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Addendum to Alternate Abatement Standard Petition (AP-112)

Empire Abo Gas Plant, Unit I (NE/4, SE/4), Section 3, Township 18S, Range 27E
Eddy County, New Mexico

Letter of determination sent to operator. Received for the record.

Prepared for:

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1.0 EXECUTIVE SUMMARY

Aka Energy Group LLC (Aka Energy), a wholly owned subsidiary of Southern Ute Indian Tribe Growth Fund (SUGF), submits this addendum for the Empire Abo Plant (GW-022) located in Eddy County, New Mexico, in response to comments from the New Mexico Oil Conservation Division (NMOCD) following review of an alternate abatement standard petition submitted to NMOCD on March 26, 2023. This addendum addresses three (3) points in an undated letter including the following:

- **19.15.30.9 (F) (a): either compliance with the abatement standards is not feasible, by the maximum use of technology within the responsible person's economic capacity; or there is no reasonable relationship between the economic and social costs and benefits, including attainment of the standards set forth in 19.15.30.9 NMAC to be obtained.**

- **19.15.30.9 (F) (b): the proposed alternative standards are technically achievable and cost-benefit justifiable.**

- **19.15.30.9 (F) (c): compliance with the proposed alternative abatement standard will not create a present or future hazard to public health or undue damage to property.**

The following conclusions and recommendations are in response to the NMOCD letter for consideration of discontinuing groundwater and light nonaqueous phase liquid (LNAPL) and dissolved hydrocarbon (BTEX) abatement at the Facility.

19.15.30.9 (F) (a)

- SVE technology employed by Aka Energy, more than any other past owner/operator combined, has greatly reduced the LNAPL beneath the Facility to the maximum extent possible and decreased the dissolved hydrocarbon (benzene) concentrations below the NMWQCC human health standard in all but three (3) monitoring wells.
- The saturated thickness of the shallow (perched) groundwater decreases east, west, and south beyond the Facility that makes the groundwater unrecoverable in quantities for domestic and agriculture including livestock use.
- TDS concentrations in the shallow (perched) groundwater exceed 10,000 mg/L over the majority of the area north of the Facility that coincides with the area of greatest saturated thickness and is not subject to regulation by the State of New Mexico under NMAC 20.6.2.3103.
- Sulfate concentrations in the shallow (perched) groundwater from dissolution of naturally occurring minerals in the Tansill Formation exceed 1,500 mg/L throughout the shallow (perched) groundwater, except monitoring well MW-08 near the southwest corner of the Facility and is therefore not suitable for livestock (cattle) due to the risk of temporary diarrhea in cattle, that contributes significantly to total sulfur intake, and causes reduction in copper availability.
- Sulfate concentrations in the shallow (perched) groundwater from dissolution of naturally occurring minerals in the Tansill Formation exceed 4,500 mg/L over the majority of the area north of the Facility is therefore not suitable for livestock (cattle) due to the risk of sulfur associated polio.
- There is no economic or social benefit to recover the residual LNAPL ($31,472,517.28) for shallow (perched) groundwater that covers an area of about 142.34 acres.

Recommendation

- Due to the above factors, Aka Energy does not believe that the shallow (perched) groundwater requires any further protection, or additional abatement. Aka Energy requests NMOCD to approve closure under natural attenuation to leave approximately 146,896.23 gallons or about 3,486.52 bbl unrecovered in the capillary beneath the Facility, as with 2RP-022.

19.15.30.9 (F) (b)

- Other viable remediation methods including pneumatic (skimmer) pumps, absorbent socks, total fluid pumps groundwater depression), and a recovery trench coupled with product separation and groundwater treatment air stripping) were extensively used by the previous owners/operators at the Facility and proved ineffective and inefficient for reducing the LNAPL thickness and/or decreasing the dissolved hydrocarbon (BTEX) concentrations.
- LAI personnel quantified by laboratory analysis that SRB are present in the shallow (perched) groundwater and actively metabolizing the dissolved hydrocarbons emanating from the residual LNAPL.
- It has also been demonstrated that the shallow (perched) groundwater is vertically discontinuous with no groundwater encountered below the perched groundwater for 200 feet and terminates or pinches out laterally between about 550 feet (south) and 1,500 feet (north) from the Facility.

Recommendation

- AKA Energy requests NMOCD to approve natural attenuation and microbial degradation by indigenous SRB as the viable option for abating the residual LNAPL and dissolved hydrocarbons (BTEX) in the shallow (perched) groundwater at the Facility.

19.15.30.9 (F) (c)

- Investigations performed by Amoco and by LAI on behalf of Aka Energy have demonstrated that the shallow (perched) groundwater is laterally and vertically delineated over an area measuring approximately 142.34 acres with about 41.94 percent occurring beneath federal (BLM) land, about 23.83 percent occurring beneath the Facility, and approximately 25.62 percent beneath State of New Mexico (SLO) land.
- The shallow (perched) groundwater pinches out approximately 1,500 feet north of the Facility, about 660 feet west of the Facility, about 1,000 feet east of the Facility and about 550 feet south of the Facility. The saturated thickness diminishes to 0 feet (south), 0.41 feet (north), 0.35 feet (west), and thins to less than 5 to 10 feet east of the Facility.
- The diminishing saturated thickness prevents the shallow (perched) groundwater from being used as a domestic or livestock resource and prohibits the potential for inorganic contaminants to continue to migrate.
- The shallow (perched) groundwater has been monitored for inorganic contaminants including RCRA metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver), sulfate, chloride, and TDS since 2006.
- Arsenic and chromium are the only RCRA metals reported in groundwater samples at concentrations above the NMWQCC human health standards of 0.1 mg/L and 0.05 mg/L, respectively.

- Arsenic was only reported above the NMWQCC human health standard (0.1 mg/L) in one (1) monitoring well (P-01) at 0.118 mg/L.
- Chromium was reported above the NMWQCC human health standard (0.05 mg/L) in groundwater samples from three (3) wells (MW-02-03, MW-07 and EB-06) at concentrations of 0.0651 mg/L, 0.057 mg/L and 0.0676 mg/L, respectively.
- The highest chromium value (0.076 mg/L) was reported in the background and hydraulically up gradient well (EB-06).
- The metal constituents (arsenic and chromium) are not pervasive throughout the shallow (perched) groundwater and do not pose a risk to the State of New Mexico water resources, or the environment.
- On May 3, 2019, NMOCD (Bradford Billings communication) approved Aka Energy's request to delete metals from groundwater monitoring at the Facility.
- TDS in the shallow (perched) groundwater exceeds 10,000 mg/L over an area including the north side to about 1,200 feet north of the Facility or about 1,086,561 square feet or about 25 acres. This area equals about 41.78 percent of the federal (BLM) land and about 16.31 percent of the entire shallow (perched) groundwater.
- Groundwater with TDS concentrations greater than 10,000 mg/L is not subject to regulation by the State of New Mexico under NMAC 20.6.2.3101.
- Sulfate concentrations in the shallow (perched) groundwater exceed the NMWQCC domestic water quality standard (600 mg/L).
- Published literature (Megan Van Emon, 2018) states, "*groundwater with sulfate concentrations between 1,500 mg/L to 2,500 mg/L may cause temporary diarrhea in cattle, contribute significantly to total sulfur intake, and cause reduction in copper*". Sulfate concentrations from dissolution of naturally occurring minerals in the Tansill Formation exceed 1,500 mg/L over the entire area of the shallow (perched) groundwater except in well MW-08 (1,470 mg/L) located near the southeast corner of the Facility.
- Published literature (Megan Van Emon, 2018) states. "*groundwater with sulfate concentrations greater than 4,500 mg/L should not be given to cattle under any circumstance due to the risk of sulfur associated polio*". Shallow (perched) groundwater with sulfate concentrations greater than 4,500 mg/L extends north from the Facility for about 1,150 feet over an area about 995,395 square feet or about 22.85 acres which equals about 16 percent of the shallow (perched) groundwater.
- Chloride concentrations in the shallow (perched) groundwater exceed the NMWQCC domestic water quality standard (250 mg/L) in eight (8) monitoring wells (MW-02-02, MW-02-05, MW-03-03, MW—08, MW-15, MW-16, and MW-18) with concentrations ranging from 279 mg/L (MW-03-03) to 9,950 mg/L (MW-02-02).
- Chloride was reported above the NMWQCC domestic water quality standard in samples from monitoring wells MW-0-2-02 (9,950 mg/L), MW-02-05 (5,700 mg/L), MW-15 (3,200 mg/L) and MW-16 (387 mg/L) which coincides with the naturally elevated TDS and sulfate concentrations.

- Chloride exceeded the NMWQCC domestic water quality standard in three (3) monitoring wells located on the Facility (MW-02-15, MW-03-03 and MW-08) with concentrations of 785 mg/L, 279 mg/L and 530 mg/L, respectively.
- Chloride was 651 mg/L in monitoring well MW-18 located west of the Facility where the saturated thickness is 0.35 feet and prevents the shallow (perched) groundwater from being used as a domestic or livestock resource and prohibits the potential for chloride to continue to migrate.
- MOC concluded in 2PR-022 that the dominant natural attenuation pathway for reducing the dissolved hydrocarbon concentrations is sulfate reduction where sulfate is consumed by and converted to sulfide by undocumented populations of SRB with the primary source for sulfate being gypsum in the mineral matrix which allows indigenous SRB to dominate the in-situ microbial ecology in the presence of petroleum hydrocarbons.
- As with 2RP-022, dissolved hydrocarbons (BTEX) migrating out of the LNAPL immediately enter into groundwater with a laboratory documented SRB populations ranging from $5.69E^{5}$ (569,000) to 3.33E6 (3,300,000) that attenuate the dissolved hydrocarbons (BTEX) through microbial decomposition, as demonstrated by laboratory analysis of groundwater samples from monitoring wells MW-20 and MW-03-04.
- Contradicting Paragraph 3 of Subsection A of 20.6.2.3103 NMAC, NMOCD granted closure approval under natural attenuation for 2RP-022, with 0.27 feet (May 2016) and 0.69 feet (December 2016) of LNAPL (condensate) measured and reported on groundwater in shallow monitoring well MW-126.

Recommendation

- AKA Energy requests NMOCD to approve discontinuing groundwater abatement and allow closure under natural attenuation for the Facility, as approved for 2RP-022.

2.0 INTRODUCTION

Aka Energy Group LLC (Aka Energy), a wholly owned subsidiary of Southern Ute Indian Tribe Growth Fund (SUGF), submits this addendum to the New Mexico Oil Conservation Division (NMOCD) to supplement the petition for alternate abatement standards for chemicals of concern (COC) and residual light nonaqueous phase liquid (LNAPL) in shallow groundwater at the Empire Abo Gas Plant (Facility) in Eddy County, New Mexico (March 26, 2023). The Facility is located about 9 miles east and southeast of Artesia, in Unit I (NE/4, SE/4), Section 3, Township 18 South, Range 27 East, Eddy County, New Mexico. The geodetic coordinates are North 32.777056° and West -104.259083°. Figure 1 presents a topographic map. Figure 2 presents an aerial map.

2.1 History

The following is a timeline for the Facility and environmental activities:

1961 — Amoco Production Company (Amoco), a wholly owned subsidiary of BP America Inc. (BP), constructed the Facility in about 1961 for processing and fractionating natural gas. On December 13, 1984, the NMOCD granted Amoco approval for the original groundwater discharge permit (GW-022) for the Facility.

December 29, 1991 — Amoco initiated a groundwater investigation as part of the groundwater discharge permit (GW-022) renewal and drilled monitoring well MW-01 near the north side of the Facility. Monitoring well MW-1 was advanced with an air rotary rig to 200 feet below ground surface (bgs) by Eades Drilling (Eades), Hobbs, New Mexico. Groundwater was not observed, and the well was plugged.

October 6, 1992 — Amoco drilled well MW-02-01 to 160 feet bgs about 350 feet east – southeast from MW-01 near the northeast corner of the Facility. Groundwater was not observed, and the well was plugged.

February 16, 1994 — Amoco reported installing twenty-nine (29) monitoring wells with fourteen (14) wells showing separate phase hydrocarbons (PSH) or light non-aqueous phase liquid (LNAPL) thickness between 0.02 feet (MW-03-01) and 12.89 feet (MW-06).

February 1996 — Amoco installed thirteen (13) Tierra Madre Model 2SK2 pneumatic skimmer pumps in wells with PSH/LNAPL, Evacuator II or Gladiator total fluid pumps in six (6) wells for groundwater depression, and a trench for groundwater and PSH/LNAPL recovery. Recovered fluids were processed through equipment to separate the LNAPL from water and an air stripper to treat dissolved hydrocarbons.

Amoco's consultant Clayton Environmental (Clayton), Naperville, Illinois, reported that the remediation system, including the skimmer pumps, total fluids recovery pumps and recovery trench, recovered 130 gallons or about 3.1 barrels of PSH/LNAPL. Clayton reported that the air stripper fouled from calcium and hydrogen sulfide (H2S). No additional information was available in the NMOCD online imaging files that suggest any additional PSH/LNAPL, or groundwater was recovered.

July 1, 1996 — Atlantic Richfield Corporation (ARCO Permian), a wholly owned subsidiary of BP, acquired the Facility.

September 1, 1996 ARCO Permian contracted with Elkhorn Field Services to operate the Facility.

March 1998 ARCO Permian contracted with Environmental Services, Inc. (ESI), Albuquerque, New Mexico, to prepare the groundwater discharge permit (GW-022) modification to include among other things:

- Reduce the number of monitoring wells to seven (7) for routine groundwater monitoring (MW-2, MW-02-08, MW-02-14, MW-02-15 and MW-03-03) to create an effective monitoring well network for detecting movement of hydrocarbons from the plant site.
- Replace the pneumatic skimmer and groundwater depression pumps with passive skimmer (absorbent) socks in wells with PSH/LNAPL greater than 0.5 feet.

December 18, 1997 ESI reported that the PSH or LNAPL thickness in the monitoring wells ranged from 0.01 to 4.30 feet.

2001 Arco contracted with R.T. Hicks Consultants Ltd to supervise the environmental activities at the Facility.

No data is available in the NMOCD online imaging files that indicates that either ARCO, Elkhorn, ESI, or R. T. Hicks recovered any LNAPL.

February 11, 2002 BP notified NMOCD of its intent to consolidate and merge its upstream U.S. assets including Amoco Production Company and ARCO Permian and changed the company name to BP America Production Company.

September 20, 2004 R.T. Hicks, on behalf of BP America Production Company, submitted a Draft Stage I/II Abatement Plan to NMOCD that included several alternatives for remedying the PSH/LNAPL and groundwater at the Facility, including:

- Use groundwater recovery pumps to recover LNAPL and groundwater and dispose of hydrocarbon impacted groundwater via deep well injection.
- Use groundwater recovery pumps to recover LNAPL and groundwater, treat and discharge treated groundwater to Scoggin Draw or Pecos River plus natural restoration.
- Use groundwater recovery pumps to recover LNAPL and groundwater, treat, then use treated groundwater at the Facility.
- Apply for Alternate Abatement Standards for the groundwater zone beneath and adjacent to the Facility; and
- Use a combination of the above strategies.

R.T. Hicks proposed implementing Alternative 1 (groundwater recovery pumps for a period of 12 months, beginning in January 2005, in five (5) wells maintaining the pumping level at 15 feet below the static level and place a block below each pump in an effort to concentrate the water withdrawal in the uppermost portion of the groundwater zone. R.T. Hicks proposed the following Alternate Abatement Standards:

- PSH/LNAPL – 3.5 feet
- Benzene – 5.0 ppm (mg/L)

- Ethylbenzene – 1.6 mg/L
- Xylenes – 2.8 mg/L

No information is available in the NMOCD online imaging file to confirm if NMOCD approved or denied the R.T. Hicks Draft Stage I/II Abatement Plan.

April 28, 2005 Aka Energy (Frontier Field Services, LLC) acquired the Facility from BP America Production Company.

September 1, 2006 R.T. Hicks submitted a memo to NMOCD regarding groundwater monitoring at the Facility during the first quarter (May 2, 2006) and second quarter (July 10, 2006) and groundwater dewatering program to reduce the potential for PSH/LNAPL to migrate off the Facility (September 1, 2006).

- The report stated that total fluid (groundwater and PSH/LNAPL) was pumped from two (2) wells (MW-03-01 and MW-08) for the purpose of lowering the groundwater potentiometric surface and hydraulic control for offsite LNAPL movement. The wells are located near the west side (MW-03-01) and southeast area (MW-08) of the Facility, respectively, at rates of 4.3 gallons per minute (gpm) for MW-03-01 and about 0.9 gpm for MW-08.
- The fluids (contaminated groundwater and LNAPL) were discharged into the lined above-ground evaporation (a.k.a Duck) pond and piped to a NMOCD permitted disposal (SWD) well. The dewatering program was discontinued after vegetation (cattails) in the evaporation pond began dying off and equipment was affected by scaling from the groundwater.

December 6, 2006 NMOCD required Frontier to submit a major modification to the groundwater discharge plan (GW-022).

December 18, 2006 Frontier notified NMOCD that it discontinued its relationship with R.T. Hicks, and Larson & Associates, Inc. (LAI), would represent Frontier going forward.

December 1, 2007 LAI, on behalf of Frontier, submitted a report to NMOCD titled, "*Interim Groundwater Monitoring Report, Frontier Field Services, LLC, Empire Abo Gas Plant (GW-022), Eddy County, New Mexico".* The report included details for install six (6) additional monitoring wells (MW-4 through MW-9) and recommendations or additional investigations including an electromagnetic (EM) terrain conductivity survey, hydrocarbon observation/recovery wells, PSH/LNAPL bailout tests, additional monitoring wells, groundwater sampling, horizontal hydraulic conductivity (slug) tests and review of historical aerial photographs.

December 11, 2007. NMOCD accepts and approves the report and additional investigations.

August 28, 2009 LAI, on behalf of Frontier, submits to NMOCD the document titled, *"Discharge Permit Renewal Application, GW-022, Frontier Field Services, LLC, Empire Abo Gas Plant, Eddy County, New Mexico, August 28, 2009"*, which included details for fourteen (14) additional monitoring wells (MW-10 through MW-23) and other investigations.

September 28, 2011 Well MW-24 was installed in response to a casing leak from an oil well (Well K-13) located about 800 southeast of the Facility (MW-23).

July 11, 2011	Frontier completed and submitted to NMOCD, a questionnaire ("Oil & Gas Facilities Questionnaire for Determination of a WQCC Discharge Permit") stating that the Facility did not have intentional discharges other than potable water onto the ground or directly into surface or groundwater. NMOCD rescinded the discharge permit based on the completed questionnaire.
August 21, 2012	NMOCD approved the groundwater abatement pilot test plan for groundwater extraction and high vacuum extraction dated August 13, 202, submitted under abatement permit AP-112.
October 23, 2017	The abatement plan was amended and approved by NMOCD for a soil vapor extraction (SVE) and air sparge pilot test.
March 1, 2019	Aka Energy sold the Facility to Durango Midstream Services but retained liability for certain environmental conditions, including soil, groundwater, and LNAPL remediation, and groundwater monitoring.

2.2 Soil and Groundwater Abatement

Aka Energy performed the following soil, LNAPL and groundwater abatement:

February 18 to April 8, 2020	Performed soil remediation according to 19.15.29 NMAC at nine (9) areas with 8,108.65 tons (equivalent to cubic yards) of hydrocarbon impacted soil and rock excavated and disposed at Lea Land Landfill, LLC (NM-1-0035), a NMOCD approved landfill.
November 6, 2020	A report titled, *"Empire Abo Gas Plant (AP-112), Soil Remediation Report, Eddy County, New Mexico"* was submitted to NMOCD with closure approval on December 30, 2020.
May 5 to September 16, 2020	Performed soil remediation for polychlorinated biphenyl (PCB) according to self-implemented remediation plan approved on February 4, 2020 by USEPA Region 6, Dallas, Texas, resulting in approximately 2,113,048 pounds or 1,056.95 tons (equivalent to cubic yards) of PCB contaminated soil, rock, and concrete excavated from five (5) locations (Area 1 through Area 5) and disposed at an EPA approved hazardous waste landfill (Waste Controlled Specialists, Andrews County, Texas).
May 16, 2021	A report titled, *"Final PCB Remediation Report, Empire Abo Gas Plant, Eddy County, New Mexico"* was submitted to EPA Region 6 and approved on October 29, 2021. A condition of closure approval by EPA was filing a deed restriction with the Eddy County Clerk's Office (May 14, 2021) prohibiting future residential use of the Facility and groundwater.
August 2018 to January 2021	Performed LNAPL and groundwater abatement using high vacuum extraction technology with recovery of approximately 227,810.1 pounds (equivalent to 113.9 tons) of hydrocarbon vapors, 3,280.2 gallons (equivalent to 78.1 barrels) of hydrocarbon liquid and 23,035 gallons (equivalent

	to 548.21 barrels) of water from the shallow (perched) groundwater.
August 25, 2022	A report titled, *"Empire Abo Gas Plant (AP-112) Remediation and Technical Infeasibility Report, Eddy County, New Mexico*" was submitted to NMOCD.
January 5, 2022 (2023)	NMOCD denied the technical infeasibility demonstration and closure request and suggested the following: a. Remove remaining LNAPL in the eight previously identified monitoring wells. b. Mitigate LNAPL and dissolved phase contaminants via commercially accepted abatement technology. c. Pursue closure via technical infeasibility per Paragraph 3 of Section E of 19.15.30.9 or by filing a petition seeking approval of alternate abatement standards under Subsection F of 19.15.30.9 NMAC. Aka Energy must state the alternative standards it seeks for wells containing LNAPL. The petition for alternate abatement standards must specifically include a transport, fate, and risk assessment.
March 31, 2023	A report titled, "*Alternate Abatement Standard Petition (AP-112), Empire Abo Gas Plant (Unit I (NE/4, SE/4), Section 3, Township 18 South, Range 27 East, Eddy County, New Mexico*" that included a risk assessment and fate and transport model demonstration was submitted as requested by NMOCD to comply with the alternate abatement standard petition requirements in Subsection A and B of 19.15.30.9 and Subsection F of 19.15.30.9 NMAC.
September 5, 2023	The NMOCD responded in writing as required under 19.15.30.8(F) (3) NMAC (90 days) to the report submitted on March 31, 2023, stating that AKA Energy has not provided tangible evidence toward an approval for an alternate abatement standard for the following reasons: **1. 19.15.30.9 (F) (a): either compliance with the abatement standards is not feasible, by the maximum use of technology within the responsible person's economic capacity; or there is no reasonable relationship between the economic and social costs and benefits, including attainment of the standards set forth in 19.15.30.9 NMAC to be obtained.** **2. 19.15.30.9 (F) (b): the proposed alternative standards are technically achievable and cost-benefit justifiable.** **3. 19.15.30.9 (F) (c): compliance with the proposed alternative abatement standard will not create a**

present or future hazard to public health or undue damage to property.

3.0 ALTERNATE ABATEMENT STANDARD ADDENDUM

The following is in response to the NMOCD's undated letter received by Aka Energy on September 5, 2023. Appendix A presents NMOCD undated letter in response to the petition for alternate abatement standard.

3.1 19.15.30.9 (F) (a)

NMOCD states, "SVE remediation under the approved abatement plan has demonstrated that compliance with abatement standards in 20.6.2.4.4103.B is feasible, by the maximum use of technology within the responsible person's economic capability. AKA Energy has monitored groundwater quality at the Facility since 2006 from samples collected from monitoring wells under the approved stage 2 abatement plan. The benzene concentration decreased in all but three monitoring wells under the current approved abatement plan demonstrating that the current SVE methods of remediation have been and will continue to be successful.

OCD cannot determine that there is no reasonable relationship between the economic and social benefits, as no viable alternatives were presented for evaluation. WQCC regulations governing discharge permits for groundwater include provisions for protecting "all groundwater of the state of New Mexico… for the present and potential future use as domestic and agricultural water supply." NMAC 20.6.2.3103. An adequate analysis of NMAC 20.6.2.3101. An adequate analysis of economic feasibility must incorporate all benefits and costs associated with reclamation to society as a whole, and not be based solely on an operator's alleged costs."

Response:

The soil vapor extraction (SVE) technology employed by Aka Energy has surpassed all other abatement technologies used by previous owners/operators (Amoco, ARCO, Elkhorn, BP, and Frontier) including pneumatic (skimmer) pumps, groundwater depression (total fluids) recovery pumps and recovery trench with separation and treatment technology (air stripper), and hydrophobic absorbent socks. The total volume of LNAPL recovered with these technologies was 130 gallons or about 3.1 barrels which confirms that the other technologies were ineffective for reducing the LNAPL thickness and/or decreasing the dissolved hydrocarbon (BTEX) concentrations.

Arco, successor to Amoco, abandoned the LNAPL/groundwater abatement after the poor recovery and fouling of the equipment by scale. ARCO removed the skimmer/groundwater depression pumps and equipment and proposed passive (hydrophobic) absorbent socks to recover LNAPL. There is no record in the NMOCD online imaging files to confirm if ARCO recovered any LNAPL with this passive technology.

R.T. Hicks, on behalf of Frontier, used total fluids (groundwater and LNAPL) pumps in two (2) wells (MW-03-01 (MW-08) to lower the groundwater potentiometric surface and provide hydraulic control to prevent LNAPL from moving offsite. The fluids (groundwater and LNAPL) were pumped at about 4.3 gpm (MW-03) and 0.9 gpm (MW-08) into the lined evaporation (a.k.a. Duck) pond for disposal in an offsite saltwater disposal (SWD)

well. Pumping was discontinued after vegetation (cattails) in the pond began dying off and scaling of equipment from the groundwater. There is no record of the volume of LNAPL/groundwater recovered by R.T. Hicks.

Amoco demonstrated that the shallow (perched) groundwater beneath the Facility is laterally and vertically discontinuous with dry monitoring wells MW-01 and MW-02-01 drilled to 200 and 160 feet bgs, respectively. The wells are separated horizontally by about 350 feet. The lateral discontinuity is supported by dry wells MW-02-07, MW-02-11, MW-04, MW-11, MW-13, EB-01, EB-04, EB-07, P-04, P-05, and AS-1. An evaluation of geologic logs and depth to groundwater measurements from monitoring wells concludes that the shallow (perched) groundwater is vertically and horizontally delineated over an area measuring approximately 6,243,988 square feet or about 142.34 acres. The shallow (perched) groundwater pinches out north of the Facility approximately 1,500 feet, west of the Facility about 660 feet, east of the Facility about 1,000 feet, and south of the Facility about 550 feet.

The shallow (perched) groundwater occurs under the following areas:

Area, square feet	Acrea, acres	Percent of Aquifer Area	Surface Ownership
2,600,608	59.70	41.94	Federal (BLM)
1,477,672	33.92	23.83	Private or Fee (Facility)
1,589,016	36.47	25.62	State (SLO)

The greatest saturated thickness occurs beneath the north side of the Facility and ranges from about 21 to 28 feet. The saturated thickness diminishes or pinches out beyond the Facility boundary to about 0.41 feet north of the Facility, 0.35 feet to the west of the Facility, 0 feet to the south of the Facility, and thins to less than 5 to 10 feet east of the Facility. The decreasing saturated thickness beyond the boundary of the Facility except north of the Facility makes the shallow (perched) groundwater unrecoverable in quantities for domestic and agriculture including livestock use. Figure 4a presents a map showing the saturated thickness and horizontal (lateral) limits for the shallow (perched) groundwater. Figure 4b presents the surface ownership map.

The area of greatest saturated thickness occurs near the north side and northeast corner of the Facility in the vicinity of monitoring wells MW-02-05 (24.50 feet) and MW-03-04 (27.94 feet), respectively, and north of the Facility on federal (BLM) land in the vicinity of monitoring well MW-25 (12.46 feet). The economic benefit of the shallow (perched) groundwater decreases to non-recoverable as the saturated thickness decreases.

On June 22, 2023, LAI personnel collected a groundwater sample from well MW-02-05 located near the north-central area of the Facility. The sample was analyzed for major cations (calcium, magnesium, sodium, and potassium), anions (alkalinity, sulfate, and chloride), fluoride, nitrate, nitrite, and pH. The chloride, total dissolved solids (TDS), and sulfate concentrations were 6,530 milligrams per liter (mg/L), 452,000 mg/L and 252,000 mg/L, respectively. The pH was neutral (7.4) and confirms that the shallow (perched) groundwater has not been affected from the cooling tower operations. The TDS concentrations in the entire shallow (perched) groundwater including background monitoring well MW-06 (2,780 mg/L) exceed the New Mexico Water Quality Control Commission (NMWQCC) domestic water quality standard of 1,000 mg/L (TDS). The concentrations of total dissolved solids (TDS) for the entire shallow (perched) groundwater exceeds the New

Mexico Water Quality Control Commission (NMQCC) domestic water quality standard of 1,000 milligrams per liter (mg/L).

The highest TDS values were reported in groundwater samples from monitoring wells MW-02-02 (583,000 mg/L) and MW-02-05 (592,000 mg/L) on April 13, 2016. On April 18, 2017, TDS concentrations in monitoring wells MW-02-02 and MW-02-05 were 475,000 mg/L and 508,000 mg/L, respectively. Previously (December 18, 1997) Environmental Services, Inc. (ESI), on behalf of Arco Permian, collected groundwater samples from wells MW-02-02 and MW-02-05. Assaigai Analytical Laboratories, Inc., Albuquerque, New Mexico, analyzed the samples for TDS and reported concentrations of 555,000 mg/L (MW-02-02) and 567,000 mg/L (MW-02-05). The area of TDS greater than 10,000 mg/L extends north of the Facility on federal (BLM) land for approximately 1,200 feet and covers an area of about 1,086,561 square feet or about 25 acres, or equal to about 41.78 percent of the federal (BLM) land and about 16.31 percent of the entire shallow (perched) groundwater area. The TDS concentrations have been consistent throughout the groundwater monitoring period back to 2006 and as previously reported by the previous owners/operators. There is no economic or social benefit of groundwater with TDS concentrations exceeding 10,000 mg/L. Furthermore, groundwater with TDS concentrations greater than 10,000 mg/L is not subject to regulation by the State of New Mexico under NMAC 20.6.2.3101. Figure 4c presents a map showing the TDS concentrations in the shallow (perched) groundwater.

Sulfate concentrations over the area of shallow (perched) groundwater exceed the NMWQCC domestic water quality standard of 600 mg/L. The area of highest sulfate concentrations coincides with the area of TDS concentrations greater than 10,000 mg/L with concentrations of 296,000 mg/L (MW-02-02), 290,000 mg/L (MW-02-05) and 39,800 mg/L (MW-15). On December 18, 1997, ESI reported sulfate at 234,000 mg/L in well MW-02-05. According to published literature (Megan Van Emmons, 2018), water containing sulfate greater than 4,500 mg/L should not be given to cattle under any circumstance due to the risk of sulfur associated polio. The area of sulfate concentrations greater than 4,500 mg/L mirrors the area of TDS concentrations exceeding 10,000 mg/L where the shallow (perched) groundwater is not subject to regulation by the State of New Mexico under NMAC 20.6.2.3101 and extends north from the Facility for about 1,150 feet over an area about 995,395 square feet or about 22.85 acres which is equal to about 16 percent of the shallow (perched) groundwater. The literature (Megan Van Emmons, 2018) states that groundwater with sulfate between 1,500 mg/L and 2,500 mg/L may cause temporary diarrhea in cattle, contribute significantly to total sulfur intake, and cause reduction in copper availability. Sulfate concentrations exceed 1,500 mg/L over the entire area of the shallow (perched) groundwater except in well MW-08 (1,470 mg/L) located near the southeast corner of the Facility. There is no agricultural benefit for groundwater with sulfate concentrations exceeding 1,500 mg/L. Figure 4d presents an isopleth map for sulfate concentrations in the shallow (perched) groundwater. The elevated sulfate is the result of dissolution of naturally occurring minerals in evaporite rocks from the Tansill Formation.

Between August 2018 and January 2022, AKA Energy used soil vapor extraction (SVE) technology to recover approximately 227,810.1 lbs or about 113.9 tons of hydrocarbon vapors, 3,280.2 gallons or about 78.1 bbl of hydrocarbon liquid and 23,035 gallons or about 548.21 bbl of water. LAI calculated the residual LNAPL in the capillary fringe above the shallow (perched) groundwater at four (4) areas beneath the Facility, based on LNAPL thicknesses from 0.07 to 0.40 feet, at 146,896.23 gallons or about 3,486.52 bbl.

In April 1991 Marathon Oil Company (MOC) reported to NMOCD District 2, in Artesia, New Mexico, that approximately 35,000 bbl or about 1.47 million gallons of natural gas condensate and 20,000 bbl of produced water were released from a segment of 6-inch steel gathering line (NMOCD Remediation Permit 2RP-022,

Discharge Permit GW-21 and Abatement Permit AP-107). The release occurred over several months and impacted shallow groundwater between about 20 and 70 feet bgs and a major aquifer (Lower Queen) between about 130 and 200 feet bgs. SVE technology was used to recover about 1,033,200 gallons or about 24,600 bbl of condensate as free product (LNAPL) and vapor. MOC reported that the remaining LNAPL (420,000 gallons, equivalent to about 10,000 bbl or 56,150 cubic feet) resided in the geologic matrix of the source area immobilized by physical interaction with surfaces in the geologic matrix and did not present a significant potential for long distance migration as a free-phase fluid. NMOCD granted closure under monitored natural attenuation (2008). NMOCD did not require MOC to remediate the source area or groundwater for inorganic constituents (sulfate, TDS, and chloride) resulting from the release of 840,000 gallons or 20,000 bbl of produced water.

On January 4 to 8, 2022, EcoVac Services, Moore, Oklahoma, under supervision from LAI used the same multi-phase SVE extraction technology for 34.25 hours at wells MW-21 and MW-02-12 to recover about 260 gallons of hydrocarbons as emulsion and 70.7 lbs of hydrocarbons as vapors at a cost of $55,705.18, which is equivalent to about $214.25 per gallon or $8,998.53 per bbl. Applying this cost to recover the estimated residual LNAPL (146,896.23 gallons or about 3,486.52 bbl) will be about $31,472,517.28, in today's dollars. There is no economic or social benefit to recover the residual LNAPL ($31,472,517.28) for shallow (perched) groundwater that is laterally and vertically discontinuous over an area of about 142.34 acres.

Conclusions:

The shallow (perched) groundwater does not require protection for the following reasons:

- TDS concentrations the shallow (perched) groundwater exceed 10,000 mg/L over the majority of the area north of the Facility that coincides with the area of greatest saturated thickness and is not subject to regulation by the State of New Mexico under NMAC 20.6.2.3103.
- SVE technology employed by Aka Energy, more than any other past owner/operator combined, has greatly reduced the LNAPL beneath the Facility and decreased the dissolved hydrocarbon (benzene) concentrations below the NMWQCC human health standard in all but three (3) monitoring wells.
- The saturated thickness of the shallow (perched) groundwater decreases east, west, and south beyond the Facility that makes the groundwater unrecoverable in quantities for domestic and agriculture including livestock use.
- Sulfate concentrations in the shallow (perched) groundwater from dissolution of naturally occurring minerals in the Tansill Formation exceed 1,500 mg/L throughout the shallow (perched) groundwater, except monitoring well MW-08 near the southwest corner of the Facility and is therefore not suitable for livestock (cattle) due to the risk of temporary diarrhea in cattle, that contributes significantly to total sulfur intake, and causes reduction in copper availability.
- Sulfate concentrations in the shallow (perched) groundwater from dissolution of naturally occurring minerals in the Tansill Formation exceed 4,500 mg/L over the majority of the area north of the Facility is therefore not suitable for livestock (cattle) due to the risk of sulfur associated polio.
- TDS concentrations exceeding 10,000 mg/L the shallow (perched) groundwater from dissolution of naturally occurring minerals in the Tansill Formation occur over the majority of the area north of the Facility and is not subject to regulation by the State of New Mexico under NMAC 20.6.2.3103.

- There is no economic or social benefit to recover the residual LNAPL ($31,472,517.28) for shallow (perched) groundwater that is laterally and vertically discontinuous over an area of about 142.34 acres.

Recommendation:

Due to the above factors, we do not believe that the shallow (perched) groundwater requires any further protection, and any additional remediation. Aka Energy requests approval from NMOCD under natural attenuation to leave approximately 146,896.23 gallons or about 3,486.52 bbl unrecovered in the capillary beneath the Facility, as with 2RP-022.

3.2 19.15.30.9 (F) (b)

NMOCD states, "Other viable remediation methods (e.g., air sparging LNAPL wells, skimmers) should be fully evaluated and compared."

Response:

The previous owners/operators, including Amoco, ARCO, Elkhorn, and Frontier, employed numerous technologies, including pneumatic (skimmer) pumps, absorbent socks, total fluid pumps (groundwater depression), and a recovery trench coupled with product (PSH/LNAPL) separation and groundwater treatment (air stripping) for abating LNAPL and dissolved hydrocarbon (BTEX) groundwater contamination. All the technologies combined were demonstrated to be inefficient and ineffective for recovering the PSH/LNAPL thickness and decreasing the dissolved hydrocarbon (BTEX) concentrations. Amoco reported recovering only 130 gallons of PSH/LNAPL only to abandon the abatement from poor performance and fouling of the equipment by scale from the groundwater. ARCO removed the skimmer and groundwater depression pumps as well as the groundwater treatment equipment (air stripper) and recovery trench and proposed passive absorbent (hydrophobic) socks as a means to recover PSH/LNAPL. There is no record in the NMOCD online imaging files to confirm if ARCO recovered any PSH/LNAPL with the passive absorbent (hydrophobic) socks.

R.T. Hicks, on behalf of Frontier, pumped groundwater and LNAPL from wells MW-03-01 and MW-08 located near the west side and southeast of the Facility, respectively, for the purpose of lowering the groundwater potentiometric surface and hydraulic control to prevent LNAPL from moving offsite to the west and southwest. Fluids were pumped at 4.3 gallon per minute (gpm) from well MW-03 and 0.9 gpm from well MW-08 and discharged to the lined evaporation (a.k.a. Duck) pond. Pumping was discontinued after vegetation (cattails) in the pond began dying off and scaling of equipment from the groundwater. There is no record of the volume of LNAPL/groundwater recovered by R.T. Hicks.

Marathon Oil Company (MOC), in 2RP-022, concluded that the dominant natural attenuation pathway for reducing the dissolved hydrocarbon concentrations is sulfate reduction with the primary source for sulfate being gypsum in the mineral matrix where sulfate is consumed and converted to sulfide by sulfate reducing micro-organisms or sulfate reducing bacteria (SRB). Further, MOC stated that readily available sulfate from gypsum in the mineral matrix allows indigenous SRB to dominate the in situ microbial ecology in the presence of petroleum hydrocarbons. MOC concluded that dissolved constituents (BTEX) migrate out of the free phase hydrocarbons (LNAPL) and are immediately attenuated by SRB. MOC did not quantify the SRB populations in

the groundwater but reported attenuation by SRB as the dominant attenuation pathway with sulfate concentrations ranging from 2,200 mg/L to 2,800 mg/L.

On June 21, 2023, LAI personnel, on behalf of Aka Energy, deployed traps (Bio-Traps®) in four (4) monitoring wells (MW-20, MW-22, MW-24 and MW-03-04) without LNAPL for the purpose of capturing and quantifying SRB populations (census) in the shallow (perched) groundwater. Bio-Traps® were acquired from Microbial Insights (MI), Knoxville, Tennessee, and were deployed according to MI instructions, after gauging the wells for depth to groundwater and purging of approximately three (3) casing-volumes of groundwater. No LNAPL was detected in the monitoring wells. The Bio-Traps® were suspended in the wells with nylon line and positioned near the center of the water column observed prior to purging the wells. August 21, 2023, sixty (60) days after deploying, the Bio-Traps® were retrieved and returned to MI via overnight courier under chain of custody and preservation. MI reported the following SRB populations in monitoring wells MW-20, MW-22, MW-24 and MW-03-04:

Well	Census, SRB	Census, SRB
MW-20	$3.33E^{6}$	3,330,000
MW-22	$6.06E^{5}$	606,000
MW-24	$5.69E^{5}$	569,000
MW-03-04	$6.25E^{6}$	6,250,000

The census data confirms that a robust SRB population is present in the shallow (perched) groundwater with high populations reported in monitoring wells MW-20 (3,300,00) located hydraulically downgradient (southeast) of the LNAPL area, and MW-03-04 (6,250,000) located near the northeast area of the Facility where LNAPL was previously reported.

LNAPL had been historically recorded in well MW-03-04 between 0.22 and 2.02 feet thick. No processing (gas) equipment or pipelines are located in this area of the Facility. LAI personnel performed SVE in the area of MW-03-04, and SRB reported at 6,250,000 continue to metabolize the dissolved hydrocarbons in the area of MW-03-04.

Dissolved benzene concentrations in groundwater samples from well MW-20 decreased from a high of 2.84 mg/L (October 15, 2014) to less than the analytical method reporting limit (April 28, 2021, and January 5, 2022) confirming that SRB have metabolized the dissolved hydrocarbons (benzene). No LNAPL abatement occurred in the area near well MW-20. The SRB populations in monitoring wells MW-22 (606,000) and MW-24 (569,000) are similar with similar trends in dissolved benzene concentrations. Dissolved benzene in groundwater from MW-22 decreased from a high of 31.3 mg/L (March 16, 2011) to 2.80 mg/L (May 17, 2023). Dissolved benzene in well MW-24 decreased from a high of 5.10 mg/L (September 27, 2012) to 2.88 mg/L (May 17, 2023). LNAPL abatement was not performed at wells MW-22 and MW-24 confirming that SRB continue to metabolize the dissolved hydrocarbons (benzene) emanating from the residual LNAPL. The shallow (perched) groundwater appears to terminate or pinch out downgradient (southeast) from well MW-

24 therefore ending further downgradient (southeast) migration. Appendix B presents the MI laboratory report.

Conclusions:

- Other viable remediation methods including pneumatic (skimmer) pumps, absorbent socks, total fluid pumps groundwater depression), and a recovery trench coupled with product separation and groundwater treatment air stripping) were extensively used by the previous owners/operators at the Facility and proved ineffective and inefficient and ineffective for reducing the LNAPL thickness and/or decreasing the dissolved hydrocarbon (BTEX) concentrations.
- LAI personnel quantified by laboratory analysis that SRB are present in the shallow (perched) groundwater and actively metabolizing the dissolved hydrocarbons emanating from the residual LNAPL.
- It has also been demonstrated that no groundwater is present below the shallow (perched) groundwater for 200 feet and terminates or pinches out between about 550 feet (south) and 1,500 feet (north) from the Facility.

Recommendation:

AKA Energy requests approval from NMOCD to allow natural attenuation and microbial degradation by indigenous SRB as the viable option for abating the residual LNAPL and dissolved hydrocarbons (BTEX) in the shallow (perched) groundwater.

3.3 19.15.30.9 (F) (c)

NMOCD states, “Inorganic contaminants persist in the subsurface and are not degraded or destroyed by natural attenuation processes and continue to migrate. The requested alternative abatement does not address long term monitoring and relies on modeling effort to demonstrate long-term protection of human health and the environment. This is not an acceptable approach to ensure protection of New Mexico’s groundwater resources. The benzene alternative abatement standard proposed (149 mg/L) is nearly 30,000 times the maximum allowable concentration of 0.005 mg/L per Subsection A of 20.6.2.3103 NMAC. Additionally, Paragraph 3 of Subsection A of 20.6.2.3103 NMAC states: Non-aqueous phase liquid shall not be present floating atop of or immersed within ground water, as can be reasonably measured. AKA Energy has not demonstrated that the proposed alternative abatement standard will not create a present or future hazard to public health or undue damage to property.”

Response:

Amoco and investigations performed on behalf of Aka Energy have demonstrated that the shallow (perched) groundwater beneath the Facility is laterally and vertically delineated and covers an area of approximately 142.34 acres with about 41.94 percent occurring beneath federal (BLM) land, about 23.83 percent occurring beneath the Facility, and approximately 25.62 percent beneath State of New Mexico (SLO) land. The shallow (perched) groundwater pinches out approximately 1,500 feet north of the Facility, about 660 feet west of the Facility, about 1,000 feet east of the Facility and about 550 feet south of the Facility. The saturated thickness diminishes between 0 feet (south), 0.41 feet (north), 0.35 feet (west), and thins to less than 5 to 10 feet east of the Facility. The diminishing saturated thickness prevents the shallow (perched) groundwater from being used as a domestic or livestock resource and prohibits the potential for inorganic contaminants to continue to migrate.

On behalf of Aka Energy, LAI has monitored groundwater for inorganic contaminants including RCRA metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver), sulfate, chloride, and TDS since 2006. Arsenic and chromium are the only RCRA metals reported in groundwater samples at concentrations above the NMWQCC human health standards of 0.1 mg/L and 0.05 mg/L, respectively. Arsenic was reported in the shallow (perched) groundwater in well P-01 at 0.118 mg/L. Chromium was reported in the shallow (perched) groundwater in three (3) wells that included MW-02-03, MW-07 and the background well EB-06 at concentrations of 0.0651 mg/L, 0.057 mg/L and 0.0676 mg/L, respectively. The metal constituents (arsenic and chromium) are not pervasive throughout the shallow (perched) groundwater and do not pose a risk to the State of New Mexico water resources, or the environment. On May 3, 2019, NMOCD (Bradford Billings communication) approved Aka Energy's request to delete metals from groundwater monitoring at the Facility. Appendix B presents NMOCD approval.

As previously discussed, the concentrations of sulfate and TDS for the entire shallow (perched) groundwater exceed the New Mexico Water Quality Control Commission (NMQCC) domestic water quality standards of 600 mg/L and 1,000 mg/L, respectively. TDS in the shallow (perched) groundwater exceeds 10,000 mg/L over an area including the north side to about 1,200 feet north of the Facility or about 1,086,561 square feet or about 25 acres. This area equals about 41.78 percent of the federal (BLM) land and about 16.31 percent of the entire shallow (perched) groundwater. Groundwater with TDS concentrations greater than 10,000 mg/L is not subject to regulation by the State of New Mexico under NMAC 20.6.2.3101.

Sulfate concentrations in the shallow (perched) groundwater exceed the NMWQCC domestic water quality standard (600 mg/L). Published literature (Megan Van Emon, 2018) states, "*groundwater with sulfate concentrations between 1,500 mg/L to 2,500 mg/L may cause temporary diarrhea in cattle, contribute significantly to total sulfur intake, and cause reduction in copper*". Sulfate concentrations from dissolution of naturally occurring minerals in the Tansill Formation exceed 1,500 mg/L over the entire area of the shallow (perched) groundwater except in well MW-08 (1,470 mg/L) located near the southeast corner of the Facility.

Published literature (Megan Van Emon, 2018) states. "*groundwater with sulfate concentrations greater than 4,500 mg/L should not be given to cattle under any circumstance due to the risk of sulfur associated polio*". Shallow (perched) groundwater with sulfate concentrations greater than 4,500 mg/L extends north from the Facility for about 1,150 feet over an area about 995,395 square feet or about 22.85 acres which equals about 16 percent of the shallow (perched) groundwater.

Chloride concentrations in the shallow (perched) groundwater exceed the NMWQCC domestic water quality standard (250 mg/L) in eight (8) monitoring wells (MW-02-02, MW-02-05, MW-03-03, MW—08, MW-15, MW-16, and MW-18) with chloride concentrations ranging from 279 mg/L (MW-03-03) to 9,950 mg/L (MW-02-02). On December 18, 1997, ESI reported chloride at 14,000 mg/L in well MW-02-05.

Chloride was reported above the NMWQCC domestic water quality standard (250 mg/L) in samples from monitoring wells MW-0-2-02 (9,950 mg/L), MW-02-05 (5,700 mg/L), MW-15 (3,200 mg/L) and MW-16 (387 mg/L) which coincides with the naturally elevated TDS and sulfate concentrations. Chloride exceeded the NMWQCC domestic water quality standard in three (3) monitoring wells located on the Facility (MW-02-15, MW-03-03 and MW-08) with concentrations of 785 mg/L, 279 mg/L and 530 mg/L, respectively. Chloride was 651 mg/L in monitoring well MW-18 located west of the Facility where the saturated thickness is 0.35 feet and prevents the shallow (perched) groundwater from being used as a domestic or livestock resource and prohibits the potential for chloride to continue to migrate.

MOC concluded in 2PR-022 that the dominant natural attenuation pathway for reducing the dissolved hydrocarbon concentrations is sulfate reduction where sulfate is consumed by and converted to sulfide by SRB with the primary source for sulfate being gypsum in the mineral matrix which allows indigenous SRB to dominate the in-situ microbial ecology in the presence of petroleum hydrocarbons. As with 2RP-022, dissolved hydrocarbons (BTEX) migrating out of the LNAPL immediately enter into groundwater with a laboratory documented SRB populations ranging from $5.69E^{5}$ (569,000) to 3.33E6 (3,300,000) that attenuate the dissolved hydrocarbons (BTEX) through microbial decomposition, as demonstrated by laboratory analysis of groundwater samples from monitoring wells MW-20 and MW-03-04.

Paragraph 3 of Subsection A of 20.6.2.3103 NMAC states: Non-aqueous phase liquid shall not be present floating atop of or immersed within ground water, as can be reasonable measured. In 2RP-022, during May 2016, and December 2016, LNAPL was measured and reported in shallow monitoring well MW-126 at 0.27 feet and 0.69 feet, respectively, concluding that NMOCD has closed sites with measurable LNAPL floating atop-of groundwater.

Conclusions:

- Investigations performed by Amoco and by LAI on behalf of Aka Energy have demonstrated that the shallow (perched) groundwater is laterally and vertically delineated over an area measuring approximately 142.34 acres with about 41.94 percent occurring beneath federal (BLM) land, about 23.83 percent occurring beneath the Facility, and approximately 25.62 percent beneath State of New Mexico (SLO) land.
- The shallow (perched) groundwater pinches out approximately 1,500 feet north of the Facility, about 660 feet west of the Facility, about 1,000 feet east of the Facility and about 550 feet south of the Facility. The saturated thickness diminishes between 0 feet (south), 0.41 feet (north), 0.35 feet (west), and thins to less than 5 to 10 feet east of the Facility.
- The diminishing saturated thickness prevents the shallow (perched) groundwater from being used as a domestic or livestock resource and prohibits the potential for inorganic contaminants to continue to migrate.
- The shallow (perched) groundwater has been monitored for inorganic contaminants including RCRA metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver), sulfate, chloride, and TDS since 2006.
- Arsenic and chromium are the only RCRA metals reported in groundwater samples at concentrations above the NMWQCC human health standards of 0.1 mg/L and 0.05 mg/L, respectively.
- Arsenic was only reported above the NMWQCC human health standard (0.1 mg/L) in one (1) monitoring well (P-01) at 0.118 mg/L.
- Chromium was reported above the NMWQCC human health standard (0.05 mg/L) in groundwater samples from three (3) wells (MW-02-03, MW-07 and EB-06) at concentrations of 0.0651 mg/L, 0.057 mg/L and 0.0676 mg/L, respectively.
- The highest chromium value (0.076 mg/L) was reported in the background and hydraulically up gradient well (EB-06).
- The metal constituents (arsenic and chromium) are not pervasive throughout the shallow (perched) groundwater and do not pose a risk to the State of New Mexico water resources, or the environment.

- On May 3, 2019, NMOCD (Bradford Billings communication) approved Aka Energy's request to delete metals from groundwater monitoring at the Facility.
- TDS in the shallow (perched) groundwater exceeds 10,000 mg/L over an area including the north side to about 1,200 feet north of the Facility or about 1,086,561 square feet or about 25 acres. This area equals about 41.78 percent of the federal (BLM) land and about 16.31 percent of the entire shallow (perched) groundwater.
- Groundwater with TDS concentrations greater than 10,000 mg/L is not subject to regulation by the State of New Mexico under NMAC 20.6.2.3101.
- Sulfate concentrations in the shallow (perched) groundwater exceed the NMWQCC domestic water quality standard (600 mg/L).
- Published literature (Megan Van Emon, 2018) states, "*groundwater with sulfate concentrations between 1,500 mg/L to 2,500 mg/L may cause temporary diarrhea in cattle, contribute significantly to total sulfur intake, and cause reduction in copper*". Sulfate concentrations from dissolution of naturally occurring minerals in the Tansill Formation exceed 1,500 mg/L over the entire area of the shallow (perched) groundwater except in well MW-08 (1,470 mg/L) located near the southeast corner of the Facility.
- Published literature (Megan Van Emon, 2018) states. "*groundwater with sulfate concentrations greater than 4,500 mg/L should not be given to cattle under any circumstance due to the risk of sulfur associated polio*". Shallow (perched) groundwater with sulfate concentrations greater than 4,500 mg/L extends north from the Facility for about 1,150 feet over an area about 995,395 square feet or about 22.85 acres which equals about 16 percent of the shallow (perched) groundwater.
- Chloride concentrations in the shallow (perched) groundwater exceed the NMWQCC domestic water quality standard (250 mg/L) in eight (8) monitoring wells (MW-02-02, MW-02-05, MW-03-03, MW—08, MW-15, MW-16, and MW-18) with concentrations ranging from 279 mg/L (MW-03-03) to 9,950 mg/L (MW-02-02).
- Chloride was reported above the NMWQCC domestic water quality standard in samples from monitoring wells MW-0-2-02 (9,950 mg/L), MW-02-05 (5,700 mg/L), MW-15 (3,200 mg/L) and MW-16 (387 mg/L) which coincides with the naturally elevated TDS and sulfate concentrations.
- Chloride exceeded the NMWQCC domestic water quality standard in three (3) monitoring wells located on the Facility (MW-02-15, MW-03-03 and MW-08) with concentrations of 785 mg/L, 279 mg/L and 530 mg/L, respectively.
- Chloride was 651 mg/L in monitoring well MW-18 located west of the Facility where the saturated thickness is 0.35 feet and prevents the shallow (perched) groundwater from being used as a domestic or livestock resource and prohibits the potential for chloride to continue to migrate.
- MOC concluded in 2PR-022 that the dominant natural attenuation pathway for reducing the dissolved hydrocarbon concentrations is sulfate reduction where sulfate is consumed by and converted to sulfide by undocumented populations of SRB with the primary source for sulfate being gypsum in the mineral matrix which allows indigenous SRB to dominate the in-situ microbial ecology in the presence of petroleum hydrocarbons.

- As with 2RP-022, dissolved hydrocarbons (BTEX) migrating out of the LNAPL immediately enter into groundwater with a laboratory documented SRB populations ranging from $5.69E^5$ (569,000) to 3.33E6 (3,300,000) that attenuate the dissolved hydrocarbons (BTEX) through microbial decomposition, as demonstrated by laboratory analysis of groundwater samples from monitoring wells MW-20 and MW-03-04.
- Contradicting Paragraph 3 of Subsection A of 20.6.2.3103 NMAC, NMOCD granted closure approval under natural attenuation for 2RP-022, with 0.27 feet (May 2016) and 0.69 feet (December 2016) of LNAPL (condensate) measured and reported on the groundwater in shallow monitoring well MW-126.

Recommendation:

- Aka Energy requests NMOCD to approve discontinuing groundwater abatement and allow closure under natural attenuation as approved for 2RP-022.

4.0 REFERENCES

Megan Van Emmons, 2018. *Water Quality for Livestock*. Montana State University Extension, Bozeman, Montana.

Figures

JWW

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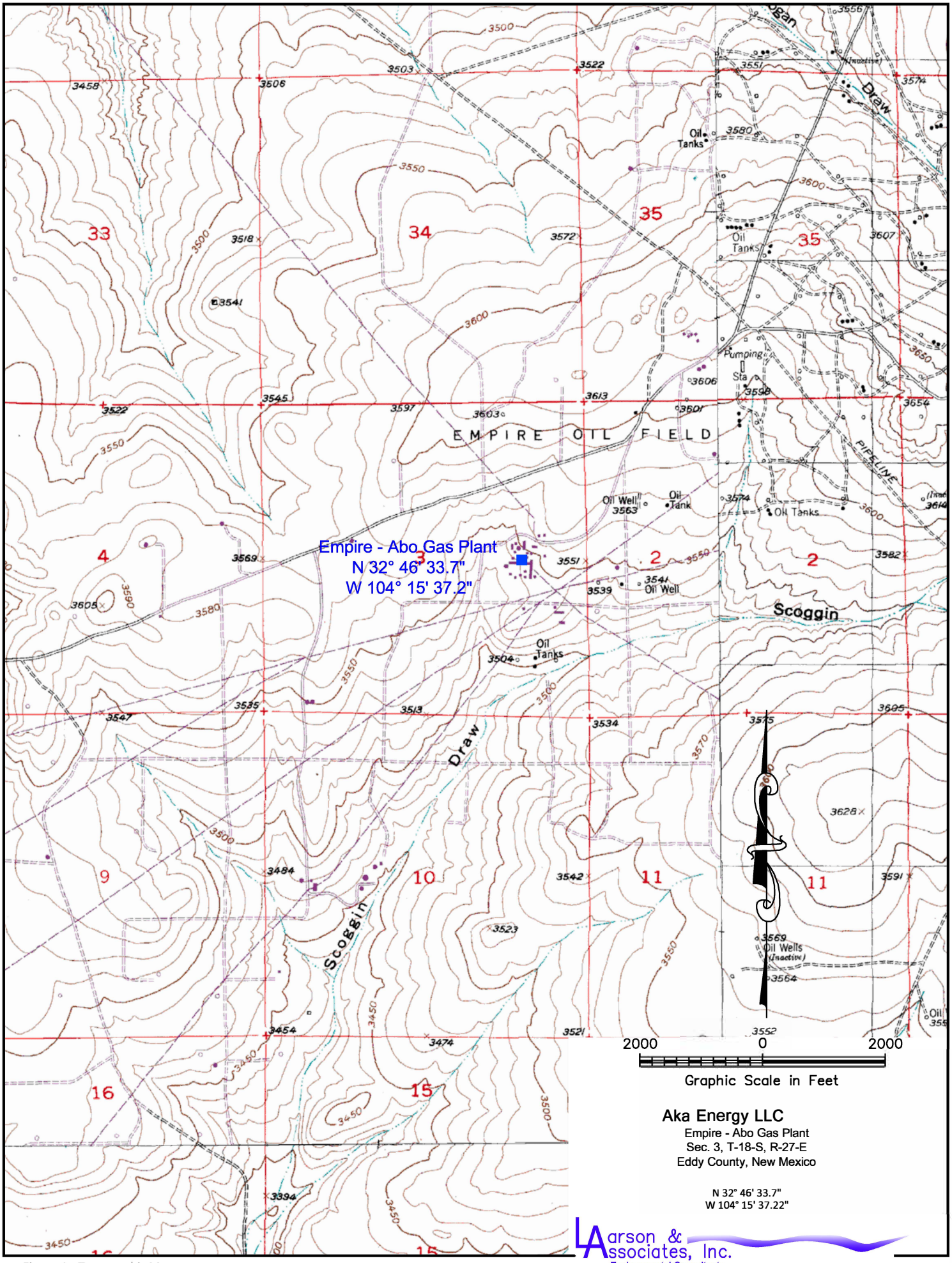


Aka Energy LLC

Empire - Abo Gas Plant
Sec. 3, T-18-S, R-27-E
Eddy County, New Mexico

N 32° 46' 33.7"
W 104° 15' 37.22"

Larson & Associates, Inc.
Environmental Consultants

Figure 1 - Topographic Map

Figure 2 - Aerial Map

MW-16
MW-15
MW-17
EB-06
MW-01
MW-13
MW-02
MW-02-01
MW-02-02
MW-03-04
BH-02
MW-2-03
MW-02-05
MW-03
MW-02-04
BH-04
BH-01
MW-02-07
BH-03
MW-07
MW-04
MW-02-06
P-02
BH-05
MW-02-10
MW-02-11
MW-02-18
MW-03-03
MW-03-01
MW-09
AS-1
MW-10
MW-02-09
MW-22
MW-18
MW-11
MW-02-13
MW-23
MW-02-12
P-01
MW-02-14
MW-06
MW-05
MW-21
EB-08
P-03
MW-02-16
MW-02-15
MW-20
MW-08
MW-19
EB-05
MW-24
Well K-13
MW-03-02
MW-12
MW-14
EB-03
P-04
EB-02
EB-07
P-05
EB-01
EB-04

Legend

MW-10	- Monitoring Well Location and Apparent LNAPL Thickness, Feet
MW-01	- Plugged and Abandoned Monitoring Well
EB-03	- Monitoring Well Location and Apparent LNAPL Thickness, Feet
P-03	- Piezometer (Fluid Level) Location
AS-1	- Test Well Location
MW-03	- Monitoring Well for Groundwater Sampling

Fence

Property Line

Draw

Road

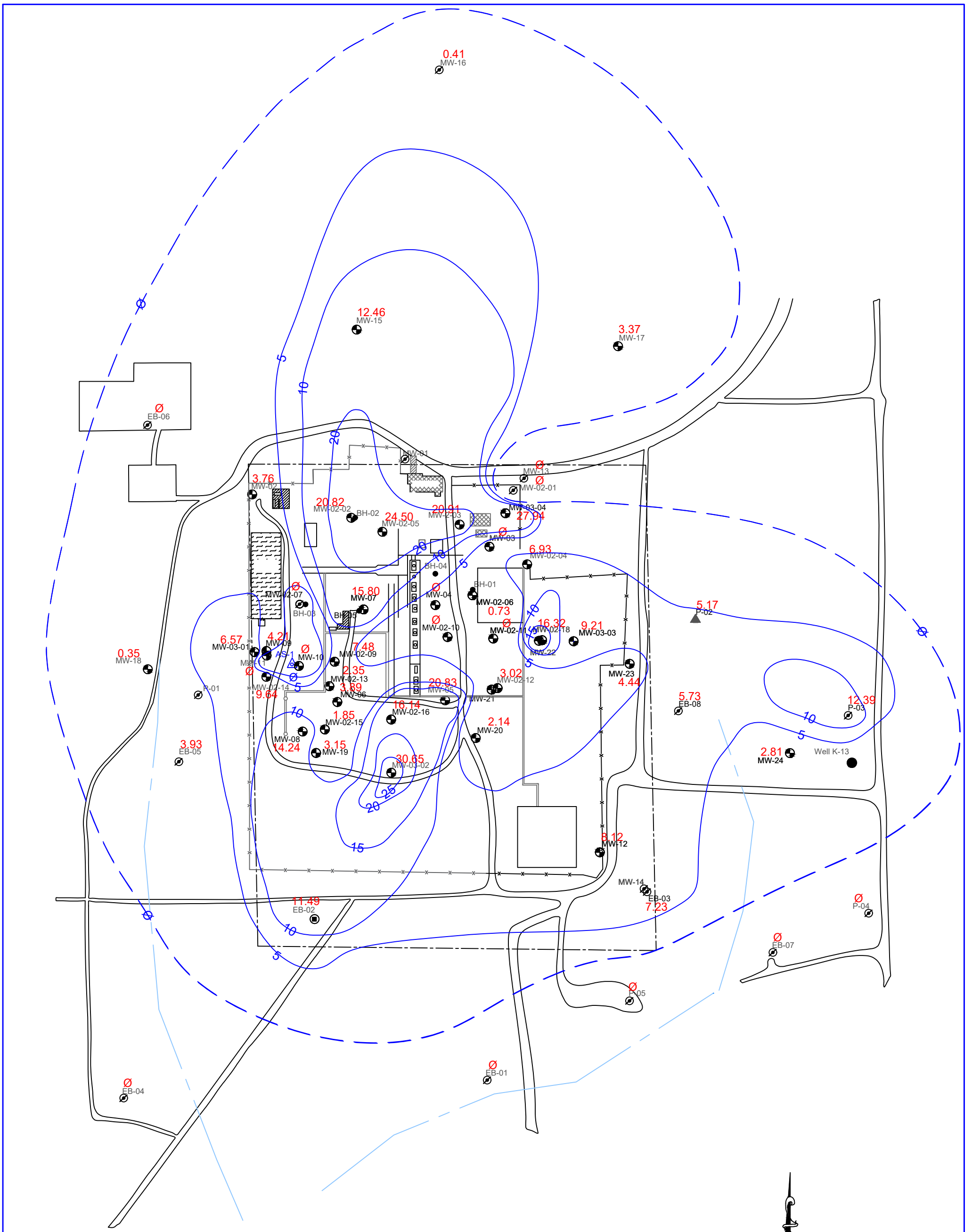
300 0 300

Graphic Scale in Feet

Frontier Field Services, LLC
AP - 112 / Empire - Abo Gas Plant
Unit I, (NE/4, SE/4)- 18 - S, R - 27 - E
Eddy County, New Mexico
32° 46' 33.7"N
104° 15' 37.22"W

Larson & Associates, Inc.
Environmental Consultants

Figure 3 - Facility Drawing



Legend

- MW-10 - Monitoring Well Location and Saturated Thickness, Feet, June 2023
- MW-01 - Plugged and Abandoned Monitoring Well
- EB-02 - Monitoring Well Location and Saturated Thickness, Feet, June 2023
- P-02 - Piezometer (Fluid Level) Location
- Test Well Location
- Contour of Saturated Thickness, Feet, June 2023
- Approximate Boundary of Shallow (perched) Groundwater
- Fence
- Property Line
- Draw
- Road

Frontier Field Services, LLC
AP - 112 / Empire - Abo Gas Plant
Unit I, (NE/4, SE/4)- 18 - S, R - 27 - E
Eddy County, New Mexico
32° 46' 33.7"N
104° 15' 37.22"W

Larson & Associates, Inc.
Environmental Consultants

Figure 4a - Saturated Thickness Map, June 2023

Federal Area: 3,025,665ft²

Shallow Area: 6,661,853ft²(153 Acres)

8,395ft²

Empire Abo Plat
Area: 1,477,672ft²

State Area: 1,589,016ft²

MW-16 MW-15 MW-17 MW-01 MW-02 MW-02-02 BH-02 MW-02-05 MW-2-03 MW-13 MW-02-01 MW-03-04 MW-03 MW-02-04 BH-04 BH-01 MW-02-07 MW-07 MW-04 MW-02-06 BH-03 BH-05 MW-02-10 MW-02-11 MW-02-18 MW-03-03 MW-22 MW-03-01 MW-09 24.82 AS-1 MW-10 MW-02-09 MW-11 MW-23 MW-02-13 MW-02-12 MW-02-14 MW-06 MW-05 MW-21 MW-02-16 MW-02-15 MW-20 MW-08 MW-19 MW-03-02 MW-18 MW-12 MW-14 EB-02 EB-03 EB-04 EB-01 EB-05 EB-06 EB-07 EB-08 P-01 P-02 P-03 P-04 P-05 MW-24 Well K-13

Legend

- MW-10 - Monitoring Well Location
- MW-01 - Plugged and Abandoned Monitoring Well
- P-02 - Piezometer (Fluid Level) Location
- - Test Well Location
- - Approximate Boundary of Shallow (perched) Groundwater
- - Empire ABO Plant
- - Federal State Property Area
- - New Mexico State Property Area
- Fence
- Property Line
- Draw
- Road

300 0 300
Graphic Scale in Feet

Frontier Field Services, LLC
AP - 112 / Empire - Abo Gas Plant
Unit I, (NE/4, SE/4)- 18 - S, R - 27 - E
Eddy County, New Mexico
32° 46' 33.7"N
104° 15' 37.22"W

Larson & Associates, Inc.
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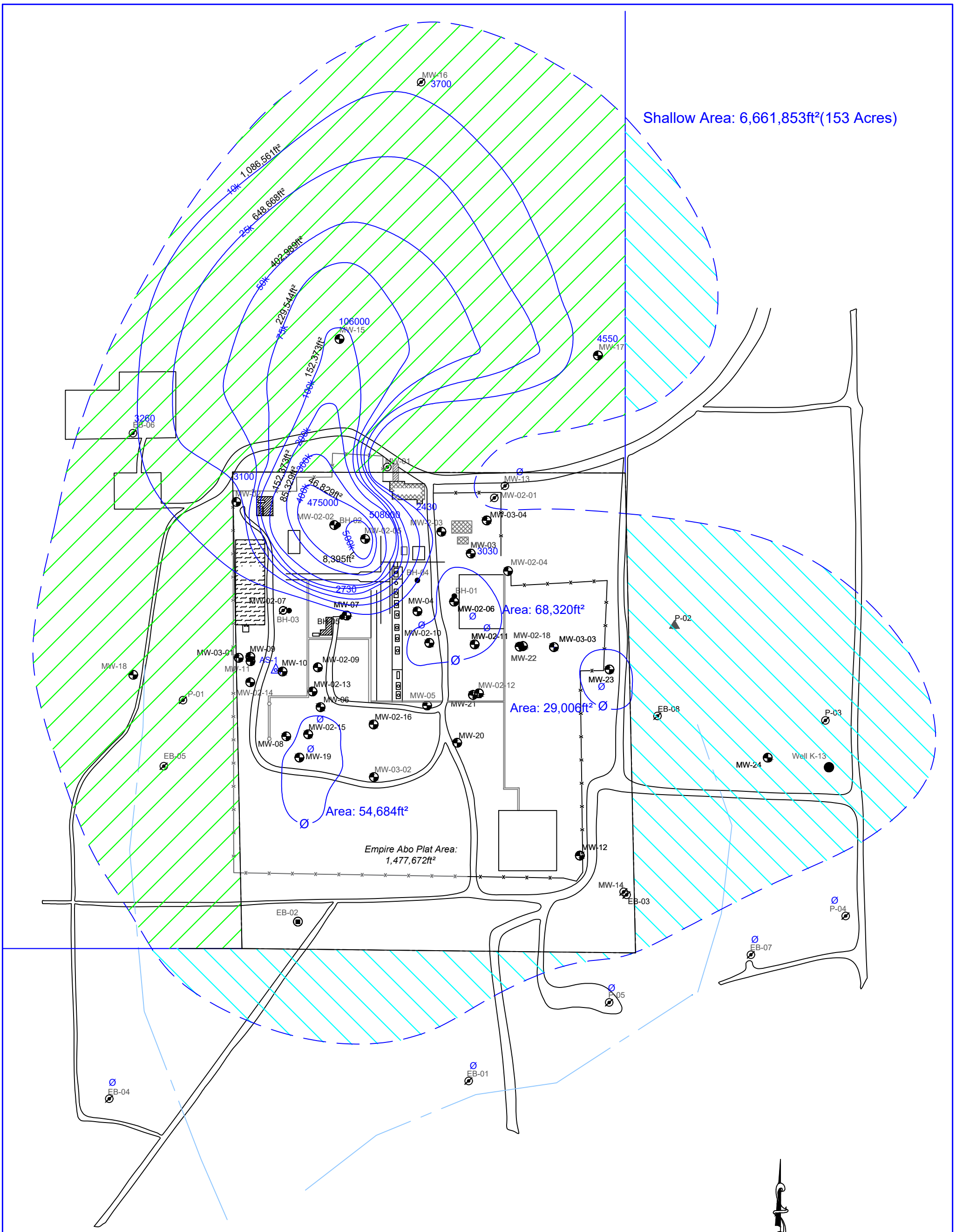
Figure 4b - Surface Ownership Map



Legend

24.92 MW-10 - Monitoring Well Location and TDS Concentration, mg/L

MW-01 - Plugged and Abandoned Monitoring Well

52.12 P-02 - Piezometer (Fluid Level) Location and TDS Concentration mg/L

- Test Well Location

—51000— - Contour of TDS Concentration, mg/L

- Approximate Boundary of Shallow (perched) Groundwater

- Federal State Property Area

- New Mexico State Property Area

Fence

Property Line

Draw

Road

300 0 300

Graphic Scale in Feet

Frontier Field Services, LLC

AP - 112 / Empire - Abo Gas Plant

Unit I, (NE/4, SE/4)- 18 - S, R - 27 - E

Eddy County, New Mexico

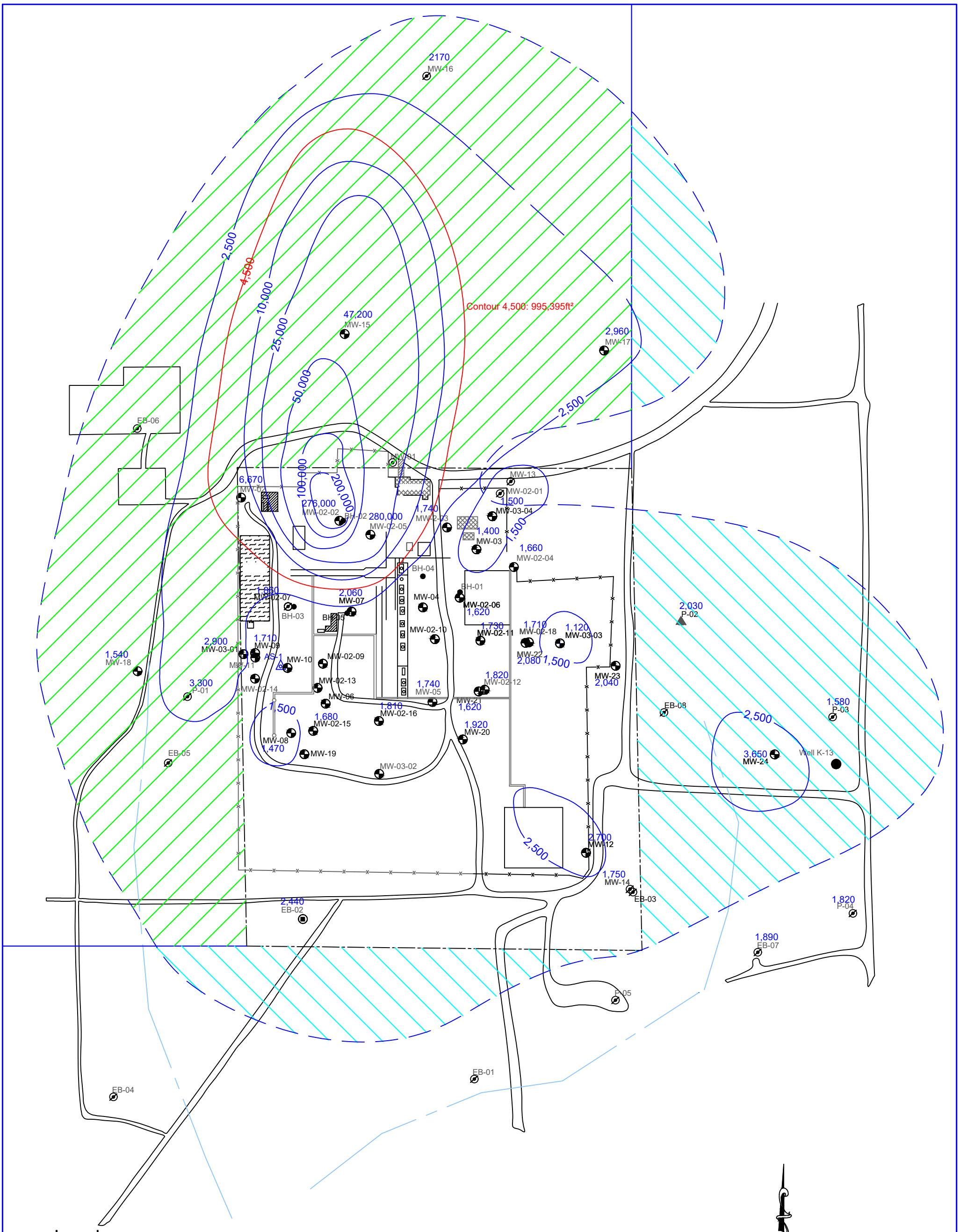
32° 46' 33.7"N

104° 15' 37.22"W

Larson & Associates, Inc.

Environmental Consultants

Figure 4c - TDS Concentation Map



Legend

24.92
MW-10 - Monitoring Well Location and Sulfate Concentration in Groundwater, Feet, June 2023

MW-01 - Plugged and Abandoned Monitoring Well

EB-02 - Monitoring Well Location and Sulfate Concentration in Groundwater, Feet, June 2023

P-02 - Piezometer (Fluid Level) Location

- Test Well Location

- Contour of Sulfate Concentration, Feet, June 2023

- Approximate Boundary of Shallow (perched) Groundwater

- Federal State Property Area

- New Mexico State Property Area

Fence

Property Line

Draw

Road

300 0 300
Graphic Scale in Feet

Frontier Field Services, LLC
AP - 112 / Empire - Abo Gas Plant
Unit I, (NE/4, SE/4)- 18 - S, R - 27 - E
Eddy County, New Mexico
32° 46' 33.7"N
104° 15' 37.22"W

Larson & Associates, Inc.
Environmental Consultants

Figure 4d - Sulfate Concentration in Groundwater, June 2023

Appendix A

NMOCD Undated Letter

State of New Mexico
Energy, Minerals and Natural Resources Department

By Electronic Mail

January 5, 2022
Graham Stahnke, P.G. - Regulatory Manager
AKA Energy Group, LLC
125 Mercado St., Suite 201
Durango, CO 80301

RE: **Empire ABO Gas Plant Site (Abatement Plan ID: AP-112; Facility ID: fGP00000000017; Incident #: NAUTOFGP000148; Application ID: 145697)**

The New Mexico Oil Conservation Division (OCD) is in receipt of the report requesting closure of the above reference abatement plan based on a demonstration of technical infeasibility, dated August 15, 2022, submitted on AKA Energy Group, LLC's (AKA Energy) behalf by Larson & Associates, Inc. The report provided details on monitoring, abatement, and a demonstration for closure based on technical infeasibility per Subsection E of 19.15.30.9 NMAC. This document was submitted on September 22, 2022, through OCD's online permitting under the ground water abatement portal. The request is denied for the following reasons:

a. The report indicates a water contaminant concentration greater than 200 percent of the applicable abatement standard. Under the applicable regulations, the OCD Director cannot approve such a proposal (Paragraph 2 of Subsection E of 19.15.30.9 NMAC).

a. Notwithstanding the foregoing, OCD also disagrees that AKA Energy is not able to meet the abatement standards set forth in Subsections A and B of 19.15.30.9 NMAC using commercially accepted abatement technology. Furthermore, the OCD believes AKA Energy did not demonstrate technical infeasibility by a statistically valid extrapolation showing that the decrease in concentrations of a water contaminant over a 20-year period such that the future reduction would be less than 20% of present concentrations (Paragraph 1 of Subsection E of 19.15.30.9 NMAC).

Moving forward, AKA Energy may consider the following options with respect to this site;

a. Removal of the remaining LNAPL (light non-aqueous phase liquid) in the 8 previously identified monitoring wells.

b. Mitigating LNAPL (light non-aqueous phase liquid) and dissolved phase

contaminants via commercially accepted abatement technology.

c. Pursuit of closure via technical infeasibility per Paragraph 3 of Subsection E of 19.15.30.9 or by filing a petition seeking approval of alternative abatement standards under Subsection F of 19.15.30.9 NMAC. Under the latter, AKA Energy must state the alternative standards it seeks for wells containing LNAPL.

For additional questions, please contact Nelson Velez at Nelson.Velez@emnrd.nm.gov.

Sincerely,

Dylan Fuge
Acting OCD Director

Appendix B

MI Laboratory Report

microbialinsights
10515 Research Drive
Knoxville, TN 37932
Phone: (865) 573-8188
Fax: (865) 573-8133

ANAB ANSI National Accreditation Board ACCREDITED ISO/IEC 17025 TESTING LABORATORY

Client:	Mark J Larson Larson & Associates, Inc. 507 N Marienfeld St Ste 202 Midland, TX 79701-4356	**Phone:**	432-556-8656 **Fax:**

Identifier: 082UH **Date Rec:** 08/22/2023 **Report Date:** 08/28/2023

Client Project #: 6-0141-13 **Client Project Name:** Oka Energy - Empire Abo Plant

Purchase Order #:

Test results provided for: CENSUS

Reviewed By:

Results relate only to the items tested and the sample(s) as received by the laboratory.

MICROBIAL INSIGHTS, INC.

10515 Research Dr., Knoxville, TN 37932
Tel. (865) 573-8188 Fax. (865) 573-8133

CENSUS

Client: **Larson & Associates, Inc.**
Project: Oka Energy - Empire Abo Plant

MI Project Number: **082UH**
Date Received: 08/22/2023

Sample Information

Client Sample ID:		**MW-20**	**MW-22**	**MW-24**	**MW-03-04**
Sample Date:		08/21/2023	08/21/2023	08/21/2023	08/21/2023
Units:		cells/bead	cells/bead	cells/bead	cells/bead
Analyst/Reviewer:		AR/SK	AR/SK	AR/SK	AR/SK
Functional Genes					
Sulfate Reducing Bacteria	APS	**3.33E+06**	**6.06E+05**	**5.69E+05**	**6.25E+06**

Legend:
NA = Not Analyzed NS = Not Sampled J = Estimated gene copies below PQL but above LQL I = Inhibited
< = Result not detected

Quality Assurance/Quality Control Data

Samples Received **8/22/2023**

Component	Date Prepared	Date Analyzed	Arrival Temperature	Positive Control	Extraction Blank	Negative Control
APS	08/22/2023	08/28/2023	0 °C	103%	non-detect	non-detect

REPORT TO:
Name: Mark J. Larson
Company: Larson & Associates, Inc.
Address: 507 N. Marienfield St. Suite 202 Midland, TX 79701
email: markelarenvironmental.com
Phone: (432) 687-0901
Fax: (432) 687-0456

Project Manager: Mark J. Larson
Project Name: BKa Energy - Empire Abo Plant
Project No.: 6-0141113

INVOICE TO: (For Invoices paid by a third party it is imperative that all information be provided)
Name: Mark J. Larson
Company: Larson & Associates, Inc
Address: 507 N. Marienfield St. Suite 202 Midland, TX 79701
email: markelarenvironmental.com
Phone: (432) 687-0901
Fax: (432) 687-0456

Purchase Order No.
Subcontract No.
MI Quote No.

microbialinsights
10515 Research Dr
Knoxville, TN 37932
865-573-8188
www.microbe.com

Ø Microbe Trap

Please Check One:
☐ More samples to follow
☒ No Additional Samples

Report Type: ☐ Standard (default) ☒ Microbial Insights Level III raw data (15% surcharge) ☐ Microbial Insights Level IV (25% surcharge) ☐ Comprehensive Interpretive (15%) ☐ Historical Interpretive (35%)

EDD type: ☐ Microbial Insights Standard (default) ☐ All other available EDDs (5% surcharge) Specify EDD Type:

Please contact us with any questions about the analyses or filling out the COC at (865) 573-8188 (9:00 am to 5:00 pm EST, M-F). After hours email: customerservice@microbe.com

Sample Information						Analyses				CENSUS: Please select the target organism/gene																						
MI ID (Laboratory Use Only)	Sample Name	Date Sampled	Time Sampled	Matrix	Total Number of Containers	PLFA	NGS	QuantArray Chlor	QuantArray Petro	DHC (Dehalococcoides)	DHC Functional genes (bvc, tce, vcr)	DHBi (Dehalobacter)	DHG (Dehalogenimonas)	DSM (Desulfuromonas)	DSB (Desulfitobacterium)	EBAC (Total)	SRB (Sulfate Reducing Bacteria-APS)	MGN (Methanogens)	MOB (Methanotrophs)	SMMO	DNF (Dentrifiers-nirS and nirK)	AMO (ammonia oxidizing bactena)	PM1 (MTBE aerobic)	RMO (Toluene Monooxygenase)	RDEG (Toluene Monooxygenase)	PHE (Phenol Hydroxylase)	NAH (Napthalene-aerobic)	BSSA (Toluene/Xylene-Anaerobic)	add. qPCR:	RNA (Expression Option)*	Other:	Other:	Other:
082UH 1	MW-20	8/21/23	08:20	Ø	1												X															
2	MW-22	↓	08:35	G	1												X															
3	MW-24		09:05	Ø	1												X															
4	MW-03-04		08:50	G	1												X															

Relinquished by: Date 08-21-2023 Received by: Date 8/22/23

It is vital that chain of custody is filled out correctly & that all relative information is provided.
Failure to provide sufficient and/or correct information regarding reporting, invoicing & analyses requested information may result in delays for which MI will not be liable.

* additional cost and sample preservation are associated with RNA samples.

**Saturday delivery: See sampling protocol for alternate shipping address.

Note: Time is Mountain Standard

Date Created	08-23-2023 17:31:22 PM EDT
Experiment Name	65 79 80 81UH ebdhcfxn 78 85UH ebdhc 77 82 86UH eb
Experiment Run Stop Time	08-23-2023 21:35:46 PM EDT
Experiment Type	Standard Curve
Instrument Name	285880036

Well	Sample Name	Detector	Task	CT	Volumes
A21	082UH 1	EBAC	UNKNOWN	19.811	20
A22	082UH 2	EBAC	UNKNOWN	20.511	20
A23	082UH 3	EBAC	UNKNOWN	22.727	20
C7	ebac pos	EBAC	UNKNOWN	20.960	1
C8	ebac pos	EBAC	UNKNOWN	20.041	1
C9	ebac neg	EBAC	UNKNOWN	Undetermined	1
C10	ebac neg	EBAC	UNKNOWN	Undetermined	1

Date Created	08-25-2023 12:24:30 PM EDT
Experiment Name	65 81 92 93 95UH ebdhcfxn 94UH ebdhc 98UH eb 87UH ebdil 65 57UH dhcRR 47 82UH 402EUH aps RS3rrs
Experiment Run Stop Time	08-25-2023 16:17:41 PM EDT
Experiment Type	Standard Curve
Instrument Name	285880036

Well	Sample Name	Detector	Task	CT	Volumes
F1	082UH 1	APS-1	UNKNOWN	28.294	20
F2	082UH 2	APS-1	UNKNOWN	31.649	20
F3	082UH 3	APS-1	UNKNOWN	35.306	20
F4	082UH 4	APS-1	UNKNOWN	33.903	20
F5	aps1 pos	APS-1	UNKNOWN	16.905	1
F6	aps1 pos	APS-1	UNKNOWN	16.778	1
F7	aps1 neg	APS-1	UNKNOWN	Undetermined	1
F8	aps1 neg	APS-1	UNKNOWN	Undetermined	1
F11	082UH 1	APS-2	UNKNOWN	28.214	20
F12	082UH 2	APS-2	UNKNOWN	34.876	20
F13	082UH 3	APS-2	UNKNOWN	36.886	20
F14	082UH 4	APS-2	UNKNOWN	30.585	20
F15	aps2 pos	APS-2	UNKNOWN	19.541	1
F16	aps2 pos	APS-2	UNKNOWN	19.705	1
F17	aps2 neg	APS-2	UNKNOWN	Undetermined	1
F18	aps2 neg	APS-2	UNKNOWN	Undetermined	1

F21	082UH 1	APS-3	UNKNOWN	24.999	20
F22	082UH 2	APS-3	UNKNOWN	27.480	20
F23	082UH 3	APS-3	UNKNOWN	27.568	20
F24	082UH 4	APS-3	UNKNOWN	24.036	20
G1	aps3 pos	APS-3	UNKNOWN	22.629	1
G2	aps3 pos	APS-3	UNKNOWN	22.459	1
G3	aps3 neg	APS-3	UNKNOWN	Undetermined	1
G4	aps3 neg	APS-3	UNKNOWN	Undetermined	1
G7	082UH 1	APS-4	UNKNOWN	Undetermined	20
G8	082UH 2	APS-4	UNKNOWN	Undetermined	20
G9	082UH 3	APS-4	UNKNOWN	Undetermined	20
G10	082UH 4	APS-4	UNKNOWN	Undetermined	20
G11	aps4 pos	APS-4	UNKNOWN	15.227	1
G12	aps4 pos	APS-4	UNKNOWN	15.275	1
G13	aps4 neg	APS-4	UNKNOWN	Undetermined	1
G14	aps4 neg	APS-4	UNKNOWN	Undetermined	1
G17	082UH 1	APS-5	UNKNOWN	Undetermined	20
G18	082UH 2	APS-5	UNKNOWN	Undetermined	20
G19	082UH 3	APS-5	UNKNOWN	Undetermined	20
G20	082UH 4	APS-5	UNKNOWN	Undetermined	20
G21	aps5 pos	APS-5	UNKNOWN	21.473	1
G22	aps5 pos	APS-5	UNKNOWN	21.283	1
G23	aps5 neg	APS-5	UNKNOWN	Undetermined	1
G24	aps5 neg	APS-5	UNKNOWN	Undetermined	1
H3	082UH 1	APS-6	UNKNOWN	Undetermined	20
H4	082UH 2	APS-6	UNKNOWN	Undetermined	20
H5	082UH 3	APS-6	UNKNOWN	Undetermined	20
H6	082UH 4	APS-6	UNKNOWN	Undetermined	20
H7	aps6 pos	APS-6	UNKNOWN	15.932	1
H8	aps6 pos	APS-6	UNKNOWN	16.415	1
H9	aps6 neg	APS-6	UNKNOWN	Undetermined	1
H10	aps6 neg	APS-6	UNKNOWN	Undetermined	1
H13	082UH 1	APS-7	UNKNOWN	Undetermined	20
H14	082UH 2	APS-7	UNKNOWN	Undetermined	20
H15	082UH 3	APS-7	UNKNOWN	Undetermined	20
H16	082UH 4	APS-7	UNKNOWN	Undetermined	20
H17	aps7 pos	APS-7	UNKNOWN	19.632	1
H18	aps7 pos	APS-7	UNKNOWN	20.380	1
H19	aps7 neg	APS-7	UNKNOWN	Undetermined	1
H20	aps7 neg	APS-7	UNKNOWN	Undetermined	1

Appendix C

NMOCD Approval to Discontinue Metals Monitoring

From: Billings, Bradford, EMNRD
To: Mark Larson; Bratcher, Mike, EMNRD
Cc: Stahnke, Graham; Rachel Owen; Robert Basom
Subject: RE: [EXT] Re: Modification to Routine Groundwater Monitoring Parameter List, AKA Energy LLC, Empire Abo Gas Plant (AP-112), Eddy County, New Mexico
Date: Monday, May 06, 2019 2:56:09 PM

5/6/2109

All Parties,

Regarding alteration of groundwater sampling as outlined in below section submitted by Larson Environmental:

The changes are specified below are approved.

Please keep this communication for your records, as NO paper copy will follow. The oil Conservation Division (OCD) appreciates you efforts.

Sincerely,

Bradford Billings
EMNRD/OCD
Santa Fe

OCD approval does not relieve the operator of liability should their operations fail to adequately investigate and remediate contamination that may pose a threat to ground water, surface water, human health or the environment. In addition, OCD approval does not relieve the operator of responsibility for compliance with any other federal, state, local laws and/or regulations.

From: Mark Larson <Mark@laenvironmental.com>
Sent: Friday, May 3, 2019 2:55 PM
To: Billings, Bradford, EMNRD <Bradford.Billings@state.nm.us>; Bratcher, Mike, EMNRD <mike.bratcher@state.nm.us>; Griswold, Jim, EMNRD <Jim.Griswold@state.nm.us>
Cc: Stahnke, Graham <gstahnke@sugf.com>; Rachel Owen <rowen@laenvironmental.com>; Robert Basom <RBasom@laenvironmental.com>
Subject: [EXT] Re: Modification to Routine Groundwater Monitoring Parameter List, AKA Energy LLC, Empire Abo Gas Plant (AP-112), Eddy County, New Mexico

Hello Bradford,
Per our discussion, AKA Energy (AKA), a wholly owned entity of Southern Ute Indian Tribe Growth

Fund (SUGF), requests approval to discontinues monitoring for dissolved metals in groundwater samples during routine (semi-annual) monitoring at the Empire Abo Plant (AP-112) until groundwater remediation is complete. This request is based on concentrations of dissolved metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver) being below the New Mexico Water Quality Control Commission (WQCC) human health standards since 2017 and light non-aqueous phase liquid (LNAPL) that is source and will continue to be a source for dissolved BTEX until remediation is complete. AKA understands that dissolved metals analysis will be required during post-groundwater remediation monitoring. AKA also requests approval to reduce the frequency of monitoring for cations (calcium, magnesium, potassium and sodium) anions (alkalinity, chloride and sulfate) and total dissolved solids (TDS) to once annually based on naturally elevated concentrations of sulfate and TDS in groundwater and the history of these constituent in groundwater samples. To recap, AKA will continue monitoring groundwater from fifteen (15) wells (MW-02, MW-03, MW-08, MW-12, MW-15, MW-17, MW-18, MW-20, MW-22, MW-23, MW-24, EB-02, EB-07, P-02 and P-05) on a semi-annual (twice yearly) schedule for BTEX and on an annual (once per year) schedule for cations (calcium, magnesium, potassium and sodium) anions (alkalinity, chloride and sulfate) and total dissolved solids (TDS). All monitoring wells at the facility will be gauged for depth to LNAPL and groundwater during each semi-annual groundwater monitoring event and laboratory results will be submitted to the New Mexico Oil Conservation Division (OCD) in an annual report with groundwater remediation updates and laboratory reports. OCD will be notified as soon as possible of any significant change in parameter concentration. Please let me know if this accurately presents our conversation and respond with your approval if correct. Please contact Graham Stahnke with SUGF at (970) 764-6484 or email gstahnke@sugf.com or me if you have questions.
Respectfully,

Mark J. Larson, P.G.
President/Sr. Hydrogeologist
507 N. Marienfeld St., Suite 205
Midland, Texas 79701
Office – 432-687-0901
Cell – 432- 556-8656
Fax – 432-687-0456
mark@laenvironmental.com

"Serving the Permian Basin Since 2000"

District I
1625 N. French Dr., Hobbs, NM 88240
Phone:(575) 393-6161 Fax:(575) 393-0720
District II
811 S. First St., Artesia, NM 88210
Phone:(575) 748-1283 Fax:(575) 748-9720
District III
1000 Rio Brazos Rd., Aztec, NM 87410
Phone:(505) 334-6178 Fax:(505) 334-6170
District IV
1220 S. St Francis Dr., Santa Fe, NM 87505
Phone:(505) 476-3470 Fax:(505) 476-3462

State of New Mexico
Energy, Minerals and Natural Resources
Oil Conservation Division
1220 S. St Francis Dr.
Santa Fe, NM 87505

CONDITIONS

Action 279543

CONDITIONS

Operator:	OGRID:
Aka Energy Group, LLC 125 Mercado St, Suite 201 Durango, CO 80301	330743
	Action Number: 279543
	Action Type: [UF-GWA] Ground Water Abatement (GROUND WATER ABATEMENT)

CONDITIONS

Created By	Condition	Condition Date
michael.buchanan	Letter of determination sent to operator. Received for the record.	2/12/2024