GW-52

Amended Remediation Workplan and Final Design

May 2013

Griswold, Jim, EMNRD

From:	Griswold, Jim, EMNRD
Sent:	Wednesday, July 03, 2013 9:58 AM
To:	Boultinghouse, Stacy (Stacy.Boultinghouse@energytransfer.com)
Subject:	Amended Remediation Plan Approval: GW-52 Roswell Compressor located in SW/4 of Section 21 in Township 9 South, Range 24 East, NMPM in Chaves County, NM

Ms. Boultinghouse,

The Oil Conservation Division has reviewed the *Amended Remediation Work Plan and Amended Final Design* for the above-referenced site submitted on your behalf by EarthCon and dated 5/22/13. That plan is hereby approved. Please proceed with field activities.

Be advised this approval does not relieve Transwestern of responsibility for any continuing threat to groundwater, surface water, human health, or the environment. Furthermore, this approval does not relieve your responsibility for compliance with any federal, state, or local laws and/or regulations. Please retain a copy of this email for your files, as no hardcopy will be sent. If you have any questions, please feel free to contact me at any time.

Jim Griswold
Senior Hydrologist
EMNRD/Oil Conservation Division
1220 South St. Francis Drive
Santa Fe, New Mexico 87505
505.476.3465
email: jim.griswold@state.nm.us

ENERGY TRANSFER PARTNERS
Transwestern Pipeline Company

May 22, 2013

Mr. Glenn von Gonten
Environmental Bureau
New Mexico Oil Conservation District
1220 South St. Francis Drive
Santa Fe, New Mexico 87505

Mr. Dave Cobrain
New Mexico Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6313

RE: Amended Remediation Work Plan and Amended Final Design
Roswell Compressor Station No. 9 Remediation Site
Transwestern Pipeline Company, LLC
Roswell, Chavez County, New Mexico
NMOCD Case #GW-052/EPA ID NO. NMD986676955

Dear Messrs. von Gonten and Cobrain:

On March 13, 2013, the New Mexico Environment Department (NMED) issued a Stipulated Order (Order) to Transwestern Pipeline Company, LLC (Transwestern) that governs corrective action activities conducted within the Project Area at Transwestern's Roswell Compressor Station No. 9. In addition, the Order indicates that the New Mexico Oil Conservation District (NMOCD) will continue to be the lead agency for the project with the NMED providing additional review.

In accordance with the terms of the Order, a scope of work is presented in the attached Amended Remediation Work Plan and Amended Final Design for your review and approval. This document discusses additional work to optimize the previously approve remediation system installed at the Site and presents a proposed schedule regarding continuing remedial activities.

If you have any questions or comments regarding this document, please do not hesitate to contact me at 210.870.2725 (office) or 281.740.0494 (cell).

Sincerely,

SBoultinghouse

Stacy Boultinghouse, PG (Texas 4889)
Environmental Specialist
Transwestern Pipeline Company, LLC

Attachment: Amended Remediation Work Plan and Amended Final Design

Xc:	Larry Campbell	Transwestern Pipeline Company (electronic via email)
	Laurie King	US EPA Region 6
	Randy Dade	NMOCD Artesia District Office (w/o attachment)
	Steve Ikeda	New Mexico State Land Office (w/o attachment)

AMENDED REMEDIATION WORK PLAN
AMENDED FINAL DESIGN
TRANSWESTERN COMPRESSOR STATION NO 9
ROSWELL, NEW MEXICO
EPA ID NO. NMD986676955

PREPARED FOR:

TRANSWESTERN PIPELINE COMPANY, LLC
711 LOUISIANA STREET, SUITE 900
HOUSTON, TEXAS 77002

PREPARED BY:

EARTHCON CONSULTANTS, INC.

14405 WALTERS ROAD, SUITE 700
HOUSTON, TEXAS 77014
281.240.5200

EarthCon Project No. 02.20120037.00

May 22, 2013

Certification:

Amended Remediation Work Plan
Amended Final Design
Roswell Compressor Station No. 9
6381 North Main Street
Roswell, Chaves County, New Mexico
EPA ID No. NMD986676955

Prepared For:

Transwestern Pipeline Company, LLC
711 Louisiana, Suite 900
Houston, TX 77002

May 2013
EarthCon Project No. 02.20120037.00

EarthCon Consultants, Inc. is submitting to Transwestern Pipeline Company, LLC (Transwestern) this Amended Remediation Work Plan and Amended Final Design for the Roswell Compressor Station No. 9 in Chaves County, New Mexico. This report has been prepared for the exclusive use of and reliance by Transwestern, and may not be relied upon by any other person or entity without the express written authorization of EarthCon. Any reliance, use, or re-use of this document (or the opinions, findings, conclusions, or recommendations if any represented herein), by parties other than those expressly authorized by EarthCon is at the sole risk of those parties. This report was prepared by or performed under the direction of the EarthCon Professionals listed below and approved by Transwestern.

Signed:

JD Haines, LPG (Indiana)
Principal Geologist
EarthCon Consultants, Inc.

David Richardson
Principal Geologist
EarthCon Consultants, Inc.

Richard A Spell
Waste, Water, & Remediation Manager
Transwestern Pipeline, LLC

Date: March 22, 2013

EXECUTIVE SUMMARY

On behalf of Transwestern Pipeline Company, LLC., this document is being prepared as an *Amended Remediation Work Plan and Remedial Design (RWP)* prepared by EarthCon Consultants, Inc. (EarthCon) for the northeastern corner and norther and eastern adjacent off0site lands at the Transwestern Pipeline Compressor Station No. 9 (also known as the Roswell Compressor Station) property located at 6381 North Main Street in Roswell, New Mexico. The Facility has been operating since the 1960s, and operations include natural gas compression and gas transmission line maintenance. The Facility is currently active. Until approximately 1986, transmission line maintenance waste and certain other wastes were discharged to earthen surface impoundments, referred to as former Pit No. 1 and Pit No. 2 (Pits), located in the northeastern corner of the Facility. The former Pits have previously been excavated and backfilled. Pits No. 1 and No. 2, as well as the surrounding area exhibiting groundwater impacts, are included in continuing corrective action.

Reportedly, wastes discharged to the former Pits contained petroleum hydrocarbons, volatile compounds (VOCs), semi-volatile organic compounds (SVOCs), and metals. Investigations conducted at the site, starting in the early 1990s, identified the presence of these constituents in soil and groundwater beneath the Project Area. Corrective actions implemented at the Facility include: removal of waste from the former Pits and backfilling with clean soil (conducted in 2001); installation of a soil and groundwater remediation system (completed in 2002 / 2003), and continued operation of the remediation system, including monitoring and maintenance since March 2003. The October 2012 laboratory results for groundwater samples indicated that of the VOCs, only benzene and 1,1-dichloroethene (DCE) were detected at concentrations above the New Mexico Water Quality Control Commission (NMWQCC) standards.

The former Pits have been remediated through removal of impacted materials and backfilling with clean soil in 2002; sidewall samples collected from each Pit location indicate that the excavation successfully removed near surface soils to an acceptable concentration of Total Petroleum Hydrocarbons (TPH). However, during that sampling soils beneath the former impoundments were found to be impacted with petroleum hydrocarbons. Beneath the former Pits, the vertical extent of impacted soils extends from the bottom of the excavation to the uppermost aquifer at approximately 60 feet. Due to local soil heterogeneities, it appears that VOCs have spread out along preferential pathways on top of the clay lenses at the 30- to 40-foot depth, prior to continued downward migration to the uppermost aquifer.

The soil vapor extraction (SVE) system installed in 2002 / 2003 consisted of nine SVE wells, 37 Multi-Phase Extraction (MPE) wells, associated conveyance piping, and two Baker Furnace thermal oxidizer units. The SVE system was started-up on March 10, 2003. Installation of a second phase of the remediation system was completed in December 2003 with the installation of 15 pneumatic recovery pumps, water treatment equipment, and an irrigation system.

Groundwater in the Project Area exhibits both phase separated hydrocarbons (PSH) and dissolved-phase constituents. Impacted groundwater has also been documented on off-site New Mexico State Land Office (SLO) State Trust Land to the north and southeast of the northeastern corner of the Facility. The migration of PSH and dissolved COCs generally reflect groundwater flow patterns beneath the site to the north and southeast.

The data obtained from the Project Area since startup of the remedial system indicates that extent of PSH has decreased approximately 55% from the maximum extent and the thickness of remaining PSH decreasing throughout much of the plume area except for near the former Pits and MW-12, where the thickness of PSH increased. Increases in PSH thickness in these areas are likely due to the dropping groundwater levels that allowed the hydrocarbons formerly trapped below the water table to drain thus mobilizing into the existing PSH plume.

In regards to the dissolved COCs, the areal extent of benzene decreased approximately 46% from its maximum. The current extent of benzene closely mirrors the current extent of PSH, which represents a continuing source of benzene to the dissolved plume. 1,1- DCE concentrations appear to be increasing in MW-26. The increase in 1,1-DCE in MW-26 does not appear to be associated with the PSH or the benzene in the Project Area. In order to better delineate the 1,1-DCE plume, Transwestern proposed to install four additional monitoring wells to the north of this location in the *Amended Investigative Work Plan* submitted in April 2013 to OCD and NMED under separate cover.

Highest vapor concentrations from the SVE/MPE extraction wells were detected in those areas of the site still exhibiting mobile PSH on the water table. Data submitted within the *2012 Report of Groundwater Remediation Activities* indicate that a total estimated mass of hydrocarbons removed by the remediation system during year 2012 was 19,202 pounds, or about 3,068 gallons.

The key limitation for the project to meet its remedial objective for groundwater is the continuing presence of PSH in the vicinity of the former Pits, an ongoing source of COCs to the dissolved groundwater plume. Despite a 55% decrease in extent, apparent PSH thickness in this area still ranges from approximately 2 to 6 feet thick during the October 2012 sampling event. In order to overcome this limitation, the ongoing remediation must remove PSH to the extent practicable by further focusing on those areas still exhibiting recoverable PSH. Therefore, the following work items have been planned to further enhance PSH recovery efforts:

1. Installation of four additional MPE wells in locations exhibiting recoverable levels of free product and relocation of pumps to optimize total fluid recovery;
2. Plugging and abandonment (P&A) of MPE Wells in areas no longer exhibiting PSH or elevated vapor concentrations which will allow efficient use of the existing equipment to power the new wells;
3. Re-location of existing recovery pumps in MPE wells to better target areas exhibiting mobile PSH;
4. Continued system optimization; and,

5. Continued plume stability and PSH analysis to support system optimization by responding to plume dynamics (i.e., follow location of center of mass, and address plume stabilization/shrinkage).

TW expects that remediation of the site to continue until mobile PSH is abated and the dissolved COCs in groundwater exhibit stability. The project will then move to either monitored natural attenuation, or a Risk Assessment, as conditions dictate. TW expects that these activities will occur over a period on the order of ten years.

Thus, the purpose of the additional remedial activities proposed in this *Amended RWP* is to concentrate remedial activities in areas of the plume still exhibiting PSH, which constitute a secondary source of the COCs impacting groundwater within the Project Area.

CONTENTS

TABLES

FIGURES

1.0 INTRODUCTION

This document is an *Amended Remediation Work Plan and Remedial Design (RWP)* prepared by EarthCon Consultants, Inc. (EarthCon) for the Transwestern Pipeline Company, LLC (Transwestern) Roswell Compressor Station No. 9 property located at 6381 North Main Street in Roswell, New Mexico (**Figure 1-1**, Site Location Map). This document amends the previously approved January, 1997 *Corrective Action Plan* prepared for the site, as well as the approved October 2002 *Final Design* documents prepared by others. For the purposes of this *RWP*, the term "Facility" will be used to denote the entire compressor station and "Project Area" will be used to refer to the northeastern corner of the compressor station and the adjacent land leased from the State of New Mexico Trust.

The Facility has been operating since the 1960s, and operations include natural gas compression and gas transmission line maintenance. The Facility is currently active. Until approximately 1986, transmission line maintenance waste and certain other wastes were discharged to earthen surface impoundments, referred to as former Pit No. 1 and Pit No. 2 (Pits), located in the northeastern corner of the Facility (**Figure 1-2**, Project Area). The former Pits have previously been excavated and backfilled. Pits No. 1 and No. 2, as well as the surrounding area exhibiting groundwater impacts, are included in continuing corrective action.

Reportedly, wastes discharged to the former Pits contained petroleum hydrocarbons, volatile compounds (VOCs), semi-volatile organic compounds (SVOCs), and metals. Investigations conducted at the site, starting in the early 1990s, identified the presence of these constituents in soil and groundwater beneath the Project Area. Corrective actions implemented at the Facility include: removal of waste from the former Pits and backfilling with clean soil (conducted in 2001); installation of a soil and groundwater remediation system (completed in 2002 / 2003), and continued operation of the remediation system, including monitoring and maintenance since March 2003. The October 2012 laboratory results for groundwater samples indicated that of the VOCs, only benzene and 1,1-dichloroethene (DCE) were detected at concentrations above the New Mexico Water Quality Control Commission (NMWQCC) standards.

The soil vapor extraction (SVE) system installed in 2002 / 2003 consisted of nine SVE wells, 37 Multi-Phase Extraction (MPE) wells, associated conveyance piping, and two Baker Furnace thermal oxidizer units. The SVE system was started-up on March 10, 2003. Installation of a second phase of the remediation system was completed in December 2003 with the installation of 15 pneumatic recovery pumps, water treatment equipment, and an irrigation system.

A Discharge Permit Modification (GW-052) was issued on June 16, 2003 for the discharge of treated groundwater. In late 2003 / 2004, a 210-barrel aboveground storage tank was introduced into the system to act as a surge tank. The surge tank was installed between the recovery wells and the oil/water separator. Due to clogging issue, the oil/water separator was later removed from the treatment train. The surge tank provides two benefits: 1) provides for gravity separation of recovered liquids into two phases, a hydrocarbon phase and a water phase and 2) it allows more control of the flow rate into the oil/water separator.

In addition, two granulated activated carbon (GAC) units were installed in series between the air stripper and the irrigation water tank to provide additional treatment of recovered groundwater. The modified recovery, treatment, and irrigation system was finally started-up for continuous operation on April 15, 2004 and has operated continuously since with the exception of brief shutdowns for repairs and maintenance.

Soil vapor and groundwater sampling and analysis have been conducted on the SVE/MPE system to assess system performance. Since 2004, these activities have been documented in annual reports submitted to the New Mexico Energy, Minerals and Natural Resources Department Oil Conservation Division (OCD).

On March 13, 2013, the New Mexico Environment Department (NMED) issued a Stipulated Order (Order) that governs activities conducted within the Project Area. Therefore, the proposed scope of work discussed in this *RWP* will be conducted in accordance of the terms of this Order and OCD requirements. The Order indicates that the OCD will continue to be the lead agency for the project with the NMED providing additional review. The Project Team for Transwestern conducting this scope of work consists of EarthCon in the capacity of project management and reporting, with Cypress Engineering Services, Inc. (CES) conducting field services.

The purpose of the additional remedial activities proposed in this *RWP* is to concentrate remedial activities in areas of the plume still exhibiting phase separated hydrocarbons (PSH), which constitute a secondary source of the constituents-of-concern (COC) impacting groundwater within the Project Area. The plugging and abandonment (P&A) of MPE wells outside of the area impacted by the current groundwater plume is discussed in greater detail in the *Amended Investigative Work Plan and Groundwater Monitoring Plan* (IWP & GWP) submitted April 2013 to the OCD and NMED under separate cover.

This *RWP* is divided into ten major sections. **Section 1** contains introductory material. **Section 2** contains background information for the project**. Section 3** summarizes information on surface and subsurface conditions in the Project Area. **Section 4** contains identification of potential receptors and remedial objectives. **Section 5** notes the identification of corrective measures options, while **Section 6** includes information pertaining to the evaluation of those options**. Section 7** identifies the preferred corrective action option. **Section 8** summarizes the proposed amended remedial design. **Section 9** lays out the proposed schedule for the project. **Section 10** contains references utilized in the preparation of this *RWP*. **Tables** and **Figures** follow the text of the *RWP*.

2.0 BACKGROUND

2.1 Site Description

The Facility is an active gas compression station located approximately 8 miles north of the city center of Roswell, New Mexico along the eastern side of U.S. Highway 285. The Facility is situated on approximately 77 acres of land in Sections 21 and 28 (T9S R24E), Chaves County, New Mexico (**Figure 1-1**). The Facility is privately owned by Transwestern, while the remainder of Sections 21 and Section 28 are State Trust Land (Glenn, 1993). The Facility is specifically located in the SW¼ of the SW¼ of Section 21 (less West ±47.98 feet) and in the NW¼ of the NW¼ of Section 28 (less West ±47.98 feet) of Township 9S and Range 24E.

Site access is via U.S. Highway 285, and the entire Facility is secured by a chain-link fence with locked gates. Transwestern leases approximately 30 acres to the north, east and southeast of the Project Area/Facility on the New Mexico State Land Office (SLO) State Trust Land for remediation and monitoring purposes (**Figure 1-2**). The Project Area within the facility is secured by the chain-link fence, while the portion on SLO lands is generally secured by a barbed wire fence. The following is pertinent information regarding the Facility (DBS&A, 1997):

Facility name	Transwestern Pipeline Company Compressor Station No. 9 (aka Roswell Compressor Station)
Facility address	Transwestern Pipeline Company, LLC 6381 North Main Street P.O. Box 1717 Roswell, New Mexico 88202-1717
Telephone number	(575) 625-8022
EPA I.D. number	NMD986676955
County and state	Chaves County, New Mexico
Facility legal description	SW1/4 of the SW1/4 of Section 21, T9S R24E, NW1/4 of the NW1/4 of Section 28, T9S R24E
Latitude/Longitude of former Pits	Pit 1: N33°30'54" / W104°30'55" Pit 2: N33°30'55" / W104°30'55"
Facility elevation	Approximately 3610 feet above sea level

The Facility is located along the Transwestern natural gas pipeline that extends from Texas to the Arizona/California border. Natural gas is transported to and from the east through two 24-inch, bidirectional pipelines, the West Texas Lateral and the Panhandle Lateral, and enters and exits to the northwest through two 30-inch pipelines. The primary function of the compressor station is to boost the pressure of the natural gas stream by means of compressors powered by natural gas internal combustion engines. Additionally, the Facility conducts gas transmission line maintenance operations which generate waste hydrocarbons, including condensate, pigging and other wastes, which were historically discharged to the former Pits (DBS&A, 1994). Wastes generated by current maintenance activities are discharged to aboveground storage tanks at the Facility.

The Facility also includes a building that houses the district offices for Transwestern's New Mexico operations, along with an engine room, ancillary equipment, pig launcher and pigging waste handling facilities, and other ancillary buildings, including a warehouse and a repair shop (**Figure 2-1**, Facility Map).

Office buildings and other structures are mainly located in the western and central portions of the property. Remediation system equipment, recovery wells, and monitoring wells are located either on the northeast portion of the Facility and within its fence, or offsite within a fenced area on land leased from the New Mexico SLO.

2.2 Constituents-of-Concern

Table 1-1 documents the primary constituents-of-concern (COCs) within the Project Area. Past remedial activities have focused upon VOCs as the primary COCs. The October 2012 laboratory results for groundwater samples indicated that of the VOCs, only benzene, toluene, xylenes and 1,1-dichloroethene (DCE) were detected at concentrations above the NMWQCC standards.

The former Pits have been remediated through removal of impacted materials and backfilling with clean soil in 2002; sidewall samples collected from each Pit location indicate that the excavation successfully removed near surface soils to an acceptable concentration of Total Petroleum Hydrocarbons (TPH). However, during that sampling soils beneath the former impoundments were found to be impacted with petroleum hydrocarbons. Beneath the former Pits, the vertical extent of impacted soils extends from the bottom of the excavation to the uppermost aquifer at approximately 60 feet. Due to local soil heterogeneities, it appears that VOCs have spread out along preferential pathways on top of the clay lenses at the 30- to 40-foot depth, prior to continued downward migration to the uppermost aquifer.

Groundwater in the Project Area exhibits both phase separated hydrocarbons (PSH) and dissolved-phase constituents. Impacted groundwater has also been documented on off-site SLO land to the north and southeast of the northeastern corner of the Facility. The migration of PSH and dissolved COCs generally reflect groundwater flow patterns beneath the site to the north and southeast. **Figure 2-2** illustrates the extent of PSH and COCs in groundwater over the NMWQCC criteria beneath the Project Area during startup of the remedial system in 2003.

2.3 Remedial History

Following removal of impacted materials from the two former Pits in 2002, a soil vapor extraction (SVE) system was installed in 2002/2003 consisting of nine SVE wells, 37 Multi-Phase Extraction (MPE) wells, associated conveyance piping, and two Baker Furnace thermal oxidizer units. **Figure 2-3** illustrates the Remediation System Layout, while **Figure 2-4** shows the Process Details for the treatment train.

The SVE system was started-up on March 10, 2003. Installation of a second phase of the remediation system was completed in December 2003 with the installation of 15 pneumatic recovery pumps, water treatment equipment (including oil water separator and air stripper), and an irrigation system. Discharge Permit Modification (GW-052) was issued on June 16, 2003 for the discharge of treated groundwater via the irrigation system, and remains current.

In late 2003/2004, a 90-barrel aboveground storage tank was introduced into the system to act as a surge tank. The surge tank was installed between the recovery wells and the oil/water separator. The surge tank provides two benefits: 1) provides for gravity separation of recovered liquids into two phases, a hydrocarbon phase and a water phase and 2) it allows more control of the flow rate into the remaining portion of the treatment train. The oil/water separator was later removed from the treatment train as it became redundant after installation of the surge tank.

In addition, two granulated activated carbon (GAC) units were installed in series between the air stripper and the irrigation water tank to provide additional treatment of recovered groundwater. The modified SVE and groundwater recovery, treatment, and irrigation system was finally started-up for operation on April 15, 2004, with the SVE portion running year-round and the groundwater recovery portion running during the warm months (typically from May to October), The system has operated continuously since, with the exception of brief shutdowns for repairs and maintenance and shut down of the groundwater portion of the system during the winter months.

3.0 SITE CONDITIONS

3.1 Surface Conditions

The Facility is located approximately 7 miles west of the Pecos River within the Pecos Valley drainage basin (**Figure 1-1**). The entire area west of the Pecos River is generally referred to as the West Pecos Slope (Kelley, 1971), which rises westward from elevations of about 3,300 feet mean sea level (MSL) at the Pecos River to over 10,000 feet MSL in the Capitan Mountains some 50 miles to the west. Local topography is generally of low relief.

The mean annual precipitation as measured at the Roswell Municipal Airport for a 23-year period was 9.82 inches (DBS&A, 1997). The majority of the precipitation occurs in July and August during frequent summer thunderstorms (DBS&A, 1997). Tributary surface streams drain west to east toward the Pecos River; however, the drainage near the Project Area are commonly dry, and only flow on an intermittent basis. The depths of the remaining impacts to soil and groundwater and the lack of consistent surface water indicate that the release from the former Pits is unlikely to have impacted surface water.

3.2 Subsurface Conditions

The Facility lies within the northernmost portion of the Roswell hydrologic basin. The basin is structurally controlled by eastward-dipping carbonate and evaporates sequences of Permian age which were uplifted during the Tertiary period during the development of the Sacramento and Guadalupe Mountains along the western margin of the basin (Kelley, 1971). Eastward flowing tributaries originating in the western highlands have deposited Quaternary alluvium over the Permian age rocks west of the Pecos River.

Because the average dip of the Permian rocks is greater than the slope of the land surface, progressively younger units are encountered eastward toward the Pecos River. Several prominent northeast trending ridges and hills interrupt the gently sloping plains near the Facility. These structures are narrow fault zones referred to as the Border Hills, Six-Mile Hill, and the Y-O faulted anticlines.

The stratigraphic units of importance with regard to water resources are, in ascending order, the San Andres Formation (Permian), the Artesia Group (Permian), and the undifferentiated Quaternary valley fill alluvium. Groundwater is produced from both a shallow water-table aquifer (alluvium) and a deeper artesian aquifer that includes the two bedrock units (Welder, 1983). The deep bedrock aquifer is commonly known as the Roswell artesian aquifer. According to the State Engineer Office (SEO), approximately 400,000 acre-feet of water are pumped annually from the two aquifers of the

Roswell hydrologic basin (DBS&A, 1992). The two aquifers are separated by a semi-confining layer, but are connected where the carbonate aquifer rises structurally to meet the shallow aquifer. Both aquifers are recharged along surface exposures on the slopes to the west and are believed to discharge to the Pecos River at the eastern margin of the basin.

The alluvium near the Facility is generally less than 50 feet thick. However, in other areas, the thickness can exceed 250 feet thick where the alluvium fills depressions in the underlying bedrock surface. SEO well records from 1992 indicate that the alluvium near the Facility is approximately 70 feet thick (DBS&A, 1992). The alluvial sediments underlying the Facility, as observed in borings drilled during several investigations, consist predominantly of interbedded cobbles, gravel, sand, silt, and clay to depths of approximately 70 feet bgs (DBS&A, 1997). The finer-grained zones form lenticular beds which appear to be discontinuous across the Facility. Some of the alluvial deposits are firmly cemented in some places. These lithologic descriptions are consistent with Lyford's descriptions of the valley fill (DBS&A, 1997). Generalized hydrogeologic cross sections of the sediments underlying the former Pits are depicted on **Figure 3-1**; Cross Section A - A' is constructed along an east-west line (**Figure 3-2)** and Cross Section B - B' is constructed along a north-south line (**Figure 3-3)**. Shallow groundwater conditions in the alluvium at the Project Area are shown on the groundwater surface elevation map of the Uppermost Aquifer, measured on October 15. 2012 (**Figure 3-4**).

Poor water quality is encountered in the shallow alluvial aquifer from slightly south of the Facility northward and is due to the presence of gypsum beds of the Fourmile Draw member at the base of the alluvium. Because of the poor water quality and the low yields, most wells completed in the shallow alluvium are used primarily as livestock water supplies. In general, the chloride content of water in the shallow aquifer increases from west to east and ranges from 20 milligrams per liter (mg/L) to 3700 mg/L (Welder, 1983). The presence of gypsum beds results in objectionably high calcium and sulfate concentrations in the shallow alluvial aquifer in the vicinity of the Facility and northward (DBS&A, 1997). Sulfate concentrations are typically in the range of 2,000 to 3,000 mg/L, which is approximately equal to the equilibrium saturation concentration for groundwater in direct contact with gypsum ($CaSO4 \bullet 2H20$). Thus, background sulfate concentrations in this area are four to five times above the NMWQCC groundwater standard for sulfate of 600 mg/L (DBS&A, 1997). The poor water quality in the alluvium is consistent with the high total dissolved solids (TDS) concentrations reported for groundwater from the on-site monitoring wells (DBS&A, 1997).

4.0 POTENTIAL RECEPTORS

4.1 Sources, Pathways and Receptors

The Conceptual Site Model (CSM) documenting the PSH and COC sources, migration pathways and receptors are detailed in the *Amended Investigative Work Plan and Groundwater Monitoring Plan* (IWP & GWP) submitted April 2013 to the OCD and NMED.

With respect to receptors near the Project Area, the land use at the Facility is commercial/industrial and likely to remain commercial/industrial. The land immediately surrounding the Facility is undeveloped New Mexico SLO land that extends across 17 sections in Township 9S and Range 24E. The land use beyond the SLO land is agricultural, commercial and residential based on a review of historical and recent aerial photographs and Chaves County Assessor's office tax plats. Agricultural properties are located to the southwest, west, north and northeast of the Facility.

Commercial properties are located to the south and southeast along Highways 285 and 70 and residential properties are located no closer than 1.5 miles to the northeast, but generally lie approximately 3 miles to the south along the northern peripheries of the City of Roswell.

Residential use of the Facility or the adjacent properties impacted by the release is unlikely as:

1) The Facility is a major gas compression station that moves gas to and from Texas and New Mexico across the southwestern United States to California.

2) The area surrounding the Facility is mostly undeveloped State Trust Lands with scattered commercial and industrial businesses and this use is also unlikely to change to residential use.

3) There is currently only one groundwater supply well within one-half mile of the Project Area; completed in the San Andres Formation (regional aquifer). This well is located on the Facility, upgradient from shallow, impacted groundwater. This bedrock water supply well completion is greater than 140 feet below the impacted alluvium water-table aquifer. The alluvium aquifer under the Project Area and adjacent property is believed to be limited in lateral and vertical extent and not in communication with the lower bedrock aquifer. Refer to **Appendix B** of the *Amended Investigative Work Plan and Groundwater Monitoring Plan* (IWP & GWP) submitted April 2013 to the OCD and NMED for Banks Environmental Water Well Report documenting water wells within a two-mile radius of the Project Area.

Given these conditions and the lack of a complete groundwater pathway or the presence of residential receptors, on-site commercial/industrial workers and construction workers are considered as the most likely potentially exposed populations. As impacted soil from the two former Pits has been removed and the Pits backfilled with clean fill material, vapor intrusion and ingestion of impacted groundwater remain as the potential exposure pathways of concern.

Vapor intrusion may be of concern in regards to excavation activities conducted in the vicinity of the Project Area, or within any buildings located near the Project Area. In terms of excavation activities, the depth of the impacted soil and the PSH layer make worker exposure during excavation unlikely. Additionally, during excavations in the vicinity of pipelines and/or compressor stations, air monitoring commonly conducted on the airspace and risks abated if detected. Therefore, worker exposure via this pathway is unlikely.

In regards to vapor intrusion into buildings, the only building in the Project Area is the metal building that houses the controls and materials for the remediation system. Access to this building is limited and the doors to the building are commonly left open when individuals are present. Therefore, worker exposure via this pathway is unlikely.

Groundwater in an alluvial aquifer is an impacted receptor in the vicinity of the two former Pits. However, the groundwater is not utilized as a drinking source. Additionally, Transwestern owns a portion of the plume area and has leased water rights on the adjacent State Land. Therefore, current or future worker exposure via ingestion of groundwater is unlikely.

Lastly, there appears to be no ecological receptors that would be impacted by the release from the former Pits. Affected surface soils were removed and replaced with clean backfill, affected groundwater is present at a depth of over 50 feet bgs and based on the shallow nature of the nearby intermittent drainage way, there is limited potential for groundwater to discharge into surface water or sediments within the intermittent drainage way. Given the depths of the impacted soil and groundwater beneath the Project Area, the release from the former Pits does not appear to be a threat to ecological receptors.

4.2 Remedial Objectives

The 2013 NMED Stipulated Order (Order) pertaining to the Project Area notes that groundwater cleanup standards to be utilized on the site are the lesser of the NMWQCC or USEPA Maximum Contaminant Levels (MCLs). If neither a NMWQCC or MCL exist for a specific COC, then the project can utilize the February 2012 NMED Risk Assessment Guidance for Site Investigation and Remediation, as updated, or, as a final resort, the most recent version of the USEPA Regional

Screening Levels. If the cleanup levels cannot be achieved, the project may utilize approved risk-based cleanup levels established by a risk assessment. As a secondary source of impact to groundwater within the Project Area, mobile PSH will be removed to the extent practicable. Past activities within the Project Area have focused upon the volatile organic compounds (VOCs) included on the COC list. A MPE system has been in-place within the Project Area since 2003-2004. In October 2012, laboratory results for groundwater samples indicated benzene, toluene, xylenes, and 1,1-DCE were measured at concentrations above the NMWQCC standards.

5.0 IDENTIFICATION OF CORRECTIVE MEASURES OPTIONS

Section 7.0, Remediation Objectives and Preliminary Strategy, of the 1997 Corrective Action Plan (CAP) prepared by Daniel B. Stephens & Associates identifies potential remedial technologies for potential application to the COCs in soil and groundwater beneath the Project Area.

6.0 EVALUATION OF CORRECTIVE MEASURES OPTIONS

6.1 Overview

Section 7.0, Remediation Objectives and Preliminary Strategy, of the 1997 CAP prepared by Daniel B. Stephens & Associates evaluates potential remedial technologies for application to the COCs in soil and groundwater beneath the Project Area. This evaluation concluded that SVE, followed by bioventing was an appropriate technology to address COCs in deeper soils beneath the Project Area. To address PSH, the RWP discussed adapting the SVE system to MPE in areas where PSH removal could be implemented. For impacted groundwater, the RWP recommended insitu enhancement of aerobic degradation. The current status of the selected remedy is briefly described in the following section.

6.2 Remediation Status

Figures 6-1, 6-2 and 6-3 present the extent of PSH, benzene, and 1,1-DCE during the October 2012 groundwater sampling event. **Figures 6-4, 6-5 and 6-6** illustrate the change in the extent of PSH, benzene, and 1,1-DCE from 1997 to October 2012. The data indicates that extent of PSH has decreased approximately 55% from the maximum extent and the thickness of remaining PSH decreasing throughout much of the plume area except for near the former Pits and MW-12, where the thickness of PSH increased. Increases in PSH thickness in these areas are likely due to the dropping groundwater levels that allowed the hydrocarbons formerly trapped below the water table to drain thus mobilizing into the existing PSH plume.

In regards to the dissolved COCs, the areal extent of benzene decreased approximately 46% from its maximum. The current extent of benzene closely mirrors the current extent of PSH, which represents a continuing source of benzene to the dissolved plume. 1,1- DCE concentrations appear to be increasing in MW-26. The increase in 1,1-DCE in MW-26 does not appear to be associated with the PSH or the benzene in the Project Area. In order to better delineate the 1,1-DCE plume, Transwestern proposed to install four additional monitoring wells to the north of this location in the *Amended Investigative Work Plan* submitted in April 2013 to OCD and NMED under separate cover.

Figure 6-7 illustrates the distribution of VOCs measured in soil vapor samples obtained from the MPE wells. As would be expected, highest vapor concentrations were detected in those areas of the site still exhibiting mobile PSH on the water table. Data submitted within the *2012 Report of Groundwater Remediation Activities* indicate that a total estimated mass of hydrocarbons removed by the remediation system during year 2012 was 19,202 pounds, or about 3,068 gallons.

7.0 SELECTION OF PREFERRED CORRECTIVE ACTION OPTION

In order to achieve the groundwater remedial objectives for the project, TW has been operating a multi-media remediation and treatment system able to address PSH via removal of VOCs in soil vapor, and address PSH and dissolved COCs in groundwater via total fluid recovery, with PSH separation for off-site disposal, and treatment of recovered groundwater prior to land application via irrigation. As discussed in **Section 6.2** above, SVE and MPE have proven effective in recovering hydrocarbons and decreasing the nature and areal extent of both the PSH and the dissolved VOCs. Based upon the physical and chemical setting within the Project Area, as well as the demonstrated effectiveness of the current remedy, the application of SVE and MPE remains the preferred corrective action option.

As discussed in **Section 8.0** below, additional effort will be placed in recovering mobile PSH using additional MPE wells, relocating pumps to areas continuing to exhibit MPE, and skimming if proven effective. When active remedial operations indicate that the apparent PSH thickness trend stabilizes and the volume recovered shows a diminishing trend and plume stability analyses indicate that the groundwater plume is stable or shrinking, TW will submit a request to shut down the active recovery and treatment system, and change from active remediation to monitoring of natural attenuation conditions in groundwater.

8.0 DESIGN CRITERIA TO MEET CLEANUP OBJECTIVES

8.1 Overview

The key limitation for the project to meet its remedial objective for groundwater is the continuing presence of PSH in the vicinity of the former Pits, an ongoing source of COCs to the dissolved groundwater plume. Despite a 55% decrease in extent, apparent PSH thickness in this area still ranges from approximately 2 to 6 feet thick during the October 2012 sampling event. In order to overcome this limitation, the ongoing remediation must remove PSH to the extent practicable by further focusing on those areas still exhibiting recoverable PSH. Therefore, the following work items have been planned to further enhance PSH recovery efforts:

1. Installation of four additional MPE wells in locations exhibiting recoverable levels of free product and relocation of pumps to optimize total fluid recovery;
2. Plugging and abandonment (P&A) of MPE Wells in areas no longer exhibiting PSH or elevated vapor concentrations which will allow efficient use of the existing equipment to power the new wells;
3. Re-location of existing recovery pumps in MPE wells to better target areas exhibiting mobile PSH;
4. Continued system optimization and selective remedial alternative evaluation in the field; and,
5. Continued plume stability and PSH analysis to support system optimization by responding to plume dynamics (i.e., follow location of center of mass, and address plume stabilization/shrinkage).

8.2 MPE Well Plugging and Abandonment

In order to focus removal efforts and resources to areas that continue to exhibit measureable PSH thicknesses, TW will continually assess recovery efficiency at each well. The purpose of this assessment is to identify wells where VOC recovery and PSH thickness have been steadily declining indicating a reduction of plume extent in that area, indicating that recovery is no longer efficient and/or needed.

In the April 2013 *Amended Investigative Work Plan*, TW is proposing to P&A six MPE wells (MPE-1 through MPE-6), which are located within Circuit A of the remedial system (see **Figure 2-2**). As shown in **Figure 6-1** and the soil vapor results illustrated in **Figure 6-7**, available data indicates that these wells are now outside of the area impacted by PSH. As VOC concentrations and PSH thickness continue to decline, TW will identify other wells that can be P&A. The required 30-day notifications, including submission of a well abandonment plan to the OCD and NMED, and intent to P&A monitoring wells notification to the New Mexico State Engineers Office will be provided in a timely manner. Methodologies for the currently proposed 30 day notice to P&A wells well P&A are discussed in the April 2013 *Amended Investigative Work Plan*, and also presented below for ease of reference. P&A methods and certification will be in accordance with Rules and Regulations Governing Well Driller Licensing; Construction, Repair and Plugging of Wells [19.27.4 NMAC].

The preferred method for well abandonment is to completely remove the well casing and screen from the borehole, overdrill the borehole, and backfill with a cement or bentonite grout, neat cement, or concrete. For wells with small diameter casing, abandonment shall be accomplished by overdrilling the well with a large diameter hollow-stem auger. After the well has been overdrilled, the well casing and grout can be lifted out of the ground with a drill rig, and the remaining filter pack can be drilled out. The open borehole can then be pressure grouted via a tremie pipe from the bottom of the borehole to the ground surface. After the grout has cured, the top two feet of the borehole shall be filled with concrete to insure a secure surface seal.

Several other well abandonment procedures are available for wells with larger diameter screens and casings and may be used at the Project Area. One method is to force a drill stem with a tapered wedge assembly or a solid-stem auger into the well casing and pull the casing out of the ground. However, if the casing breaks or the well cannot be pulled from the ground, the well will have to be grouted in place. To abandon a well in place, a tremie pipe shall be placed at the lowest point in the well (at the bottom of the screen or in the well sump). The entire well is then pressure grouted from the bottom of the well upward. The pressurized grout shall be forced out through the well screen into the filter pack and up the inside of the well casing sealing off all breaks and holes in the casing. Once the well is grouted, the casing is cut off even with the ground surface and covered with concrete.

If a PVC well cannot be abandoned due to internal casing damage (e.g., the tremie pipe cannot be extended to the bottom of the screen), it may be necessary to drill out the casing with a roller cone or drag bit using the wet rotary drilling method, or grind out the casing using a solid-stem auger equipped with a carbide tooth bit. Once the casing is removed, the open borehole can be cleaned out and pressure grouted from the bottom of the borehole upward.

Every attempt will be made to remove the entire riser pipe and screen at each well location; however, a field determination will be made for an alternative P&A method if total well removal is not possible.

Future proposed P&A activities will be documented in the *Annual Report* to be submitted for the site and occur in accordance with the methods outlined above.

8.3 Extraction Well Installation

Figure 8-1 illustrates the proposed locations for the new MPE wells to be installed within the Project Area. The proposed borings will be advanced using either air rotary (AR) or hollow stem augers (HSA) to an approximate depth of 75 feet below grade (bg), or ten feet into the lower confining layer to allow for a sump to place the pump. The locations will be direct bored to 50 feet bg; soil samples will be collected from approximately 50 feet bg to the bottom of the boring on a continuous basis in order to log the aquifer in these locations.

While it is not expected based on previous well installations at the site, if conditions arise or are encountered that do not allow the advancement of borings to the proposed depths, then as early as practicable the OCD/NMED will be notified and alternative drilling methods will be proposed.

In accordance with the design of past MPE wells, the new wells will be constructed of 4-inch diameter schedule 40 PVC pipe and will include, in ascending order, a flush-threaded silt trap (sump) at the bottom, 15 to 30 feet of flush-threaded 0.020-inch machine-slotted, high flow, PVC screen, and blank casing from the top of the screen to ground surface. Well installation will include a 10-20 mesh silica sand filter pack. The MPE wells will be completed as flush-mounted wells.

Soil from drilling cuttings and samples will be handled and disposed of in an appropriate manner. Cuttings and samples will be placed in drums at the boring location. A waste characterization sample will be collected from each location and analyzed for toxicity characteristic leaching procedure (TCLP) VOCs. These soils may be spread around the boring location if VOCs are not detected, or, if VOCs are detected, disposed of in an appropriate manner depending upon the results of the laboratory analyses.

Drilling equipment shall be in good working condition and capable of performing the assigned task. In addition, drilling equipment shall be properly decontaminated before drilling the first boring, and prior to drilling each subsequent boring. Downhole sampling equipment will be decontaminated between each discrete sampling interval.

The drilling and sampling shall be accomplished under the direction of a qualified engineer or geologist who shall maintain a detailed log of the materials and conditions encountered in each boring. Both sample information and visual conditions of the cuttings and core samples shall be recorded on the boring log. Known site features and/or site survey grid markers shall be used as references to locate each boring prior to surveying the location. The boring locations shall be measured to the nearest foot, and locations recorded on a scaled site map upon completion of each boring.

Relatively undisturbed discrete soil samples shall be obtained during the advancement of each boring for the purpose of logging and field screening purposes. A decontaminated split-spoon sampler lined with brass sleeves, a coring device, or other method approved by the OCD/NMED will be used to obtain samples during the drilling of each boring.

Samples obtained from all exploratory borings shall be visually inspected and the soil or rock type classified in general accordance with ASTM (American Society for Testing and Materials) D2487 (Unified Soil Classification System) and D2488 and/or AGI (American Geological Institute) Methods for soil and rock classification. Detailed logs of each boring shall be completed in the field by a qualified engineer or geologist. Additional information, such as the presence of water-bearing zones and any unusual or noticeable conditions encountered during drilling, shall be recorded on the logs. Field boring and field well construction diagrams shall be converted to the format acceptable for use in final reports submitted to the OCD/NMED.

Samples obtained from the borings shall also be screened in the field for evidence of the potential presence of COCs. Field screening results shall be recorded on the boring logs. The primary screening methods to be used shall include the following: (1) visual examination and (2) headspace vapor screening for VOCs. Visual screening will include examination of soil samples for evidence of staining caused by petroleum-related compounds or other substances that may cause staining of natural soils.

Headspace vapor screening targets VOCs and involves placing a soil sample in a plastic sample bag or a foil sealed container allowing space for ambient air. The container shall be sealed and then shaken gently to expose the soil to the air trapped in the container. The sealed container shall be allowed to rest for a minimum of 5 minutes while vapors equilibrate. Vapors present within the sample bag's headspace will then be measured by inserting the probe of the instrument in a small opening in the bag or through the foil. The maximum value and the ambient air temperature shall be recorded on the field boring or test pit log for each sample. The monitoring instruments shall be calibrated each day to the manufacturer's standard for instrument operation. A photo-ionization detector (PID) equipped with a 10.6 or higher electron volt (eV) lamp or combustible gas indicator shall be used for VOC field screening.

The borehole shall be bored, drilled, or augered as close to vertical as possible, and checked with a plumb bob, level, or appropriate downhole logging tool. A minimum two-inch annular space will be available between the edge of the boring and the placement of the well casing and screen. The two-inch annular space around the casing will allow the filter pack, bentonite seal, and annular grout to be placed at an acceptable thickness. Also, the two-inch annular space will allow up to a 1.5-inch outer diameter tremie pipe to be used for placing the filter pack, bentonite seal, and grout at the specified intervals.

It may be necessary to overdrill the borehole to create a sump so that any soils that have not been removed (or that have fallen into the borehole during augering or drill stem retrieval) will fall to the bottom of the borehole below the depth where the filter pack and well screen are to be placed. Normally, three to five feet is sufficient for overdrilling shallow wells. Deep wells may require deeper overdrilling. The borehole can also be overdrilled to allow for an extra space for a well sump to be installed. If the borehole is overdrilled deeper than desired, it can be backfilled to the designated depth with bentonite pellets or the filter pack. Immediately prior to well construction, the total depth of the borehole will be determined using a weighted steel tape or tag line.

The well casings (riser assembly) will be secured to the well screen by flush-jointed threads or other appropriate connections and placed into the borehole and plumbed by the use of centralizers, a plumb bob, or a level. No petroleum-based lubricating oils or grease shall be used on casing threads. Teflon tape or Teflon "O" rings can also be used to obtain a tight fit and minimize leakage. No glue of any type shall be used to secure casing joints.

Before the well screen and casings are placed at the bottom of the borehole, at least six inches of filter material shall be placed at the bottom to serve as a firm footing. The string of well screen and casing should then be placed into the borehole and plumbed. If centralizers are used, they shall be placed below the well screens and above the bentonite annular seals so that the placement of the filter pack, overlying bentonite seal, and annular grout will not be hindered. If installing the well screen and casings through hollow-stem augers, the augers shall be slowly extracted as the filter pack, bentonite seal, and grout are tremied or poured into place. The gradual extraction of the augers allows the materials being placed in the augers to flow out of the bottom of the augers into the borehole

Once the well casing has been lowered to the bottom of the borehole, a filter pack consisting of 12-20 silica sand will be poured down the annulus of the auger in a maximum of 3-foot lifts. This will ensure at least two inches of filter pack material is installed between the wall screen and the borehole wall. After each 3-foot interval is filled, the augers will be pulled up approximately the same distance. This procedure will be repeated until the filter pack level is approximately 2 feet above the top of the screened section. The filter pack will be installed in a manner that prevents bridging and particle-size segregation. Filter packs placed below the water table will be installed by the tremie pipe method. Filter pack materials will not be poured into the annular space unless the well is shallow (e.g., less than 30 feet deep) and the filter pack material may be poured continuously into the well without stopping. The precise volume of filter pack material required will be calculated and recorded before placement, and the actual volume used will be determined and recorded during well construction. Any significant discrepancy between the calculated and actual volume will be documented in the field notebook. The annular space between the well casing and the borehole will be properly sealed to prevent cross-contamination of samples and the groundwater. The materials used for annular sealants will be chemically inert with respect to the highest concentration of chemical constituents expected in the groundwater at the Project Area. The permeability of the sealing material shall be one to two orders of magnitude lower than the least permeable parts of the formation in contact with the well. The precise volume of annular sealants required will be calculated and recorded before placement, and the actual volume will be determined and recorded during well construction. Any significant discrepancy between the calculated volume and the actual volume will be documented in the field notebook.

The annular seal will consist of a high solids (10-30 percent) bentonite material in the form of bentonite pellets, granular bentonite, or bentonite chips. The bentonite seal will be placed in the annulus through a tremie pipe if the well is deep (greater than 30 feet), or by pouring directly down the annulus in shallow wells (less than 30 feet). If the bentonite materials are poured directly down the annulus (which is an acceptable method only in wells less than 30 feet deep); a tamping device will be used to emplace the seal at the proper depth and prevent the bentonite from bridging higher in the well casing. The bentonite seal will be placed above the filter pack a minimum of two feet vertical thickness. The bentonite seal will be allowed to completely hydrate in conformance with the manufacturer's specifications prior to installing the overlying annular grout seal. The time required for the bentonite seal to completely hydrate will differ with the materials used and the specific conditions encountered, but generally a minimum of four to 24 hours is required.

A grout seal will be installed on top of the filter pack annular seal. The grout seal may consist of a high solids (30 percent) bentonite grout, a neat cement grout, or a cement/bentonite grout consisting of approximately 3 percent bentonite by weight. The grout will be pumped under pressure (not gravity fed) into the annular space by the tremie pipe method, from the top of the filter pack annular seal to within a few feet of ground surface. The tremie pipe will be equipped with a side discharge port (or bottom discharge for grouting at depths greater than 100 feet) to minimize damage to the filter pack or filter pack annular bentonite seal during grout placement. The grout seal will be allowed to cure for a minimum of 24 hours before the concrete surface seal and surface pad are installed at the ground surface. All grouts will be prepared in accordance with the manufacturer's specifications. High solids (30 percent) bentonite grouts will have a minimum density of ten pounds per gallon (as measured by a mud balance) to ensure proper setup. Cement grouts will be mixed using six and one-half to seven gallons of water per 94-pound bag of Type I Portland cement. Bentonite (five to ten percent) may be added to delay the setting time and reduce the shrinkage of the grout.

A surface seal will be installed over the grout seal and extended vertically up the well annulus to the land surface. The lower end of the surface seal will extend a minimum of one foot below the frost line to prevent damage from frost heaving. The composition of the surface seal will be neat cement or concrete. These measures should include outfitting the protective structure with a steel lid or manhole cover that has a rubber seal or gasket, and ensuring that the bond between the cement surface seal and the protective structure is watertight.

A flush-mounted lid will be installed above the irrigation or utility vault to prevent damage or unauthorized entry. A cap will be placed on the well riser to serve as a connecting point for the pneumatic pumps and the vapor phase extraction; as well as to prevent tampering or the entry of foreign materials.

Wells will be developed to clean the filter pack around the well screen, correct damage to the formation caused by drilling, remove fine particles from the formation near the borehole, and assist in restoring the natural water quality of the aquifer in the vicinity of the well. Newly installed wells will not be developed for at least 48 hours after the surface pad and outer protective casing are installed, allowing sufficient time for the well materials to cure before the development procedures are initiated. A new well will be developed until the column of water in the well is free of visible sediment, and the pH, temperature, turbidity, and specific conductivity have stabilized. If the well remains turbid, continuous flushing over a period of several days may be necessary to complete the well development. If the well is pumped dry, the water level will be allowed to sufficiently recover before the next development period is initiated. One or more of the following methods will be used for developing the wells:

1. Pumping,
2. Over pumping,
3. Bailing, and/or
4. Surging.

Well development methods and equipment that alter the chemical composition of the groundwater will not be used.

If water is introduced to a borehole during well drilling and completion, then the same or greater volume of water will be removed from the well during development. In addition, the volume of water withdrawn from a well during development will be recorded. Water from development activities will be collected from each developed well and placed in the surge tank for the MPE system, with the water treated through air stripping and discharged through the irrigation system. As these wells are remediation wells, they will not need to be surveyed or sampled.

All information on the design, construction, and development of each well will be recorded in a field notebook and presented on a boring log, a well construction log, and well construction diagram.

If addition monitoring and/or remediation wells are required, the installation of such will occur in accordance with the methods outlined above.

8.4 Recovery Pump Relocation

In order to enhance removal of PSH in MPE wells, the location of total fluid recovery pumps will be evaluated annually (at a minimum) to focus recovery in areas with recurrent PSH presence and/or highest measurable thickness.

Currently, a total of ten pneumatic, total fluid pumps are located in MPE-12, MPE-14, MPE-20, MPE-23, MPE-23, MPE-27, MPE-28, MPE-32, MPE-33, MPE-36 and MPE-37. The 2012 gauging data indicates that, of these wells, five are outside the likely boundary of the area impacted by the PSH, including MPE-12, MPE-14, MPE-33, MPE-36 and MPE-37. Accordingly, the recovery pumps in MPE-37 and MPE-12 will remain in place as these locations are downgradient of the PSH plume, while the three remaining pumps will be moved to locations within the PSH plume including MPE-24, MPE-17, and MPE-31.

Additional pumps will be placed in the four new MPE wells for a total of 14 pneumatic pumps within the Project Area. Pump locations may be changed throughout the remediation effort to focus on those wells continuing to exhibit recoverable quantities of PSH.

8.5 Remediation Optimization

Remedial efforts in the Project Area will be implemented in a continuous improvement approach designed to optimize the removal of PSH to the extent practicable. The vapor removal lines will be monitored on a regular basis to increase the flow at those locations exhibiting high VOC concentrations and decrease flow at those locations with low VOC concentrations. Pump locations may be changed as necessary in order to keep pumps in MPE wells with the higher thicknesses of PSH. The need for additional pumps or extraction wells to increase the effectiveness of the system will be evaluated annually, with recommended actions included within the *Annual Report* for the project.

The optimization of system operations may also involve conducting short term field studies on various technologies in the Project Area. At the present, the use of an active skimming system is being evaluated for testing at the site. The system could run off batteries or solar power and be moved from well to well to recover PSH and minimize the recovery of associated groundwater. Additional technologies may be evaluated in the field as the project continues to progress. The description and results of these optimization field tests will also be included within the *Annual Report* for the project.

8.6 Plume Stability Analysis

Plume stability analysis will be performed periodically on groundwater data from the site using time-series analysis of the data according to the procedures described in *A Practical Method to Evaluate Ground Water Contaminant Plume Stability;* referred to as the Ricker Plume Stability Analysis. Ricker Plume Stability Analysis compares relative changes in contaminant plume characteristics, including area, average concentration, and mass. In order to demonstrate that a plume is stable, temporal changes in these calculated values should result in an overall decreasing or stable trend. An increasing trend in any of these values may indicate that the plume is not stable and/or is even expanding.

In addition to temporal trend analysis of plume characteristics, the center of plume mass is calculated. To further evaluate plume stability, the location of center of plume mass should be evaluated over time. Typically, a stable or decreasing plume does not show continual downgradient migration of center of mass over time. However, a stable plume could show the center of mass moving downgradient in instances, for example, when in-situ remediation occurred in the source area of a particular site. In this case, this downgradient shift would be due to the rapid loss of mass in the upgradient portion of plume, as opposed to a gradual migration resulting from groundwater transport.

The results of the plume stability analysis will be used to guide optimization of the soil vapor and groundwater/PSH components of recovery system, to identify areas where active remediation is no longer required. When active remediation is no longer required, TW will move either to monitored natural attenuation, or provide the OCD and NMED a site-specific risk assessment, as conditions at that time dictate. The results of the Ricker Plume Stability Evaluation will be included within the *Annual Report* for the project.

8.7 Operation and Maintenance

Operation and maintenance activities in the Project Area will continue according to the operating schedule previously approved and established for the project. During its period of operation, the soil vapor extraction system may shut down for a variety of reasons. As these situations arise, they are addressed by the team assigned to the project. In addition, the remediation system is anticipated to be updated to include an autodialer that will notify the Project Team when the system unexpectedly shuts down. The alarm conditions indicate an automatic alert to technical personnel who must manually rectify the condition prior to restarting the system. The Project Team will document any planned or unplanned shutdown of the systems of two days or less in the Annual Report on Groundwater Remediation.

Balancing of the system will be necessary on an intermittent basis to optimize the effectiveness of the system. Balancing the system will include flow adjustments to maintain the desired vapor flow gradients, optimize VOC removal rates, or stay within the design flow rates for the vapor treatment systems.

In the case of system failure leading to a release of PSH or groundwater from the treatment train, the procedures established by the *Health and Safety Plan* (HSP) for the project must be adhered to by personnel responding to the event. Appropriate notification to personnel and agencies for immediate response are included in the HSP. OCD and NMED will be notified in writing within 24 hours of any shutdown expected to last over two days.

OCD and NMED will be notified in the event that system failure or shutdown requires a major modification to the system to address the cause of the failure or shutdown. For minor modifications that do not significantly impact system operation, the Project Team will make the required modifications. For major modifications which require a significant change to system operation or approach, the Project will confer with OCD and NMED prior to making the required changes.

9.0 SCHEDULE

Figure 9-1 illustrates a tentative schedule for continuation of remedial activities within the Project Area. TW expects that remediation of the site to continue until mobile PSH is abated and the dissolved COCs in groundwater exhibit stability. TW expects that these activities to continue over a period of at least ten years.

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TABLES

TABLE 1.1
INITIAL COC DETERMINATION
TRANSWESTERN ROSWELL COMPRESSOR STATION NO. 9
ROSWELL, CHAVES COUNTY, NEW MEXICO

Class	Constituent	NMWQCC Criteria
BTEX (µg/L)	Benzene	10.0
	Toluene	750.0
	Ethylbenzene	750.0
	Xylenes (total)	620.0
Other VOCs (µg/L)	Methyl ethyl ketone (2-butanone)	none
	1,1-Dichloroethane	25.0
	1,2-Dichloroethane	10.0
	1,1-Dichloroethene	5.0
	1,2-Dichloroethene	none
	1,2,4-Trimethylbenzene	none
SVOCs (µg/L)	PAHs (Total Naphthalene + monomethylnaphthalenes)	30.0
	4-Methylphenol (p-Cresol)	none
Major Ions (mg/L)	TDS	1000.0
	Chloride	250.0
	Sulfate	600.0
	Nitrate (NO_2/NO_3 - $N_{,total)}$	10.0
	Calcium	none
	Potassium	none
	Magnesium	none
	Sodium	none
	Total Alkalinity (as $CaCO_3$)	none
Metals (mg/L)	Arsenic	0.1
	Barium	1.0
	Cadmium	0.01
	Chromium	0.05
	Copper	1.0
	Iron	1.0
	Lead	0.05
	Manganese	0.2
	Mercury	0.002
	Selenium	0.05
	Silver	0.05
	Zinc	10.0
	Aluminium	5.0

FIGURES

FILE NAME: \\emerald\Share\PROJECT FILES\Energy Transfer\Roswell\3-Amended RWP\CAD\Figure 1-1.dwg

LEGEND

N W E S

SCALE
FEET

0 3000 6000

TRANSWESTERN PIPELINE COMPANY
COMPRESSOR STATION NO. 9

ROSWELL, CHAVES COUNTY, NEW MEXICO

PROJ. NO: 02.2012037.00

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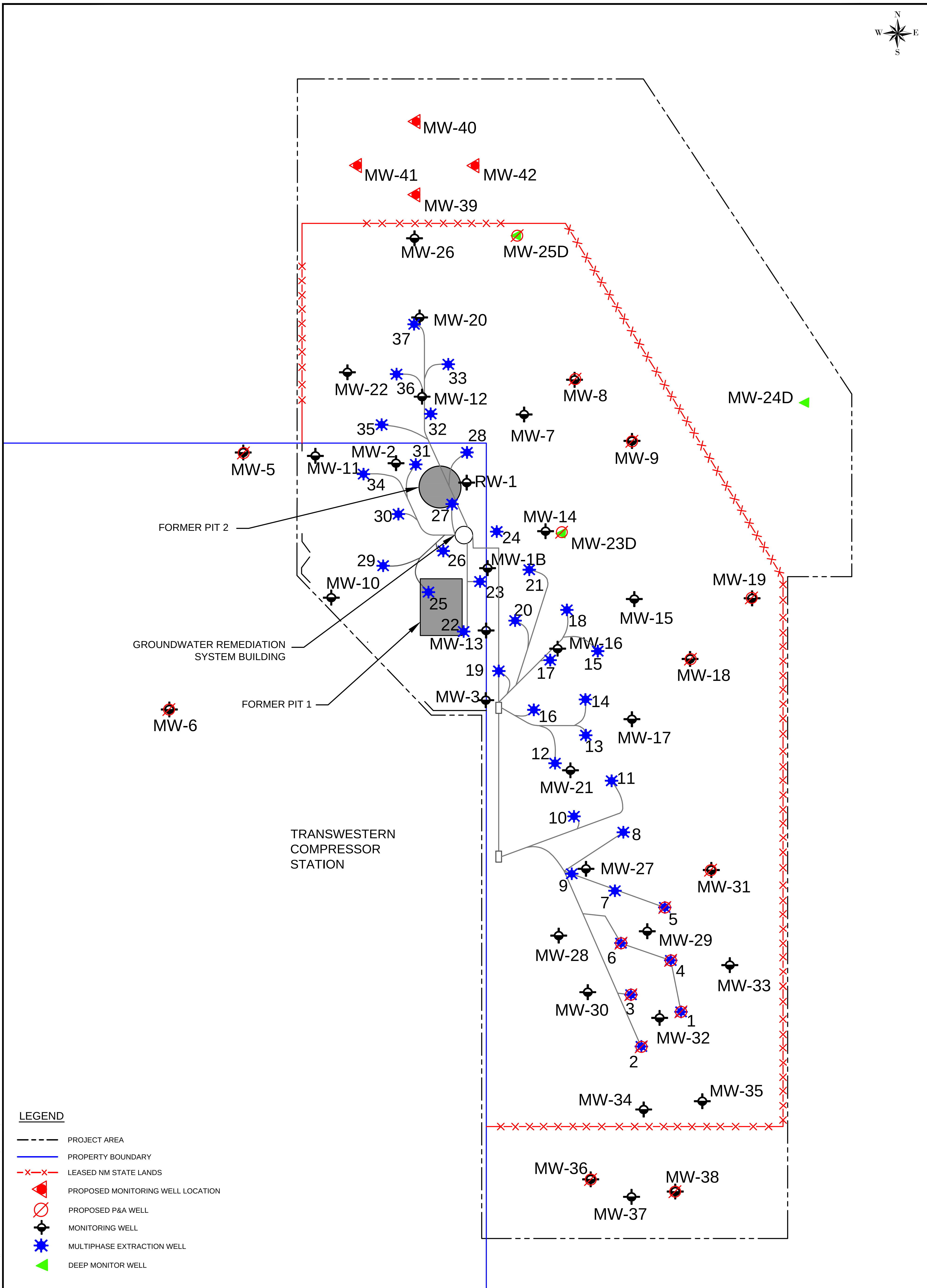
SITE LOCATION MAP

DRAWN:	CHECKED:	DATE:	FIGURE:
LDG	JDH	05/13	1-1

SOURCE: USGS TOPO MAPS/ROSWELL/MELENA/BITTER LAKE/PANTHER HILL



FROM: MAY 2013 INVESTIGATION WORK PLAN (FIGURE 2-2)

FILE NAME: \\emerald\Share\PROJECT FILES\Energy Transfer\Roswell\3-Amended RWP\CAD\Figure 1-2.dwg

SCALE FEET 0 75 150

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PROJECT AREA MAP

DRAWN:	CHECKED:	DATE:	FIGURE:
LDG	JDH	05/13	1-2

LEGEND

- PROPERTY BOUNDARY
- NM STATE LAND
- PIPELINE

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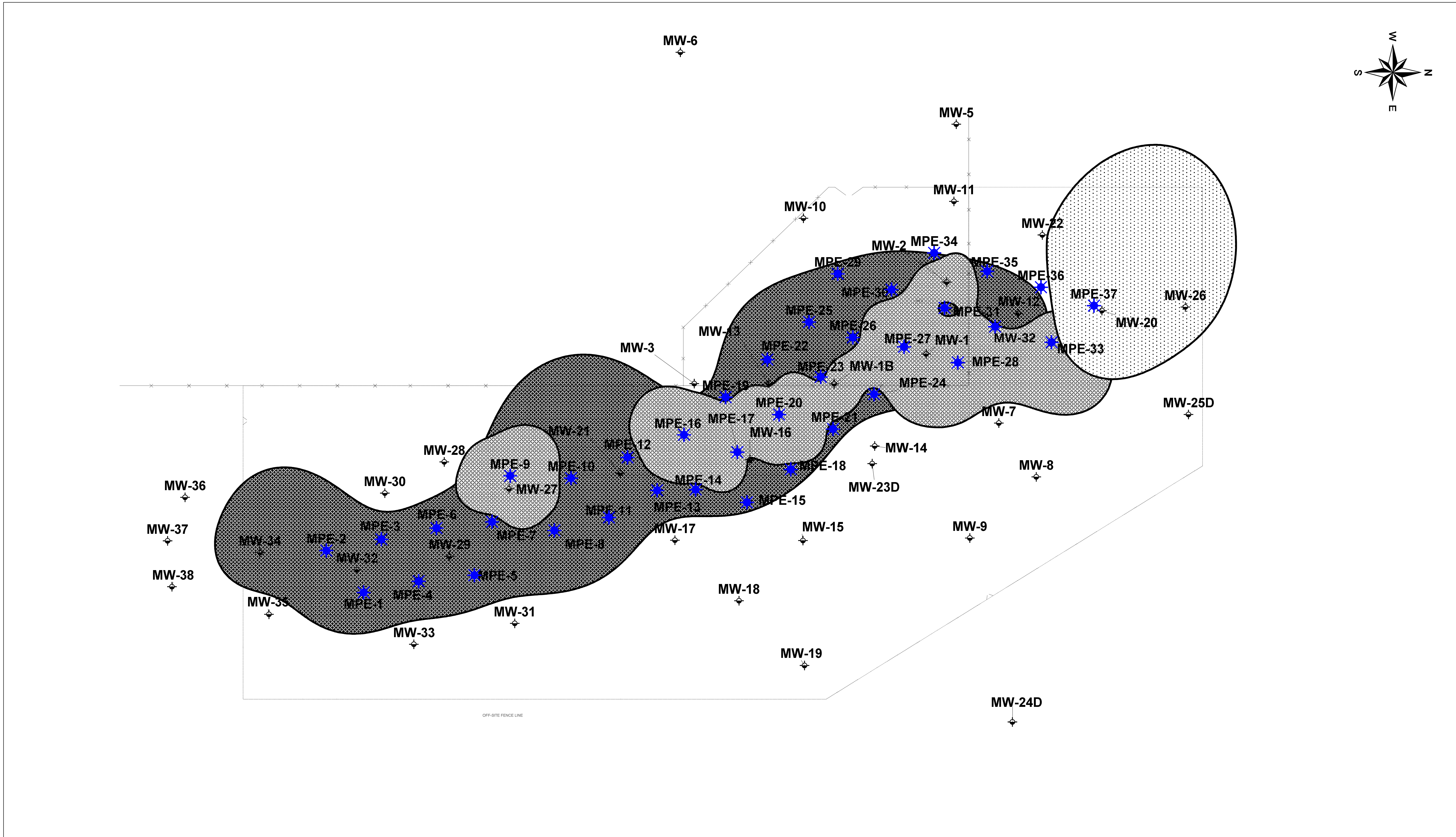
FACILITY MAP

DRAWN:	CHECKED:	DATE:	FIGURE:
LDG	JDH	05/13	2-1

FILE NAME: \\emerald\Share\PROJECT FILES\Energy Transfer\Roswell\3-Amended RWP\CAD\Figure 2-1.dwg

SOURCE: USGS TOPO MAPS/ROSWELL/MELENA/BITTER LAKE/PANTHER HILL



LEGEND

MW-4 Monitoring Well

MPE-31 Multi-Phase Extraction Well

2003 Extent of PSH

2003 Extent of Benzene Plume

2003 Extent of 1,1 - DCE Plume

SCALE

0 FT 75 FT 150 FT

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COMPRESSOR STATION NO. 9

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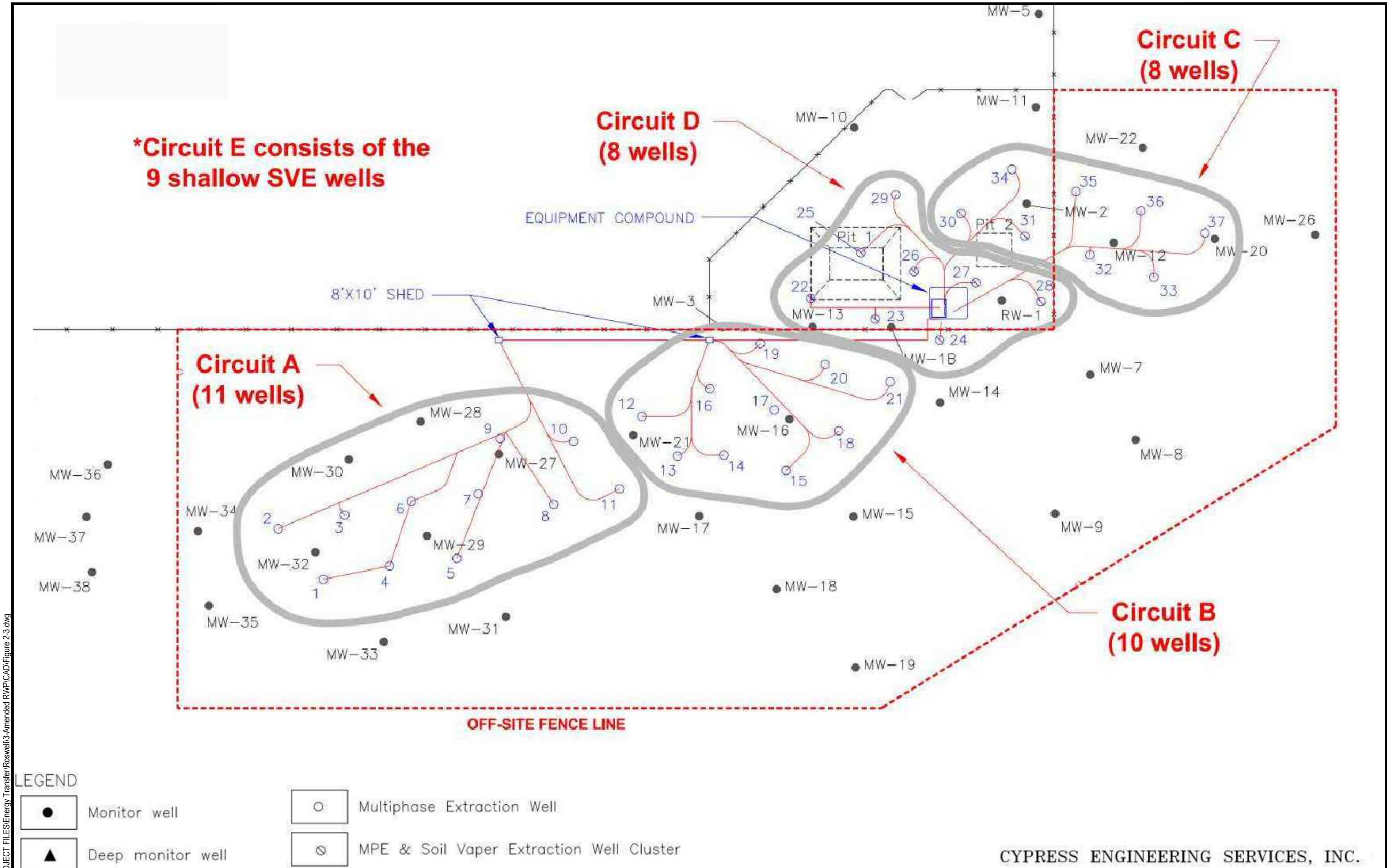
2003 EXTENT OF PSH, BENZENE, AND 1,1 - DCE

DRAWN:	CHECKED:	DATE:	FIGURE:
KMG	JDH	05/13	2-2

FILENAME:



FILE NAME: \\emerald\Share\PROJECT FILES\Energy Transfer\Roswell\3-Amended RWP\CAD\Figure 2-3.dwg

W
S N
E

SCALE
FEET
0 100 200

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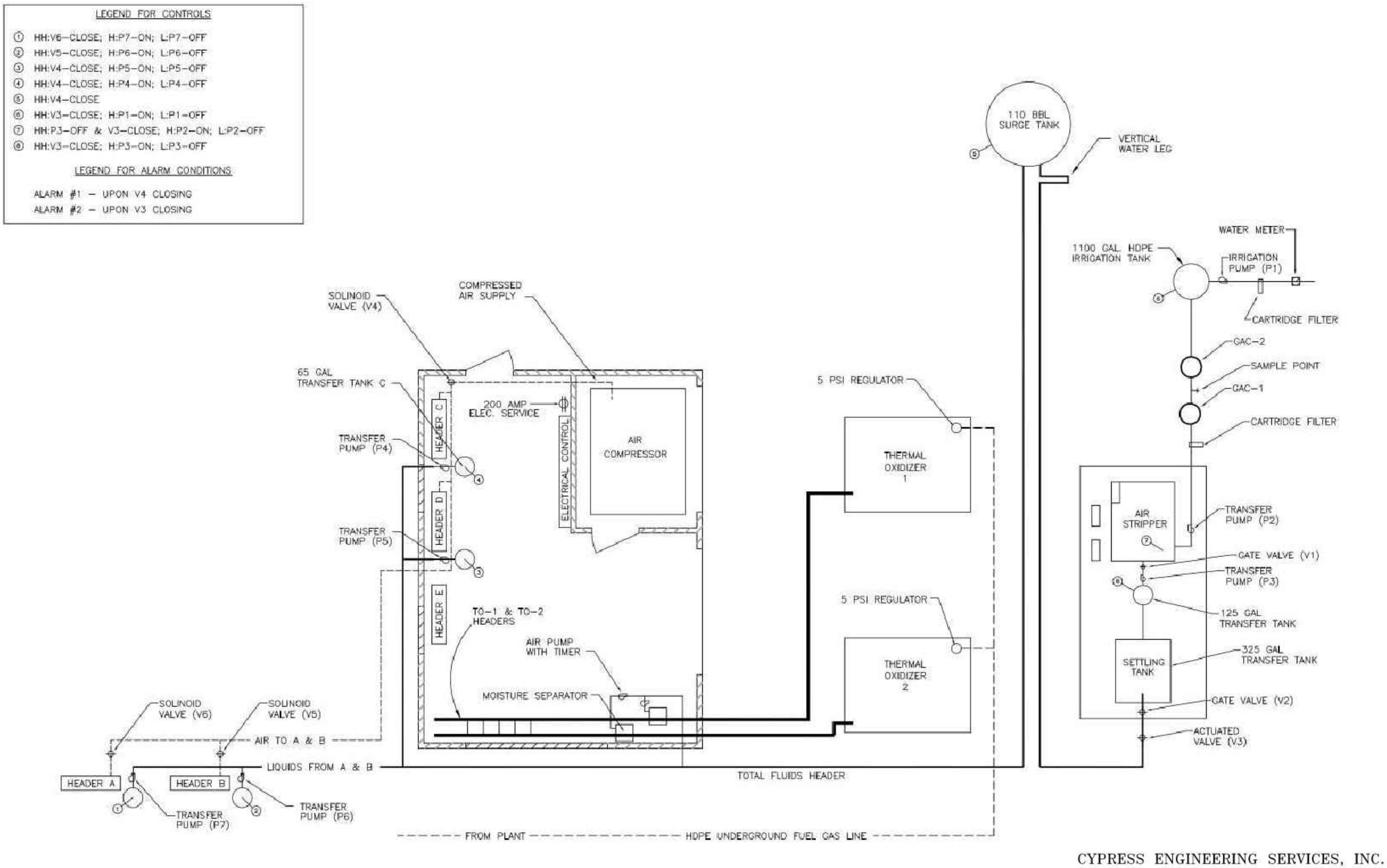
REMEDIATION SYSTEM LAYOUT

DRAWN: LDG	CHECKED: JDH	DATE: 05/13	FIGURE: 2-3

SOURCE: CYPRESS ENGINEERING SERVICES INC.



CYPRESS ENGINEERING SERVICES, INC.

0 Not to Scale

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COMPRESSOR STATION NO. 9

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PROJ. NO: 02.2012037.00

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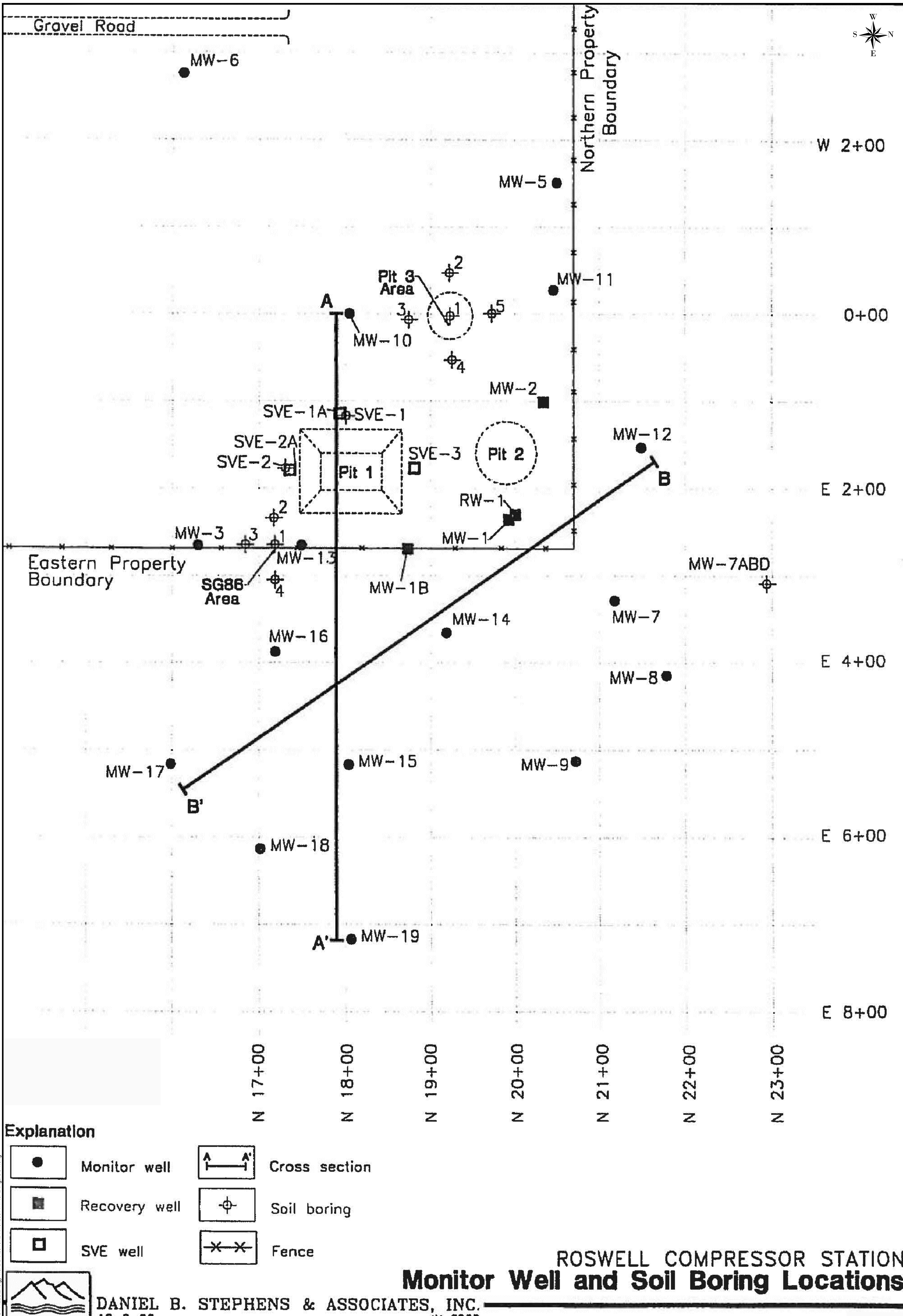
PROCESS DIAGRAM

DRAWN: LDG	CHECKED: JDH	DATE: 05/13	FIGURE: 2-4

FILE NAME: \\emerald\Share\PROJECT FILES\Energy Transfer\Roswell\3-Amended RWP\CAD\Figure 2-4.dwg

SOURCE: CYPRESS ENGINEERING SERVICES INC.



SCALE
FEET
0 50 100

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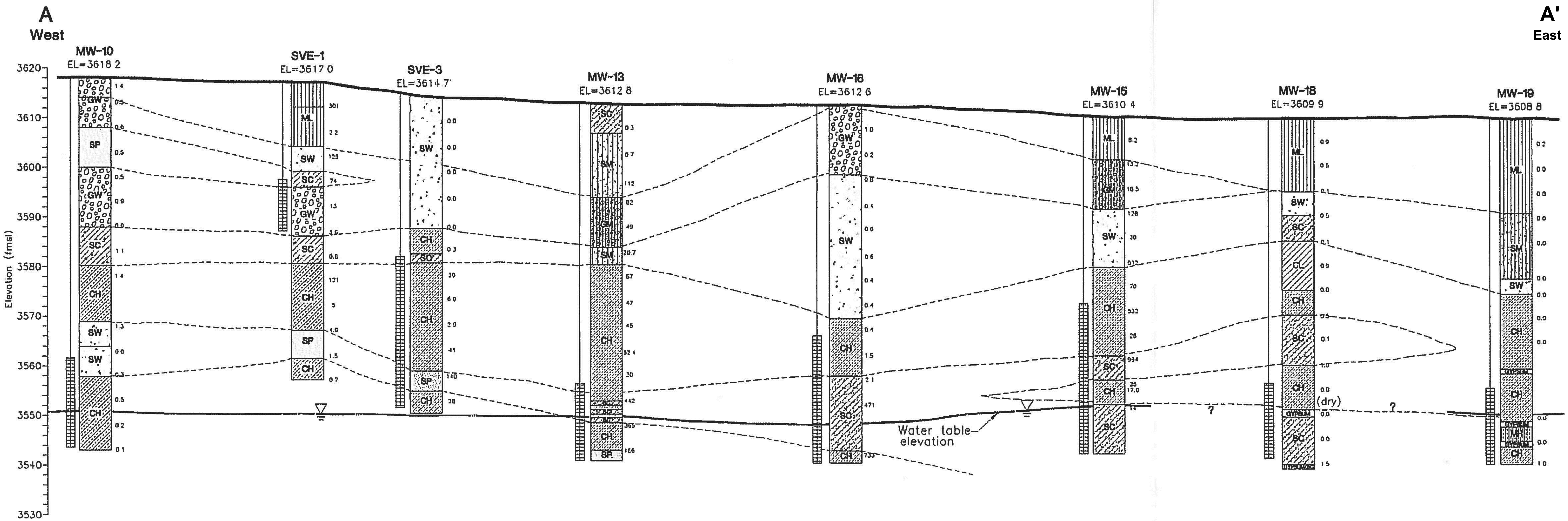
CROSS SECTION LINES

DRAWN:	CHECKED:	DATE:	FIGURE:
LDG	JDH	05/13	3-1

FILE NAME: \\emerald\Share\PROJECT FILES\Energy Transfer\Roswell\3-Amended RWP\CAD\Figure 3-1.dwg



Horizontal Scale: 1" = 50'
Vertical Scale: 1" = 20'

Ground surface

Well screen

Water table elevation (fmsl)

3 9 Organic vapor meter reading (ppmv)

Approximate contact between soil types

GYPSUM Gypsum

GW – Gravel, well graded, gravel-sand mixture, little or no fines

GM – Silty gravels, gravels-sand-silty mixtures

SW – Well graded sands, gravelly sand, little or no fines

SP – Poorly graded sands, gravelly sands, little or no fines

SM – Silty sands, sand-silt mixtures

SC – Clayey sands, sand-clay mixtures

ML – Inorganic silts and very fine sands, rock flour, silt or clayey fine sands, or clayey silt with slight plasticity

MH – Elastic silts, sandy silts, and clayey silts with low to moderate plasticity

CH – Inorganic clays of high plasticity

ROSWELL COMPRESSOR
Hydrogeologic Cross Section

DANIEL B. STEPHENS & ASSOCIATES, INC.
12-2-96 JN 6033

FILE NAME: \\emerald\Share\PROJECT FILES\Energy Transfer\Roswell\3-Amended RWP\CAD\Figure 3-2.dwg

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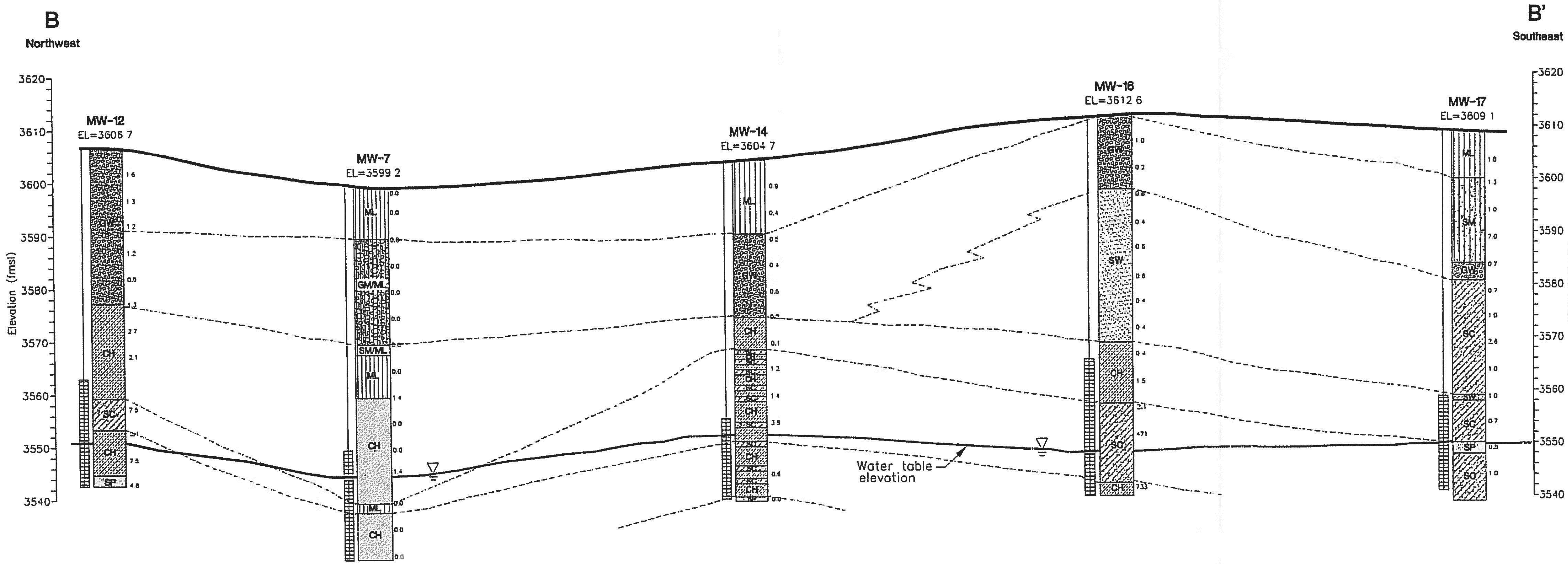
CROSS SECTION
A - A'

DRAWN: LDG | CHECKED: JDH | DATE: 05/13 | FIGURE: 3-2



Horizontal Scale: 1" = 50'
Vertical Scale: 1" = 20'

Ground surface

Well screen

Water table elevation (fmsl)

7 5 Organic vapor meter reading (ppmv)

Approximate contact between soil types

GYPSUM Gypsum

GW – Gravel, well graded, gravel–sand mixture, little or no fines

GM – Silty gravels, gravels–sand–silty mixtures

SW – Well graded sands, gravelly sand, little or no fines

SP – Poorly graded sands, gravelly sands, little or no fines

SM – Silty sands, sand–silt mixtures

SC – Clayey sands, sand–clay mixtures

ML – Inorganic silts and very fine sands, rock flour, silt or clayey fine sands, or clayey silt with slight plasticity

CH – Inorganic clays of high plasticity

ROSWELL COMPRESSOR STATION

Hydrogeologic Cross Section B-B'

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12-2-96 JN 6033

FILE NAME: \\emerald\Share\PROJECT FILES\Energy Transfer\Roswell\3-Amended RWP\CAD\Figure 3-3.dwg

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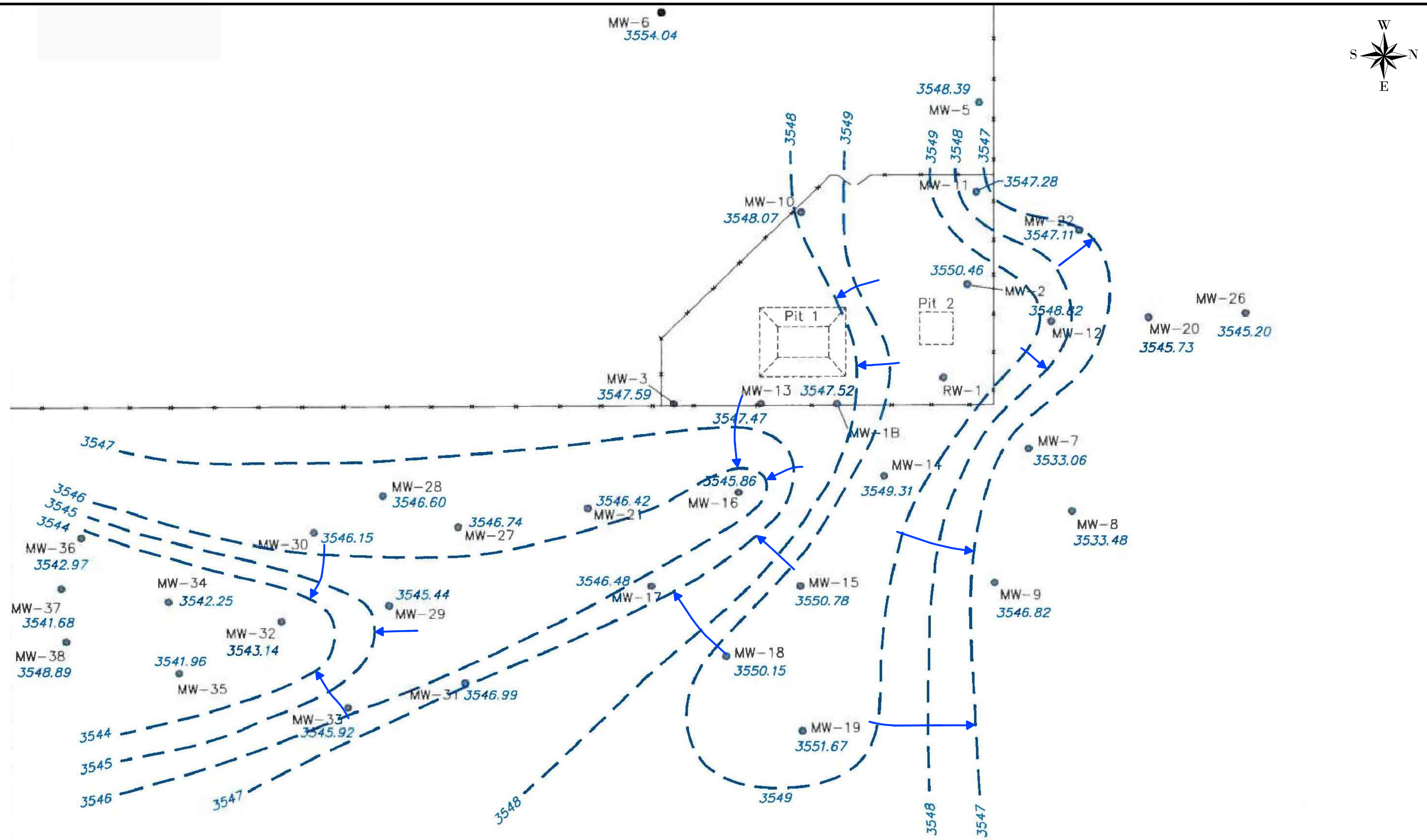
CROSS SECTION
B - B'

DRAWN:	CHECKED:	DATE:	FIGURE:
LDG	JDH	05/13	3-3



LEGEND

●	Monitor well
▲	Deep monitor well
○	Multiphase Extraction Well
⊘	MPE & Soil Vaper Extraction Well Cluster
3551.97	Water level elevation (ft msl) (Note: *NM* = Not Measured)
3549	Elevation contour (ft msl)

CYPRESS ENGINEERING SERVICES, INC

ROSWELL STATION REMEDIATION SITE

Groundwater Surface Elevations in the Uppermost Aquifer

October 15, 2012

SCALE
FEET

0 100 200

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ROSWELL, CHAVES COUNTY, NEW MEXICO

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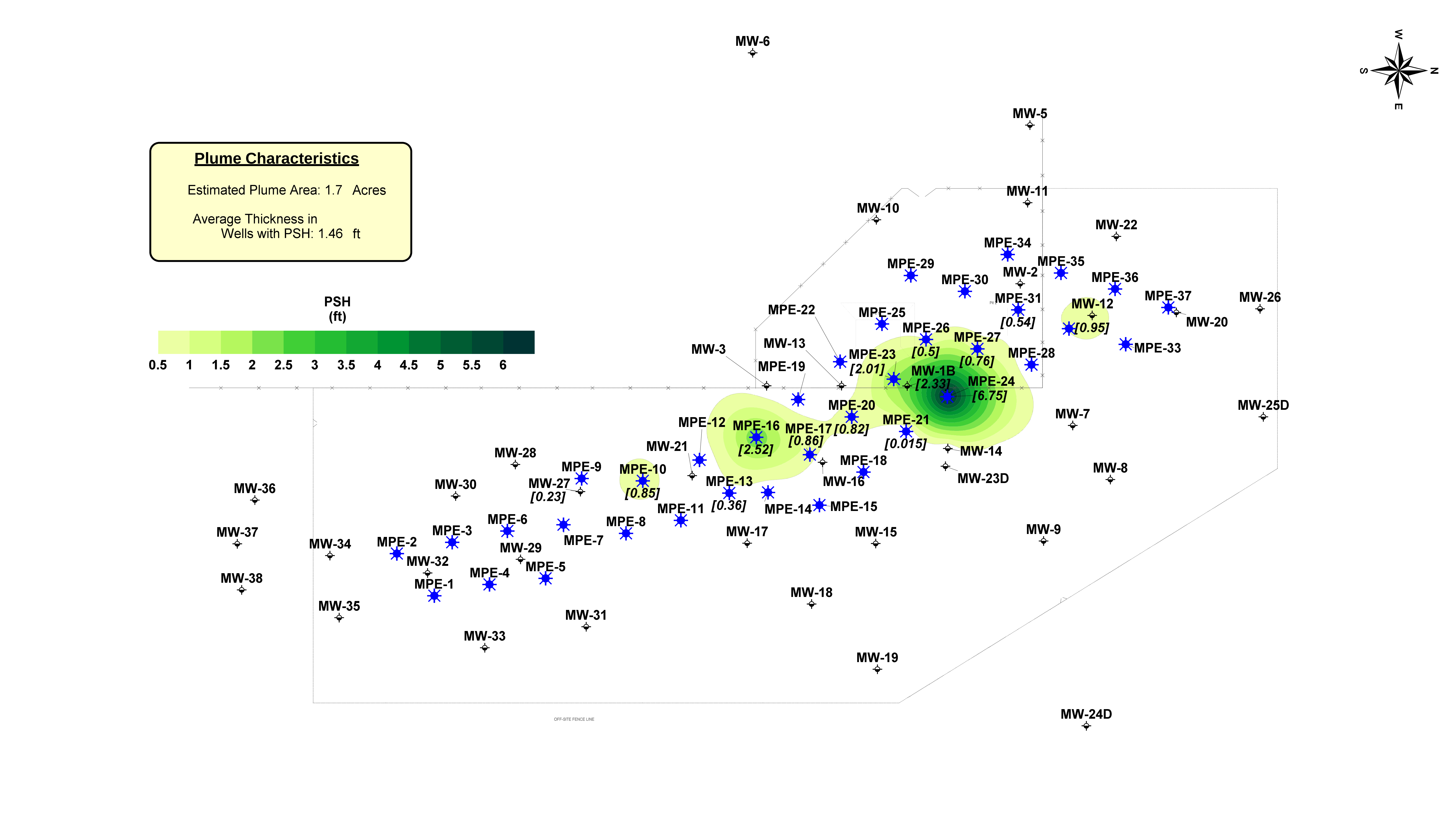
OCTOBER 2012
GROUNDWATER FLOW MAP
(MODIFIED CES MAP WITH FLOW LINES)

DRAWN:	CHECKED:	DATE:	FIGURE:
LDG	JDH	05/13	3-4

FILE NAME: \\emerald\Share\PROJECT FILES\Energy Transfer\Roswell\3-Amended RWP\CAD\Figure 3-4.dwg



LEGEND

MW-4 [3.00] Monitoring Well with PSH Thickness (ft)

MPE-31 [2.52] Multi-Phase Extraction Well with PSH Thickness (ft)

SCALE

0 FT 75 FT 150 FT

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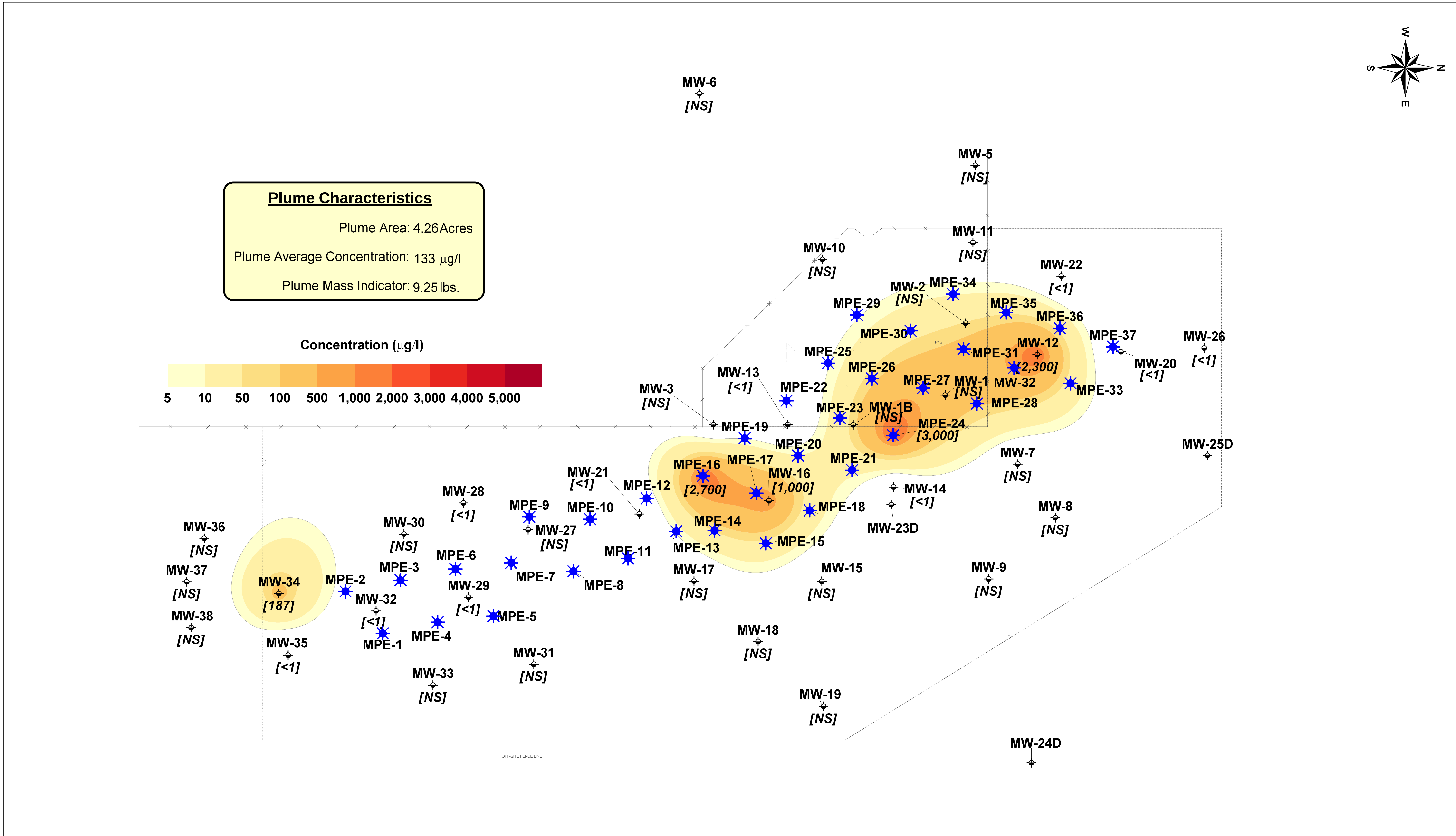
OCTOBER 2012 EXTENT OF PSH

DRAWN: KMG	CHECKED: JDH	DATE: 05/13	FIGURE: 6-1

FILENAME:



LEGEND

MW-4 [300] Monitoring Well and Concentration (µg/l)

[NS] Well Not Sampled

MPE-31 [250] Multi-Phase Extraction Well and Concentration (µg/l)

SCALE

0 FT 75 FT 150 FT

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COMPRESSOR STATION NO. 9

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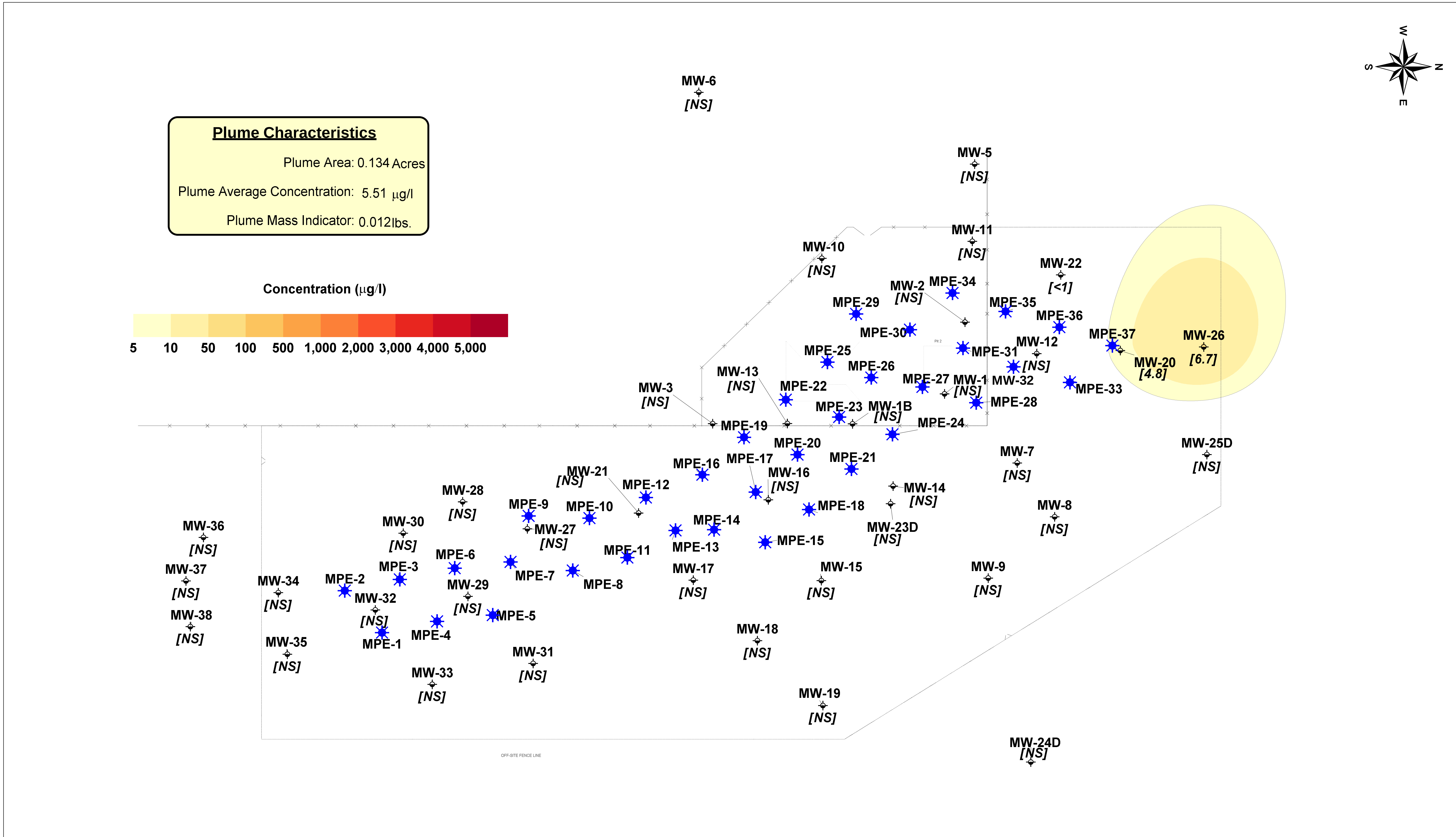
ESTIMATED EXTENT OF BENZENE BASED UPON 2012 AVERAGED CONCENTRATIONS

DRAWN:	CHECKED:	DATE:	FIGURE:
KMG	JDH	05/13	6-2

FILENAME:



LEGEND

MW-4 [300] Monitoring Well and Concentration (µg/l)

MPE-31 [250] Multi-Phase Extraction Well and Concentration (µg/l)

[NS] Well Not Sampled

SCALE

0 FT 75 FT 150 FT

TRANSWESTERN PIPELINE COMPANY
COMPRESSOR STATION NO. 9

ROSWELL, CHAVES COUNTY, NEW MEXICO

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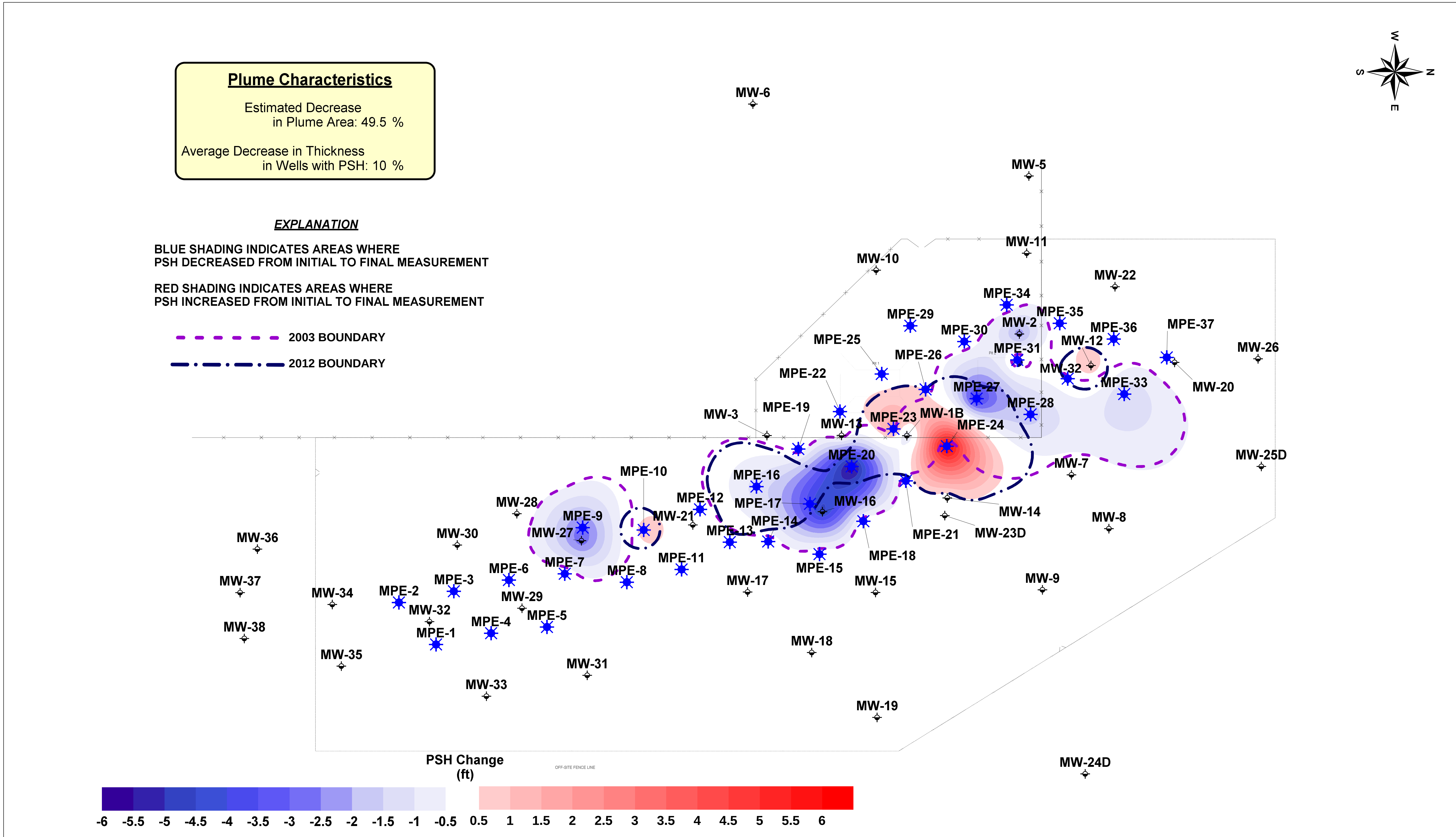
ESTIMATED EXTENT OF 1,1-DCE
BASED UPON 2012
AVERAGED CONCENTRATIONS

DRAWN:	CHECKED:	DATE:	FIGURE:
KMG	JDH	05/13	6-3

FILENAME:



LEGEND

MW-4 Monitoring Well

MPE-31 Multi-Phase Extraction Well

SCALE

0 FT 75 FT 150 FT

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COMPRESSOR STATION NO. 9

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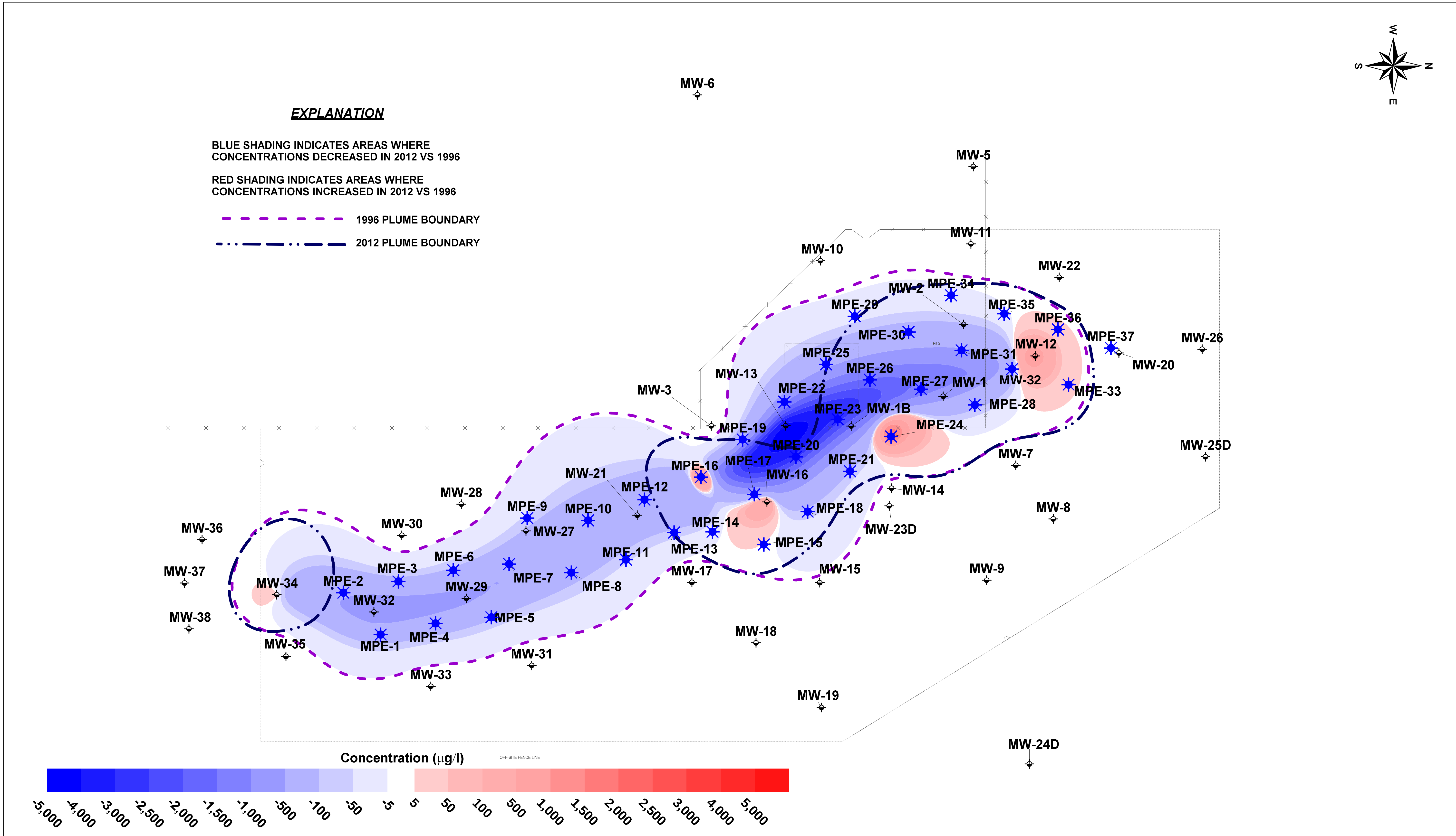
CHANGE IN EXTENT OF PSH

DRAWN:	CHECKED:	DATE:	FIGURE:
KMG	JDH	05/13	6-4

FILENAME:



LEGEND

MW-4 Monitoring Well

MPE-31 Multi-Phase Extraction Well

SCALE

0 FT 75 FT 150 FT

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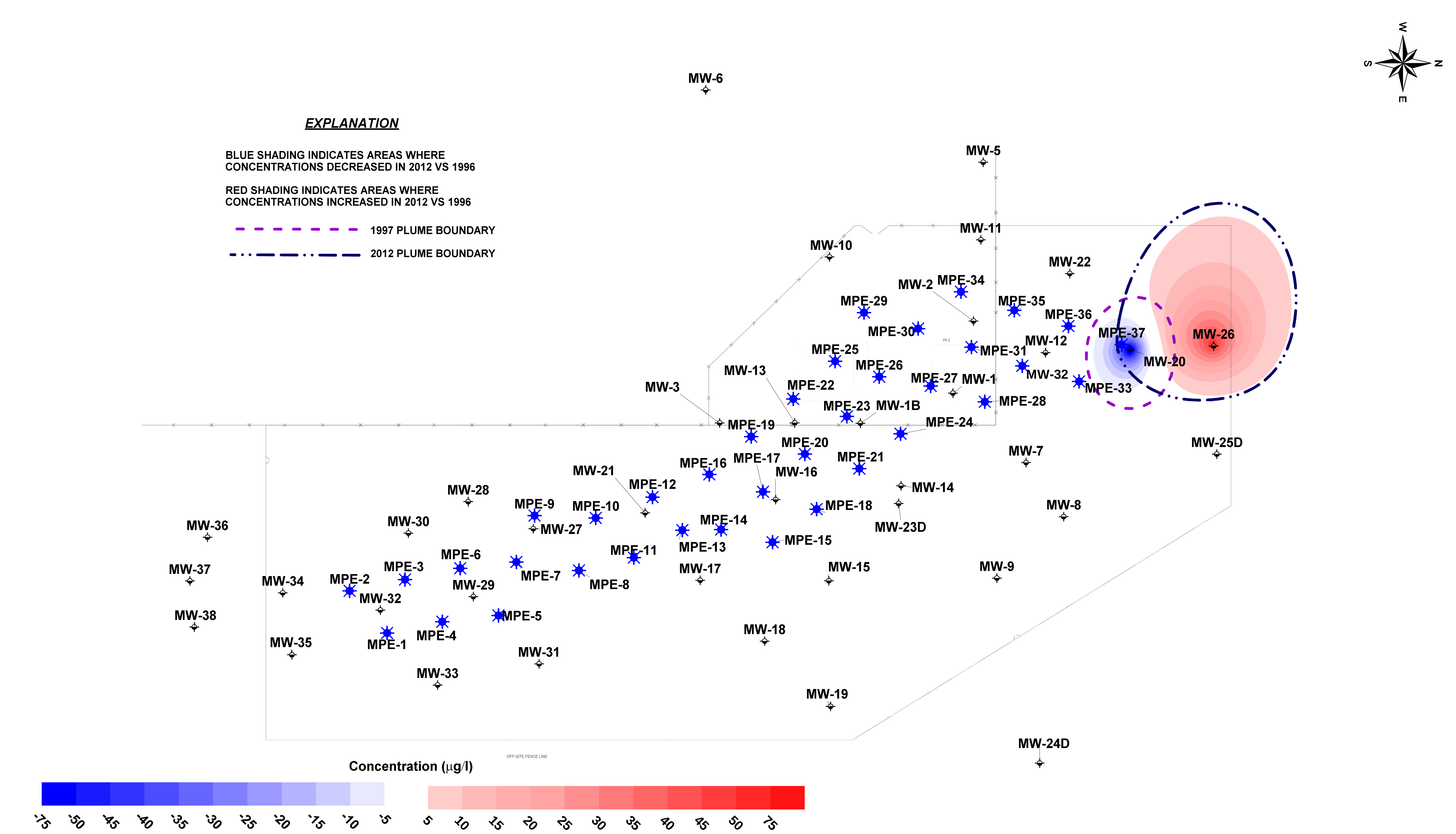
CHANGE IN EXTENT OF BENZENE

DRAWN:	CHECKED:	DATE:	FIGURE:
KMG	JDH	05/13	6-5

FILENAME:



LEGEND MW-4 Monitoring Well

MPE-31 Multi-Phase Extraction Well

SCALE

0 FT 75 FT 150 FT

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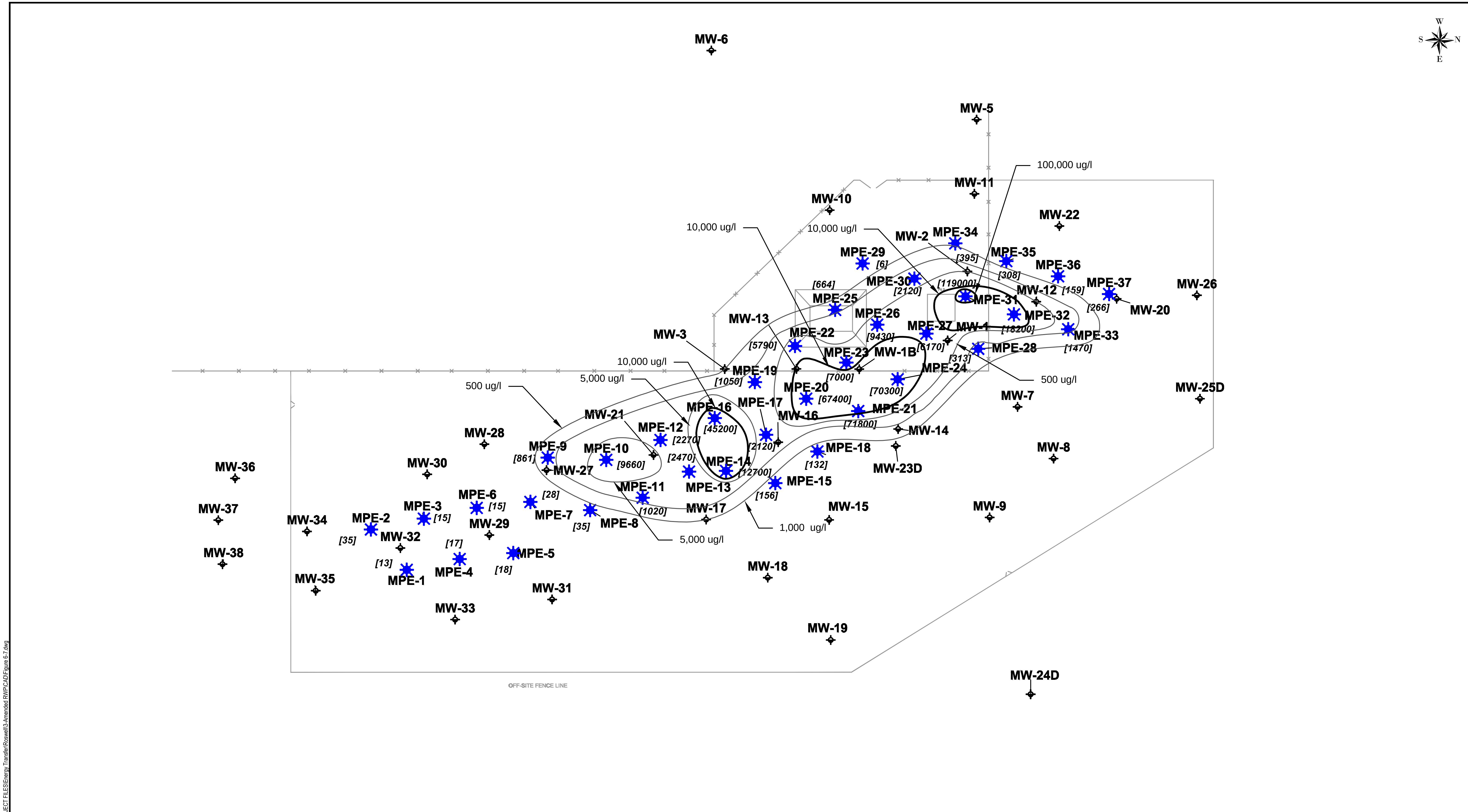
CHANGE IN EXTENT OF 1,1 - DCE

DRAWN:	CHECKED:	DATE:	FIGURE:
KMG	JDH	05/13	6-6

FILENAME:



FILE NAME: \\emerald\Share\PROJECT FILES\Energy Transfer\Roswell\3-Amended RWP\CAD\Figure 6-7.dwg

LEGEND

- Monitoring Well
- Multi-Phase Extraction Well
- *[300]* Soil Vapor Concentration (ug/l)

SCALE
FEET
0 75 150

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COMPRESSOR STATION NO. 9

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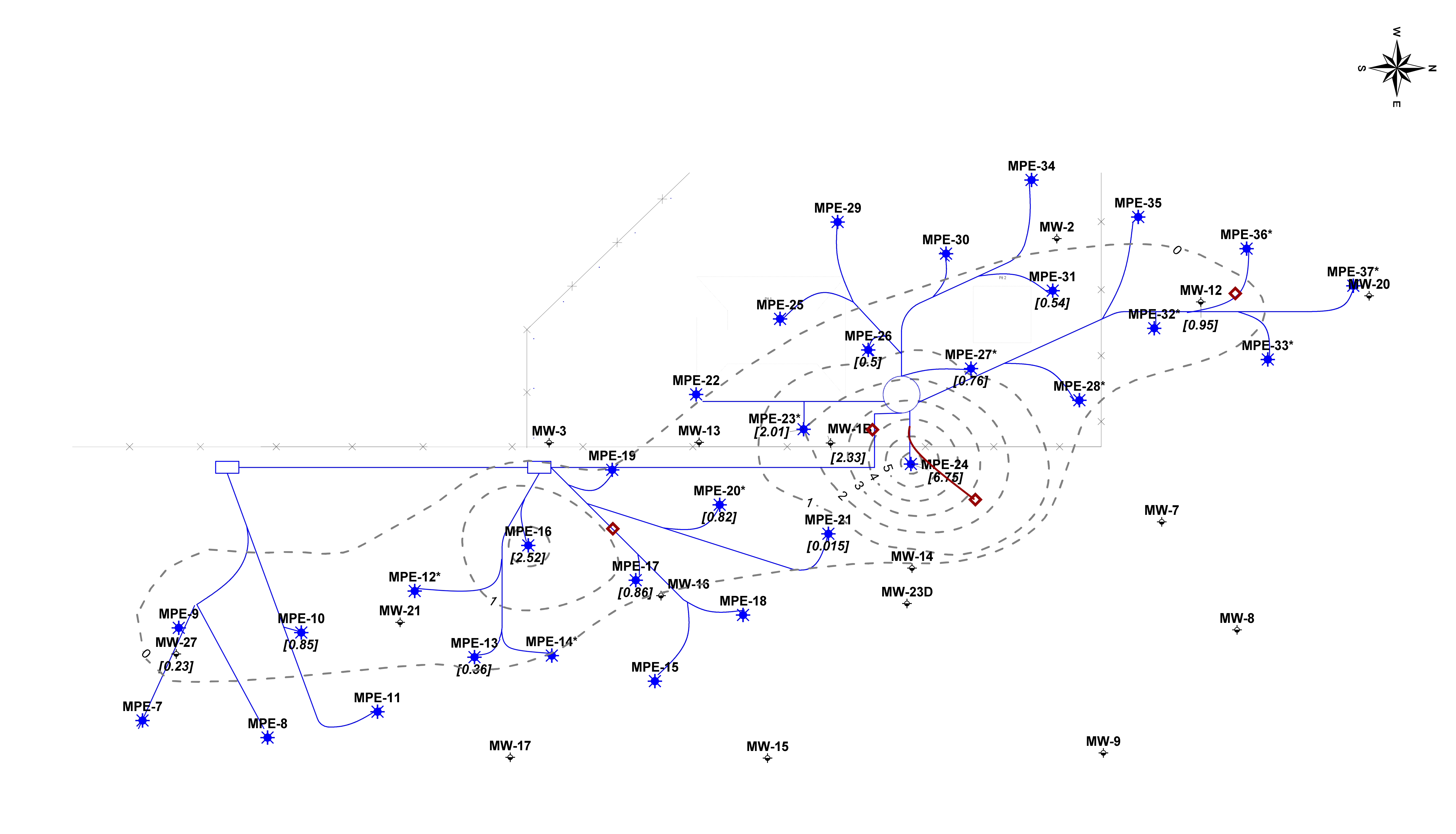
OCTOBER 2012
MPE VAPOR CONCENTRATIONS

DRAWN:	CHECKED:	DATE:	FIGURE:
LDG	JDH	05/13	6-7

SOURCE:



LEGEND MW-4 [300] Monitoring Well with PSH Thickness (ft)

MPE-31 [2.52] Multi-Phase Extraction Well with PSH Thickness (ft)

Proposed Well Location and Recovery Line

Recovery Line

PSH Thickness Contour

SCALE

0 FT 37.5 FT 75 FT

Note: * by Well ID means a pump is in the well

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ROSWELL, CHAVES COUNTY, NEW MEXICO

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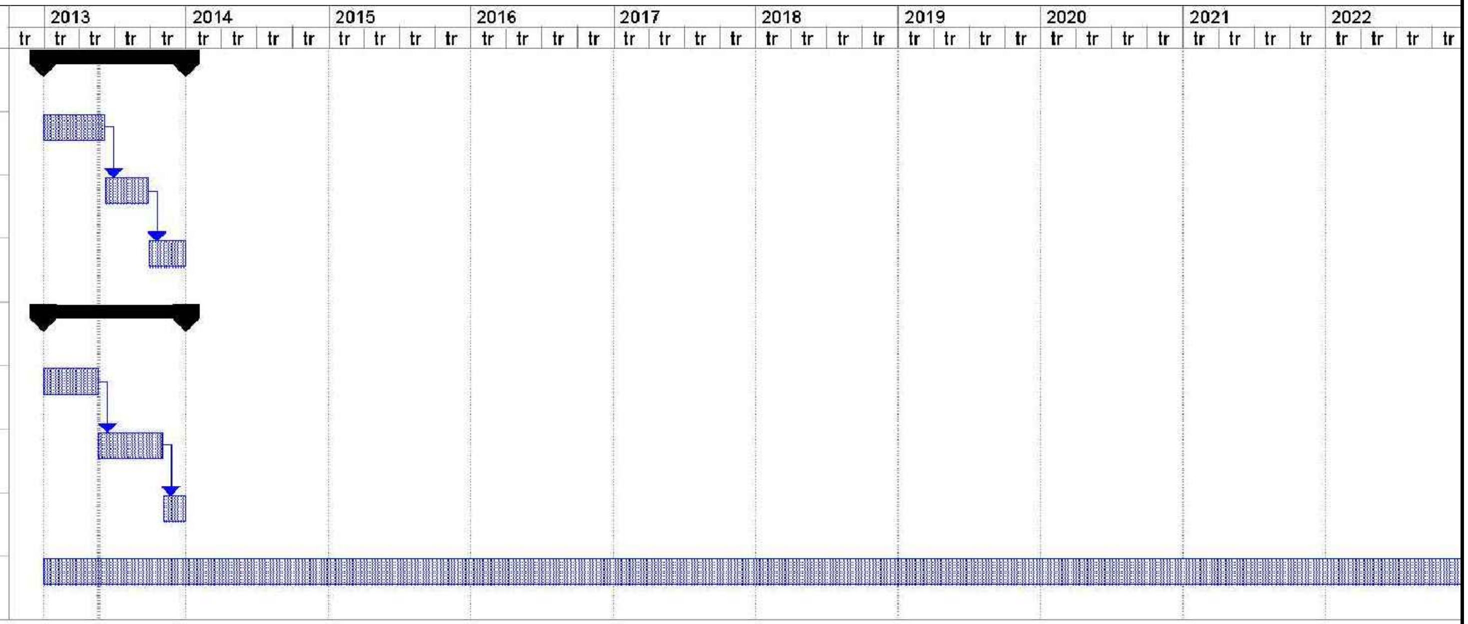
PROPOSED LOCATIONS
FOR NEW MPE WELLS

DRAWN:	CHECKED:	DATE:	FIGURE:
KMG	JDH	05/13	8-1

FILENAME:

ID	Task Name
1	**Delineation Investigation**
2	Amended IWP & Permits
3	Well Installation, P&A, and Sampling
4	Report
5	**Corrective Measures**
6	Amended RWP
7	System Adjustments
8	Reporting
9	Operation, Maintenance, Annual Reporting



LEGEND

Task

Split

Progress

Milestone

Summary

Project Summary

External Tasks

External Milestone

Deadline

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COMPRESSOR STATION NO. 9

ROSWELL, CHAVES COUNTY, NEW MEXICO

PROJ. NO: 02.2012037.00

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PROJECT SCHEDULE

DRAWN: LDG | CHECKED: JDH | DATE: 05/13 | FIGURE: 9-1

FILENAME: \\emerald\Share\PROJECT FILES\Energy Transfer\Roswell\3-Amended RWP\CAD\Figure 9-1.dwg

SOURCE: