used for trench top butt joints. All other joints shall be sealed with Type I or Type II sealant. Sealant in trench bottom shall finish flush with floor.

2.11.2 Concrete Trench Tops

Concrete trench tops shall be metal grate with H-20 load ratings when on vehicle traffic right of way. Concrete trench tops shall be constructed in maximum lengths of 8 feet. Each top section shall be provided with means to accept a lifting device for removal of grate, or as indicated on the drawings.

3.7.4 Concrete Trench Construction

The concrete trench shall be of the sizes indicated on drawings. Inside edge and top of walls shall have smooth even surfaces to accommodate trench tops.

3.7.6 Coordination with Existing Utilities

Before beginning work in a given area, all utility information shall be field verified by surface markings made by the affected utility Owner's Representative. Notify Shaw in advance, and receive prior approval before excavating in any areas. The actual concrete trench routing may be offset or changed if approved by Shaw in order to reduce conflicts, interruptions, expedite the work, or for any other reason to the mutual benefit of the Contractor and the Government.

3.7.9 Pipe Anchors and Supports

Pipe anchors and supports shall be as indicated on the drawings.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing the work.

3.2 PREPARATION

3.2.1 Protection

Pipe and equipment openings shall be closed with caps or plugs during installation. Equipment shall be protected from dirt, water, and chemical or mechanical damage.

3.2.2 System Preparation

3.2.2.1 Pipe and Fittings

Pipe and fittings shall be inspected before exposed piping is installed or buried piping is lowered into the trench. Clean the ends of pipes thoroughly, remove foreign matter and dirt from inside of pipes, and keep piping clean during and after laying.

3.2.2.2 Damaged Coatings

Repair damaged coating areas in the field with material equal to the original coating, except for damaged glass-lined pipe which shall be promptly removed from the site. Do not install damaged piping materials. Field repair of damaged and uncoated areas of galvanized piping shall conform to ASTM A 780/A 780M.

3.2.2.3 Field Fabrication

Notify the Contracting Officer at least 2 weeks prior to the field fabrication of pipe or fittings and at least 3 days prior to the start of any surface preparation or coating application work. Welding electrodes shall be provided in accordance with Table 3.1 of AWS D1.1/D1.1M as required for the applicable base metals and welding process. Fabrication of fittings shall be performed in accordance with the manufacturer's instructions.

3.3 EXPOSED PIPING INSTALLATION

Exposed piping shall be run as straight as practical along the alignment shown on the contract drawings and with a minimum of joints. Piping and appurtenances shall be installed in conformance with reviewed shop drawings, manufacturer's instructions and ASME B31.3. Piping shall be installed without springing or forcing the pipe.

3.3.1 Anchors and Fasteners

Impact expansion (hammer and explosive charge drive-type) anchors and fastener systems are not acceptable. Lead shields, plastic or fiber inserts, and drilled-in plastic sleeve/nail drive systems are also not acceptable.

3.3.1.1 Drilled-In Expansion Anchors and Fasteners

Anchors shall be designed to accept both machine bolts and/or threaded rods. Such anchors shall consist of an expansion shield and expander nut contained inside the shield. The expander nut shall be fabricated and designed to climb the bolt or rod thread and simultaneously expand the shield as soon as the threaded item, while being tightened, reaches, and bears against the shield bottom. The shield body shall consist of four legs, the inside of each shall be tapered toward shield bottom (or nut end). The end of one leg shall be elongated and turned across shield bottom. The outer surface of shield body shall be ribbed for grip-action. The expander nut shall be of square design with sides tapered inward from bottom to top. The anchor materials of construction shall be TP304 stainless steel 43,541 psi minimum tensile strength. Fasteners shall be machine bolts for use with above anchors; nuts and washers shall conform to ASTM A 194/A 194M. The anchor length, diameter, and embedment depth shall meet the manufacturer's requirements for the maximum allowable working load of the application.

3.3.1.2 Drilled-In Adhesive Anchors

Drilled-in adhesive anchors shall not be used for overhead applications. The anchors shall be composed of an anchor rod assembly and an anchor rod adhesive cartridge. The anchor rod assembly shall be a chamfered and threaded stud rod of TP304 stainless steel with a nut and washer of TP316 stainless steel. The anchor length, diameter, and embedment depth shall meet the manufacturer's requirements for the maximum allowable working load of the application. The adhesive cartridge shall be a sealed capsule containing premeasured amounts of resin, quartz sand aggregate, and a hardener contained in a separate vial within the capsule. The capsule ingredients shall be activated by the insertion procedure of the anchor rod assembly.

3.3.2 Piping Expansion and Contraction Provisions

The piping shall be installed to allow for thermal expansion and contraction resulting from the difference between installation and operating temperatures. Design for installation of plastic pipe exposed to ambient conditions or in which the temperature variation of the contents is substantial shall have provisions for movement due to thermal expansion and contraction documented to be in accordance with PPI TR-21. Anchors shall be installed as shown in the contract drawings to withstand expansion thrust loads and to direct and control thermal expansion. An intermediate pipe guide shall be installed for every pipe at each metal channel framing support not carrying an anchor or alignment guide. Where pipe expansion joints are required, pipe alignment guides shall be installed adjacent to the expansion device and within four pipe diameters. Expansion devices shall be installed in accordance with the manufacturer's instructions and at the locations shown in the mechanical piping drawings.

3.3.3 Piping Flexibility Provisions

Thrust protection shall be provided as required. Flexible couplings and expansion joints shall be installed at connections to equipment, and where shown on the contract drawings. Additional pipe anchors and flexible couplings beyond those shown on the mechanical piping drawings, shall be provided to facilitate piping installation, in accordance with reviewed shop drawings.

3.3.4 Couplings, Adapters and Service Saddles

Pipes shall be thoroughly cleaned of oil, scale, rust, and dirt in order to provide a clean seat for gaskets. Gaskets shall be wiped clean prior to installation. Flexible couplings and flanged coupling adapter gaskets shall be lubricated with the manufacturer's standard lubricant before installation on the pipe ends. Couplings, service saddles, and anchor studs shall be installed in accordance with manufacturer's instructions. Bolts shall be tightened progressively, drawing up bolts on opposite sides a little at a time until all bolts have a uniform tightness. Torque-limiting wrenches shall be used to tighten bolts.

3.3.5 Piping Equipment/Component Installation

Piping components and indicators shall be installed in accordance with manufacturer's instructions. Required upstream and downstream clearances, isolation valves, and miscellaneous devices shall be provided for an operable installation. Straight runs of piping upstream and downstream of flow measuring devices shall be as shown in the mechanical piping drawings or as recommended by the instrument manufacturer.

3.3.6 Pipe Flanges

Pipe flanges shall be set level, plumb, and aligned. Flanged fittings shall be installed true and perpendicular to the axis of the pipe. The bolt holes shall be concentric to the centerline of the pipe.

3.3.7 Valve Locations

Valves shall be located in accordance with the contract drawings where actuators are shown. Where actuators are not shown, valves shall be located and oriented to permit easy access to the valve operator, and to avoid interferences.

3.3.8 Pipe Tap Connections

Taps to pipe barrels are unacceptable. Taps to ductile iron piping shall be made only with a service saddle or at a tapping boss of a fitting, valve body, or equipment casting. Taps to steel piping shall be made only with a welded threadolet connection.

3.3.9 Plastic Pipe Installation

All plastic pipe shall be cut, made up, and installed in accordance with the pipe manufacturer's recommendations. Heat joining and electrofusion joining shall be performed in accordance with AWWA C901/C906. Schedule 40 pipe shall not be threaded. Schedule 80 threaded nipples shall be used where necessary to connect to threaded valves or fittings. Strap wrenches shall be used for tightening threaded plastic joints, and care shall be taken not to over tighten these fittings. Pipe shall not be laid when the temperature is below 40.1 degrees F, nor above 90 degrees F when exposed to direct sunlight. Any plastic pipe installed above grade and outdoors shall be ultraviolet (UV) protected or UV resistant. The pipe ends that are to be joined shall be shielded from direct sunlight prior to and during the laying operation. Adequate ventilation shall be provided when working with pipe joint solvent cement and the handling of solvent cements, primers and cleaners shall be in accordance with ASTM F 402. Provide and install supports and hangers in accordance with the manufacturer's recommendations. Where plastic pipe is subjected to severe temperature fluctuations, provisions for expansion and contraction must be provided. This shall be accomplished with the use of expansion joints and offset piping arrangements. All lines shall be hydrostatically tested at the maximum operating pressures.

3.3.9.1 PVC Piping

Solvent-cemented joints shall be constructed in accordance with ASTM D 2855.

3.4 CONNECTING DISSIMILAR PIPE

Flexible transition couplings, dielectric fittings and isolation joints shall be installed in accordance with the manufacturer's instructions.

3.5 EXTERNAL CORROSION PROTECTION

Protect all pipe and piping accessories from corrosion and adverse environmental conditions.

3.6 ABOVE GRADE METALLIC PIPING

Nonferrous and stainless steel piping shall not be painted except for aluminum alloy piping. Where dissimilar metals are joined, isolation joints shall be used. Primed surfaces shall be painted in accordance with Section 099000 Painting.

3.7 FLEXIBLE JOINTS AT CONCRETE STRUCTURES

Flexible joints shall be provided at the face of all structures. Refer to mechanical piping drawings for types and locations of flexible joints.

3.8 CLOSURES

Closure pieces shall be installed as necessary to end pipe runs and shall conform to ASME B16.9 or ASME B16.11. Elastomer sleeves bonded to pipe ends are not acceptable. Pressure piping shall have closures of blind flanges, with thickness matching the nominal wall thickness of the associated pipe, unless otherwise shown on mechanical piping drawings or approved by the Contracting Officer.

3.10 VALVE INSTALLATION

Flanged valve bolt holes shall be installed so as to straddle the vertical centerline of pipe. Flanged faces shall be cleaned prior to inserting the gasket and bolts, and then the nuts shall be tightened progressively and uniformly. Threaded ends shall have the threads cleaned by wire brushing or swabbing prior to installation.

3.10.1 Valve Orientation

The operating stem of a manual valve shall be installed in a vertical position when the valve is installed in horizontal runs of pipe having centerline elevations 4.5 feet or less above finished floor, unless otherwise shown on mechanical piping drawings.

3.10.1.1 Butterfly Valves

Orientation of butterfly valves shall take into account changes in pipe direction. Valve shafts shall be oriented so that unbalanced flows caused by pipe direction changes or other disturbances are equally divided to each half of the disc.

3.10.2 Isolation Valve

Safety isolation valves shall be installed on compressed air supplies. The valve shall be located to provide accessibility for control and maintenance. If necessary, access doors shall be installed in finished walls and plaster ceilings for valve access.

3.11 AIR RELEASE, DRAINS AND SAMPLE PORTS

Install sample ports, drains, and air release valves shall be provided where indicated on the mechanical piping drawings.

3.12 PIPING SUPPORT SYSTEMS INSTALLATION

The absence of pipe supports and details on the mechanical piping drawings shall not relieve the Contractor of responsibility for sizing and providing supports throughout plant.

3.12.1 General Support Requirements

Pipe support systems shall meet the requirements of MSS SP-58. Contractor-designed and selected support systems shall be installed in accordance with MSS SP-69, and as specified herein. Piping connections to equipment shall be supported by pipe supports and not off the equipment. Large or heavy valves, fittings, and/or equipment shall be supported independently of associated piping. Pipes shall not be supported off other pipes. Supports shall be provided at piping changes in direction or in elevation, adjacent to flexible joints and couplings, and where otherwise shown on the contract drawings. Pipe supports and hangers shall not be installed in equipment access areas or bridge crane runs. Hanging pipes shall be braced against horizontal movement by both longitudinal and lateral sway bracing. At each channel type support, every pipe shall be provided with an intermediate pipe guide, except where pipe anchors are required. Existing support systems may be used to support additional new piping only if the Contractor can demonstrate that the existing support systems are adequate for the additional loads, or if the existing systems are strengthened to support the additional loads. Pedestal type pipe supports shall be provided under base flanges adjacent to rotating equipment and where required to isolate vibration.

3.12.3 Dielectric Barriers

Dielectric barriers shall be installed between supports and copper or stainless steel piping, and between stainless steel supports and non-stainless steel ferrous piping.

3.12.4 Support Spacing

Refer to mechanical piping drawings and notes for support spacing.

3.14 FIELD QUALITY CONTROL

3.14.1 Hydrostatic Tests

Where any section of a pipeline is provided with concrete thrust blocking for fitting, the hydrostatic tests shall not be made until at least 5 days after the installation of the concrete thrust blocking, unless otherwise approved by the Contracting Officer.

3.14.1.2 Exposed Piping

3.14.2 Pneumatic Tests

Pneumatic testing shall be prepared for and conducted in accordance with the requirements of ASME B31.3. Care must be taken to minimize the chance of a brittle fracture or failure during a pneumatic leak test. Only non-toxic, nonflammable, inert gases or air shall be used.

3.14.2.1 Pressure Relief Device

During pneumatic testing, a pressure relief device shall be provided for each piping section being tested. The device shall have a set pressure not higher than the test pressure plus the lesser of 10 percent of the test pressure or 50.8 psi.

3.14.3 Pipe Leakage Tests

Unless approved by the Contracting Officer, leakage testing shall be conducted after the pressure tests have been satisfactorily completed. The duration of each leakage test shall be at least 2 hours, and during the test the piping shall be subjected to not less than 200 psig pressure. Leakage is defined as the quantity of the test liquid, water, that is supplied to the piping system, or any valved or approved section thereof, in order to maintain pressure within 5 psi of the specified leakage test pressure after the piping has been filled with the test liquid and all air is expelled. No piping installation will be accepted if leakage exceeds the allowable leakage determined by the following formula:

L = Cf x N x D x P0.5
Cf = conversion factor = 0.0001351
L = allowable leakage, gallons per hour
N = number of joints in the length of piping tested
D = nominal pipe diameter, inches
P = average test pressure during the test, psig.

Should any test disclose leakage greater than that allowed, the leaks shall be located and repaired until the leakage is within the specified allowance, without additional cost.

3.14.4 Testing New to Existing Connections

New piping connected to existing pipe, existing equipment, existing treatment systems, or tanks and treatment systems furnished under other Sections shall be tested. Isolate the new piping with pipe caps, spectacle blinds, or blind flanges. The joint between new piping and existing piping shall be tested by methods that do not place the entire existing system under the test load. Proceed. then, with the testing of new piping systems as specified herein.

3.14.5 Valve Testing

Valves may either be tested while testing pipelines, or as a separate step. It shall be demonstrated that valves open and close smoothly with operating pressure on one side and atmospheric pressure on the other, and in both directions for two-way valve applications. Count and record the number of turns required to open and close each valve, and account for any discrepancies with manufacturer's data. Air and vacuum relief valves shall be examined as the associated pipe is being filled to verify venting and seating is fully functional. Set, verify, and record set pressures for all relief and regulating valves. Self-contained automatic valves shall be tested at both maximum and minimum operating ranges, and reset upon completion of test to the design value.

3.15 FINAL CLEANING

3.15.1 Interim Cleaning

Prevent the accumulation of weld rod, weld spatter, pipe cuttings and filings, gravel, cleaning rags, and other foreign material within piping sections during fabrication. The piping shall be examined to assure removal of these and other foreign objects prior to assembly and installation.

3.16 TRENCH SYSTEMS

The concrete trench system shall be installed per manufacturer's installation instructions and contract drawings. Install the concrete trench at the elevation shown on the drawings and grade the adjacent areas. Any cut or fill areas adjacent to the concrete trench shall be graded back to the existing grade at a 1 to 10 slope, or as indicated. Care shall be taken to avoid forming pockets adjacent to the concrete trench; thereby, preventing surface drainage. The trench system grating and top elevation shall be installed at the same elevation as existing road elevation and a smooth transition shall be made between the two surfaces.

-- End of Section --

SECTION 33 51 15

NATURAL-GAS / LIQUID PETROLEUM GAS DISTRIBUTION

PART 1 GENERAL

1.1 SYSTEM DESCRIPTION

The gas distribution system includes natural gas piping and appurtenances from point of connection with existing system to final terminiation point, as indicated on drawings.

1.2 QUALITY ASSURANCE

1.2.1 Jointing of Polyethylene Piping

a. Join piping by performance qualified PE joiners, qualified by a person who has been trained and certified by the manufacturer of the pipe, using manufacturer's pre-qualified joining procedures in accordance with AGA XR0603. Inspect joints by an inspector qualified in the joining procedures being used and in accordance with AGA XR0603. Welders training, qualifications and procedures,(metal and PE) includes use of equipment, explanation of the procedure, and successfully making joints which pass tests specified in AGA XR0603.

b. Submit a certificate of qualified jointing procedures, training procedures, qualifications of trainer, and training test results for joiners and inspectors. Notify the Contracting Officer at least 24 hours in advance of the date to qualify joiners and inspectors.

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery and Storage

Inspect materials delivered to the site for damage, and store with a minimum of handling. Store materials on site in enclosures or under protective coverings. Store plastic piping under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes and fittings free of dirt and debris.

1.3.2 Handling

Handle pipe and components carefully to ensure a sound, undamaged condition. Take particular care not to damage pipe coating. Repair damaged coatings to original finish. Do not place pipe or material of any kind inside another pipe or fitting after the coating has been applied, except as specified in paragraph INSTALLATION. Handle steel piping with coal-tar enamel coating in accordance with AWWA C203, and fusion-bonded epoxy coatings per AWWA C213. Handle plastic pipe in conformance with AGA XR0603.

PART 2 PRODUCTS

2.1 PIPE, FITTINGS, AND ASSOCIATED MATERIALS

Provide materials and equipment which are the standard products of a manufacturer regularly engaged in the manufacture of the products and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Asbestos or products containing asbestos are not allowed. Provide written verification and point of contact for a supporting service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site. Mark all valves, flanges, and fittings in accordance with MSS SP-25. Submit a complete list of materials and equipment, including manufacturer's descriptive and technical literature, performance charts and curves, catalog cuts, and installation instructions, including, but not limited to the following:

a. Dielectric Waterways and Flange Kits.
b. Fittings
c. Piping
d. Pipe and Accessory coatings
e. Pressure Reducing Valves.
f. Meters
g. Regulators.
h. Shut-off Valves

2.1.1 Polyethylene Pipe, Tubing, Fittings and Joints

Provide polyethylene pipe, tubing, fittings and joints conforming to ASTM D3350 and ASTM D2513, pipe designations PE 2406 and PE 3408, rated SDR 11 or less, as specified in ASME B31.8. Mark pipe sections as required by ASTM D2513. Provide butt fittings conforming to ASTM D3261 and socket fittings conforming to ASTM D2683. Match fittings to the service rating of the pipe, ASTM D2774.

2.1.2 Sealants for Steel Pipe Threaded Joints

2.1.3 Sealing Compound

Provide joint sealing compound as listed in UL Gas&Oil Dir, Class 20 or less.

2.1.4 Tape

Provide polyetrafluoroethylene tape conforming to ASTM D3308.

2.1.5 Identification
Provide pipe flow markings and metal tags for each valve, meter, and regulator as required by local codes.

2.1.6 Insulating Joint Materials
Provide insulating joint materials between flanged or threaded metallic pipe systems where shown to isolate galvanic or electrolytic action.

2.1.7 Gas Transition Fittings
Provide manufactured steel gas transition fittings approved for jointing steel and polyethylene or fiberglass pipe, conforming to AGA XR0603 requirements for transition fittings.

2.2 PRESSURE REGULATORS
Provide ferrous bodied regulators with backflow protection, designed to meet the pressure, load and other service conditions.

2.2.1 Service Line Regulators

a. Provide ferrous bodied pressure regulators for individual service lines, capable of reducing distribution line pressure to pressures required for users. Provide regulators where gas will be distributed at pressures in excess of 10 inches of water column, with pressure relief set at a lower pressure than would cause unsafe operation of any connected user.

b. Provide regulator(s) having a single port with orifice diameter no greater than that recommended by the manufacturer for the maximum gas pressure at the regulator inlet. Provide regulator valve vent of resilient materials designed to withstand flow conditions when pressed against the valve port, capable of regulating downstream pressure within limits of accuracy and limiting the buildup of pressure under no-flow conditions to 50 percent or less of the discharge pressure maintained under flow conditions. Provide a self contained service regulator, and pipe not exceeding exceed 2 inch size.

2.4 METERS
Provide meters conforming to AGA ANSI B109.2, pipe mounted. Provide meters with over-pressure protection as specified in ASME B31.8, tamper-proof protection, frost protection suitable for accurately measuring and handling gas at pressures, temperatures, and flow rates indicated in drawing.

PART 3 EXECUTION

3.1 EXAMINATION
After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing the work.

3.2 SERVICE LINES

3.2.1 General
Construct service lines of materials specified for gas mains and extend from a gas main to and including the point of delivery as shown on drawings. Where indicated, provide service line with an isolation valve of the same size as the service line. Make the service lines as short and as straight as practicable between the point of delivery and the gas main, without bends or lateral curves unless necessary to avoid obstructions or otherwise permitted. Lay service lines with as few joints as practicable using standard lengths of pipe, use shorter lengths only for closures. Do not install polyethylene or fiberglass service lines aboveground.

3.5 WORKMANSHIP AND DEFECTS
Make pipe, tubing, and fittings clear and free of cutting burrs and defects in structure or threading, and thoroughly brushed and blown free of chips and scale. Do not repair, but replace defective pipe, tubing, or fittings.

3.6 PROTECTIVE COVERING

3.6.1 Protective Covering for Underground Steel Pipe
Except as otherwise specified, apply protective coverings mechanically in a factory or field plant especially equipped for the purpose. Hand apply protective covering to valves and fittings that cannot be coated and wrapped mechanically, preferably at the plant that applies the covering to the pipe. Coat and wrap joints by hand, in a manner and with materials that will produce a covering equal in thickness to that of the covering applied mechanically.

3.6.1.1 Thermoplastic Resin Coating System
Provide a thermoplastic coating system conforming to NACE SP0185, Type A. Clean the exterior of the pipe to a commercial grade blast cleaning finish in accordance with SSPC SP 6/NACE No.3, and apply adhesive compound to the pipe. Immediately after the adhesive is applied, extrude a seamless tube of polyethylene over the adhesive to produce a bonded seamless coating, with a nominal thickness of 10 mils (plus or minus 10 percent) of adhesive and 40 mils (plus or minus 10 percent) of polyethylene for pipes up to 16 inches in diameter. Apply joint coating and field repair material as recommended by the coating manufacturer, consisting of one the following:

a. Heat shrinkable polyethylene sleeves.

b. Polyvinyl chloride pressure-sensitive adhesive tape.

c. High density polyethylene/bituminous rubber compound tape.

Inspect the coating system for holes, voids, cracks, and other damage during installation.

3.6.1.2 Inspection of Pipe Coatings
Repair any damage to the protective covering during transit and handling before installation. After field coating and wrapping has been applied, inspect the entire pipe using an electric holiday detector with impressed current set at a value in accordance with NACE RP0274 using a full-ring, spring-type coil electrode. Equip the holiday detector with a bell, buzzer, or other type of audible signal which sounds when a holiday is detected. Immediately repair all holidays in the protective covering upon detection. The Contracting Officer reserves the right to inspect and determine the suitability of the detector. Furnish labor, materials, and equipment necessary for conducting the inspection.

3.6.2 Protective Covering for Aboveground Piping Systems
Apply finish painting conforming to normal pipe coating practices, subject to approval by Shaw.

3.7 INSTALLATION
Install gas distribution system and equipment in conformance with the manufacturer's recommendations and applicable sections of ASME B31.8, AGA XR0603 and 49 CFR 192. Perform abandonment of existing gas piping in accordance with ASME B31.8. Cut the pipe without damaging the pipe; unless otherwise authorized, use an approved type of mechanical cutter. Use wheel cutters where practicable. On steel pipe 6 inches and larger, an approved gas-cutting-and-beveling machine may be used. Cut plastic pipe in accordance with AGA XR0603. Design valve installation in plastic pipe to protect the plastic pipe against excessive torsional or shearing loads when the valve is operated and from other stresses which may be exerted through the valve or valve box.

3.7.1 Installing Pipe Underground
Grade gas mains and service lines as indicated. Weld joints in steel pipe except as otherwise permitted for installation of valves. Provide service lines with 36 inch minimum cover; and place both mains and service lines on firmly compacted select material for the full length. Where indicated, encase, bridge, or design the main to withstand any anticipated external loads as specified in ASME B31.8. Provide standard weight black steel pipe encasement material with a protective coating as specified. Separate the pipe from the casing by insulating spacers and seal the ends with casing bushings. Excavate the trench below pipe grade, bed with bank sand, and compact to provide full-length bearing. Laying pipe on blocks to produce uniform grade is not permitted. Ensure that the pipe is clean inside before it is lowered into the trench and keep free of water, soil, and all other foreign matter that might damage or obstruct the operation of the valves, regulators, meters, or other equipment. When work is not in progress, securely close open ends of pipe or fittings with expandable plugs or other suitable means. Minor changes in line or gradient of pipe that can be accomplished through the natural flexibility of the pipe material without producing permanent deformation and without overstressing joints may be made when approved. Make changes in line or gradient that exceed the limitations specified with fittings. When cathodic protection is furnished,

provide electrically insulated joints or flanges. When polyethylene or fiberglass piping is installed underground, place foil backed magnetic tape above the pipe to permit locating with a magnetic detector. After laying of pipe and testing, backfill the trench in accordance with drawings.

3.7.2 Installing Pipe Aboveground

Protect aboveground piping against dirt and other foreign matter, as specified for underground piping.

3.8 PIPE JOINTS

Design and install pipe joints to effectively sustain the longitudinal pullout forces caused by the contraction of piping or superimposed loads.

3.8.1 Threaded Steel Joints

Provide threaded joints in steel pipe with tapered threads evenly cut, made with UL approved graphite joint sealing compound for gas service or polytetrafluoroethylene tape applied to the male threads only. Caulking of threaded joints to stop or prevent leaks is not permitted.

3.8.2 Polyethylene Pipe Jointing Procedures

Use jointing procedures conforming to AGA XR0603. Avoid making indiscriminate heat fusion joining of plastic pipe or fittings made from different polyethylene resins by classification or by manufacturer if other alternative joining procedures are available. If heat fusion joining of dissimilar polyethylene is required, special procedures are required. Test the method of heat fusion joining dissimilar polyethylene resins in accordance with paragraph TESTS.

3.8.3 Connections Between Metallic and Plastic Piping

Only make metallic to plastic connections outside, underground, and with approved transition fittings.

3.9 DRIPS

Install drips at locations where indicated, conforming to the details shown, or provide commercial units of approved type and capacity. Connect a blow off pipe 1-1/4 inches or larger to each drip at its lowest point and extend to or near the ground surface at a convenient location away from traffic. Provide a reducing fitting for each discharge at each drip terminal (outlet), a plug valve, and a 1/2 inch nipple turned down. Locate the discharge terminal (outlet) inside a length of 12 inches or larger vitrified clay pipe, concrete sewer pipe or concrete terminal box set vertically on a bed of coarse gravel 1 foot thick and 3 feet square, and closed at the ground surface with a suitable replacement cover.

3.11 PRESSURE REGULATOR INSTALLATION

3.11.1 Service Line Regulators

Install a shutoff valve and service regulator on the service line, 18 inches above the ground on the riser. Install an insulating joint on the inlet side of the service regulator and construct to prevent flow of electrical current. Provide a 3/8 inch tapped fitting equipped with a plug on both sides of the service regulator for installation of pressure gauges for adjusting the regulator. Terminate all service regulator vents and relief vents in the outside air in rain and insect resistant fittings. Locate the open end of the vent where gas can escape freely into the atmosphere, away from any openings into the building and above areas subject to flooding.

3.12 METER INSTALLATION

Install meters in accordance with ASME B31.8. Install permanent gas meters with provisions for isolation and removal for calibration and maintenance, and suitable for operation in conjunction with an energy monitoring and control system.

3.13 CONNECTIONS TO EXISTING LINES

Make connections between new work and existing gas lines, where required, in accordance with ASME B31.8, using proper fittings to suit the actual conditions. When connections are made by tapping into a gas main, provide the same size connecting fittings as the pipe being connected.

3.13.1 Connection to Government Owned/Operated Gas Lines

Provide connections to the existing gas lines in accordance with approved procedures. Only perform deactivation of any portion of the existing system at the valve location shown on the drawings. Reactivation of any existing gas lines will only be done by the Operating Agency. Notify the Contracting Officer, in writing, 10 days before connections to existing lines are to be made.

3.14 CATHODIC PROTECTION

Provide cathodic protection for all metallic gas piping installed underground and install as specified in the drawings.

3.15 TESTS

3.15.1 Pressure and Leak Tests

Test the system of gas mains and service lines after construction and before being placed in service, using air as the test medium. Submit data in booklet form from all pressure tests of the distribution system. Conform testing to ASTM D1598 and ASTM D1599 for plastic piping. The normal operating pressure for the system is 25. The test pressure shall be in accordance with the operating agency.

a. Prior to testing the system, blow-out, clean, and clear the interior of all foreign materials. Remove all meters, regulators, and controls before blowing out and cleaning,and reinstall after clearing of all foreign materials.

b. Perform testing of service lines with due regard for the safety of employees and the public during the test. Keep persons not working on the test operations out of the testing area while testing is proceeding. Perform the test on the system as a whole or on sections that can be isolated.

c. Test joints in sections prior to backfilling when trenches will be backfilled before the completion of other pipeline sections. Continue the test for at least 24 hours from the time of the initial readings to the final readings of pressure and temperature. Do not take the initial test readings of the instrument for at least 1 hour after the pipe has been subjected to the full test pressure. Do not take initial or final readings at times of rapid changes in atmospheric conditions, and temperatures are representative of the actual trench conditions. No indication of reduction of pressure is allowed during the test after corrections have been made for changes in atmospheric conditions in conformity with the relationship T(1)P(2)=T(2)P(1), in which T and P denote absolute temperature and pressure, respectively, and the numbers denote initial and final readings.

d. During the test, completely isolate the entire system from all compressors and other sources of air pressure. Test each joint by means of soap and water or an equivalent nonflammable solution prior to backfilling or concealing any work. Secure approval of testing instruments from Shaw. Furnish all labor, materials and equipment for conducting the tests subject to inspection at all times during the tests. Maintain safety precautions for air pressure testing at all times during the tests.

3.16 UNDERGROUND WARNING TAPE

A minimum of 3-inch wide polyethylene detectable type marking tape shall be installed above piping. The tape shall be resistant to alkalis, acids and other destructive agents found in soil and impregnated with metal so that it can be readily recognized after burial by standard locating equipment.

A. Lamination bond of one (1) layer of Minimum 0.35 mils thick aluminum foil between two (2) layers of minimum 4.3 mils thick inert plastic film.

B. Minimum tensile strength: 63 LBS per 3 IN width.

C. Minimum elongation: 500 percent.

D. Provide continuous yellow with black letter printed message repeated every 16 to 36 inches warning of pipe buried below (e.g.: "CAUTION GAS LINE BURIED BELOW").

3.17 TRACER WIRE

A minimum of 12 (AWG) (or larger) insulated tracer wire shall be installed in the trench above the polyethylene pipe. The tracer wire shall be approximately 6 inches above the pipe where practical. The tracer wire shall be installed so that electrical continuity is maintained throughout the pipe system. As few connections as possible shall be made in the tracer wire. Connections will be made by stripping the insulation back one inch and joining the two ends using an approved mechanical connector and a split bolt connector. (Twisting of copper wire will not be acceptable.) To complete this connection, wrap all exposed wire thoroughly with electrical tape. A minimum 5 foot of additional tracer wire will be coiled, buried and terminate at the ends of the gas pipeline. Of the 5 foot tracer wire section at the ends of the pipeline, one foot of insulation will be stripped back, prior to burial.

-- End of Section -

BULK FUELS FACILITY (BFF) SOIL VAPOR EXTRACTION AND THERMAL TREATMENT SYSTEM

KIRTLAND AIR FORCE BASE
ALBUQUERQUE, NEW MEXICO

DRAWING INDEX

CIVIL

DRAWING NO.	DRAWING TITLE
C-01	COVER SHEET
C-02	SITE PLAN
C-03	CIVIL DETAILS
C-04	CIVIL DETAILS
C-05	CIVIL DETAILS

STRUCTURAL

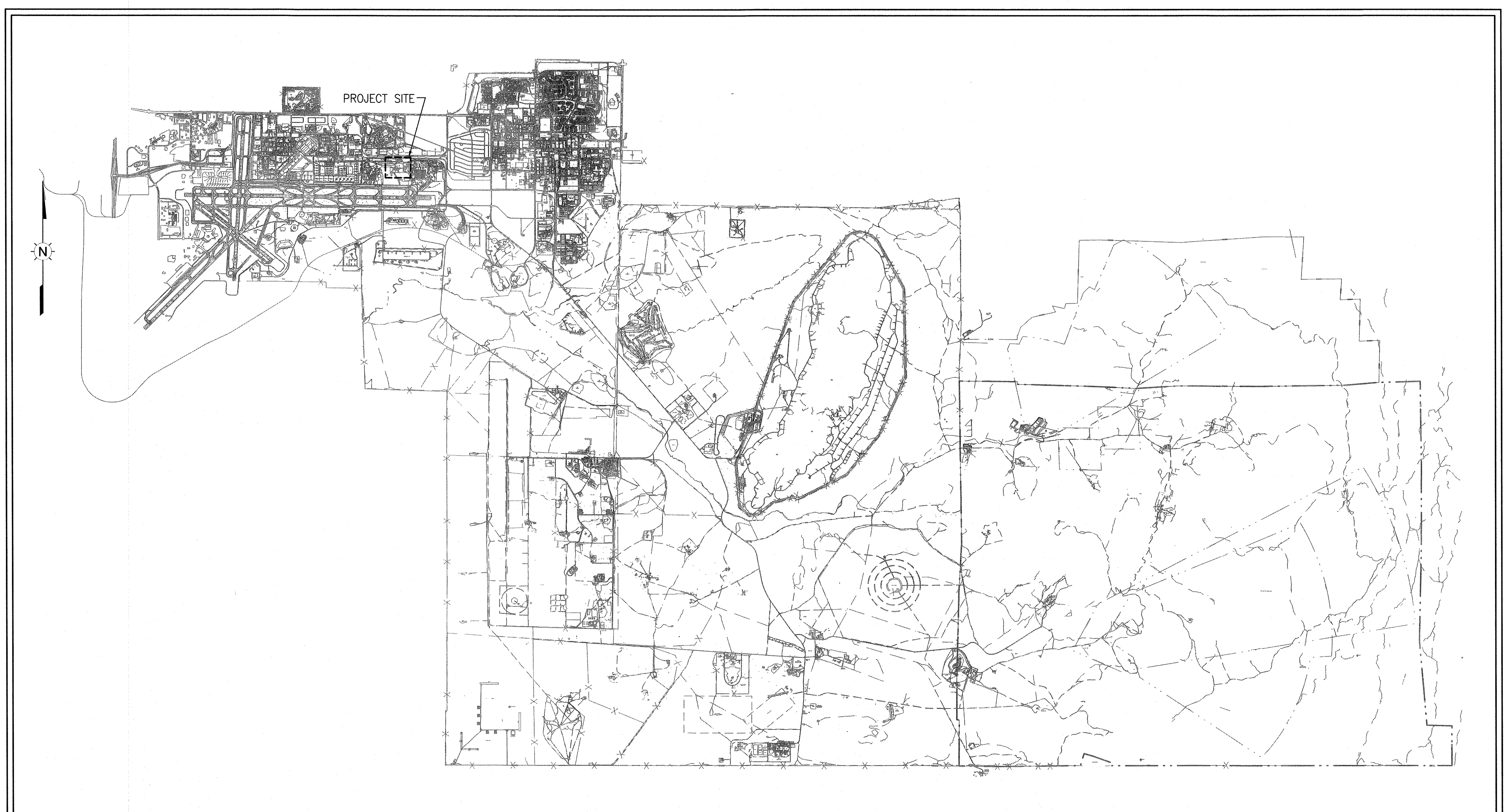
DRAWING NO.	DRAWING TITLE
S-01	STRUCTURAL NOTES
S-02	FOUNDATION PLAN

MECHANICAL

DRAWING NO.	DRAWING TITLE
P-1	PROCESS FLOW DIAGRAM
M-01	MECHANICAL – GENERAL ARRANGEMENT
M-02	MECHANICAL – SECTION VIEW

ELECTRICAL

DRAWING NO.	DRAWING TITLE
E-01	LAYOUT AND ONE LINE DIAGRAM



1/C-1 SITE LOCATION MAP
SCALE: NTS

Revisions			
Symbol	Descriptions	Date	Approved
0	ISSUED FOR CONSTRUCTION	11/05/12	

Shaw Environmental, Inc.

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ALBURQUERQUE, NEW MEXICO

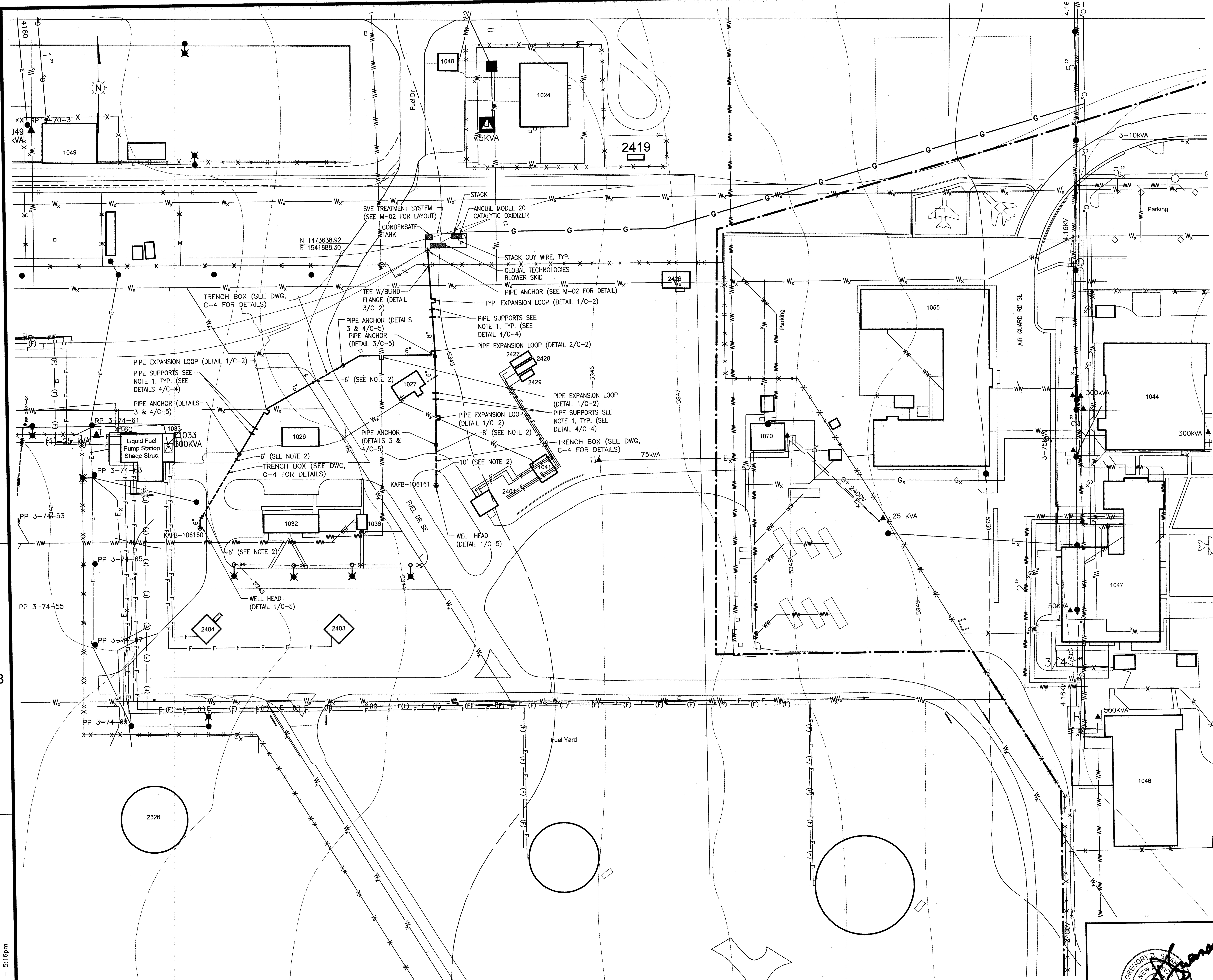
Designed by: JS
Drawn by: JW
Checked by: AS
Reviewed by:
Submitted by:

KIRTLAND AIR FORCE BASE ALBUQUERQUE, NEW MEXICO

BULK FUELS FACILITY (BFF)
SOIL VAPOR EXTRACTION AND
THERMAL TREATMENT SYSTEM
COVER SHEET

Plot Scale Ratio: 1 = 1
Design File: 140705-C01.dwg
Date: 10/11/12
Spec. No.:
Drawing Code:
Contract No.:
Sheet reference number: C-1

File: K:\Kirtland AFB\140705\Civil\Drawing – Design\141705– C01.dwg
Plot Date/Time: Nov 05, 2012 – 5:08pm



LEGEND:

EXISTING

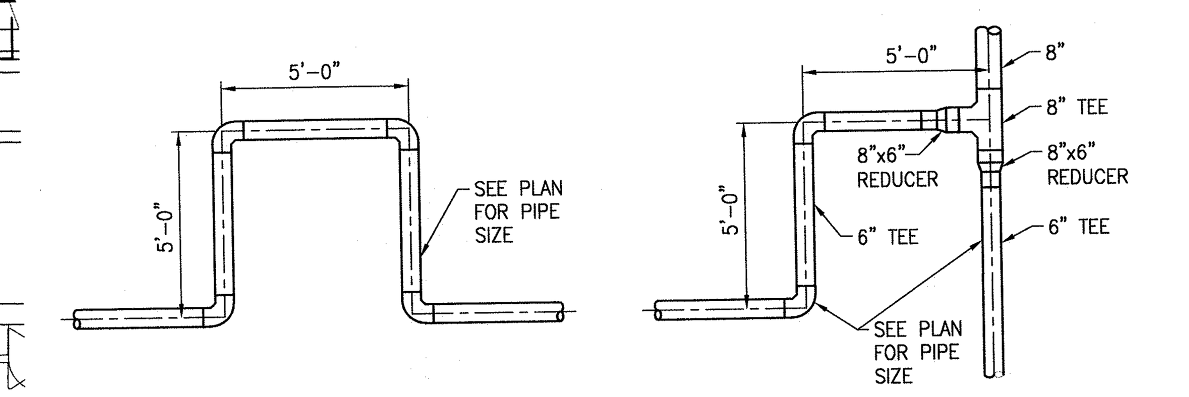
- BUILDING
- ROAD
- FENCE
- 5350 MAJOR CONTOURS
- MINOR CONTOUR
- GAS LINE
- STORM SEWER
- WASTE WATER LINE
- WATER LINE
- ELECTRICAL CABLE
- FUEL LINE
- FORMER FUEL LINE
- INDUSTRIAL WASTE LINE
- T1049 (3)-25 kVA TRANSFORMER
- LIGHT POLE
- POWER POLE

NEW

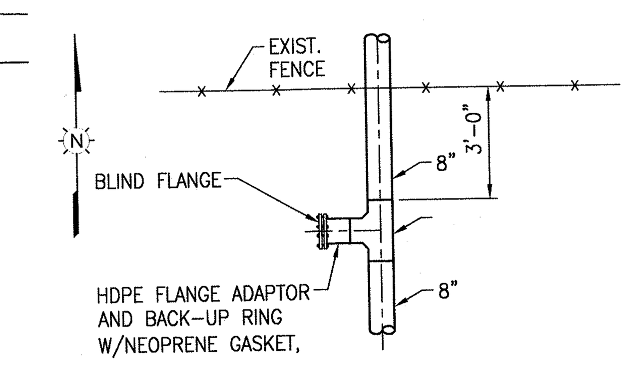
- SVE TREATMENT SYSTEM
- KAFB-106161 EXTRACTION WELLS
- EXTRACTION WELL PIPING IN TRENCH BOX
- EXTRACTION WELL ABOVE GRADE PIPING
- GAS LINE
- PIPE SUPPORTS
- PIPE ANCHOR
- OR EXPANSION LOOP

NOTES:

1. VACUUM PIPING WILL BE SUPPORTED BY 4"x4" PRESSURE TREATED POSTS LAID HORIZONTALLY ON GRADE EXCEPT WHERE NOTED BY PIPE ANCHORS. 6"ø PIPING SHALL BE SUPPORTED EVERY 8'-0" OC. 8"ø PIPING SHALL BE SUPPORTED EVERY 10'-0" OC.
2. MINIMUM DISTANCE REQUIRED FROM EDGE OF PAVED ROAD TO OUTSIDE DIAMETER OF PIPE.



2/C-2 DETAIL PIPE EXPANSION LOOP
SCALE: NTS



3/C-2 DETAIL TEE W/BLIND FLANGE FACING WEST
SCALE: NTS

SCALE: 1"=60'
0 60 120 FEET

Revisions			
Symbol	Descriptions	Date	Approved
0	ISSUED FOR CONSTRUCTION	11/05/12	

Shaw® Shaw Environmental, Inc.

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ALBUQUERQUE, NEW MEXICO

ARCHITECT/ENGINEER SEAL

5 NOV 2012

Designed by: JS	KIRTLAND AIR FORCE BASE ALBUQUERQUE, NEW MEXICO
Drawn by: JW	BULK FUELS FACILITY (BFF) SOIL VAPOR EXTRACTION AND THERMAL TREATMENT SYSTEM SITE PLAN
Checked by: AS	
Reviewed by:	Plot Scale Ratio: 1 = 1 / Date: 10/11/12 / Design File: 140705-C02.dwg / Sheet reference number:
Submitted by:	Spec. No.: / Drawing Code: / Contract No.: / C-2

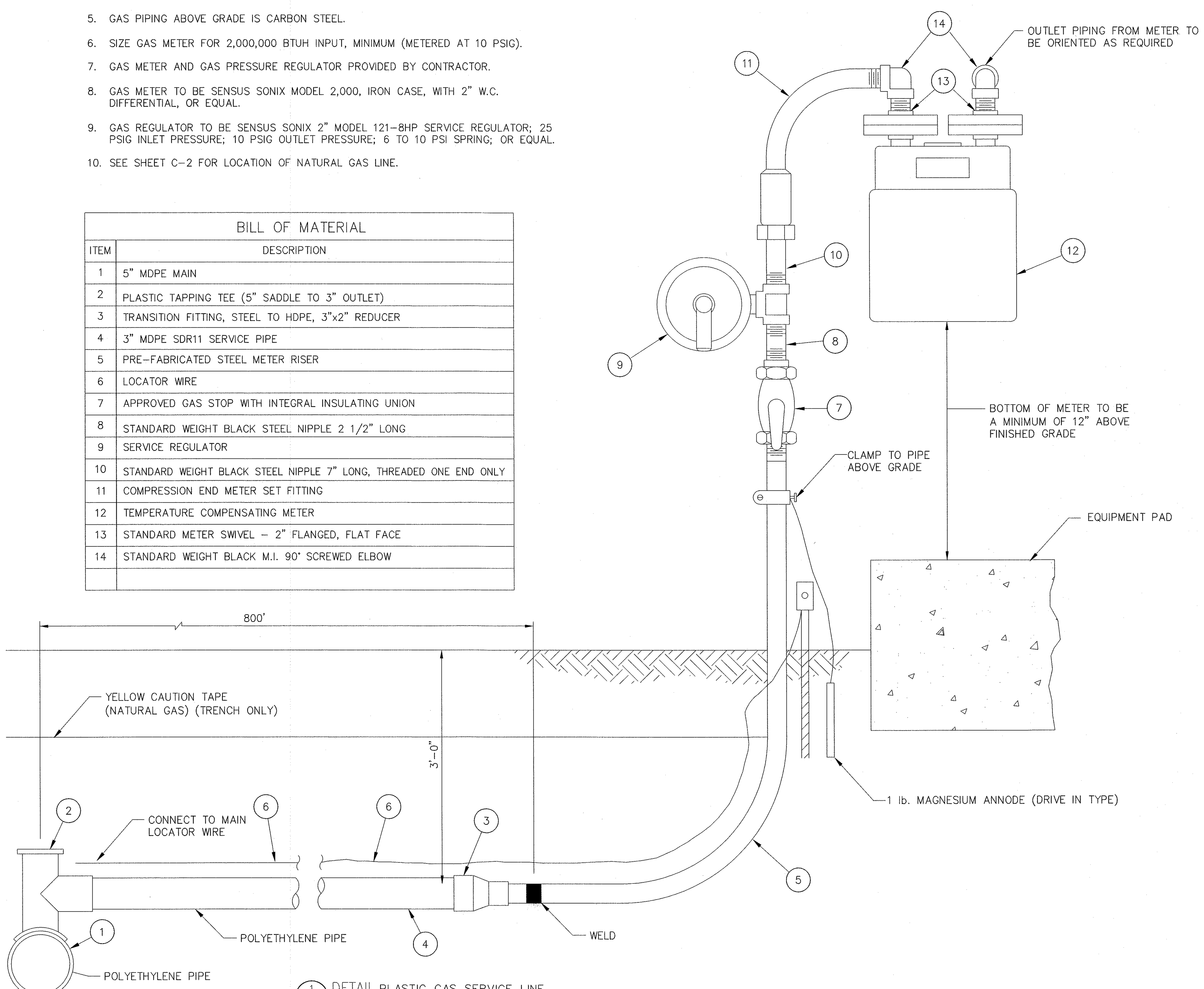
File: K:\Kirtland AFB\140705\Civil\Drawing - Design\141705- C02.dwg
Plot Date/Time: Nov 05, 2012 - 5:16pm

NOTES FOR DETAIL 1:

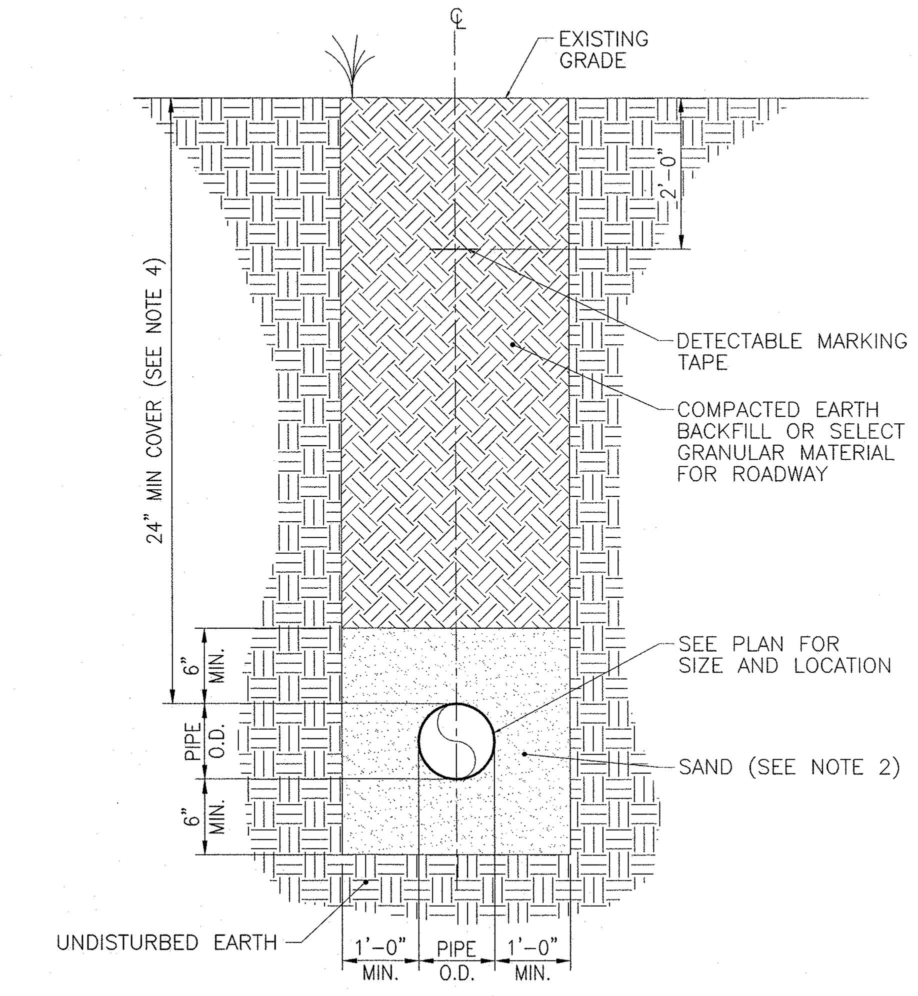
1. PRESSURE AT 5" MAIN IS 25 PSIG.
2. PRESSURE AT OUTLET OF GAS REGULATOR IS 10 PSIG.
3. GAS SERVICE LINE IS BURIED AT A DEPTH OF APPROXIMATELY 3'-0" BELOW GRADE, WITH LOCATION WIRE ON TOP.
4. GAS PIPING BELOW GRADE IS MDPE SDR11.
5. GAS PIPING ABOVE GRADE IS CARBON STEEL.
6. SIZE GAS METER FOR 2,000,000 BTUH INPUT, MINIMUM (METERED AT 10 PSIG).
7. GAS METER AND GAS PRESSURE REGULATOR PROVIDED BY CONTRACTOR.
8. GAS METER TO BE SENSUS SONIX MODEL 2,000, IRON CASE, WITH 2" W.C. DIFFERENTIAL, OR EQUAL.
9. GAS REGULATOR TO BE SENSUS SONIX 2" MODEL 121-8HP SERVICE REGULATOR; 25 PSIG INLET PRESSURE; 10 PSIG OUTLET PRESSURE; 6 TO 10 PSI SPRING; OR EQUAL.
10. SEE SHEET C-2 FOR LOCATION OF NATURAL GAS LINE.

BILL OF MATERIAL

ITEM	DESCRIPTION
1	5" MDPE MAIN
2	PLASTIC TAPPING TEE (5" SADDLE TO 3" OUTLET)
3	TRANSITION FITTING, STEEL TO HDPE, 3"x2" REDUCER
4	3" MDPE SDR11 SERVICE PIPE
5	PRE-FABRICATED STEEL METER RISER
6	LOCATOR WIRE
7	APPROVED GAS STOP WITH INTEGRAL INSULATING UNION
8	STANDARD WEIGHT BLACK STEEL NIPPLE 2 1/2" LONG
9	SERVICE REGULATOR
10	STANDARD WEIGHT BLACK STEEL NIPPLE 7" LONG, THREADED ONE END ONLY
11	COMPRESSION END METER SET FITTING
12	TEMPERATURE COMPENSATING METER
13	STANDARD METER SWIVEL – 2" FLANGED, FLAT FACE
14	STANDARD WEIGHT BLACK M.I. 90° SCREWED ELBOW



1 / C-3 DETAIL PLASTIC GAS SERVICE LINE
SCALE: NTS



TYPICAL UNPAVED
2 / C-3 DETAIL POLYETHYLENE PIPE BEDDING
SCALE: NTS

SECTION & DETAIL KEY
NUMBER FOR SECTION OR DETAIL LABEL
DRAWING ON WHICH SECTION OR DETAIL IS SHOWN

Revisions			
Symbol	Descriptions	Date	Approved
0	ISSUED FOR CONSTRUCTION	11/05/12	

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U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ALBUQUERQUE, NEW MEXICO

GREGORY D. SMITH NEW MEXICO 18367 PROFESSIONAL ENGINEER
5 NOV 2012
ARCHITECT/ENGINEER SEAL

Designed by: MFL	KIRTLAND AIR FORCE BASE ALBUQUERQUE, NEW MEXICO
Drawn by: MFL	BULK FUELS FACILITY (BFF) SOIL VAPOR EXTRACTION AND THERMAL TREATMENT SYSTEM CIVIL DETAILS
Checked by: JTS	
Reviewed by:	Plot Scale Ratio: 1 = 1; Design File: 140705-C3.dwg; Date: 10/11/12; Spec. No.:; Drawing Code:
Submitted by:	Contract No.:

Sheet reference number: C-3

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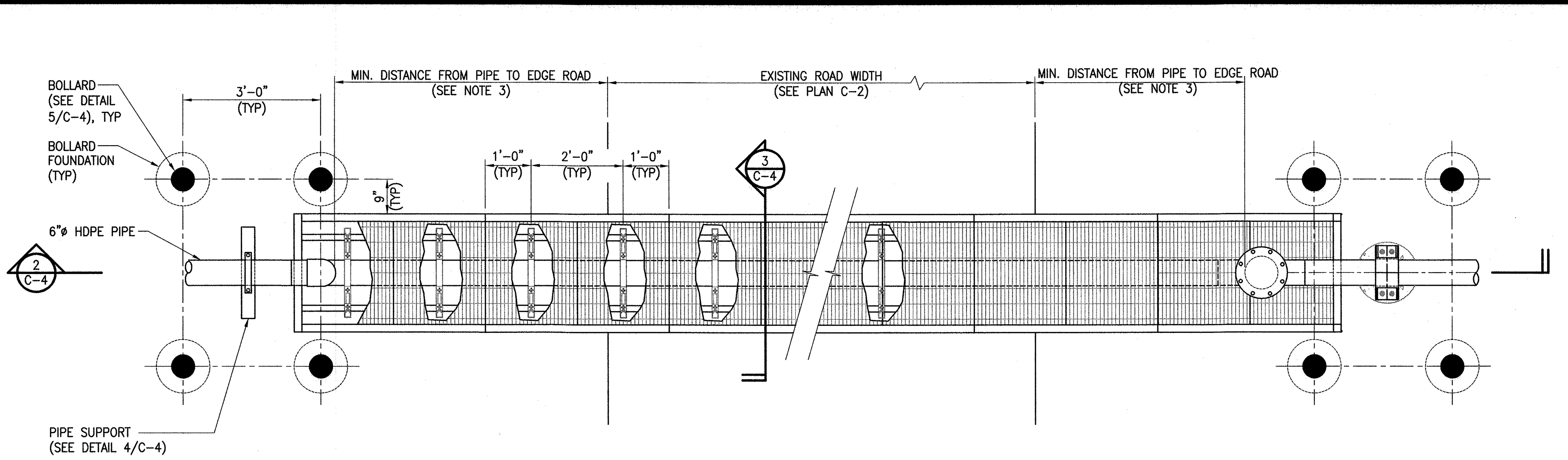
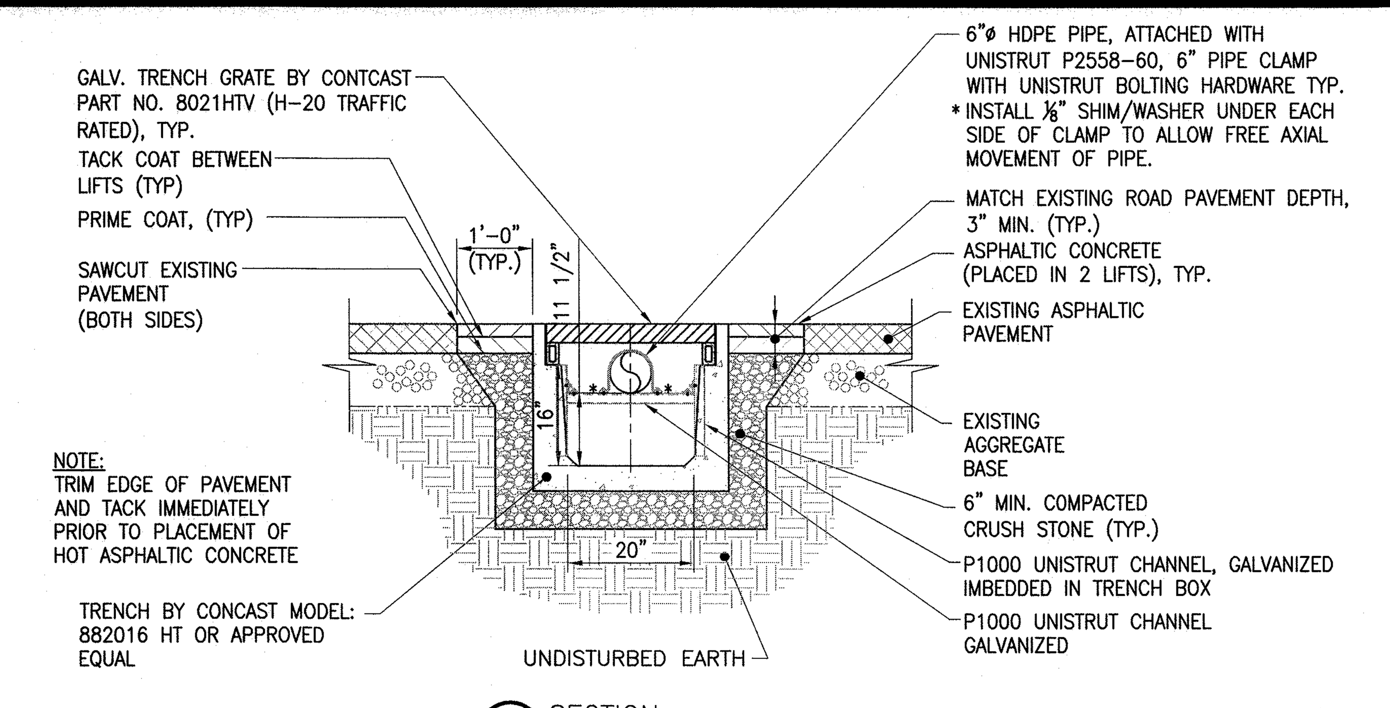
Plot Date/Time: Nov 05, 2012 - 5:09pm



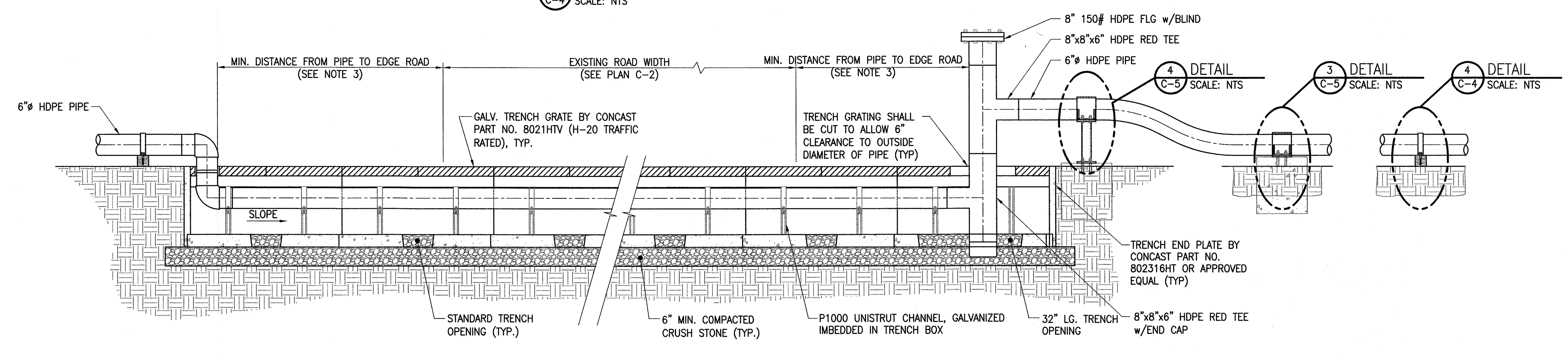
1 C-4 PLAN TRENCH BOX ROAD CROSSING
SCALE: NTS



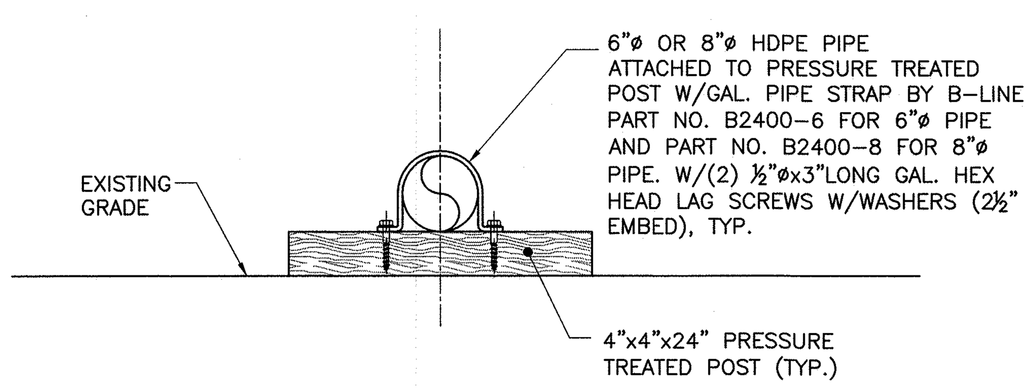
3 C-4 SECTION
SCALE: 1/2"=1'-0"

TRENCH BOX NOTES:

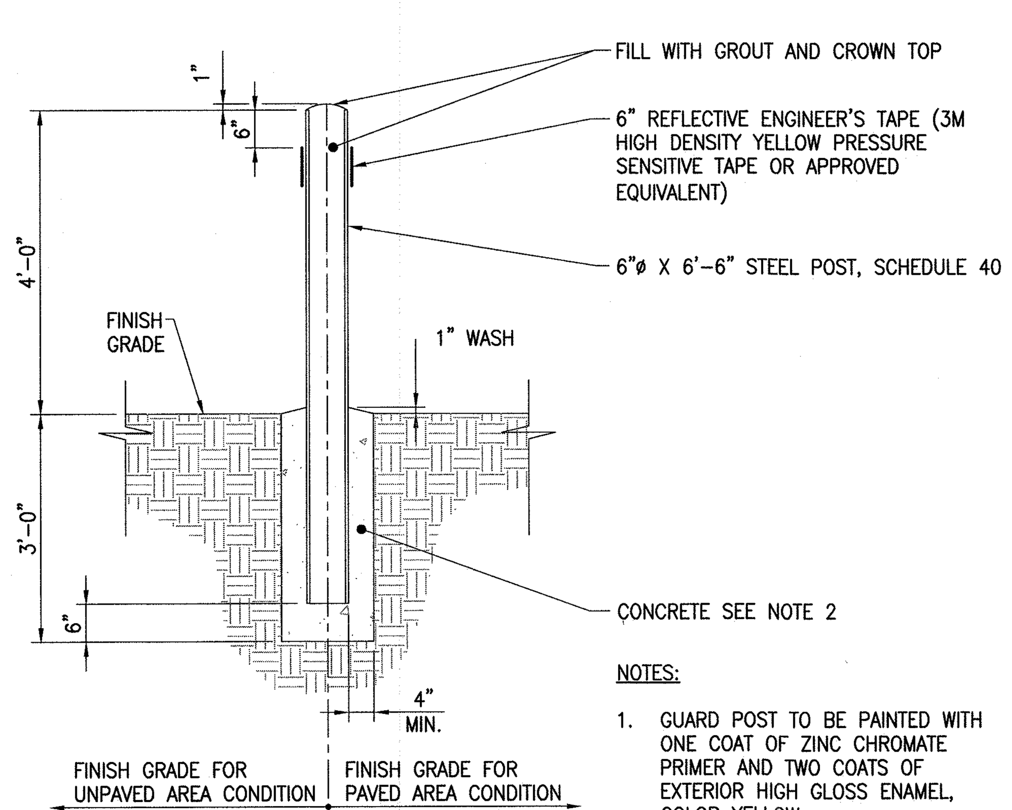
1. TRENCH BOX SHALL BE H-20 RATED, OPEN END, REINFORCED CONCRETE TRENCH BOX WITH STEEL GRATING, BY CONCAST MODEL: 88206 HT, OR APPROVED EQUAL.
2. TRENCH BOX END PLATE SHALL BE SUITED FOR SELECTED TRENCH BOX, BY CONCAST MODEL: 802316 HT.
3. DISTANCE FROM EDGE OF ROAD FOR EACH ROAD CROSSING IS SHOWN ON DRAWING C-2.



2 C-4 SECTION
SCALE: NTS



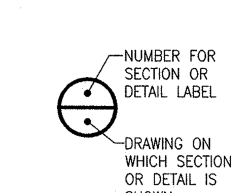
4 C-4 DETAIL TYPICAL PIPE SUPPORT
SCALE: NTS



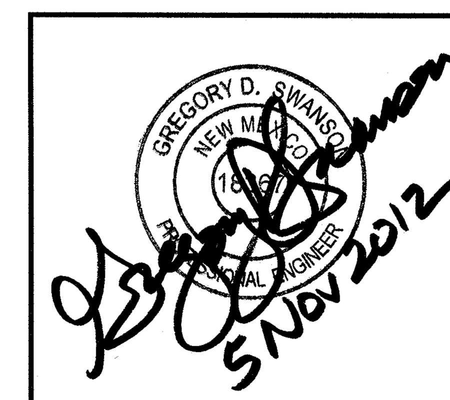
NOTES:

1. GUARD POST TO BE PAINTED WITH ONE COAT OF ZINC CHROMATE PRIMER AND TWO COATS OF EXTERIOR HIGH GLOSS ENAMEL, COLOR YELLOW.
2. SEE DRAWING S-01 FOR CONCRETE SPECIFICATIONS.

5 C-4 DETAIL TYPICAL BOLLARD
SCALE: NTS



SECTION & DETAIL KEY



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Revisions			
Symbol	Descriptions	Date	Approved
0	ISSUED FOR CONSTRUCTION	11/05/12	

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U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ALBUQUERQUE, NEW MEXICO

Designed by: MFL	KIRTLAND AIR FORCE BASE — ALBUQUERQUE, NEW MEXICO
Drawn by: JW	BULK FUELS FACILITY (BFF) SOIL VAPOR EXTRACTION AND THERMAL TREATMENT SYSTEM CIVIL DETAILS
Checked by: JTS	
Reviewed by:	Plot Scale Ratio: 1 = 1 · Date: 08/02/12 · Design File: 140705-C4.dwg · Spec. No.: · Drawing Code:
Submitted by:	Contract No.: · Sheet reference number: C-4

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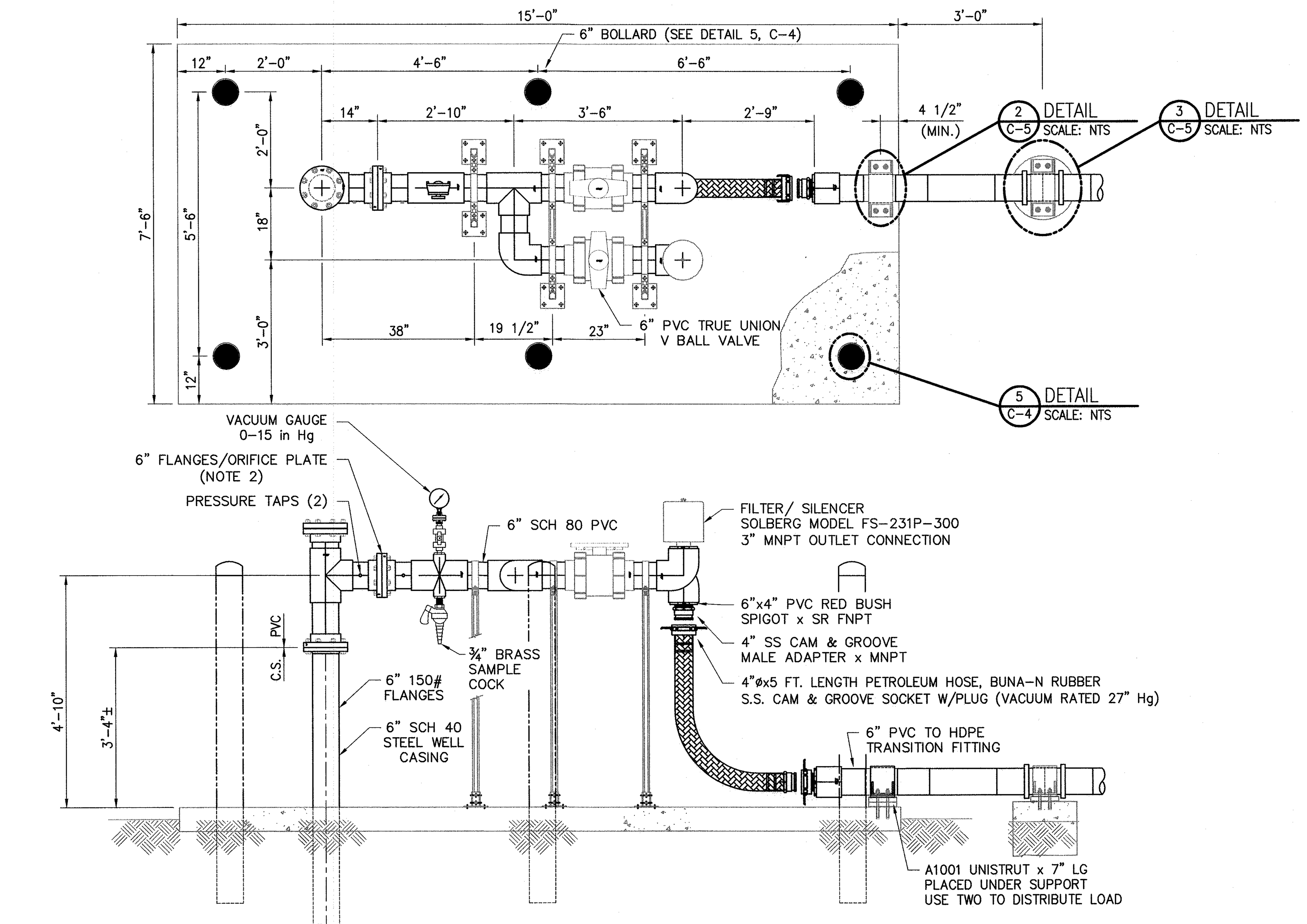
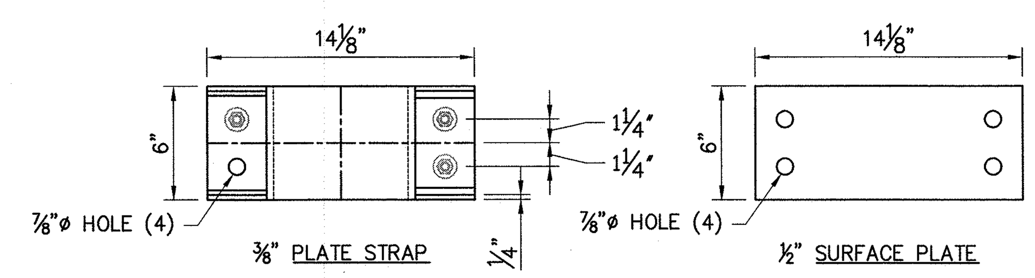
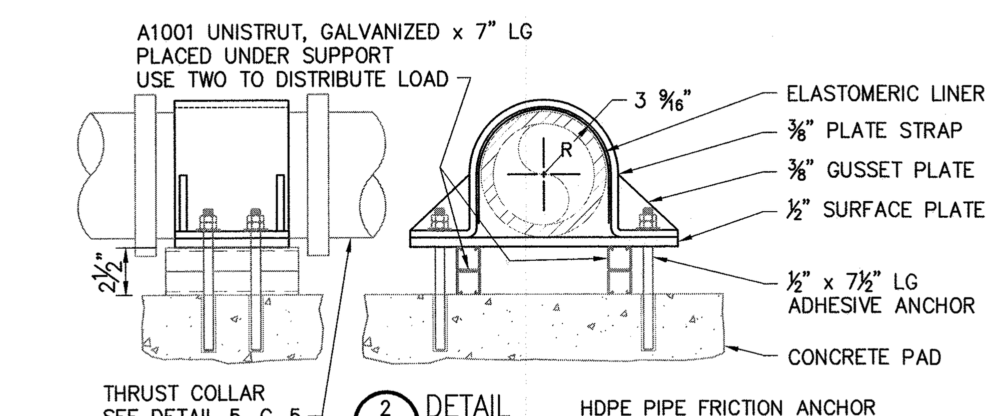
Plot Date/Time: Nov 05, 2012 — 5:10pm

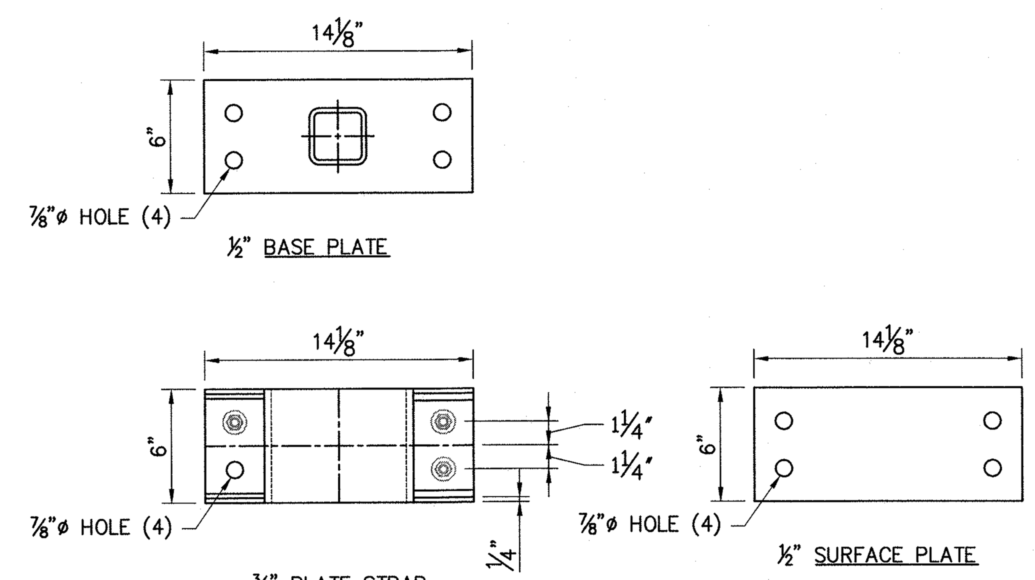


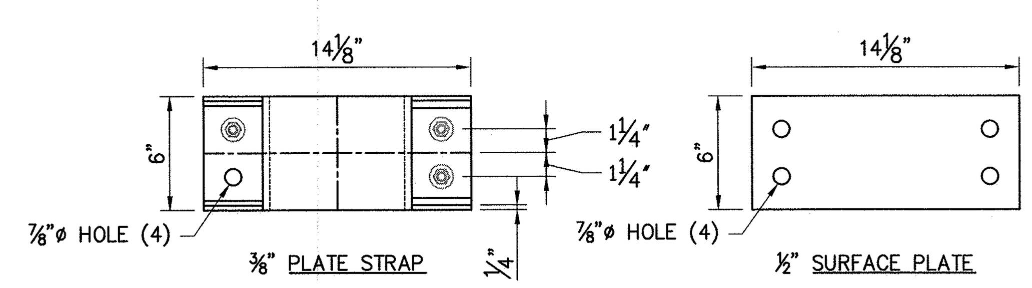
1 DETAIL WELL HEAD
C-5 SCALE: NTS

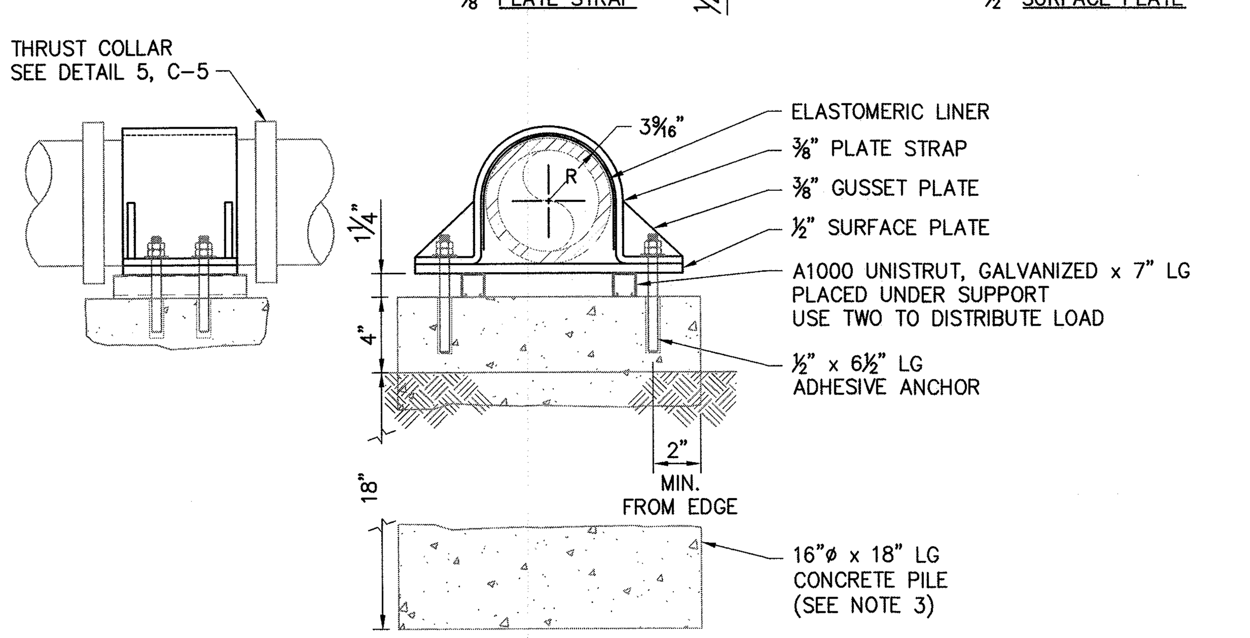




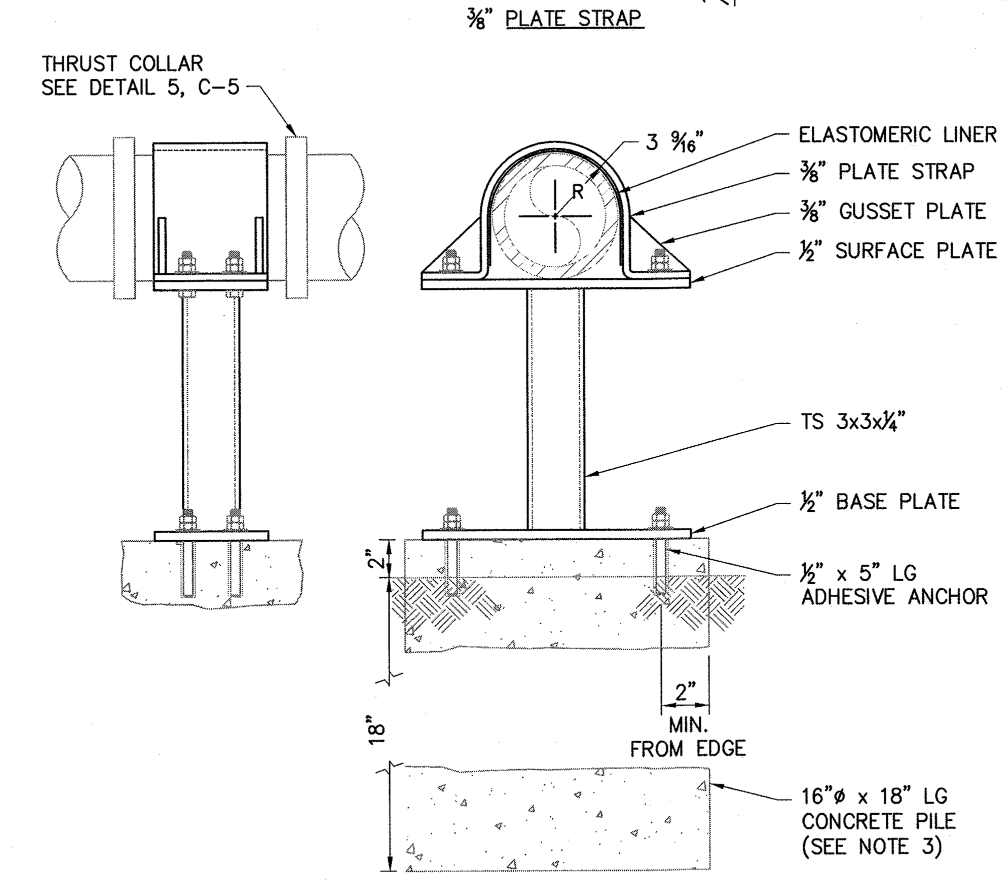
2 DETAIL HDPE PIPE FRICTION ANCHOR
C-5 SCALE: NTS (SEE C-2 FOR LOCATIONS)



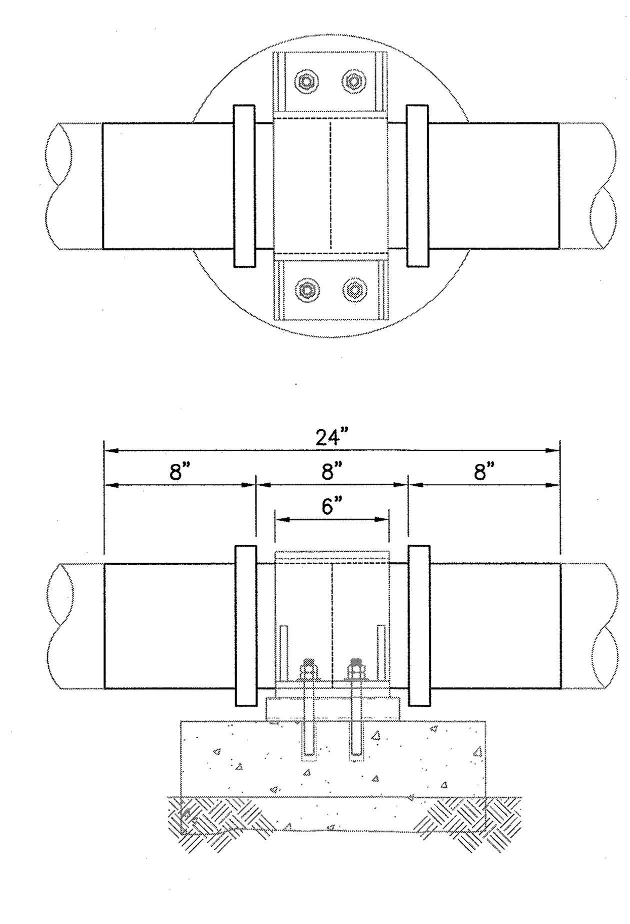




3 DETAIL HDPE PIPE FRICTION ANCHOR
C-5 SCALE: NTS (SEE C-2 FOR LOCATIONS)



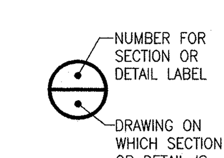
4 DETAIL HDPE PIPE FRICTION ANCHOR
C-5 SCALE: NTS



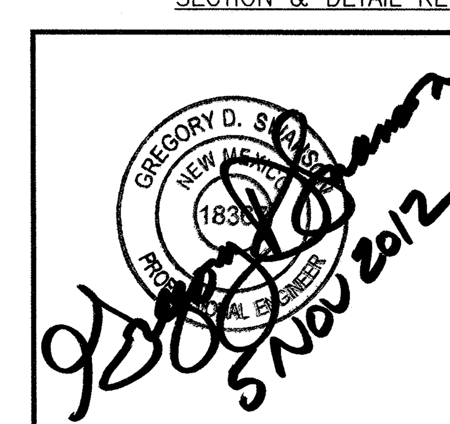
5 DETAIL HDPE PIPE THRUST COLLAR
C-5 SCALE: NTS

WELL HEAD NOTES:

1. VACUUM PIPING INSTRUMENT AND VALVE CLUSTER SHALL BE FIELD SUPPORTED WITH UNISTRUT SUPPORTS AND STRAPPING..
2. MEASUREMENT DEVICE SHALL BE AN ORIFICE PLATE TO FIT A 6" FLANGE.
3. SEE DRAWING S-01 FOR CONCRETE SPECIFICATIONS.



SECTION & DETAIL KEY



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Revisions			
Symbol	Descriptions	Date	Approved
0	ISSUED FOR CONSTRUCTION	11/05/12	

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ALBUQUERQUE, NEW MEXICO

Designed by: MFL	KIRTLAND AIR FORCE BASE ALBUQUERQUE, NEW MEXICO BULK FUELS FACILITY (BFF) SOIL VAPOR EXTRACTION AND THERMAL TREATMENT SYSTEM CIVIL DETAILS		
Drawn by: MFL			
Checked by: JTS			
Reviewed by:	Plot Scale Ratio: 1 = 1 Design File: 140705-C5.dwg	Date: 09/07/12	Sheet reference number:
Submitted by:	Spec. No.: Contract No.:	Drawing Code:	C-5

File: K:\Kirtland AFB\140705\Civil\Drawing - Design\141705- C05.dwg
Plot Date/Time: Nov 05, 2012 - 5:11pm

STRUCTURAL SYSTEM DESCRIPTION:

THE EXTENT OF NEW CONSTRUCTION FOR THIS PROJECT INCLUDES AN 18'-0" x 53'-0" CAST-IN-PLACE CONCRETE SLAB-ON-GRADE AND ISOLATED SPREAD FOUNDATIONS AND GUY-WIRE ANCHOR FOOTINGS TO SUPPORT SOIL VAPOR EXTRACTION TREATMENT EQUIPMENT, INCLUDING A CANTILEVER STACK STRUCTURE. STRUCTURAL DRAWINGS S-01 AND S-02 INCLUDE THE DESIGN OF THE CONCRETE FOUNDATION CONSTRUCTION CONSISTING OF A CONCRETE SLAB AND ISOLATED FOOTINGS. ENGINEER IS NOT RESPONSIBLE FOR ANY PORTION OF THE WORK OTHER THAN THAT OUTLINED ABOVE. THE DESIGN ADEQUACY OF THE EQUIPMENT BASES FRAME (SKID) AND STACK STRUCTURE INCLUDING BASE PLATE, GUY-WIRES AND ASSOCIATED HARDWARE INCLUDING ANCHORAGE OF ALL EQUIPMENT AND THE STACK STRUCTURE IS THE RESPONSIBILITY OF THE EQUIPMENT VENDOR.

CODES, GUIDES, SPECIFICATIONS AND REFERENCES:

ACI 318	BUILDING CODE REQUIREMENTS FOR REINFORCED CONCRETE
ACI 301	SPECIFICATIONS FOR STRUCTURAL CONCRETE
ACI	MANUAL OF CONCRETE PRACTICE
ASCE/SEI 7	MINIMUM DESIGN LOADS FOR BUILDINGS AND OTHER STRUCTURES
CRSI	CODE OF STANDARD PRACTICE
IBC 2009	INTERNATIONAL BUILDING CODE = GOVERNING BUILDING CODE
UFC	UNIFIED FACILITIES CRITERIA 1-200-01, GENERAL BUILDING REQUIREMENTS
UFC	UNIFIED FACILITIES CRITERIA 3-310-01, STRUCTURAL LOAD DATA

ABBREVIATIONS:

ACI = AMERICAN CONCRETE INSTITUTE
A.F.F. = ABOVE FINISHED FLOOR
B.F.F. = BELOW FINISHED FLOOR
B.F.G. = BELOW FINISHED GRADE
C.J. = CONTROL/CONTRACTION OR CONSTRUCTION JOINT
C.L. = CENTER LINE
CONT. = CONTINUOUS LENGTH
CRSI = CONCRETE REINFORCING STEEL INSTITUTE
NS & FS = NEAR SIDE AND FAR SIDE
O.C. AND C.C. = CENTER TO CENTER SPACING
SYMM. = SYMMETRICAL
T&B = TOP & BOTTOM
U.N.O. = UNLESS NOTED OTHERWISE
UFC = UNIFIED FACILITIES CRITERIA
V.I.F. = VERIFY IN FIELD

DESIGN LOADS:

1. GRAVITY LOADS:
   CONCRETE SLAB-ON-GRADE:
   UNIFORM LIVE LOAD = 125 PSF
   CONCENTRATED LIVE LOAD = 3000 LB FORCE ACTING ON 36 SQ. IN. AREA
2. SNOW LOADS:
   GROUND SNOW LOAD = 10 PSF
3. WIND LOADS:
   BASIC WIND SPEED = 100 MPH
   WIND IMPORTANCE FACTOR = 1.15
   OCCUPANCY CATEGORY = III
   WIND EXPOSURE = C
4. SEISMIC LOADS (CANTILEVER STACK):
   SEISMIC IMPORTANCE FACTOR = 1.25
   OCCUPANCY CATEGORY = III
   Ss = 0.550
   S1 = 0.170
   SITE CLASS = D
   Sds = 0.500
   Sd1 = 0.240
   SEISMIC DESIGN CATEGORY = D
   ANALYSIS PROCEDURE = NONSTRUCTURAL COMPONENT DESIGN
   DESIGN BASE SHEAR:
   OXIDIZER STACK = 390 LBS

SPECIAL LOADS:

1. BLOWER SKID = 9300 LBS
2. OXIDIZER SKID = 6000 LBS
3. OXIDIZER STACK = 1850 LBS

FOUNDATION NOTES:

1. FOUNDATIONS HAVE BEEN DESIGNED BASED ON AN ASSUMED SOIL BEARING CAPACITY OF 2000 PSF. FOUNDATIONS HAVE BEEN DESIGNED TO BEAR ON MATERIAL WHICH PROVIDES EVEN UNIFORM SUPPORT OF SHALLOW SPREAD AND CONTINUOUS FOOTINGS. SHOULD SUBSTANDARD SOIL CONDITIONS BE DISCOVERED, REMOVE MATERIAL AS REQUIRED AND PROVIDE ENGINEERED BACKFILL BELOW FOUNDATION BEARING AS REQUIRED TO PREVENT DIFFERENTIAL SETTLEMENT. DEPTH AND INSTALLATION REQUIREMENTS OF COMPACTED BACKFILL AS WELL AS VERIFICATION OF ALLOWABLE SOIL BEARING CONDITIONS SHALL BE PROVIDED BY A GEOTECHNICAL ENGINEER REGISTERED AND IN GOOD STANDING IN THE STATE OF NEW MEXICO PRIOR TO INSTALLATION OF REINFORCING OR CASTING OF CONCRETE.
2. ALL EXCAVATIONS FOR FOUNDATION BEARING SHALL BE APPROVED BY GEOTECHNICAL ENGINEER PRIOR TO PLACEMENT OF CONCRETE AND REINFORCING. PROVIDE PROTECTIVE MEASURES TO COVER EXCAVATIONS SUBJECT TO RAINFALL IN AREAS THAT MUST REMAIN OPEN. IN THE EVENT EXCAVATIONS FILL WITH WATER, PROVIDE DEWATERING MEASURES AS REQUIRED TO THOROUGHLY REMOVE ALL STANDING WATER PRIOR TO CONSTRUCTION OF FOUNDATION. AT CONTRACTOR'S OPTION, THE EXCAVATIONS SHALL BE UNDERCUT AND A 3" THICK MUD MAT OF 2000 PSI "CLSM" CONCRETE PLACED IN THE BOTTOM TO PROTECT THE BEARING SOILS.
3. THE GEOTECHNICAL ENGINEER SHALL MONITOR EXCAVATION AND BACKFILLING OPERATIONS TO VERIFY THAT THE DESIGN PARAMETERS LISTED HEREIN ARE OBTAINED DURING CONSTRUCTION. THE ENGINEER SHALL BE NOTIFIED OF DEFICIENCIES PRIOR TO ANY SUBSEQUENT CONSTRUCTION.
4. CONCRETE FOUNDATION CONSTRUCTION HAS BEEN DESIGNED ASSUMING THE FOLLOWING MINIMUM SOIL PROPERTIES:

   UNIT WEIGHT OF SOIL = 110 PCF

   PASSIVE PRESSURE COEFFICIENT = 3.0

   MODULUS OF SUB-GRADE REACTION "k" FOR DESIGN OF SLAB-ON-GRADE = 150 PCI

   A COEFFICIENT OF FRICTION AGAINST SLIDING OF 0.40 WAS ASSUMED FOR DESIGN OF FOUNDATIONS. GEOTECHNICAL ENGINEER TO VERIFY ALL ASSUMPTIONS USED FOR DESIGN AND NOTIFY ENGINEER IN WRITING OF ANY DISCREPANCIES OR DEFICIENCIES PRIOR TO START OF FOUNDATION/SLAB INSTALLATION. GEOTECHNICAL ENGINEER SHALL ALSO PROVIDE ANY REQUIREMENTS NECESSARY TO DESCRIBE SITE PREPARATION AND FOUNDATION CONSTRUCTION TECHNIQUES. GEOTECHNICAL ENGINEER'S REPORT SHALL SATISFY ALL REQUIREMENTS OF IBC 2009, SECTION 1803.1 AND THE GOVERNING BUILDING OFFICIAL.

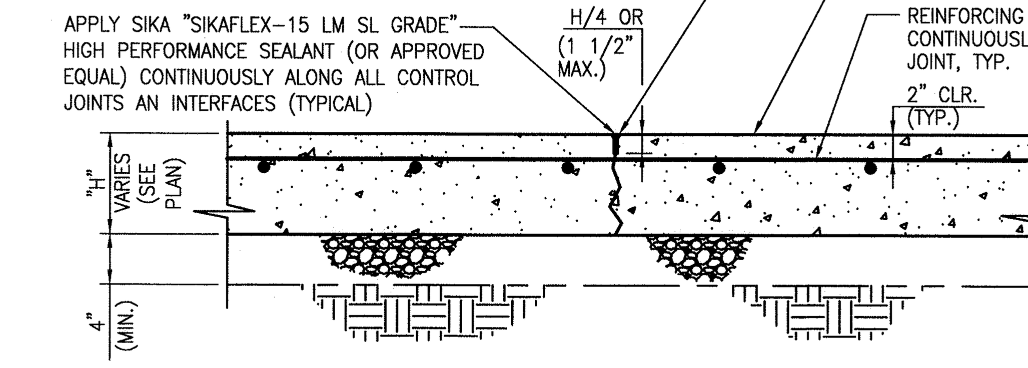
GENERAL NOTES:

1. ALL DESIGN AND CONSTRUCTION SHALL CONFORM TO THE REQUIREMENTS OF THE INTERNATIONAL BUILDING CODE, 2009.
2. THE DESIGN AND SAFETY OF BRACING, TEMPORARY SUPPORTS, OPEN EXCAVATIONS, MEANS AND METHODS OF CONSTRUCTION AND SEQUENCES OF BUILDING ERECTION FOR ALL WORK IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR DURING CONSTRUCTION.
3. SUBMITTALS: AT A MINIMUM THE FOLLOWING ITEMS SHALL BE SUBMITTED TO THE ENGINEER FOR REVIEW AND APPROVAL PRIOR TO INSTALLATION OR FABRICATION OF MATERIALS:
   - CONCRETE MIX DESIGN
   - REINFORCING STEEL SHOP DRAWINGS FOR CAST-IN-PLACE CONCRETE
4. THE CONTRACTOR SHALL INVESTIGATE ACTUAL LOCATION OF EXISTING UNDERGROUND LINES AND UTILITIES BEFORE EXCAVATING AND ADVISE THE ENGINEER OF ANY INTERFERENCES. ALL EXCAVATIONS NEAR EXISTING LINES SHALL BE PERFORMED WITH EXTREME CAUTION.
5. CONTRACTOR SHALL COORDINATE STRUCTURAL DRAWINGS WITH DRAWINGS OF OTHER DISCIPLINES AND SHOP/VENDOR DRAWINGS RELATED TO OTHER TRADES. VERIFY DIMENSIONS, ANCHORAGE LAYOUT/DETAILS AND WEIGHT OF ACTUAL EQUIPMENT PURCHASED OR OWNER FURNISHED EQUIPMENT WITH DETAILS AND MAXIMUM WEIGHTS SHOWN ON DRAWINGS. NOTIFY THE ENGINEER OF ANY DISCREPANCIES PRIOR TO FABRICATION OR INSTALLATION.
6. ALTERNATE PRODUCTS DESIGNATED AS "APPROVED EQUAL" MUST HAVE GOVERNING BUILDING CODE ACCEPTANCE AND BE SUBMITTED AND APPROVED IN WRITING BY THE ENGINEER PRIOR TO ORDERING OR FABRICATION OF MATERIALS. ALTERNATE PRODUCTS OR MATERIALS INSTALLED WITHOUT PRIOR WRITTEN APPROVAL ARE SUBJECT TO REMOVAL AND REPLACEMENT AT CONTRACTOR'S EXPENSE.

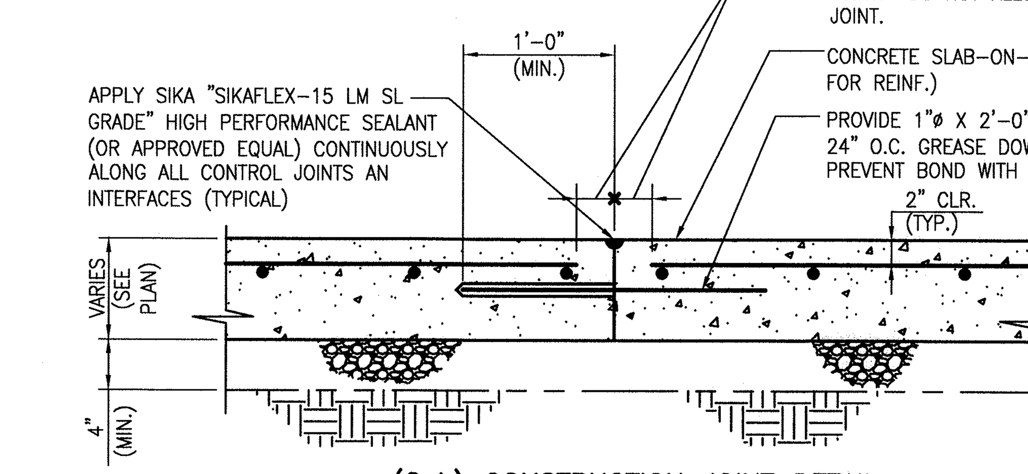
CONCRETE:

1. DESIGN AND CONSTRUCTION PER ACI 318, 301, AND THE GOVERNING BUILDING CODE.
   CONCRETE NOT EXPOSED TO WEATHER:
   NORMAL WEIGHT, 28 DAY COMPRESSIVE STRENGTH = 4000 PSI MINIMUM
   TYPE I PORTLAND CEMENT. AGGREGATE PER ASTM C33 WITH MAX. SIZE = 1"
   WATER CEMENT RATIO = 0.45 (MAXIMUM)
   SLUMP LIMITS = 1" TO 3" (SLUMP WITHOUT ADMIXTURE). FOR CONCRETE WITH WATER REDUCING ADMIXTURES ADDED, MAXIMUM SLUMP SHALL NOT EXCEED 8" WITH ADMIXTURE.
   FLY-ASH MEETING ASTM C618 MAY BE SUBSTITUTED FOR MAXIMUM 20% OF THE REQUIRED PORTLAND CEMENT BY WEIGHT WITH PRIOR ENGINEER APPROVAL.
2. CONCRETE SUPPLIER NOTE: PROVIDE NON-CHLORIDE, WATER REDUCING AND ACCELERATING CONCRETE ADMIXTURE CONFORMING TO ASTM C 494, TYPE C AND E FOR HIGH EARLY STRENGTH. PROVIDE DOSING AND EVIDENCE OF PERFORMANCE IN CONCRETE MIX DESIGN SUBMITTAL WITH TEST DATA TO SUPPORT MIX DESIGN, SEE NOTE #7 BELOW.
3. CONTRACTOR SHALL PROVIDE CURING METHODS NOT LIMITED TO MOIST CURING OR INCORPORATION OF A CURING COMPOUND WHICH IS NOT A CURING/SLEALER COMPOUND. PROVIDE SUBMITTAL OF PROPOSED CURING METHODS TO ENGINEER FOR APPROVAL.
4. CONCRETE EXPOSED TO WEATHERING: SAME MIX AS CONCRETE NOT EXPOSED TO WEATHER WITH THE ADDITION OF 3% TO 6% ENTRAINED AIR CONFORMING TO ASTM C260. WATER CEMENT RATIO = 0.45, SLUMP LIMITS – 1" TO 3" (SLUMP WITHOUT ADMIXTURE)
5. REINFORCING BARS TO BE DEFORMED BARS, ASTM A615 GR. 60 (F_y = 60 KSI)
6. ALL JOB SITE STRUCTURAL CONCRETE SHALL BE PROVIDED BY A SUPPLIER CERTIFIED BY THE NATIONAL READY-MIX CONCRETE ASSOCIATION IN ACCORDANCE WITH ASTM C94.
7. CONCRETE SHALL BE PLACED WITHIN 1 1/2 HOURS OF MIXING. DELIVERY TIMES FOR CONCRETE IS REDUCED WHEN AIR TEMPERATURE EXCEEDS 85-DEG. F. WATER ABOVE THE AMOUNTS CALLED FOR IN THE SUPPLIERS APPROVED MIX DESIGN SHALL NOT BE ADDED WITHOUT APPROVAL OF THE ENGINEER.
8. CONTRACTOR NOTE: CONCRETE SUPPLIER SHALL PROVIDE MIX DESIGNS CONTAINING THE FOLLOWING INFORMATION TO THE ENGINEER FOR APPROVAL: COMPRESSIVE STRENGTH, WATER CEMENT RATIOS, FLY ASH CONTENT, PORTLAND CEMENT TYPE, FLY ASH TYPE, AGGREGATE SIZE, DATED TEST RESULTS AS OUTLINED AS SPECIFIED ACCORDING TO MINIMUM REQUIREMENTS OF ACI 301 AND ACI 318, CHAPTER 5, AND ANY ADMIXTURES PROPOSED FOR THE SPECIFIC MIX. **MIX DESIGNS THAT DO NOT CONTAIN THE PRECEDING INFORMATION WILL NOT BE APPROVED BY THE ENGINEER. CONCRETE PLACED WITHOUT PRIOR APPROVAL OF THE MIX SHALL BE REMOVED AT THE CONTRACTOR'S EXPENSE.**
9. CONTRACTOR SHALL PROVIDE ALL QUALITY ASSURANCE EVALUATIONS AND TESTS OF ALL CONCRETE PLACED FOLLOWING THE MINIMUM REQUIREMENTS OF ACI 301.
10. CONCRETE REINFORCING SHALL BE DETAILED AND THE CHECKED SHOP DRAWINGS SUBMITTED FOR ENGINEER APPROVAL PRIOR TO FABRICATION. SUBMIT ONE SET OF REPRODUCIBLE COPIES AND ONE SET OF PRINTS.
11. UNLESS OTHERWISE SHOWN OR NOTED, REINFORCING SHALL BE PLACED TO PROVIDE THE FOLLOWING CLEAR COVER (FACE OF CONCRETE TO FACE OF REINFORCING) 3" FOR CONCRETE CAST AGAINST GROUND, 2" FOR CAST IN FORMS AND EXPOSED TO WEATHER OR GROUND, AND 1½" FOR ALL OTHER CONDITIONS.
12. ALL CONCRETE AND REINFORCING SHALL BE PLACED AND CURED IN ACCORDANCE WITH ACI MANUAL OF CONCRETE PRACTICE AND CRSI CODE OF STANDARD PRACTICE. TOLERANCES FOR CONCRETE CONSTRUCTION SHALL CONFORM TO ACI 117.
13. FORMWORK SHALL CONFORM TO ACI 347.
14. HOT WEATHER CONCRETING SHALL CONFORM TO ACI 305R. COLD WEATHER CONCRETING SHALL CONFORM TO ACI 306.1.
15. UNLESS NOTED OR DETAILED OTHERWISE, ALL REINFORCING STEEL TO BE SPLICED PER REQUIREMENTS OF ACI 318 CLASS "B" TENSION SPLICE.
16. AT ALL STRUCTURALLY REINFORCED SLABS CORNERS AND REENTRANT CORNERS, PROVIDE ADDITIONAL #4 DIAGONAL REINFORCING BARS AT EACH CORNER IN THE SLAB, SEE TYPICAL DETAIL, THIS SHEET. CENTER BARS ON CORNER AND ORIENT AT 45-DEGREES TO PRIMARY REINFORCING AS INDICATED. PROVIDE BARS IN THE TOP AND BOTTOM FACE OF SLABS-ON-GRADE WHERE INDICATED, TYPICAL.
17. VERIFY SIZE AND LOCATION OF ALL MECHANICAL AND ELECTRICAL OPENINGS AND/OR SLEEVES AND EQUIPMENT PADS WITH THE MECHANICAL AND ELECTRICAL EQUIPMENT DETAILS AND SHOP DRAWINGS.
18. REFER TO DRAWINGS OF OTHER DISCIPLINES AND VENDOR DRAWINGS FOR EMBEDDED ITEMS AND RECESSES NOT SHOWN ON THE STRUCTURAL DRAWINGS.
19. REINFORCING STEEL SHALL BE ACCURATELY PLACED AND FIRMLY HELD IN THE POSITIONS SPECIFIED. REINFORCING SHALL BE HELD IN PLACE WITH APPROVED BOLSTERS, CHAIRS AND SPACERS. CHAIR SPACING SHALL NOT EXCEED FOUR-FEET IN EITHER DIRECTION. THE USE OF PLASTIC CHAIRS, PRECAST CONCRETE, STONE, BRICK, CMU, METAL PIPE, WOODEN BLOCKS OR ANY OTHER FOREIGN OBJECTS IS NOT PERMITTED. WELDING OF REINFORCING STEEL IS NOT PERMITTED.

NOTE:
1. ALL SLAB-ON-GRADE JOINT CONSTRUCTION SHOULD BE LOCATED AS REQUIRED TO PROVIDE A MAXIMUM DISTANCE BETWEEN JOINTS OF 20'-0". THE RESULTING PANELS SHOULD BE APPROXIMATELY SQUARE; ELONGATED AND L-SHAPED PANELS SHOULD BE AVOIDED.
2. JOINT SEALING OF SLAB CONSTRUCTION SHOULD BE DEFERRED 30 DAYS AFTER SLAB IS CAST TO ALLOW FOR CONCRETE SHRINKAGE. PROVIDE BACKER ROD SUCH THAT DEPTH OF SEALANT IS 1/2" MAXIMUM AT ALL JOINT LOCATIONS AS REQ'D. JOINTS SHOULD BE COMPLETELY FREE OF CONCRETE DUST/DEBRIS AND SHOULD BE CLEANED TO THEIR FULL DEPTH OR 2" MINIMUM PRIOR TO INSTALLATION OF BACKER MATERIAL AND FLEXIBLE JOINT SEALANT. INSTALL SEALANT FOLLOWING ALL MANUFACTURER'S REQUIREMENTS, TYP.

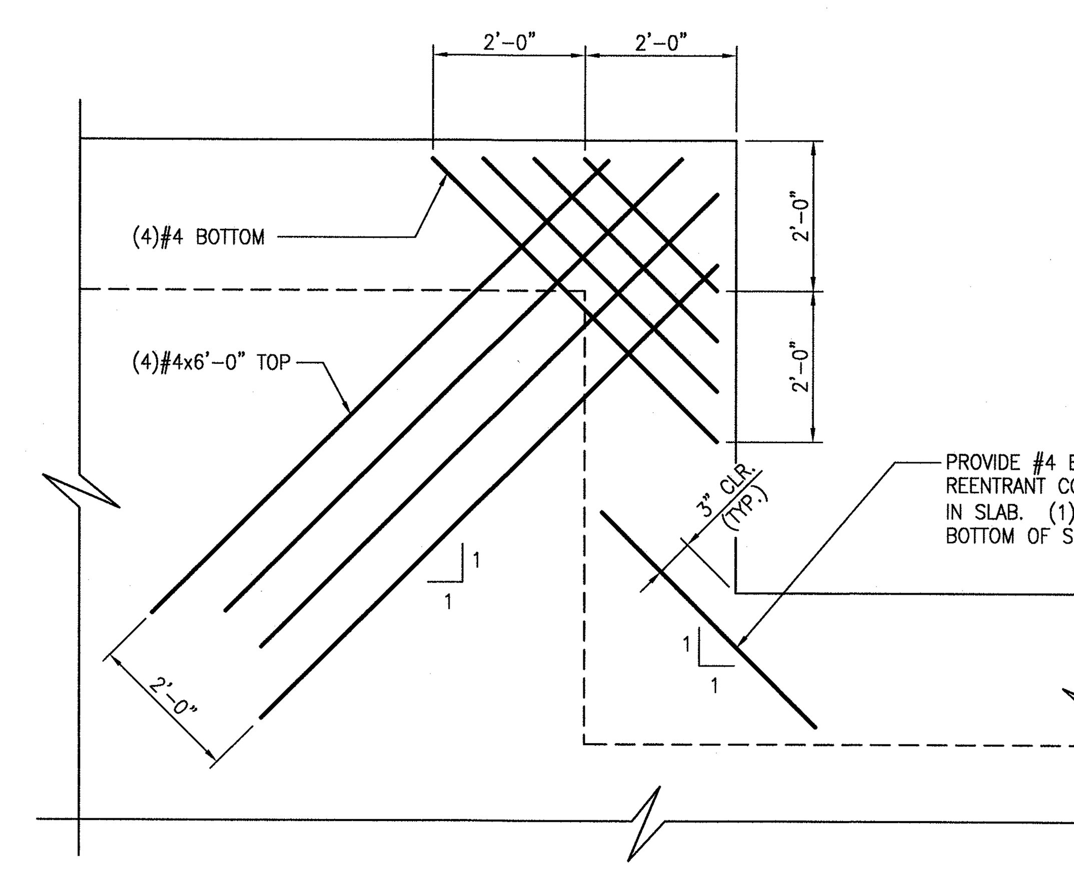


(C.J.) CONTROL/CONTRACTION JOINT DETAIL



(C.J.) CONSTRUCTION JOINT DETAIL

TYPICAL SLAB JOINT DETAILS FOR ALL 8" REINFORCED SLAB-ON-GRADE, SEE FOUNDATION PLAN
SCALE 1"=1'-0"

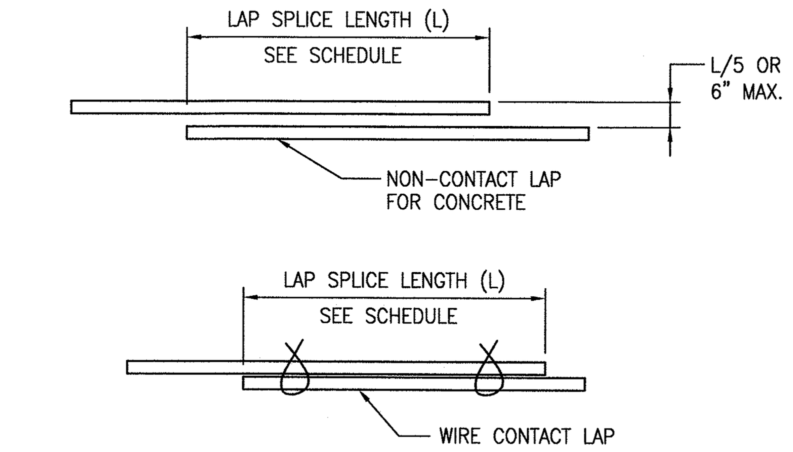


TYPICAL SLAB-ON-GRADE CORNER REINF. DETAILS
N.T.S.

CLASS "B" LAP SPLICE SCHEDULE (fy = 60 KSI)		
BAR. NO.	(LAP SPLICE "L" IN INCHES)	
	HORIZ. TOP BARS W/ 12" OF CONCRETE BELOW	ALL OTHER HORIZ. AND VERTICAL BARS
#4 BAR	34	26
#5 BAR	42	32
#6 BAR	50	38
#7 BAR	74	56
#8 BAR	86	63
#9 BAR	96	70

NOTES:
1. ALL DETAILING OF REINFORCEMENT SHALL COMPLY WITH THIS SCHEDULE UNLESS SPECIFICALLY DETAILED OTHERWISE ON THE DRAWINGS.
2. THESE BAR DEVELOPMENT LENGTHS APPLY TO REGULAR WEIGHT CONCRETE.

CLASS "B" REINFORCING LAP SPLICE DETAILS AND SCHEDULE



MIN. 2 WIRE TIES AT ALL SPLICES PROJECTING FROM FOOTINGS, TYP.

SCALE: 1"=1'-0"
1 0 1 2 FEET

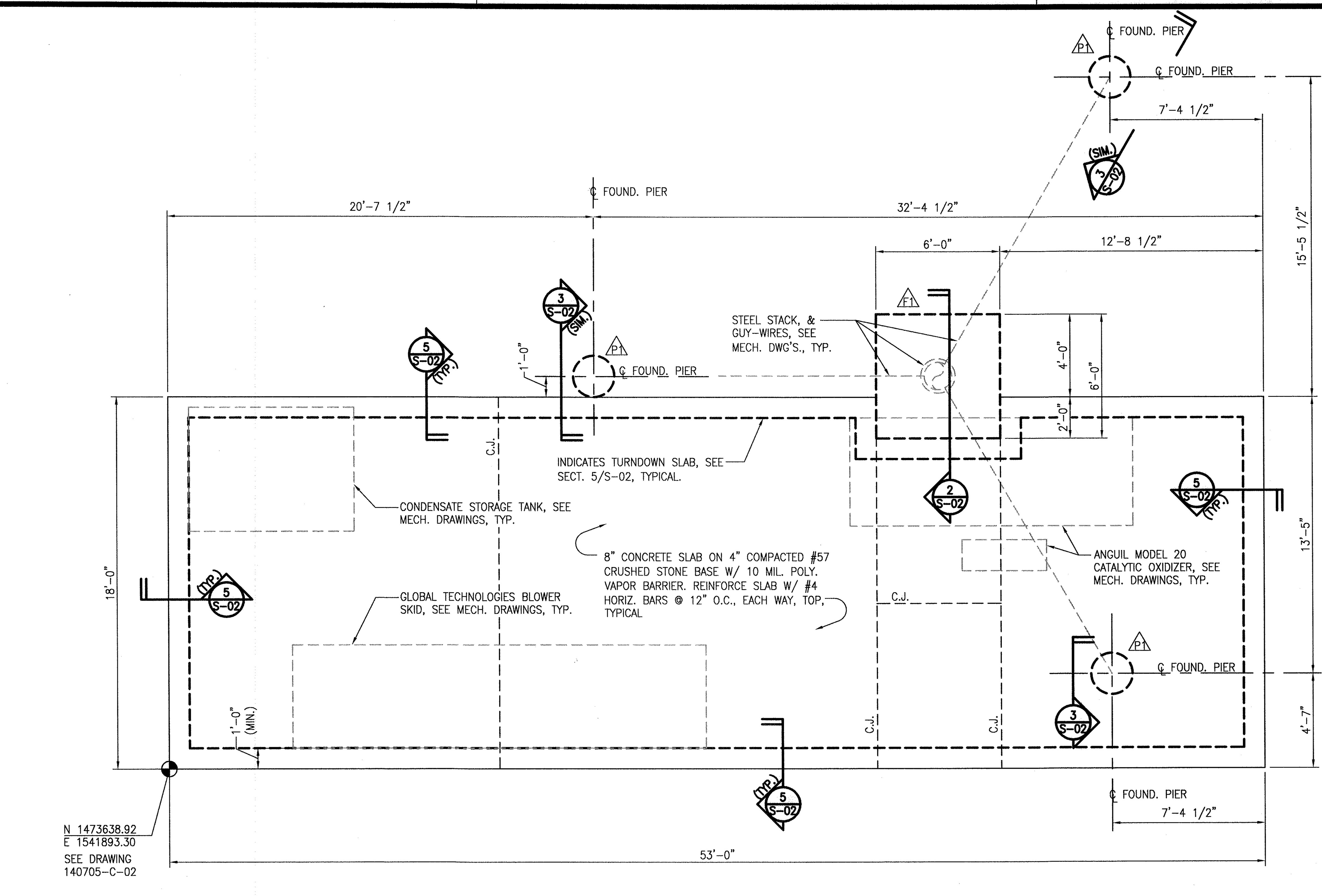
Revisions			
Symbol	Descriptions	Date	Approved
0	ISSUED FOR CONSTRUCTION	09/24/12	

Shaw® Shaw Environmental, Inc.

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ALBUQUERQUE, NEW MEXICO

TOMMY L. COOK
NEW MEXICO
17105
LICENSED PROFESSIONAL ENGINEER
9.24.12
ARCHITECT/ENGINEER SEAL

Designed by: TLC	KIRTLAND AIR FORCE BASE ALBUQUERQUE, NEW MEXICO
Drawn by: TLC	BULK FUELS FACILITY (BFF) SOIL VAPOR EXTRACTION AND THERMAL TREATMENT SYSTEM STRUCTURAL NOTES
Checked by: CLL	
Reviewed by: ---	Plot Scale Ratio: 1 = 1; Design File: 140705-S01.dwg; Date: 09/24/12; Sheet reference number: S-01
Submitted by: TLC	Spec. No.:; Drawing Code:; Contract No.:



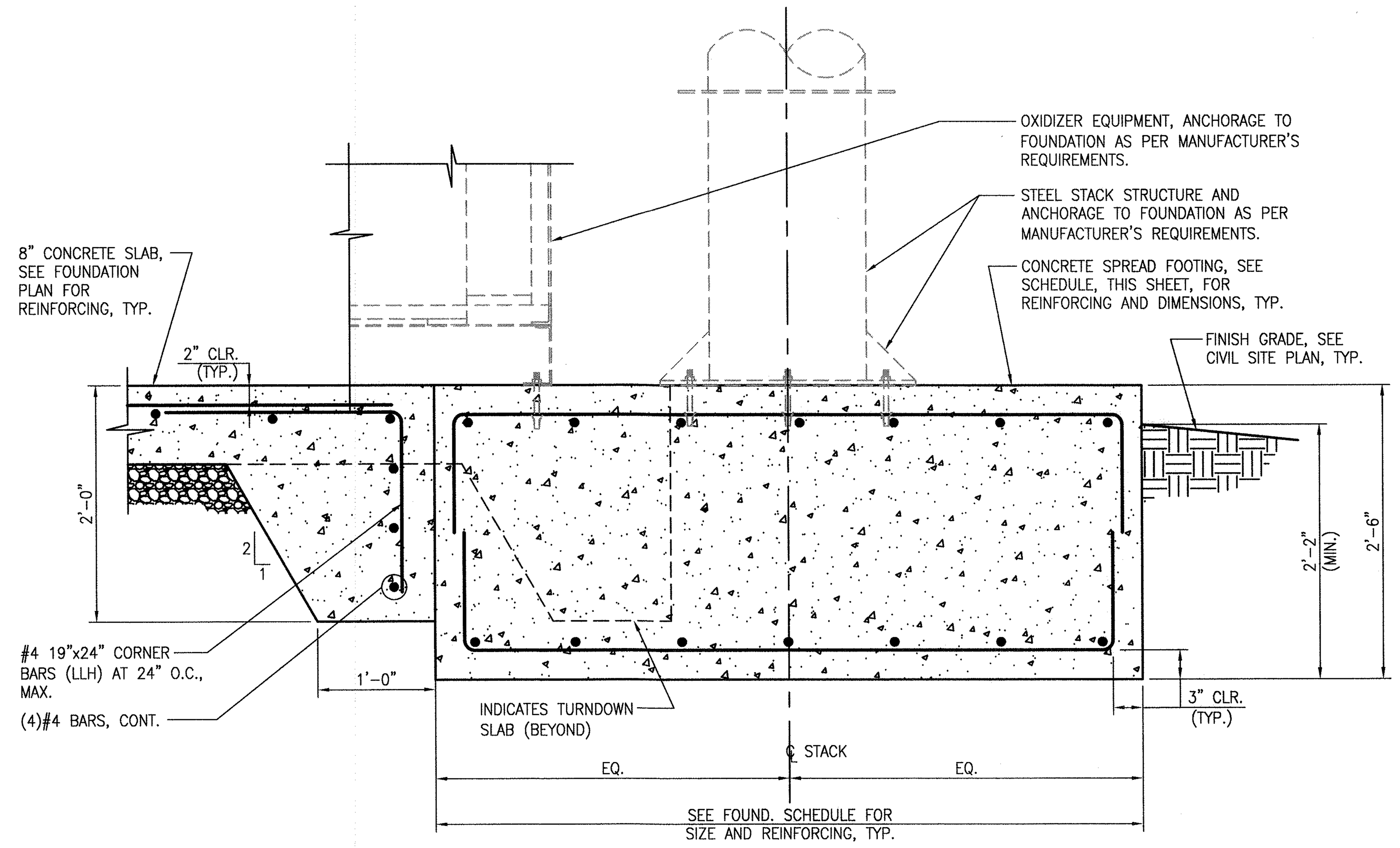
FOUNDATION PLAN
1/4"=1'-0"

NOTES:

1. SEE SHEET S-01 STRUCTURAL NOTES AND TYPICAL DETAILS.
2. ENGINEER IS NOT RESPONSIBLE FOR ANY PORTION OF CONSTRUCTION OTHER THAN THE FOUNDATIONS/SLAB CONSTRUCTION.
3. THE DESIGN AND SAFETY OF BRACING, ERECTION SEQUENCES, TEMPORARY SUPPORTS, MEANS AND METHODS OF CONSTRUCTION FOR ALL WORK IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR DURING CONSTRUCTION. CONTRACTOR SHALL FIELD VERIFY DESIGN FOR CONSTRUCTION SEQUENCES, ACTUAL EQUIPMENT AND MATERIALS USED PRIOR TO CONSTRUCTION.
4. ALL DIMENSIONS ARE TO EDGE OF CONCRETE SLAB/FOOTING UNLESS NOTED OTHERWISE.
5. FOUNDATIONS HAVE BEEN SIZED BASED ON AN ASSUMED MINIMUM ALLOWABLE SOIL BEARING CAPACITY OF 2000 PSF AND MODULUS OF SUBGRADE REACTION OF 150 PCI. CONTRACTOR TO RETAIN THE SERVICES OF A GEOTECHNICAL ENGINEER, LICENSED AND IN GOOD STANDING IN THE STATE WHERE THE WORK IS PERFORMED TO FIELD VERIFY THAT EXISTING CONDITIONS MEET OR EXCEED THOSE ASSUMED PRIOR TO PLACEMENT OF REINFORCING OR CONCRETE. PREPARE THE SITE AS PER RECOMMENDATIONS OF THE GEOTECHNICAL ENGINEER.
6. C.J. = CONTROL JOINT/CONSTRUCTION JOINT. SEE TYPICAL JOINT DETAILS, SHEET S-01.
7. CONTRACTOR SHALL COORDINATE STRUCTURAL DRAWINGS WITH DRAWINGS OF OTHER DISCIPLINES INCLUDING PLACEMENT OF ALL CONDUITS, PIPING, ETC. EMBEDDED IN OR INSTALLED BELOW CONCRETE PRIOR TO CONCRETE PLACEMENT. SEE TYPICAL DETAILS, SHEET S-01 FOR REINF. IN SLABS AT CORNERS.
8. PROVIDE SLEEVES FOR MECHANICAL AND ELECTRICAL OPENINGS IN CONCRETE SLAB BEFORE CASTING CONCRETE. DO NOT CUT ANY REINFORCING WHICH MAY CONFLICT WITH SLEEVES. CORING IN CONCRETE IS NOT ALLOWED UNLESS PRIOR APPROVAL HAS BEEN PROVIDED BY THE ENGINEER.
9. SEE MECHANICAL AND ELECTRICAL DRAWINGS FOR LOCATION AND DIMENSIONS OF EQUIPMENT AND CONTROLS.
10. SEAL ALL JOINTS IN SLAB-ON-GRADE CONSTRUCTION WITH SIKA "SIKAFLEX-15 LM SL GRADE" HIGH PERFORMANCE SEALANT (OR APPROVED EQUAL),

FOUNDATION SCHEDULE

MARK	DIMENSIONS	REINFORCING
F1	6'-0"x6'-0"x2'-6"	PROVIDE (7)#6 x 5'-6", EACH WAY, TOP AND BOTTOM, WITH STD. HOOK AT EACH END
P1	24" ø PIER	SEE SECTIONS 3/S-02 & 4/S-02 FOR REINFORCING



SECTION
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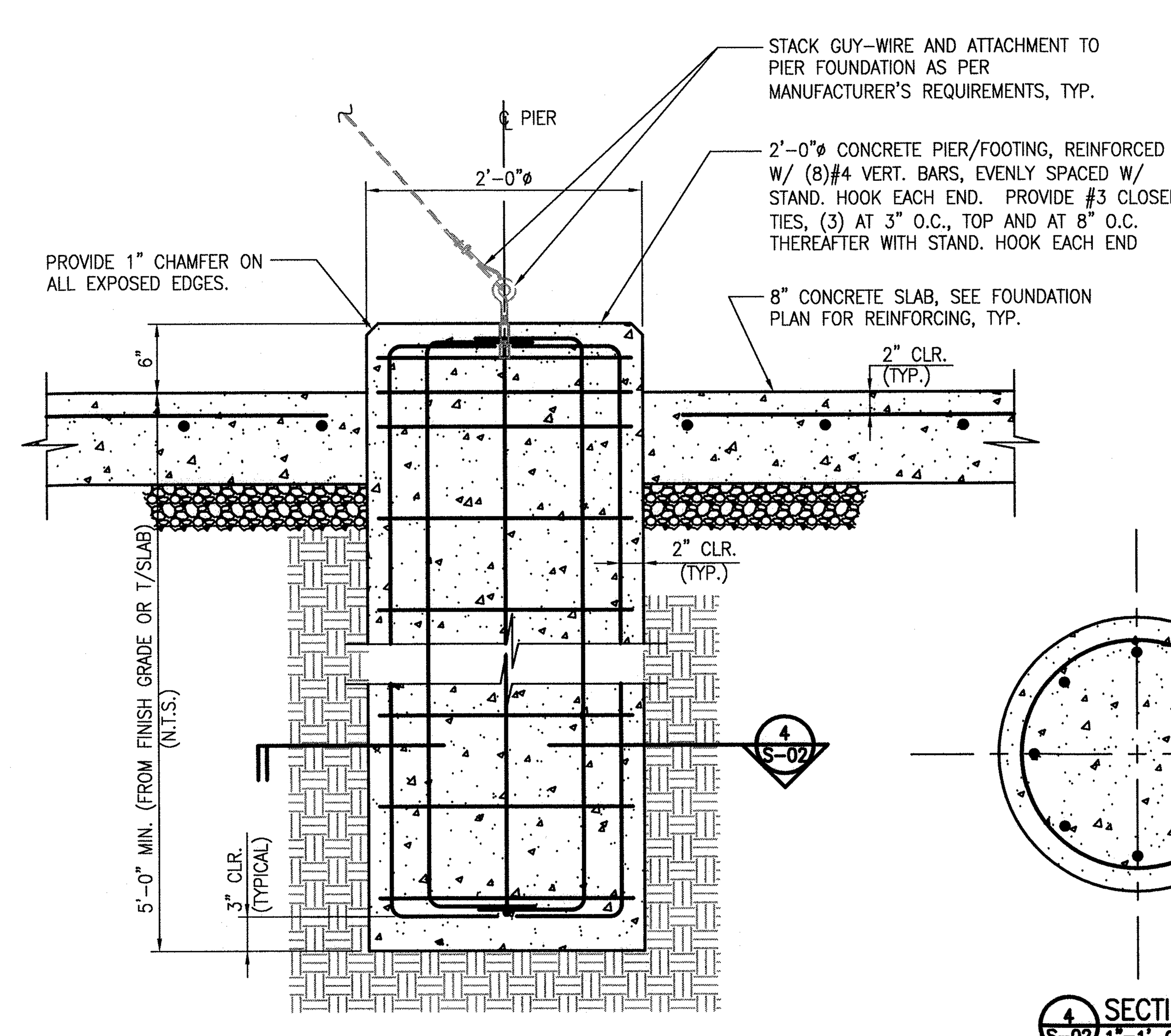

SECTION
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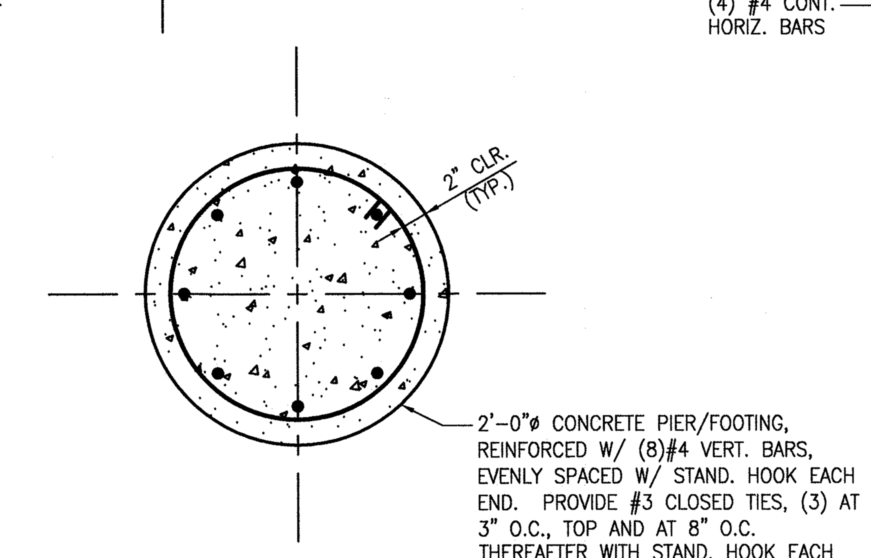
(TYPICAL GUY-WIRE PIER FOUNDATION, TYPICAL)



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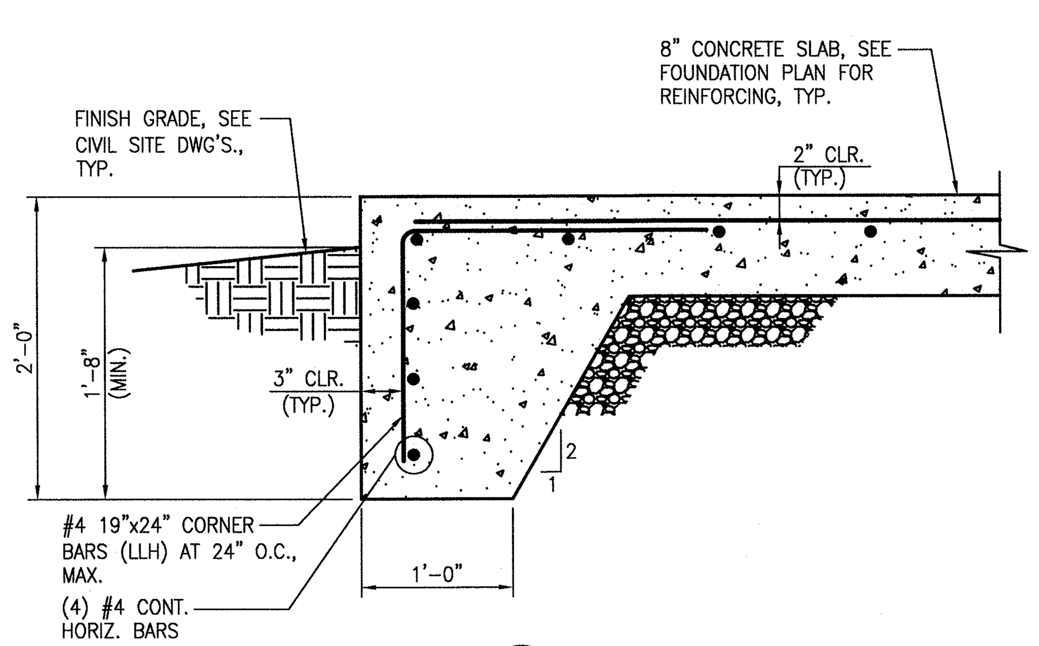

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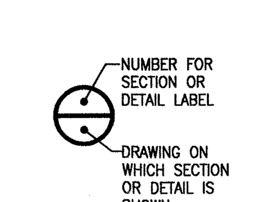
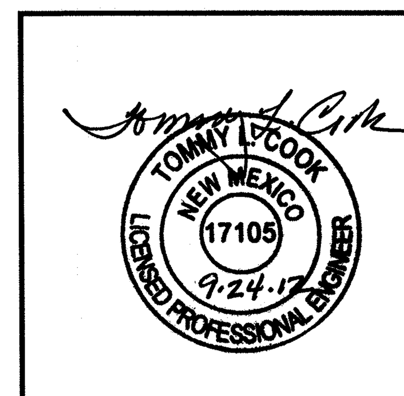


SECTION & DETAIL KEY

SCALE: ¼"=1'-0"
4 3 2 1 0 4 8 FEET

SCALE: 1"=1'-0"
1 0 1 2 FEET



ARCHITECT/ENGINEER SEAL

Revisions			
Symbol	Descriptions	Date	Approved
0	ISSUED FOR CONSTRUCTION	09/24/12	

Shaw® Shaw Environmental, Inc.

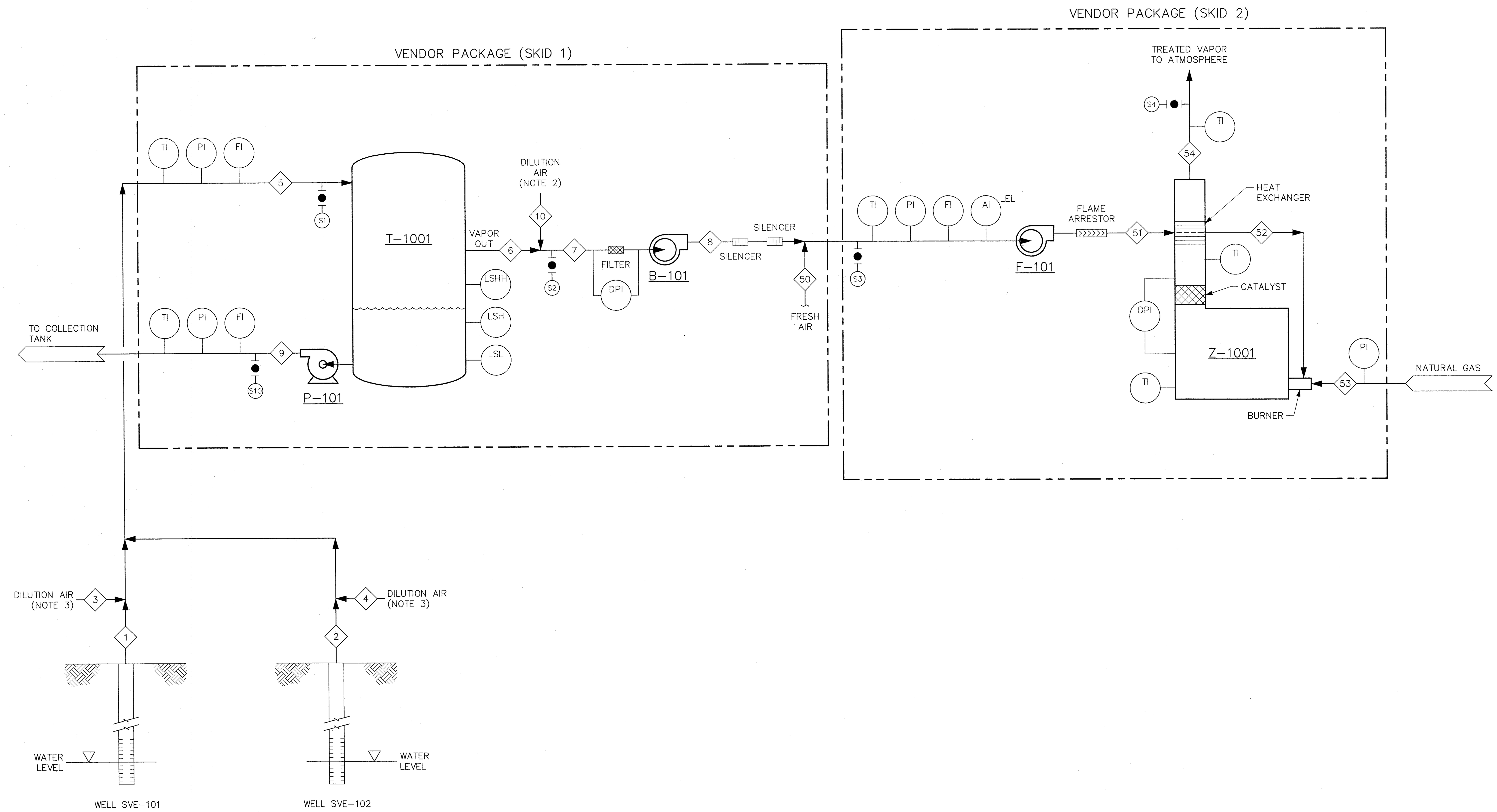
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ALBUQUERQUE, NEW MEXICO

KIRTLAND AIR FORCE BASE ALBUQUERQUE, NEW MEXICO

BULK FUELS FACILITY (BFF) SOIL VAPOR EXTRACTION AND THERMAL TREATMENT SYSTEM FOUNDATION PLAN

Designed by: TLC
Drawn by: TLC
Checked by: CLL
Reviewed by: ---
Submitted by: TLC

Plot Scale Ratio: 1 = 1
Design File: 140705-S02.dwg
Date: 09/24/12
Spec. No.:
Contract No.:
Drawing Code:
Sheet reference number: S-02



NOTES:

1. VENDOR TO SUPPLY ITEMS MARK WITH AN ASTERICK (∗).
2. DILUTION AIR MANUALLY ADJUSTED TO LIMIT LEL IN VAPORS TO THERMAL TREATMENT SYSTEM.
3. DILUTION AIR TO REDUCE CONDENSATION IN PIPELINE.
4. CONDENSATE RATE WILL DEPEND ON OUTSIDE TEMPERATURE. DURING WINTER UP TO 112 GALLONS PER DAY OF CONDENSATE CAN BE PRODUCED.

LEGEND:

LEL – LOWER EXPLOSION LIMIT

S2 – SAMPLE PORT

B-101
SVE-1 VACUUM/BLOWER SYSTEM
1,200 SCFM
-12" Hg VACUUM
125 HP

F-101
SYSTEM FAN
2,500 SCFM

P-101
SVE-1 LIQUID PUMP
5 GPM

T-1001
SVE-1 AIR/WATER SEPARATOR
600 GALLON
48" DIA x 6' H

Z-1001
THERMAL CATALYTIC OXIDIZER

STREAM NO. / COMPONENT		1 AIR FLOW FROM SVE-101	2 AIR FLOW FROM SVE-102	3 DILUTION AIR FROM SVE-101	4 DILUTION AIR FROM SVE-102	5 VAPOR FROM WELLS	6 SEPARATOR VAPOR	7 DILUTED INLET VAPOR	8 BLOWER VAPOR	9 CONDENSATE	10 DILUTION AIR	50 FRESH AIR	51 EXTRACTED VAPOR	52 COMBUSTION AIR	53 NATURAL GAS	54 STACK GAS
WATER FLOW (average)	lb/hr															
AIR FLOW (average)	lb/hr	1,800	1,800	900	900	5,400	5,400	7,200	7,200	(NOTE 4)	1,800	4,050	11,250	11,250		11,340
LIQUID FLOW (maximum)	gpm															
LIQUID FLOW (average)	gpm															
AIR FLOW	acfm	529	529			1,633	1,633	2,177	2,105		479	1,078	3,104	5,529		6,153
AIR FLOW	scfm	400	400	200	200	1,200	1,200	1,600	1,600		400	900	2,500	2,500		2,520
TOTAL HYDROCARBONS	lb/hr	45	45			90	90	90	90				90	90		1.8
TOTAL HYDROCARBONS	ppmv	6,800	6,800			4,533	4,533	3,400	3,400				2,176	2,176		44
GAS FLOW	lb/hr (scfh)														6 (162)	
TEMPERATURE	°F	50	50	60	60	60	60	60	111	60	60	60	95	500		600
PRESSURE	psia	10.7	10.7	10.7	10.7	10.6	10.6	10.6	12.04		12.04	12.04	12.40	12.04		12.04
AIR DENSITY (AT 70°F)	lb/ft³	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075		0.075	0.075	0.075	0.075		0.075
WATER DENSITY	lb/gal									8.340						

Revisions			
Symbol	Descriptions	Date	Approved
0	ISSUED FOR CONSTRUCTION	11/5/12	

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CORPS OF ENGINEERS
ALBUQUERQUE, NEW MEXICO

KIRTLAND AIR FORCE BASE — ALBUQUERQUE, NEW MEXICO

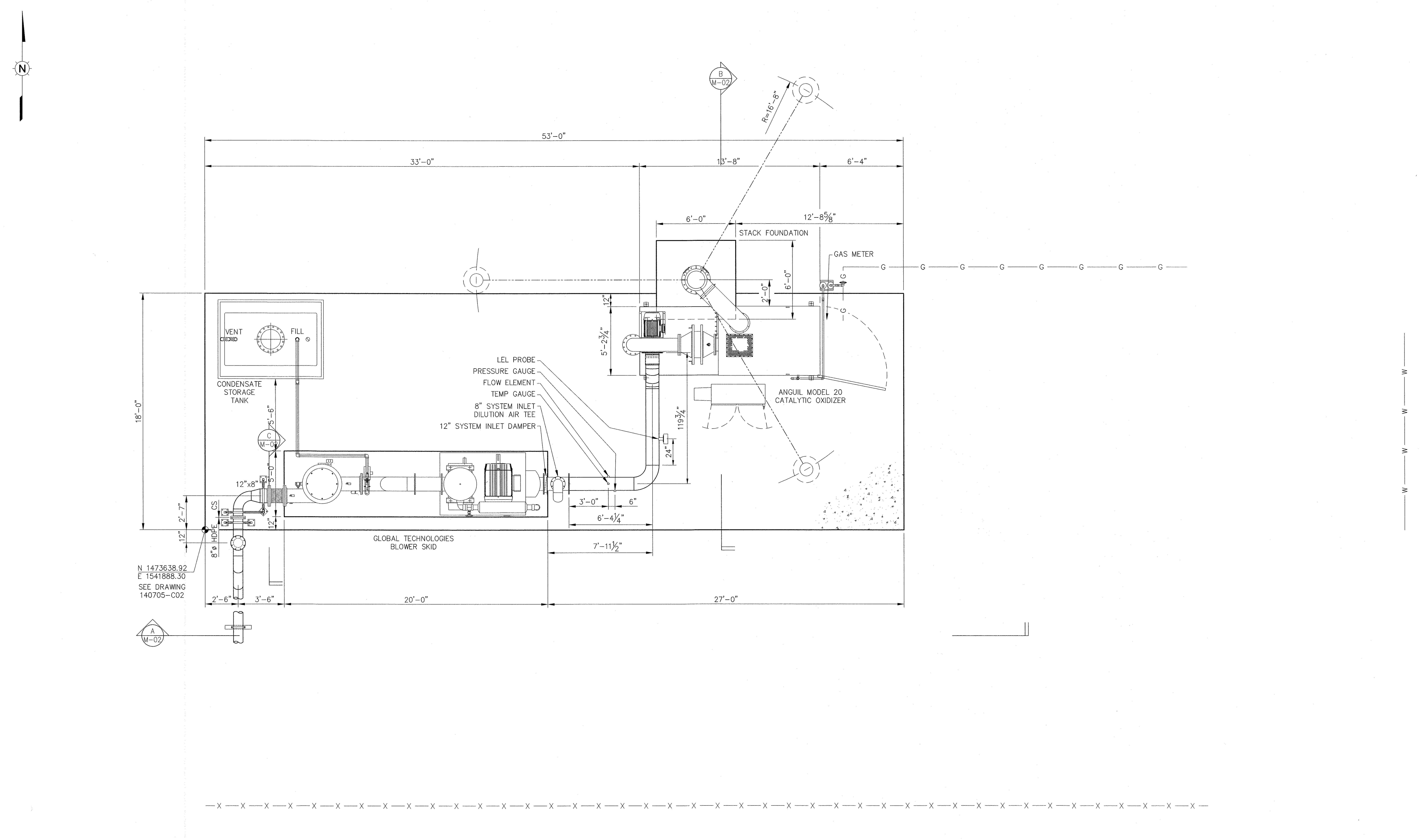
SOIL VAPOR EXTRACTION (SVE) SYSTEM BULK FUELS FACILITY PROCESS FLOW DIAGRAM

Designed by: ACS
Drawn by: JWH
Checked by: SES
Reviewed by: JTS
Submitted by:

Plot Scale Ratio: 1 = 1
Design File: 140705-P1.dwg
Date: 11/22/11
Spec. No.:
Drawing Code:
Contract No.:
Sheet reference number: P-1

ARCHITECT/ENGINEER SEAL

File: K:\Kirtland AFB\140705\Process\140705-P1.dwg
XREF Files: Border 24X36 IMAGE Files:
Plot Date/Time: Nov 05, 2012 - 3:31pm
Plotted By: john.hubbard



PLAN VIEW
SCALE: 1/4"=1'-0"

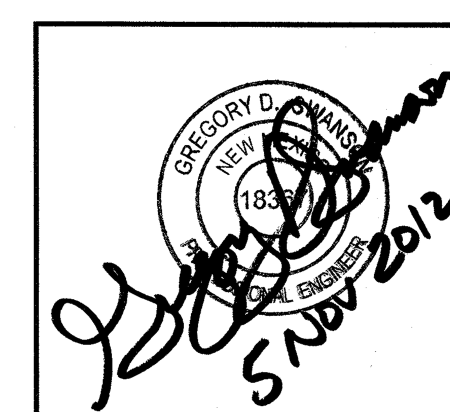
EQUIPMENT GENERAL ARRANGEMENT

SCALE: ¼"=1'-0"

SECTION & DETAIL KEY

NUMBER FOR SECTION OR DETAIL LABEL

DRAWING ON WHICH SECTION OR DETAIL IS TAKEN



Revisions			
Symbol	Descriptions	Date	Approved
0	ISSUED FOR CONSTRUCTION	11/05/12	

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U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ALBUQUERQUE, NEW MEXICO

Designed by: MFL	KIRTLAND AIR FORCE BASE — ALBUQUERQUE, NEW MEXICO
Drawn by: MFL	BULK FUELS FACILITY (BFF) SOIL VAPOR EXTRACTION AND THERMAL TREATMENT SYSTEM MECHANICAL - GENERAL ARRANGEMENT
Checked by: JTS	
Reviewed by:	Plot Scale Ratio: 1 = 1 — Date: 08/10/12 — Sheet reference number: M-01
	Design File: 140705-M01_M02.dwg
Submitted by:	Spec. No.: — Drawing Code:
	Contract No.:

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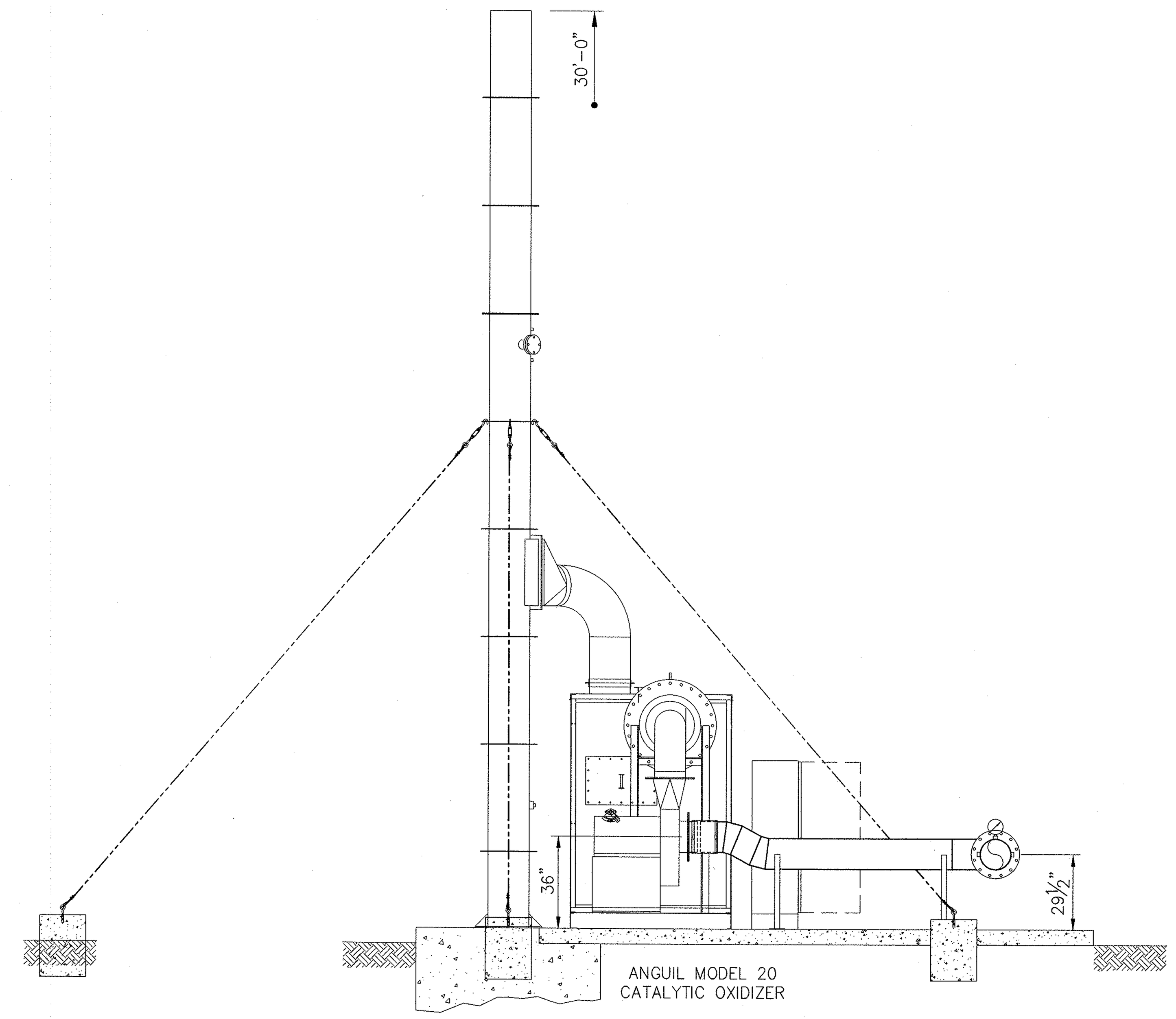
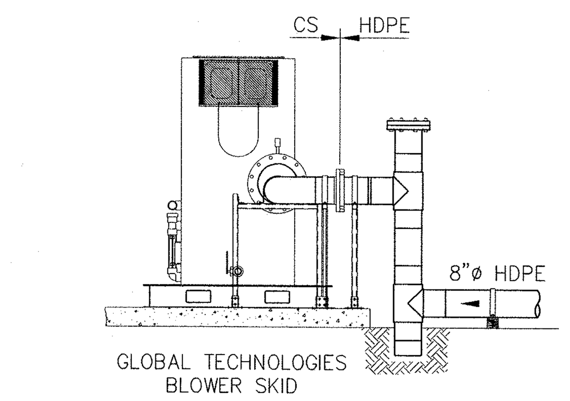
Plot Date/Time: Nov 05, 2012 - 5:12pm



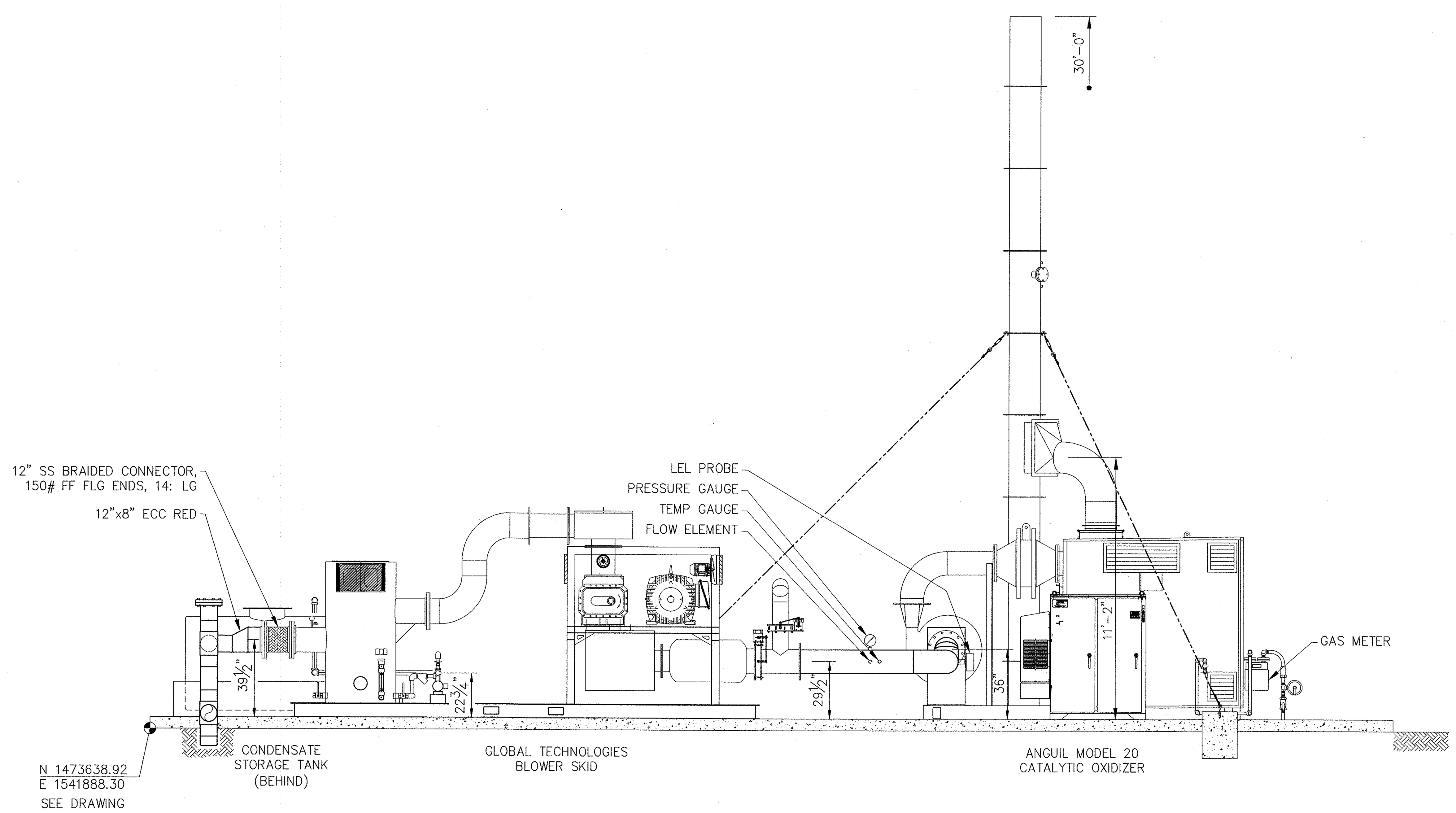
B M-01 SECTION VIEW
SCALE: 1/4"=1'-0"

MECHANICAL EQUIPMENT ARRANGEMENT
ELEVATION VIEW
LOOKING EAST



INLET CONNECTION PIPING
ELEVATION VIEW
LOOKING EAST

C M-01 SECTION VIEW
SCALE: 1/4"=1'-0"



A M-01 SECTION VIEW
SCALE: 1/4"=1'-0"

MECHANICAL EQUIPMENT ARRANGEMENT
ELEVATION VIEW
LOOKING NORTH

SCALE: ¼"=1'-0"
4 3 2 1 0 4 8 FEET

SECTION & DETAIL KEY
NUMBER FOR SECTION OR DETAIL LABEL
DRAWING ON WHICH SECTION OR DETAIL IS TAKEN

ARCHITECT/ENGINEER SEAL

Revisions

Symbol	Descriptions	Date	Approved
0	ISSUED FOR CONSTRUCTION	11/05/12	

Shaw® Shaw Environmental, Inc.

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ALBUQUERQUE, NEW MEXICO

Designed by: MFL
Drawn by: MFL
Checked by: JTS
Reviewed by:
Submitted by:

KIRTLAND AIR FORCE BASE ALBUQUERQUE, NEW MEXICO

BULK FUELS FACILITY (BFF) SOIL VAPOR EXTRACTION AND THERMAL TREATMENT SYSTEM MECHANICAL - SECTION VIEW

Plot Scale Ratio: 1 = 1
Design File: 140705-M01_M02.dwg
Date: 08/10/12
Spec. No.:
Drawing Code:
Contract No.:
Sheet reference number: M-02

VERIFY SCALE 0 1"

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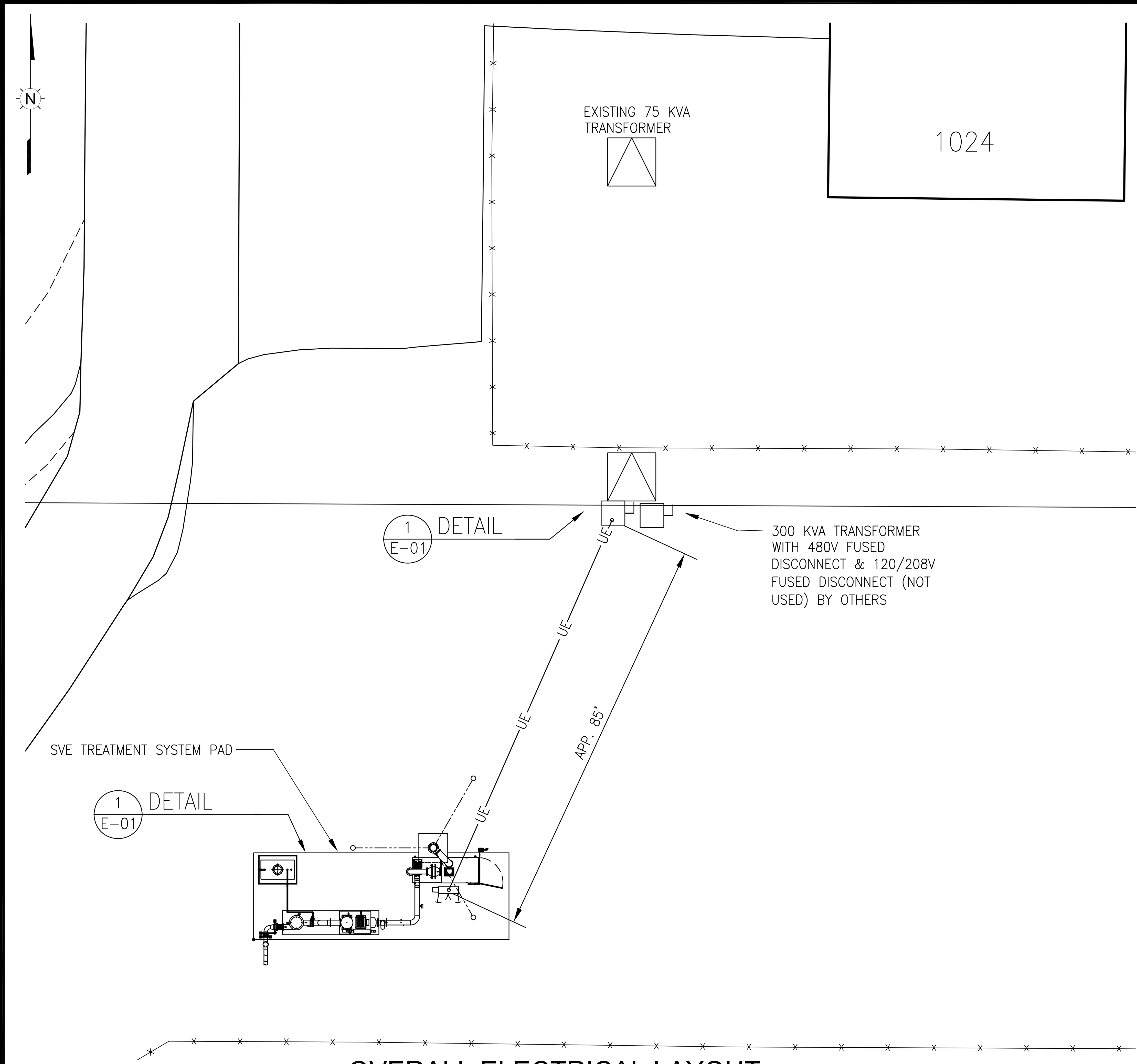

OVERALL ELECTRICAL LAYOUT

SCALE: ¾"=1'-0"
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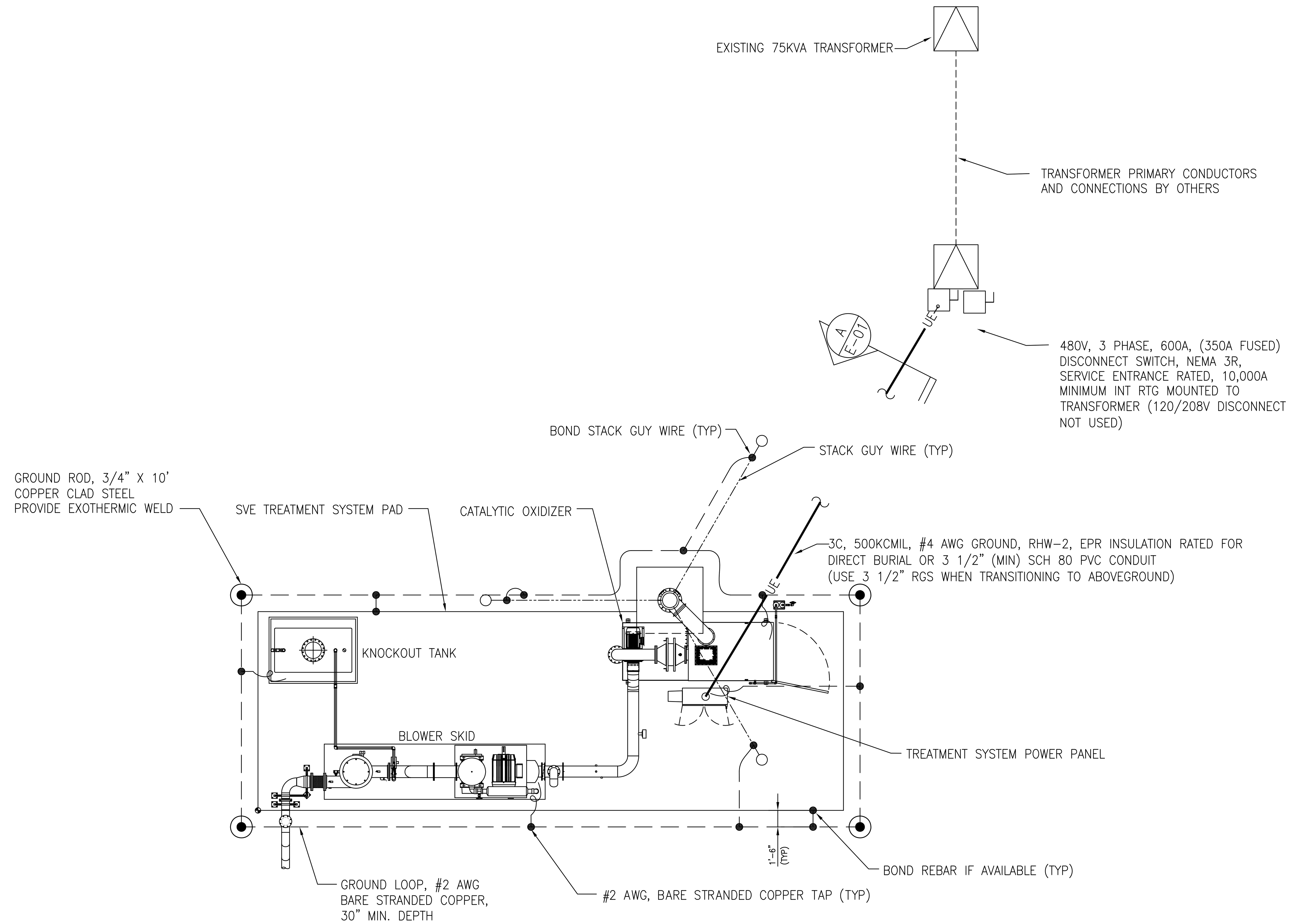
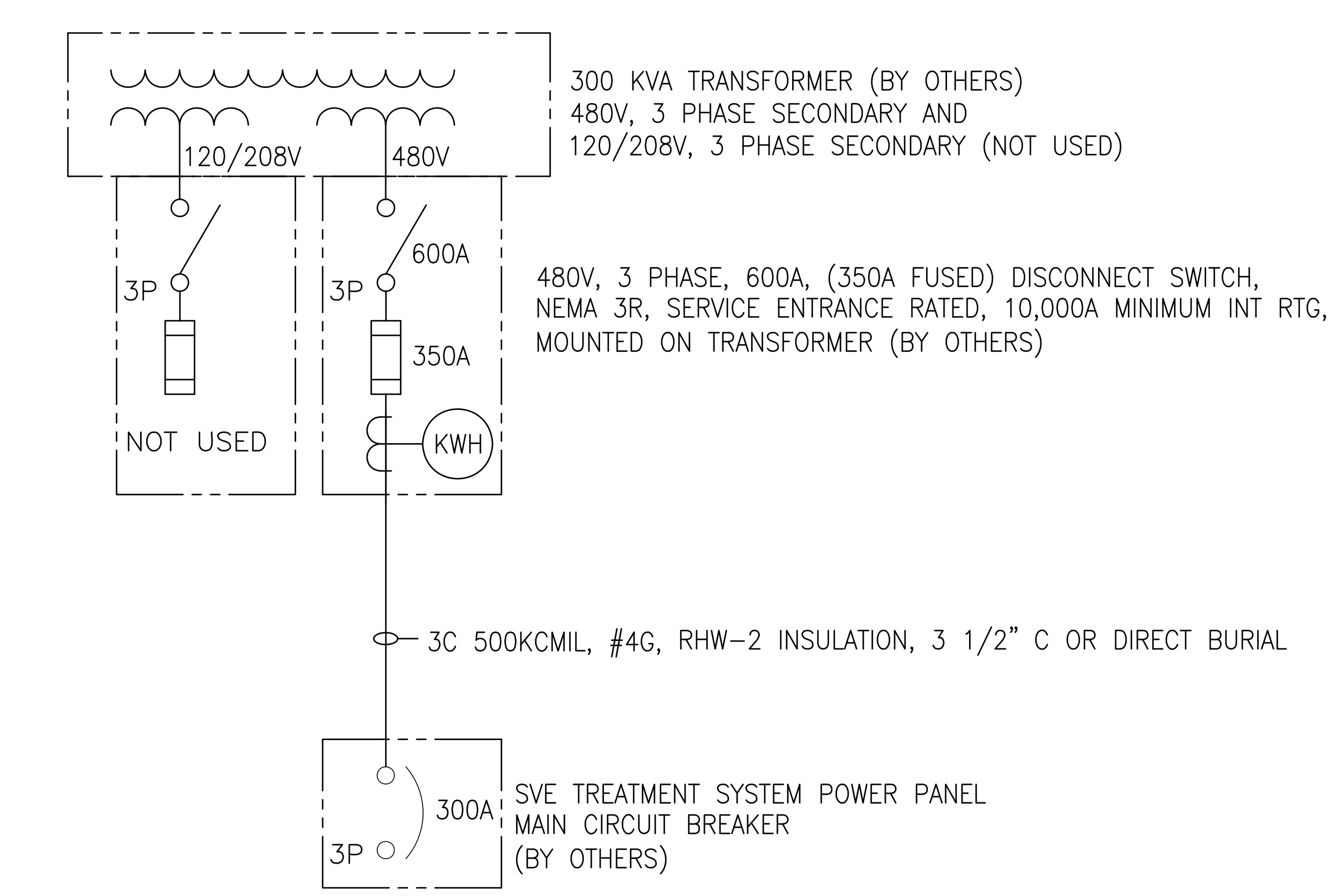


1 DETAIL
E-01 SCALE: 3"=1'-0"

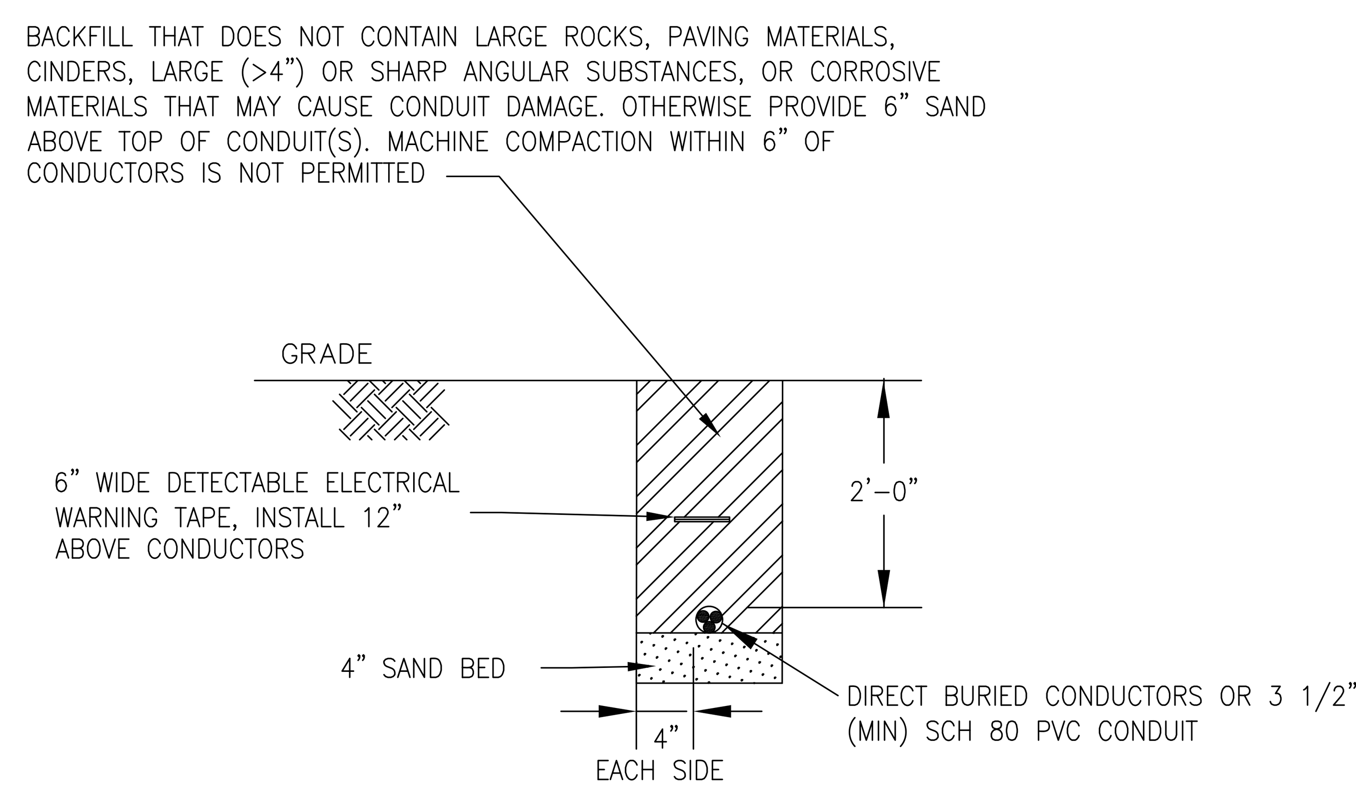
SCALE: 3"=1'-0"
6 0 6 INCHES

FOR REVIEW ONLY! – NOT FOR CONSTRUCTION

PRELIMINARY PROGRESS DRAWINGS ARE NOT FOR CONSTRUCTION OR FABRICATION. BILL OF MATERIALS, SHOP DRAWINGS, ETC., CREATED FROM THESE DRAWINGS MAY BE REVISED AT THE EXPENSE OF THE CONTRACTOR.

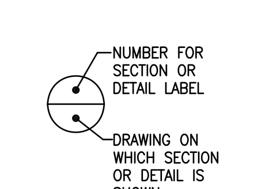


SVE SYSTEM ELECTRICAL SERVICE ONE LINE DIAGRAM



DISTANCES & CLEARANCES ARE MINIMUM REQUIREMENTS

A SECTION
E-01 SCALE: NONE



SECTION & DETAIL KEY

Revisions			
Symbol	Descriptions	Date	Approved
C	ISSUE FOR REVIEW	11/05/12	
B	ISSUE FOR REVIEW	10/18/12	
A	ISSUE FOR BID	08/20/12	

Shaw® Shaw Environmental, Inc.

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ALBURQUERQUE, NEW MEXICO

ARCHITECT/ENGINEER SEAL

Designed by: TMB	KIRTLAND AIR FORCE BASE ALBUQUERQUE, NEW MEXICO BULK FUELS FACILITY (BFF) SOIL VAPOR EXTRACTION AND THERMAL TREATMENT SYSTEM ELECTRICAL LAYOUT AND ONE LINE DIAGRAM		
Drawn by: TMB			
Checked by: JSD			
Reviewed by: JSD	Plot Scale Ratio: 1 = 1 Design File: 140705-E01.dwg	Date: 08/20/12	Sheet reference number:
Submitted by:	Spec. No.: Contract No.:	Drawing Code:	E-01

VERIFY SCALE 0 1"

File: K:\Kirtland AFB\140705\Electrical\141705- E01.dwg
Plot Date/Time: Nov 05, 2012 - 4:15pm

ANGUIL ENVIRONMENTAL SYSTEMS, INC. September 4, 2012
Job # Kirkland AFB, Albuquerque, NM
Model 20 Catalytic Oxidizer Stack Calculations Job 16512

CHARLES J. MEYER ENGINEER 32517 STATE OF MICHIGAN LICENSED PROFESSIONAL ENGINEER

GUY STACK DESIGN CALCULATIONS

	English Units			
Design Parameters				
Stack Base length	13.00	ft		
Stack Base diameter	1.33	ft	16	in
Transition lengths	17.00	ft		
Transition diameters	1.33	ft	16	in
Stack material	A36 Carbon Steel			
Plate Thickness, 0-13 ft	3/16	in.		
Plate Thickness, 13-30 ft	3/16	in.	Transition	
Wind speed	100	mph	(3-second gust) Figure 6-1	
Importance Category	"III"		ASCE 7-05 Table 1-1	
Importance Factor	1.15		ASCE 7-05 Table 6-1	
Exposure Category	C open terrain		ASCE 7-05 Factor Table 6-2	
Seismic Site Soil Class	D		ASCE 7-05 Tables 11.4-1	
Seismic Design Category	A		ASCE 7-05 Tables 11.6-1 and 11.6-2	
Design Code	International Building Code 2009			
	ASCE 7-05 Minimum Design Loads			
	Lateral Forces due to Earthquakes have been evaluated			
Design Calculations				
Base Wind shear, ASCE 7-05	1,250	lbs	ASCE 7-05 eq. 6-28	
Seismic shear at base, ASCE 7-05	66	lbs		
Wind moment, ASCE 7-05	37,495	ft-lbs		
Dead Load	6,556	lbs		
Base Section Modulus	36	in^3		
Base Section Area	9.31	in^2		
Transition Wind shear	621	lbs		
Transition Wind moment	5,281	ft-lbs		
Transition Section Modulus	36	in^3		
Transition Section Area	9.31	in^2		
Stack Design Calculations				
Allowable Base Moment	65,477	ft-lbs		
Calculated Max. Moment	37,495	ft-lbs		
Factor of Safety	1.75		A.O.K.	
Allow Base Shear	134,058	lbs		
Calculated Base Shear	1,250	lbs		
Factor of Safety	107		A.O.K.	
Allowable Transition Moments	65,477	ft-lbs		
Calculated Max. Transition Moment	5,281	ft-lbs		
Factors of Safety	12.40		A.O.K.	
Allow Transition Shears	134,058	lbs		
Calculated Transition Shears	621	lbs		
Factors of Safety	216		A.O.K.	

	English Units	
Anchor Bolt Design Calculations		
Anchor bolt number	8	
Material Type	ASTM N.C. A325	
Bolt Diameter	3/4 in	
Allowable Bolt Tension	26,500 psi	
Calculated Bolt Tension	5,667 psi	
Factor of Safety	4.68	A.O.K.
Allowable Bolt Shear	19,076 lbs	
Calculated Bolt Shear	1,250 lbs	
Factor of Safety	15.3	A.O.K.
Transition Bolt Design Calculations		
Anchor bolt number	12	
Material Type	ASTM N.C. A325	
Bolt Diameter	3/4 in	
Allowable Bolt Tension	13,500 psi	
Calculated Bolt Tension	798 psi	
Factor of Safety	16.91	A.O.K.
Allowable Bolt Shear	19,076 lbs	
Calculated Bolt Shear	621 lbs	
Factor of Safety	30.7	A.O.K.
Suggested Foundation Design		
Assumed Soil Bearing	2,000 psf	
Assumed Soil Lateral Resistance	150 psf	
Base Foundation		
Depth	6 feet	
Width	6 feet	
Length	6 feet	
Allowable Foundation Moment	71,100 ft-lbs	
Calculated Max. Moment	37,495 ft-lbs	
Factor of Safety	1.9	A.O.K.
Guy Wire Foundation		
Depth	5 feet	
Width	5 feet	
Length	5 feet	
Calculated Max. Guy Anchor Uplift	2,250 lbs	
Allowable Guy Anchor Uplift	11,250 lbs	
Factor of Safety	5.0	A.O.K.
Calculated Max. Guy Anchor Sliding	2,250 lbs	
Allowable Guy Anchor Sliding	3,750 lbs	
Factor of Safety	1.7	A.O.K.

ANGUIL ENVIRONMENTAL SYSTEMS, INC. September 4, 2012

Job # Kirkland AFB, Albuquerque, NM

Model 20 Catalytic Oxidizer Stack Calculations

DESIGN SUMMARY

	Units	
Stack Base length	13 ft	
Stack Base diameter	1.33 ft	16 in
Transition 1 height	17.00 ft	
Transition 1 diameter	1.33 ft	16 in
Plate Thickness 0-13 ft	3/16 ft	
Plate Thickness 13-30 ft	3/16 in.	
Total Stack Height	30.00 ft	See Note 4
Material	A36 Carbon Steel	
Base Plate Lower Ring	1 in.	
Base Plate Upper Ring	0 in.	
Base Gusset Plates	16	
thickness	3/4 in.	
Transition Flange, min.	1/4 x 1 1/2 x 1 1/2	equiv. 2x1/2 rolled bar
Stack Stiffeners, min.	rolled angles or equivalent	
	2 X 1/2 in.	rolled bar
Stack Stiffener Spacing, max.	5 ft	
Bolt type		
Anchor Bolt diameter	3/4 in.	ASTM N.C. A325
Anchor Bolt number	8	
Cast-in-Place Bolt Embedment	17 in.	See Note 3
Transition Bolt diameter	3/4 in.	ASTM N.C. A325
Transition Bolt number	12	

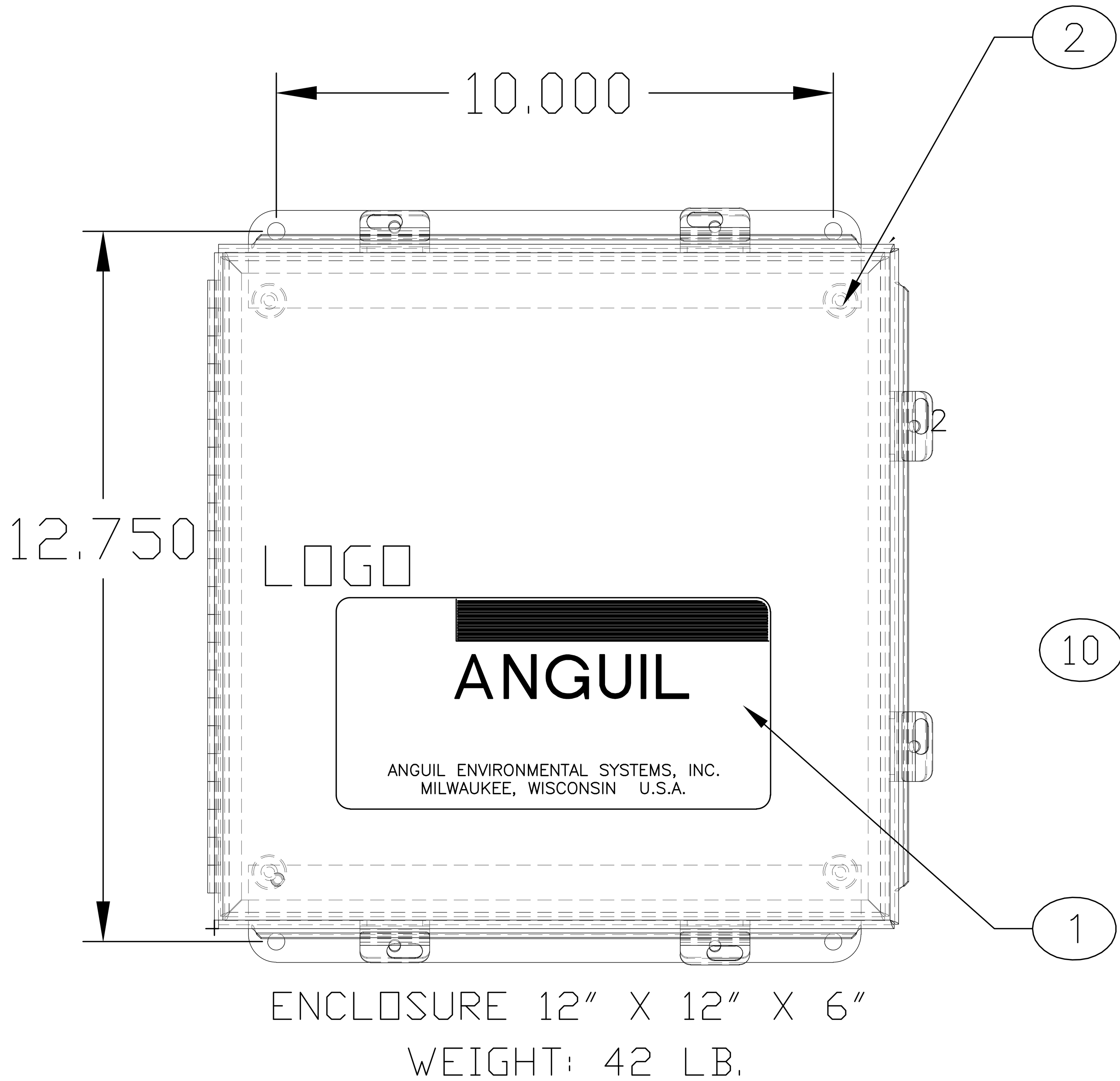
Notes:

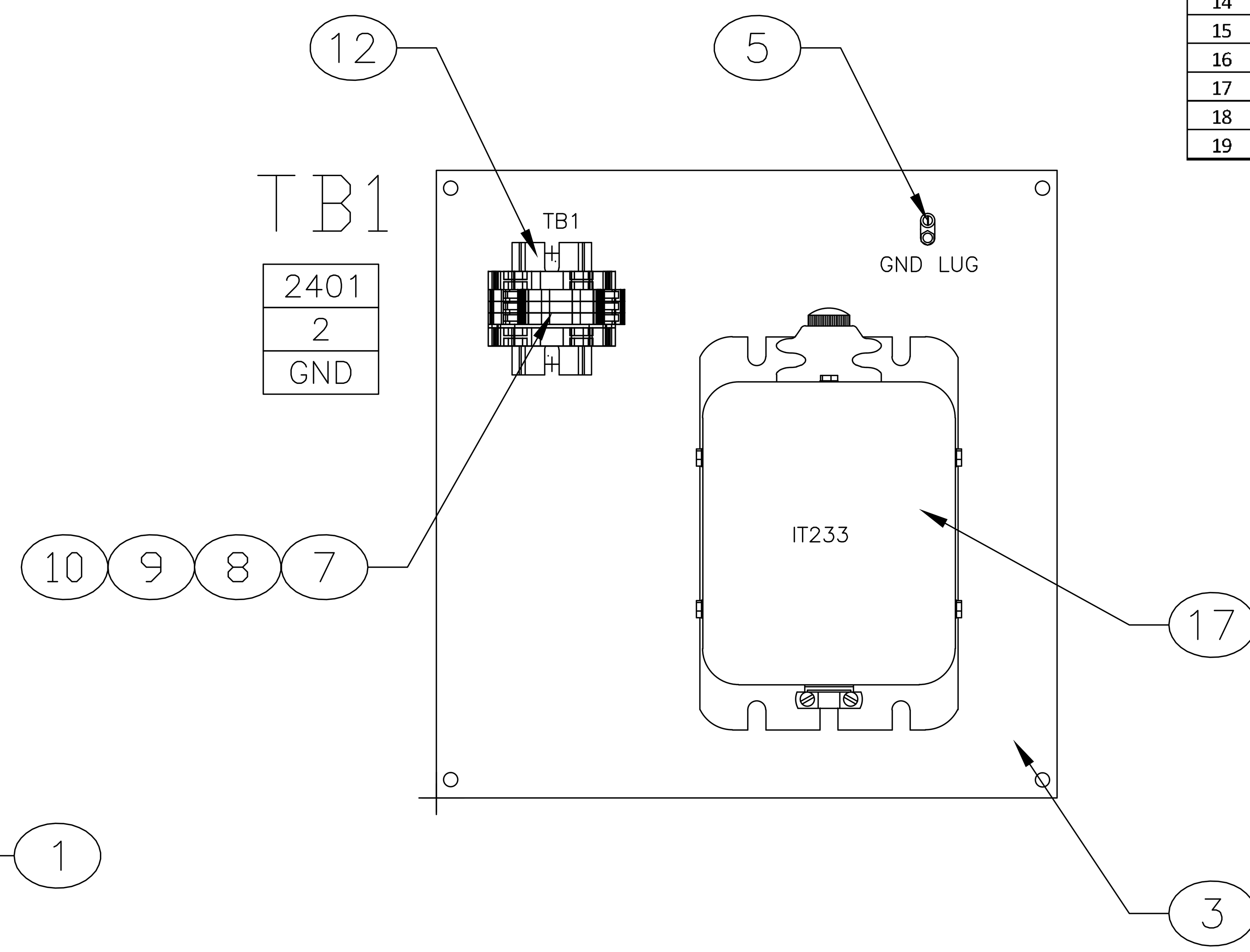
1 All welds shall be 80% penetration.

2 Concrete shall be 4000 psi

3 Epoxy or chemically bonded concrete anchor bolts can be substituted for Cast-in-Place bolts. The epoxy anchor bolts shall be installed to a depth of at least 12" in 4000 psi concrete and have a design strength of at least 10,009 lbs The concrete foundation must be reinforced with a minimum of #4 rebar 12" O.C. each way, top and each side face if epoxy or chemically bonded bolts are use.

4 Guy wires and connections shall have a minimum rating of 7000 lbs.





BOM ID	QTY	TAG ID	MFGR	P/N	DESCRIPTION
1	1			AESLOGO	ANGUIL SUPPLIED - ANGUIL, LOGO, NAME PLATE
2	1			A1212CHNFSS	JUNCTION BOX, 12.00" X 12.00" X 6.00", CONTINUOUS HINGE, NEMA 4X, CHNFSS, CLASSIC STYLE, 304 SS
3	1			A12P12	SUB PANEL, 10.75" x 10.88", STEEL, WHITE FINISH
4					
5	1	GND LUG		L70	GROUND LUG, 14 Sol - 4 Str.
6					
7	3	TB1		1492-J3	TERMINAL BLOCK, GRAY, SCREW, FEED THRU, 25A, 600V AC/DC, 1-CIRCUIT, DIN RAIL MTG., AWG 22 - 12
8	1	TB1		1492-EBJ3	END BARRIER, TERMINAL BLOCK, GRAY, USED ON 1492-J
9	2	TB1		1492-EAJ35	END ANCHOR, USED w/STANDARD 35mm DIN RAIL
10	A/R	TB1		1492-M5X12-ENG	MARKER CARD, TERMINAL BLOCK, ENGRAVED, 144/CARD, 1492-J/-L
11					
12	A/R		WIELAND	98.300.1000	MOUNTING RAIL, RIGID, DIN, 2 M
13					
14	A/R		TICC	THT-19-435-1-PR	LABEL, SPEC/FUSE/TORQUE, ENGRAVED, SILVER, 3" X 2"
15	A/R		TICC	THT-68-499-10-PR	LABEL, WIREMARKER, .ENGRAVED, 5" X.75"
16					
17	1	IT233	DONGAN	A06-SA6	IGNITION TRANSFORMER
18					
19					

14

PART ID	MANUFACTURER	PART NUMBER	TORQUE (LB-IN)	WIRE TEMP (DEG C)
TB1	AB	1492-J3	4.5-7.1	60
GND LUG	T&B	L70	45 (4-6 GA)	60
GND LUG	T&B	L70	40 (8 GA)	60
GND LUG	T&B	L70	35 (10-14 GA)	60

REV	BY	DATE	CHANGE
A	RLG	9/18/12	AS BUILT

ANGUIL

ANGUIL ENVIRONMENTAL SYSTEMS, INC.
MILWAUKEE, WISCONSIN

TITLE: MODEL 20 CATALYTIC OXIDIZER
IGNITION TRANSFORMER CONTROL PANEL
ENCLOSURE DETAILS & ELECTRICAL BOM

DRAWING NO. 16512458

REV. A

CUSTOMER: SHAW ENVIRONMENTAL
KIRTLAND AFB, NM

PAGE 9 OF 9

SOURCE –

NOTE:

DRAWN	DATE	AUTOCAD PATH	SCALE	CHECKED:	APPROVED:	LAST CHANGED BY:
RLG	8/19/12	JOBS\16000s\16512\ELEC	NONE	DATE:	DATE:	DATE:

BOM ITEM NO.	QTY	COMPONENT ID	DESCRIPTION	PART NUMBER	MANUFACTURER
1	1		ANGUIL SUPPLIED - ANGUIL, LOGO, NAME PLATE	AESLOGO	ANGUIL
2					
3					
4	1		MODIFIED ENCLOSURE PER DRAWING CSD483612M002	CSD483612M002	HOFFMAN
5	1		SUB PANEL, 46.20" x 34.20", STEEL, WHITE FINISH	CP4836	HOFFMAN
6	1		MOUNTING KIT, ENCLOSURE, USED ON PTD, BRACKET, STEEL, ZINC PLATED	CMFK	HOFFMAN
7					
8					
9	5	GND BAR	GROUND BAR, 10-CIRCUIT, ALUMINUM, MULTIPLE CONDUCTORS, #4-#14 AWG	4-14 (12112)	T&B
10					
11	1	CB1311	CIRCUIT BREAKER, 10A, 1-POLE, 277V AC/48V DC, SUPPLEMENTARY, 10kA, DIN RAIL MTG, TRIP CURVE C	1489-A1C100	AB
12	1	CB3270	CIRCUIT BREAKER, 5A, 1-POLE, 277V AC/48V DC, SUPPLEMENTARY, 10kA, DIN RAIL MTG, TRIP CURVE C	1489-A1C050	AB
13					
14					
15	1	FAN1380	FILTER FAN, 8.78" X 8.78" CUTOUT, 115V AC, 147 CFM FREE AIR, 120 CFM INSTALLED, LT GRAY (RAL 7035), NEMA 12, NORMAL OR REVERSE FLOW, MATCHES EXHAUST GRILLE/FILTER 3240200	3241110	RITTAL
16	1	FAN1380	EXHAUST GRILLE/FILTER, 8.78" X 8.78" CUTOUT, LT GRAY (RAL 7035), NEMA 12, MATCHES FILTER FAN 3241110	3240200	RITTAL
17	1	FAN1380	FILTER MATS, 5 PACK, MATCHES FILTER FAN 3241110 & EXHAUST GRILLE 3240200	3172100	RITTAL
18					
19	1	PS1490	POWER SUPPLY, 120 WATT, 24V DC OUTPUT, 120/230V AC 1 - PHASE INPUT, DIN RAIL MTG, SWITCHED MODE	1606-XL120D	AB
20					
21	1	PB11410, LT1430	PUSH-PULL ILL 2 POS RED MUSHRROM HEAD, LED,12-130V AC/DC, 1 NO 1 NCLB, 30.5 MM	800T-FXQH2RA1	AB
22	1	PB11410, LT1430	GUARD, PUSHBUTTON, 30.5mm, 2-POS PUSH-PULL/E-STOP, STAINLESS STEEL	800T-N310	AB
23	1	PB11410, LT1430	LEGEND PLATE, YELLOW W/ BLACK TEXT	LP-30MM-ESTOP	TICC
24	1	LT4460	30.5MM TYPE 4/13 PILOT LIGHT, LED, RED, 12-130V AC/DC	800T-QH2R	AB
25	1	LT1640	30.5MM TYPE 4/13 PILOT LIGHT LED, WHITE 12-130V AC/DC	800T-QH2W	AB
26					
27	2	PB1411, PB5300	PUSHBUTTON, 30.5mm NEMA 4/13, 2-POS MOMENTARY, FLUSH, GREEN, NON-ILLUMINATED, 1 NO, STANDARD, ROUND METAL	800T-A1D1	AB
28	1	SW2360	SELECTOR SWITCH, 30.5mm NEMA 4/13, STANDARD KNOB, 2-POS SPRING RETURN FROM RIGHT, BLACK w/WHITE INSERT, NON-ILLUMINATED, 1 NO 1 NC, STANDARD, ROUND METAL	800T-H5A	AB
29	1	SW2360	CONTACT BLOCK, 1 NO 1 NC, SHALLOW BLOCK, PUSHBUTTON, 800T-	800T-XA	AB
30					
31	1	HOA101	SELECTOR SWITCH, 30.5mm NEMA 4/13, STANDARD KNOB, 3-POS MAINTAINED, BLACK w/WHITE INSERT, NON-ILLUMINATED, 1 NO 1 NC, STANDARD, ROUND METAL	800T-J2A	AB
32	6	LT4460, LT1640, PB1411, PB5300, SW2360, HOA101	LEGEND PLATE, WHITE W/ BLACK TEXT	LP-30MM-902	TICC
33	1	AL4480	PANEL MT SOUNDER, 22.5mm, IP65/NEMA 4/4X/13, 120V AC 50/60 Hz, 105 dB, STEADY TONE, 65mm Alarm, BLACK HOUSING, TERMINAL: PLUG-IN TERMINAL BLOCK	855P-B10LE22	AB
34					
35					

BOM ITEM NO.	QTY	COMPONENT ID	DESCRIPTION	PART NUMBER	MANUFACTURER
36					
37					
38	15	MCR1410, CR2040, CR4380, CR4420, CR4440, CR4500, CR4540, CR4600, CR4620, CR4640, CR5050, CR5110, CR5130, CR5150, CR5250,	RELAY, 4 NO, MINI CONTROL, 110V 50Hz/120V 60Hz, IEC SCREW, 500V AC, DIN/BASE MTG, 10A	XTRM10A40A	EATON
39	1	CR4360	RELAY, 2NO 2NC, 120V AC, IEC SCREW, DIN/BASE MTG, 10A, 500V AC, MINI-CONTROL,	XTRM10A22A	EATON
40					
41					
42	1	TR2310	TIMING RELAY, ANALOG, PIN STYLE QUICK CONNECT, 120V AC, DIN RAIL MTG, ON-DELAY, DPDT, 1 OR 10 SEC/MIN/HRS	339B200Q2X	ATC
43	1	TR2310	RELAY SOCKET, DIN RAIL SNAP-MOUNT, 8 SCREW TERMINALS, USED ON GE1A/GT3/GT5P/RR1PA/RR2P	SR2P-06	IDEC
44					
45	2	ISB5340, ISB5430	I-SAFE BARRIER, DUAL CHANNEL, SWITCH ISOLATOR, 24V DC, 8V DC @ 8 mA INPUT, 1 FORM C RELAY OUTPUT	KFD2-SR2-Ex2.W	P+F
46					
47	1	SW1580	ETHERNET SWITCH, UN-MANAGED, 5-PORT, 24V DC, DIN RAIL MTG	LNX-500A	AAXEON
48	3	HMI1490, CREC1490, REC1610	CABLE, CAT5, ETHERNET, 96" LONG, RJ45M TO RJ45M, STRAIGHT THRU	RJ45M-096-000-RJ45M	CC&H
49	1	PLC1490	CABLE, CAT5, ETHERNET, 24" LONG, RJ45M TO RJ45M, STRAIGHT THRU	RJ45M-024-000-RJ45M	CC&H
50	1	MOD1490	CABLE, CAT5, ETHERNET, 12" LONG, RJ45M TO RJ45M, STRAIGHT THRU	RJ45M-012-000-RJ45M	CC&H
51	1	REC1610	LEGEND PLATE, WHITE W/ BLACK TEXT	LAM-5.00-3.50-902	TICC
52	1	REC1610	ETHERNET PORT, CAT5 RJ45 F/F BULKHEAD, 120V AC, 15A, DUPLEX GFCI, IP65/NEMA 12/4, PANEL MOUNT	P-R2-K3RF5	GRACE ENGINEERING
53					
54					
55					
56	19	FU2010, FU2400, FU4340, FU4400, FU4520, FU5010, FU5030, FU5060, FU5100, FU5120, FU5140, FU5160, FU5180, FU5200, FU5220, FU5240, FU5260, FU5280, FU5520	TERMINAL FUSE BLOCK, BLACK, 1/4" X 1-1/4" FUSE, NEON INDICATOR, NEMA/EEMAC, 12A, 300V AC, 30 - 12 AWG, 1-CIRCUIT, A-B/DIN RAIL MTG	1492-H4	AB
57	1	FU'S	END BARRIER, TERMINAL BLOCK, BLACK, 1.96" x 2.81" x .11", NEMA/EEMAC, 1492-H	1492-N37	AB
58					
59					
60	1	FU2010	FUSE, 1/4" X 1-1/4", 5 AMPS, 250V AC, TIME DELAY, NON-INDICATING, GLASS TUBE	MDL-5	BUSSMANN
61	1	FU2400	FUSE, 1/4" X 1-1/4", 3 AMPS, 250V AC, TIME DELAY, NON-INDICATING, GLASS TUBE	MDL-3	BUSSMANN
62	17	FU4340, FU4400, FU4520, FU5010, FU5030, FU5060, FU5100, FU5120, FU5140, FU5160, FU5180, FU5200, FU5220, FU5240, FU5260, FU5280, FU5520	FUSE, 1/4" X 1-1/4", 2A, TIME DELAY, 250V AC, NON-INDICATING, GLASS TUBE	MDL-2	BUSSMANN
63					
64					

BOM ITEM NO.	QTY	COMPONENT ID	DESCRIPTION	PART NUMBER	MANUFACTURER
65	142	TB1, TB2, TB3	TERMINAL BLOCK, GRAY, SCREW, 25A, 600V AC/DC, 22 - 12 AWG, FEED THRU, 1-CIRCUIT, DIN RAIL MTG.	1492-J3	AB
66	7	TB1	TERMINAL BLOCK, GRAY, IEC SCREW 30 - 12 AWG, K THERMOCOUPLE, 2-CIRCUIT, DIN RAIL MTG,, NOT UL RATED	1492-JTC3K	AB
67	3	TB1, TB2, TB3	END BARRIER, TERMINAL BLOCK, GRAY, USED ON 1492-J	1492-EBJ3	AB
68	6	TB1, TB2, TB3	END ANCHOR, TERMINAL BLOCK, SCREWLESS FASTENING, 0.31" X 2.20" X 1.85", IEC, 35mm DIN RAIL	1492-EAJ35	AB
69	2	TB2	JUMPER, TERMINAL BLOCK, 10-POLE, INSULATED, PLUG-IN, 5mm CENTER-to-CENTER, 1492-LM3/-LC3/-LDC3/-LDAG3/-LDG3P/-JKD3/-J3P/-J3/-J3TW	1492-CJLJ5-10	AB
70					
71					
72	A/R		MOUNTING RAIL, RIGID, DIN, 2 M	98.300.1000	WIELAND
73	A/R		PANEL CHANNEL, 1X4 WHITE	G1X4WH6	PANDUIT
74	A/R		COVER, PANEL CHANNEL, WHITE 1"	C1WH6	PANDUIT
75	A/R		SLOTTED DUCT, PVC, 1X2 WHITE	G1X2WH6	PANDUIT
76					
77	A/R		SLOTTED DUCT, PVC, 1.5X4X6 WHT	G1.5X4WH6	PANDUIT
78	A/R		COVER, PANEL CHANNEL, WHITE 1.5"	C1.5WH6	PANDUIT
79	A/R		LABEL, SPEC/FUSE/TORQUE, ENGRAVED, SILVER, 3" X 2"	THT-19-435-1-PR	TICC
80	A/R		LABEL, ID, ENGRAVED, 1" X 0.5"	THT-5-435-10-PR	TICC
81	A/R		LABEL, WIREMARKER, .ENGRAVED, 5" X.75"	THT-68-499-10-PR	TICC
82					
83					
84					
85	1	VFD105	REMOTE HIM MODULE	20-HIM-C3S	AB
86	1	PLC1490	PROCESSOR MODULE	1769-L32E	AB
87	1	PLC1490	PLC POWER SUPPLY	1769-PA4	AB
88	1	PLC1490	END CAP	1769-ECR	AB
89	2	PLC1490	INPUT MODULE, 16 POINT, AC	1769-IA16	AB
90	1	PLC1490	OUTPUT MODULE, 16 POINT, CONTACT	1769-OW16	AB
91	1	PLC1490	OUTPUT MODULE, 8 POINT, ANALOG	1769-OF8C	AB
92	1	PLC1490	INPUT MODULE, 8 POINT, ANALOG	1769sc-IF8u	AB
93					
94	1	HMI1490	PANELVIEW PLUS COMPACT, 10" COLOR, TOUCH, 24V DC INPUT POWER	2711PC-T10C4D1	AB
95					
96	1	MOD1490	ETHERNET PHONE MODEM/SWITCH	EW2620B	eWON
97					
98	1	CREC1490	CHART RECORDER, DATA ACQUISITION	NANODAC/VH/X/X/LRR/XX/ES/SV/XXXXX/ENG/XXX/XXXXX/XXXXXX/XX/XX	EUROTHERM
99					
100					
101	3	HLC4120, HLC4190, HLC4260	HIGH LIMIT CONTROLLER	07SL-91113-000-0-00	EUROTHERM
102	6	VFD105, FSC235, CREC1490,HLC4120, HLC4190, HLC4260	LEGEND PLATE, WHITE W/ BLACK TEXT	LAM-2.50-0.625-902	TICC
103					
104					
105	1	FSC235	FLAME SAFETY CONTROL	MEC120RD	FIREYE
106	1	FSC235	WIRING BASE	61-5042	FIREYE
107	1	FSC235	PURGE TIMER	MEP104	FIREYE
108	1	FSC235	UV FLAME ROD AMPLIFIER	MERT4	FIREYE
109	1	FSC235	REMOTE DISPLAY	ED510	FIREYE
110	1	FSC235	REMOTE DISPLAY MTG BKT AND CABLE	129-145-2	FIREYE
111					
112					
113					
114					

REV	BY	DATE	CHANGE
A	RLG	9/18/12	AS BUILT

ANGUIL

ANGUIL ENVIRONMENTAL SYSTEMS, INC.
MILWAUKEE, WISCONSIN

TITLE
MODEL 20 CATALYTIC OXIDIZER
MAIN CONTROL PANEL
ELECTRICAL BOM

DRAWING NO. 16512457

REV. A

CUSTOMER
SHAW ENVIRONMENTAL
KIRTLAND AFB, NM

PAGE 8 OF 9

SOURCE –

NOTE:

DRAWN RLG DATE 8/19/12

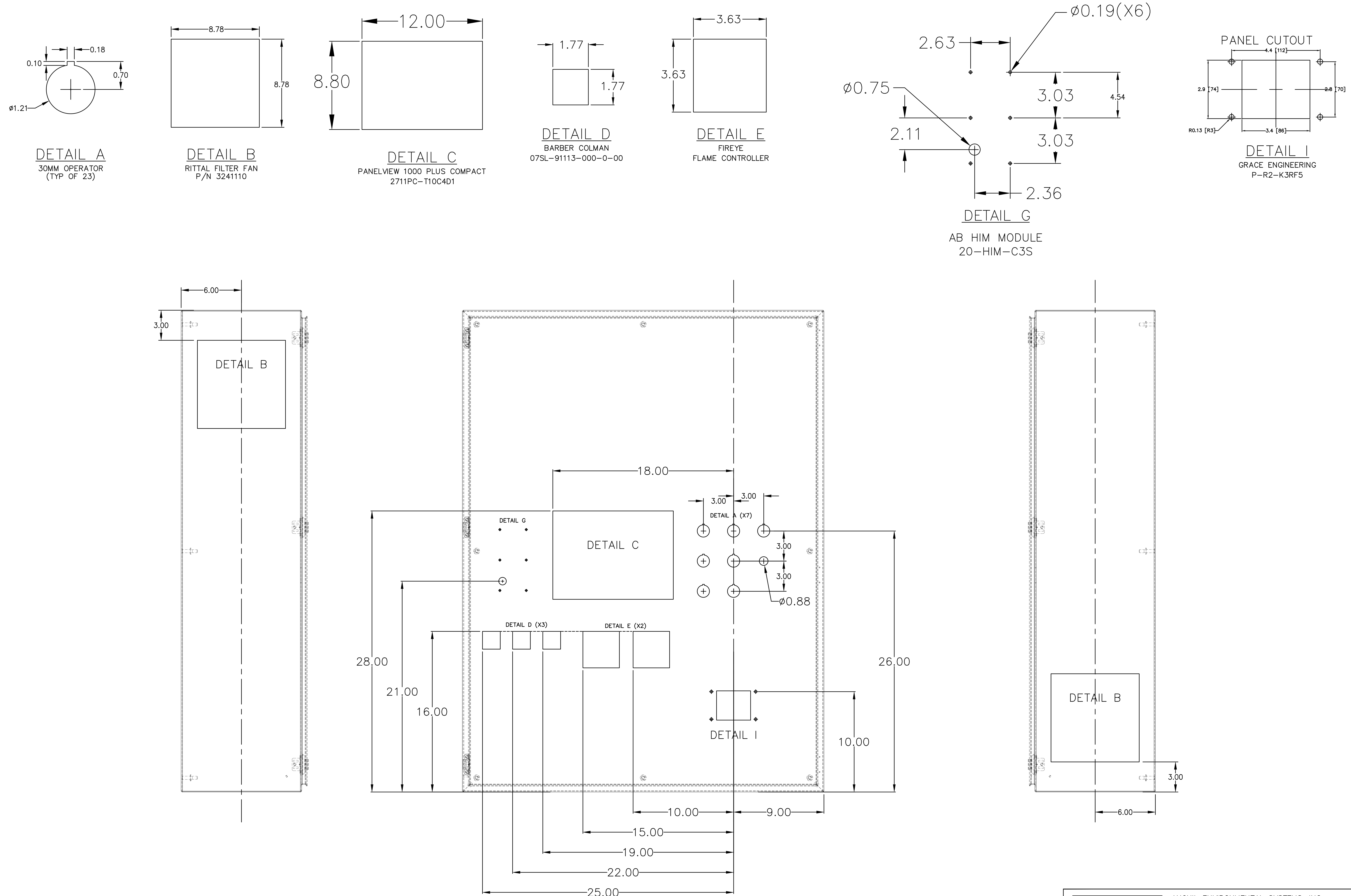
AUTOCAD PATH JOBS\16000s\16512\ELEC

SCALE NONE

CHECKED:
DATE:

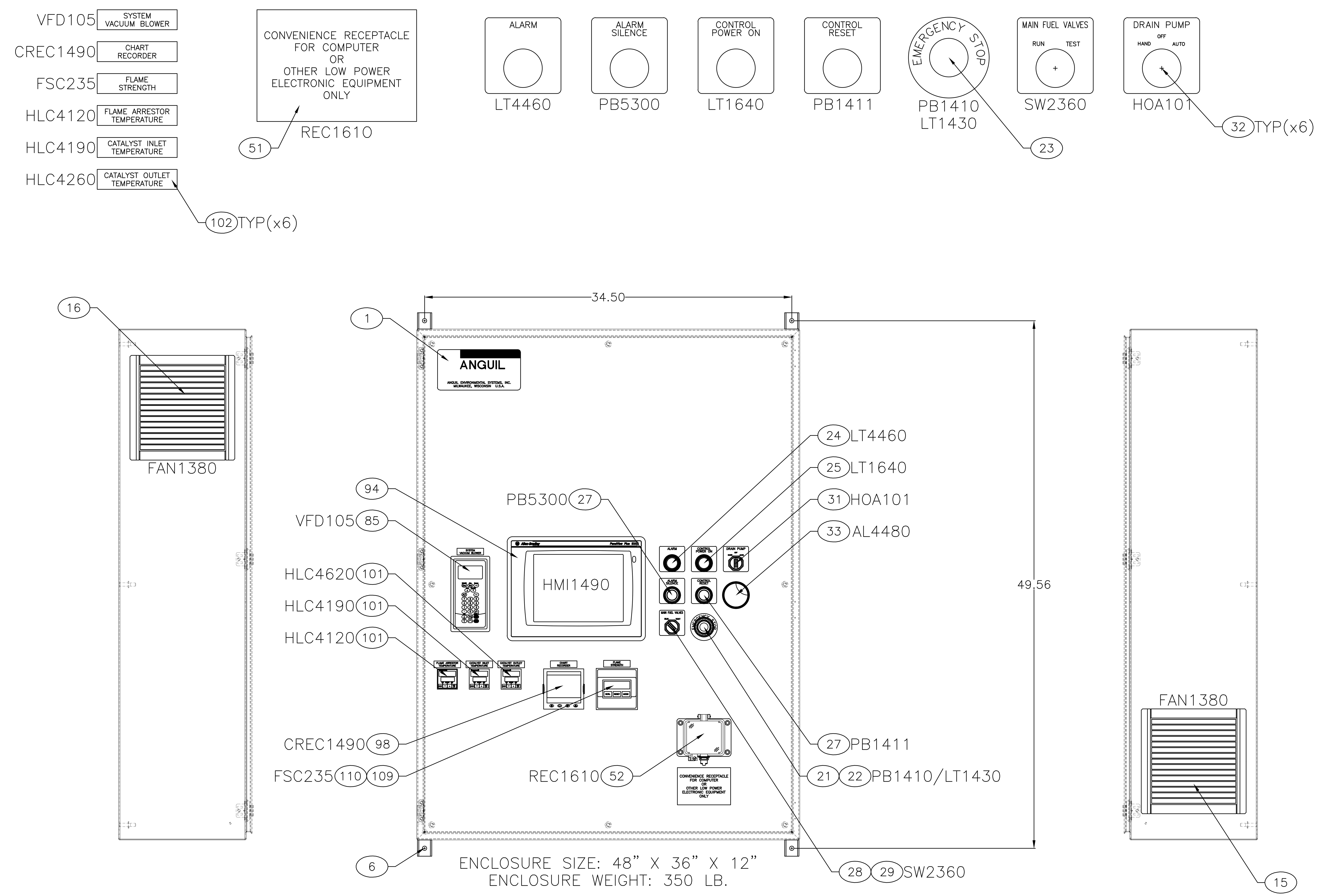
APPROVED:
DATE:

LAST CHANGED BY:
DATE:



REV	BY	DATE	CHANGE
A	RLG	9/18/12	AS BUILT

ANGUIL	ANGUIL ENVIRONMENTAL SYSTEMS, INC. MILWAUKEE, WISCONSIN
TITLE	MODEL 20 CATALYTIC OXIDIZER MAIN CONTROL PANEL ENCLOSURE CUTOUT DETAILS
DRAWING NO.	16512456
REV.	A
PAGE	7
OF	9
SOURCE	–
CUSTOMER	SHAW ENVIRONMENTAL KIRTLAND AFB, NM
NOTE:	
DRAWN	RLG
DATE	8/19/12
AUTOCAD PATH	JOBS\16000s\16512\ELEC
SCALE	NONE
CHECKED:	
DATE:	
APPROVED:	
DATE:	
LAST CHANGED BY:	
DATE:	



REV	BY	DATE	CHANGE
A	RLG	9/18/12	AS BUILT

ANGUIL ENVIRONMENTAL SYSTEMS, INC.
MILWAUKEE, WISCONSIN

TITLE: MODEL 20 CATALYTIC OXIDIZER
MAIN CONTROL PANEL
ENCLOSURE DETAILS

DRAWING NO. 16512455

REV. A

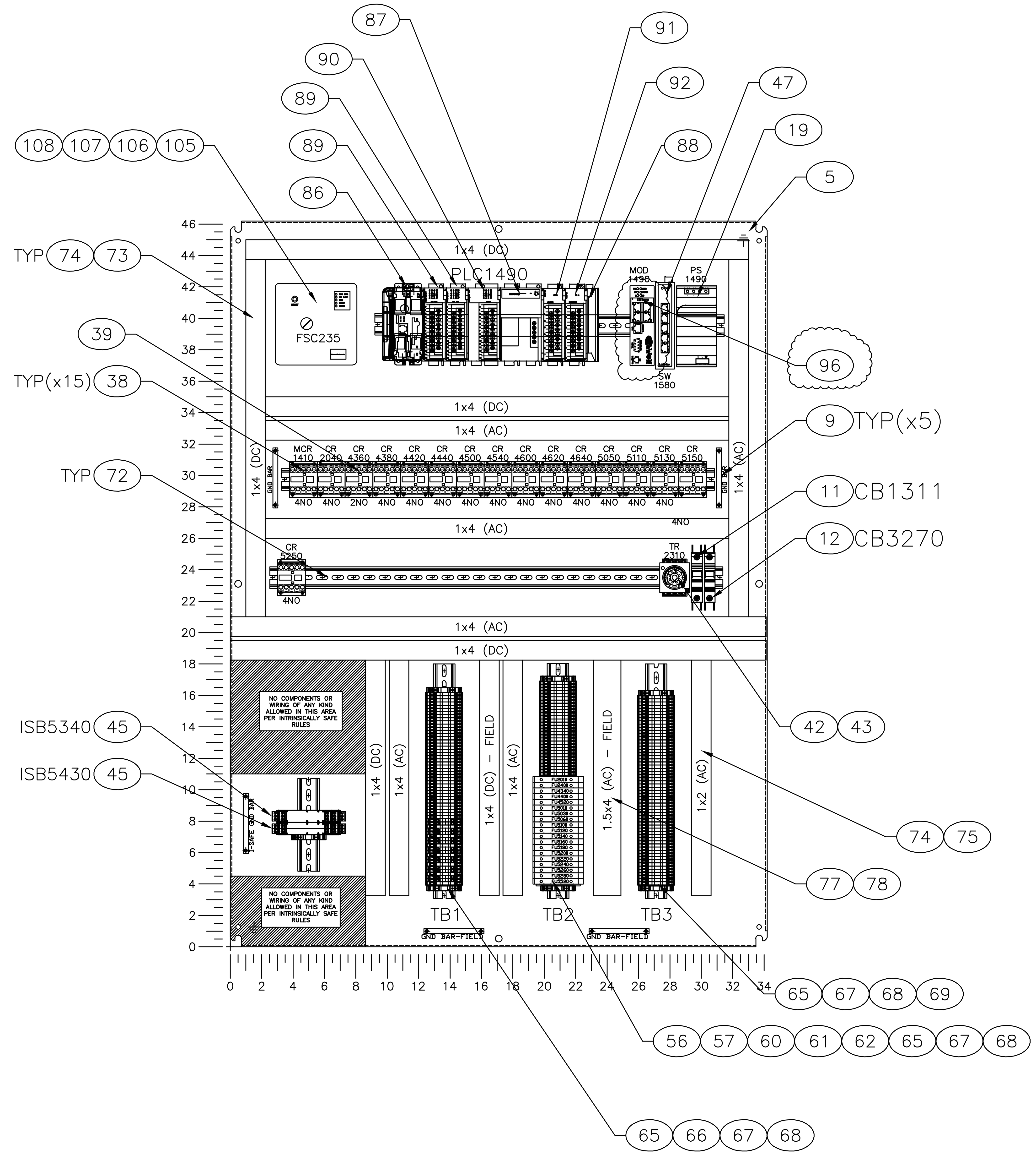
CUSTOMER: SHAW ENVIRONMENTAL
KIRTLAND AFB, NM

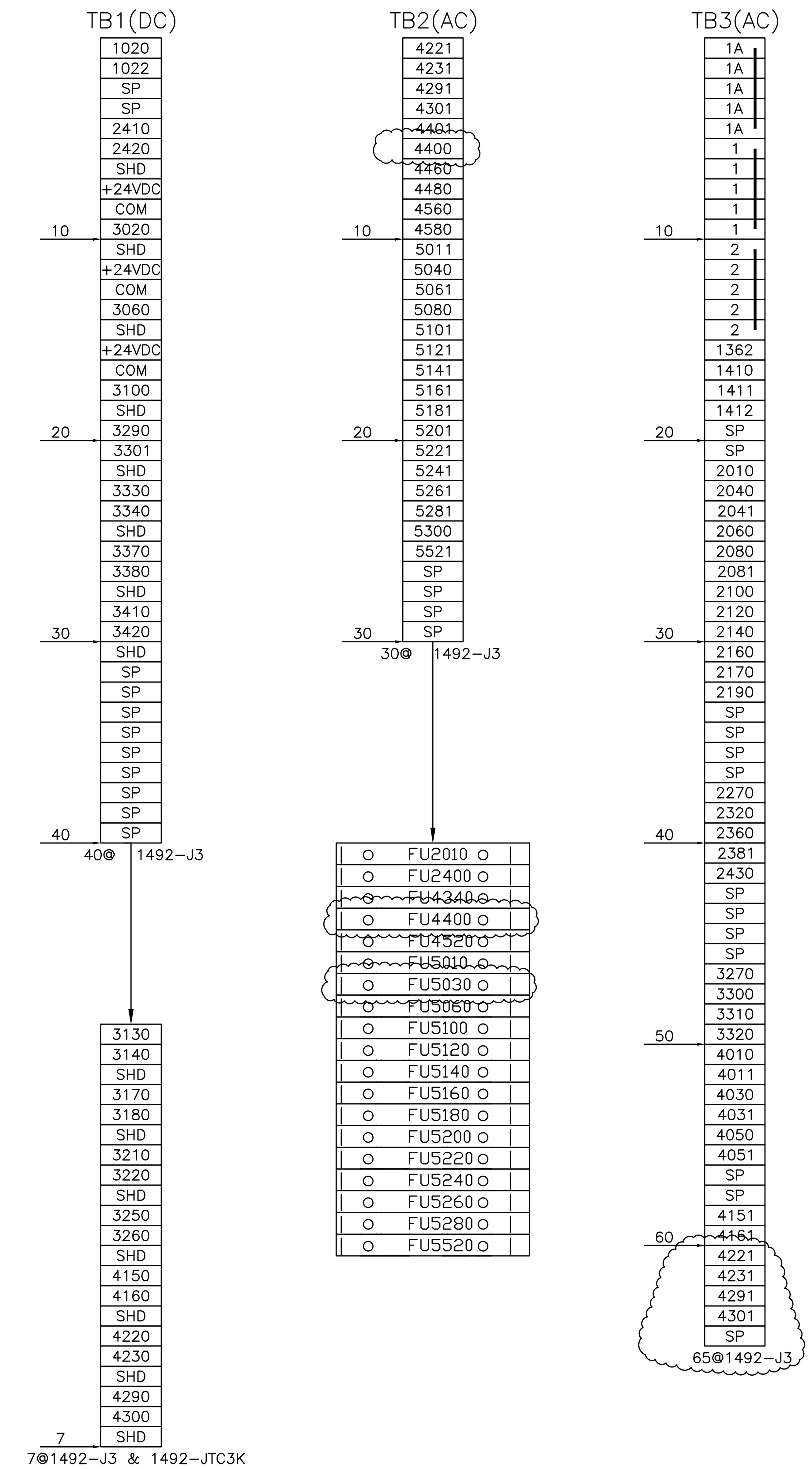
PAGE 6 OF 9

SOURCE –

NOTE:

DRAWN	DATE	AUTOCAD PATH	SCALE	CHECKED:	APPROVED:	LAST CHANGED BY:
RLG	8/19/12	JOBS\16000s\16512\ELEC	NONE	DATE:	DATE:	DATE:





79

THT-19-435-1

PART ID	MANUFACTURER	PART NUMBER	TORQUE (LB-IN)	WIRE TEMP (DEG C)
TB1	AB	1492-J3TCK	3.5-5.3	60
TB1-TB3	AB	1492-J3	3.7-7.1	60
GND BAR	NSI	4-14(12112)	45 (4-6 GA.)	60
GND BAR	NSI	4-14(12112)	40 (8 GA.)	60
GND BAR	NSI	4-14(12112)	35 (10-14 GA.)	60
ISB5340	P+F	KFD2-SR2-Ex2.W	4.4	60
ISB5430	P+F	KFD2-SR2-Ex2.W	4.4	60

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THT-19435-1

Fuse ID	Manufacturer	Fuse# or Equivalent	Volts
FU2010	BUSSMANN	MDL-5	250
FU2400	BUSSMANN	MDL-2	250
FU4340	BUSSMANN	MDL-2	250
FU4520	BUSSMANN	MDL-2	250
FU5010	BUSSMANN	MDL-2	250
FU5060	BUSSMANN	MDL-2	250
FU5100	BUSSMANN	MDL-2	250
FU5120	BUSSMANN	MDL-2	250
FU5140	BUSSMANN	MDL-2	250
FU5160	BUSSMANN	MDL-2	250

79

THT-19435-1

Fuse ID	Manufacturer	Fuse# or Equivalent	Volts
FU5180	BUSSMANN	MDL-2	250
FU5200	BUSSMANN	MDL-2	250
FU5220	BUSSMANN	MDL-2	250
FU5240	BUSSMANN	MDL-2	250
FU5260	BUSSMANN	MDL-2	250
FU5280	BUSSMANN	MDL-2	250
FU5220	BUSSMANN	MDL-2	250
FU5030	BUSSMANN	MDL-2	250

REV	BY	DATE	CHANGE
A	RLG	9/18/12	AS BUILT

ANGUIL

ANGUIL ENVIRONMENTAL SYSTEMS, INC.
MILWAUKEE, WISCONSIN

TITLE: MODEL 20 CATALYTIC OXIDIZER
MAIN CONTROL PANEL
SUB PANEL LAYOUT

DRAWING NO. 16512454

REV. A

CUSTOMER: SHAW ENVIRONMENTAL
KIRTLAND AFB, NM

PAGE 5 OF 9

SOURCE –

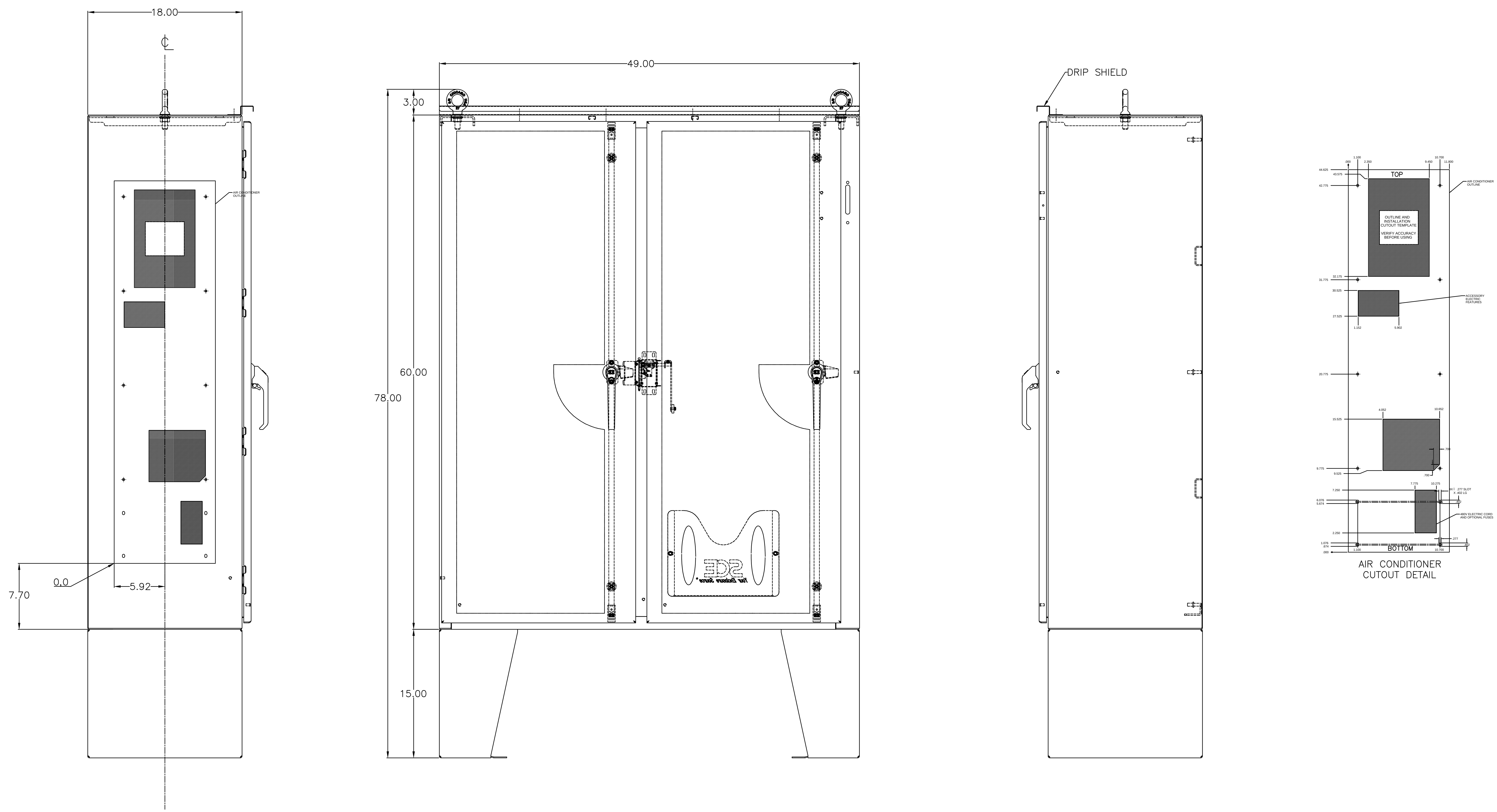
NOTE:

DRAWN: RLG | DATE: 8/19/12 | AUTOCAD PATH: JOBS\16000s\16512\ELEC | SCALE: NONE

CHECKED: | DATE:

APPROVED: | DATE:

LAST CHANGED BY: | DATE:

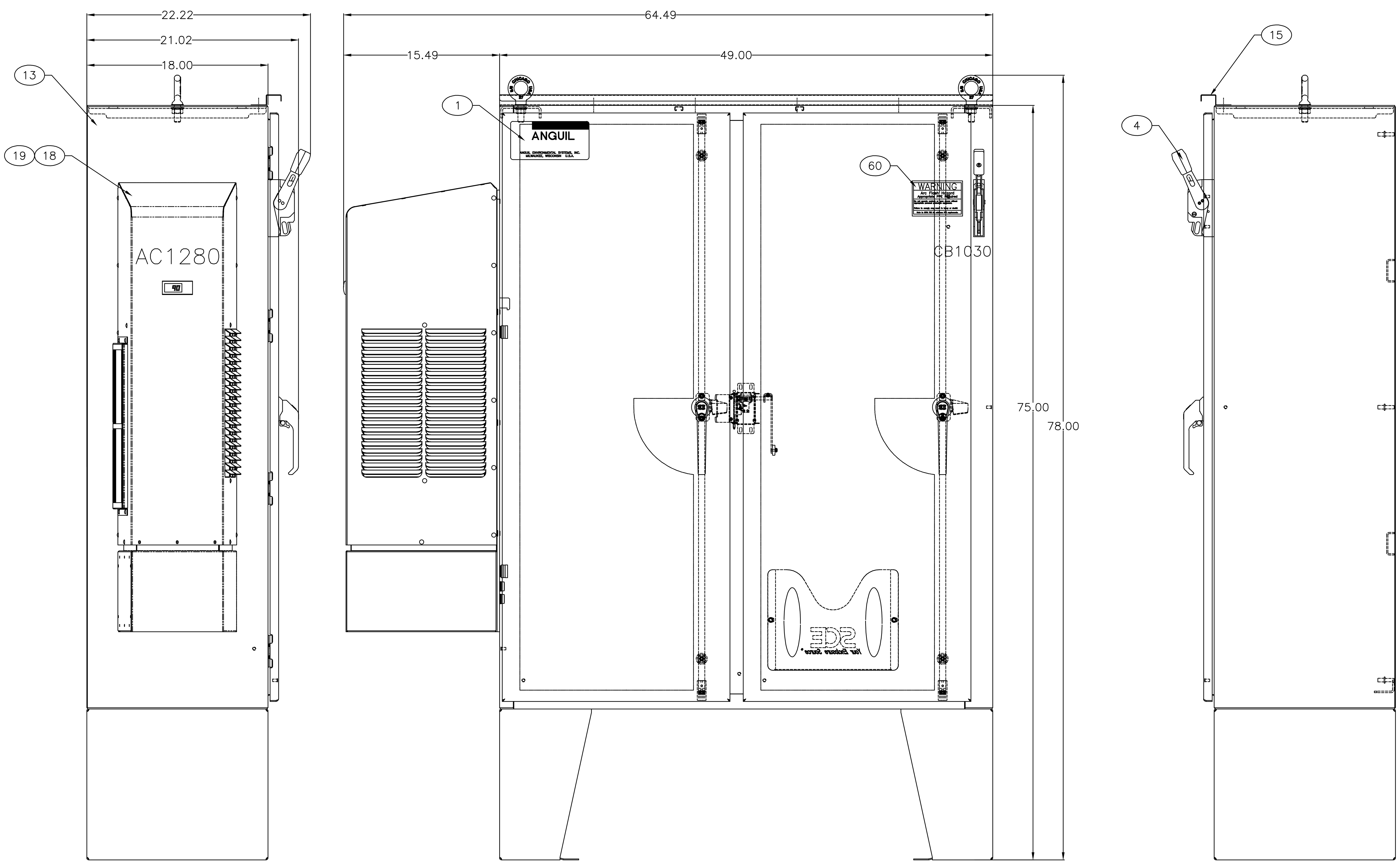


ANGUIL ANGUIL ENVIRONMENTAL SYSTEMS, INC.
MILWAUKEE, WISCONSIN

TITLE	DRAWING NO.	REV.	CUSTOMER
MODEL 20 CATALYTIC OXIDIZER POWER PANEL ENCLOSURE CUTOUT DETAILS	16512452	A	SHAW ENVIRONMENTAL KIRTLAND AFB, NM
	PAGE 3 OF 9	SOURCE –	NOTE:

DRAWN	DATE	AUTOCAD PATH	SCALE	CHECKED:	APPROVED:	LAST CHANGED BY:
RLG	8/19/12	JOBS\16000s\16512\ELEC	NONE	DATE:	DATE:	DATE:

REV	BY	DATE	CHANGE
A	RLG	9/18/12	AS BUILT



ENCLOSURE SIZE: 60" X 49" X 18"
APPROXIMATE ENCLOSURE WEIGHT: 1100 LB.

REV	BY	DATE	CHANGE
A	RLG	9/18/12	AS BUILT

ANGUIL

ANGUIL ENVIRONMENTAL SYSTEMS, INC.
MILWAUKEE, WISCONSIN

TITLE
MODEL 20 CATALYTIC OXIDIZER
POWER PANEL
ENCLOSURE DETAILS

DRAWING NO. 16512451

REV. A

CUSTOMER
SHAW ENVIRONMENTAL
KIRTLAND AFB, NM

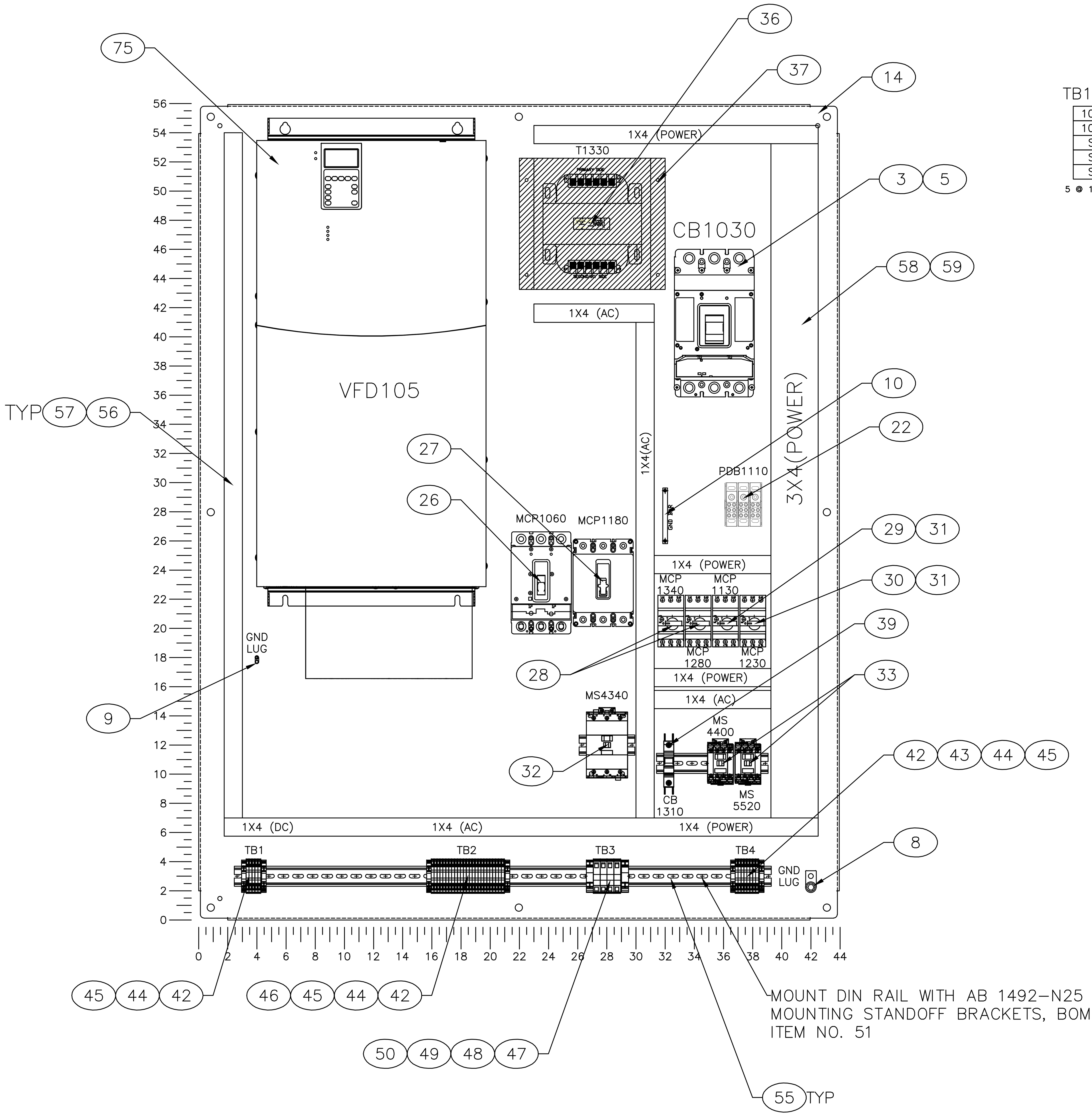
PAGE 2 OF 9

SOURCE –

NOTE:

DRAWN RLG | DATE 8/19/12 | AUTOCAD PATH JOBS\16000s\16512\ELEC | SCALE NONE

CHECKED: DATE: | APPROVED: DATE: | LAST CHANGED BY: DATE:



TB1(DC)
1020
1022
SP
SP
SP

5 @ 1492-J3

TB2(AC)
2
2
SP
SP
1362
2100
2120
4341
4403
5140
5141
5260
5261
5280
5281
5521
SP
SP
SP
SP
SP
SP

22 @ 1492-J3

TB3(MOTOR)
3T1A
3T2A
3T3A
3TGND

3 @ 1492-J16
1 @ 1492-JG16

TB4(MOTORS)
2T1A
2T2A
2T3A
2TGND
4T1A
4T2A
4T3A
4TGND

6 @ 1492-J3
2 @ 1492-JG3

THT-19-435-1

SPEC. LABEL

460 V. 221.3 F.L.A. (TOTAL)

60 CY. 156 F.L.A. (LARGEST MOTOR)

3 PH. 16512401 DRAWING NUMBER

SHORT CIRCUIT CURRENT 5 kA RMS

SYMMETRICAL, 460 V MAXIMUM

(66)

THT-19-435-1

PART ID	MANUFACTURER	PART NUMBER	TORQUE (LB-IN)	WIRE TEMP (DEG C)
TB1,TB2,TB4	AB	1492-J3, JG3	4.5-7.1	60
TB3	AB	1492-J16, JG16	35	60
GND LUG (MAIN)	ILSCO	CP-0	275	60
GND LUG (VFD)	T&B	L70	45	60
GND BAR	NSI	4-14 (12112)	35	60
CB1030	EATON	LGE3300FAG	370	60
VFD105	AB	20BD156A3ANNANC0	52	60

(66)

REV	BY	DATE	CHANGE
A	RLG	9/18/12	AS BUILT

ANGUIL — ANGUIL ENVIRONMENTAL SYSTEMS, INC. MILWAUKEE, WISCONSIN

TITLE: MODEL 20 CATALYTIC OXIDIZER POWER PANEL SUB PANEL LAYOUT

DRAWING NO. 16512450

PAGE 1 OF 9

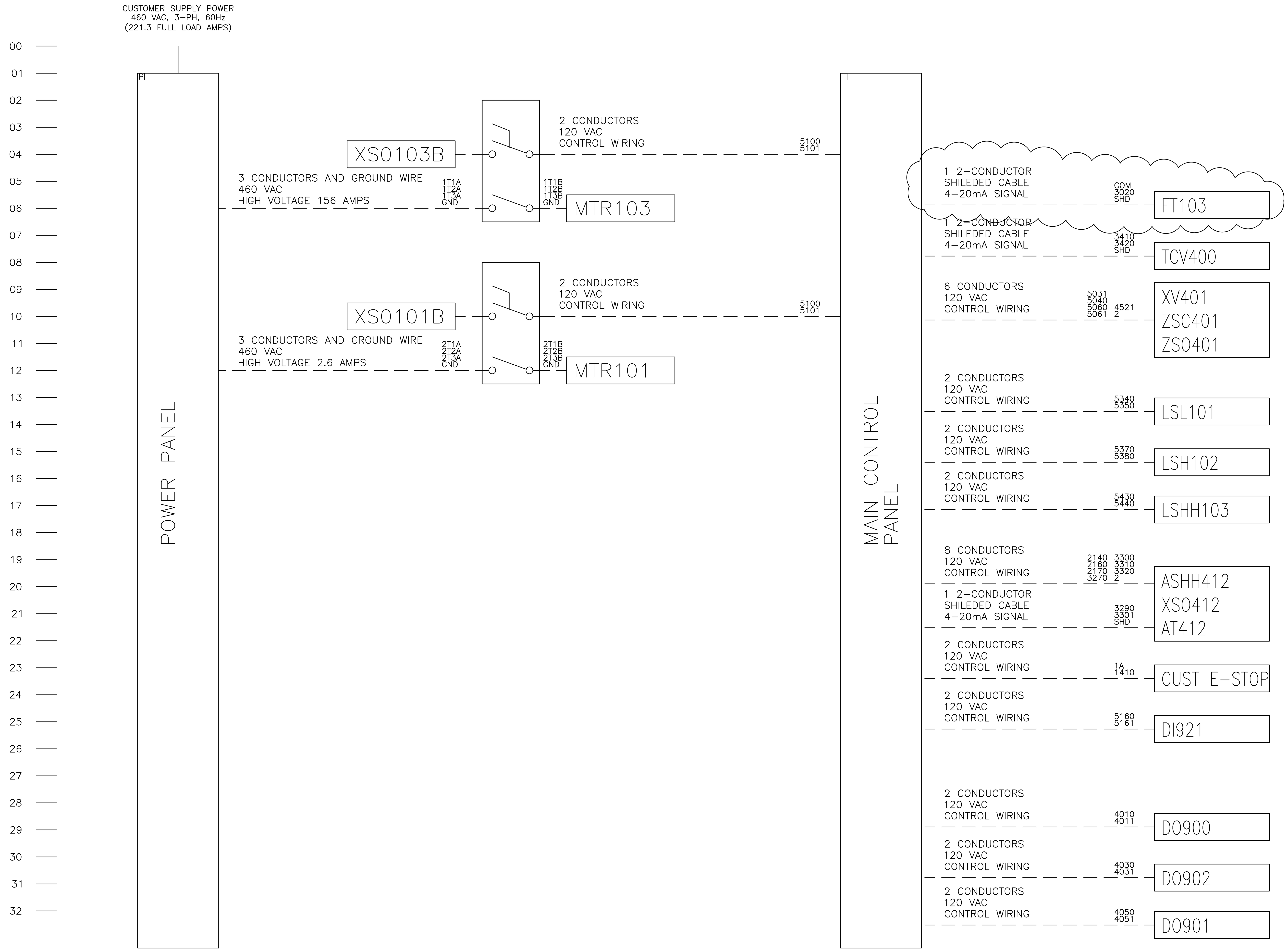
REV. A

SOURCE –

CUSTOMER: SHAW ENVIRONMENTAL, KIRTLAND AFB, NM

NOTE:

DRAWN	DATE	AUTOCAD PATH	SCALE	CHECKED:	APPROVED:	LAST CHANGED BY:
RLG	8/19/12	JOBS\16000s\16512\ELEC	NONE	DATE:	DATE:	DATE:



= PANEL WIRING
= EXTERNAL WIRING COMPLETED AS SHIPPED
= FIELD WIRING BY ANGUIL

MAIN CONTROL PANEL TERMINAL (NEMA 12 INDOOR)
POWER PANEL TERMINAL (NEMA 3R OUTDOOR)
IGNITION TRANSFORMER J-BOX TERMINAL
PANEL ELEVATION: 5300 FASL

REV	BY	DATE	CHANGE
B	RLG	9/18/12	AS BUILT
A	RLG	8/15/12	RELEASED FOR APPROVAL

ANGUIL
ANGUIL ENVIRONMENTAL SYSTEMS, INC.
MILWAUKEE, WISCONSIN

TITLE: MODEL 20 CATALYTIC OXIDIZER
ELECTRICAL INTERCONNECT

DRAWING NO. 16512406
REV. B
CUSTOMER: SHAW ENVIRONMENTAL
KIRTLAND AFB, NM
PAGE 6 OF 6
SOURCE 13450
NOTE:
DRAWN SAM
DATE 8/3/12
AUTOCAD PATH JOBS\16000s\16512\ELEC
SCALE NONE
CHECKED:
DATE:
APPROVED:
DATE:
LAST CHANGED BY:
DATE:

————	= PANEL WIRING
—·—·—·—	= EXTERNAL WIRING COMPLETED AS SHIPPED
— — — —	= FIELD WIRING BY ANGUIL

□ MAIN CONTROL PANEL TERMINAL (NEMA 12 INDOOR)
▣ POWER PANEL TERMINAL (NEMA 3R OUTDOOR)
⊠ IGNITION TRANSFORMER J-BOX TERMINAL
PANEL ELEVATION: 5300 FASL

REV	BY	DATE	CHANGE
B	RLG	9/18/12	AS BUILT
A	RLG	8/15/12	RELEASED FOR APPROVAL

ANGUIL — ANGUIL ENVIRONMENTAL SYSTEMS, INC. MILWAUKEE, WISCONSIN

TITLE: MODEL 20 CATALYTIC OXIDIZER — ELECTRICAL SCHEMATIC

DRAWING NO. 16512405 | REV. B | PAGE 5 OF 6 | SOURCE 13450 | SCALE NONE

DRAWN SAM | DATE 8/3/12 | AUTOCAD PATH JOBS\16000s\16512\ELEC

CUSTOMER: SHAW ENVIRONMENTAL, KIRTLAND AFB, NM

NOTE:

CHECKED: DATE: | APPROVED: DATE: | LAST CHANGED BY: DATE:

= PANEL WIRING
= EXTERNAL WIRING COMPLETED AS SHIPPED
= FIELD WIRING

□ MAIN CONTROL PANEL TERMINAL (NEMA 12 INDOOR)
POWER PANEL TERMINAL (NEMA 3R OUTDOOR)
IGNITION TRANSFORMER J-BOX TERMINAL
PANEL ELEVATION: 5300 FASL

REV	BY	DATE	CHANGE
B	RLG	9/18/12	AS BUILT
A	RLG	8/15/12	RELEASED FOR APPROVAL

ANGUIL

ANGUIL ENVIRONMENTAL SYSTEMS, INC.
MILWAUKEE, WISCONSIN

TITLE
MODEL 20 CATALYTIC OXIDIZER
ELECTRICAL SCHEMATIC

DRAWING NO. 16512404
REV. B
CUSTOMER SHAW ENVIRONMENTAL
KIRTLAND AFB, NM
PAGE 4 OF 6
SOURCE 13450
NOTE:
DRAWN SAM
DATE 8/3/12
AUTOCAD PATH JOBS\16000s\16512\ELEC
SCALE NONE
CHECKED:
DATE:
APPROVED:
DATE:
LAST CHANGED BY:
DATE:

______ = PANEL WIRING

\-·-·-·- = EXTERNAL WIRING COMPLETED AS SHIPPED

\- - - - = FIELD WIRING

☐ MAIN CONTROL PANEL TERMINAL (NEMA 12 INDOOR)

☐ POWER PANEL TERMINAL (NEMA 3R OUTDOOR)

☐ IGNITION TRANSFORMER J-BOX TERMINAL

PANEL ELEVATION: 5300 FASL

REV	BY	DATE	CHANGE
B	RLG	9/18/12	AS BUILT
A	RLG	8/15/12	RELEASED FOR APPROVAL

ANGUIL

ANGUIL ENVIRONMENTAL SYSTEMS, INC.
MILWAUKEE, WISCONSIN

REV.	B
CUSTOMER	SHAW ENVIRONMENTAL KIRTLAND AFB, NM
TITLE	MODEL 20 CATALYTIC OXIDIZER ELECTRICAL SCHEMATIC
DRAWING NO.	16512403
PAGE	3
OF	6
SOURCE	13450
NOTE:	
DRAWN	SAM
DATE	8/3/12
AUTOCAD PATH	JOBS\16000s\16512\ELEC
SCALE	NONE
CHECKED:	
APPROVED:	
LAST CHANGED BY:	
DATE:	

———	= PANEL WIRING
—·—·—	= EXTERNAL WIRING COMPLETED AS SHIPPED
— — —	= FIELD WIRING BY OTHERS

□	MAIN CONTROL PANEL TERMINAL (NEMA 12 INDOOR)
⊡	POWER PANEL TERMINAL (NEMA 3R OUTDOOR)
⊠	IGNITION TRANSFORMER J-BOX TERMINAL
	PANEL ELEVATION: 5300 FASL

REV	BY	DATE	CHANGE
B	RLG	9/18/12	AS BUILT
A	RLG	8/15/12	RELEASED FOR APPROVAL

ANGUIL
ANGUIL ENVIRONMENTAL SYSTEMS, INC.
MILWAUKEE, WISCONSIN

TITLE: MODEL 20 CATALYTIC OXIDIZER
ELECTRICAL SCHEMATIC

DRAWING NO. 16512402 — REV. B

CUSTOMER: SHAW ENVIRONMENTAL
KIRTLAND AFB, NM

PAGE 2 OF 6 — SOURCE 13450 — NOTE:

DRAWN SAM — DATE 8/3/12 — AUTOCAD PATH JOBS\16000s\16512\ELEC — SCALE NONE

CHECKED: DATE: — APPROVED: DATE: — LAST CHANGED BY: DATE:

* SET BREAKERS & OVERLOADS BASED ON EQUIPMENT NAMEPLATE

= PANEL WIRING
= EXTERNAL WIRING COMPLETED AS SHIPPED
= FIELD WIRING

MAIN CONTROL PANEL TERMINAL (NEMA 12 INDOOR)
POWER PANEL TERMINAL (NEMA 3R OUTDOOR)
IGNITION TRANSFORMER J-BOX TERMINAL
PANEL ELEVATION: 5300 FASL

REV	BY	DATE	CHANGE
B	RLG	9/18/12	AS BUILT
A	RLG	8/15/12	RELEASED FOR APPROVAL

ANGUIL — ANGUIL ENVIRONMENTAL SYSTEMS, INC. MILWAUKEE, WISCONSIN

TITLE: MODEL 20 CATALYTIC OXIDIZER — ELECTRICAL SCHEMATIC

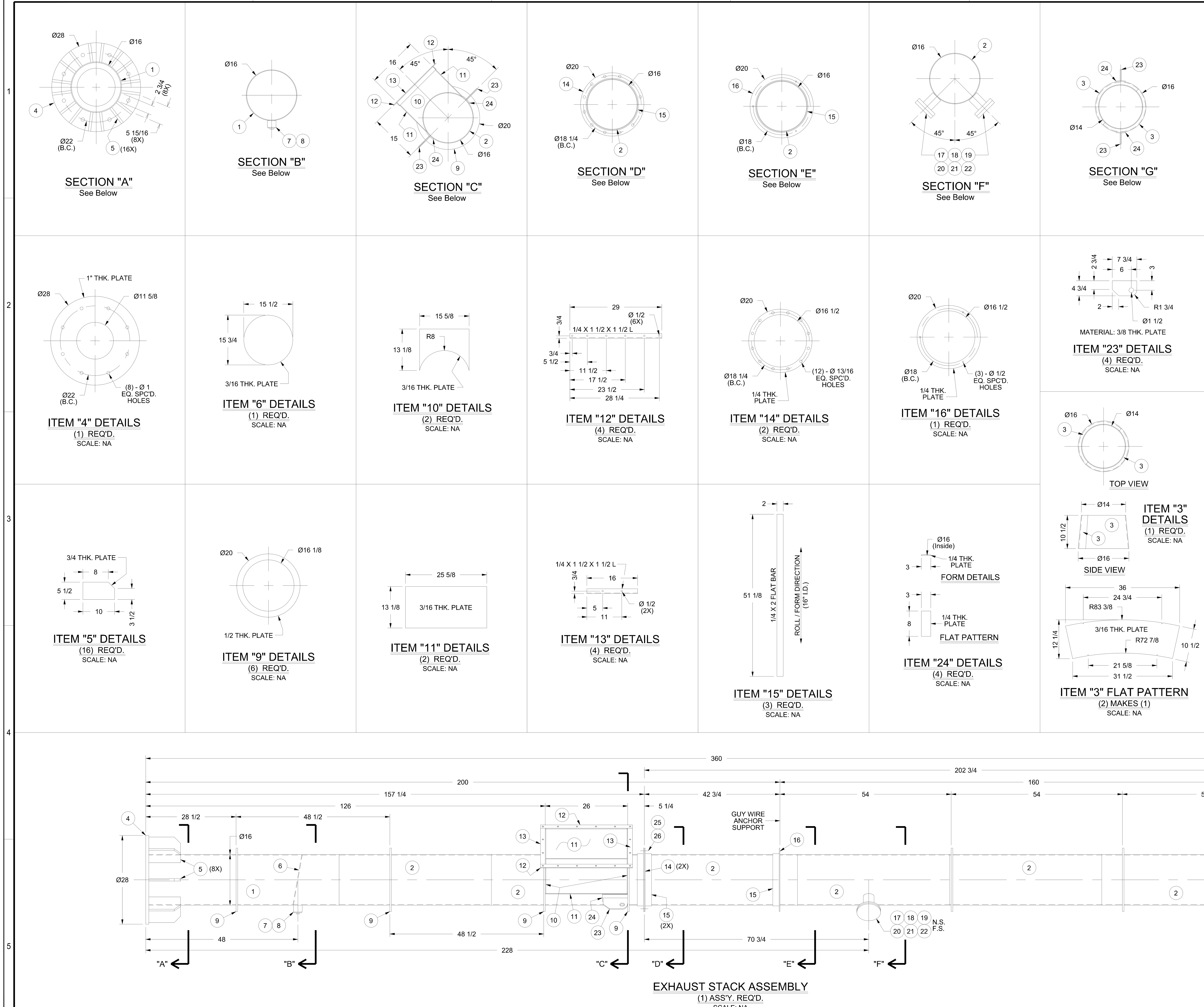
DRAWING NO. 16512401 — REV. B

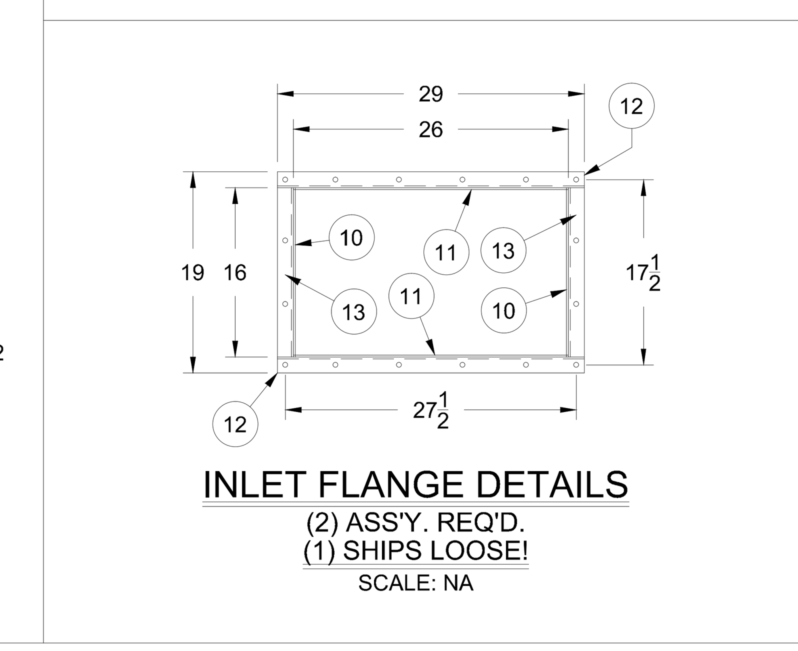
CUSTOMER: SHAW ENVIRONMENTAL — KIRTLAND AFB, NM

PAGE 1 OF 6 — SOURCE 13450 — NOTE:

DRAWN SAM — DATE 8/3/12 — AUTOCAD PATH JOBS\16000s\16512\ELEC — SCALE NONE

CHECKED: DATE: — APPROVED: DATE: — LAST CHANGED BY: DATE:





BILL OF MATERIALS

ITEM	QTY	SIZE - DIMENSION - REFERENCE	MTL
1	1	3/16" X 16" O.D. X 60" LG. CYL. (49 5/8")	A36
2	6	3/16" X 16" O.D. X 48" LG. CYL. (49 5/8")	A36
3	2	3/16" THK. PLATE - SEE DETAIL	A36
4	1	1" THK. PLATE - SEE DETAIL	A36
5	16	3/4" THK. PLATE - SEE DETAIL	A36
6	1	3/16" THK. PLATE - SEE DETAIL	A36
7	1	2" DIA. STANDARD COUPLING	STL
8	1	2" DIA. PIPE PLUG	STL
9	6	1/2" THK. PLATE - SEE DETAIL	A36
10	2	3/16" THK. PLATE - SEE DETAIL	A36
11	2	3/16" THK. PLATE - SEE DETAIL	A36
12	4	1/4" X 1 1/2" X 1 1/2" L - SEE DETAIL	A36
13	4	1/4" X 1 1/2" X 1 1/2" L - SEE DETAIL	A36
14	2	1/4" THK. PLATE - SEE DETAIL	A36
15	3	1/4" X 2" FLAT BAR - SEE DETAIL	A36
16	1	1/4" THK. PLATE - SEE DETAIL	A36
17	2	3" DIA. SCH.40 PIPE - 5 1/2" LONG	STL
18	2	3" DIA. R.F.S.O. FLANGE	STL
19	2	3" DIA. BLIND FLANGE	STL
20	2	3" DIA. STANDARD GASKET	FIBER
21	8	5/8" N.C. X 2 3/4" LONG - H.H.C.S.	GR8
22	8	5/8" N.C. HEX NUT	GR8
23	4	3/8" THK. PLATE - SEE DETAIL	A36
24	4	1/4" THK. PLATE - SEE DETAIL	A36
25	12	3/4" N.C. X 1 1/4" LG BOLT - (FULL THREAD)	A325
26	12	3/4" N.C. HEX NUT	A325

REV	DESCRIPTION	DWN	APR	DATE

JOB: Shaw Exhaust Stack

TITLE: Stack Ass'y. & Details

SCALE: NA

DATE: 9-4-12

FILE: 16512S | MATERIAL: Varies | DWG BY: SBG

Superior Welding
W5521 Railroad Ave.
Hermansville, MI 49847
Ph.: (906) 498-7659
Fax: (906) 498-7649

SWM NUMBER: 16512

ANGUIL NUMBER: 16512

DRAWING NUMBER: 16512-S

REV -

TERMINAL POINT SCHEDULE

T.P.	DESCRIPTION	MEDIA	SIZE	CONNECTION	MATERIAL
A	SYSTEM INLETS	VOC LADEN AIR	12"ø	FLANGED	CARBON STEEL
B	FUEL INLET	NATURAL GAS	1"ø	FNPT	CARBON STEEL

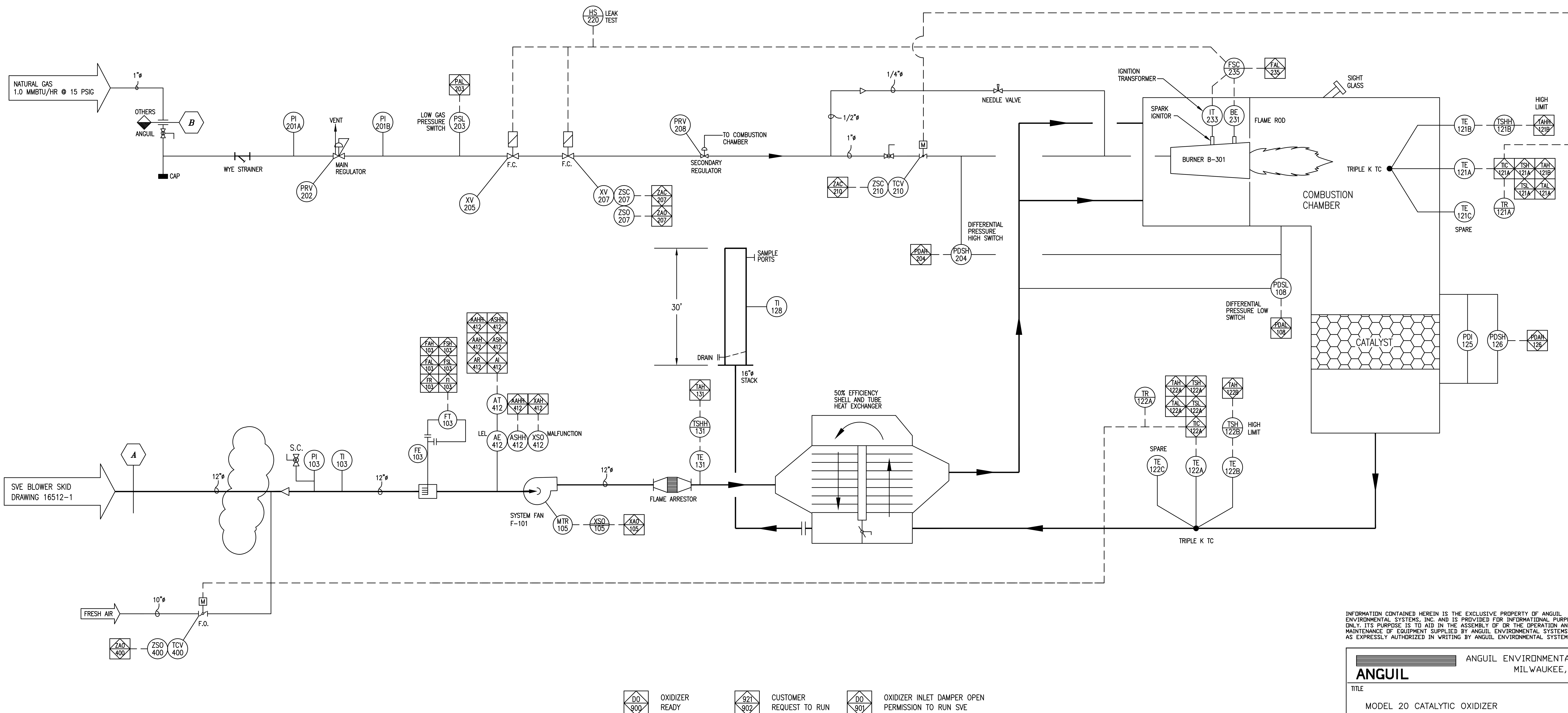
PROCESS DESIGN CONDITIONS

DESIGN FLOW	2,000 SCFM
PROCESS AIR INLET TEMPERATURE	60–100 °F
VOC CONSTITUENT	VOLATILE FUEL HYDROCARBONS
MAXIMUM VOC LOADING	25% LEL @ 1600 SCFM
DESTRUCTION EFFICIENCY	98%
HEAT EXCHANGER EFFICIENCY	50%
STATIC PRESSURE AT TERMINAL POINT "A"	–1" W.C.
ELEVATION	5,300 FT ABOVE SEA LEVEL

UTILITIES

NATURAL GAS	1000 SCFH @ 15 PSIG
POWER	460V / 60 Hz / 3 PH

NOTES:
1) ELECTRICAL CLASSIFICATION: GENERAL
2) SVE BLOWER EXHAUST WILL BE OPERATED BELOW 25% LEL.
3) COLOR TBD
4) FAN UPSIZED FOR ADDITIONAL DILUTION AIR DURING HIGH LOADING. AT MAXIMUM LOADING OF 1600 SCFM @ 25% LEL FAN HAS BEEN SIZED FOR AN ADDITIONAL 900 SCFM DILUTION AIR.



ANGUIL

ANGUIL ENVIRONMENTAL SYSTEMS, INC.
MILWAUKEE, WISCONSIN

TITLE: MODEL 20 CATALYTIC OXIDIZER
PROCESS AND INSTRUMENTATION DIAGRAM

DRAWING NO. 16512–102

SCALE NTS

DRAWN AE DATE 7/17/12

CHECKED DATE

APPROVED DATE

LAST DRAWN BY AE DATE 10/18/12

CUSTOMER: SHAW ENVIRONMENTAL
KIRKLAND AFB, NM

SOURCE

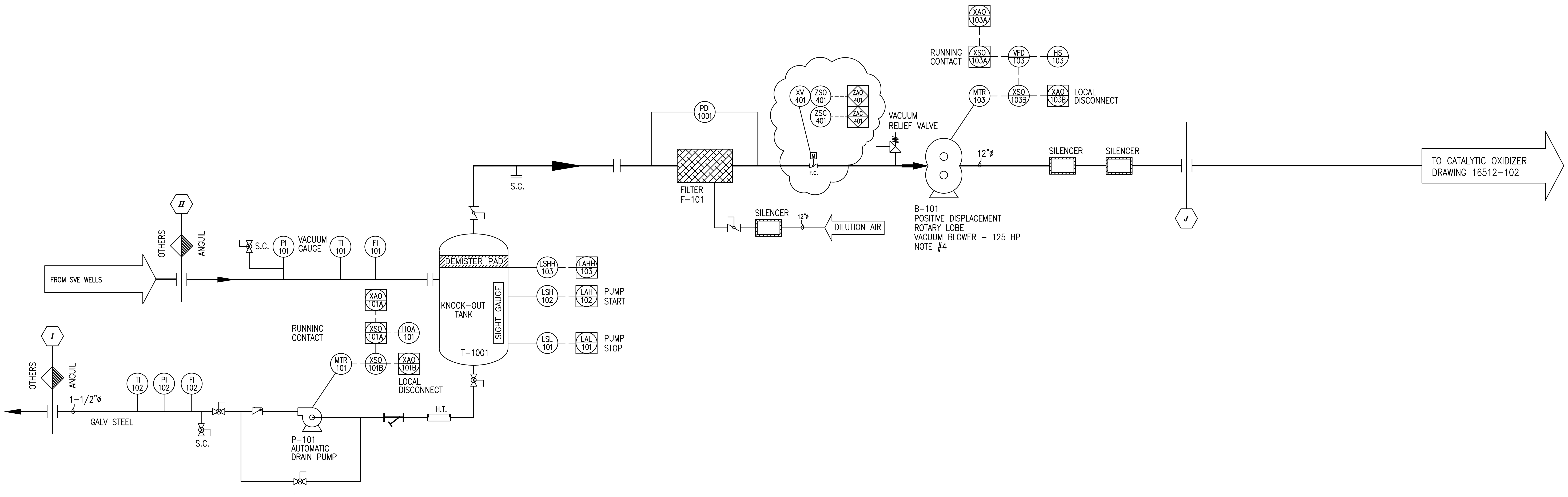
REV. D

PAGE 1 OF 1

AUTOCAD PATH H:\CAD\JOBS\16000

REV	BY	DATE	CHANGE
D	AE	10/18/12	AS–BUILD
C	AE	9/7/12	CHANGE AS INDICATED
B	AE	8/14/12	CHANGE AS INDICATED
A	AE	8/1/12	CHANGE AS INDICATED

LAST PLOTTED BY _ DATE _



PROCESS DESIGN CONDITIONS

DESIGN FLOW	1,600 SCFM @ -40"WC VAC
OR	1,000 SCFM @ -11" HG VAC
PROCESS AIR INLET TEMPERATURE	60-100 °F
VOC CONSTITUNENT	VOLATILE FUEL HYDROCARBONS
MAXIMUM VOC LOADING	<25% LEL
ELEVATION	5,300 FT ABOVE SEA LEVEL

TERMINAL POINT SCHEDULE

T.P.	DESCRIPTION	MEDIA	SIZE	CONNECTION	MATERIAL
H	SVE PROCESS INLET	VOC LADEN AIR	12"	FLANGED	CS PIPE SCH 10
I	CONSENSATE OUTLET	CONDENSATE	1-1/2"	NPT	GALV
J	SVE PROCESS OUTLET	VOC LADEN AIR	12"	FLANGED	CS PIPE SCH 10

NOTES:

1) ELECTRICAL AREA CLASSIFICATION: C1D2
2) S.C. = SAMPLE CONNECTION PORT
3) COLOR: TBD
4) NOISE ABATEMENT ENCLOSURE INCLUDED. NOISE ABATEMENT ENCLOSURE HAS A 1/4 HP VENT FAN.
5) LOCAL DISCONNECTS PROVIDED BY OTHERS
6) ELEVATION 5300 FASL

REV	BY	DATE	CHANGE
b	AE	10/18/12	AS-BUILD
A	AE	8/8/12	CHANGE AS INDICATED

ANGUIL

ANGUIL ENVIRONMENTAL SYSTEMS, INC.
MILWAUKEE, WISCONSIN

TITLE: SVE BLOWER SKID
PROCESS AND INSTRUMENTATION DIAGRAM

DRAWING NO. 16512-101

SCALE NTS

DRAWN AE DATE 7/17/12
CHECKED DATE
APPROVED DATE
LAST DRAWN BY AE DATE 10/18/12

CUSTOMER: SHAW ENVIRONMENTAL
KIRKLAND AFB, NM

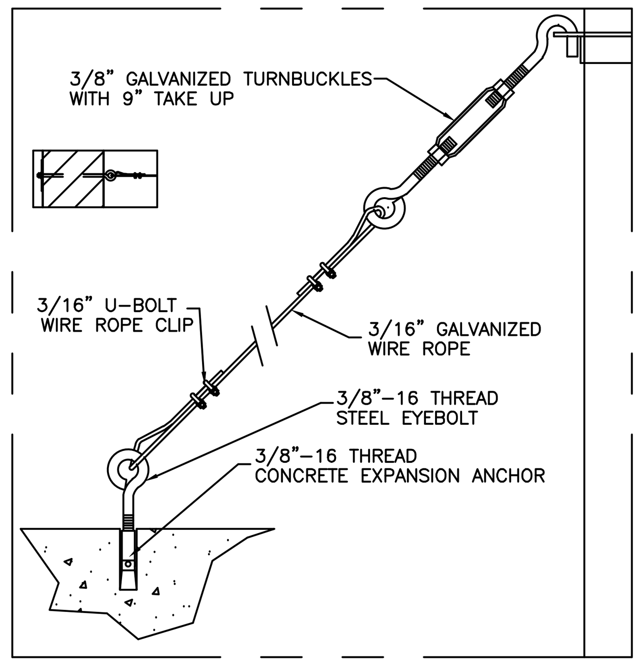
REV. B

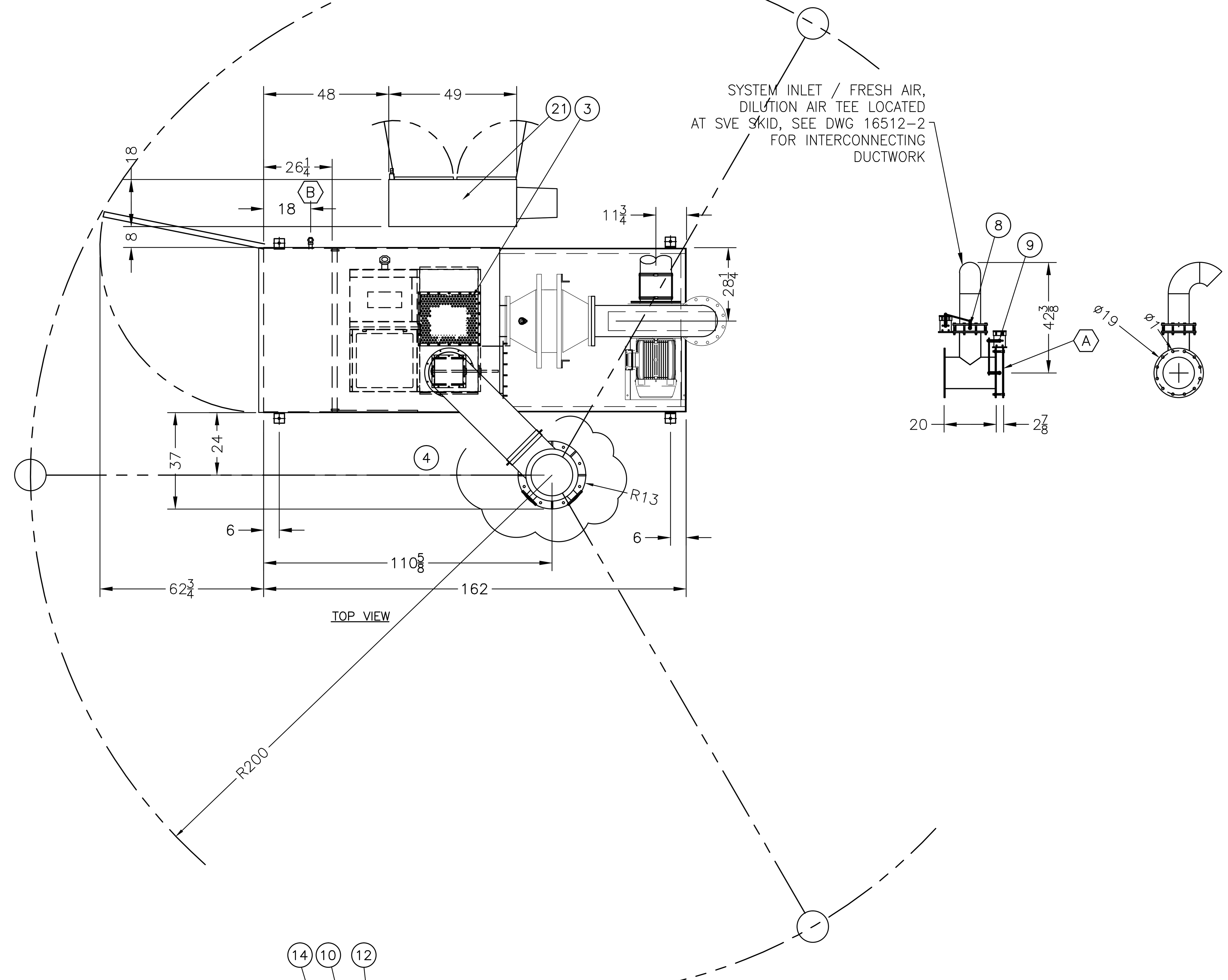
SOURCE

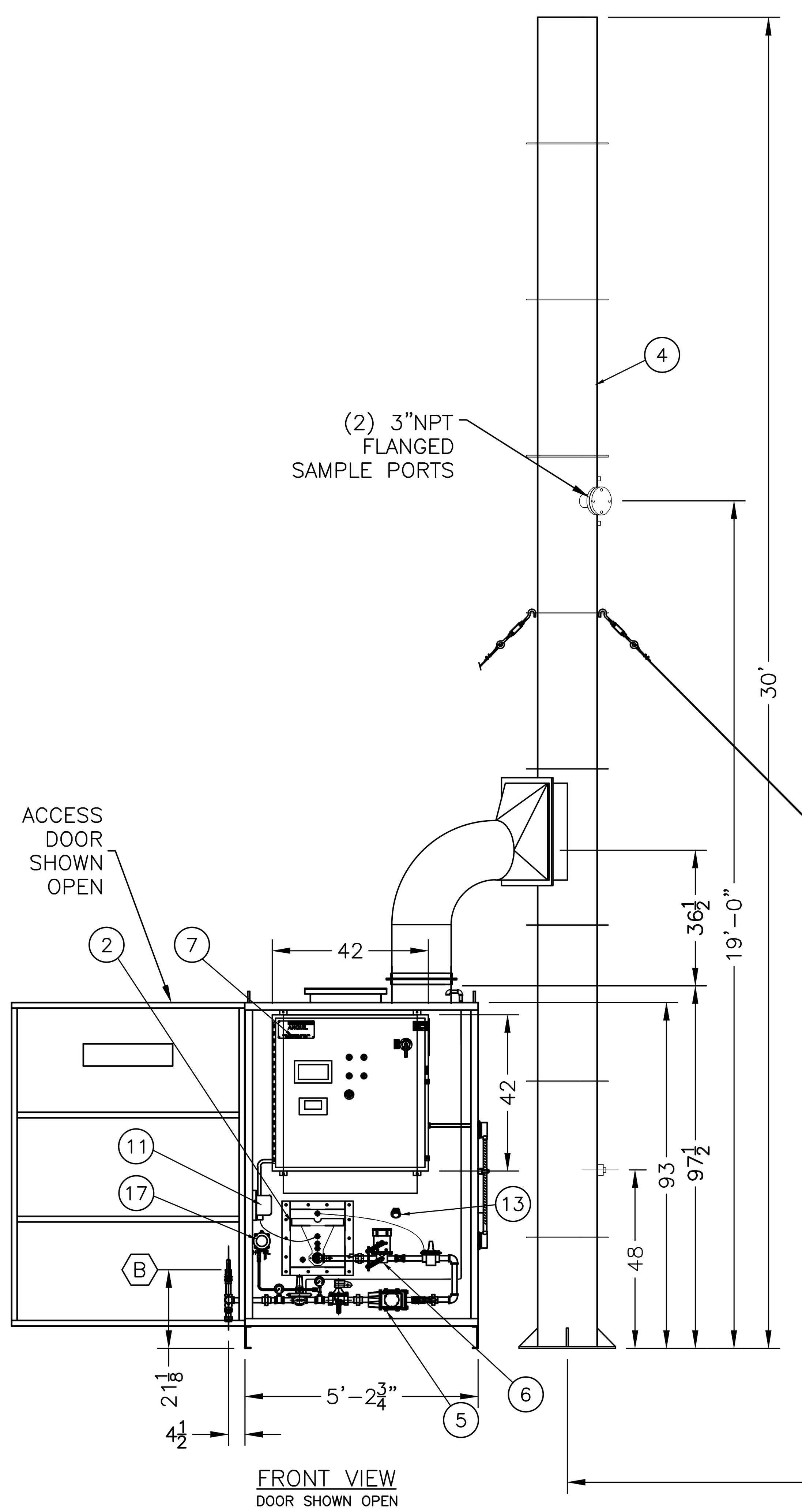
PAGE 1 OF 3

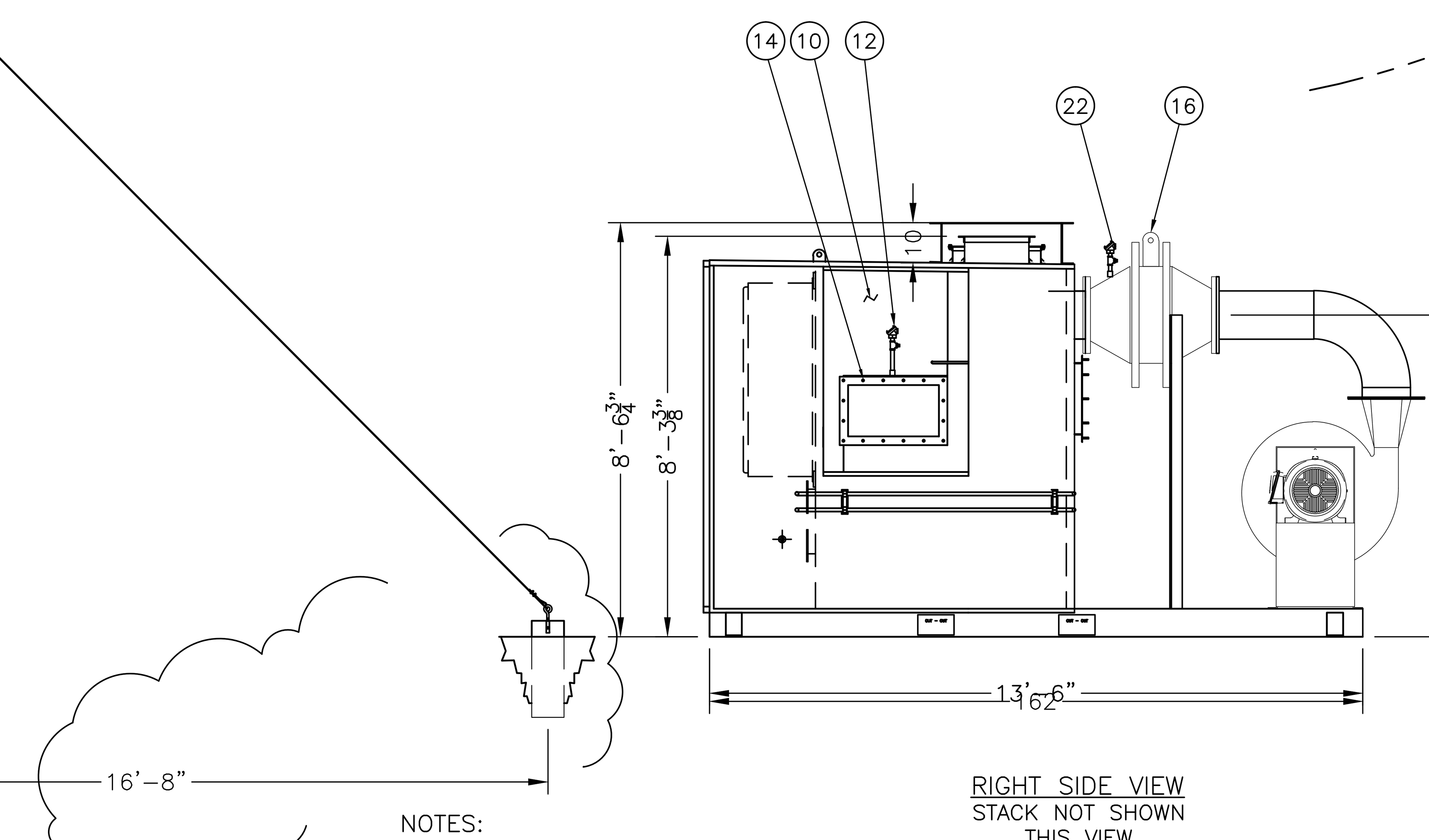
AUTOCAD PATH H:\CAD\JOBS\16000

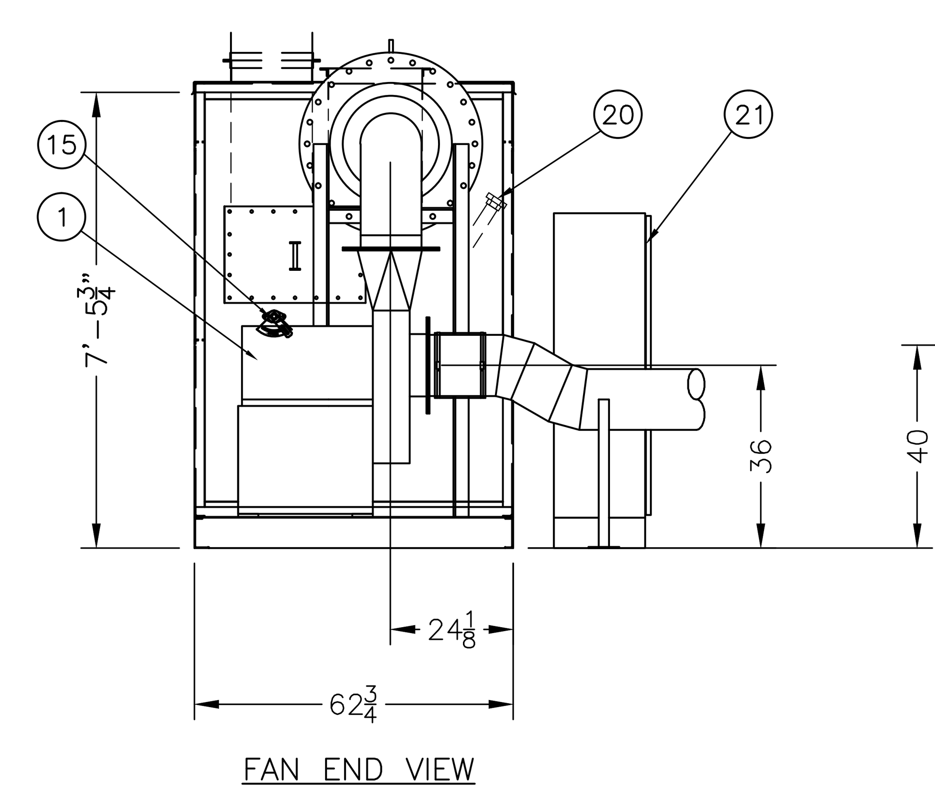
LAST PLOTTED BY _ DATE _

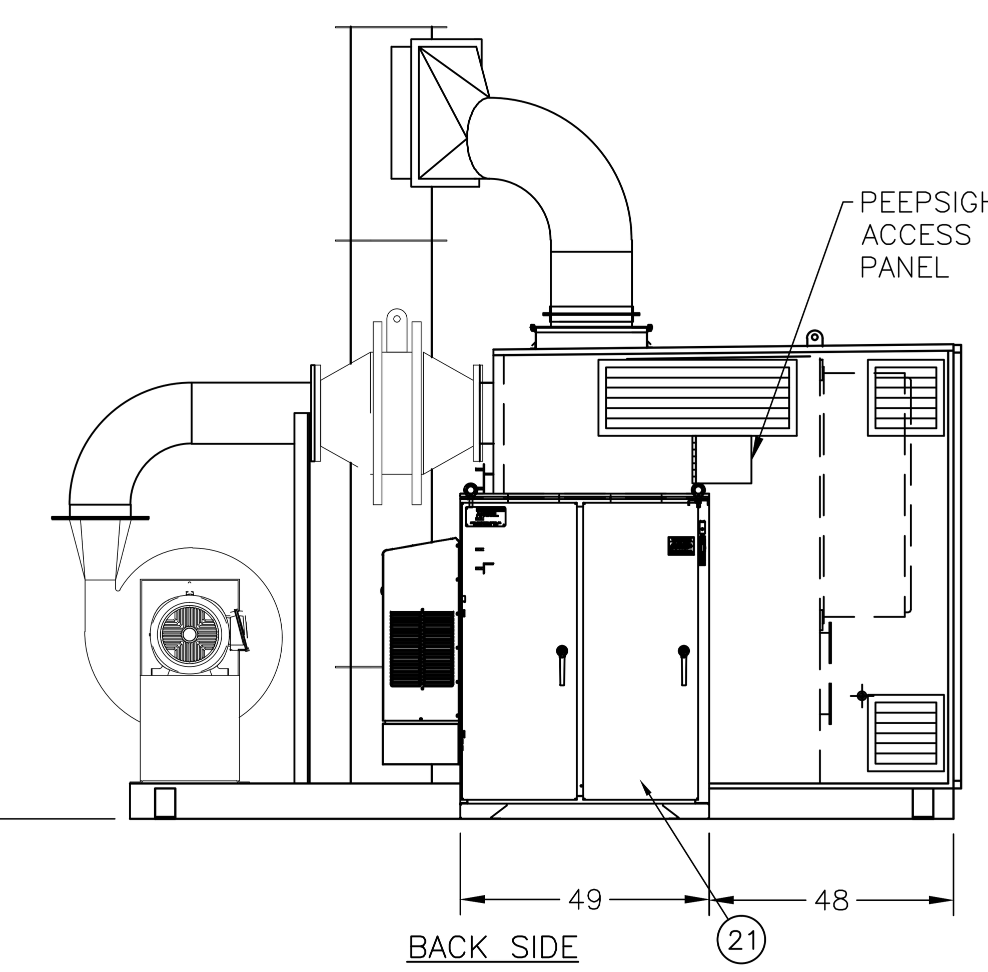












ITEM NO	DESCRIPTION	DWG. NO	TAG NO	COMMENTS
1	SYSTEM FAN	D000	F-101	
2	BURNER ACCESS PANEL			ECLIPSE AH-MA
3	HEAT EXCHANGER ACCESS PANEL			
4	EXHAUST STACK 16"ø X 30' TALL	E000		GUY WIRED
5	FUEL TRAIN	H000		
6	GAS FIRING RATE VALVE		TCV-210	
7	OXIDIZER CONTROL PANEL 110VAC	-451		
8	FRESH AIR / DILUTION AIR DAMPER 6"ø & ACTUATOR		TCV-400	
9	SYSTEM INLET DAMPER 12"ø AND ACTUATOR		XV-401	
10	OUTER CATALYST ACCESS DOOR			SHOWN REMOVED
11	IGNITION TRANSFORMER		IT-233	
12	THERMOCOUPLE, CAT INLET TYPE K		TE-121	
13	THERMOCOUPLE, CAT OUTLET TYPE K		TE-122	
14	INNER CATALYST ACCESS DOOR			
15	MANUAL HEAT EXCHANGER BYPASS DAMPER			
16	FLAME ARRESTOR BANK 16"ø			
17	LOW GAS PRESSURE SWITCH		PSL-203	
18	LEL PROBE		AE-160	
19	SYSTEM INLET VALVE/ FRESH AIR/DILUTION VALVE TEE			10" LINE/ 8" BRANCH HRS LOCATED AT SVE SKID
20	BURNER PEEPSIGHT			
21	OXIDIZER / SVE SKID POWER PANEL 460VAC			NEMA 4
22	THERMOCOUPLE, CAT OUTLET TYPE K		TE-131	

NOTES:
- SYSTEM FAN MOTOR SIZE: 30HP
- ELECTRICAL SERVICE REQ'D: 460V/3PH/60HZ
- BURNER RATING: 1,000,000 BTU/HR, 1000SCFH @ 2PSI MINIMUM
- INSTALLED CATALYST: 3 CUBIC FEET
- STACK EXIT TEMPERATURE 300°F TO 500°F
- MINIMUM OXYGEN CONTENT OF PROCESS STREAM 18%
- MAX GUY WIRE PULL OUT FORCE 875#.

TERMINAL POINT SCHEDULE

TERMINAL POINT	DESCRIPTION	TERMINAL SIZE	CONNECTION TYPE
A1 / A2	PROCESS AIR INLET	12"	FLANGED
B	FUEL INLET	1"	NPT

REV	BY	DATE	CHANGE
C	JPW	30AUG12	MOVE STACK TO GRADE
B	JPW	24AUG12	ADD FLAME ARRESTOR, DEL FAN HOUSING, CHG POWER PANEL
A	JPW	03AUG12	LARGER FAN, ADD POWER PANEL

[redacted]
ANGUIL

ANGUIL ENVIRONMENTAL SYSTEMS, INC.
MILWAUKEE, WISCONSIN

TITLE: MODEL 20 CATALYTIC OXIDIZER GENERAL ARRANGEMENT

DRAWING NO. 16512-7

SCALE 3/8"=1'-0"

DRAWN JPW DATE 25JUL12
CHECKED DATE
APPROVED DATE
LAST DRAWN JPW DATE 30AUG12

CUSTOMER: SHAW ENVIRONMENTAL
KIRTLAND AFB, ALBUQUERQUE, NM

REV. C

SOURCE

PAGE 1 OF 1

AUTOCAD PATH H:\CAD\JOBS\16512

LAST PLOT BY DATE

ITEM NO	DESCRIPTION	DWG. NO	TAG NO	COMMENTS
1	OXIDIZER SKID	16512-7		
2	VAPOR EXTRACTION MODULE	Q14154		
3	SYSTEM INLET VALVE 12"ø		XV-401	
4	DILUTION AIR VALVE 10"ø		TCV-400	
5	FLOW ELEMENT		FE-103	
6	TEMP GAUGE		TI-103	
7	PRESSURE GAUGE	PI-103		
8	LEL PROBE ASSEMBLY	AE-103		

REV	BY	DATE	CHANGE
A	CAG	18SEP12	REVISED PLANVIEW OF CATOX AND AS BUILT SVE SKID

[redacted]
ANGUIL

ANGUIL ENVIRONMENTAL SYSTEMS, INC.
MILWAUKEE, WISCONSIN

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TITLE
MODEL 20 CATALYTIC OXIDIZER
SITE LAYOUT

DRAWING NO. 16512-2
SCALE 3/8"=1'-0"

DRAWN JPW	DATE 18SEP12	CUSTOMER SHAW ENVIRONMENTAL	REV. A
CHECKED	DATE		
APPROVED	DATE	KIRTLAND AFB, ALBUQUERQUE, NM	
LAST DRAWN CAG	DATE 24AUG12	SOURCE	PAGE 1 OF 1

AUTOCAD PATH H:\CAD\JOBS\16512

LAST PLOT BY CAG DATE 18SEPT12

APPENDIX C

Key Personnel

(to be submitted at a later date)

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APPENDIX D

Construction Quality Assurance Plan

(to be submitted at a later date)

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APPENDIX E

System Operations and Maintenance Manual

(to be submitted at a later date)

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APPENDIX F

System Friction Loss Calculations

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Shaw E & I

Calculation Title: Vacuum Pipe Friction Loss

Calculation Number: 140705-M-0001-00

Project Name/Number: Bulk Fuel Facility (BFF) Kirtland AFB, Albuquerque, New Mexico

Table of Contents — Page Number

1. Problem Statement

The objective of this calculation is to determine the frictional losses for the influent vacuum piping to the soil-vapor extraction (SVE) system at the Bulk Fuel Facilities (BFF), Kirtland AFB, Albuquerque, New Mexico. The vacuum pipeline begins at two vapor extraction wells, combines then continues on to the treatment system.

2. References

2.1 Design Flow Solutions Software. Version 4, ABZ, Incorporated

2.2 Soil Vapor Extraction and Thermal Treatment System, Process Flow Diagram, Drawing No. P-1

2.3 Soil Vapor Extraction and Thermal Treatment System, Site Plan, Drawing No. C-2

2.4 Soil Vapor Extraction and Thermal Treatment System, Civil Details, Drawing No. C-4 and C-5

3. Calculation Methodology

Design Flow Solutions (DFS), a pipeline modeling software program is used to calculate the velocities and pressures within the vacuum pipeline. The piping system is built by creating individual branches or pipelines. The model is created to show influent pipelines from well KAFB-106160 and well KAFB-106161 to the main treatment system. The piping was evaluated for two scenarios, a low vacuum flow (Case 1) and a high vacuum flow (Case 2). In both cases, the pipeline models are identical and the only input changes were flow rate and pressure.

3.1 Pipeline

Each extraction well KAFB-106160 and KAFB-160161 contains a well head with drop pipe to the well and a dilution air entry port at the well head. Flows are input for the well vapor and ambient dilution air. Individual pipelines are modeled from each well with pipe components from the well heads to a common header. The common header is modeled to the inlet of the vacuum blower system. A pressure from the vacuum blower curve is input at the end of the pipeline closest to the blower system.

3.2 Cases

The most common flow scenario for remediation is a low vacuum case. Case 1 depicts a scenario using 1,200 standard cubic feet per minute (SCFM) at a vacuum of 40 inches of Mercury (in Hg). Case 2 is a scenario that could be used to pull high vacuum from the extraction wells. A scenario was setup with inputs of 1,000 SCFM at 11 in Hg.

With given fluid conditions, piping materials, piping lengths, preliminary pipe diameters are input. An output of velocity and pressure are calculated. Pipe diameters are adjusted for each pipeline to produce a minimal friction loss within the piping.

4. Input and Assumptions

4.1 Well Head Piping

Each well head for extraction wells KAFB-160160 and KAFB-160161 is identically modeled. Properties and components of each modeled pipeline are shown below. The components of all piping within the wellhead are estimated from the design drawings (reference 2.4). All data is detailed within the calculation outputs (Attachment A).

4.1.1 Material

Piping material within the well head piping is Polyvinylchloride (PVC), schedule 80 with a rubberized hose to connect to the outgoing pipeline to the treatment system.

4.1.2 Valves & Fittings

The well head is modeled with the following components:

- 6-inch ball valve (from well)
- 6-inch ball valve (from dilution air)
- Three (3) 90-degree elbows
- Enlarger/Reducer for pipe schedule and pipe size change

4.1.3 Lengths and Elevations

Piping at the well head includes 25 feet of 6-inch PVC pipe. A 5 foot section of 4-inch diameter rubberized hose connects the well head piping to the HDPE pipeline leaving the wellhead.

The pipeline contains mostly air from the well with little water vapor. Elevation changes do not significantly affect frictional losses within air pipelines, so no elevation changes were entered in the model.

4.2 Vacuum Pipeline

The branch lines from each well head to the common header were modeled. A common header was then modeled to the treatment system.

4.2.1 Material

Piping material within the vacuum pipeline is High Density Polyethylene (HDPE), SDR-17

4.2.2 Valves & Fittings

The vacuum pipeline is modeled with the following components:

- Five (5) 90-degree elbows (from KAFB-160160 well head to common header)
- Five (5) 90-degree elbows (from KAFB-160161 well head to common header)
- Enlargers/Reducers for pipe schedule and pipe size change

4.2.3 Lengths and Elevations

Piping from well KAFB-160160 to the common header includes 440 feet of 6-inch pipe. Piping from well KAFB-160161 to the common header includes 165 feet of 6-inch pipe. When the two separate lines join to the common header an 8-inch section of pipe, 140 feet long, extends to the treatment system.

Elevation changes do not significantly affect frictional losses within air pipelines, so no elevation changes were entered in the model.

4.3 Fluid Conditions

Fluid references are to air, and entering the piping at the wellhead at 50 degrees Fahrenheit. Atmospheric conditions of 12.04 psia and 50 degrees Fahrenheit are modeled at the treatment system.

For Case 1 conditions include 400 SCFM from the well and 200 SCFM of dilution air for each well. A vacuum of 40 inches of water or 10.6 psia is input at the treatment system. (See Attachment B)

For Case 2 conditions include 500 SCFM from the well and no dilution air for each well. A vacuum of 11 in Hg or 6.6 psia is input at the treatment system.

5. Calculations

5.1 Frictional Head Loss

Design Flow Solutions (DFS) is a computerized software tool implementing macroscopic fluid flow calculations to solve networks of branches and pipelines. Using the inputs from section 4, velocities and pressures are determined through a compressible flow calculation. Consecutive iterations are conducted changing the pipe diameter until ideal velocities and pressures are reached.

6. Results and Conclusions

The frictional head loss within the vacuum pipeline is detailed in the table below.

Pipeline	Vacuum at Well Heads [psia]	
	Case 1 1200 SCFM @ 40 in. water	Case 2 1000 SCFM @ 11 in. Hg
KAFB-160160	10.7	7.5
KAFB-160161	10.7	7.2

The vacuum allowed at the pipeline is acceptable for normal low vacuum operation.

7. Attachments

Attachment A includes the following information for each case:

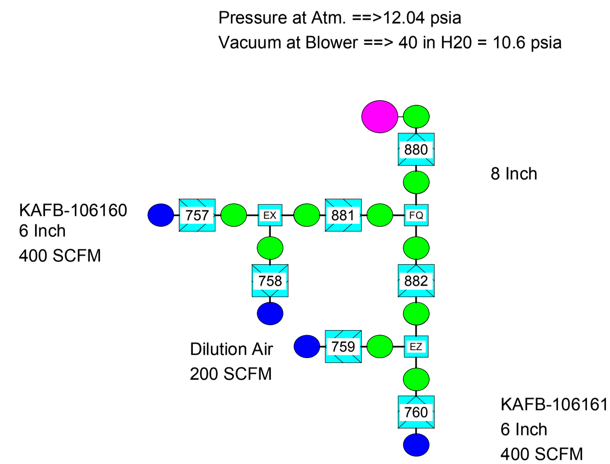
- Branch Numbers
- Pressure
- Volumetric Flow Rate
- Velocity
- Pipe Inside Diameter
- Branch Summaries

Attachment B includes the vacuum/blower curve of the soil-vapor extraction system.

Attachment A
Design Flow Solutions Software Output

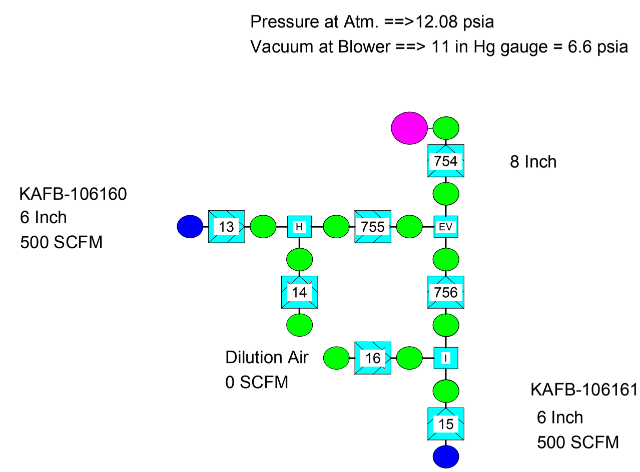
Case 1

Kirtland AFB
Soil-Vapor Extraction Vacuum Piping
HDPE DR17
1200 SCFM @ Low Vac 40 in H20



Case 2

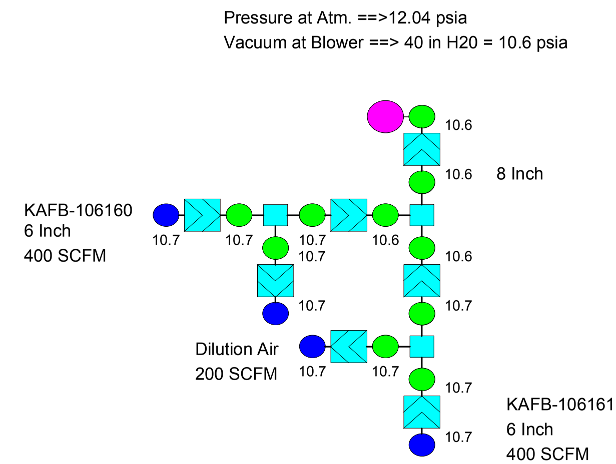
Kirtland AFB
Soil-Vapor Extraction Vacuum Piping
HDPE DR17
1000 SCFM @ HIGH Vac 11 in Hg



Pressure in PSIA

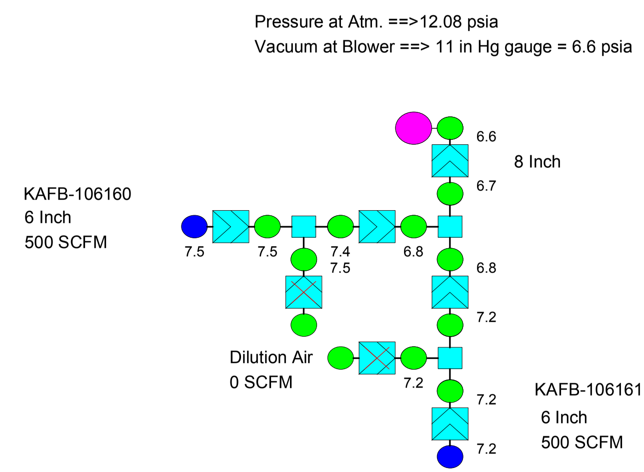
Case 1

Kirtland AFB
Soil-Vapor Extraction Vacuum Piping
HDPE DR17
1200 SCFM @ Low Vac 40 in H20



Case 2

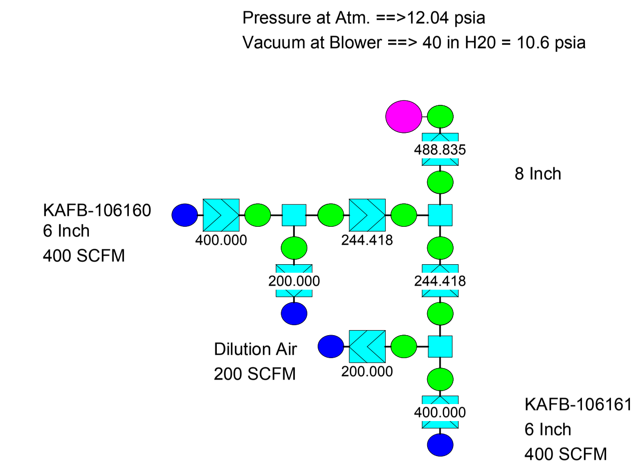
Kirtland AFB
Soil-Vapor Extraction Vacuum Piping
HDPE DR17
1000 SCFM @ HIGH Vac 11 in Hg



Standard Flow Rate in SCFM

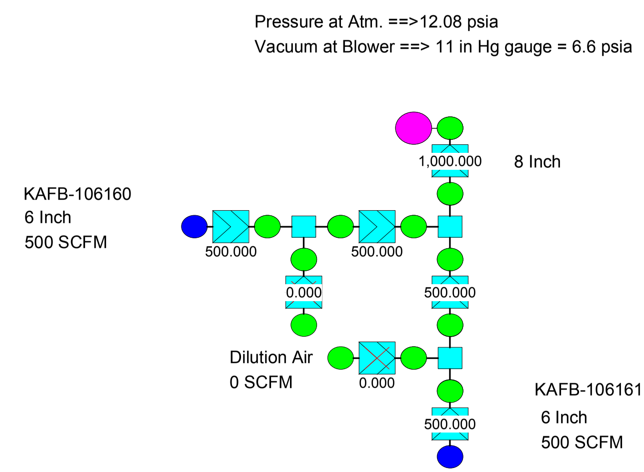
Case 1

Kirtland AFB
Soil-Vapor Extraction Vacuum Piping
HDPE DR17
1200 SCFM @ Low Vac 40 in H20



Case 2

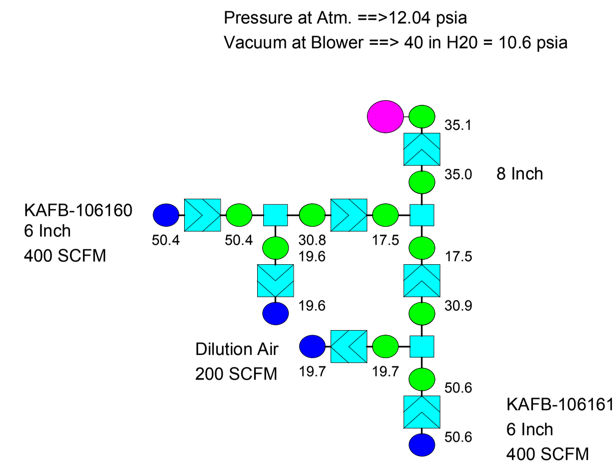
Kirtland AFB
Soil-Vapor Extraction Vacuum Piping
HDPE DR17
1000 SCFM @ HIGH Vac 11 in Hg



Velocity in ft/sec (FPS)

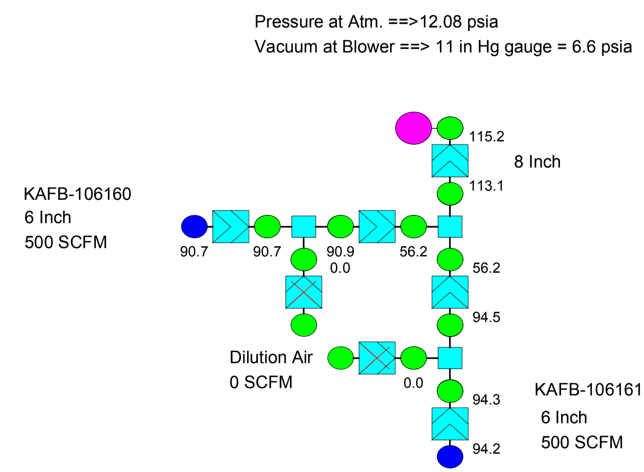
Case 1

Kirtland AFB
Soil-Vapor Extraction Vacuum Piping
HDPE DR17
1200 SCFM @ Low Vac 40 in H20



Case 2

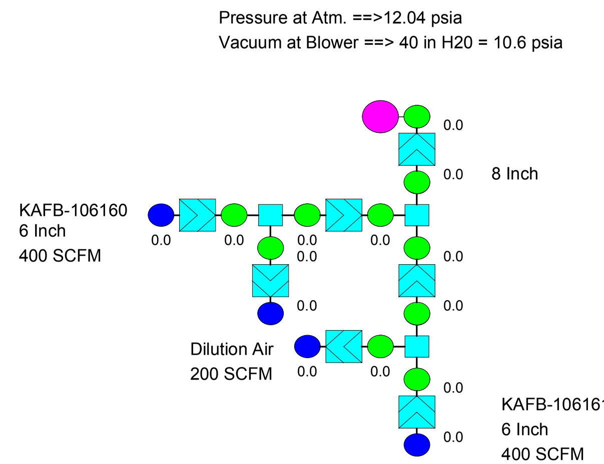
Kirtland AFB
Soil-Vapor Extraction Vacuum Piping
HDPE DR17
1000 SCFM @ HIGH Vac 11 in Hg



Relative Elevation in feet

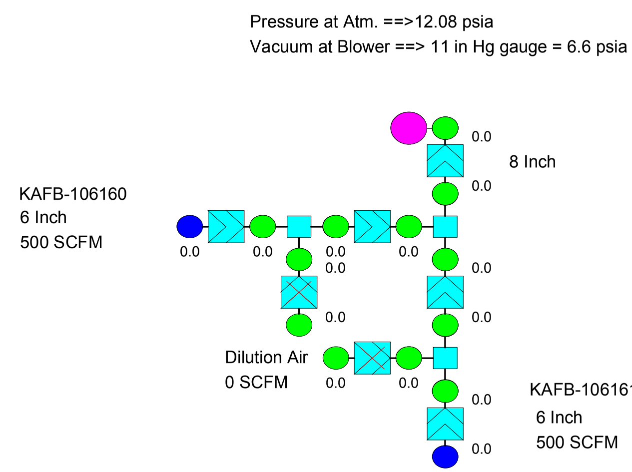
Case 1

Kirtland AFB
Soil-Vapor Extraction Vacuum Piping
HDPE DR17
1200 SCFM @ Low Vac 40 in H20



Case 2

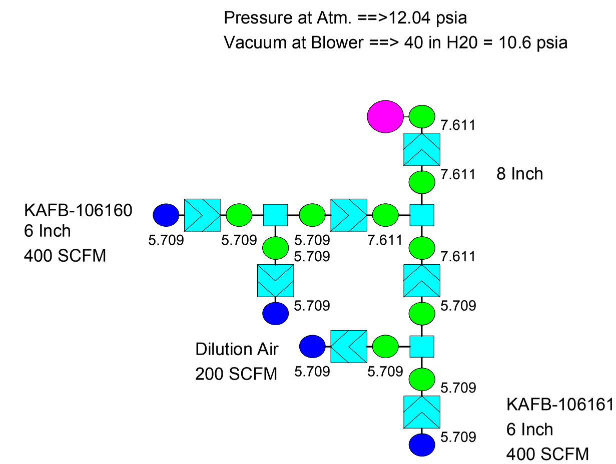
Kirtland AFB
Soil-Vapor Extraction Vacuum Piping
HDPE DR17
1000 SCFM @ HIGH Vac 11 in Hg



Diameter in inches

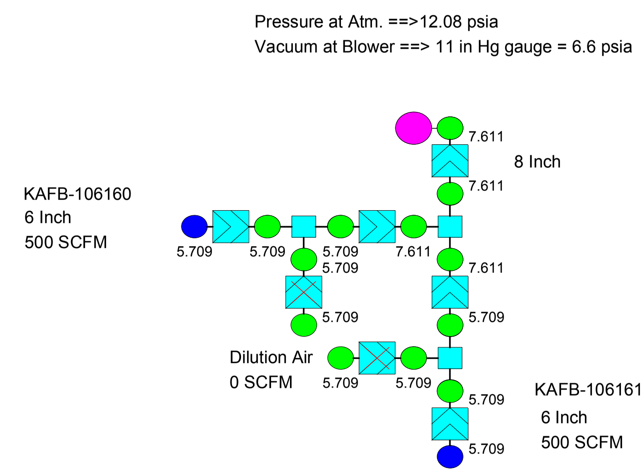
Case 1

Kirtland AFB
Soil-Vapor Extraction Vacuum Piping
HDPE DR17
1200 SCFM @ Low Vac 40 in H20



Case 2

Kirtland AFB
Soil-Vapor Extraction Vacuum Piping
HDPE DR17
1000 SCFM @ HIGH Vac 11 in Hg



ONE-PAGE SUMMARY

Branch Number: 754

FLUID DESCRIPTION

Outlet Fluid Conditions		
Spec. Heat Ratio (Cp/Cv):	1.400	
Molecular Weight:	28.96	
Specific Gravity:	1.000	
Temperature:	50.00	Fahrenheit
Pressure:	6.60	PSIA
Density:	0.03	lb/cu ft
Specific Volume:	28.608	cu ft/lb
Abs. Viscosity:	0.017	centipoise
Kin. Viscosity:	31.063	centistokes

HARDWARE DESCRIPTION

Number of Components:	1	
Branch Inlet Diameter:	7.611	inches
Branch Outlet Diameter:	7.611	inches
Branch Elevational Change:	0.0	feet
Branch K Factor:	2.48	

FLOW DESCRIPTION

Mass Flow Rate:	4,580.8	lb/hr
Std Vol. Flow Rate:	1,000.000	SCFM
Inlet Vol. Flow Rate:	16,036.2	US gal/min
Inlet Velocity:	113.1	ft/sec (FPS)
Inlet Mach No.:	0.102	
Outlet Vol. Flow Rate:	16,338.4	US gal/min
Outlet Velocity:	115.2	ft/sec (FPS)
Outlet Mach No.:	0.104	
Differential Pressure:	0.12	PSID

HARDWARE DESCRIPTION - TABLE 1

Symbols and Units:

- Din - Inlet Diameter - inches
- Dout - Outlet Diameter - inches
- A - Inlet Area - sq inches
- dZ - Elevational Change - feet
- Re - Reynolds Number
- EL - Equivalent Length - Diameters
- K - K Factor relative to Inlet Diameter
- Pin - Inlet Pressure - PSIA
- Pout - Outlet Pressure - PSIA
- DP - Differential Pressure - PSID
- HL - Frictional Head Loss - feet
- D - Inlet Density - lb/cu ft
- mu - Inlet Absolute Viscosity - centipoise
- W - Mass Flow Rate - lb/hr
- Q - Actual Volumetric Flow Rate - US gal/min
- Vin - Inlet Velocity - ft/sec (FPS)
- Vout - Outlet Velocity - ft/sec (FPS)

Component Name: Pipe, NPS 8, sched 17.0, 140.00 feet

Din:	7.611	Dout:	7.611	Area:	45.496	dZ:	0.00
Re:	218339	f:	0.011237	EL:	220.73	K:	2.48
Pin:	6.72	Pout:	6.60	DP:	0.12	HL:	
D:	0.036	mu:	0.017				
W:	4580.77	Q:	16036.23	Vin:	113.09	Vout:	115.22

ONE-PAGE SUMMARY

Branch Number:	755
File Name:	well head 106160

FLUID DESCRIPTION

Outlet Fluid Conditions

Spec. Heat Ratio (Cp/Cv):	1.400
Molecular Weight:	28.96
Specific Gravity:	1.000

HARDWARE DESCRIPTION

Number of Components:	14
Branch Inlet Diameter:	5.709 inches
Branch Outlet Diameter:	7.611 inches
Branch Elevational Change:	0.0 feet
Branch K Factor:	19.63

FLOW DESCRIPTION

Mass Flow Rate:	2,290.4 lb/hr
Std Vol. Flow Rate:	500.000 SCFM
Inlet Vol. Flow Rate:	7,248.9 US gal/min
Inlet Velocity:	90.9 ft/sec (FPS)
Inlet Mach No.:	0.082
Outlet Vol. Flow Rate:	7,968.2 US gal/min
Outlet Velocity:	56.2 ft/sec (FPS)
Outlet Mach No.:	0.051
Differential Pressure:	0.67 PSID

HARDWARE DESCRIPTION - TABLE 1

Symbols and Units:
- Din - Inlet Diameter - inches
- Dout - Outlet Diameter - inches
- A - Inlet Area - sq inches
- dZ - Elevational Change - feet
- Re - Reynolds Number
- EL - Equivalent Length - Diameters
- K - K Factor relative to Inlet Diameter
- Pin - Inlet Pressure - PSIA
- Pout - Outlet Pressure - PSIA
- DP - Differential Pressure - PSID
- HL - Frictional Head Loss - feet
- D - Inlet Density - lb/cu ft
- mu - Inlet Absolute Viscosity - centipoise
- W - Mass Flow Rate - lb/hr
- Q - Actual Volumetric Flow Rate - US gal/min
- Vin - Inlet Velocity - ft/sec (FPS)
- Vout - Outlet Velocity - ft/sec (FPS)

Component Name: Pipe, NPS 6, sched 80, 15.00 feet

Din:	5.709	Dout:	5.709	Area:	25.598	dZ:	0.00
Re:	145454	f:	0.015097	EL:	31.53	K:	0.48
Pin:	7.44	Pout:	7.43	DP:	0.02	HL:	
D:	0.039	mu:	0.017				
W:	2290.39	Q:	7248.92	Vin:	90.85	Vout:	91.06

Component Name: [3] Elbow, 6" 90 Thr/SW

Din:	5.709	Dout:	5.709	Area:	25.598	dZ:	0.00
Re:	145455	f:	0.015096	EL:	30.00	K:	0.45
Pin:	7.43	Pout:	7.38	DP:	0.05	HL:	
D:	0.039	mu:	0.017				
W:	2290.39	Q:	7265.35	Vin:	91.06	Vout:	91.65

Component Name: Reducer, 6 X 4" sud

Din:	5.709	Dout:	4.000	Area:	25.598	dZ:	0.00
Re:	145457	f:	0.015096	EL:	69.98	K:	1.06
Pin:	7.38	Pout:	7.23	DP:	0.15	HL:	
D:	0.039	mu:	0.017				
W:	2290.39	Q:	7312.88	Vin:	91.65	Vout:	189.80

Component Name: Pipe, NPS 4, 5.00 feet

Din:	4.000	Dout:	4.000	Area:	12.566	dZ:	0.00
Re:	208358	f:	0.016312	EL:	15.00	K:	0.24
Pin:	7.23	Pout:	7.19	DP:	0.04	HL:	
D:	0.038	mu:	0.017				
W:	2290.39	Q:	7433.72	Vin:	189.80	Vout:	190.80

Component Name: Enlarger, 4 X 6" sud

Din:	4.000	Dout:	5.845	Area:	12.566	dZ:	0.00
Re:	142061	f:	0.016311	EL:	17.33	K:	0.28
Pin:	7.19	Pout:	7.30	DP:	-0.11	HL:	
D:	0.038	mu:	0.017				
W:	2290.39	Q:	7472.76	Vin:	190.80	Vout:	88.42

Component Name: Pipe, NPS 6, sched 17.0, 440.00 feet

Din:	5.845	Dout:	5.845	Area:	26.832	dZ:	0.00
Re:	142062	f:	0.015021	EL:	903.34	K:	13.57
Pin:	7.30	Pout:	6.84	DP:	0.46	HL:	
D:	0.039	mu:	0.017				
W:	2290.39	Q:	7395.25	Vin:	88.42	Vout:	94.37

Component Name: [5] Elbow, 6" 90 Thr/SW

Din:	5.845	Dout:	5.845	Area:	26.832	dZ:	0.00
Re:	142082	f:	0.015020	EL:	30.00	K:	0.45
Pin:	6.84	Pout:	6.76	DP:	0.08	HL:	
D:	0.036	mu:	0.017				
W:	2290.39	Q:	7892.41	Vin:	94.37	Vout:	95.48

Component Name: Enlarger, 6 X 8" sud

Din:	5.845	Dout:	7.611	Area:	26.832	dZ:	0.00
Re:	109033	f:	0.015020	EL:	11.20	K:	0.17
Pin:	6.76	Pout:	6.78	DP:	-0.02	HL:	
D:	0.036	mu:	0.017				
W:	2290.39	Q:	7985.14	Vin:	95.48	Vout:	56.19

ONE-PAGE SUMMARY

Branch Number: 756
File Name: well head 106160

FLUID DESCRIPTION

Outlet Fluid Conditions
Spec. Heat Ratio (Cp/Cv): 1.400
Molecular Weight: 28.96
Specific Gravity: 1.000

HARDWARE DESCRIPTION

Number of Components: 14
Branch Inlet Diameter: 5.709 inches
Branch Outlet Diameter: 7.611 inches

Branch Elevational Change: 0.0 feet
Branch K Factor: 11.91

FLOW DESCRIPTION

Mass Flow Rate: 2,290.4 lb/hr
Std Vol. Flow Rate: 500.000 SCFM
Inlet Vol. Flow Rate: 7,536.7 US gal/min
Inlet Velocity: 94.5 ft/sec (FPS)
Inlet Mach No.: 0.085
Outlet Vol. Flow Rate: 7,976.4 US gal/min
Outlet Velocity: 56.2 ft/sec (FPS)
Outlet Mach No.: 0.051

Differential Pressure: 0.39 PSID

HARDWARE DESCRIPTION - TABLE 1

Symbols and Units:

- Din - Inlet Diameter - inches
- Dout - Outlet Diameter - inches
- A - Inlet Area - sq inches
- dZ - Elevational Change - feet
- Re - Reynolds Number
- EL - Equivalent Length - Diameters
- K - K Factor relative to Inlet Diameter
- Pin - Inlet Pressure - PSIA
- Pout - Outlet Pressure - PSIA
- DP - Differential Pressure - PSID
- HL - Frictional Head Loss - feet
- D - Inlet Density - lb/cu ft
- mu - Inlet Absolute Viscosity - centipoise
- W - Mass Flow Rate - lb/hr
- Q - Actual Volumetric Flow Rate - US gal/min
- Vin - Inlet Velocity - ft/sec (FPS)
- Vout - Outlet Velocity - ft/sec (FPS)

Component Name: Pipe, NPS 6, sched 80, 15.00 feet

Din:	5.709	Dout:	5.709	Area:	25.598	dZ:	0.00
Re:	145467	f:	0.015097	EL:	31.53	K:	0.48
Pin:	7.16	Pout:	7.14	DP:	0.02	HL:	
D:	0.038	mu:	0.017				
W:	2290.39	Q:	7536.68	Vin:	94.46	Vout:	94.69

Component Name: [3] Elbow, 6" 90 Thr/SW

Din:	5.709	Dout:	5.709	Area:	25.598	dZ:	0.00
Re:	145468	f:	0.015096	EL:	30.00	K:	0.45
Pin:	7.14	Pout:	7.09	DP:	0.05	HL:	
D:	0.038	mu:	0.017				
W:	2290.39	Q:	7555.17	Vin:	94.69	Vout:	95.36

Component Name: Reducer, 6 X 4" sud

Din:	5.709	Dout:	4.000	Area:	25.598	dZ:	0.00
Re:	145470	f:	0.015096	EL:	69.98	K:	1.06
Pin:	7.09	Pout:	6.93	DP:	0.16	HL:	
D:	0.038	mu:	0.017				
W:	2290.39	Q:	7608.69	Vin:	95.36	Vout:	197.75

Component Name: Pipe, NPS 4, 5.00 feet

Din:	4.000	Dout:	4.000	Area:	12.566	dZ:	0.00
Re:	208443	f:	0.016312	EL:	15.00	K:	0.24
Pin:	6.93	Pout:	6.89	DP:	0.04	HL:	
D:	0.037	mu:	0.017				
W:	2290.39	Q:	7745.29	Vin:	197.75	Vout:	198.89

Component Name: Enlarger, 4 X 6" sud

Din:	4.000	Dout:	5.845	Area:	12.566	dZ:	0.00
Re:	142074	f:	0.016311	EL:	17.33	K:	0.28
Pin:	6.89	Pout:	7.01	DP:	-0.11	HL:	
D:	0.037	mu:	0.017				
W:	2290.39	Q:	7789.62	Vin:	198.89	Vout:	92.09

Component Name: Pipe, NPS 6, sched 17.0, 165.00 feet

Din:	5.845	Dout:	5.845	Area:	26.832	dZ:	0.00
Re:	142074	f:	0.015021	EL:	338.75	K:	5.09
Pin:	7.01	Pout:	6.83	DP:	0.18	HL:	
D:	0.037	mu:	0.017				
W:	2290.39	Q:	7701.77	Vin:	92.09	Vout:	94.46

Component Name: [5] Elbow, 6" 90 Thr/SW

Din:	5.845	Dout:	5.845	Area:	26.832	dZ:	0.00
Re:	142082	f:	0.015020	EL:	30.00	K:	0.45
Pin:	6.83	Pout:	6.75	DP:	0.08	HL:	
D:	0.036	mu:	0.017				
W:	2290.39	Q:	7900.37	Vin:	94.46	Vout:	95.58

Component Name: Enlarger, 6 X 8" sud

Din:	5.845	Dout:	7.611	Area:	26.832	dZ:	0.00
Re:	109033	f:	0.015020	EL:	11.20	K:	0.17
Pin:	6.75	Pout:	6.77	DP:	-0.02	HL:	
D:	0.036	mu:	0.017				
W:	2290.39	Q:	7993.39	Vin:	95.58	Vout:	56.25

ONE-PAGE SUMMARY

Branch Number: 13
File Name: pipe and valve

FLUID DESCRIPTION

Outlet Fluid Conditions
Spec. Heat Ratio (Cp/Cv): 1.400
Molecular Weight: 28.96
Specific Gravity: 1.000

HARDWARE DESCRIPTION

Number of Components: 2
Branch Inlet Diameter: 5.709 inches
Branch Outlet Diameter: 5.709 inches

Branch Elevational Change: 0.0 feet
Branch K Factor: 0.17

FLOW DESCRIPTION

Mass Flow Rate: 2,290.4 lb/hr
Std Vol. Flow Rate: 500.000 SCFM
Inlet Vol. Flow Rate: 7,232.7 US gal/min
Inlet Velocity: 90.7 ft/sec (FPS)
Inlet Mach No.: 0.082
Outlet Vol. Flow Rate: 7,238.6 US gal/min
Outlet Velocity: 90.7 ft/sec (FPS)
Outlet Mach No.: 0.082

Differential Pressure: 0.006006 PSID

HARDWARE DESCRIPTION - TABLE 1

Symbols and Units:

- Din - Inlet Diameter - inches
- Dout - Outlet Diameter - inches
- A - Inlet Area - sq inches
- dZ - Elevational Change - feet
- Re - Reynolds Number
- EL - Equivalent Length - Diameters
- K - K Factor relative to Inlet Diameter
- Pin - Inlet Pressure - PSIA
- Pout - Outlet Pressure - PSIA
- DP - Differential Pressure - PSID
- HL - Frictional Head Loss - feet
- D - Inlet Density - lb/cu ft
- mu - Inlet Absolute Viscosity - centipoise
- W - Mass Flow Rate - lb/hr
- Q - Actual Volumetric Flow Rate - US gal/min
- Vin - Inlet Velocity - ft/sec (FPS)
- Vout - Outlet Velocity - ft/sec (FPS)

Component Name: Pipe, NPS 6, sched 80, 5.00 feet

Din:	5.709	Dout:	5.709	Area:	25.598	dZ:	0.00
Re:	145454	f:	0.011856	EL:	10.51	K:	0.12
Pin:	7.46	Pout:	7.46	DP:	0.00	HL:	
D:	0.039	mu:	0.017				
W:	2290.39	Q:	7232.75	Vin:	90.65	Vout:	90.70

Component Name: Ball valve

Din:	5.709	Dout:	5.709	Area:	25.598	dZ:	0.00
Re:	145454	f:	0.015096	EL:	3.00	K:	0.05
Pin:	7.46	Pout:	7.45	DP:	0.00	HL:	
D:	0.039	mu:	0.017				
W:	2290.39	Q:	7237.01	Vin:	90.70	Vout:	90.72

ONE-PAGE SUMMARY

Branch Number: 14
File Name: pipe and valve

FLUID DESCRIPTION

Outlet Fluid Conditions
Spec. Heat Ratio (Cp/Cv): 1.400
Molecular Weight: 28.96
Specific Gravity: 1.000

HARDWARE DESCRIPTION

Number of Components: 2
Branch Inlet Diameter: 5.709 inches
Branch Outlet Diameter: 5.709 inches

Branch Elevational Change: 0.0 feet

FLOW DESCRIPTION

Mass Flow Rate: 0.0 lb/hr
Std Vol. Flow Rate: 0.000 SCFM
Outlet Vol. Flow Rate: 0.0 US gal/min
Outlet Velocity: 0.0 ft/sec (FPS)
Outlet Mach No.: 0.000

HARDWARE DESCRIPTION - TABLE 1

Symbols and Units:

- Din - Inlet Diameter - inches
- Dout - Outlet Diameter - inches
- A - Inlet Area - sq inches
- dZ - Elevational Change - feet
- Re - Reynolds Number
- EL - Equivalent Length - Diameters
- K - K Factor relative to Inlet Diameter
- Pin - Inlet Pressure - PSIA
- Pout - Outlet Pressure - PSIA
- DP - Differential Pressure - PSID
- HL - Frictional Head Loss - feet
- D - Inlet Density - lb/cu ft
- mu - Inlet Absolute Viscosity - centipoise
- W - Mass Flow Rate - lb/hr
- Q - Actual Volumetric Flow Rate - US gal/min
- Vin - Inlet Velocity - ft/sec (FPS)
- Vout - Outlet Velocity - ft/sec (FPS)

Component Name: Pipe, NPS 6, sched 80, 5.00 feet

Din:	5.709	Dout:	5.709	Area:	25.598	dZ:	0.00
Re:		f:		EL:		K:	
Pin:		Pout:		DP:		HL:	
D:		mu:					
W:	0.00	Q:		Vin:		Vout:	

Component Name: Ball valve

Din:	5.709	Dout:	5.709	Area:	25.598	dZ:	0.00
Re:		f:	0.015096	EL:	3.00	K:	1.0E+24
Pin:		Pout:	7.48	DP:		HL:	
D:		mu:					
W:	0.00	Q:		Vin:		Vout:	0.00

HARDWARE DESCRIPTION - TABLE 1

Symbols and Units:

- Din - Inlet Diameter - inches
- Dout - Outlet Diameter - inches
- A - Inlet Area - sq inches
- dZ - Elevational Change - feet
- Re - Reynolds Number
- EL - Equivalent Length - Diameters
- K - K Factor relative to Inlet Diameter
- Pin - Inlet Pressure - PSIA
- Pout - Outlet Pressure - PSIA
- DP - Differential Pressure - PSID
- HL - Frictional Head Loss - feet
- D - Inlet Density - lb/cu ft
- mu - Inlet Absolute Viscosity - centipoise
- W - Mass Flow Rate - lb/hr
- Q - Actual Volumetric Flow Rate - US gal/min
- Vin - Inlet Velocity - ft/sec (FPS)
- Vout - Outlet Velocity - ft/sec (FPS)

Component Name: Ball valve

Din:	5.709	Dout:	5.709	Area:	25.598	dZ:	0.00
Re:	45285	f:	0.015096	EL:	3.00	K:	0.05
Pin:	10.69	Pout:	10.69	DP:	0.00	HL:	
D:	0.057	mu:	0.017				
W:	712.69	Q:	1569.84	Vin:	19.68	Vout:	19.68

Component Name: Pipe, NPS 6, sched 80, 5.00 feet

Din:	5.709	Dout:	5.709	Area:	25.598	dZ:	0.00
Re:	45285	f:	0.021680	EL:	10.51	K:	0.23
Pin:	10.69	Pout:	10.69	DP:	0.00	HL:	
D:	0.057	mu:	0.017				
W:	712.69	Q:	1569.86	Vin:	19.68	Vout:	19.68

ONE-PAGE SUMMARY

Branch Number:	15
File Name:	pipe and valve

FLUID DESCRIPTION

Outlet Fluid Conditions

Spec. Heat Ratio (Cp/Cv):	1.400
Molecular Weight:	28.96
Specific Gravity:	1.000

HARDWARE DESCRIPTION

Number of Components:	2
Branch Inlet Diameter:	5.709 inches
Branch Outlet Diameter:	5.709 inches
Branch Elevational Change:	0.0 feet
Branch K Factor:	0.17

FLOW DESCRIPTION

Mass Flow Rate:	2,290.4 lb/hr
Std Vol. Flow Rate:	500.000 SCFM
Inlet Vol. Flow Rate:	7,518.5 US gal/min
Inlet Velocity:	94.2 ft/sec (FPS)
Inlet Mach No.:	0.085
Outlet Vol. Flow Rate:	7,525.0 US gal/min
Outlet Velocity:	94.3 ft/sec (FPS)
Outlet Mach No.:	0.085
Differential Pressure:	0.006249 PSID

HARDWARE DESCRIPTION - TABLE 1

Symbols and Units:

- Din - Inlet Diameter - inches
- Dout - Outlet Diameter - inches
- A - Inlet Area - sq inches
- dZ - Elevational Change - feet
- Re - Reynolds Number
- EL - Equivalent Length - Diameters
- K - K Factor relative to Inlet Diameter
- Pin - Inlet Pressure - PSIA
- Pout - Outlet Pressure - PSIA
- DP - Differential Pressure - PSID
- HL - Frictional Head Loss - feet
- D - Inlet Density - lb/cu ft
- mu - Inlet Absolute Viscosity - centipoise
- W - Mass Flow Rate - lb/hr
- Q - Actual Volumetric Flow Rate - US gal/min
- Vin - Inlet Velocity - ft/sec (FPS)
- Vout - Outlet Velocity - ft/sec (FPS)

Component Name: Pipe, NPS 6, sched 80, 5.00 feet

Din:	5.709	Dout:	5.709	Area:	25.598	dZ:	0.00
Re:	145466	f:	0.011856	EL:	10.51	K:	0.12
Pin:	7.18	Pout:	7.17	DP:	0.00	HL:	
D:	0.038	mu:	0.017				
W:	2290.39	Q:	7518.51	Vin:	94.23	Vout:	94.29

Component Name: Ball valve

Din:	5.709	Dout:	5.709	Area:	25.598	dZ:	0.00
Re:	145466	f:	0.015096	EL:	3.00	K:	0.05
Pin:	7.17	Pout:	7.17	DP:	0.00	HL:	
D:	0.038	mu:	0.017				
W:	2290.39	Q:	7523.30	Vin:	94.29	Vout:	94.31

ONE-PAGE SUMMARY

Branch Number: 16
File Name: pipe and valve

FLUID DESCRIPTION

Outlet Fluid Conditions
Spec. Heat Ratio (Cp/Cv): 1.400
Molecular Weight: 28.96
Specific Gravity: 1.000

HARDWARE DESCRIPTION

Number of Components: 2
Branch Inlet Diameter: 5.709 inches
Branch Outlet Diameter: 5.709 inches

Branch Elevational Change: 0.0 feet

FLOW DESCRIPTION

Mass Flow Rate: 0.0 lb/hr
Std Vol. Flow Rate: 0.000 SCFM
Outlet Vol. Flow Rate: 0.0 US gal/min
Outlet Velocity: 0.0 ft/sec (FPS)
Outlet Mach No.: 0.000

HARDWARE DESCRIPTION - TABLE 1

Symbols and Units:

- Din - Inlet Diameter - inches
- Dout - Outlet Diameter - inches
- A - Inlet Area - sq inches
- dZ - Elevational Change - feet
- Re - Reynolds Number
- EL - Equivalent Length - Diameters
- K - K Factor relative to Inlet Diameter
- Pin - Inlet Pressure - PSIA
- Pout - Outlet Pressure - PSIA
- DP - Differential Pressure - PSID
- HL - Frictional Head Loss - feet
- D - Inlet Density - lb/cu ft
- mu - Inlet Absolute Viscosity - centipoise
- W - Mass Flow Rate - lb/hr
- Q - Actual Volumetric Flow Rate - US gal/min
- Vin - Inlet Velocity - ft/sec (FPS)
- Vout - Outlet Velocity - ft/sec (FPS)

Component Name: Pipe, NPS 6, sched 80, 5.00 feet

Din:	5.709	Dout:	5.709	Area:	25.598	dZ:	0.00
Re:		f:		EL:		K:	
Pin:		Pout:		DP:		HL:	
D:		mu:					
W:	0.00	Q:		Vin:		Vout:	

Component Name: Ball valve

Din:	5.709	Dout:	5.709	Area:	25.598	dZ:	0.00
Re:		f:	0.015096	EL:	3.00	K:	1.0E+24
Pin:		Pout:	7.20	DP:		HL:	
D:		mu:					
W:	0.00	Q:		Vin:		Vout:	0.00

ONE-PAGE SUMMARY

Branch Number: 880

FLUID DESCRIPTION

Outlet Fluid Conditions		
Spec. Heat Ratio (Cp/Cv):	1.400	
Molecular Weight:	28.96	
Specific Gravity:	1.000	
Temperature:	50.00	Fahrenheit
Pressure:	10.60	PSIA
Density:	0.06	lb/cu ft
Specific Volume:	17.811	cu ft/lb
Abs. Viscosity:	0.017	centipoise
Kin. Viscosity:	19.340	centistokes

HARDWARE DESCRIPTION

Number of Components:	1	
Branch Inlet Diameter:	7.611	inches
Branch Outlet Diameter:	7.611	inches
Branch Elevational Change:	0.0	feet
Branch K Factor:	2.48	

FLOW DESCRIPTION

Mass Flow Rate:	2,239.2	lb/hr
Std Vol. Flow Rate:	488.835	SCFM
Inlet Vol. Flow Rate:	4,963.9	US gal/min
Inlet Velocity:	35.0	ft/sec (FPS)
Inlet Mach No.:	0.032	
Outlet Vol. Flow Rate:	4,972.6	US gal/min
Outlet Velocity:	35.1	ft/sec (FPS)
Outlet Mach No.:	0.032	
Differential Pressure:	0.02	PSID

HARDWARE DESCRIPTION - TABLE 1

Symbols and Units:

- Din - Inlet Diameter - inches
- Dout - Outlet Diameter - inches
- A - Inlet Area - sq inches
- dZ - Elevational Change - feet
- Re - Reynolds Number
- EL - Equivalent Length - Diameters
- K - K Factor relative to Inlet Diameter
- Pin - Inlet Pressure - PSIA
- Pout - Outlet Pressure - PSIA
- DP - Differential Pressure - PSID
- HL - Frictional Head Loss - feet
- D - Inlet Density - lb/cu ft
- mu - Inlet Absolute Viscosity - centipoise
- W - Mass Flow Rate - lb/hr
- Q - Actual Volumetric Flow Rate - US gal/min
- Vin - Inlet Velocity - ft/sec (FPS)
- Vout - Outlet Velocity - ft/sec (FPS)

Component Name: Pipe, NPS 8, sched 17.0, 140.00 feet

Din:	7.611	Dout:	7.611	Area:	45.496	dZ:	0.00
Re:	106738	f:	0.011237	EL:	220.73	K:	2.48
Pin:	10.62	Pout:	10.60	DP:	0.02	HL:	
D:	0.056	mu:	0.017				
W:	2239.24	Q:	4963.91	Vin:	35.00	Vout:	35.07

ONE-PAGE SUMMARY

Branch Number: 881
File Name: well head 106160

FLUID DESCRIPTION

Compressible - Location Not Specified
Spec. Heat Ratio (Cp/Cv): 1.400
Molecular Weight: 28.96
Specific Gravity: 1.000

HARDWARE DESCRIPTION

Number of Components: 14
Branch Inlet Diameter: 5.709 inches
Branch Outlet Diameter: 7.611 inches

Branch Elevational Change: 0.0 feet
Branch K Factor: 19.63

FLOW DESCRIPTION

Mass Flow Rate: 1,119.6 lb/hr
Std Vol. Flow Rate: 244.418 SCFM
Inlet Vol. Flow Rate: 2,456.0 US gal/min
Inlet Velocity: 30.8 ft/sec (FPS)
Inlet Mach No.: 0.028
Outlet Vol. Flow Rate: 2,480.5 US gal/min
Outlet Velocity: 17.5 ft/sec (FPS)
Outlet Mach No.: 0.016

Differential Pressure: 0.10 PSID

HARDWARE DESCRIPTION - TABLE 1

Symbols and Units:

- Din - Inlet Diameter - inches
- Dout - Outlet Diameter - inches
- A - Inlet Area - sq inches
- dZ - Elevational Change - feet
- Re - Reynolds Number
- EL - Equivalent Length - Diameters
- K - K Factor relative to Inlet Diameter
- Pin - Inlet Pressure - PSIA
- Pout - Outlet Pressure - PSIA
- DP - Differential Pressure - PSID
- HL - Frictional Head Loss - feet
- D - Inlet Density - lb/cu ft
- mu - Inlet Absolute Viscosity - centipoise
- W - Mass Flow Rate - lb/hr
- Q - Actual Volumetric Flow Rate - US gal/min
- Vin - Inlet Velocity - ft/sec (FPS)
- Vout - Outlet Velocity - ft/sec (FPS)

Component Name: Pipe, NPS 6, sched 80, 15.00 feet

Din:	5.709	Dout:	5.709	Area:	25.598	dZ:	0.00
Re:	71147	f:	0.015097	EL:	31.53	K:	0.48
Pin:	10.73	Pout:	10.73	DP:	0.00	HL:	
D:	0.057	mu:	0.017				
W:	1119.62	Q:	2455.97	Vin:	30.78	Vout:	30.79

Component Name: [3] Elbow, 6" 90 Thr/SW

Din:	5.709	Dout:	5.709	Area:	25.598	dZ:	0.00
Re:	71147	f:	0.015096	EL:	30.00	K:	0.45
Pin:	10.73	Pout:	10.72	DP:	0.01	HL:	
D:	0.057	mu:	0.017				
W:	1119.62	Q:	2456.61	Vin:	30.79	Vout:	30.81

Component Name: Reducer, 6 X 4" sud

Din:	5.709	Dout:	4.000	Area:	25.598	dZ:	0.00
Re:	71147	f:	0.015096	EL:	69.98	K:	1.06
Pin:	10.72	Pout:	10.70	DP:	0.02	HL:	
D:	0.057	mu:	0.017				
W:	1119.62	Q:	2458.42	Vin:	30.81	Vout:	62.88

Component Name: Pipe, NPS 4, 5.00 feet

Din:	4.000	Dout:	4.000	Area:	12.566	dZ:	0.00
Re:	101587	f:	0.016312	EL:	15.00	K:	0.24
Pin:	10.70	Pout:	10.69	DP:	0.01	HL:	
D:	0.057	mu:	0.017				
W:	1119.62	Q:	2462.85	Vin:	62.88	Vout:	62.92

Component Name: Enlarger, 4 X 6" sud

Din:	4.000	Dout:	5.845	Area:	12.566	dZ:	0.00
Re:	69491	f:	0.016311	EL:	17.33	K:	0.28
Pin:	10.69	Pout:	10.71	DP:	-0.02	HL:	
D:	0.057	mu:	0.017				
W:	1119.62	Q:	2464.22	Vin:	62.92	Vout:	29.43

Component Name: Pipe, NPS 6, sched 17.0, 440.00 feet

Din:	5.845	Dout:	5.845	Area:	26.832	dZ:	0.00
Re:	69491	f:	0.015021	EL:	903.34	K:	13.57
Pin:	10.71	Pout:	10.64	DP:	0.07	HL:	
D:	0.057	mu:	0.017				
W:	1119.62	Q:	2461.45	Vin:	29.43	Vout:	29.63

Component Name: [5] Elbow, 6" 90 Thr/SW

Din:	5.845	Dout:	5.845	Area:	26.832	dZ:	0.00
Re:	69491	f:	0.015020	EL:	30.00	K:	0.45
Pin:	10.64	Pout:	10.62	DP:	0.01	HL:	
D:	0.056	mu:	0.017				
W:	1119.62	Q:	2478.17	Vin:	29.63	Vout:	29.66

Component Name: Enlarger, 6 X 8" sud

Din:	5.845	Dout:	7.611	Area:	26.832	dZ:	0.00
Re:	53363	f:	0.015020	EL:	11.20	K:	0.17
Pin:	10.62	Pout:	10.63	DP:	0.00	HL:	
D:	0.056	mu:	0.017				
W:	1119.62	Q:	2480.98	Vin:	29.66	Vout:	17.49

ONE-PAGE SUMMARY

Branch Number: 882
File Name: well head 106160

FLUID DESCRIPTION

Compressible - Location Not Specified
Spec. Heat Ratio (Cp/Cv): 1.400
Molecular Weight: 28.96
Specific Gravity: 1.000

HARDWARE DESCRIPTION

Number of Components: 14
Branch Inlet Diameter: 5.709 inches
Branch Outlet Diameter: 7.611 inches

Branch Elevational Change: 0.0 feet
Branch K Factor: 11.91

FLOW DESCRIPTION

Mass Flow Rate: 1,119.6 lb/hr
Std Vol. Flow Rate: 244.418 SCFM
Inlet Vol. Flow Rate: 2,466.6 US gal/min
Inlet Velocity: 30.9 ft/sec (FPS)
Inlet Mach No.: 0.028
Outlet Vol. Flow Rate: 2,480.7 US gal/min
Outlet Velocity: 17.5 ft/sec (FPS)
Outlet Mach No.: 0.016

Differential Pressure: 0.06 PSID

HARDWARE DESCRIPTION - TABLE 1

Symbols and Units:

- Din - Inlet Diameter - inches
- Dout - Outlet Diameter - inches
- A - Inlet Area - sq inches
- dZ - Elevational Change - feet
- Re - Reynolds Number
- EL - Equivalent Length - Diameters
- K - K Factor relative to Inlet Diameter
- Pin - Inlet Pressure - PSIA
- Pout - Outlet Pressure - PSIA
- DP - Differential Pressure - PSID
- HL - Frictional Head Loss - feet
- D - Inlet Density - lb/cu ft
- mu - Inlet Absolute Viscosity - centipoise
- W - Mass Flow Rate - lb/hr
- Q - Actual Volumetric Flow Rate - US gal/min
- Vin - Inlet Velocity - ft/sec (FPS)
- Vout - Outlet Velocity - ft/sec (FPS)

Component Name: Pipe, NPS 6, sched 80, 15.00 feet

Din:	5.709	Dout:	5.709	Area:	25.598	dZ:	0.00
Re:	71147	f:	0.015097	EL:	31.53	K:	0.48
Pin:	10.69	Pout:	10.68	DP:	0.00	HL:	
D:	0.057	mu:	0.017				
W:	1119.62	Q:	2466.55	Vin:	30.91	Vout:	30.92

Component Name: [3] Elbow, 6" 90 Thr/SW

Din:	5.709	Dout:	5.709	Area:	25.598	dZ:	0.00
Re:	71147	f:	0.015096	EL:	30.00	K:	0.45
Pin:	10.68	Pout:	10.67	DP:	0.01	HL:	
D:	0.057	mu:	0.017				
W:	1119.62	Q:	2467.20	Vin:	30.92	Vout:	30.95

Component Name: Reducer, 6 X 4" sud

Din:	5.709	Dout:	4.000	Area:	25.598	dZ:	0.00
Re:	71147	f:	0.015096	EL:	69.98	K:	1.06
Pin:	10.67	Pout:	10.65	DP:	0.02	HL:	
D:	0.057	mu:	0.017				
W:	1119.62	Q:	2469.03	Vin:	30.95	Vout:	63.15

Component Name: Pipe, NPS 4, 5.00 feet

Din:	4.000	Dout:	4.000	Area:	12.566	dZ:	0.00
Re:	101587	f:	0.016312	EL:	15.00	K:	0.24
Pin:	10.65	Pout:	10.64	DP:	0.01	HL:	
D:	0.056	mu:	0.017				
W:	1119.62	Q:	2473.52	Vin:	63.15	Vout:	63.19

Component Name: Enlarger, 4 X 6" sud

Din:	4.000	Dout:	5.845	Area:	12.566	dZ:	0.00
Re:	69491	f:	0.016311	EL:	17.33	K:	0.28
Pin:	10.64	Pout:	10.66	DP:	-0.02	HL:	
D:	0.056	mu:	0.017				
W:	1119.62	Q:	2474.91	Vin:	63.19	Vout:	29.56

Component Name: Pipe, NPS 6, sched 17.0, 165.00 feet

Din:	5.845	Dout:	5.845	Area:	26.832	dZ:	0.00
Re:	69491	f:	0.015021	EL:	338.75	K:	5.09
Pin:	10.66	Pout:	10.63	DP:	0.03	HL:	
D:	0.056	mu:	0.017				
W:	1119.62	Q:	2472.11	Vin:	29.56	Vout:	29.63

Component Name: [5] Elbow, 6" 90 Thr/SW

Din:	5.845	Dout:	5.845	Area:	26.832	dZ:	0.00
Re:	69491	f:	0.015020	EL:	30.00	K:	0.45
Pin:	10.63	Pout:	10.62	DP:	0.01	HL:	
D:	0.056	mu:	0.017				
W:	1119.62	Q:	2478.42	Vin:	29.63	Vout:	29.67

Component Name: Enlarger, 6 X 8" sud

Din:	5.845	Dout:	7.611	Area:	26.832	dZ:	0.00
Re:	53363	f:	0.015020	EL:	11.20	K:	0.17
Pin:	10.62	Pout:	10.63	DP:	0.00	HL:	
D:	0.056	mu:	0.017				
W:	1119.62	Q:	2481.23	Vin:	29.67	Vout:	17.49

ONE-PAGE SUMMARY

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Branch Number:              757
File Name:       pipe and valve
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FLUID DESCRIPTION

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Compressible - Location Not Specified
Spec. Heat Ratio (Cp/Cv): 1.400
Molecular Weight:         28.96
Specific Gravity:         1.000
```

HARDWARE DESCRIPTION

```
Number of Components:         2
Branch Inlet Diameter:    5.709 inches
Branch Outlet Diameter:   5.709 inches

Branch Elevational Change:  0.0 feet
Branch K Factor:           0.17
```

FLOW DESCRIPTION

```
Mass Flow Rate:         1,832.3 lb/hr
Std Vol. Flow Rate:     400.000 SCFM
Inlet Vol. Flow Rate:   4,019.7 US gal/min
Inlet Velocity:            50.4 ft/sec (FPS)
Inlet Mach No.:           0.046
Outlet Vol. Flow Rate:  4,020.7 US gal/min
Outlet Velocity:           50.4 ft/sec (FPS)
Outlet Mach No.:          0.046

Differential Pressure: 0.002652 PSID
```

HARDWARE DESCRIPTION - TABLE 1

Symbols and Units:

- Din - Inlet Diameter - inches
- Dout - Outlet Diameter - inches
- A - Inlet Area - sq inches
- dZ - Elevational Change - feet
- Re - Reynolds Number
- EL - Equivalent Length - Diameters
- K - K Factor relative to Inlet Diameter
- Pin - Inlet Pressure - PSIA
- Pout - Outlet Pressure - PSIA
- DP - Differential Pressure - PSID
- HL - Frictional Head Loss - feet
- D - Inlet Density - lb/cu ft
- mu - Inlet Absolute Viscosity - centipoise
- W - Mass Flow Rate - lb/hr
- Q - Actual Volumetric Flow Rate - US gal/min
- Vin - Inlet Velocity - ft/sec (FPS)
- Vout - Outlet Velocity - ft/sec (FPS)

Component Name: Pipe, NPS 6, sched 80, 5.00 feet

Din:	5.709	Dout:	5.709	Area:	25.598	dZ:	0.00
Re:	116459	f:	0.011856	EL:	10.51	K:	0.12
Pin:	10.73	Pout:	10.73	DP:	0.00	HL:	
D:	0.057	mu:	0.017				
W:	1832.31	Q:	4019.72	Vin:	50.38	Vout:	50.39

Component Name: Ball valve

Din:	5.709	Dout:	5.709	Area:	25.598	dZ:	0.00
Re:	116459	f:	0.015096	EL:	3.00	K:	0.05
Pin:	10.73	Pout:	10.72	DP:	0.00	HL:	
D:	0.057	mu:	0.017				
W:	1832.31	Q:	4020.45	Vin:	50.39	Vout:	50.39

ONE-PAGE SUMMARY

Branch Number: 758
File Name: pipe and valve

FLUID DESCRIPTION

Compressible - Location Not Specified
Spec. Heat Ratio (Cp/Cv): 1.400
Molecular Weight: 28.96
Specific Gravity: 1.000

HARDWARE DESCRIPTION

Number of Components: 2
Branch Inlet Diameter: 5.709 inches
Branch Outlet Diameter: 5.709 inches

Branch Elevational Change: 0.0 feet
Branch K Factor: 0.27

FLOW DESCRIPTION

Mass Flow Rate: 712.7 lb/hr
Std Vol. Flow Rate: 200.000 SCFM
Inlet Vol. Flow Rate: 1,563.1 US gal/min
Inlet Velocity: 19.6 ft/sec (FPS)
Inlet Mach No.: 0.018
Outlet Vol. Flow Rate: 1,563.2 US gal/min
Outlet Velocity: 19.6 ft/sec (FPS)
Outlet Mach No.: 0.018

Differential Pressure: 0.0006433 PSID

HARDWARE DESCRIPTION - TABLE 1

Symbols and Units:

- Din - Inlet Diameter - inches
- Dout - Outlet Diameter - inches
- A - Inlet Area - sq inches
- dZ - Elevational Change - feet
- Re - Reynolds Number
- EL - Equivalent Length - Diameters
- K - K Factor relative to Inlet Diameter
- Pin - Inlet Pressure - PSIA
- Pout - Outlet Pressure - PSIA
- DP - Differential Pressure - PSID
- HL - Frictional Head Loss - feet
- D - Inlet Density - lb/cu ft
- mu - Inlet Absolute Viscosity - centipoise
- W - Mass Flow Rate - lb/hr
- Q - Actual Volumetric Flow Rate - US gal/min
- Vin - Inlet Velocity - ft/sec (FPS)
- Vout - Outlet Velocity - ft/sec (FPS)

Component Name: Ball valve

Din:	5.709	Dout:	5.709	Area:	25.598	dZ:	0.00
Re:	45285	f:	0.015096	EL:	3.00	K:	0.05
Pin:	10.73	Pout:	10.73	DP:	0.00	HL:	
D:	0.057	mu:	0.017				
W:	712.69	Q:	1563.10	Vin:	19.59	Vout:	19.59

Component Name: Pipe, NPS 6, sched 80, 5.00 feet

Din:	5.709	Dout:	5.709	Area:	25.598	dZ:	0.00
Re:	45285	f:	0.021680	EL:	10.51	K:	0.23
Pin:	10.73	Pout:	10.73	DP:	0.00	HL:	
D:	0.057	mu:	0.017				
W:	712.69	Q:	1563.12	Vin:	19.59	Vout:	19.59

ONE-PAGE SUMMARY

Branch Number:	759
File Name:	pipe and valve

FLUID DESCRIPTION

Compressible - Location Not Specified

Spec. Heat Ratio (Cp/Cv):	1.400
Molecular Weight:	28.96
Specific Gravity:	1.000

HARDWARE DESCRIPTION

Number of Components:	2
Branch Inlet Diameter:	5.709 inches
Branch Outlet Diameter:	5.709 inches
Branch Elevational Change:	0.0 feet
Branch K Factor:	0.27

FLOW DESCRIPTION

Mass Flow Rate:	712.7 lb/hr
Std Vol. Flow Rate:	200.000 SCFM
Inlet Vol. Flow Rate:	1,569.8 US gal/min
Inlet Velocity:	19.7 ft/sec (FPS)
Inlet Mach No.:	0.018
Outlet Vol. Flow Rate:	1,569.9 US gal/min
Outlet Velocity:	19.7 ft/sec (FPS)
Outlet Mach No.:	0.018

Differential Pressure: 0.0006461 PSID

ONE-PAGE SUMMARY

Branch Number: 760
File Name: pipe and valve

FLUID DESCRIPTION

Compressible - Location Not Specified
Spec. Heat Ratio (Cp/Cv): 1.400
Molecular Weight: 28.96
Specific Gravity: 1.000

HARDWARE DESCRIPTION

Number of Components: 2
Branch Inlet Diameter: 5.709 inches
Branch Outlet Diameter: 5.709 inches

Branch Elevational Change: 0.0 feet
Branch K Factor: 0.17

FLOW DESCRIPTION

Mass Flow Rate: 1,832.3 lb/hr
Std Vol. Flow Rate: 400.000 SCFM
Inlet Vol. Flow Rate: 4,037.0 US gal/min
Inlet Velocity: 50.6 ft/sec (FPS)
Inlet Mach No.: 0.046
Outlet Vol. Flow Rate: 4,038.0 US gal/min
Outlet Velocity: 50.6 ft/sec (FPS)
Outlet Mach No.: 0.046

Differential Pressure: 0.002664 PSID

HARDWARE DESCRIPTION - TABLE 1

Symbols and Units:

- Din - Inlet Diameter - inches
- Dout - Outlet Diameter - inches
- A - Inlet Area - sq inches
- dZ - Elevational Change - feet
- Re - Reynolds Number
- EL - Equivalent Length - Diameters
- K - K Factor relative to Inlet Diameter
- Pin - Inlet Pressure - PSIA
- Pout - Outlet Pressure - PSIA
- DP - Differential Pressure - PSID
- HL - Frictional Head Loss - feet
- D - Inlet Density - lb/cu ft
- mu - Inlet Absolute Viscosity - centipoise
- W - Mass Flow Rate - lb/hr
- Q - Actual Volumetric Flow Rate - US gal/min
- Vin - Inlet Velocity - ft/sec (FPS)
- Vout - Outlet Velocity - ft/sec (FPS)

Component Name: Pipe, NPS 6, sched 80, 5.00 feet

Din:	5.709	Dout:	5.709	Area:	25.598	dZ:	0.00
Re:	116460	f:	0.011856	EL:	10.51	K:	0.12
Pin:	10.68	Pout:	10.68	DP:	0.00	HL:	
D:	0.057	mu:	0.017				
W:	1832.31	Q:	4037.04	Vin:	50.60	Vout:	50.61

Component Name: Ball valve

Din:	5.709	Dout:	5.709	Area:	25.598	dZ:	0.00
Re:	116460	f:	0.015096	EL:	3.00	K:	0.05
Pin:	10.68	Pout:	10.68	DP:	0.00	HL:	
D:	0.057	mu:	0.017				
W:	1832.31	Q:	4037.78	Vin:	50.61	Vout:	50.61

Attachment B
Vacuum Blower System Performance Data

Company:	Fliteway Technologies, Inc.
Address:	2129 East Birchwood Ave. Cudahy, WI 53110
	Ph: 414-483-5600

Customer:	Global Technologies, Inc. - Shaw / Kirkland AFB, NM
Project:	Q14145 SVE Blower

ROOTS BLOWER PERFORMANCE SUMMARY : Program Version 6.000 Release Date 2/28/2008
Program Mode: SELECTION Run Date: 03/06/2012

AMBIENT CONDITIONS:

Gas	AIR	
Relative Humidity	36%	
Molecular Weight	28.812	
k-Value	1.395	
Specific Gravity	.995	
Ambient Temperature	68	deg F
Ambient Pressure	12.04	PSIA
Elevation	5388	feet

STANDARD CONDITIONS:

Pressure	14.7	PSIA
Temperature	68	deg F
Relative Humidity	36	%

INPUT CONDITIONS:

Actual Inlet Volume	2274	ICFM +/-4 %
Standard Volume	1000	SCFM
Mass/Weight Flow	74.7	#/min +/-4 %
System Inlet Pressure	11	in Hg Vac
Inlet Pressure Loss	0.3	PSI
Blower Inlet Pressure	11.61	in Hg Vac
Blower Discharge Pressure	12.64	PSIA
Discharge Pressure Loss	0.6	PSI
System Discharge Pressure	12.0	PSIA
Inlet Temperature	60	deg F

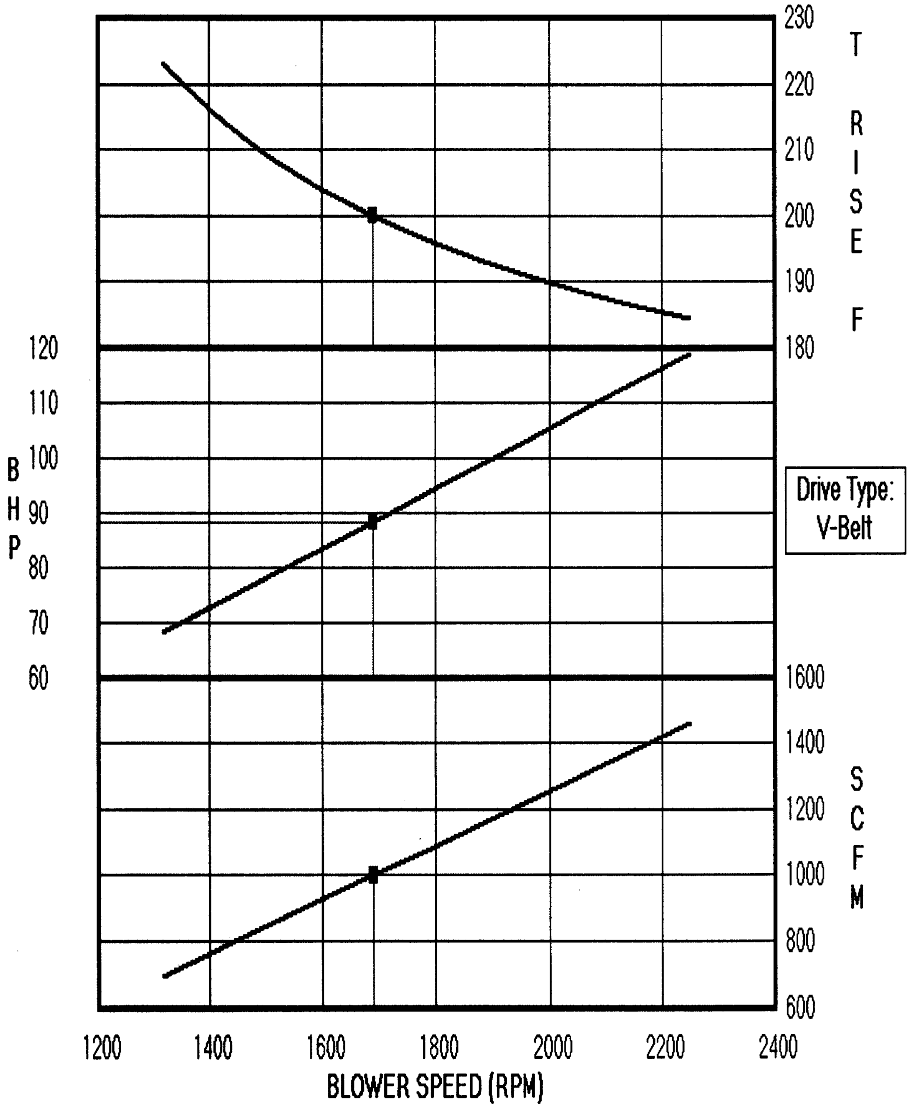
SELECTED UNIT DETAIL:

Model	821	RCS-J	
Speed	1690	RPM	75.1%
Blower Differential Pressure	6.28	PSI	41.9%
Power at Blower Shaft	88.27	BHP	+/- 4%
Temperature Rise	200	deg F	86.9%
Discharge Temperature	260	deg F	
System Discharge Volume	1584	ACFM	
Relief Valve Setting	NO RELIEF VALVE SPECIFIED		
V-Belt: Est. B10 Brg Life:	914526	hours	
Coupling: Est. B10 Brg Life:	5590476	hours	
Est. Free Field Noise	88.5	dBa	

Measured as sound pressure level per ISO 2151:2004E with +/-3 dBA tolerance.

821 RCS-J: Variable Speed Performance

Dresser ROOTS



Enter a new Speed

Recalc

Close Form

Print Curve

You must press the Print Screen keyboard button before the Print Curve Button.

```
INLET CONDITIONS: AIR
                  RH = 36.00%, MW = 28.812, k = 1.395, Tin = 60 deg F
          DESIGN: Speed = 1690 RPM
                  System Inlet P = 11 in Hg Vac, Inlet P Loss = 0.3 PSI
                  System Disch P = 12.04 PSIA, Disch P Loss = 0.6 PSI
STD:       RH = 36%, T = 68 deg F, P = 14.7 PSIA
```

Design Data ———

CUSTOMER: Global Technologies, Inc. - Shaw / Kirkland AFB, NM
PROJECT: Q14145 SVE Blower

APPENDIX G

Project Schedule

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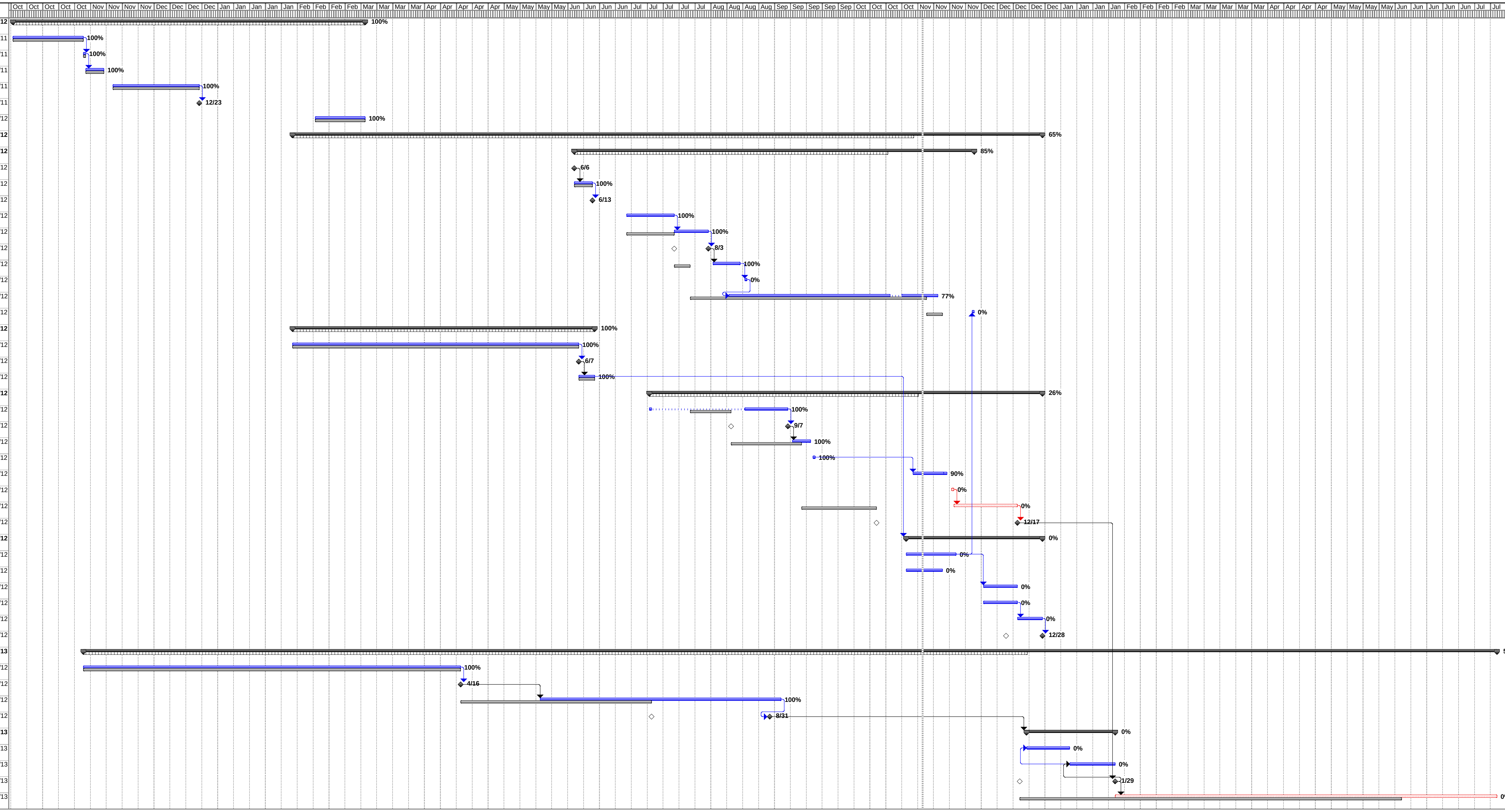
ID		Task Name	Duration	Start	Finish
1	✓	**Data Evaluation/Pre-liminary Design**	**111 days**	**Mon 10/3/11**	**Mon 3/5/12**
2	✓	Soil Vapor Data Analysis	23 days	Mon 10/3/11	Wed 11/2/11
3	✓	NMED Tiger Team Working Group	1 day	Thu 11/3/11	Thu 11/3/11
4	✓	SVE Well Design	6 days	Fri 11/4/11	Fri 11/11/11
5	✓	NMED Review of SVE Well Design Letter	28 days	Wed 11/16/11	Fri 12/23/11
6	✓	NMED Approval of SVE Well Design	0 days	Fri 12/23/11	Fri 12/23/11
7	✓	SVE Well Installation	16 days	Mon 2/13/12	Mon 3/5/12
8		**SVE Design/Construction**	**247 days**	**Fri 2/3/12**	**Fri 12/28/12**
9		**SVE System Delivery**	**130 days**	**Wed 6/6/12**	**Wed 11/28/12**
10	✓	Submit SVE Component Letter to NMED	0 days	Wed 6/6/12	Wed 6/6/12
11	✓	NMED review of Component Letter	6 days	Wed 6/6/12	Wed 6/13/12
12	✓	NMED Approval on SVE Component Letter	0 days	Wed 6/13/12	Wed 6/13/12
13	✓	Place Order for SVE System	15 days	Fri 6/29/12	Thu 7/19/12
14	✓	Vendor Preparation of Drawings	11 days	Fri 7/20/12	Fri 8/3/12
15	✓	Receipt of Vendor SVE Drawings	0 days	Fri 8/3/12	Fri 8/3/12
16	✓	Shaw review of Vendor Drawings	10 days	Mon 8/6/12	Fri 8/17/12
17		Shaw Approval of Vendor Drawings	1 day	Mon 8/20/12	Mon 8/20/12
18		SVE Fabrication	66 days	Mon 8/13/12	Mon 11/12/12
19		SVE System Delivery	1 day	Wed 11/28/12	Wed 11/28/12
20	✓	**SVE Utilities**	**95 days**	**Fri 2/3/12**	**Thu 6/14/12**
21	✓	Preperation of Utility and Site Plan	90 days	Fri 2/3/12	Thu 6/7/12
22	✓	Submission of Utility and Site Plan to KAFB	0 days	Thu 6/7/12	Thu 6/7/12
23	✓	KAFB review of Utility and Site Plan	5 days	Fri 6/8/12	Thu 6/14/12
24		**SVE Design Plan**	**136 days**	**Mon 7/9/12**	**Fri 12/28/12**
25	✓	Prepare SVE Design Plan	16 days	Mon 7/9/12	Fri 9/7/12
26	✓	Submit SVE Desing Plan to USACE and KAFB	0 days	Fri 9/7/12	Fri 9/7/12
27	✓	USACE and KAFB review of SVE Design Plan	6 days	Mon 9/10/12	Mon 9/17/12
28	✓	Meeting with NMED with preliminary design	1 day	Wed 9/19/12	Wed 9/19/12
29		Final SVE design plan to NMED	14 days	Fri 11/2/12	Fri 11/16/12
30		Deliver Final SVE design plan to NMED	1 day	Mon 11/19/12	Mon 11/19/12
31		NMED review of Final SVE Design Plan	23 days	Tue 11/20/12	Mon 12/17/12
32		NMED Approval of Final SVE Design Plan	0 days	Mon 12/17/12	Mon 12/17/12
33		**Construction of SVE System**	**53 days**	**Tue 10/30/12**	**Fri 12/28/12**
34		Concrete pad construction	21 days	Tue 10/30/12	Tue 11/20/12
35		Eletrical lines	15 days	Tue 10/30/12	Wed 11/14/12
36		Natural Gas	15 days	Mon 12/3/12	Mon 12/17/12
37		HDPE piping and system connections	15 days	Mon 12/3/12	Mon 12/17/12
38		HPLC programming and system testing	10 days	Tue 12/18/12	Fri 12/28/12
39		System Operation Begins	0 days	Fri 12/28/12	Fri 12/28/12
40		**Air Permit**	**455 days?**	**Thu 11/3/11**	**Tue 7/16/13**
41	✓	Prepare Emergency Air Permit	118 days?	Thu 11/3/11	Mon 4/16/12
42	✓	Submit Emergency Air Permit to AEHD	0 days	Mon 4/16/12	Mon 4/16/12
43	✓	AEHD review of Emergency Air Permit	76 days	Tue 5/22/12	Tue 9/4/12
44	✓	AEHD approval of Emergency Air Permit	0 days	Fri 8/31/12	Fri 8/31/12
45		**Prepare Air Permit Modification**	**28 days**	**Sat 12/22/12**	**Tue 1/29/13**
46		KAFB Review of Air Permit Modification	14 days	Sat 12/22/12	Wed 1/9/13
47		Staffing for Commander Signature	14 days	Thu 1/10/13	Tue 1/29/13
48		Submit Air Permit Mod to AEHD	0 days	Tue 1/29/13	Tue 1/29/13
49		AEHD review of Air Permit Modification	120 days	Wed 1/30/13	Tue 7/16/13



UPDATED: 7 November 2012
NOT FINAL

Project: SVE Schedule 009052012
Date: Tue 11/6/12

Critical, Critical Split, Critical Progress, Task, Split, Task Progress, Baseline, Baseline Split, Baseline Milestone, Milestone, Summary Progress, Summary, Project Summary, External Tasks, External Milestone, Deadline