EA Engineering, Science, and Technology, Inc., PBC
320 Gold Avenue SW, Suite 1300
Albuquerque, New Mexico 87102

June 8, 2023

Mr. Jaben Richards
Ground Water Quality Bureau
New Mexico Environment Department
PO Box 5469
Santa Fe, NM 87502

Dear Mr. Richards:

On behalf of Doña Ana Dairies, Inc., EA Engineering, Science, and Technology, Inc., PBC is submitting this Annual Groundwater Monitoring Report (Report) for Doña Ana Dairies located in Mesquite, Vado, and Anthony, New Mexico. The Report discusses the annual groundwater sampling events conducted to fulfill requirements of the Stage 2 Abatement Plan for Doña Ana Dairies.

Please let me know if you have any questions regarding the information provided in this report.

Sincerely,

Gina Mullen
Project Manager

Jay Snyder
Senior Hydrogeologist

Enclosure

cc: Linda Armstrong, Doña Ana Dairies
File

ANNUAL GROUNDWATER MONITORING REPORT
DOÑA ANA DAIRIES
MESQUITE, NEW MEXICO

Prepared for:

Doña Ana Dairies
Mesquite, New Mexico

Prepared by:

EA Engineering, Science,
and Technology, Inc., PBC
320 Gold Avenue SW, Suite 1300
Albuquerque, New Mexico 87102

June 2023

EA Project No. 1464109.05

320 Gold Avenue SW, Ste.1300
Albuquerque, NM 87102
Telephone: 505-224-9013

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06/08/2023

Gina Mullen — Date
Project Manager

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Jay Snyder — Date
Senior Hydrogeologist

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1.0 INTRODUCTION

On behalf of Doña Ana Dairies (Dairies), EA Engineering, Science, and Technology, Inc., PBC (EA) has prepared this Annual Monitoring Report (Report) for Doña Ana Dairies located south of Las Cruces, New Mexico (Figure 1). The Report was completed in accordance with the *Stage 2 Abatement Plan* and the *Sampling and Analysis Plan, Doña Ana Dairies, Doña Ana County, New Mexico* dated November 7, 2013 (EA 2013b), and August 11, 2008 (Golder 2008d), respectively, and the Conceptual Work Plan (CWP) dated February 1, 2008 (Golder 2008a). All were prepared to satisfy requirements stated in the New Mexico Administrative Code (NMAC), Title 20, Chapter 6, Part 2, Sections 4106 through 4110 (20.6.2.4106 – 20.6.2.4110 NMAC). The Sampling and Analysis Plan was approved by the New Mexico Environment Department (NMED) Ground Water Quality Bureau (GWQB) on September 25, 2008 (NMED 2008). On March 25, 2015, the stipulated agreement to additional requirements to the Doña Ana Dairies Stage 2 Abatement Plan was agreed upon by NMED, Doña Ana Dairies, and the Rio Valle Concerned Citizens (NMED 2015). On April 10, 2015, the Stage 2 Abatement Plan was approved by NMED by Final Order (NMED 2015).

1.1 Objectives

The objectives of this monitoring program are to satisfy the requirements set forth in the Stage 2 Abatement Plan and the Stipulated Agreement and to satisfy the requirements set forth in 20.6.2.4110 NMAC.

The following work was performed to meet the objective of the monitoring program:

- Representatives from D&H Petroleum and Environmental Services, Inc. (D&H) gauged discharge plan (DP) monitoring wells, abatement plan (AP) monitoring wells, and Anthony Wastewater Treatment Plant (WWTP) wells from February 2 through February 8, 2023. Glorieta Geoscience, Inc. (Glorieta) gauged Organ Dairy wells on January 11, 2023. Monitoring well gauging data is provided in Appendix A.

- From February 8 through March 10, 2023, D&H representatives collected groundwater samples from all AP, DP, and irrigation/supply wells that contained sufficient water. Glorieta sampled Organ Dairy wells on January 11, 2023. Groundwater samples were analyzed for nitrate/nitrite, total Kjeldhal nitrogen (TKN), chloride, total dissolved solids (TDS), and sulfate. Field parameters including specific conductance, dissolved oxygen, oxidation reduction potential (ORP), pH, and temperature, were monitored and recorded on field forms during sampling. Field sampling forms and analytical data reports are provided in Appendix A and B, respectfully.

- Hydrographs for select DP monitoring wells were updated and provided in Appendix C.

- Field parameter trends for specific conductance, dissolved oxygen, and ORP were updated and provided in Appendix D.

- Concentration trends analyses were updated and provided in Appendix E for AP monitoring wells and in Appendix F for DP monitoring wells.

- Mann-Kendall Trend Analysis of analytes was updated, performed, and provided in Appendix G.

- First-order decay rate calculations for nitrate at monitoring wells for monitored natural attenuation (showing decreasing nitrate concentrations) were updated, calculated, and provided in Appendix H.

1.2 Background

In correspondence dated April 7, 2006, NMED required a Stage 1 Abatement Plan for 13 dairies in Doña Ana County, based on analytical results from DP monitoring of on-site compliance monitoring wells that showed concentrations of nitrate, chloride and TDS exceeding ground water standards promulgated in New Mexico Water Quality Control Commission (NMWQCC) Regulations (20.6.2.3103 NMAC). The 13 dairies were:

1. Organ Dairy (Former Daybreak and Del Norte Dairy),
2. Mountain View Dairy,
3. Buena Vista I Dairy,
4. Bright Star Dairy,
5. Dominguez 2 (Former D&J Dairy),
6. Dominguez Dairy,
7. Gonzales Dairy,
8. Buena Vista Dairy I and II,
9. River Valley Dairy,
10. Big Sky Dairy,
11. Sunset Dairy,
12. Desert Land Dairy,
13. Del Oro Dairy.

On October 30, 2006, the 13 dairies notified NMED that they had reached an agreement to work as a group and submit a joint response to NMED's request (Doña Ana Dairies, 2006). Currently the Doña Ana Dairies (DAD) consortium consists of 9 dairies with the departure from the group by Buena Vista I Dairy in 2011, River Valley Dairy in April 2019, and Gonzalez Dairy in October 2020.

The current DAD consortium (9 dairies) is organized geographically into the northern area, central area and southern area. The northern area currently consists of Organ Dairy, Mountain View Dairy, Bright Star Dairy, Dominguez 2 Dairy, and Dominguez Dairy. The northern land application is also included in the northern area of DAD. Buena Vista Dairy and Gonzalez Dairy, though no longer members of the DAD consortium, are located within the northern area. The central area consists of Buena Vista Dairy II, Big Sky Dairy, and Sunset Dairy/Desert Land Dairy. Though no longer a member of the DAD consortium, River Valley Dairy is also located in the central area. The southern area includes only the Del Oro Dairy.

On December 11, 2006, on behalf of the Doña Ana Dairies, Golder Associates Inc. (Golder) submitted a Stage 1 and 2 Abatement Plan Proposal to address impacts to groundwater in the area containing the Dairies (Golder 2006). The first major deliverable in the Abatement Plan

Proposal was an Existing Data Report (EDR) to bring together in one document historical data and practices of the constituent dairies.

The EDR, submitted on February 1, 2008 (Golder 2008a), was intended to satisfy the DAD consortiums ‘commitment for compilation and submission of existing data identified in the Doña Ana Dairies response (Golder 2006) to the NMED requirement for Stage 1 Abatement Plans. Section 9 of the EDR outlined data gaps identified during the preparation of the report, as well as the actions recommended. To facilitate the discussion of the path forward after the submittal of the EDR and concurrent with the EDR submission, a conceptual work plan (CWP) was prepared (Golder 2008b).

On July 15, 2008, the DAD consortium, Golder and NMED met (Golder 2008c). During that meeting, plume maps presented in the EDR (Golder 2008a), new monitoring data, and knowledge of monitoring well locations and groundwater chemistry results at adjacent DP-regulated facilities were used to identify data gaps with respect to ground water flow direction and plume delineation. The agreed upon data gaps yielded monitoring well locations (including contingency monitoring well locations) recorded in the meeting minutes (Golder 2008c) and depicted in the Sampling and Analysis Plan (SAP) dated August 8, 2008 (Golder 2008d). The SAP outlined the details of the field operations to be implemented for completion of data gaps, such that a Site Investigation Report (§4106.C.6) and Stage 2 Abatement Plan (§4106.D) could be prepared.

Groundwater gauging was conducted concurrent to discussions with NMED at the DAD consortium for four quarters, February 2008, June 2008, September 2008, and December 2008, to determine the current and historical site groundwater gradient.

In May 2009, field work was conducted as outlined in the SAP and ten AP monitoring wells (DAD-01 through DAD-10) were installed. In July 2009, the Site Investigation Report was submitted to the NMED (EA 2009).

On February 9, 2012, the Final Site Investigation Report was submitted to NMED (EA 2012a). The report summarized field activities that occurred from October 10 through October 14, 2011, and November 10 through 18, 2011, during which eleven soil borings were advanced at the site and converted into monitoring wells DAD-12 through DAD-14, DAD-16 through DAD-22, and DP well 177-03A.

On August 16, 2012, soil boring/monitoring well DAD-15 was installed and on August 20, 2012, well DAD-15 was sampled. An addendum to the Final Site Investigation Report was submitted to NMED on September 9, 2012 (EA, 2012b), which summarized DAD-15 field activities.

A Stage 2 Abatement Plan was submitted to NMED on March 13, 2013 (EA 2013a). Based on an NMED response in August 2013, a Revision to the Stage 2 Abatement Plan was submitted on November 7, 2013 (EA 2013b).

On March 25, 2015, the stipulated agreement to additional requirements to the Doña Ana Dairies Stage 2 Abatement Plan was agreed to by NMED Doña Ana Dairies, and the Rio Valle

Concerned Citizens. On April 10, 2015, the Stage 2 Abatement Plan with the stipulated agreement was approved by NMED by Final Order (NMED 2015).

EA began implementation of the Stage 2 Abatement Plan and stipulated agreement as directed by the Final Order in December 2015. To meet objectives, four monitoring wells were installed (DAD-23 through DAD-26) and Del Oro Dairy discharge plan (DP) well 692-01 was plugged and abandoned. Details on implementation of these tasks are included *Stage 2 Implementation and Quarterly Groundwater Monitoring Report* dated July 2016 (EA 2016).

In accordance with the approved Stage 2 Abatement Plan and stipulated agreement, a baseline compound specific isotope analysis (CSIA) for nitrogen 14 and nitrogen 15 ($^{15}N/^{14}N$ [$\delta^{15}N$]) and total organic carbon (TOC) was completed for 16 monitoring wells in spring of 2016. Additionally, existing conditions concentrations were recalculated for the contaminants of concern. Results of these analyses are presented in the *Stage 2 Implementation and Quarterly Groundwater Monitoring Report* dated July 2016 (EA 2016). A five-year review containing results of repeated CSIA sampling and recalculated existing conditions concentrations was submitted to NMED in December 2020 (EA 2020).

Contaminant concentration trend analysis as well as geospatial analysis to evaluate changes in plume behavior are required on an annual basis and are provided in the report. Additionally, the results of the annual sampling of irrigation and supply wells and concentration trends of analytes in AP and DP wells.

A Stage 2 Abatement Plan Modification proposal was submitted to NMED on August 10, 2018, to address plume instability in the perched aquifer nitrate plume at Del Oro Dairy. Following discussions with NMED, a revised Stage 2 Abatement Plan Modification proposal was submitted on May 1, 2019. A public meeting to discuss the plan was held in Anthony, New Mexico on May 17, 2019. The Stage 2 Abatement Plan Modification proposal was revised based on additional input from NMED and the public and submitted on July 26, 2019 (EA 2019). Public notice for the proposal was initiated on October 23, 2019, and closed on December 31, 2019. An addendum to the Stage 2 Abatement Plan Modification proposal was submitted on July 13, 2020. A revised addendum to the Stage 2 Abatement Plan Modification proposal was submitted on July 13, 2021, based on additional comments from the public. An additional virtual townhall meeting was held on December 15, 2021, that presented the current proposal. The performance plan was submitted to NMED on February 15, 2022. NMED approved the Stage 2 Abatement Plan Modification for Doña Ana Dairies (EA 2019), the accompanying Stage 2 Abatement Plan Addendum for Reuse of Pumped Groundwater at Del Oro Dairy (EA 2021b), and the Stage 2 Abatement Plan Modification Performance Plan (EA 2022) on April 26, 2022. Implementation is detailed in the *Stage 2 Abatement Plan Modification Completion Report* (EA 2023).

2.0 GROUNDWATER MONITORING ACTIVITIES

Groundwater monitoring activities included gauging DP and AP monitoring wells and Anthony Waste Water Treatment Plant monitoring wells. Groundwater samples were collected from DP and AP monitoring wells and irrigation/supply wells. Groundwater gauging and sampling was conducted for Organ Dairy by Glorieta; gauging and sampling for all other wells was conducted by D&H. Groundwater samples were analyzed for nitrate, chloride, TDS, and TKN. The resulting data from this groundwater monitoring event are compiled and presented herein.

2.1 Monitoring Well Gauging

From February 2 through February 8, 2023, representatives from D&H gauged DP and AP monitoring wells, and Anthony WWTP monitoring wells with an electronic water level indicator. Organ Dairy wells were gauged by Glorieta on January 11, 2023. Table 1 provides a summary of groundwater gauging data collected from the monitoring well network. Data obtained during gauging are shown on potentiometric surface maps included as Figures 2, 3, 4, and 5. Monitoring well gauging data and field forms are provided in Appendix A.

2.2 AP and DP Monitoring Well Groundwater Sampling

From February 8 through March 10, 2023, D&H representatives collected groundwater samples from AP and DP monitoring wells that contained sufficient water. Glorieta sampled Organ Dairy DP monitoring wells on January 11, 2023. Groundwater samples were analyzed for nitrate/nitrite by Environmental Protection Agency (EPA) Method 300.0, chloride by EPA Method 300.0, TDS by Method SM 2540C MOD, and TKN by Method SM 4500 NORG C.

For AP monitoring wells, a new, disposable bailer was used to purge and groundwater sample monitoring wells. Three well casing volumes were purged by hand bailing with a new, disposable bailers and twine unless the monitoring well contained insufficient water to purge and groundwater sample.

Due to a lower groundwater table, several DP monitoring wells were dry or contained insufficient water for groundwater sampling. Prior to groundwater sampling, DP monitoring wells were purged of three well casing volumes, if practicable, by either (1) hand-bailing with new, disposable bailers and twine, (2) pumping with a submersible pump and new, disposable polyethylene tubing, or (3) pumping with a dedicated pump with new, disposable polyethylene tubing.

All AP and DP monitoring wells were groundwater sampled from historically clean to dirty to the extent possible to minimize the potential for cross-contamination. When non-disposable or non-dedicated equipment was used from groundwater sampling, it was decontaminated between monitoring wells with an Alconox™ solution to ensure groundwater sample quality and to eliminate the potential of cross-contamination. Prior to use, water quality meters were calibrated and/or checked with standards in accordance with the manufacturer's specifications daily. All purge or decontamination water was discharged on the ground at the monitoring well location it was generated.

When sufficient groundwater was available, field parameters including specific conductance, temperature, pH, and ORP were monitored using a Myron L Ultrameter II and recorded on field forms. Dissolved oxygen was measured using a YSI 556 MPS. Note: Dissolved oxygen and ORP were only measured in the first set of readings. Field parameters from August 2015 to present are presented in Table 2. The sampling field forms are presented in Appendix A.

All groundwater samples were collected immediately after purging. Sampling was accomplished by carefully pouring groundwater from the bailer into the sample containers or by pumping groundwater through new polyethylene tubing into the sample container. Groundwater sample containers were provided by Hall Environmental Analysis Laboratory, Inc. (Hall). Container size, type, sample preservatives, analytical methods, and holding times are specified in Table 3. All groundwater samples were preserved in accordance with method requirements, labeled, then immediately cooled to <6°C with ice and delivered under chain-of-custody procedures to Hall in Albuquerque, New Mexico. Analytical data reports including chain-of-custodies are provided in Appendix B.

2.3 Irrigation/Supply Well Groundwater Sampling

From February 8 through March 10, 2023, D&H representatives collected groundwater samples from twelve irrigation/supply wells. Irrigation/supply wells were sampled by collecting a grab aliquot from a faucet or tank located nearest to the pump outlet. Tap samples were collected while the pumps were running; as a result, no purging was completed. Groundwater samples were analyzed for nitrate/nitrite by EPA Method 300.0, chloride by EPA Method 300.0, TDS by Method SM 2540C MOD, and TKN by Method SM 4500 NORG C.

Ten supply wells adjacent to their milking parlors, Organ Dairy (LRG-458 S), Mountain View Dairy (LRG-00952), Bright Star Dairy (LRG-00953), Dominguez Dairy 2 (LRG-00591-S/S-2 and LRG-965), Buena Vista Dairy II (LRG-01876), Big Sky Dairy (LRG-4116), Sunset Dairy/Desert Land (LRG-3348-AS and LRG-3348-B), and Del Oro Dairy (LRG-5820, LRG-5820-S, LRG-5820-S-2) were sampled from their holding tanks using new disposable bailers, from taps located on the tank, or from valves located on lines going into the tank. At Del Oro Dairy three supply wells pumped water into the holding tank; therefore, the groundwater sample collected was a composite sample.

Groundwater samples were collected from two irrigation wells, Mountain View Northern Land Application Area well LRG-457 and Dominguez Dairy LRG-00590-S-6. Irrigation well Sunset Land Dairy LRG-314495-POD1 was not in use and was not sampled.

3.0 GROUNDWATER MONITORING RESULTS

3.1 Hydraulic Gradient and Direction of Groundwater Flow

During this past quarter, groundwater was present beneath the site at depths ranging from 14.08 feet below top-of-casing (btoc) in central area DP well 257-03, to 134.54 feet btoc in the northern area DP well 42-12. Groundwater was encountered at shallower depths on the eastern portion of the Abatement Plan Area (near the Mesquite Drain) and at greater depths on the western side, near I-10 where the topographic elevation increases.

AP monitoring well DAD-25 may have been completed in a perched aquifer, as groundwater elevations have consistently measured several feet higher than groundwater elevations in surrounding wells. As a result, this groundwater elevation has not been used in contouring the central area potentiometric surface map.

Potentiometric surface maps of groundwater elevations were completed using monitoring well gauging data for the northern area, central area, and southern areas (perched and regional aquifers) of the DAD consortium. Groundwater elevation data from the monitoring well and irrigation/supply well network is provided in Table 1. Potentiometric surface maps were updated and are shown on Figures 2, 3, 4 and 5.

Hydrographs were completed for select wells within the northern, central, and southern areas and are provided in Appendix C. In comparison to November 2022, groundwater levels increased by an average of 0.04 foot in the northern area and increased by an average of 0.36 foot in the central area. In the southern area, average groundwater levels increased by approximately 0.30 foot in the regional aquifer, while average groundwater levels in the perched aquifer decreased by an average of 0.09 foot.

At the time the Stage 2 Abatement Plan was written in 2013, groundwater flow direction in the northern portion was to the east-southeast. Over time, the groundwater flow direction has shifted. During the most recent gauging event, groundwater flow direction at the south end of the northern area was still to the southeast, but groundwater in the northern and central portions of the northern area was flowing to the east. The groundwater flow direction in the central and southern areas remains unchanged from 2013. In the central area, groundwater flow direction was generally to the southeast. Flow in the southern area regional aquifer was to the southeast and flow in the southern perched aquifer was to the south-southwest.

The hydraulic gradient across the DAD consortium in the regional aquifer was approximately 0.001 ft/ft and the hydraulic gradient in the perched aquifer in the southern area was approximately 0.002 ft/ft.

3.2 Groundwater Field Parameters

Field parameters including pH, specific conductance, temperature, dissolved oxygen, and ORP were recorded on the sampling field forms provided in Appendix A and are summarized in Table 2. Specific conductance, dissolved oxygen, and ORP trends for select monitoring wells within the northern, central, and southern areas are presented in Appendix D. Although dissolved oxygen and ORP measurements from monitoring wells containing a dedicated pump were recorded, these measurements were not considered representative of aquifer conditions.

3.3 Groundwater Nitrate, Chloride, and TDS Analytical Results

Groundwater analytical results from DP and AP monitoring wells and irrigation/supply wells are summarized and discussed in the following sections by type of well, by area (e.g., northern, central, southern areas), and by aquifer (e.g., regional and perched). In addition, groundwater analytical results are compared to New Mexico Water Quality Control Commission (NMWQCC) standards for nitrate, chloride, and TDS.

Groundwater analytical results are provided for AP monitoring wells in Table 4, for DP monitoring wells in Table 5, and for irrigation/supply wells in Table 6.

Groundwater analytical results are presented for all wells within the northern area in Figure 6, and for all wells within the central area in Figure 7. Groundwater analytical results from the southern area are presented for all wells within the regional aquifer in Figure 8, and for all wells within the perched aquifer in Figure 9.

Analytical laboratory reports are provided in Appendix B. Concentration trends by area for nitrate, chloride, and TDS for select AP monitoring wells are presented in Appendix E. Concentration trends by area for nitrate, chloride, and TDS for select DP monitoring wells are presented in Appendix F.

3.3.1 Abatement Plan Monitoring Well Results

Nitrate concentrations in the 26 AP monitoring wells sampled ranged from the highest concentration of 45 mg/L in DAD-08 (central area) and DAD-14 (northern area) to the lowest concentration of <1.0 mg/L (the laboratory reporting limit [RL]) in DAD-03, DAD-05, DAD-16, and DAD-17. Nitrate concentrations in 11 of 26 AP monitoring wells were below NMWQCC standard of 10 milligrams per liter (mg/L). The following 15 of the 26 AP monitoring wells had nitrate concentrations at or above the NMWQCC standard: DAD-01, DAD-07, DAD-08, DAD-09, DAD-11 (vertical delineation), DAD-12 (vertical delineation), DAD-13, DAD-14, DAD-15, DAD-19 (vertical delineation), DAD-20, DAD-21, DAD-22, DAD-23, and DAD-26. Compared to the previous sampling event, nitrate concentrations decreased or remained the same in the following AP monitoring wells: DAD-03, DAD-05, DAD-07, DAD-08, DAD-09, DAD-12 (vertical delineation), DAD-13, DAD-15, DAD-16, DAD-17, DAD-21, DAD-22, and DAD-26.

Chloride concentrations exceeded the NMWQCC standard of 250 mg/L in all AP monitoring wells except for DAD-05, DAD-06R, and DAD-17, with chloride concentrations ranging from 88 mg/L to 170 mg/L. The highest chloride concentration of 1,600 mg/L was detected in DAD-08 within the central area.

TDS concentrations exceeded the NMWQCC standard of 1,000 mg/L in all AP monitoring wells except for DAD-05, DAD-06R, and DAD-17, with TDS concentrations ranging from 610 mg/L to 938 mg/L. The highest TDS concentration of 4,260 mg/L was detected in DAD-08 within the central area.

3.3.2 Abatement Plan and Discharge Plan Monitoring Well Results by Area

AP monitoring well DAD-04 and DP monitoring wells 126-04, 126-05, 126-07, 126-09, 340-02, 257-03, and 692-04 were dry or had insufficient groundwater to sample during this sampling event. Groundwater analytical results for nitrate, chloride, and TDS are provided for AP monitoring wells in Table 4 and for DP monitoring wells in Table 5. Groundwater analytical results for AP and DP monitoring wells are presented in Figure 6 for the northern area, Figure 7 for the central area, Figure 8 for the southern area regional aquifer, and in Figure 9 for the southern area perched aquifer. The following subsection summarizes groundwater analytical results for nitrate, chloride, and TDS results by area.

Northern Area

Nitrate concentrations in the DP monitoring wells within the northern area ranged from the highest concentration of 120 mg/L in Dominquez 2 well 42-06 to the lowest concentration of <1.0 mg/L in Dominguez 2 and Dominguez Dairy wells 42-11, 624-09, and 624-10 (Figure 6).

In general, the northern area nitrate plume is defined on the northern edge by the upgradient DP monitoring well 86/340-01, located on the northern boundary of the Northern Land Application Area. The southern edge of the plume is defined by the AP monitoring well DAD-02, the western edge by Dominguez Dairy DP monitoring well 624-09, and the eastern edge by Dominguez Dairy DP monitoring wells 42-10, 42-11, 42-12, and AP monitoring well DAD-13.

The upgradient DP monitoring well 86/340-01 has had nitrate concentrations below the NMWQCC standard of 10 mg/L since February 2018. Historically, nitrate concentrations in this DP monitoring well were above the NMWQCC standard. Nitrate contamination remains undefined on the eastern edge in the vicinity of DAD-01, east of the I-10 corridor, and on the western edge in the vicinity of Dominguez Dairy DP monitoring well 624-02.

Chloride concentrations in AP and DP monitoring wells are generally at or above the NMWQCC standard of 250 mg/L within the northern area of the DAD consortium, except for DP monitoring well 624-09 at Dominquez Dairy with a concentration of 180 mg/L. The highest chloride concentration within the northern area was 2,000 mg/L, in the Northern Land Application Area well 70/86/340-01.

TDS concentrations in AP and DP monitoring wells are generally at or above the NMWQCC standard of 1,000 mg/L within the northern area of the DAD consortium. No DP monitoring wells were below the NMWQCC standard of 1,000 mg/L. The highest TDS concentration within the northern area for DP monitoring wells was 6,560 mg/L, in the Northern Land Application Area well 70/86/340-01.

Central Area

Nitrate concentrations in the DP monitoring wells within the central area ranged from the highest concentration of 100 mg/L at Big Sky Dairy in 833-09 to the lowest concentration of 1.1 mg/L at Las Cruces Community Farms (formerly McAnally Enterprises) in MW-4, as shown in Figure 7.

In general, the central area nitrate plume is defined on the northern edge by Buena Vista Dairy II DP monitoring well 74-03, the southern edge by the Las Cruces Community Farms (formerly McAnally Enterprises) DP monitoring well MW-4, and AP monitoring well DAD-17. The western edge is defined by Buena Vista Dairy II DP monitoring well 74-02, AP monitoring well DAD-16, and DP monitoring wells 833-10 and 257-02. The eastern edge is only defined by DAD-06. Historically, DAD-07 and DAD-15 also defined the eastern edge of the nitrate plume;

however, these wells exceeded the standard at concentrations of 19 mg/L and 17 mg/L, respectively.

Chloride concentrations in AP monitoring wells are generally at or above the NMWQCC standard of 250 mg/L within the central area of the DAD consortium, except for DAD-05, DAD-06R, and DAD-17, with concentrations of 110 mg/L, 88 mg/L, and 170 mg/L, respectively. Chloride concentrations in all DP monitoring wells are at or above the NMWQCC standard of 250 mg/L within the central area of the DAD consortium. The highest chloride concentration within the central area was at DAD-08 with a concentration of 1,600 mg/L.

TDS concentrations in AP monitoring wells are generally at or above the NMWQCC standard of 1,000 mg/L within the central area of the DAD consortium, except for DAD-05, DAD-06R, and DAD-17, with concentrations of 830 mg/L, 610 mg/L, and 938 mg/L, respectively. TDS concentrations in all DP monitoring wells are at or above the NMWQCC standard of 1,000 mg/L within the central area of the DAD consortium. The highest TDS concentration within the central area was 4,290 mg/L, in MW-4 at the Las Cruces Community Farms (formerly McAnally Enterprises).

Southern Area – Regional and Perched Aquifers

Nitrate concentrations for both the regional and perched aquifers within the southern area are discussed below and shown in Figure 8 and Figure 9.

Regional Aquifer:

All sampled wells in the regional aquifer were below the NMWQCC standard for nitrate, except for Del Oro well 692-05. Nitrate concentrations in AP and DP monitoring wells at Del Oro Dairy within the southern area regional aquifer ranged from the highest concentration of 16 mg/L in 692-05 to the lowest concentration of 1.3 mg/L in DAD-10 (Figure 8).

Chloride concentrations in all AP and DP monitoring wells were above the NMWQCC standard of 250 mg/L within the southern area regional aquifer of the DAD consortium. The highest chloride concentration was 640 mg/L in 692-10.

TDS concentrations in all AP and DP monitoring wells were above the NMWQCC standard of 1,000 mg/L within the southern area regional aquifer of the DAD consortium. The highest chloride concentrations were in DP monitoring wells 692-05 and 692-07, at a concentration of 1,560 mg/L.

Perched Aquifer:

Nitrate was above the standard in all monitoring wells in the perched aquifer at Del Oro Dairy, except for downgradient well DAD-27. Nitrate concentrations in AP and DP monitoring wells at Del Oro Dairy within the southern area perched aquifer ranged from the highest concentration of 35 mg/L in DAD-09 to the lowest concentration of 5.9 mg/L in DAD-27 (Figure 9). The downgradient extent of the nitrate plume is now defined by well DAD-27.

Chloride concentrations in all AP and DP monitoring wells are above the NMWQCC standard of 250 mg/L within the southern area regional aquifer of the DAD consortium. The highest chloride concentration within the southern perched aquifer was in DAD-22, at 870 mg/L.

TDS concentrations in all AP and DP monitoring wells are above the NMWQCC standard of 1,000 mg/L within the southern area regional aquifer of the DAD consortium. The highest chloride concentration within the southern perched aquifer was in DAD-21, at 2,380 mg/L.

3.3.3 Irrigation/Supply Well Results

A total of 12 irrigation/supply wells were sampled during this sampling event, while 3 irrigation/supply wells were not sampled because the pump was not on or in use at the time of the sampling event. Groundwater analytical results for nitrate, chloride, and TDS are provided for irrigation/supply wells in Table 6. Groundwater analytical results for irrigation/supply wells are presented in Figure 6 for the northern area, in Figure 7 for the central area, and in Figure 8 for the southern area regional aquifer. There are no irrigation/supply wells in the southern area perched aquifer.

Nitrate concentrations were above the NMWQCC standard for nitrate in 3 of the 12 irrigation/supply well sample locations. Irrigation/supply wells LRG-00953 (Bright Star Dairy), LRG-00591-S (Dominguez Dairy), and LRG-00591-S-2 (Dominguez Dairy) had nitrate concentrations above the standard with concentrations of 15 mg/L, 27 mg/L, and 27 mg/L, respectively. All three wells are located in the northern area.

Chloride concentrations in all irrigation/supply wells are above the NMWQCC standard of 250 mg/L within the DAD consortium. The highest chloride concentration in the irrigation/supply wells was in LRG-00591-S-2 (Dominguez Dairy), with a concentration of 1,200 mg/L.

TDS concentrations in all irrigation/supply wells are above the NMWQCC standard of 1,000 mg/L within the DAD consortium. The highest TDS concentration for the irrigation/supply wells were in LRG-00591-S (Dominguez Dairy), with a concentration of 3,500 mg/L.

Chloride and TDS concentrations ranges in irrigation/supply wells are generally similar to concentrations observed in DP and AP monitoring wells, further indicating that chloride and TDS concentrations observed are above NMWQCC standards regionally across the northern, central, and southern areas.

4.0 TREND ANALYSIS

Trend analysis can indicate whether concentrations of constituents such as nitrate, chloride and TDS are stable, increasing, or decreasing at a particular well (Gilbert 1987). The trend analysis is based on analytical data collected from November/December 2015 through the current quarter. Analytical data collected from all AP and DP wells were analyzed using the Mann-Kendall test, except for three new monitoring wells installed in December 2022 (AP well DAD-06R, AP well DAD-27, and DP well 692-10). The Mann-Kendall test for temporal trend was conducted for all analytes with 4 or more groundwater samples and at least 1 detected concentration within the monitoring period for nitrate, chloride, and TDS.

Table 7 provides the list of wells where trend analysis was conducted and a summary of the trend analysis (e.g., stable, decreasing, or increasing) for nitrate, chloride, and TDS.

Concentration trend analysis graphs for nitrate, chloride, and TDS for AP monitoring wells are provided in Appendix E, and for DP monitoring wells in Appendix F. The Mann Kendall Trend Analysis technical discussion, input data from November/December 2015 through the current quarter, and ProUCL outputs are provided in Appendix G.

4.1 Northern Area

Trend analysis was conducted on 29 AP and DP monitoring wells within the northern area. 12 monitoring wells were not analyzed because they were dry, plugged and abandoned, or had fewer than four quarters of groundwater samples to analyze. Of the 29 monitoring wells analyzed, six monitoring wells had increasing concentration trends for nitrate and TDS, and three monitoring wells had increasing concentration trends for chloride. Stable or decreasing trends were present for all three constituents in 19 monitoring wells.

Nitrate decreasing and increasing concentration trends are as follows:

- <u>Increasing Nitrate Trends:</u> Bright Star Dairy well 340-01, Dominguez 2 Dairy wells 42-06, 42-10, and 42-12, and AP monitoring wells DAD-01 and DAD-23. All monitoring wells were above the NMWQCC standard of 10 mg/L, except for Dominguez 2 Dairy wells 42-10 and 42-12.
- <u>Decreasing Nitrate Trends:</u> Northern Land Application Area wells 70-03 and 86/340-01, Organ Dairy wells 126-12 and 126-13, Mountain View Dairy well 70-01, Dominguez 2 Dairy wells 42-03, 42-08, and 42-13, Dominguez Dairy wells 624-02 and 624-11, and AP wells DAD-02, DAD-11, DAD-12, and DAD-14.

Chloride decreasing and increasing concentration trends are as follows:

- <u>Increasing Chloride Trends:</u> Dominguez 2 Dairy wells 42-06, 42-08, and 42-11.
- <u>Decreasing Chloride Trends:</u> Northern Land Application Area wells 70-03 and 86/340-01, Organ Dairy well 126-13, Dominguez 2 Dairy wells 42-03 and 42-12, Dominguez Dairy wells 624-01, 624-02, 624-09, and AP wells DAD-02, DAD-11 and DAD-14.

TDS decreasing and increasing concentration trends are as follows:

- Increasing TDS Trends: Mountain View Dairy wells 70-01 and 70-04, and Dominguez 2 Dairy wells 42-06, 42-08, 42-10, and 42-11.
- Decreasing TDS Trends: Northern Land Application Area wells 70-03, Organ Dairy wells 126-12, Mountain View Dairy well 70-02, Dominguez 2 Dairy wells 42-03, 42-12, and 42-13, Dominguez Dairy wells 624-01 and 624-09, and AP wells DAD-02 and DAD-14.

Northern upgradient boundary DP monitoring well 70/86/340-01 at the Northern Land Application Area had stable nitrate, chloride, and TDS concentration trends. Northern upgradient boundary DP monitoring well 86/340-01 at Northern Land Application Area had decreasing concentration trends of nitrate and chloride and stable concentration trends of TDS. Nitrate, chloride, and TDS in these monitoring wells are expected to stabilize as land application has been phased out.

Southern boundary AP monitoring wells for the Northern Land Application Area include DAD-02, DAD-14, and DAD-23. Both AP monitoring wells DAD-02 and DAD-14 had decreasing concentration trends for nitrate, chloride, and TDS. AP monitoring well DAD-23 had increasing concentration trends for nitrate, but stable concentrations trends for chloride and TDS.

Eastern boundary DP monitoring wells 42-10, 42-11, and 42-12 (Dominguez 2) showed mixed concentration trends; however, nitrate concentrations are below the NMWQCC standards. DP monitoring well 42-10 displayed increasing nitrate concentration trends, stable chloride concentration trends, and increasing TDS concentration trends. DP monitoring well 42-11 displayed stable nitrate concentration trends, increasing chloride concentration trends, and increasing TDS concentration trends. DP monitoring well 42-12 displayed increasing nitrate concentration trends, decreasing chloride concentration trends, and decreasing TDS concentration trends. Eastern boundary AP well DAD-01 displayed increasing nitrate concentration trends and stable chloride and TDS concentration trends. The other eastern boundary AP monitoring well, DAD-13, had stable concentration trends for nitrate, chloride, and TDS concentrations.

Western boundary DP monitoring well 42-02 (Dominguez 2) displayed stable nitrate, chloride, and TDS concentration trends. Western boundary DP monitoring well 624-09 (Dominguez Dairy) contained stable nitrate concentration trends and decreasing chloride and TDS concentration trends. Western boundary DP monitoring well 126-12 (Organ Dairy) had decreasing concentration trends of nitrate and TDS and stable chloride concentration trends.

4.2 Central Area

Trend analysis was conducted on 29 AP and DP monitoring wells within the central area. 3 monitoring wells were not analyzed because they were dry, plugged and abandoned, or had fewer than four quarters of groundwater samples to analyze. Of the 29 monitoring wells analyzed, 4 monitoring wells displayed increasing concentration trends for nitrate, and 10 monitoring wells had increasing concentration trends for chloride and TDS. Stable or decreasing concentration trends were present for nitrate, chloride, and TDS in 17 monitoring wells. Increasing and decreasing concentration trends for nitrate, chloride, and TDS are presented below.

Nitrate decreasing and increasing concentration trends are as follows:

- <u>Increasing Nitrate Trends:</u> Buena Vista Dairy II well 74-02, and AP wells DAD-04, DAD-07, and DAD-15. All monitoring wells were above the NMWQCC standard of 10 mg/L, except for Buena Vista Dairy II well 74-02.
- <u>Decreasing Nitrate Trends:</u> Big Sky Dairy wells 833-07, 833-08, and 833-10, Sunset Dairy well 257-01, and AP wells DAD-18 and DAD-25.

Chloride decreasing and increasing concentration trends are as follows:

- <u>Increasing Chloride Trends:</u> Buena Vista Dairy II wells 74-02, 74-04, and 74-05, Big Sky Dairy wells 833-06 and 833-10, Sunset/Desert Dairy wells 257-01, 257-02, and 257-03, and AP wells DAD-15 and DAD-24.
- <u>Decreasing Chloride Trends:</u> Buena Vista Dairy II well 74-03, and AP wells DAD-03, DAD-05, DAD-08, DAD-16, and DAD-25.

TDS decreasing and increasing concentration trends are as follows:

- <u>Increasing TDS Trends:</u> Buena Vista Dairy II wells 74-02, 74-04, and 74-05, Big Sky wells 833-06, and 833-10, Sunset Dairy well 257-03, and AP wells DAD-04, DAD-07, DAD-15, and DAD-24.
- <u>Decreasing TDS Trends:</u> Buena Vista Dairy II well 74-03, Big Sky Dairy well 833-02, Sunset Dairy well 257-01, and AP wells DAD-03, DAD-05, DAD-08, DAD-16, DAD-18, and DAD-25.

Northern upgradient boundary DP monitoring well 74-03 at Buena Vista Dairy well and AP DAD-03 had stable nitrate concentration trends and decreasing concentration trends for chloride and TDS.

Southern boundary DP monitoring wells 257-02 at Sunset Dairy and MW-4 at Former McAnally Enterprise had stable concentration trends for nitrate and TDS. Southern boundary DP monitoring wells 257-02 at Sunset Dairy had increasing concentration trends for chloride. AP monitoring well DAD-25 had decreasing concentration trends for nitrate, chloride, and TDS.

Eastern boundary AP monitoring wells DAD-07 and DAD-15 had increasing concentration trends for nitrate and TDS. Eastern cross-gradient boundary AP monitoring well DAD-07 had stable concentration trends for chloride.

Western boundary monitoring wells 833-10 (Big Sky Dairy), DAD-04, and DAD-16 showed variable concentration trends. DP monitoring well 833-10 had decreasing nitrate concentration trends and increasing trends for chloride and TDS. AP monitoring well DAD-04 had increasing nitrate and TDS concentration trends and stable trends for chloride. AP monitoring well DAD-16 had stable concentration trends for nitrate and decreasing concentration trends for chloride and TDS.

4.3 Southern Area– Regional and Perched Aquifers

Trend analysis was conducted on 13 monitoring wells within the southern area regional and perched aquifers. Monitoring wells DAD-27 and 692-10 were not included, both had fewer than four quarters of groundwater samples to analyze. Of the 13 AP and DP monitoring wells analyzed, 3 monitoring wells had increasing concentration trends for nitrate and 4 monitoring wells had increasing trends for TDS. Stable or decreasing concentration trends were present for nitrate, chloride, and TDS in 8 monitoring wells. Increasing and decreasing concentration trends for nitrate, chloride, and TDS are presented below.

Regional aquifer concentration trends are as follows:

- <u>Increasing Nitrate Trends:</u> Increasing nitrate concentration trends were observed in Del Oro Dairy wells 692-05, 692-06, and 692-09. Del Oro Dairy well 692-05 was above the NMWQCC standard of 10 mg/L, and Del Oro Dairy wells 692-06 and 692-09 were below.
- <u>Increasing TDS Trends:</u> Increasing TDS concentration trends were observed in Del Oro Dairy wells 692-05, 692-07, 692-08, and 692-09.

Perched aquifer concentration trends are as follows:

- <u>Stable or Decreasing Nitrate Trends:</u> Nitrate concentration trends were stable or decreasing in all perched aquifer monitoring wells. Nitrate concentrations were above the NMWQCC standard of 10 mg/L in all monitoring wells in the perched aquifer except for AP well DAD-27. Observed increasing nitrate concentration trends have been further addressed by the implementation of an approved abatement plan as detailed in the *Stage 2 Abatement Plan Modification Completion Report* (EA 2023).
- <u>Stable or Decreasing Chloride Trends:</u> Chloride concentration trends were stable or decreasing in all perched aquifer monitoring wells.
- <u>Stable or Decreasing TDS Trends:</u> TDS concentration trends were stable or decreasing in all regional aquifer monitoring wells.

5.0 FIRST ORDER NITRATE DECAY RATES

First order nitrate decay rates were calculated for AP and DP monitoring wells where nitrate concentrations were detected above the NMWQCC standard of 10 mg/L and nitrate concentrations showed decreasing trends based on the Mann-Kendall trend analysis. First order nitrate decay rates for monitored natural attenuation were calculated using an excel spreadsheet developed by the Utah Leaking Underground Storage Tank program and is based on EPA's Ground Water Issue paper EPA/540/S-02/500, *Calculation and Use of First-Order Rate Constants for Monitored Natural Attenuation Studies* (EPA 2002).

First order nitrate decay rates were calculated for 16 monitoring wells. 10 of these monitoring wells are in the northern area, 3 monitoring wells are in the central area, and 3 monitoring wells are in the southern area perched aquifer.

A summary of the first order nitrate decay rate calculations for monitored natural attenuation by monitoring well and area are summarized and provided in Table 8. Decay rate calculation spreadsheets for each monitoring well are presented in Appendix H.

- <u>Northern Area:</u> Nitrate decay rates ranged from 0.0033 years^{-1} to 0.2152 years^{-1}. The estimated average half-life was calculated as approximately 30.3 years and the average estimated time to reach the NMWQCC standard for nitrate of 250 mg/L was calculated as approximately 32.0 years.
- <u>Central Area:</u> Nitrate decay rates ranged from 0.00343 years^{-1} to 0.0813 years^{-1}. The estimated average half-life was calculated as approximately 12.7 years and the average estimated time to reach the NMWQCC standard for nitrate of 250 mg/L was calculated as approximately 35.8 years.
- <u>Southern Area - Perched Aquifer:</u> Nitrate decay rates ranged from 0.0823 years^{-1} to 0.5565 years^{-1}. The estimated average half-life was calculated as approximately 4.1 years and the average estimated time to reach the NMWQCC standard for nitrate of 250 mg/L was calculated as approximately 6.4 years. These AP and DP monitoring wells were likely impacted by a nearby municipal water line release and that calculated nitrate decay rates may not be predictive of future trends.

6.0 GEOSTATISTICAL ANALYSIS

A geostatistical analysis was completed to estimate analyte distribution and calculate groundwater contamination plume areas for nitrate, chloride, and TDS. Nitrate plumes were defined as areas where nitrate concentrations exceed the NMWQCC standard of 10 mg/L. Chloride and TDS plumes were defined as areas where concentrations exceed the 2016 calculated background concentrations as stated in the Five-Year Review (EA 2020) and 2021 Annual Report (EA 2021a). The 2016 calculated background concentrations for chloride and TDS were used to provide a consistent baseline from the initiation of the Stage 2 Abatement Plan in 2016 and comparison thorough each year of monitoring.

Plume areas were calculated based on results of interpolation by kriging, performed using analytical concentrations from AP and DP monitoring wells during the February/March 2022 sampling event. If data were not available for the most recent sampling event, data from the most recent sampling event within the last year were used. Changes in the plume areas since 2016 are defined as an increase or decrease of 10% or more. An increase or decrease of less than 10% is defined as stable.

Exclusions to the geostatistical analysis data set include the following:

- Vertical delineation AP monitoring wells DAD-11, DAD-12, DAD-18, DAD-19, DAD-24, and DAD-25, likely completed in a perched aquifer, were excluded from the data set.
- Central area chloride and TDS and southern area TDS in the regional aquifer were not modeled because concentrations were below 2016 calculated background concentrations.

The calculated groundwater plume areas by analyte and area from 2016 to February/March 2022 sampling event are summarized and provided in Table 9. Distribution and calculate groundwater contamination plume areas by analyte based on geostatistical analysis are provided in Figure 10 through Figure 18. Contaminant plume geometries were statistically modeled, and as a result, concentration intervals may be offset from measured concentrations at individual monitoring locations. In locations where plume edges were not defined by the model, isopleth lines were manually drawn using professional judgment.

Northern Area Geostatistics

The total size of the nitrate, chloride, and TDS groundwater plumes decreased by over 25% between 2016 and 2023. Though the overall size of the nitrate plume decreased substantially, the highest nitrate concentration area of the plume expanded in the vicinity of DP monitoring well 42-06 at Dominguez Dairy 2.

Central Area Geostatistics

The chloride and TDS plumes are no longer present in the central area. The size of the 2023 nitrate plume decreased by 11.6%, just above the criteria (<10%) to consider the plume area stable. AP well DAD-06R was installed in late 2022 and may have impacted the plume model relative to last year.

Southern Area – Regional Aquifer Geostatistics

The nitrate plume size has increased between 2016 and 2023. The chloride plume size has decreased. TDS has been stable and has not been detected above existing conditions. DP well 692-10 was installed in late 2022 and may have impacted the plume model relative to last year.

Southern Area – Perched Aquifer Geostatistics

Nitrate and chloride plumes increased in total size between 2016 and 2023, and the TDS plume size has decreased since 2016. Because of the distribution of contamination and monitoring wells, the modeled plume geometries in the perched aquifer required manual interpretation for large areas and are therefore limited in their ability to offer accurate comparisons from year-to-year. AP well DAD-27 was installed in late 2022 and data from this well may have impacted the plume model relative to last year.

7.0 MONITORING WELL INSTALLATION ACTIVITES

As part of the approved *Stage 2 Abatement Plan Modification Proposal and DAD-06 Monitoring Well Rehabilitation Plan, Doña Ana Dairies, Doña Ana County, New Mexico, Revision 02* (EA 2019), EA was to install three new AP monitoring wells, DAD-06R and DAD-27, and DP monitoring well 692-10, associated with Del Oro Dairy within the southern area. The following summarizes the well installation activities.

7.1 Borehole Installation

From October 28 through November 1, 2022, 3 soil borings were advanced at the site and converted into monitoring wells DAD-27, 692-10, and DAD-06R. The locations of the newly installed wells are shown in Figures 3 and 5. DAD-27 was installed to delineate the downgradient extent of the groundwater plume within the perched aquifer in the southern area. DAD-06R was installed as a replacement well for DAD-06, which was silted in. AP well 692-10 was to be installed within the perched aquifer southwest of the lagoon to further delineate contamination.

Borings were advanced using the hollow stem auger drilling method. During drilling activities, the site geologist logged soil samples every five feet using the Unified Soil Classification System. Soil samples were retrieved using a decontaminated split spoon sampling device during hollow stem auger drilling and from cuttings during mud rotary drilling. Lithology was recorded on boring log forms, which are included in Appendix I.

The subsurface lithology within the southern and central areas were similar and corresponded to lithology encountered during previous investigations, except for boring 692-10. Typically, a clay layer (aquitard) separates the perched from the regional aquifer, and at 692-10, it appears the perched aquifer is absent. To assess the nature of the clay layer and perched aquifer, a subcrop map (Figure 19) and an isopach map (Figure 20) were prepared. The clay layer was encountered during the drilling of 692-10 at a much higher elevation (Figure 19). In addition, the clay layer is thicker in the vicinity of boring 692-10 (Figure 20) and thins to the southwest. This is interpreted as a meander eroding into the clay, depositing channel sands, which form the perched aquifer. The clay layer is thickest near the lagoons and thins toward the southwest.

To confirm that groundwater was not present at 692-10, drilling stopped at 55 feet below ground surface (bgs), the augers were left in the borehole over the weekend, and groundwater was not observed in the borehole on Monday. Drilling proceeded and groundwater was encountered at 70 feet bgs. The borehole was then advanced to 77 feet bgs.

7.2 Monitoring Well Installation

The monitoring wells were constructed with 2-inch Schedule 40 polyvinyl chloride (PVC), flush thread-jointed casing, and 20 feet of Schedule 40 PVC 0.010-inch machine-slotted screen. One exception, well DAD-26, was completed with 15 feet of Schedule 40 PVC 0.010-inch machine-slotted screen. Filter pack consisting of 10-20 mesh silica sand was placed from the bottom of the borehole to at least 2 feet above the screen interval, followed by a 3- to 4-foot hydrated bentonite seal, and finally cement-bentonite grout to the surface.

DAD-27 was completed with a well vault, flush with the ground surface, set in 2-foot by 2-foot by 4-inch-thick concrete pads. Wells DAD-06R and 692-10 were completed with an above-grade steel locking shroud, 2-foot stick up, placed in 2-foot by 2-foot by 4-inch-thick concrete pads. Four 4-inch carbon steel bollards were placed around each well head to protect the monitoring wells. Soil boring/well completion diagrams are included in Appendix I. Photographic documentation of the well completions is provided in Appendix J.

7.3 Well Development

Groundwater monitoring wells DAD-27, DAD-06R and 692-10 were developed on November 2, 2022. Water levels and total depths were gauged in the wells with an electronic water level indicator. Development was accomplished by bailing and surging, followed by pumping with a submersible pump, except for well 692-10, which did not yield enough water to sustain pumping. Instead, well 692-10 was developed by hand bailing. Wells were purged until the well yielded clear water to the extent practicable. Development water was ground discharged. Well development forms are included after the groundwater sampling field forms in Appendix A.

7.4 Well Redevelopment and Plugging and Abandonment

On November 2, 2022, Terracon and EA attempted to redevelop DAD-06R by high pressure jetting to remove the silt that had accumulated in the well casing. Redevelopment of well DAD-06R was unsuccessful.

On November 2, 2015, EA and Terracon plugged and abandoned Del Oro Dairy well 692-01 by removing the surface completion and approximately 50 feet of well casing. Afterwards, neat cement was pumped via tremie pipe from the total depth to approximately 2 feet bgs, pursuant of the New Mexico Office of the State Engineer. Photographic documentation of the plugging & abandonment is provided in Appendix J. The Office of the State Engineer Plugging Record is included in Appendix K.

7.5 Surveying

Newly installed AP monitoring wells were surveyed by Christian A. Clausen, a New Mexico Licensed Surveyor. All well locations were surveyed using United States State Plane Coordinates, North American Datum of 1983. Elevations are based on the North America Vertical Datum of 1988. Wells were located to within 0.01 foot horizontal and 0.01 foot vertical. The survey results are attached in Appendix I.

8.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the data collected, including monitoring well gauging, analytical data, Mann Kendall trend analysis, first order nitrate decay rates, and geostatistical analysis, the following conclusions and recommendations are presented:

8.1 Hydraulic Gradient and Direction of Groundwater Flow

- The depth to groundwater at the site ranged from 14.08 to 134.54 ft btoc.
- Since November 2022, groundwater elevations increased in the northern, central, and southern area regional aquifer, while groundwater elevations decreased in the southern area perched aquifer.
- In general, regional groundwater flow direction within the Rio Grande River basin is in a north-northwest to south-southeast direction parallel to the Rio Grande River and the I-10 corridor. Groundwater flow in the southern area perched aquifer is also in the south-southwest direction.
- The hydraulic gradient across the DAD consortium in the regional aquifer was approximately 0.001 ft/ft and the hydraulic gradient in the perched aquifer in the southern area was approximately 0.002 ft/ft.

8.2 Groundwater Nitrate, Chloride, and TDS Analytical Results

- Nitrate concentrations exceeded the NMWQCC standard in 15 AP monitoring wells, while 11 AP monitoring wells were below the NMWQCC standard. The highest nitrate concentration of 45 mg/L was detected in both DAD-14 within the northern area and DAD-08 within the central area.
- Chloride concentrations exceeded the NMWQCC standard in all AP monitoring wells except for DAD-05, DAD-06R, and DAD-17. The highest chloride concentration of 1,600 mg/L was detected in DAD-08 within the central area.
- TDS concentrations exceeded the NMWQCC standard in all AP monitoring wells except for DAD-05, DAD-06R, and DAD-17. The highest TDS concentration of 4,260 mg/L was detected in DAD-08 within the central area.
- Nitrate concentrations exceeded the NMWQCC standard in 26 DP monitoring wells, while 18 AP monitoring wells were below the NMWQCC standard. The highest nitrate concentration of 120 mg/L was detected in 42-06 within the northern area.
- Chloride concentrations exceeded the NMWQCC standard in all DP monitoring wells except for 624-09. The highest chloride concentration of 2,000 mg/L was detected in 70/86/340-01 within the northern area.

- TDS concentrations exceeded the NMWQCC standard in all DP monitoring wells. The highest TDS concentration of 6,560 mg/L was detected in 70/86/340-01 within the northern area.

- Nitrate concentrations exceeded the NMWQCC standard in 3 irrigation/supply wells, while 9 irrigation/supply wells were below the NMWQCC standard. The highest nitrate concentration of 27 mg/L was detected in both LRG-00591-S and LRG-00591-S-2 within the northern area.

- Chloride concentrations exceeded the NMWQCC standard in all irrigation/supply wells. The highest chloride concentration of 1,200 mg/L was detected in LRG-00591-S-2 within the northern area.

- TDS concentrations exceeded the NMWQCC standard in all irrigation/supply wells. The highest TDS concentration of 3,500 mg/L was detected in LRG-00591-S within the northern area.

8.3 Trend Analysis

- Trend analysis indicates that 19 of the 34 AP and DP monitoring wells analyzed in the northern area had decreasing or stable trends for nitrate, chloride, and TDS.

- Trend analysis indicates that 17 of the 29 AP and DP monitoring wells analyzed in the central area had decreasing or stable trends for nitrate, chloride, and TDS.

- Trend analysis indicates that 8 of the 13 AP and DP monitoring wells analyzed in the southern area had decreasing or stable trends for nitrate, chloride, and TDS.

8.4 First Order Nitrate Decay Rates

- <u>Northern Area:</u> Nitrate decay rates ranged from 0.0033 $years^{-1}$ to 0.2152 $years^{-1}$. The estimated average half-life was calculated as approximately 30.3 years and the average estimated time to reach the NMWQCC standard for nitrate of 250 mg/L was calculated as approximately 32.0 years.

- <u>Central Area:</u> Nitrate decay rates ranged from 0.00343 $years^{-1}$ to 0.0813 $years^{-1}$. The estimated average half-life was calculated as approximately 12.7 years and the average estimated time to reach the NMWQCC standard for nitrate of 250 mg/L was calculated as approximately 35.8 years.

- <u>Southern Area – Perched Aquifer:</u> Nitrate decay rates ranged from 0.0823 $years^{-1}$ to 0.5565 $years^{-1}$. The estimated average half-life was calculated as approximately 4.1 years and the average estimated time to reach the NMWQCC standard for nitrate of 250 mg/L was calculated as approximately 6.4 years.

8.5 Geostatistical Analysis

- The total size of the northern area nitrate, chloride, and TDS plumes decreased by at least 25% between 2016 and 2022.
- The central area chloride and TDS plumes decreased by 100% relative to the 2016 baseline, indicating that the chloride and TDS plumes in the central area are no longer present. The size of the 2023 nitrate plume changed by 11.6%, and as a result is considered decreasing relative to 2016.
- In the southern area of the regional aquifer, the nitrate plume size has increased between 2016 and 2023. The chloride plume in the regional aquifer has decreased by 93.9%. The TDS plume in the southern regional aquifer remains stable and has not been detected above existing conditions.
- In the southern perched aquifer, the nitrate and chloride plumes have increased in total size between 2016 and 2023. The TDS plume in the southern perched aquifer has decreased in total size by 98.6% since 2016.

9.0 REFERENCES

Doña Ana Dairies. 2006. Letter Regarding Agreement for Joint Stage 1 and Stage 2 Abatement Plan and Storm Water and Wastewater Pond Upgrades. Letter from Mr. Michael Weatherly, Chairman, Doña Ana Dairies, to Mr. William Olson, Chief, Ground Water Quality Bureau. 30 October 2006.

EA Engineering, Science, and Technology, Inc., PBC. (EA). 2009. Site Investigation Report, Doña Ana Dairies, Mesquite, New Mexico. 16 July 2009.

EA. 2012a. Final Site Investigation Report, Doña Ana Dairies, Mesquite, New Mexico. 9 February 2012.

EA. 2012b. Final Site Investigation Report Addendum, Doña Ana Dairies, Mesquite, New Mexico. 9 September 2012.

EA. 2013a. Stage 2 Abatement Plan, Doña Ana Dairies, Mesquite, New Mexico. 13 March 2013.

EA. 2013b. Stage 2 Abatement Plan, Revision 01, Doña Ana Dairies, Mesquite, New Mexico. 7 November 2013.

EA. 2016. Stage 2 Implementation and Quarterly Groundwater Monitoring Report, Doña Ana Dairies, Mesquite, New Mexico. 26 July 2016.

EA. 2019. Stage 2 Abatement Plan Modification Proposal and DAD-06 Monitoring Well Rehabilitation for Doña Ana Dairies, Doña Ana County, New Mexico, Revision 02. 26 July 2019.

EA. 2020. Five-Year Evaluation and Quarterly Groundwater Monitoring Report, Doña Ana Dairies, Mesquite, New Mexico. 23 December 2020.

EA. 2021a. Annual Groundwater Monitoring Report, Doña Ana Dairies, Mesquite, New Mexico. 29 May 2021.

EA. 2021b. Stage 2 Abatement Plan Addendum for Reuse of Pumped Groundwater, Revision 02, Del Oro Dairy, Anthony, New Mexico. 13 July 2021.

EA. 2022. Stage 2 Abatement Plan Modification Performance Plan for Doña Ana Dairies. 25 January 2022.

EA. 2023. Stage 2 Abatement Plan Modification Completion Report for Doña Ana Dairies (Del Oro Dairy), Anthony, New Mexico. 16 May 2023.

Gilbert, R.O. 1987. Statistical Methods for Environmental Pollution Monitoring, New York: Van Nostrand Reinhold.

Golder Associates, Inc. (Golder). 2006. Stage 1 and 2 Abatement Plan Proposal, prepared for New Mexico Environment Department, Remediation Oversight Section, on behalf of Doña Ana Dairies. 11 December 2006.

Golder. 2008a. Existing Data Report and Conceptual Work Plan, Doña Ana Dairies, Mesquite, New Mexico. 1 February 2008.

Golder. 2008b. Conceptual Work Plan. Doña Ana Dairies, Mesquite, New Mexico. 1 February 2008.

Golder. 2008c. Notes for the Meeting Regarding New Monitoring Well Installation. Meeting Participants: Doña Ana Dairy representative, DAD technical representatives, and NMED staff. 28 July 2008.

Golder. 2008d. Sampling and Analysis Plan. Doña Ana Dairies, Mesquite, New Mexico. 11 August 2008.

New Mexico Environment Department (NMED). 2018. Stage 2 Abatement Plan Modification Required and DAD-06 Monitoring Well Replacement Required for Doña Ana Dairies, Doña Ana County, New Mexico. 12 June 2018.

NMED. 2015. Approval of Stage 2 Abatement Plan Proposal for Doña Ana Dairies. Final Order from Mr. Ryan Flynn, Secretary, Ground Water Quality Bureau. 10 April 2015.

NMED. 2008. Approval of Sampling and Analysis Plan for the Doña Ana Dairies, Stage 1 Abatement Plan, Doña Ana County, New Mexico. 25 September 2008.

NMED, Doña Ana Dairies, and Rio Valle Concerned Citizens. 2015. Stipulated Agreement, Doña Ana Dairies Stage 2 Abatement Plan. 25 March 2015.

Newell, C. J., H. S. Rifai, J. Wilson, J. A. Connor, J. A. Aziz, AND M. P. Suarez. 2002. Ground Water Issue - Calculation and Use of First-Order Rate Constants for Monitored Natural Attenuation Studies. U.S. Environmental Protection Agency, Washington, DC, EPA/540/S-02/500. November 2002.

US Environmental Protection Agency (EPA), 2002. Workbook developed by the Utah Leaking Underground Storage Tank (LUST) program and is based on EPA's Ground Water Issue paper EPA/540/S-02/500, "*Calculation and Use of First-Order Rate Constants for Monitored Natural Attenuation Studies*," by Newell, Rifai, Wilson, Connor, Aziz, and Suarez (2002).