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June 28, 2024

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 for Doña Ana Dairies located in Mesquite, Vado, and Anthony, New Mexico. The report discusses the annual groundwater sampling event 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 2024

EA Project No. 1464112.05

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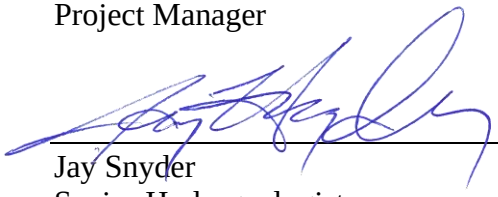
Gina Mullen
Project Manager

Date



06/28/2024

Jay Snyder
Senior Hydrogeologist

Date

June 2024

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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 Quarterly Monitoring 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, and August 11, 2008, respectively, and the Conceptual Work Plan (CWP) dated February 1, 2008. 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 Dona Ana Dairies Stage 2 Abatement Plan was agreed upon by NMED, the Dairies, and the Rio Valle Concerned Citizens (NMED, Doña Ana Dairies, and Rio Valle Concerned Citizens 2015). The Stage 2 Abatement Plan was approved by NMED by Final Order on April 10, 2015. A Stage 2 Abatement Plan Modification was approved by NMED on April 26, 2022 (NMED 2022). Full document references are provided in Section 10.0.

1.1 Objective and Monitoring Scope

The objective of this monitoring program is 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 Waste Water Treatment Plant (WWTP) wells from February 5 through February 8, 2024. Glorieta Geoscience, Inc. (Glorieta) gauged Organ Dairy wells on January 10, 2024.

- From February 9 through March 14, 2024, 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 10, 2024. Samples were analyzed for nitrate, chloride, total dissolved solids (TDS), and total Kjeldhal nitrogen (TKN). Field parameters including specific conductance, pH, temperature, oxidation reduction potential (ORP), and dissolved oxygen were monitored and recorded on field forms during sampling.

- Analyte trend analyses were updated.

- First order decay rates for nitrate at wells with decreasing nitrate concentrations were calculated.

- Geostatistical analysis of analytes was performed.

Additionally, a performance assessment was performed on the Del Oro pump and reuse system in compliance with the Stage 2 Abatement Plan Modification Performance Plan for Dona Ana Dairies (EA 2022). The performance assessment is provided in Appendix A.

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. Buena Vista II, Dominguez, and Dominguez 2 left the consortium in May 2024.

The current DAD consortium 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), created to combine all existing and 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).

A meeting was held on July 15, 2008, between the DAD consortium, Golder, and NMED. 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 NMAC) and Stage 2 Abatement Plan (§4106.D NMAC) could be prepared.

Between February 2008 and December 2008, quarterly groundwater gauging was conducted concurrent to discussions with NMED at the DAD consortium 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 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 compound specific isotope analysis sampling and recalculated existing conditions concentrations was submitted to NMED in December 2020 (EA 2020a). The next five-year review will be performed in 2025.

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 annual report. Additionally, the results of the annual sampling of irrigation and supply wells and concentration trends of analytes in AP and DP wells are provided in the annual report.

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 (EA 2020b). A revised addendum to the Stage 2 Abatement Plan Modification proposal was submitted on July 13, 2021, based on additional comments from the public (EA 2021). 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 (EA 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 2021), and the Stage 2 Abatement Plan Modification Performance Plan (EA 2022) on April 26, 2022 (NMED 2022). Implementation is detailed in the Stage 2 Abatement Plan Modification Completion Report (EA 2023). The quarterly performance assessment of the Del Oro Dairy pump and reuse system, as required by Stage 2 Abatement Plan Modification Performance Plan (EA 2022) is provided in Appendix A.

2.0 GROUNDWATER MONITORING ACTIVITIES

Groundwater monitoring activities included gauging AP monitoring wells, DP monitoring wells for dairies that are a part of the DAD consortium, and the Anthony WWTP monitoring wells. Groundwater samples were collected from AP monitoring wells, DP monitoring wells, and irrigation/supply wells for dairies that are a part of the DAD consortium. The DAD consortium currently consists of the following dairies: Big Sky, Bright Star, Del Oro, Mountain View, Organ, and Sunset/Desert Land. Groundwater samples were analyzed for nitrate, chloride, TDS, and TKN. A summary of the groundwater monitoring data from February/March 2024 is presented below.

2.1 Well Gauging

From February 5 through February 8, 2024, representatives from D&H gauged DP monitoring wells, AP monitoring wells, and Anthony WWTP wells with an electronic water level indicator. Organ Dairy wells were gauged by Glorieta on January 10, 2024. Table 1 provides groundwater gauging data collected from the monitoring network. Data obtained during gauging are shown on potentiometric surface maps included as Figures 2, 3, 4, and 5. Well gauging field forms are available in Appendix B.

2.2 AP and DP Well Groundwater Sampling

D&H collected groundwater samples from all AP monitoring wells with sufficient water from March 1 through March 11, 2024. Groundwater sampling from AP wells was accomplished with new, disposable bailers. Three well casing volumes were purged unless the well contained insufficient water. AP well DAD-20 has been destroyed and could not be sampled.

D&H sampled DP wells from February 9 through February 29, 2024. Glorieta sampled Organ Dairy DP wells on January 10, 2024. Prior to sampling, the DP 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 polyethylene tubing, or (3) pumping with a dedicated pump and new polyethylene tubing. Due to a lower water table, several DP wells were dry or contained insufficient water for sampling. Organ Dairy wells 126-04, 126-05, 126-07, and 126-09, and Mountain View Dairy well 70-02 contained insufficient water and were not sampled. Bright Star well 340-02 and Del Oro Dairy well 692-04 were dry. Sunset/Desert Land Dairy well 257-03 was not sampled due to an unknown blockage in the well.

Wells were sampled from historically clean to dirty to the extent possible to minimize cross-contamination potential. All non-dedicated or disposable equipment was decontaminated between wells with an Alconox™ solution to further ensure sample quality. All meters were calibrated and/or checked with standards in accordance with the manufacturer's specifications prior to daily use. Purge water was ground discharged.

When sufficient water 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. 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 B.

All groundwater samples were collected immediately after purging. Sampling was either accomplished by carefully pouring groundwater from the bailer into the sample containers or by pumping groundwater through new polyethylene tubing into the sample container. Sample containers were provided by Eurofins Environment Testing South Central, LLC (Eurofins). Container size, type, sample preservatives, analytical methods, and holding times are specified in Table 3. All samples were preserved in accordance with method requirements, labeled, then immediately cooled to <6°C with ice and delivered under chain-of-custody to Eurofins in Albuquerque, New Mexico. All analytical laboratory reports are provided in Appendix C.

2.3 Irrigation/Supply Well Groundwater Sampling

Eight irrigation/supply locations were sampled March 13 through March 14, 2024. Samples were analyzed for nitrate, chloride, TDS, and TKN in most wells. Chloride and TDS were not analyzed in samples collected from Mountain View Dairy well LRG-457, Sunset Dairy well LRG-3348-AS, and Desert Land Dairy well LRG-3348-B; groundwater from these wells will be sampled for chloride and TDS next quarter. 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.

Seven of the collected samples are from dairy supply wells located near their respective milking parlors. The supply wells at Mountain View Dairy, Bright Star Dairy, Dominguez Dairy, Buena Vista Dairy II, Sunset Dairy/Desert Land Dairy, and Del Oro Dairy 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 Dominguez Dairy, wells LRG-591-S and LRG-591-S-2 pump into a holding tank; as a result, the sample collected is a composite sample. At Del Oro Dairy three supply wells pumped water into the holding tank; therefore, the groundwater sample collected was a composite sample. One irrigation well, Mountain View Land Application Area well LRG-457, was sampled.

Organ Dairy well LRG-458 S, Dominguez 2 well LRG-956, and Dominguez Dairy well LRG-00590-S-6 were not operating and as a result, the wells could not be sampled. Big Sky well LRG-4116 was not sampled because the valve was removed and an alternate sampling location could not be identified.

3.0 GROUNDWATER MONITORING RESULTS

3.1 Hydraulic Gradient and Direction of Groundwater Flow

During the past quarter, groundwater was present beneath the site at depths ranging from 14.68 feet below top-of-casing (ft btoc) in AP well DAD-03 to 137.50 ft btoc in Dominguez 2 DP well 42-12. Groundwater was encountered at shallower depths near the Mesquite Drain and at greater depths 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 was not used in contouring for the central area potentiometric surface map.

Potentiometric surface maps were completed using the monitoring well gauging data for the northern, central, and southern portions (perched and regional aquifers) of the Dairies. Groundwater elevation data are provided in Table 1 and potentiometric surface maps are provided as Figures 2, 3, 4, and 5. Hydrographs were completed for select monitoring wells in each area and are provided in Appendix D. In comparison to November 2023, groundwater levels increased by an average of 0.15 foot in the northern area, though increases in groundwater levels were larger in the northern and southern wells in the northern portion and groundwater levels decreased in the middle of the northern portion. Groundwater levels increased by an average of approximately 0.50 foot in the central area. In the southern area, average groundwater levels increased by approximately 1.0 foot in the regional aquifer while average groundwater levels in the perched aquifer decreased by an average of 0.15 foot but increased at the southern end of the southern perched aquifer.

During the most recent gauging event, groundwater flow direction of the regional aquifer was to the southeast except in the middle portion of the northern area where groundwater flowed to the northeast. Flow direction in the southern perched aquifer was to the southwest.

The hydraulic gradient across the Dairies in the northern, central, and southern regional aquifer was approximately 0.001 ft/ft. The hydraulic gradient in the perched aquifer in the southern area was approximately 0.004 ft/ft.

3.2 Groundwater Field Parameters

Field parameters from the most recent monitoring event including specific conductance, pH, temperature, ORP, and dissolved oxygen were recorded on the sampling field forms (Appendix B) and are summarized in Table 2. Specific conductance, dissolved oxygen, and ORP trends for select wells are presented in Appendix E. Though dissolved oxygen and ORP measurements from wells containing a dedicated pump were recorded, these measurements are not considered representative of aquifer conditions.

3.3 Groundwater Nitrate, Chloride, and TDS Analytical Results

3.3.1 Abatement Plan Monitoring Well Analytical Results

Groundwater analyte concentrations were below the 10 milligrams per liter (mg/L) NMWQCC standard for nitrate as nitrogen in 13 of the 26 AP monitoring wells sampled. AP monitoring well DAD-20 was unable to be sampled due to well damage. The well is located on Anthony Waste Water Treatment Plant property and was damaged along with the protective bollards around it. Groundwater collected from the following 13 AP wells had nitrate concentrations at or above the standard: DAD-01, DAD-07, DAD-08, DAD-09, DAD-11 (vertical delineation well), DAD-13, DAD-14, DAD-15, DAD-19 (vertical delineation well), DAD-21, DAD-22, DAD-23, and DAD-26.

Nitrate concentrations decreased or were the same in groundwater collected from AP wells DAD-01, DAD-02, DAD-03, DAD-04, DAD-05, DAD-06R, DAD-10, DAD-12, DAD-13, DAD-14, DAD-16, DAD-17, DAD-18, DAD-21, DAD-23, and DAD-24 compared to the previous sampling event. The largest decrease in nitrate concentration was observed in well DAD-21, which decreased from 28 mg/L in December 2023 to 16 mg/L in March 2024. The largest nitrate concentration increase was observed in groundwater collected from well DAD-09, where concentrations increased from 33 mg/L in December 2023 to 49 mg/L in March 2024. During this sampling event, nitrate concentrations in groundwater collected from AP wells ranged from 76 mg/L in well DAD-14 to below the laboratory reporting limit of 2.0 mg/L in wells DAD-03, DAD-04, DAD-10, and DAD-16, and below the laboratory reporting limit of 1.0 mg/L in wells DAD-05 and DAD-17. The nitrate concentrations in DAD-07 and DAD-11 (vertical delineation well) continue to increase.

Both chloride and TDS concentrations equaled or exceeded their respective NMWQCC standards in most AP wells. Exceptions include wells DAD-06R and DAD-17, where both chloride and TDS groundwater concentrations were below the 250 mg/L and 1,000 mg/L standards, respectively. The highest chloride concentration in the AP wells was 1,500 mg/L, in well DAD-08. The highest TDS concentration in the AP wells was found in also found in well DAD-08, where groundwater concentration was 4,300 mg/L. Last quarter, AP well DAD-15 had an anomalously high TDS concentration of 5,060 mg/L, however, the TDS concentration has returned to its historical range this quarter with a concentration of 2,700 mg/L.

Table 4 and Figures 6 through 9 present the analytical results for AP monitoring wells. Analytical laboratory reports are provided in Appendix C. Nitrate, chloride, and TDS concentration trends for select AP wells are presented by area in Appendix F.

3.3.2 Abatement Plan and Discharge Plan Well Analytical Results by Area

DP groundwater analytical results are presented in Table 5. Nitrate, chloride, and TDS concentration trends for the DP wells by area are presented in Appendix G. Analytical data for all sampled DP wells are also presented in Figures 6 through 9. Analytical laboratory reports are included in Appendix C. Discussions of upgradient/downgradient conditions reflect current

groundwater flow directions discussed in section 3.1. The following discussions summarize the results by area at the Dairies.

Northern Portion

Groundwater collected from upgradient well 86/340-01 (located north of the abatement area) has been below the nitrate NMWQCC standard of 10 mg/L since February 2018; historically, groundwater concentrations in this well were consistently above the nitrate standard. Northern Land Application Area well 70/86/340-01, located at the northern-most boundary of the abatement area, contained groundwater above the nitrate standard at a concentration of 24 mg/L. Organ Dairy well 126-12, Dominguez Dairy 2 well 42-08, and Dominguez Dairy 624-02 delineate the western edge of the plume. The nitrate plume is defined to the east by Dominguez Dairy well 42-11 and AP well DAD-01, although during this sampling event, nitrate concentrations were reported in AP well DAD-01 just above the standard at 11 mg/L. DAD-13 usually serves as an eastern delineation well with a nitrate concentration just above the standard; however, the March 2024 sample had a high concentration of 16 mg/L. EA will continue to monitor this well for increasing trends. AP well DAD-02 (6.4 mg/L) delineates the southern nitrate plume. The highest nitrate concentration in the northern portion was observed in DAD-14 with a concentration of 76 mg/L.

The chloride and TDS concentrations in DP wells were at or above their standards in all wells sampled within the northern portion of the Dairies. The highest concentrations of chloride and TDS were observed in the Northern Land Application area well 70/86/340-01 at concentrations of 2,000 mg/L and 6,290 mg/L, respectively.

Central Portion

The northern extent of the central portion nitrate plume is defined by Buena Vista Dairy II well 74-03 where the nitrate concentration was detected below the NMWQCC standard, at a concentration of 1.2 mg/L. The southern extent is defined by Las Cruces Community Farms (formerly McAnally Enterprises) well MW-4, where nitrate was detected at a concentration of 1.1 mg/L in February 2024. The eastern edge of the nitrate plume is currently delineated by AP well DAD-06R at a concentration of 8.4 mg/L. Historically, the eastern extent of the plume was defined by wells DAD-07 and DAD-15. In the most recent sampling event, nitrate concentrations in groundwater collected from these wells exceeded the standard with concentrations of 50 mg/L and 21 mg/L, respectively. The western extent is defined by Buena Vista Dairy well 74-02 and AP wells DAD-16 and DAD-05; nitrate was detected just above the NMWQCC standard in DP well 74-02 at 11 mg/L. Nitrate was not detected above the reporting limit of 1.0 mg/L in AP well DAD-05 or above the 2.0 mg/L reporting limit in AP well DAD-16. The highest nitrate concentration in the central portion was 86 mg/L, observed in Big Sky Dairy well 833-07.

Chloride and TDS concentrations were generally at or above standards in wells within the central portion of the Dairies. Chloride was below the standard in Buena Vista Dairy II well 74-03 (230 mg/L) and in AP wells DAD-06R (100 mg/L) and DAD-17 (99 mg/L). TDS was below the standard in AP wells DAD-06R (690 mg/L) and DAD-17 (680 mg/L). The highest chloride concentration was observed at AP well DAD-08, at 1,500 mg/L. The highest TDS concentration

of 4,300 mg/L was also detected at AP well DAD-08.

Southern Portion – Regional Aquifer

Wells completed in the regional aquifer in the southern portion of the dairies include AP well DAD-10 and Del Oro wells 692-05 through 692-10 (Figure 8). All groundwater collected from wells in the regional aquifer contained nitrate below the NMWQCC standard except for Del Oro well 692-05 (16 mg/L).

Chloride concentrations were detected above the NMWQCC standard and ranged from 390 mg/L in Del Oro Dairy well 692-08 to 630 mg/L in Del Oro Dairy well 692-10. TDS concentrations ranged from 1,330 mg/L in DP well 692-08 to 1,750 mg/L in Del Oro Dairy well 692-10.

Southern Portion – Perched Aquifer

Wells completed in the perched aquifer in the southern portion that are sampled on a quarterly basis by DAD include wells 692-02, 692-04, DAD-09, DAD-20, DAD-21, DAD-22, DAD-26, and DAD-27 (Figure 9). However, during the February 2024 sampling event, AP well DAD-20 and Del Oro well 692-04 were unable to be sampled; DAD-20 was damaged and 692-04 was dry. Groundwater nitrate concentrations were above the standard in all sampled monitoring wells in the perched aquifer except downgradient well DAD-27 (7.0 mg/L). The highest nitrate concentration was detected at AP well DAD-09 (49 mg/L). The concentration of nitrate in groundwater collected from downgradient AP wells DAD-22 and DAD-26 are 16 mg/L and 24 mg/L, respectively. The nitrate plume is delineated to the southwest by AP well DAD-27. The nitrate concentration has remained relatively steady in DAD-27. The performance assessment of the system, including concentrations of groundwater samples collected from the extraction wells, is provided in Appendix A.

Chloride concentrations in the perched aquifer monitoring wells ranged from 430 mg/L in AP well DAD-09 to 970 mg/L in AP well DAD-26. TDS in the perched aquifer ranged from 1,800 mg/L in AP well DAD-09 to 2,700 mg/L in AP well DAD-26.

3.3.3 Irrigation/Supply Well Results

Groundwater analytical results for the sampled irrigation/supply wells are presented in Table 6. Analytical results are included in Figures 6, 7, and 8. Analytical laboratory reports are provided in Appendix C.

Nitrate concentrations were above the NMWQCC standard for nitrate in 3 of the 9 irrigation/supply well sample locations that were sampled. 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, 26 mg/L, and 27 mg/L, respectively. All three wells are located in the northern area.

Chloride and TDS concentrations were above the NMWQCC standards in all sampled irrigation/supply wells. The highest chloride concentration of 1,200 mg/L was detected at

Dominguez Dairy wells LRG-00591-S and LRG-00591-S-2. The highest TDS concentration of 3,500 mg/L was detected in the sample collected from Dominguez Dairy well LRG-00591-S-2. Chloride and TDS concentration ranges in the irrigation/supply wells are generally similar to the concentrations observed in discharge plan and abatement plan monitoring wells, further indicating that chloride and TDS concentrations observed are above standards regionally.

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). Analytical data collected from all AP and DP wells sampled in 2024 were included in a statistical trend analysis using the Mann-Kendall test. The trend analysis is based on analytical data collected from November/December 2015 through the current quarter. Concentration trend graphs for nitrate, chloride, and TDS are found in Appendices E and F. The statistical trend analysis is provided in Appendix H. Table 7 provides a summary of the trend analysis for the AP and DP wells.

4.1 Northern Portion

Trend analysis was conducted on 29 wells within the northern portion. Twelve DP wells were not analyzed for trend because they were dry or plugged and abandoned. Of the 29 wells analyzed, four wells had increasing trends for chloride and TDS: Dominguez 2 Dairy wells 42-08 and 42-11, and Dominguez Dairy wells 624-10 and 624-11. None of the analyzed wells had increasing trends for all three constituents. Stable or decreasing trends were present for all three constituents in 17 of the 29 wells.

Nitrate decreasing and increasing concentration trends are as follows:

- Decreasing Nitrate Trend: Northern Land Application Area wells 70-03 and 86/340-01, Organ Dairy wells 126-12 and 126-13, Mountain View Dairy wells 70-01, 70-02, and 70-04, Dominguez 2 Dairy wells 42-02, 42-03, 42-08, and 42-13, Dominguez Dairy wells 624-02 and 624-11, and AP wells DAD-02, DAD-12, and DAD-14.

- Increasing Nitrate Trend: Bright Star Dairy well 340-01, Dominguez 2 Dairy wells 42-10 and 42-12, and AP well DAD-01.

Chloride decreasing and increasing concentration trends are as follows:

- Decreasing Chloride Trend: Northern Land Application Area wells 70-03 and 86/340-01, Organ Dairy well 126-13, Mountain View Dairy well 70-02, Dominguez 2 Dairy wells 42-03 and 42-12, Dominguez Dairy well 624-02, and AP wells DAD-12, DAD-14, and DAD-23.

- Increasing Chloride Trend: Northern Land Application Area well 70/86/340-01, Dominguez 2 Dairy wells 42-08 and 42-11, and Dominguez Dairy wells 624-10 and 624-11.

TDS decreasing and increasing concentration trends are as follows:

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

- Increasing TDS Trend: Mountain View Dairy wells 70-01 and 70-04, Dominguez 2 Dairy wells 42-06, 42-08, 42-10, and 42-11, and Dominguez Dairy wells 624-10 and 624-11.

Upgradient Land Application Area well 70/86/340-01 had stable nitrate and TDS concentrations and increasing concentrations of chloride. Upgradient well 86/340-01 had decreasing concentrations of nitrate and chloride and stable concentrations of TDS. Nitrate, chloride, and TDS in these wells are expected to stabilize as land application has been phased out.

The Dominguez 2 eastern boundary wells 42-10, 42-11, and 42-12 had mixed concentration trends; however, nitrate concentrations are below the standard. Nitrate concentrations were increasing in wells 42-10 and 42-12, but stable in well 42-11. Chloride concentrations were stable in well 42-10, increasing in 42-11, and decreasing in 42-12. TDS concentrations were increasing in wells 42-10 and 42-11 and decreasing in well 42-12. AP eastern boundary well DAD-01 showed an increasing nitrate trend, stable chloride trend, and decreasing TDS trend. The other AP eastern boundary well, DAD-13, showed stable trends for nitrate, chloride, and TDS concentrations.

The western boundary wells Dominguez Dairy 2 well 42-02 and Dominguez Dairy well 624-09 had nitrate concentrations below the standard, and show a decreasing and stable nitrate trend, respectively. Chloride trends are stable in both well 42-02 and well 624-09. TDS trends in western boundary wells 42-02 and 624-09 are stable and decreasing, respectively. Organ Dairy well 126-12 had decreasing concentrations of nitrate and TDS and stable concentrations of chloride.

The southern boundary wells for the northern area are AP wells DAD-02, DAD-14, and DAD-23. AP well DAD-14 shows decreasing concentrations of nitrate, chloride, and TDS. DAD-02 had a decreasing nitrate trend and stable trends for chloride and TDS, while DAD-23 had a decreasing trend for chloride, and stable trends for nitrate and TDS concentrations.

4.2 Central Portion

A trend analysis was conducted on all 30 wells with adequate water for sampling within the central portion. Decreasing or stable trends for all three constituents were present in 16 of the 30 wells analyzed. Increasing trends for all three contaminants (nitrate, chloride, and TDS) were only present in Buena Vista Dairy II well 74-05 and AP well DAD-15.

A decreasing to stable nitrate trend was present in wells downgradient of eight of the nine lagoons in the central area. It is expected that similar trends will occur downgradient of all synthetically lined lagoons in the future.

Nitrate decreasing and increasing concentration trends are as follows:

- Decreasing Nitrate Trend: Big Sky Dairy wells 833-02, 833-07, 833-08, and 833-10, Sunset Dairy wells 257-01 and 257-02, and AP wells DAD-05, DAD-18, and DAD-25.

- Increasing Nitrate Trend: Buena Vista Dairy II well 74-05, and AP wells DAD-04, DAD-06R, DAD-07, and DAD-15.

Chloride decreasing and increasing concentration trends are as follows:

- Decreasing Chloride Trend: Buena Vista Dairy II well 74-03, and AP wells DAD-03, DAD-05, DAD-08, and DAD-16.

- Increasing Chloride Trend: Buena Vista Dairy II wells 74-02, 74-04, and 74-05, Big Sky Dairy wells 833-06, 833-08, 833-09, and 833-10, Sunset Dairy wells 257-01 and 257-03, and AP wells DAD-15 and DAD-24.

TDS decreasing and increasing concentration trends are as follows:

- Decreasing TDS Trend: 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, and DAD-18.

- Increasing TDS Trend: 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.

Upgradient wells Buena Vista Dairy well 74-03 and AP well DAD-03 had stable nitrate trends and decreasing trends for chloride and TDS. Eastern cross-gradient AP wells DAD-07 and DAD-15 had increasing trends for all constituents except for chloride in DAD-07, which was stable. Western cross-gradient wells 833-10 (Big Sky), DAD-04 (AP), and DAD-16 (AP) showed variable trends. Big Sky well 833-10 had a decreasing nitrate trend and increasing trends for chloride and TDS. AP well DAD-04 had increasing nitrate and TDS trends and stable trends for chloride. AP well DAD-16 had a stable trend for nitrate and decreasing trends for chloride and TDS.

Downgradient wells 257-02 (Sunset Dairy) and MW-4 (Former McAnally Enterprise) had stable trends for all three constituents, except for a decreasing nitrate trend in well 257-02. AP well DAD-25 additionally had a decreasing nitrate trend, but stable chloride and TDS trends.

4.3 Southern Portion

The southern portion statistical trend analysis was completed on all wells within the regional and perched aquifers. Of the 13 wells analyzed in the southern portion of the Dairies, ten had decreasing or stable concentrations of nitrate, chloride, and TDS.

Within the regional aquifer, an increasing nitrate trend was observed in Del Oro Dairy wells 692-05, 692-06, and 692-09. Nitrate was above the standard in 692-05 and below the standard in wells 692-06 and 692-09. Chloride trends were decreasing or stable in all regional wells. TDS trends were increasing in Del Oro Dairy wells 692-05 and 692-09.

In the perched aquifer, statistical trend analysis indicated all seven wells had stable or decreasing trends for all analytes. Nitrate was above the standard in Del Oro Dairy well 692-02, and AP wells DAD-09, DAD-21, DAD-22, and DAD-26. Nitrate was below the standard in AP well DAD-27. Chloride and TDS were above existing conditions in all seven wells, except for chloride in AP well DAD-09 (below existing conditions).

5.0 FIRST ORDER DECAY RATE

First order nitrate decay rates were calculated for wells where nitrate was detected above the standard and nitrate concentrations were exhibiting decreasing trends according to the Mann-Kendall trend analysis. The 1st order 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," by Newell, Rifai, Wilson, Connor, Aziz and Suarez, November 2002. Decay rate spreadsheets are presented in Appendix I.

Decay rates were calculated for a total of 18 monitoring wells. Eleven wells from the northern area: four wells from the central area, and three wells from the southern area (perched aquifer) were analyzed. A summary of the results of the decay rate analysis is presented in Table 8.

- Northern Area: Nitrate decay rates ranged from 0.0033 $years^{-1}$ to 0.1526 $years^{-1}$. These rates correspond to an average half-life of approximately 37 years. In these northern locations where groundwater attenuation is occurring, cleanup times averaging 48 years are expected.

- Central Area: Nitrate decay rates ranged from 0.0117 $years^{-1}$ to 0.0739 $years^{-1}$. The predicted average half-life was calculated as approximately 35 years and the average predicted cleanup time was calculated as approximately 102 years.

- Southern Area (Perched Aquifer): The nitrate decay rates for Del Oro well 692-02, and AP wells DAD-22 and DAD-26, were calculated as 0.3248 $years^{-1}$, 0.0823 $years^{-1}$, and 0.2131 $years^{-1}$, respectively. The predicted average half-life was calculated as approximately 5 years and the average predicted cleanup time was calculated as approximately 8 years.

6.0 GEOSTATISTICAL ANALYSIS

A geostatistical analysis was completed to estimate analyte distribution and calculate contaminant plume area changes over time. Nitrate plumes were defined as areas where concentrations exceed the NMWQCC nitrate standard of 10 mg/L. Consistent with the Five-Year Review (EA 2020) and 2021 Annual Report (EA 2021a), chloride and TDS plumes were defined as areas exceeding the 2016 calculated background concentration. The 2016 chloride background concentration is 1,015 mg/L for the northern area, 1,781 for the central area, and 503 mg/L for the southern area. The 2016 TDS background concentration is 3,178 mg/L for the northern area, 5,328 mg/L for the central area, and 2,552 for the southern area. This historical background concentration is used to provide a consistent baseline from initiation of abatement for comparison of year over year changes.

Interpolation by kriging was applied to nitrate, chloride, and TDS concentrations from the February/ March 2024 sampling event. Elements of the plume generated through kriging are displayed with solid lines. In locations where plume edges were not defined by the model, isopleth lines were manually drawn using professional judgment.

Bright Star Dairy well 340-02, Organ Dairy wells 126-04, 126-05, 126-07, and 126-09, Del Oro well 692-04, and Del Oro extraction well EW-03 were not included due to insufficient water for sampling. AP well DAD-20 was damaged before the December 2023 sampling event and can no longer be sampled. Sunset Dairy well 257-03 could not be sampled due to a well obstruction during the most recent sampling event as well as the previous sampling event; as a result, this well was not included in modeling. Additionally, vertical delineation wells and AP well DAD-25, which was likely completed in a perched aquifer, were excluded from the data set. Extraction well EW-05 could not be sampled due to pump malfunction; as a result, results from November 2023 were used in modeling. Dominguez Dairy 624-09 was not used for modeling because it is located across the Mesquite Drain.

Central area chloride and TDS and southern area TDS in the regional aquifer were not modeled because concentrations were below 2016 regional background levels.

Table 9 provides the calculated areas of plumes in the north, central, and south portions for 2016 through 2024. Distributions of contaminants modeled from 2024 data are displayed in Figures 10 through 18. Note that the contaminant plume geometries were statistically modeled, and as a result, concentration intervals may be offset from measured concentrations at individual monitoring locations. Additionally, there are instances where kriging generates a plume shape that is unlikely to represent the true distribution of analytes. The unlikely plume shape generated by the model is kept intact to standardize plume generation methods to the extent possible. Based on current and historical groundwater flow direction to the south/southeast, the nitrate plume in the central area has been identified as a low confidence model output (Figure 13).

The following is a discussion of the geostatistical analysis of analyte distribution for each portion of the Dairy:

- Northern portion - The total size of the nitrate plume was stable in 2024 as compared to 2016. Chloride and TDS plume sizes increased by over 40% between 2016 and 2024. Increases in chloride and TDS plume sizes can be attributed to increased concentrations at Northern Land Application well 70/86/340-01 as well as the loss of Organ Dairy wells 126-07 and 126-09, which previously provided delineation but are currently dry.

- Central portion - The size of the 2024 nitrate plume was stable relative to 2016. Although a portion of the central nitrate plume is considered low confidence model output, the area is included in the area total to provide a conservative estimate. The chloride and TDS plumes decreased in size relative to the 2016 baseline; these plumes above existing conditions are longer present.

- Southern portion (regional aquifer) – The nitrate plume size has increased between 2016 and 2024 though has decreased relative to the size of the 2021, 2022, and 2023 nitrate plume sizes. The chloride plume size has decreased by 0.1 acres since 2016, which is considered stable. TDS has never been detected above existing conditions, and therefore, the plume size has been stable between 2016 and 2024.

- Southern portion (perched aquifer) – Nitrate and chloride plumes increased in total size between 2016 and 2024, though plume sizes have decreased relative to the size of the 2021, 2022, and 2023 nitrate plumes. Because of the distribution of contamination and monitoring wells, the modeled plume geometries in the perched aquifer have required manual interpretation for large areas and are therefore limited in their ability to offer accurate comparisons from year to year. Four new data points (Del Oro Extraction wells EW-01, EW-02, EW-04, and EW-05) were added in the 2024 contaminant modeling. These additional wells provide additional information on the distribution of contaminants in the perched aquifer at the south end of Del Oro Dairy.

7.0 CONCLUSIONS AND RECOMMENDATIONS

The groundwater monitoring event included the gauging of all accessible DP and AP wells and the sampling of 25 AP wells and the DP wells that were accessible and contained sufficient water to sample. Additionally, 8 irrigation and supply wells were sampled. Based on the data collected, the following conclusions and recommendations are presented:

7.1 Hydraulic Gradient and Direction of Groundwater Flow

- The depth to groundwater at the site ranged from 14.68 to 137.50 ft btoc.
- On average, groundwater levels increased relative to last quarter in the regional aquifer and decreased in the southern perched aquifer.
- Groundwater flow direction in the northern area varied from southeast to northeast during the most recent gauging event.
- Flow in the central and southern area regional aquifer was to the southeast and flow in the southern perched aquifer was to the southwest.
- Hydraulic gradient in the regional aquifer was 0.001 ft/ft.
- The perched aquifer at Del Oro Dairy has a groundwater flow direction toward the south-southwest. The hydraulic gradient in the perched aquifer was 0.004 ft/ft.

7.2 Groundwater Nitrate, Chloride, and TDS Analytical Results

- Nitrate was below the NMWQCC standard of 10 mg/L in 13 of the 26 groundwater samples collected from the AP wells.
- Chloride was above the NMWQCC standard of 250 mg/L in all AP monitoring wells sampled, except for wells DAD-06R and DAD-17, which had chloride concentrations of 100 mg/L and 99 mg/L, respectively.
- TDS was above the NMWQCC standard of 1,000 mg/L in all monitoring wells sampled, except for wells DAD-06R and DAD-17, which had TDS concentrations of 690 mg/L and 680 mg/L, respectively.
- Chloride and TDS remain near or above NMWQCC standards in wells upgradient of the northern, central, and southern portions of the plume at the Dairies. Chloride and TDS are regionally elevated above standards and not necessarily attributed to the Dairies.

7.3 Trend Analysis

- Trend analysis indicates that 17 of the 29 wells analyzed in the northern portion had decreasing or stable trends for nitrate, chloride, and TDS.

- Trend analysis indicates that 16 of the 30 wells analyzed in the central portion had decreasing or stable trends for nitrate, chloride, and TDS.

- Trend analysis indicates that 10 of the 13 wells analyzed in the southern portion had decreasing or stable trends for nitrate, chloride, and TDS.

7.4 First Order Nitrate Decay Rates

- Nitrate decay rates in the northern area ranged from 0.0033 $years^{-1}$ to 0.1526 $years^{-1}$. These rates correspond to an average half-life of approximately 37 years. In these northern locations where groundwater attenuation is occurring, cleanup times averaging 48 years are expected.

- In the central area, nitrate decay rates ranged from 0.0117 $years^{-1}$ to 0.0739 $years^{-1}$. The predicted average half-life was calculated at approximately 35 years and the predicted cleanup time was calculated as approximately 102 years.

- In the southern perched aquifer, nitrate decay rates for Del Oro well 692-02, and AP wells DAD-22 and DAD-26 were calculated as 0.3248 $years^{-1}$, 0.0823 $years^{-1}$, and 0.2131 $years^{-1}$, respectively. The predicted average half-life was calculated as approximately 5 years and the average predicted cleanup time was calculated as approximately 8 years.

7.5 Geostatistical Analysis

- Northern portion - The total size of the nitrate plume was stable in 2024 as compared to 2016. Chloride and TDS plume sizes increased by over 40% between 2016 and 2024. Increases in chloride and TDS plume sizes can be attributed to increased concentrations at Northern Land Application well 70/86/340-01 as well as the loss of Organ Dairy wells 126-07 and 126-09, which previously provided delineation but are currently dry.

- Central portion - The size of the 2024 nitrate plume was stable relative to 2016. Although a portion of the central nitrate plume is considered low confidence model output, the area is included in the area total to provide a conservative estimate. The chloride and TDS plumes decreased in size relative to the 2016 baseline; these plumes above existing conditions are longer present.

- Southern portion (regional aquifer) – The nitrate plume size has increased between 2016 and 2024 though has decreased relative to the size of the 2021, 2022, and 2023 nitrate plume sizes. The chloride plume size has decreased by 0.1 acres since 2016, which is considered stable. TDS has never been detected above existing conditions, and therefore, the plume size has been stable between 2016 and 2024.

- Southern portion (perched aquifer) – Nitrate and chloride plumes increased in total size between 2016 and 2024, though plume sizes have decreased relative to the size of the 2021, 2022, and 2023 nitrate plumes. Because of the distribution of contamination and

monitoring wells, the modeled plume geometries in the perched aquifer have required manual interpretation for large areas and are therefore limited in their ability to offer accurate comparisons from year to year. Four new data points (Del Oro Extraction wells EW-01, EW-02, EW-04, and EW-05) were added in the 2024 contaminant modeling. These additional wells provide additional information on the distribution of contaminants in the perched aquifer at the south end of Del Oro Dairy.

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