ENSOLUM

GAS MITIGATION MONTHLY REPORT - September 2023

Property:

South Hobbs G/SA Unit
Unit F, Section 5, Township 19S, Range 38E
Latitude 32.690683, Longitude -103.173158
Lea County, New Mexico

New Mexico EMNRD OCD
Order No. R-4934-F, Case No. 14981
Incident ID No. nAPP2227033082

February 5, 2024

Prepared for:

Occidental Permian LTD
1600 Gehrig Dr.
Midland, Texas 79706
Attn: Ms. Melissa Gilliland

Prepared by:

Beaux Jennings
Senior Project Manager

Elizabeth Scaggs, PG
Principal

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1.0 INTRODUCTION

1.1 Site Description & Background

Operator:	Occidental Permian LTD (OXY)
Site Name:	South Hobbs G/SA Unit Operations (Site)
Location:	Unit F, Section 5, Township 19 South, Range 38 East Latitude 32.690683, Longitude -103.173158 Lea County, New Mexico
Property Owner:	OXY
Regulatory:	New Mexico Energy, Minerals and Natural Resources Department (EMNRD) New Mexico Oil Conservation Division (NMOCD) Incident ID No. nAPP2227033082 Order No. R-4934-F Case No. 14981

This Gas Mitigation Monthly Report - September 2023 summarizes activities subsequent to the *Gas Mitigation Monthly Report - August 2023*, dated February 5, 2024. All wells are located within operations that are part of the South Hobbs Grayburg/San Andres Unit (SHU) Field in the southwestern area of the City of Hobbs, Lea County, New Mexico. Collectively, the Levey water well (Levey Well) and the two monitoring wells (MW-1 and MW-2) are referred to as the "Site". OXY has investigated groundwater and oil and gas operation well conditions in the area of the Site. A Site Map, which indicates the approximate locations of the Levey Well and monitoring wells MW-1 and MW-2 in relation to pertinent structures and general Site boundaries, is included as **Figure 1** in **Appendix A**.

On June 30, 2019, elevated pressure was observed at the Levey Well. At the request of the New Mexico Oil Conservation Division (NMOCD), localized area wells were "shut in" from operational use. Over time, the pressure being observed at the Levey Well declined until pressure was no longer recorded. Observations and water analysis of the Levey water well did identify free gas in the well bore; however, pressure from the underlying groundwater-bearing zone was no longer present. Operational data was analyzed as part of the area wide assessment and adjacent wells investigated as potential sources for the gas infiltration. During maintenance operations at SHU #183, located approximately 575 feet southwest of the Levey Well, the SHU #183 well string was pulled, and pressures measured for proof of casing integrity. During these operations, SHU #183 was found to have a casing leak, which is believed to be the source of the pressure observed at Levey well. In response, OXY plugged the SHU #183 well to the surface. No other anomalies

were observed in the adjacent area oil and gas wells. After SHU #183 was plugged, OXY drilled a nearby replacement well. This replacement well, designated as SHU #297, is currently operational and shows no concerns of free gas migration.

In February of 2020, permission was obtained from the NMOCD to drill two monitoring wells (MW-1 and MW-2) for analysis and observation purposes. Monitoring well MW-1 was installed in the vicinity of the Levey Well and monitoring well MW-2 was installed in the vicinity of SHU #183.

During initial pre-start up background sampling of the Levey Well, MW-1 and MW-2 on two separate events, May 25th and June 20th of 2020, gas with lower explosive limits (LEL's) at or over 60% were observed in the Levey Well and monitoring well MW-2. This finding was consistent with previous analysis and findings within the Levey Well and not an unexpected result as the previous contributions of gas from the SHU #183 had been sufficient to result in pressure at the surface through the Levey Well.

OXY's groundwater monitoring program included the collection of a groundwater sample from each monitoring well (MW-1 and MW- 2). The monitoring wells were gauged and sampled on May 26, June 30, August 20, October 23, November 24, December 18, 2020, and weekly thereafter. The Levey Well has been sampled consistently from December 6, 2019, to September 25, 2023. The groundwater samples collected from the monitoring wells (MW-1 and MW-2) were analyzed for total petroleum hydrocarbons (TPH), gasoline range organics (GRO), diesel range organics (DRO), and oil range organics (ORO) utilizing Environmental Protection Agency (EPA) Method 8015M, volatile organic compounds (VOCs) utilizing EPA Method SW-846 #8260 (full list), carbon dioxide utilizing Standard Method 4500 CO2 C, dissolved sulfide utilizing EPA Method SW-846 #376.2, chloride using EPA Method SW-846 #300.0 and pH utilizing EPA Method SW-846 #150.1. The groundwater samples collected from the Levey Well were analyzed for VOCs, recoverable metals per ICP by EPA 200.7, inorganic anions by EPA 300/300.1, pH by SM4500-H, total dissolved solids (TDS) by SM2540C, alkalinity by SM2320B and cation-anion balance by SM1030E.

During the September 2023 groundwater sampling event the groundwater samples did not exhibit constituent concentrations above New Mexico Water Quality Control Commission (WQCC) *Groundwater Quality Standards* (*GQSs*), with the exception of benzene, Nitrite as N, and TDS. Benzene concentrations ranged from 0.00916 milligrams per liter (mg/L) to 0.0211 mg/L in monitoring well MW-2. Nitrite as N exceedances ranging from 1.25 mg/L to 2.69 mg/L were observed in the Levey Well, Nitrite as N exceedances ranging from 2.13 mg/L to 2.43 mg/L observed in monitoring well MW-1, and Nitrite as N exceedances ranging from 4.04 mg/L to 4.90 mg/L observed in monitoring well MW-2. In addition, TDS concentrations ranged from 1,030 mg/L to 1,320 mg/L in the Levey Well. Although above the GQS, these TDS concentrations are consistent with background levels in the Quaternary Alluvium, Ogallala Formation, and the Dockum Group (i.e., the three groundwater bearing units) in Southern Lea County (Nicholson and Clebsch, 1961). The groundwater analytical summary tables are included in **Appendix B**.

OXY utilized automated processes to compile and monitor dates related to the SHU localized wells to ensure tracking of production and injection activities as related to the re-start of these area operations. No anomalies were observed in the area oil and gas wells that could contribute free gas into the groundwater-bearing zone.

To mitigate potential exposures, the Levey residence was purchased by OXY and remains unoccupied. A passive vent was installed on the Levey Well to mitigate safety and explosivity concerns for the residential and work area. There has been no detectable build-up of pressure in the Levey Well or monitoring wells MW-1 and MW-2. Hydrogen sulfide (H_2S) has not been detected

in any of the three forementioned wells since July 15, 2020. All detections of H_2S prior to July 15, 2020 were within the well bore. No H_2S above permissible exposure limits was observed outside of the well bores.

OXY installed pressure reading charts at the Levey Well to measure the potential for any returning pressure at the well. These charts measure pressure 24 hours a day and show that no pressure has returned to the Levey Well. Monitoring wells MW-1 and MW-2 were physically monitored for the presence of gas and pressure on several dates from 7/1/2020 to 9/25/2023, with no pressure observed in either monitoring well. The pressure reading chart available for September 2023 is included in **Appendix D**.

The data indicates that pressure sourced from SHU #183 contributed to the infiltration of free gas into the red beds just beneath the groundwater-bearing zone, creating a pressurized pool of gas that traveled to the Levey Well. Once SHU #183 was plugged, the pressure source was removed from the red beds and overlying groundwater-bearing zone and the remaining free gases below remain pooling within the red bed underlying the groundwater-bearing zone. This is supported by the data described above and is consistent with findings reported in two reports, one co-authored and supplied by Lisa Molofsky of GSI Environmental Inc. The first is "Purging and other sampling variables affecting dissolved methane concentration in water supply wells", and the second "Factors affecting the variability of stray gas concentration and composition in groundwater" authored by A.W. Gorody, referenced below. The reports state:

> *As free-phase gas spreads vertically and/or laterally from a source of release, it can become trapped beneath low permeability sediments (e.g., the "red beds" which separate the overlying Ogallala aquifer from the underlying Santa Rosa). Irregularities in the base topography of these barriers can result in discretized pools of free-phase gas. In many ways, this trapping and accumulation of free-phase gases beneath impermeable units is analogous to the development of structural traps that form in conventional oil and gas reservoirs. This phenomenon can also be viewed as the conceptual inverse of a chlorinated solvent release (a dense NAPL, or "DNAPL") in which the dense liquid can migrate downward through the groundwater via available pathways, until encountering a resistant layer, where the dense liquid pools and accumulates.*
>
> *In water supply wells, free-phase gas entry is most likely to occur when water levels are lowered in a well by pumping or drought, because this reduces the pressure head resisting gas entry from the formation into the well (Gorody 2012, Molofsky et al. 2018). This may allow free-phase gas to enter the well from one unit (e.g., red bed), while water is primarily originating from another (e.g., the Ogallala aquifer). When the two phases (free-phase gas from the red bed and groundwater from the Ogallala) mix in the water well, there is relatively little time for equilibration under pumping conditions; consequently, dissolved gas concentrations may be very low even though free-phase gas is observed in the well headspace.*

These studies and OXY's related findings are that the remaining free gas beneath portions of the Site is pooled within the red beds and the overlying geologic pressure is such that it is confining the free gas. The free gas observed in the Levey Well and monitoring well MW-2 well bores are traveling through these conduits to near surface but lack the pressure to release from the subsurface as the additional pressure from SHU #183 has been eliminated. This coupled with the finding that there is little mixing of constituents of gases into the dissolved phase within the adjacent groundwater supports the understanding that the gases are remaining beneath the water interface and only traveling up to surface when the relative pressure allows it to do so, rather than mixing with the water source.

The data indicates that the current free gas in the subsurface has reached a point of equilibrium and, without influence, is stable. To mobilize the free gas, a pressure change was proposed to release the free gas pool from the subsurface red bed, as described below in Section 1.3.

1.2 Groundwater Recovery – Levey Well

As of July 1, 2021, the Levey Well has run full time and recovered groundwater is transferred via flowline to a nearby tank for proper disposal. The groundwater recovered from the Levey Well during September 1 - 25, 2023 was approximately 464,367 gallons.

1.3 Gas Recovery – Levey Well

OXY conducted two vacuum recovery event during the month of September 2023 with positive results as shown on **Table 4** in **Appendix B**. The purpose of this event was to attach a vacuum pump truck to the Levey Well, creating a vacuum on the wellbore, and displacing the underlying water releasing the overlying pressure restraining the free gas pool, and releasing it to the surface. This process will continue into September 2023 once every two weeks until the sampling results of the air are minimal after displacement of the overlying pressure, or the process proves to become ineffective.

2.0 AIR AND GROUNDWATER MONITORING

2.1 Air Sampling Program

Levey Well

The air samples from September 11, 2023 and September 25, 2023, were taken prior to, during, and subsequent to the vacuum recovery event utilizing Summa® canisters. Upon arrival at the Site, the Levey Well is turned off and allowed to stabilize for approximately one hour. An air sample is taken after one hour of the Levey Well stabilization, prior to initiating the vacuum recovery event.

During both days, vacuum recovery event, the vacuum was applied to the Levey Well for a duration of approximately two hours. Approximately one hour and two hours into the event, an air sample was taken. The vacuum was then turned off and an additional air sample from the Levey Well was taken one hour subsequent to the vacuum recovery event. Water was not recovered during the vacuum recovery event.

The Summa® canisters were shipped under proper chain-of-custody to Pace Analytical Laboratory in Mount Juliet, TN for analysis of volatile organic compounds (VOCs) by Method TO-15. Laboratory analytical results are summarized in **Table 4** in **Appendix B**. The executed chain-of-custody forms and laboratory data sheets from the September 2023 sampling event are provided in **Appendix C**.

2.2 Groundwater Sampling Program

Groundwater sampling events were conducted each week on the Levey Well and monitoring wells MW-1 and MW-2. The groundwater sampling program followed the requirements from NMOCD and consists of the following:

Levey Well

As of July 1, 2021, the Levey water well has run full time. The Levey well recovered groundwater is transferred via flowline to a nearby tank battery for proper disposal. Prior to sample collection, the Levey Well is turned off and allowed to stabilize for approximately one hour prior to sampling. Once the Levey Well is properly purged and readings from the AquaTROLL 500 stabilize, a groundwater sample is collected.

The groundwater samples collected from the Levey Well were analyzed for VOCs, recoverable metals per ICP by EPA 200.7, inorganic anions by EPA 300/300.1, pH by SM4500-H, TDS by SM2540C, alkalinity by SM2320B and cation-anion balance by SM1030E.

Monitoring Wells MW-1 and MW-2

Prior to sample collection, the depth to fluids in each monitoring well (MW-1 and MW-2) are gauged using a water level meter capable of detecting groundwater up to 0.01 feet. Each monitoring well is then sampled utilizing micro-purge low-flow sampling techniques. Subsequent to the completion of the micro-purge process, one groundwater sample is collected from each monitoring well.

The groundwater samples collected from monitoring wells MW-1 and MW-2 were analyzed for TPH GRO, TPH DRO and ORO utilizing EPA Method 8015M, VOCs utilizing EPA Method SW-846 #8260, carbon dioxide utilizing Standard Method 4500, dissolved sulfide utilizing EPA Method SW-846 #376.2, chloride using EPA Method SW-846 300.0 and pH utilizing EPA Method SW-846 #150.1.

Low flow refers to the velocity with which groundwater enters the pump intake and is imparted to the formation water in the immediate vicinity of the well screen. The objective is to pump in a manner that minimizes stress (drawdown) to the system, to the extent practical, taking into account established Site sampling objectives. Flow rates on the order of 0.1 to 0.5 liters per minute (l/min) will be maintained during sampling activities, using dedicated or decontaminated sampling equipment.

The groundwater samples are collected from each monitoring well once produced groundwater is consistent in color, clarity, pH, temperature, and conductivity. Measurements during purging are taken every three to five minutes. Purging is considered complete once key parameters (especially pH and conductivity) have stabilized for three successive readings.

Groundwater samples were collected in laboratory supplied containers, labeled/sealed using the laboratory supplied labels and custody seals, and stored on ice in a cooler. The groundwater samples were relinquished to the courier for Eurofins Midland in Midland, Texas under proper chain-of-custody procedures.

Laboratory analytical results are summarized in **Tables 1** through **Table 3** in **Appendix B**. The executed chain-of-custody forms and laboratory data sheets are provided in **Appendix C**.

3.0 DATA EVALUTATION

3.1 Air Samples

Gas mitigation activities at the Levey Well began on November 8, 2021, and will continue on a bi-weekly basis through October 2023. Based on the concentrations observed in the Levey Well air samples, the vacuum recovery events are drawing the free gas over to the Levey Well. Prior to each vacuum recovery event, an air sample is taken to give a representative snapshot of static conditions of gas in the subsurface. Elevated concentrations of cyclohexane, heptane, n-hexane, 2-propanol, m&p-xylene, o-xylene, and/or TPH were observed prior to the initiation of each vacuum recovery event.

Once initiated, an air sample is taken at one hour and two hours into the vacuum recovery event. During each of the vacuum recovery events, cyclohexane, heptane, n-hexane, 2-propanol, m&p-xylene, o-xylene, and/or TPH concentrations significantly decrease throughout the duration of the event.

Approximately one hour after the termination of the vacuum recovery event, a final air sample is collected. Elevated concentrations of acetone, cyclohexane, ethanol, ethylbenzene, 4-ethyltoluene, heptane, n-hexane, isopropylbenzene, 2-propanol, toluene, 1,2,4-trimethylbenzene, m&p-xylene, o-xylene, and/or TPH begin to accumulate inside the Levey water well casing. These results indicate that the vacuum recovery events are successful in drawing the subsurface gas over to the Levey Well.

Air samples are also collected on a bi-weekly basis approximately one week subsequent to the vacuum recovery event. During each of the bi-weekly air sampling events, elevated concentrations of carbon disulfide, cyclohexane, ethylbenzene, 4-ethyltoluene, heptane, n-hexane, isopropylbenzene, 2-propanol, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, m&p-xylene, o-xylene, and/or TPH were observed inside the Levey water well casing. These results again indicate that the vacuum recovery events are successful in drawing the subsurface gas over to the Levey Well.

3.2 Groundwater Samples

Ensolum compared the laboratory analytical results or laboratory practical quantitation limits (PQLs) associated with the September 2023 groundwater samples collected from the Levey Well and monitoring wells MW-1 and MW-2 to the New Mexico WQCC GQSs. The results of the groundwater sample analyses are summarized in **Table 1** through **Table 3** of **Appendix B**. All analytical results were below the WQCC GQSs, with the exception of the analytes, as discussed below.

Levey Well

TDS concentrations of 1,030 mg/L to 1,320 mg/L were observed during the September 2023 sampling. Although above the GQS, these TDS concentrations are consistent with background levels in the Quaternary Alluvium, Ogallala Formation, and the Dockum Group (i.e., the three groundwater bearing units) in Southern Lea County (Nicholson and Clebsch, 1961). Specifically, for the 20 water supply wells sampled by the USGS in Southern Lea County with TDS analyses, the median TDS concentration was 722 mg/L, and the 75th percentile TDS concentration was 1,953 mg/L.

The Levey Well sampling first began on December 6, 2019. Through mitigation activities, including groundwater recovery and vacuum recovery events, the benzene concentration in the Levey Well has significantly decreased over time, with the exception of December 29, 2021, which had a benzene analytical result of 0.00611 mg/L, the January 19, 2022, which had a benzene analytical result of 0.00684 mg/L, the March 9, 2022, which had a benzene analytical result of 0.00552 mg/L, the January 25, 2023, which had a benzene analytical result of 0.00589 mg/L, the July 27, 2023, which had a benzene analytical result of 0.00659 mg/ L, and the August 14, 2023, which had a benzene analytical result of 0.00575 mg/ L, which exceeds the WQCC GQS of 0.005 mg/L. This slight rise in concentration is indicative that the vacuum recovery events are successful in drawing the subsurface gas over to the Levey Well. Benzene concentrations over time are graphed and included in **Appendix A**, showing the significant decrease of benzene in the Levey Well over time.

The Levey Well also showed Nitrite as N exceedances ranging from 1.25 mg/L to 2.69 mg/L.

Monitoring Well MW-1 and MW-2

The groundwater samples collected from monitoring well MW-1 did not exhibit benzene concentrations above the WQCC GQS of 0.005 mg/L. The groundwater samples collected from monitoring well MW-2 exhibited benzene concentrations ranging from 0.00916 mg/L to 0.0211 mg/L, which exceed the WQCC GQS of 0.005 mg/L.

In addition, several Nitrite as N exceedances ranging from 2.13 mg/L to 3.43 mg/L were observed in monitoring well MW-1 and exceedances ranging from 4.04 mg/L to 4.90 mg/L were observed in monitoring well MW-2, which is above the WQCC GQS of 1.0 mg/L.

All other VOC concentrations were either below the laboratory reporting limit or below the WQCC GQS protective concentrations. All laboratory reporting limits were below the WQCC GQS protective concentrations, indicating a lack of dissolved phase gas infiltration into the localized groundwater.

4.0 RECOMMENDATIONS

OXY has demonstrated over time that the SHU #290 and the surrounding oil and gas operations were and are not a contributor to the previous related pressure observed in the Levey Well. This has been demonstrated by over four months of readings (**Appendix D**) which show that the pressures and gas readings are very consistent with pre-injection background, including, but not limited to carbon dioxide. The plugging of the SHU #183 well has shown to be effective in discontinuing the source of free gas related to the Levey water well.

OXY requests from the NMOCD moving forward in 2024 to:

- **Plug and abandon the Levey Well and monitoring well MW-1;**
- **Remove impacted groundwater utilizing monitoring well MW-2 full time. The recovered groundwater will be transferred via flowline to a nearby tank for proper disposal. Groundwater removal will continue until acceptable levels achieving compliance expectations are complete;**
- **Implement monthly sampling for water and air on monitoring well MW-2 moving forward in 2024;**

- **Utilizing monitoring well MW-2, continue to remove free gas accumulations from the underlying red bed and groundwater-bearing zone on a bi-weekly basis to acceptable levels of removal to achieve compliance expectations. The air sampling process performed at the Levey Well will continue utilizing monitoring well MW-2, as described in Section 2.1; and**

- **Continue to monitor MW-2 utilizing daily pressure checks for significant changes in pressure, which could indicate a secondary source, until compliance of free gas removal is achieved.**

5.0 REFERENCES

GSI Environmental Inc. Preliminary Draft -Results of Water Supply Well Sampling and Investigation. November 2019. Hobbs New Mexico Municipal Code, Title 13.04.017. Accessed Sept. 2020.

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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 311326

CONDITIONS

Operator: OCCIDENTAL PERMIAN LTD P.O. Box 4294 Houston, TX 772104294	OGRID: 157984
	Action Number: 311326
	Action Type: [UF-GWA] Ground Water Abatement (GROUND WATER ABATEMENT)

CONDITIONS

Created By	Condition	Condition Date
michael.buchanan	GAS MITIGATION MONTHLY REPORT - September 2023 has been accepted for the record. Property: South Hobbs G/SA Unit Unit F, Section 5, Township 19S, Range 38E Latitude 32.690683, Longitude -103.173158 Lea County, New Mexico	4/17/2024