EXPERT REPORT

OF

DAVID J. ERICKSON

Community Association for Restoration of the Environment, Inc., Friends of Toppenish Creek, and Center for Food Safety, Inc.,
v.

Austin Jack DeCoster, DeCoster Enterprises, LLC, Agricultural Investment-Fund II, LLC, Idaho Agri Investments, LLC, Idaho Dairy Holdings, LLC, Dry Creek Dairies, LLC, Washington Agri Investments, LLC, Washington Dairy Holdings, LLC, DBD Washington, LLC, and SMD, LLC.

(E.D. Wash. No. 1:19-CV-3110-TOR)

Prepared for:
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INTRODUCTION

1. I, David J. Erickson, have been retained by Plaintiffs in the above-captioned matter to provide expert testimony about the manure management and storage practices of Defendants Austin Jack DeCoster, DeCoster Enterprises, LLC, Agricultural Investment-Fund II, LLC, Idaho Agri Investments, LLC, Idaho Dairy Holdings, LLC, Dry Creek Dairies, LLC, Washington Agri Investments, LLC, Washington Dairy Holdings, LLC, DBD Washington, LLC, and SMD, LLC ("Defendants"), including whether these activities have caused contamination of soils and groundwater. Figure 1 shows the location of both DBD and SMD Dairies.

2. I have worked in the in the Hydrogeology/Geology field for 35 years. I am currently the Principal/Founder of Water & Environmental Technologies, PC in Butte, Montana. I served as the President/Principal for 20 years. I am a registered Professional Geologist in Utah and Wyoming and a Certified Professional Geologist with the American Institute of Professional Geologists. I graduated with a degree in Geological Engineering from Montana Tech.

3. During my 35 years of professional experience, my main focus has been on contaminant hydrogeology: identification of contaminant behavior in the subsurface and remediation of the impacts. I have been responsible

for investigation and remediation of many Underground Storage Tank and Hazardous Waste Sites with contaminants including: fuels, solvents, wood treating compounds, metals, pesticides, herbicides, fungicides, and fertilizers.

4. As Project Manager/Principal Hydrogeologist, I have supervised, designed, installed, and monitored various types of remedial technologies or remedial methods including air stripping, air sparging, vapor extraction, bioventing, bio-cell treatment, biostimulation, Non-Aqueous Phase Liquid recovery, in-situ and ex-situ bioremediation, natural attenuation, barrier wall technology, pump & treat, and excavation & off-site disposal.

5. I have extensive experience working with waste storage impoundments. For instance, I was involved in the hydrogeologic investigation and characterization of groundwater contamination at a Wyoming power facility, where large settling ponds containing coal ash and flue gas desulfurization liquor were leaking, resulting in impacts to groundwater. The investigation included geochemical modeling to identify contaminant fingerprints and a geostatistical model of the alluvium/bedrock contact. After investigating and characterizing the site, I was responsible for the installation of a monitoring system, and, later the development of a groundwater flow and contaminant transport model.

6. During my career, I have looked at and/or investigated over 100 waste lagoons and impoundments. A vast majority have impacted groundwater due to seepage through earthen liners.

7. In the last eight years, I have investigated over thirty Concentrated Animal Feeding Operations ("CAFOs") in six different states. In the 1990s, I investigated twenty-seven grain storage/agricultural chemical distribution facilities across Montana and North Dakota; nine of these facilities required remediation. I am very familiar with agricultural chemicals, their use and storage, and the contaminant fate and transport of these various compounds.

8. Water & Environmental Technologies ("WET") is responsible for installing or operating remedial systems at several locations. Recently, we have installed or operated:

a. A pumpback system for a major industrial waste pond in Wyoming.
b. A dewatering system for a waste pond in central Wyoming.
c. A capture system for seepage of waste from a waste impoundment and landfill in Utah.
d. A pump and treat system for a leaking pond at a Coal Fired Generator Site in Kemmerer, Wyoming.
e. A free product recovery system to remediate a 250,000-gallon

diesel spill at a county shop in Montana.

f. An air sparging/vapor extraction system with oxygen injection for gasoline contamination in Colorado.

g. Installation and optimization of free product recovery by installing interceptor trenches in Wyoming.

h. A multi-million-dollar restoration project involving excavation, vapor extraction and multi-phase extraction at a refinery in Sunburst, Montana.

9. I have also completed work on several projects involving nitrate contamination caused by both individual wastewater treatment systems and agricultural activities. These projects include remedial activities at 12 fertilizer distribution facilities and investigation work at both hog and dairy CAFOs. With respect to wastewater treatment and septic discharges, WET has completed an eight-year study of septic system impacts to groundwater and developed a patented treatment system (SepticNET) to remove both nitrate and phosphorous from individual and small community septic discharges.

10. The development of the SepticNET involved several years of sampling and characterizing septic discharges from both individual and community treatment systems, delineating the extent and magnitude of

septic impacts to groundwater, and evaluating the hydrogeologic characteristics of multiple areas where nitrate impacts have degraded groundwater above drinking water standards.

11. The SepticNET system uses a biological process to nitrify the raw wastewater and denitrify the treated wastewater. It requires a complete understanding of the Nitrification-Denitrification (NDN) process that sometimes occurs in soil. It also requires an understanding and optimization of the nitrogen cycle.

12. My curriculum vitae is attached hereto as Exhibit E. It contains a list of my prior work history and activities.

13. I am being compensated at a rate of $250/hour for the time I have spent on this report. This fee is doubled for depositions and trial testimony.

14. I have reviewed numerous documents about DBD and SMD, the Yakima Valley, and resource information for Yakima County. This information includes:

a. The Dairy Nutrient Management Plans ("DNMP") for DBD and SMD, along with all appendices and attached information;

b. Annual Reports submitted by Defendants for the DBD and SMD dairies, identified with the following Bates Nos.:

i. 2018 DBD Revised, DAIRIES-00018575

ii. 2019 SMD, DAIRIES-00012512, as well as DAIRIES-00000607

iii. 2019 DBD, DAIRIES-00012536

iv. 2020 SMD, DAIRIES-00016540

v. 2020 DBD, DAIRIES-00016481

vi. 2021 SMD – No Bates

vii. 2021 DBD – No Bates

viii. 2022 SMD – No Bates

ix. 2022 DBD – No Bates

c. A variety of soil sampling, manure sampling, and fertilizer recommendation information, outside of what is reported in the Defendants' Annual Reports:

i. DAIRIES-00000673 (Fall 2019 SMD Lab Data)

ii. DAIRIES-00002620 (2019 SMD Fertility Report)

iii. DAIRIES-00002640 (2018 SMD manure sampling information)

iv. DAIRIES-00002562 (SMD 2019 manure sampling information)

v. DAIRIES-00002923 (2018 SMD soil sampling data)

vi. DAIRIES-00011065 (Fall, 2020 SMD soil sampling data)

vii. DAIRIES-00011075 (Spring, 2020 SMD soil sampling data)

viii. DAIRIES-00003058, 3058, and 3060 (Fall, 2019 SMD soil sampling data)

ix. DAIRIES-00003216 & 3217 (incomplete early Spring, 2020 SMD soil sampling data from two fields, sampling occurred in March)

x. DAIRIES-00000631 (Fall 2019 DBD Lab information)

xi. DAIRIES-00002575 (Ecology nutrient budget with many fields in very high “red” category)

xii. DAIRIES-00002656 (Fall 2017 DBD soil sampling and fertility information)

xiii. DAIRIES-00002698 (2018 DBD soil sampling and fertility information)

xiv. DAIRIES-00002786 (2019 DBD soil sampling and fertility information)

xv. DAIRIES-00002949 through 2063 (Spring, 2019 DBD soil sampling and fertility information, incomplete)

xvi. DAIRIES-00003011 (Fall, 2019 DBD soil sampling and fertility information)

xvii. DAIRIES-00003201, 3246-3254 (Spring, 2020 DBD soil sampling and fertility information, appears incomplete)

xviii. DAIRIES-00003134 (Fall, 2019 DBD manure and nutrient analyses)

xix. DAIRIES-00003256 (Email from Ecology concerning very high field results)

xx. DAIRIES-00010552 (Fall, 2020 DBD soil sampling results)

xxi. DAIRIES-00011019 (Spring, 2020 DBD soil sampling results)

d. Portions (pp. 70-77) of the deposition testimony of Karina Chavarin.

e. Data collected in connection with two investigations into the groundwater nitrate concentrations at the DBD facility. First, WET conducted a Rule 34 investigation on behalf of the Law Offices of Charles M. Tebbutt, P.C. between May 19 and May 21, 2021, where it collected groundwater samples from borings; second, Farallon Consulting, L.L.C. ("Farallon") conducted an investigation on June

29, 2021, from samples of ten monitoring wells at DBD.

f. Documents and data created in connection with the Clean Drinking Water Project.

g. Data on E.coli values in samples collected on or near the Dairies collected by RSBOJC Water Quality Laboratory and WSDA.

h. The log of a boring by Farallon Consulting on or around June 22, 2021.

i. Several studies and reports from the Washington State Department of Ecology, including: Carey, Barbara, Effects of Land Application of Manure on Groundwater at Two Dairies over the Sumas-Blaine Surficial Aquifer, 2002, Washington State Dept. of Ecology Publication No. 02-03-007; Erickson, Denis R., Effects of Leakage from four Dairy Waste Storage Ponds on Groundwater Quality, Final Report, 1994, Washington State Dept. of Ecology Publication No. 94-109; E.S. Marx, J. Hart and R.G. Stevens, Soil Test Interpretation Guide, Oregon State Extension Service EC 1778. 1999; Vaccaro, J.J., Jones, M.A., Ely, D.M., Key, M.E., Olsen, T.D., Welch, W.B., and Cox, S.E., 2009, Hydrogeologic Framework of the Yakima River Basin Aquifer System, Washington: U.S. Geological Survey Scientific Investigations Report 2009-5152, 106 p.

15. All opinions expressed herein are to a reasonable degree of scientific certainty, unless otherwise specified. I reserve the right to modify or supplement this report based on information obtained by Plaintiffs after the date of this report.

16. Generally, I have been requested by Plaintiffs to render an opinion about whether DBD and SMD's manure management and storage practices have resulted in nitrogen-containing contaminants, principally nitrate, from cow manure being leached through the ground and into groundwater. Specifically, I have been asked to render an opinion about whether DBD's lagoons, applications fields, and composting areas, and SMD's lagoons, applications fields, composting areas, and pens, are responsible for the release of nitrogen and other compounds into soils and groundwater. Based on my review of the available information and pertinent literature, I conclude that DBD and SMD's manure management and storage practices are one of the primary contributing sources of the nitrogen (in the form of nitrate and ammonia) contamination observed in the groundwater.

17. Infiltration of wastes and associated contaminants occurs from lagoon seepage, from animal operations, from composting operations, from silage processing and from overapplication of manure to the fields.

18. I have also been asked to render an opinion as to what measures DBD

and SMD could reasonably take that would reduce nitrogen loading from the dairies and would remediate the nitrate contamination currently in groundwater. I discuss these options at the end of this report.

SCIENTIFIC AND FACTUAL BACKGROUND REGARDING THE DAIRIES

19. The DBD dairy facility (Figure 1) is located at and near 5111 Van Belle Road, Outlook, WA 98938. The SMD dairy facility is located at 211 Nichols Road, Outlook, WA 98938 (the DBD and SMD dairy facilities collectively the "Dairies"). I understand that the Dairies share common ownership with the DeCoster Enterprises Defendants, and that all entities are jointly controlled and operated by all Defendants. I also understand that the Dairies share common manure management and application practices, and both use Mr. Scott Stephen and Agrimanagement as their crop advisor and agronomist.

20. According to Defendants' most recent Annual Reports, the DBD facility increased the number of dairy cows from 1300 to 2800 during 2022 and houses 300 heifers, producing an estimated 19.5 million gallons of liquid manure and 54,000 tons of solid manure in 2022. The total acres available for land application in 2022 was 848, although only 293 acres were used for manure application.

21. The SMD facility is not presently milking, according to the 2022 Annual Report. The facility houses 2,000 dairy heifers, however, and produced an estimated 1,000,000 gallons of liquid manure and 12,000 tons of solid manure, all of which is reportedly sent to the DBD facility. The facility states it has 147 acres available for manure application, and that it used 27 acres for application in 2022.

Image: Heifer Pens

22. Based on my observations over the last three years, the number and

location of these cows has changed significantly on a year-to-year basis. Similarly, the Heifer pens have a different density of heifers depending on the time of year.

23. Using 1997 USDA-National Agricultural Statistics Service data, the U.S. Environmental Protection Agency ("EPA") estimated that a facility with 2,500 dairy cattle is estimated to create a similar waste load as a city of 411,000 people.[1] Even this extraordinary comparison is likely an underestimate for these Dairies, given that milk production per cow has increased by 16% in Washington State, from 20,968 pounds per cow in 1997[2] to 24,346 pound per cow in 2021[3] (Ref 3), and both milk and manure production reflect the quantity and quality of feed consumed.[4,5] Moreover, a significant difference between a city and a dairy farm is that human waste is extensively treated before discharge into the environment, whereas waste from CAFOs has no such requirement and is not treated, or treated

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1 "Risk Assessment Evaluation for Concentrated Animal Feeding Operations" EPA-600-R-04-042, at p. 7.

2 Milk Production Per Cow. USDA's National Agricultural Statistics Service, Washington Field Office, <https://www.nass.usda.gov/Statistics_by_State/Washington/Publications/Historic_Data/index.php> (accessed February 13, 2023).

3 Milk Production 02/23/2022. USDA's National Agricultural Statistics Service, <https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwjviefstZP9AhUVkGoFHVgCD3QQFnoECA0QAQ&url=https%3A%2F%2Fdownloads.usda.library.cornell.edu%2Fusda-esmis%2Ffiles%2Fh989r321c%2F7d279w693%2Ff7624g40c%2Fmkpr0222.pdf&usg=AOvVaw00vbJXOzq0_Rl0cDcHSr-c> (accessed February 27, 2023).

4 Nennich, T.D. , J.H. Harrison, L.M. VanWieringen, D. Meyer, A.J. Heinrichs, W.P. Weiss, N.R. St-Pierre, R.L. Kincaid, D.L. Davidson, and E. Block. 2005. Prediction of Manure and Nutrient Excretion from Dairy Cattle. Journal of Dairy Science, 88:3721–3733.

5 Bougouin, A., A. Hristov, J. Dijkstra, and 40 others. 2002. Prediction of nitrogen excretion from data on dairy cows fed a wide range of diets compiled in an intercontinental database: A meta-analysis. Journal of Dairy Science. 105:7462-7481.

minimally, before reaching the environment.

24. Given that the Dairies collectively have between two to three times as many cows as in the EPA's example, based on the above estimate, they produce a similar waste load as a human population of more than a million people. Moreover, the number of cows at DBD was substantially higher prior to 2020; the number of dairy cows and heifers in 2018 was 5,640, producing 54,020,062 gallons of liquid manure and 36,864 tons of sold manure;[6] and 5,500 in 2019, producing 75 million gallons of liquid manure and 36,864 tons of sold manure.[7]

25. Septic discharges from a single-family home average approximately 60 gallons per person per day with an average concentration of total nitrogen of 75 ppm, prior to the nitrate attenuation that occurs in the drainfield. The discharge of nitrates and other nutrients to groundwater, if any, occurs beneath the drainfield and results in a groundwater mixing zone or groundwater impacts within 300-500 feet of the drainfield. Septic systems can cause elevated nitrates in groundwater under specific conditions, such as housing densities less than 1.5 acres/house, locations with poor topsoil for secondary treatment, locations with bedrock aquifers of low permeability,

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[6] DAIRIES-00018575
[7] DAIRIES-00012536

and locations with a shallow groundwater table (i.e., less than 4 feet below ground surface or "bgs"). These conditions do not exist in the vicinity of the DBD or SMD Dairy.

26. There are two main aquifer types in the area. The first is a surficial unconfined to semi-confined alluvial aquifer. This aquifer is composed of highly layered alluvial material with predominantly silt, sand and cobbles and, according to USGS, has a total thickness of up to 500 feet. The second aquifer is an extensive basalt aquifer of great thickness underlying the surficial aquifer described above. The basalt aquifer is believed by the USGS to be semi-isolated from the surficial aquifer and stream systems. Natural groundwater flow within the shallower, surficial aquifer generally follows topography, but may be locally influenced by irrigation practices, ponds, lagoons, drains, ditches, and canals.[8] Groundwater in this shallower aquifer generally flows to the south or southwest, down the valley, and is used locally for residential drinking water supply and eventually feeds the Yakima River.[9] Figure 2 provides groundwater contours in blue derived from the monitoring wells at the site and ground water flow direction arrows in orange.

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[8] EPA Report at 7.

[9] Vaccaro, J.J., Jones, M.A., Ely, D.M., Key, M.E., Olsen, T.D., Welch, W.B., and Cox, S.E., 2009, Hydrogeologic Framework of the Yakima River Basin Aquifer System, Washington: U.S. Geological Survey Scientific Investigations Report 2009-5152, 106 p.

27. The Lower Yakima Valley is filled with sediments eroded from nearby highlands, such as the Rattlesnake Hills, and those deposited in the valley bottom by the Yakima River.[10] The alluvial sediments were deposited by area rivers and streams and provide a preferential flowpath horizontally along the depositional direction (*i.e.,* the permeability down the valley (Kx) is greater than the longitudinal permeability across the valley (Ky) and up to 100 times greater than the vertical permeability (Kz), which is typical of most alluvial systems). This typically results in flow in perched aquifers, especially near lagoons and irrigation ditches, where water is introduced at the surface, infiltrates until reaching a less permeable layer, and flows horizontally until a conduit is found to allow the fluid to migrate vertically. Water wells drilled in this depositional environment can penetrate the perched layer and provide a conduit for contaminant migration into the water table aquifer. As a result, a well that is located along a preferential flow path may capture a substantial portion of its water from a particular surface source, whereas a neighboring well located along a different flow path may exhibit entirely different contaminant characteristics.

28. Shallower wells located in the Lower Yakima Valley are more likely to be contaminated with nitrates than deeper wells, because the sources of

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[10] *Id.*

the nitrogen loading to the groundwater are man-made and occur on the land's surface. These activities include land-application of solid or liquid manure, transmission of liquids in contact with manure, application of chemical fertilizers, and storage of manure in unlined, earthen lagoons or composting areas. The EPA Report, along with other earlier studies, document more contaminated wells screened within the shallower aquifer than the deeper, basalt aquifer; in fact, the highest levels of nitrate generally occur in the shallow alluvial aquifer, especially in the upper portion of the alluvial aquifer.[11]

29. The shallow alluvial aquifer is the primary source of drinking water in the immediate area. Most houses in the area rely on this shallow groundwater source for drinking water supply.

30. Even the deeper aquifer, although believed by the USGS to be semi-isolated from the surficial aquifer, may be susceptible to impacts from the shallower aquifer when large scale pumping occurs in a preferential vertical flowpath. Appendix A of the EPA Report contains sample data collected from three wells completed in the deeper basalt aquifer (EPA Phase 3 well numbers WW-02, WW-07, and WW-09). Natural background nitrate concentrations are generally less than 2 ppm in groundwater (caused by

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[11] *Id*. at 8.

fixation of nitrogen gas in the atmosphere and by breakdown of organic matter).[12]

31. Manure contains two primary forms of nitrogen: ammonium and organic nitrogen. The organic form of nitrogen is nearly immobile; however, it becomes mobile, and available to crops as fertilizer, through mineralization. Mineralization is the process by which soil microbes decompose organic nitrogen into ammonium, which is then available as fertilizer for crops. By tilling manure into the subsurface to depths of 4-5 feet, plant uptake is eliminated and mineralization results in elevated ammonium in the subsurface. The rate of mineralization varies with soil temperature, soil moisture, and the amount of oxygen in the soil. After mineralization, microorganisms within the soil convert ammonium into nitrate. This process, called nitrification, occurs most rapidly when the soil is warm, moist, and well-aerated. Nitrates are the most plant-available form of nitrogen for fertilization purposes, but as described above, are highly mobile and susceptible to leaching loss to groundwater, especially when tilled below the root zone or over applied to the fields and leached below the root zone.

[12] U.S. Geological Survey Circular 1136 Nutrients in the Nation's Waters--Too Much of a Good Thing? By David K. Mueller and Dennis R. Helsel.

32. The predominant soils underlying and in the vicinity of the DBD and SMD dairies present little potential for any loss of nitrate through denitrification.[13] Denitrification is the conversion of nitrate to nitrogen gas by bacteria under anaerobic conditions. It can only occur in poorly drained, anoxic conditions or organic soils where oxygen is depleted in the root zone. In the absence of denitrification, nitrate moves with the groundwater through natural processes until the groundwater is discharged to surface water, or extracted from a well. Zones of higher permeable sand and gravel in the subsurface provide ample oxygen to limit denitrification in this area. I am not aware of any data that shows significant denitrification is occurring beneath the DBD or SMD facilities.

33. Because denitrification is very limited in the soils underlying the DBD and SMD dairies, any excess nitrate located in the ground where no crops are located will continue to migrate downward with water movement, eventually reaching groundwater. Once in groundwater, the nitrate can either be removed via water supply wells, or it will continue to migrate with groundwater flow and discharge to surface water.

DISCUSSION AND OPINIONS:

DEFENDANTS' MANURE STORAGE LAGOONS ARE A MAJOR SOURCE OF THE NITRATE CONTAMINATION OBSERVED IN

[13] EPA Report, Appendix B at B-4.

THE GROUNDWATER

34. Significant nitrate contamination exists in and around the Dairies, and such contamination is a result of the improper manure management practices of the Defendants. In particular, the contamination results in significant part from the fact that the DBD and SMD lagoons leaked up to 56,097,000 gallons of manure each year when both Dairies were operating at or near capacity and presently leak approximately 8,943,000 gallons per year. On average, under typical operating conditions, the presently active lagoons at DBD and SMD most likely leak 28,500,000 gallons per year assuming they averaged half full over the one- year time period. In addition, the Dairies' applications fields, pens, silage areas and composting areas also release nitrate, as do the heifer pens. These conclusions and site-specific data supporting these conclusions are further described below. A summary of estimated seepage rates is provided in the following table.

1. Significant Nitrate Contamination Exists in the Soil and Groundwater at DBD and SMD, Resulting in Part from Field Overapplication

35. There is significant nitrate contamination observed in the groundwater and soil found beneath and downgradient of the Dairies. This fact is evident from three investigations into the area's contamination. First, WET

conducted a Rule 34 investigation on behalf of the Law Offices of Charles M. Tebbutt, P.C. between May 19 and May 21, 2020, where it collected groundwater samples from borings and soil samples from the application fields and compost area of DBD and the abandoned lagoons, compost area, pens and application fields at SMD. Figure 1 shows the sample locations where WET collected groundwater and/or soil samples. Second, Farallon conducted an investigation on June 29, 2021, from samples of ten monitoring wells at DBD and SMD, which it re-tested on November 21, 2022. Farallon also tested soil samples from the borings that were converted to monitoring wells. The Farallon sample locations are also shown on Figure 1. Third, Agrimanagement has performed a significant number of investigations involving collection and analysis of soil and groundwater samples; while I am not confident that Defendants have shared all of Agrimanagement's data, the data that they have shared is consistent with the high concentrations observed by WET and Farallon. The Agrimanagement sample locations have not been supplied and, thus, are not shown on the figure.

a. WET Investigation

36. The soil data from WET's investigation are presented in Exhibit A, and the groundwater data are in Exhibit B. The data in Exhibit A are labeled

according to the application fields where the composite samples were collected. Each field was sampled across the complete area by dividing the field into 50-100 subareas and selecting up to 10 subareas randomly and sampling four or more locations. These locations were composited on 1-foot intervals and submitted to the laboratory for analysis. Knowledge of irrigation practices in the field was used to randomize the samples. In fields DBD-3C and 3B, since the crop was still growing, samples were collected along a thin strip that was mowed while WET was on-site.

37. The WET soil data generally shows overapplication of manure to the fields, with elevated nitrate and total nitrogen extending below the root zone in the field. For example, the sites DBD-1C-176 (44 mg/kg), DBD-2EB-139 (45 mg/kg), SMD-01-176 (24 mg/kg), and SMD-FIELD01-32 (25 mg/kg) all show high concentrations of nitrates at a depth below five feet. In many cases, these elevated concentrations extend to groundwater, which is very shallow on these two facilities: around 10 feet on the northern fields and 3-5 feet below ground surface on the southern SMD fields. These shallow depths contrast with the significantly deeper groundwater depths underneath the testing locations for Cow Palace and the "Cluster" Dairies, which were greater than 100 feet on the northern areas and around 30 feet in the southern fields. The close proximity between soil with elevated nitrate and

groundwater is direct evidence of groundwater contamination due to overapplication of manure.

38. Moreover, as mentioned above, because the soil at the Dairies permits very limited denitrification, we should also be concerned about nitrate concentrations even within the root zone. In fields where crops are planted every year and the field is tilled, the root zone may only be present in the top 6" of soil. And, indeed, we observe extremely high levels of nitrate concentrations in that 1-foot zone. For example, we see 110 mg/kg within the first foot at DBD-1C-176, 86 mg/kg within the first foot at DBD-2EB-139, and 370 mg/kg within the first foot at DBD-3C-139.

39. More concerning, and direct evidence of nitrate leaching to groundwater, is the high concentration of nitrate throughout the soil column. DBD-3C shows concentration in the 170 to 240 mg/kg range all the way through the soil column.

40. The heifer pens south of SMD have been observed with ponded water on top of the manure multiple times over the last several years. Efforts to contour and slope the area have been made by the dairy, mainly by creating manure mounds in the pens. Infiltration of precipitation remains an issue resulting in soil and groundwater contamination beneath the heifer pens. Soil Samples SMD-H1 and SMD-H2 were collected in the pens; both samples

show infiltration of nitrate and ammonia through the soil column and into groundwater. Groundwater was encountered at the bottom of both sample cores. Based on sampling of mounds at other dairies, the mounds are also a likely continuing source of nitrogen loading to groundwater.

41. In areas where groundwater was encountered, WET collected a groundwater sample from the downgradient edge of the field. These samples are shown as the first four data points in Exhibit C.

39. These data provide a good example of the cumulative effects of overapplication. While the upper field shows concentrations of nitrate in groundwater from overapplication in the 5-7 mg/L range in addition to ammonia in the groundwater, the lower field shows concentrations as high

as 29.1 mg/l, or almost three times the maximum contaminant level standard. These data collected along groundwater flowpaths represent cumulative effects from a constant uniform nitrate load to groundwater as it flows under several fields. Overapplication at several fields results in increasing groundwater contaminant concentration along the groundwater flow direction. Simply, groundwater concentrations are only slightly impacted where groundwater enters the property from the North. By the time groundwater flows under the field, lagoons and source areas on DBD and SMD, groundwater is contaminated above drinking water standards, indicating that the operations at DBD and SMD are directly impacting groundwater quality under the Dairy property. Groundwater is severely impacted after flowing under the Dairies, and then flows off-site downgradient to impact other private properties and groundwater supply wells. Figure 2 shows these groundwater flowpaths across the Dairy and onto surrounding properties.

b. Farallon Investigation

42. Farallon conducted an investigation of both groundwater and soil in June of 2021, which WET oversaw, and DBD re-tested the groundwater in November 2022. Farallon collected soil samples from monitoring well borings around the lagoons and the facility. Farallon's soil data is in Exhibit

C, and the groundwater data is in Exhibit D.

43. In all drilling locations, ammonia, nitrate, and phosphorus were detected at depths below or adjacent to the lagoons or other manure sources. Groundwater samples from these monitoring wells show wells upgradient of the Dairy operations to be below drinking water standards (FWW-4 at 4.1 mg/l and FWW-5 at 5.0 mg/l nitrate), while all other wells are above drinking water standards (12.1-210 mg/l nitrate). The only exception is FWW-6 at 5.4 mg/l.

44. Concerningly, as is clear from the empty entries in Farallon's soil analyses in Exhibit C, we were not provided any data for FMW-03. However, one document Defendants produced for Daniel Chavarin's deposition is a Farallon boring log (no Bates number) for that location, which indicates that samples at both five and fifteen feet were collected and analyzed. We hope to see those results before the close of discovery.

45. The groundwater data indicates the lagoons and other areas of the facility, including the southern heifer pens, are causing contamination of the groundwater and resulting in groundwater that is not safe for human consumption. With respect to DBD, based on the groundwater analytical results for FWW-1 and FWW-3, the lagoons at DBD are discharging manure waste directly to groundwater and with respect to SMD, based on the

groundwater analytical results for FWW-8 and FWW-9, the lagoons at SMD were discharging manure waste directly to groundwater. The presence of these concentrations of ammonia in groundwater indicates that the lagoon bottoms are in direct contact with groundwater (i.e. insufficient oxygen is present to convert the ammonia to nitrate, nitrification). Soil borings and monitoring wells completed in the historical footprint of the lagoons showed manure buried in the subsurface. The core photo below shows a manure layer on top of a grey stained saturated soil; the buried manure in the lagoon bottom causes anoxic conditions in the groundwater, resulting in ammonia in the shallow aquifer.

46. Because the lagoons were abandoned and the abandonment was

completed improperly by burying manure in contact with groundwater, these lagoons will continue to act as source areas for contaminants for decades in the future. The boring FWW-10 shows ammonia and nitrate in the soil and 40 mg/l of nitrate in the groundwater beneath the heifer pens. The heifer pens are a continuing source of contaminants to groundwater in the area.

c. Agrimanagement Testing

47. During discovery, Plaintiffs were provided with a number of results of various tests conducted by Agrimanagement that showed consistently high levels of nitrate and ammonium. For example, soil tests in May of 2022 revealed nitrate levels at 130 and 190 for Fields 3 and 4 at DBD, respectively. Based on information from Agrimanangement, most fields have been overapplied in the past, and efforts to crop without any application are not lowering the soil concentration. This is an indication that the nutrients in the groundwater from overapplication in the field or from an upgradient field are high enough to sustain the crop requirements with no additional application.

48. To summarize this point, nitrate contamination from the Dairies has impacted the groundwater to a degree that the crops do not require application of nitrogen. The crop receives sufficient fertilizer from groundwater to sustain crop yields.

2. *The Significant Nitrate Contamination Results in Part from Lagoon Leakage at DBD and SMD.*

49. The high levels of nitrate contamination observed result in part because the lagoons at DBD and SMD leaked up to 56,097,000 gallons of manure per year when operating at full capacity, and presently leak approximately 12,092,000 gallons of manure per year, given that only DBD Lagoons 1 and 2 and SMD Lagoon 3 are presently operating. (However, as described below, this estimate for present leakage is conservative, because the decommissioned lagoons at SMD continue to leach.) The principle that governs fluid movement in lagoons and the subsurface is known as Darcy's Law. It is the equation that describes how fluid moves through porous media. At its most basic level, Darcy's Law is based on the fact that the amount of fluid movement between two points is directly related to the distance between the points, the pressure or head difference between them, and the permeability or the hydraulic conductivity of the media that the fluid moves through.

50. In equation form, Darcy's Law is typically described as $Q = KIA$, where "Q" is equal to the discharge, or volume of liquid per time unit; "K" is hydraulic conductivity, or permeability; "A" is the cross-sectional area where flow occurs, and "I" is the hydraulic gradient, the change in hydraulic

head per unit distance. In the case of lagoons, the hydraulic gradient is equivalent to the lagoon liquid depth. With knowledge of a few basic hydraulic characteristics, this equation can be used to calculate seepage to an aquifer from a lagoon. Most importantly, the permeability of the lagoon, if designed per NRCS guidelines should be $1X10^{-6}$ cm/sec.

51. In the tables below, I use Darcy's Law to calculate the seepage rates from each of the Dairies' manure storage lagoons using either known values or conservative estimates. I arrived at the 56,097,094 gallons of manure per year figure for conditions when the lagoons were operating at full capacity, and 8,942,707 for present leakage at average capacity. Table 3 shows a typical leakage if the lagoons are assumed to be one half full during the year.

Table 1: Leakage at Maximum Capacity

Lagoon Number	**Hydraulic Gradient**	**Lagoon Area**	**Estimated Seepage**	
	Feet	**Square Feet**	**Gallons/Day**	**Gallons/Year**
DBD Lagoons				
1	8.5	55,000	9,914	3,611,069
2	9.0	50,000	9,543	3,475,896
3	7.5	100,000	15,904	5,793,159
4	10.5	150,000	33,399	12,165,635
5	12.0	175,000	44,532	16,220,847
SMD Lagoons				
1	9	72,000	13,741	5,005,290
2	8	62,000	10,518	3,831,209
3	8	62,000	10,518	3,831,209
Settling lanes	6	58,000	4,920	1,792,017
5 - Nicholls Rd	4	8,000	1,018	370,762
Total		**792,000**	**154,007**	**56,097,094**

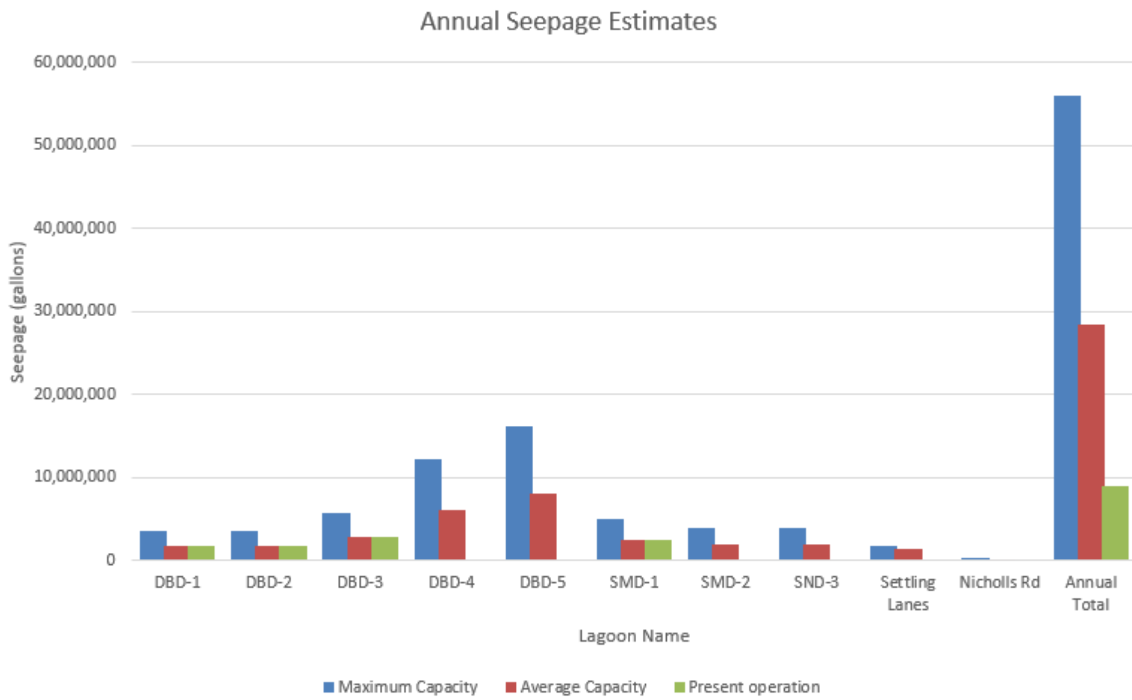
Table 2: Present Leakage

Lagoon Number	Lagoon Area	Estimated Seepage	
	Square Feet	Gallons/Day	Gallons/Year
DBD Lagoons			
1	55,000	4,957	1,805,535
2	50,000	4,771	1,737,948
3	100,000	7,952	2,896,580
4	150,000	0	0
5	175,000	0	0
SMD Lagoons			
1	72,000	6,871	2,502,645
2	62,000	0	0
3	62,000	0	0
Settling lanes	58,000	0	0
5 - Nicholls Rd	8,000	0	0
Total	**792,000**	**24,551**	**8,942,707**

Table 3: Typical Annual Leakage

Lagoon Number	Lagoon Area	Estimated Seepage	
	Square Feet	Gallons/Day	Gallons/Year
DBD Lagoons			
1	55,000	4,957	1,805,535
2	50,000	4,771	1,737,948
3	100,000	7,952	2,896,580
4	150,000	16,700	6,082,817
5	175,000	22,266	8,110,423
SMD Lagoons[3]			
1	72,000	6,871	2,502,645
2	62,000	5,259	1,915,605
3	62,000	5,259	1,915,605
Settling lanes	58,000	3,690	1,344,013
5 - Nicholls Rd	8,000	509	185,381
Total	**792,000**	**78,233**	**28,496,552**

52. The graph below compares each of these estimates.



53. For all lagoons calculations here, the permeability is assumed to be 1 X 10^{-6} cm/s. None of the lagoons contains any type of geosynthetic liner; each was instead constructed into the ground using a native soil-lined bottom and no documentation on compaction. The Dairies' Dairy Nutrient Management Plans claim that their lagoons comply with the Natural Resource Conservation Service ("NRCS") 313 standards for manure storage impoundments,[14] which is the aforementioned number assumed here. The NRCS standard requires waste storage impoundments to be located on soils that have a permeability "that meets all applicable regulation, or the pond

[14] DAIRIES-00016419 at 8 ("All earthen storage structures were constructed according to NRCS standards and specifications"); DAIRIES-00001132 ("Three existing storage ponds and four settling basins built to NRCS standards and specifications provide temporary storage of liquid manure").

shall be lined."[15] As Judge Rice observed in the *Cow Palace* case, "Even assuming the lagoons were constructed pursuant to NRCS standards, these standards [which are not regulations] specifically allow for permeability, and thus, the lagoons are designed to leak."[16]

54. Moreover, the use of that standard here is conservative or a low estimate for seepage. Notwithstanding the DNMP's claims to be in compliance, assessments from Inland Earth Sciences found that some of the lagoons at both DBD and SMD did not meet the NRCS 313 standard. The March 5, 2019, DBD assessment[17] found that, while Lagoons 4 and 5 were NRCS compliant, Lagoons 1, 2, and 3 were not. For both Lagoons 1 and 2, the embankment side slope of 4:1 differed from the NRCS 313 standard of 5:1; in addition, the assessment noted "significant erosion of the interior slopes . . . around inlet structures."[18] For Lagoon 3, the assessment stated "compliance with the Liner type requirements could not be verified," and that "erosion of the interior side slopes near inlet locations was noted."[19] Similarly, the March 22, 2019, SMD assessment[20] found that, while Lagoon 3 was NRCS compliant, Lagoons 1 and 2 were not. For both, the assessment

[15] WA313-3.
[16] CARE, Inc. v. Cow Palace, LLC, 80 F. Supp. 3d 1180, 1223 (E.D. Wash. 2015).
[17] DAIRIES-00000333
[18] *Id.* at 2-3.
[19] *Id.* at 3.
[20] DAIRIES-00000563

noted the same issue with the embankment side slope ratio as noted for DBD Lagoons 1 and 2; the erosion of interior side slopes; and the fact that no design information regarding the liner was available.[21] To date, we have no evidence that the Dairies ever addressed the issues identified in these assessments. In addition, I have inspected Lagoons 3, 4 & 5 at DBD on two occasions. Both times the lagoons were empty or near empty. All three lagoons have a significant portion of sand and gravel in the bottoms that would not meet the permeability requirement in the NRCS guidelines. Therefore, the 1 X 10^{-6} cm/s permeability number is a best-case scenario; in actuality, the permeability and, consequently, the manure leakage, could be significantly higher than the already-significant amounts stated in the Tables above.

55. The lagoon sizes were all derived from Google Earth, while the hydraulic gradient numbers were taken from the Inland Earth Sciences assessments for DBD[22] and SMD.[23] I will note that these numbers, again, are conservative; in particular, when I observed DBD Lagoons 4 & 5 after they were emptied and excavated, they appeared to be about 15 feet deep, not the 10 and a half and 12-foot numbers reported.

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[21] Id. at 2.
[22] DAIRIES-00000333
[23] DAIRIES-00000563

56. SMD Lagoons 2 and 3, as well as the Settling lanes and Nicholls Rd. lagoon, are now buried under natural soil. The investigation data, borings SMD-1, 2 &3, showed that the Dairy simply buried the manure and sludge in the bottom of the lagoons with soil, and that waste is now in contact with groundwater acting as a source of nitrate contamination. The detections of significant ammonia in the soil cores are also direct evidence of both the presence and decomposition of manure wastes in an anaerobic environment.

3. *The Dairies' Pens, Composting Fields, and Silage Areas, as well as the Heifer Pens, Also Release Contamination*

57. Soil samples collected in the DBD compost area showed concentrations of Total Kjeldahl Nitrogen (TKN) and ammonia in the soils above thegroundwater zone (DBD-CA-139-01 and DBD-CA-176-02). The soil beneath the compost area appeared to have about 1 foot of compacted manure in the subsurface, as evidenced by the high concentration of TKN. The groundwater (DBD-CA-139-01 and DBD-CA-176-02) shows elevated concentration of nitrate in the groundwater samples.

Image: Sampling at DBD Compost Area

58. Similarly, soil samples from the compost area at SMD (SMD-CA1) show high TKN into and below the water table and high nitrates changing to ammonia with depth. Both compost areas are source areas for groundwater contamination.

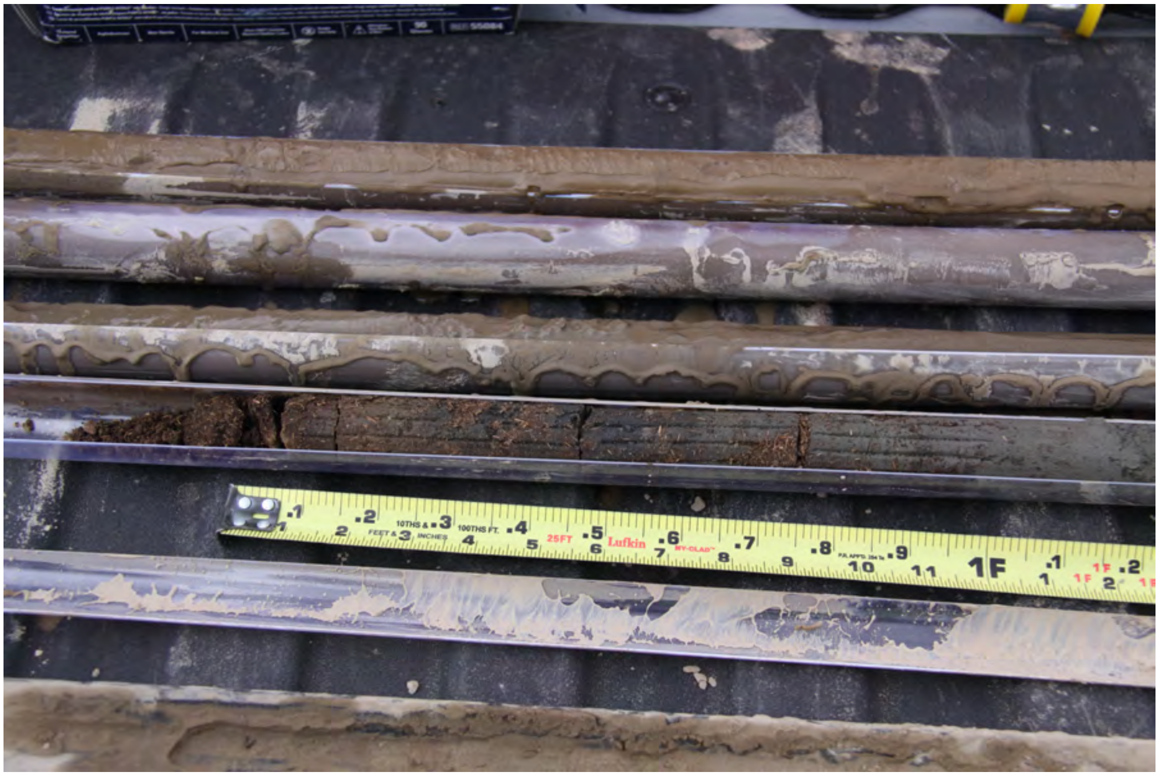


Image: Sample from DBD Compost area with 1' of compacted manure

Image: Leachate at SMD Compost Area seeping into the ground

59. The sileage areas are mostly contained on concrete; however, during our inspections, leachate has been viewed seeping out of the silage piles onto bare ground. Past sampling of the silage leachate shows high concentration of nutrients, so the drainage in the silage area needs to be contained in the site wastewater system. Well FWW-1 has high nitrate concentration that may be influenced by silage seepage.

60. Two samples were collected in the heifer pens south of SMD with the Geoprobe. Continuous samples were collected to a depth of 10' (SMD-H1 and SMD-H2). Both sample cores were analyzed on 1-foot intervals. High TKN or manure content was detected in the first foot, with high nitrate or Ammonia detected throughout the soil column. These data, combined with Farallon's well (FWW-10 at 40 mg/l nitrate in groundwater) show the migration path through the soil and the resulting groundwater contamination beneath the Heifer Pens.

61. I have reviewed some of the drinking water data from wells collected by the Clean Drinking Water Project ("CDWP"), which was set up through the Cluster Dairy Consent Decrees and other consent decrees between polluting dairies and the community group plaintiffs. The CDWP data show widespread manure contamination of the aquifer that is the primary drinking water source for thousands of homes in the Lower Yakima Valley. Nitrates

are the primary contaminant of concern tested by the CDWP. Wells in the vicinity of DBD and SMD have shown contamination above the 10 mg/L Safe Drinking Water Act standard, while others have shown the presence of nitrate above 2 mg/L. Generally speaking, nitrate contamination above 2 mg/L is likely human caused. This information, summarized in the maps attached hereto. Some homes have tested above 100 mg/L for nitrate, which is an alarmingly high number. This information further supports my conclusions that DBD and SMD are contributing to the nitrate contamination of the overall area as are other dairies in the area. Due to confidentiality agreements between the CDWP and some of the residents, all specific locations are not available. But the detections in the general locations do provide further support for the fact that nitrates are moving off the DBD and

SMD operations.

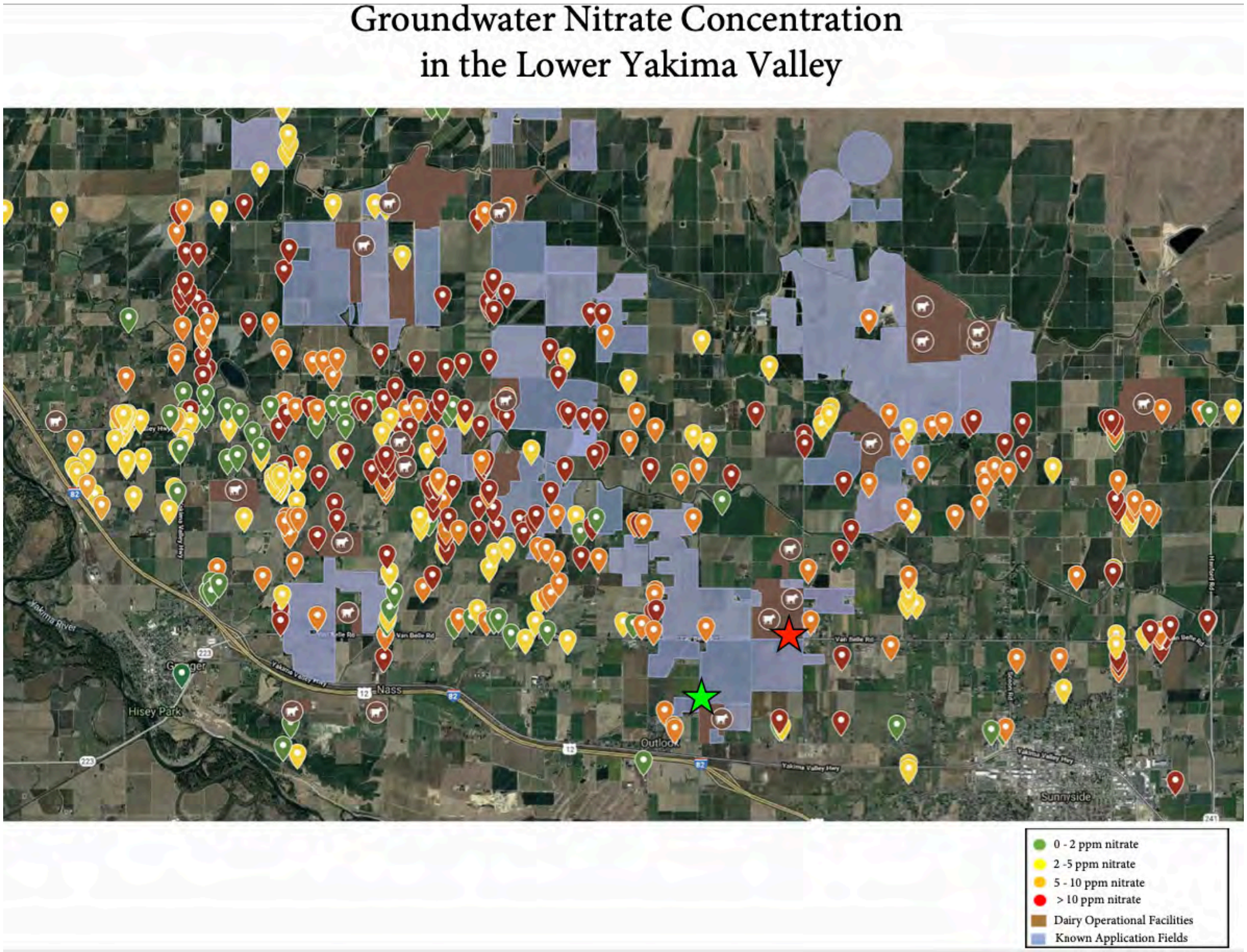


Image: Clean Drinking Water Project Results

62. I have also reviewed pictures and a request for enforcement from Department of Ecology related to applications of manure by DBD on fields near the Wassemiller residence. These types of applications, apparently performed by DBD employees and done without regard for nutrient needs as discussed in the Ecology report, are the type of applications that cause cumulative impacts to the groundwater relied upon by the surrounding

community.

63. Finally, I'll note that I was alarmed by the deposition testimony of Karina Chavarin, an employee at DBD, when she indicated that she had not tested the well water at her residence directly adjacent to the DBD facility,[24] nor did she appear interested in getting a free test,[25] despite the fact that she has children.[26] It is extremely important that residents understand the substantial health risks that the contaminants released by these facilities pose to them; the fact that a key employee of the facility was unaware is not indicative of a company culture that safeguards its stakeholders against the health and environmental risks it creates.

THE DAIRIES SHOULD BE REQUIRED TO TAKE REMEDIAL STEPS TO RECTIFY THE NITRATE CONTAMINATION OF THE GROUNDWATER

64. I have concluded that the Dairies' lagoons, as well as DBD's applications fields and composting areas and SMD's applications fields, composting areas, and pens are substantial sources of nitrate loading to groundwater. These facilities are typical of 1940-1960 era chemical manufacturing and industrial operations. In that era, it was believed that discharge to the ground made the problem disappear. Now, with both

[24] K. Chavarin Dep. 72:18-19.
[25] *Id.* 75:24-25.
[26] *Id.* 74:17-18.

RCRA and CERCLA investigations, we know that these operations caused significant contamination of soil, groundwater and surface water.

65. During my career, I have worked on numerous facilities that have mishandled their waste or failed to recognize the potential impacts from not preventing spills and leaks from entering the subsurface. This facility is handling their waste in a manner that causes impacts to soil, groundwater and surface water both from nutrients and potentially from livestock antibiotics and hormones.

66. As I indicated earlier, I am familiar with the RCRA remedial investigation and feasibility study (RI/FS) regulations. I have conducted RI/FS investigations previously in my career, one for a packing plant and one for a dry-cleaning operation. I have completed many other projects under RCRA regulation, such as Underground Storage Tank and Landfill investigations and remediation. The type of investigation that should be done at DBD and SMD should be similarly robust, planned, thorough and supervised by a third party.

67. We already know, however, that numerous actions should be taken promptly while a full investigation of the loading contributions are properly assessed in parallel (Interim Corrective Measures). In order to rectify the current contaminant issues, the Dairies should be required to synthetically

line all of their liquid storage lagoons using proper compaction techniques and current state of the industry liner construction quality assurance/quality control (QA/QC). Based on the calculations conducted above, these storage facilities discharge substantial amounts of liquid manure and its constituents, such as nitrate, ammonium, and phosphorus, into the soil, and directly into groundwater at some of these lagoons. This contamination eventually migrates off site onto other private properties

68. The Washington NRCS 313 standard specifically recognizes that synthetically lined lagoons may be necessary where a lagoon is situated over a domestic water supply aquifer.[27] An HDPE double-lined lagoon should be constructed according to RCRA landfill requirements cited in 40 C.F.R. § 264.301, but must include a protective soil layer on top of the liner to prevent puncture while cleaning or manually pumping to a haul truck. The double-lined lagoon provides both a higher level of protection than a single liner and leak detection, should a release occur. In addition, a leak detection system should be put into place between the synthetic liners, ensuring that the Dairies would be alerted if there were some issues with the integrity of the uppermost liner. This allows the operator to recognize a leak, stop the

[27] Natural Resources Conservation Service, Conservation Practice Standard No. 313 (Waste Storage Facility) at 313-8, December 2004.

release and immediately fix the leak without a release to the subsurface.

69. After five years of operation, a leak has recently occurred at the first lagoon lined at Cow Palace. The engineered system performed exactly as designed and dispelled all previous concerns lodged by the Dairies. The inspector visited the lagoon, and there was manure liquid in the leak detection sump. The system was in alarm mode and was pumping the liquid out from between the primary and secondary liner. The leak was easily located at the top of the liquid manure level as a separation of welds around the overflow pipe. While the primary liner leaked, the secondary liner prevented a release to the environment. A simple repair around the leak location can be completed by the lining subcontractor. With the designed gas venting system, the leaked manure will not cause any further compromise of the primary liner.

70. Double-lined waste storage or treatment ponds are the current state of the industry for waste handling operations. I have worked with facilities that have both liquid waste handling and solid waste handling operations on double lined systems.

71. The Dairies could greatly reduce the discharge by lining the lagoons that have liquids present during the longest period and continue to line these facilities until the waste handling portion is addressed. This should include

an assessment of the liquids handling conveyance infrastructure (underground piping).

72. Second, the Dairies should be required to compost only on lined impermeable pads that collect the leachate generated by the composting operation. When manure is hauled to the composting area, it typically contains more than 50% liquid. This liquid drains from the manure onto the ground and leached into the subsurface, causing soil and groundwater contamination, especially with the shallow groundwater present at both sites. No crop exists on the composting are to beneficially use the nutrients that have leached into the subsurface.

73. The leachate could be used to maintain the proper moisture content for composting, but should not be allowed to enter the subsurface. Commercial compost operations are required to conduct composting and compost handling on concrete surfaces with storm water collection systems. They are also required to maintain the integrity of the concrete through routine crack and joint sealing. The compost area at DBD is very flat and seepage will always be an issue without an impermeable liner under the compost.

74. Furthermore, the Dairies should be required to provide to Plaintiffs all construction plans and specifications for review and approval prior to

construction. The Dairies should also provide all construction QA/QC testing results to Plaintiffs along with access during construction so independent, third-party QA/QC testing may be conducted.

75. Finally, the Dairies must control water balance issues and use irrigation practices that actually follow a realistic nutrient management plan. Data from the application fields clearly show that nutrients are over-applied and have migrated deeper than any possible plant uptake. As a result, large areas contribute high nitrate concentration to the groundwater and recent studies show that other compounds, such as livestock antibiotics and hormones can be sourced to groundwater from application fields.

76. In addition, given one of the questionable actions taken by this operator/owner, independent inspection and enforcement must be provided to ensure the actions are completed to current construction and construction quality assurance standards. All construction, investigation and remediation activities at the DBD and SMD operation should require independent third-party oversight. Every time I have inspected the facility, the current operator has completed projects incorrectly and without oversight. After the first visit, Lagoons 2, 3, the settling lanes, and the Nichols Road lagoon were abandoned improperly (i.e., the lagoon sludges and manure were buried under fill). The next visit Lagoons 2 and 3 were excavated; however, the

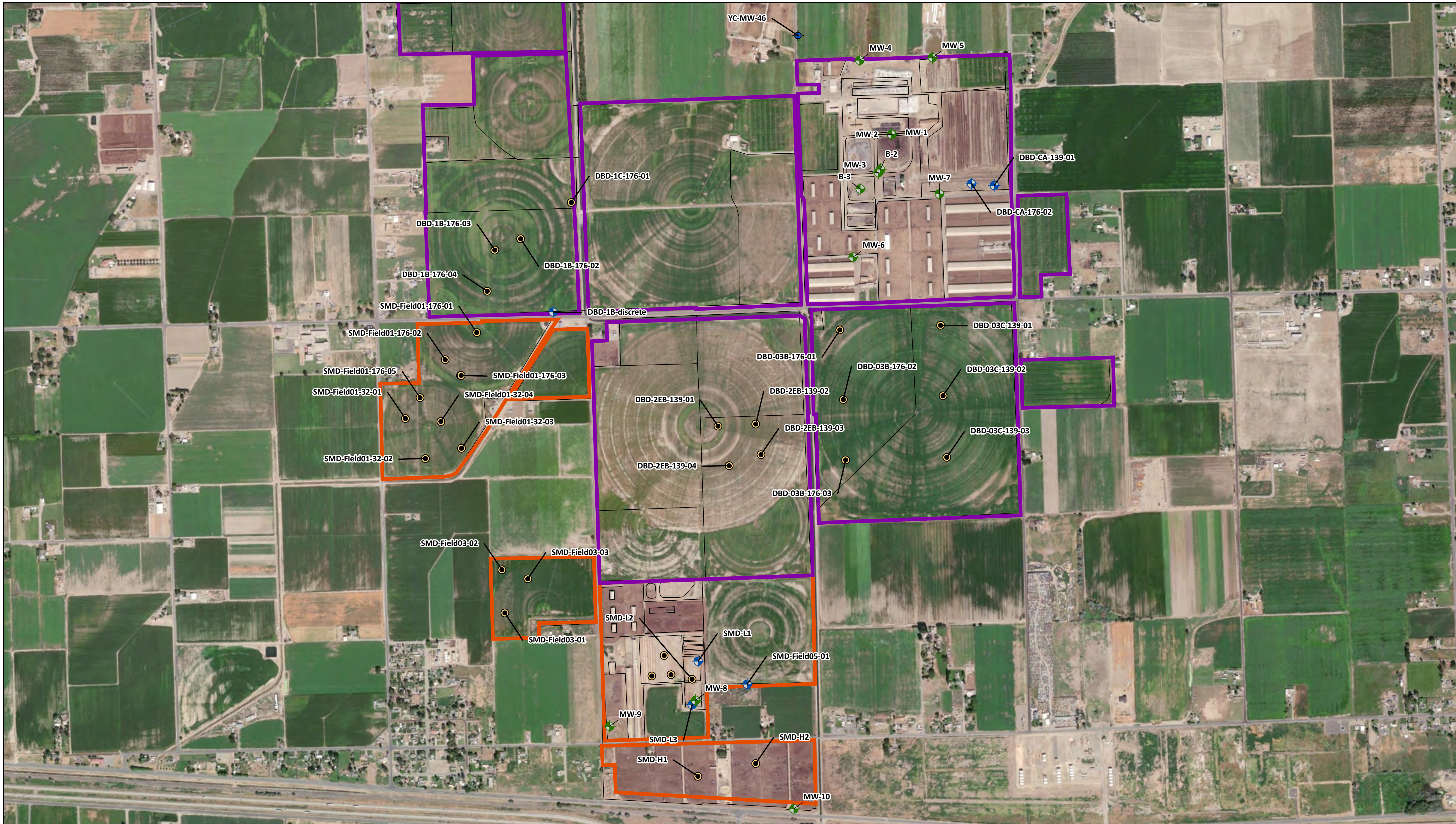
soil remaining was still stained with manure because it could not be removed, due to the fact that it was in groundwater.

77. In conclusion, the Dairies are a significant source of nutrients in the area (along with Cow Palace and the "Cluster" Dairies). Given the current waste handling practices and the volume of liquid and solid waste generated by these facilities and the preliminary investigation data generated, to conclude that nitrate impacts to groundwater are caused by some other source, such as the few residential septic systems in the area, is irresponsible.

Dated: March 10, 2023

David J. Erickson PG CPG
Principal/Founder
Water & Environmental,
Technologies, PC

Figures



Legend

- Farralon Data Point
- Yakima county Monitoring Well
- WET Soil Boring Location
- WET Groundwater Sampling Location
- Snipes Mountain Dairy
- DeRuyter Brothers Dairy

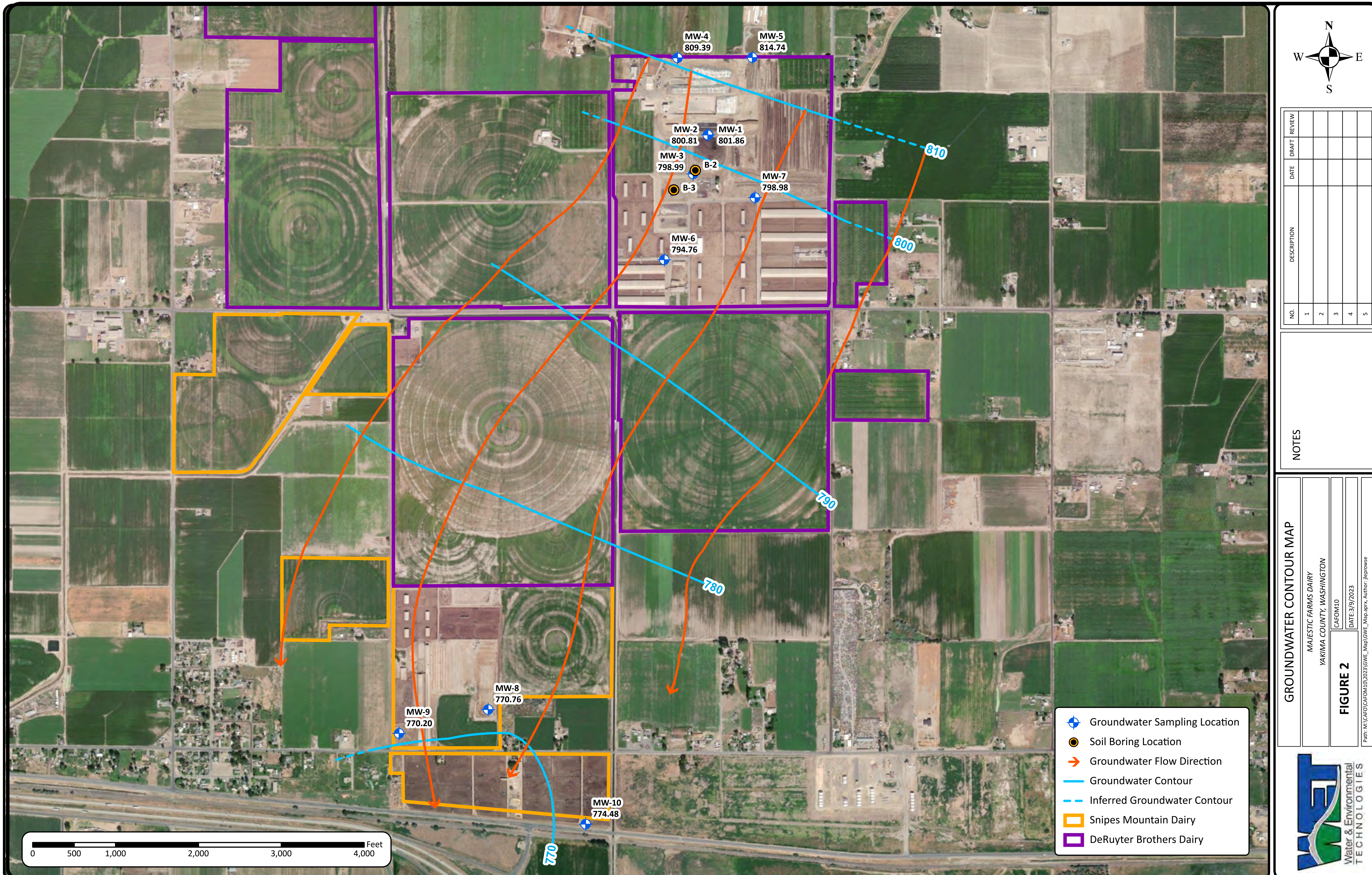
Water & Environmental TECHNOLOGIES

PROPOSED BORNING LOCATIONS

Majestic Farms Dairy
Yakima County, Washington

Job#: CAFOM010	**FIGURE 1**
Date: 5/24/2022	

Path: M:\CAFO\CAFOM010\2022\CAFO_maps\CAFO_maps.aprx, Author: jleprowse


MW-4
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MW-5
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MW-2
800.81
MW-1
801.86
MW-3
798.99
B-2
B-3
MW-7
798.98
MW-6
794.76
810
800
790
780
770
MW-8
770.76
MW-9
770.20
MW-10
774.48
0 500 1,000 2,000 3,000 4,000 Feet
N
S
E
W
Groundwater Sampling Location
Soil Boring Location
Groundwater Flow Direction
Groundwater Contour
Inferred Groundwater Contour
Snipes Mountain Dairy
DeRuyter Brothers Dairy
NO.
DESCRIPTION
DATE
DRAFT
REVIEW
1
2
3
4
5
NOTES
GROUNDWATER CONTOUR MAP
MAJESTIC FARMS DAIRY
YAKIMA COUNTY, WASHINGTON
FIGURE 2
CAFOM10
DATE:3/9/2023
Path: M:\CAFO\CAFOM10\2023\GWE_Map\GWE_Map.aprx, Author: jleprowse
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TECHNOLOGIES

Exhibit A – WET Soil Data

Soil Analytical Results

Station ID	Depth (ft bgs)		Date	Time	Sample type	Sand	Silt	Clay	Texture	pH, sat. paste		Calcium, Extractable		Magnesium, Extractable		Potassium, Extractable		Sodium, Extractable		Organic Matter		Lime as CaCO3		Nitrogen, Kjeldahl, Total as N		Phosphorus, Olsen		Ammonia as N, KCL Extract		Nitrate as N, KCL Extract		Nitrite as N, KCL Extract	
	Start	End				%	%	%	--	s.u.	Q	meq /100g	Q	meq /100g	Q	meq /100g	Q	meq /100g	Q	%	Q	%	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg /kg-dry	Q	mg/kg	Q
DBD-1B-DISCRETE	0	1	5/21/2020	09:35		36	47	17	L	7.5		18.3	J	3.59	J+	1.64	J	0.223	J+	3.3		2.91		1920	J	220	J	26	J+	7.2	J+	<1	J
	1	2	5/21/2020	09:37		34	50	16	SiL	7.6		16.1	J	4.58	J+	2.09	J	0.360	J+	2.4		2.74		1670	J	210	J	32	J+	3.7	J+	<1	J
	2	3	5/21/2020	09:39		22	66	12	SiL	8.1		15.2	J	4.71	J+	4.11	J	0.371	J+	0.5		2.15		364	J	61	J	31	J+	1.4	J+	<1	J
	3	4	5/21/2020	09:41		34	57	9	SiL	8.3		17.3	J	3.77	J+	4.40	J	0.277	J+	<0.2		2.58		145	J	27	J	15.3	J	1.7	J+	<1	J
	4	5	5/21/2020	09:43		20	67	13	SiL	8.4		19.4	J	4.34	J+	2.41	J	0.421	J+	0.2		4.21		137	J	17	J	8.0	J+	3.8	J+	<1	J
	5	7.5	5/21/2020	09:45		12	76	12	SiL	8.3		19.7	J	5.52	J+	0.447	J	0.590	J+	0.2		7.11		161	J	3	J	17.1	J	2.7	J+	<1	J
	7.5	10	5/21/2020	09:47		-	-	-	-	-		-		-		-		-		-		-		106	J	2	J	8.4	J+	4.0	J+	<1	J
DBD-1C-176	0	1	5/19/2020	11:30		34	50	16	SiL	8.0		17.3	J	4.92	J	3.08	J	1.87	J	3.1		4.62		1970	J	390	J	7.3	J+	110	J	<1	J
	1	2	5/19/2020	11:31		38	49	13	L	8.1		16.7	J	4.41	J	3.61	J	1.79	J	1.2		4.50		659	J	170	J	6.3	J+	61	J	<1	J
	2	3	5/19/2020	11:32		34	57	9	SiL	8.2		16.8	J	4.07	J	3.09	J	1.63	J	0.3		5.01		201	J	22	J	7.9	J+	34	J	<1	J
	3	4	5/19/2020	11:34		28	62	10	SiL	8.1		17.0	J	3.86	J+	2.26	J	1.58	J	0.4		5.00		291	J	37	J	6.0	J+	72	J	<1	J
	4	5	5/19/2020	11:35		32	60	8	SiL	8.1		16.7	J	3.46	J+	2.16	J	1.39	J	<0.2		3.73		128	J	11	J	7.9	J+	74	J	<1	J
	5	6	5/19/2020	11:33		32	60	8	SiL	8.2		14.9	J	3.28	J+	2.50	J	1.12	J	<0.2		3.02		67	J	3	J	5.3	J+	44	J	<1	J
	6	7	5/19/2020	11:36		36	56	8	SiL	8.2		15.7	J	3.37	J+	2.03	J	1.24	J	<0.2		3.35		56	J	3	J	5.7	J+	31	J	<1	J
	7	8	5/19/2020	11:37		-	-	-	-	-		-		-		-		-		-		-		47	J	2	J	4.4	J+	37	J	<1	J
	8	9	5/19/2020	11:38		-	-	-	-	-		-		-		-		-		-		-		62	J	2	J	4.7	J+	46	J	<1	J
	9	10	5/19/2020	11:39		-	-	-	-	-		-		-		-		-		-		-		49	J	2	J	5.2	J+	38	J	<1	J
DBD-2EB-139	0	1	5/19/2020	13:30		50	36	14	L	8.2		14.0	J	4.74	J	3.97	J	2.33	J	2.4		3.32		1440	J	310	J	4.2	J+	86	J	<1	J
	1	2	5/19/2020	13:31		36	52	12	SiL	8.3		16.6	J	5.33	J	2.85	J	2.98	J	0.8		6.21		742	J	130	J	4.6	J+	82	J	<1	J
	2	3	5/19/2020	13:32		30	60	10	SiL	8.3		17.2	J	5.47	J	1.09	J	3.16	J	0.2		6.62		133	J	7	J	3.7	J+	68	J	<1	J
	3	4	5/19/2020	13:33	Natural	24	70	6	SiL	8.2		16.4	J	5.38	J	0.509	J	2.91	J	<0.2		5.29		83	J	2	J	5.4	J+	56	J	<1	J
			5/19/2020	13:34	Duplicate	20	74	6	SiL	8.3		17.9	J+	6.02	J	0.596	J+	2.95	J+	0.2		4.90		85	J	3	J	4.2	J+	64	J	<1	J
	4	5	5/19/2020	13:35		38	56	6	SiL	8.2		14.9	J	4.02	J	0.508	J	2.44	J	<0.2		3.44		34	J	2	J	5.3	J+	54	J	<1	J
	5	6	5/19/2020	13:36		44	49	7	L	8.0		13.8	J	3.20	J+	0.535	J	2.20	J	<0.2		2.67		<30	J	3	J	4.9	J+	45	J	<1	J
	6	7	5/19/2020	13:37		34	58	8	SiL	8.0		15.8	J	3.32	J+	0.655	J	2.04	J	<0.2		3.05		31	J	2	J	3.1	J+	35	J	<1	J
	7	8	5/19/2020	13:38		38	54	8	SiL	7.9		17.4	J	3.72	J+	0.703	J	2.02	J	0.2		2.94		36	J	2	J	3.5	J+	38	J	<1	J
	8	9	5/19/2020	13:39		-	-	-	-	-		-		-		-		-		-		-		<30	J	2	J	3.9	J+	32	J	<1	J
	9	10	5/19/2020	13:40		-	-	-	-	-		-		-		-		-		-		-		<30	J	2	J	4.3	J+	29	J	<1	J
DBD-3B-176	0	1	5/20/2020	17:19		34	51	15	SiL	8.1		17.0	J	4.61	J	3.45	J	2.06	J	2.4		4.30		1630	J	310	J	6.6	J+	110	J	<1	J
	1	2	5/20/2020	17:21		32	58	10	SiL	8.2		17.7	J	4.61	J	2.72	J	2.17	J	0.8		5.53		495	J	99	J	2.7	J+	83	J	<1	J
	2	3	5/20/2020	17:23		48	46	6	SL	8.2		16.9	J	4.10	J	1.17	J	1.74	J	<0.2		3.77		69	J	3	J	3.4	J+	57	J	<1	J
	3	4	5/20/2020	17:24		34	58	8	SiL	8.3		17.7	J	3.98	J+	0.482	J	1.48	J	<0.2		3.67		<30	J	1	J	2.3	J+	63	J	<1	J
	4	5	5/20/2020	17:25		40	52	8	SiL	8.2		18.2	J	4.16	J+	0.432	J	1.40	J	0.2		3.38		67	J	2	J	3.9	J+	59	J	<1	J
DBD-3C-139	0	1	5/21/2020	11:30		30	55	15	SiL	7.9		17.6	J	6.14	J+	5.74	J	3.42	J	2.5		4.34		1930	J	420	J	3.9	J+	370	J	<1	J
	1	2	5/21/2020	11:32		24	62	14	SiL	7.9		17.6	J	5.44	J+	5.27	J	3.28	J	1.1		4.29		892	J	200	J	5.9	J+	310	J	<1	J
	2	3	5/21/2020	11:33		26	62	12	SiL	7.9		19.7	J	5.46	J+	3.39	J	2.94	J	0.3		5.45		277	J	13	J	5.5	J+	230	J	<1	J
	3	4	5/21/2020	11:35		28	60	12	SiL	7.8		19.6	J	5.25	J+	1.68	J	2.46	J	0.2		4.08		201	J	1	J	6.9	J+	240	J	<1	J
	4	5	5/21/2020	11:37		34	56	10	SiL	7.8		18.1	J	4.40	J+	0.802	J	2.33	J	<0.2		3.42		90	J	2	J	6.1	J+	170	J	<1	J

< indicates below detection
- indicates the sample was not analyzed for this constituent
mg/kg indicates milligram per kilogram
s.u. indicates standard units
meq/100 g indicates milliequivalents per 100 grams

Si indicates silt
S indicates sand
L indicates loam
SiL indicates silty loam
SL indicates sandy loam

Q - Data validation qualifier

J Estimated
J+ Overestimated
UJ Estimated Non-Detect
J- Underestimated
R Unusable

Soil Analytical Results

Station ID	Depth (ft bgs)		Date	Time	Sample type	Sand	Silt	Clay	Texture	pH, sat. paste		Calcium, Extractable		Magnesium, Extractable		Potassium, Extractable		Sodium, Extractable		Organic Matter		Lime as CaCO3		Nitrogen, Kjeldahl, Total as N		Phosphorus, Olsen		Ammonia as N, KCL Extract		Nitrate as N, KCL Extract		Nitrite as N, KCL Extract	
	Start	End				%	%	%	--	s.u.	Q	meq /100g	Q	meq /100g	Q	meq /100g	Q	meq /100g	Q	%	Q	%	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg /kg-dry	Q	mg/kg	Q
DBD-CA-139-01	0	1	5/19/2020	09:14		42	44	14	L	8.3		15.1	J	4.75	J+	6.70	J	1.58	J	2.4		4.31		1130	J	160	J	22	J+	1.6	J+	<1	J
	1	2	5/19/2020	09:17		40	50	10	SiL	8.2		16.8	J	3.68	J+	1.10	J	0.792	J+	0.2		4.62		104	J	3	J	16.4	J	<1.0	J	<1	J
	2	3	5/19/2020	09:24		32	60	8	SiL	8.2		17.8	J	4.03	J+	0.627	J	0.774	J+	0.2		4.33		<30	J	2	J	7.3	J+	1.6	J+	<1	J
	3	5	5/19/2020	09:28		32	61	7	SiL	8.2		18.0	J	4.00	J+	0.629	J	0.690	J+	<0.2		4.48		<30	J	2	J	7.1	J+	2.4	J+	<1	J
	5	7.5	5/19/2020	09:34		36	57	7	SiL	8.2		18.5	J	3.86	J+	0.619	J	0.470	J+	<0.2		3.88		<30	J	2	J	7.5	J+	2.6	J+	<1	J
	7.5	10	5/19/2020	09:40		38	53	9	SiL	8.2		19.1	J	3.91	J+	0.694	J	0.517	J+	<0.2		3.82		<30	J	2	J	8.6	J+	2.6	J+	<1	J
DBD-CA-176-02	0	1	5/20/2020	11:01		40	46	14	L	8.5		11.1	J	5.63	J	10.8	J	4.62	J	4.1		3.13		2080	J	210	J	12.6	J+	41	J	4	J+
	1	2	5/20/2020	11:03		60	28	12	SL	8.0		7.23	J	3.14	J+	3.33	J	1.18	J	0.4		1.56		177	J	31	J	30	J+	1.7	J+	<1	J
	2	3	5/20/2020	11:05		40	48	12	L	7.8		17.8	J	3.63	J+	0.954	J	1.06	J	0.4		4.50		175	J	4	J	7.1	J+	<1.0	J	<1	J
	3	5	5/20/2020	11:07		24	68	8	SiL	7.8		18.8	J	3.93	J+	0.373	J	1.05	J	0.3		4.13		87	J	2	J	4.5	J+	1.5	J+	<1	J
	5	7.5	5/20/2020	11:09		30	63	7	SiL	8.0		16.9	J	3.81	J+	0.370	J	0.909	J	<0.2		3.85		<30	J	2	J	7.4	J+	2.5	J+	<1	J
	7.5	10	5/20/2020	11:11		28	64	8	SiL	8.0		17.5	J	4.70	J+	0.474	J	0.905	J	<0.2		3.62		<30	J	2	J	9.5	J+	2.5	J+	<1	J
	10	12.5	5/20/2020	11:13		-	-	-	-	-		-		-		-		-		-		-		<30	J	2	J	12.9	J+	2.7	J+	<1	J
	12.5	15	5/20/2020	11:15		-	-	-	-	-		-		-		-		-		-		-		<30	J	2	J	9.7	J+	2.4	J+	<1	J
	15	17.5	5/20/2020	11:18		-	-	-	-	-		-		-		-		-		-		-		<30	J	2	J	7.9	J+	2.7	J+	<1	J
	17.5	20	5/20/2020	11:20		-	-	-	-	-		-		-		-		-		-		-		<30	J	5	J	8.7	J+	4.7	J+	<1	J
SMD-01-176	0	1	5/19/2020	15:45		32	53	15	SiL	8.0		19.3	J+	5.50	J	4.26	J+	1.09	J+	2.6		4.21		1550	J	270	J	7.5	J+	45	J	<1	J
	1	2	5/19/2020	15:46		30	58	12	SiL	8.1		19.2	J+	5.26	J	3.32	J+	1.07	J+	1.3		3.94		872	J	150	J	5.6	J+	48	J	<1	J
	2	3	5/19/2020	15:47		22	70	8	SiL	8.0		19.6	J+	4.90	J	1.53	J+	0.922	J+	0.2		3.76		169	J	18	J	3.0	J+	30	J	<1	J
	3	4	5/19/2020	15:48		26	66	8	SiL	8.0		19.9	J+	4.88	J	0.523	J+	1.08	J+	0.2		4.62		71	J	7	J	3.5	J+	33	J	<1	J
	4	5	5/19/2020	15:49		28	64	8	SiL	8.1		19.6	J+	4.62	J	0.458	J+	1.18	J+	0.2		4.55		74	J	3	J	5.3	J+	42	J	<1	J
	5	6	5/19/2020	15:50		32	60	8	SiL	8.0		18.9	J+	3.86	J+	0.517	J+	0.970	J+	<0.2		3.45		57	J	2	J	6.9	J+	24	J+	<1	J
	6	7	5/19/2020	15:51		36	57	7	SiL	8.1		18.2	J+	3.63	J+	0.584	J+	1.13	J+	<0.2		3.31		33	J	2	J	7.1	J+	20	J+	<1	J
	7	8	5/19/2020	15:52		42	51	7	SiL	7.9		18.0	J+	3.17	J+	0.613	J+	1.09	J+	<0.2		2.98		<30	J	2	J	5.0	J+	25	J+	<1	J
	8	9	5/19/2020	15:53		36	56	8	SiL	7.9		20.8	J+	3.04	J+	0.693	J+	1.14	J+	0.2		3.93		38	J	2	J	4.8	J+	23	J+	<1	J
	9	10	5/19/2020	15:54		-	-	-	-	-		-		-		-		-		-		-		33	J	2	J	5.0	J+	24	J+	<1	J
SMD-03-139	0	1	5/20/2020	16:14		26	60	14	SiL	8.2		17.2	J	5.08	J	6.68	J	0.873	J	3.3		6.66		1920	J	280	J	5.4	J+	11	J+	<1	J
	1	2	5/20/2020	16:15		28	60	12	SiL	8.1		17.7	J	4.06	J	5.93	J	0.895	J	1.9		6.42		1220	J	150	J	7.3	J+	15	J+	<1	J
	2	3	5/20/2020	16:16	Natural	38	54	8	SiL	8.4		17.1	J	3.58	J+	4.43	J	0.787	J+	<0.2		5.23		166	J	22	J	13.6	J+	6.7	J+	<1	J
			5/20/2020	16:19	Duplicate	40	51	9	SiL	8.4		17.2	J	3.65	J+	4.28	J	0.757	J+	0.2		5.87		163	J	24	J	9.4	J+	6.9	J+	<1	J
	3	4	5/20/2020	16:17		48	46	6	SL	8.4		13.6	J	2.82	J+	3.26	J	0.477	J+	<0.2		3.06		32	J	7	J	6.7	J+	3.3	J+	<1	J
	4	5	5/20/2020	16:18		62	31	7	SL	8.3		14.8	J	2.95	J+	2.47	J	0.454	J+	<0.2		2.91		<30	J	3	J	7.9	J+	3.2	J+	<1	J
SMD-05-01	0	1	5/21/2020	08:42		44	42	14	L	8.0		19.6	J	2.31	J+	1.92	J	0.205	J+	1.7		4.69		1100	J	140	J	16.6	J	2.6	J+	<1	J
	1	2	5/21/2020	08:44		44	47	9	L	8.2		19.1	J	2.91	J+	1.98	J	0.239	J+	0.5		4.90		233	J	71	J	18.6	J	1.4	J+	<1	J
	2	3	5/21/2020	08:46		34	58	8	SiL	8.4		18.6	J	3.46	J+	2.74	J	0.228	J+	<0.2		4.03		92	J	9	J	14.1	J+	2.4	J+	<1	J
	3	5	5/21/2020	08:48		48	44	8	L	8.4		17.2	J	3.48	J+	4.25	J	0.214	J+	<0.2		4.27		42	J	3	J	7.2	J+	3.0	J+	<1	J
	5	7.5	5/21/2020	08:50		58	35	7	SL	8.3		15.4	J	3.19	J+	5.08	J	0.238	J+	<0.2		3.23		<30	J	2	J	4.5	J+	6.1	J+	<1	J
	7.5	10	5/21/2020	08:52		-	-	-	-	-		-		-		-		-		-		-		38	J	1	J	5.9	J+	7.8	J+	<1	J

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Si indicates silt
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SiL indicates silty loam
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Q - Data validation qualifier
J Estimated
J+ Overestimated
UJ Estimated Non-Detect
J- Underestimated
R Unusable

Soil Analytical Results

Station ID	Depth (ft bgs)		Date	Time	Sample type	Sand	Silt	Clay	Texture	pH, sat. paste		Calcium, Extractable		Magnesium, Extractable		Potassium, Extractable		Sodium, Extractable		Organic Matter		Lime as CaCO3		Nitrogen, Kjeldahl, Total as N		Phosphorus, Olsen		Ammonia as N, KCL Extract		Nitrate as N, KCL Extract		Nitrite as N, KCL Extract	
	Start	End				%	%	%	--	s.u.	Q	meq /100g	Q	meq /100g	Q	meq /100g	Q	meq /100g	Q	%	Q	%	Q	mg/kg	Q	mg/kg	Q	mg/kg	Q	mg /kg-dry	Q	mg/kg	Q
SMD-CA1	0	3.8	5/20/2020	13:25		50	41	9	L	8.6		13.2	J	3.37	J+	9.91	J	2.62	J	0.5		5.54		387	J	43	J	2.5	J+	140	J	<1	J
	3.8	5.3	5/20/2020	13:30		48	44	8	L	7.9		14.1	J	4.80	J	1.80	J	1.78	J	<0.2		3.09		<30	J	2	J	11.8	J+	2.1	J+	<1	J
	5.3	9	5/20/2020	13:35		-	-	-	-	-		-		-		-		-		-		-		<30	J	2	J	4.6	J+	15	J+	<1	J
SMD-FIELD01-32	0	1	5/19/2020	17:30		24	56	20	SiL	8.0		20.9	J+	7.49	J	5.05	J+	2.99	J+	2.6		3.64		625	J	270	J	4.7	J+	82	J	<1	J
	1	2	5/19/2020	17:32		24	60	16	SiL	7.9		21.8	J+	6.31	J	2.29	J+	2.60	J+	0.8		3.38		1570	J	83	J	3.6	J+	35	J	<1	J
	2	3	5/19/2020	17:34		16	71	13	SiL	7.9		23.1	J+	5.17	J	0.401	J+	3.07	J+	0.4		7.27		173	J	6	J	3.8	J+	36	J	<1	J
	3	4	5/19/2020	17:36		18	68	14	SiL	7.8		27.1	J+	5.55	J	0.297	J+	3.22	J+	0.2		4.40		176	J	3	J	4.7	J+	32	J	<1	J
	4	5	5/19/2020	17:38		26	64	10	SiL	7.8		22.7	J+	4.84	J	0.412	J+	2.94	J+	0.2		3.37		111	J	3	J	4.5	J+	29	J+	<1	J
	5	6	5/19/2020	17:40	Natural	24	66	10	SiL	7.9		18.4	J+	3.69	J+	0.538	J+	2.59	J+	0.2		2.57		78	J	4	J	5.0	J+	16	J+	<1	J
			5/19/2020	18:09	Duplicate	42	51	7	SiL	8.0		13.1	J+	2.91	J+	0.514	J+	1.82	J+	<0.2		2.04		26	J	3	J	5.9	J+	25	J+	<1	J
	6	7	5/19/2020	17:42		30	61	9	SiL	7.9		14.8	J+	3.03	J+	0.559	J+	2.06	J+	<0.2		2.16		69	J	4	J	5.0	J+	19	J+	<1	J
	7	8	5/19/2020	17:44		28	63	9	SiL	7.8		17.5	J+	3.24	J+	0.607	J+	2.11	J+	<0.2		2.50		102	J	4	J	4.1	J+	18	J+	<1	J
	8	9	5/19/2020	17:46		-	-	-	-	-		-		-		-		-		-		-		64	J	4	J	4.2	J+	18	J+	<1	J
	9	10	5/19/2020	17:48		-	-	-	-	-		-		-		-		-		-		-		39	J	4	J	5.8	J+	18	J+	<1	J
SMD-H1	0	1	5/20/2020	14:12		70	22	8	SL	9.0		9.27	J	2.53	J+	14.5	J	3.13	J	2.7		3.02		1380	J	310	J	9.8	J+	56	J	2	J+
	1	2	5/20/2020	14:14		70	21	9	SL	8.3		6.20	J	2.25	J+	7.12	J	2.53	J	<0.2		1.55		86	J	3	J	5.0	J+	33	J	<1	J
	2	3	5/20/2020	14:16		42	48	10	L	7.9		18.3	J	6.27	J	1.40	J	3.98	J	<0.2		5.08		137	J	1	J	6.6	J+	37	J	<1	J
	3	4	5/20/2020	14:18		48	45	7	L	7.9		18.5	J	5.72	J	0.465	J	4.15	J	<0.2		3.72		39	J	2	J	8.9	J+	28	J+	<1	J
	4	5	5/20/2020	14:20		60	34	6	SL	7.9		16.4	J	4.06	J	0.615	J	3.51	J	<0.2		3.30		<30	J	2	J	11.4	J+	18	J+	<1	J
	5	6	5/20/2020	14:22		-	-	-	-	-		-		-		-		-		-		-		<30	J	1	J	13.6	J+	2.8	J+	<1	J
	6	7	5/20/2020	14:24		-	-	-	-	-		-		-		-		-		-		-		<30	J	2	J	10.6	J+	1.4	J+	<1	J
	7	8	5/20/2020	14:26		-	-	-	-	-		-		-		-		-		-		-		42	J	1	J	11.0	J+	1.4	J+	<1	J
	8	9	5/20/2020	14:28		-	-	-	-	-		-		-		-		-		-		-		<30	J	1	J	10.8	J+	1.1	J+	<1	J
	9	10	5/20/2020	14:30		-	-	-	-	-		-		-		-		-		-		-		27	J	1	J	12.5	J+	1.4	J+	<1	J
SMD-H2	0	1	5/20/2020	15:00		58	30	12	SL	8.9		10.5	J	3.23	J+	17.4	J	4.66	J	1.5		4.16		1060	J	380	J	5.9	J+	81	J	2	J+
	1	2	5/20/2020	15:02		54	39	7	SL	8.4		11.8	J	1.60	J+	10.5	J	2.03	J	0.2		3.18		117	J	5	J	2.5	J+	39	J	<1	J
	2	3	5/20/2020	15:04		44	50	6	SiL	8.0		12.8	J	1.67	J+	7.00	J	1.40	J	<0.2		2.85		50	J	2	J	6.6	J+	26	J+	<1	J
	3	4	5/20/2020	15:06		48	44	8	L	7.8		15.9	J	2.46	J+	3.00	J	0.816	J	<0.2		2.87		29	J	2	J	6.0	J+	13	J+	<1	J
	4	5	5/20/2020	15:07		-	-	-	-	-		-		-		-		-		-		-		<30	J	2	J	5.3	J+	11	J+	<1	J
	5	6	5/20/2020	15:08		-	-	-	-	-		-		-		-		-		-		-		<30	J	2	J	12.1	J+	9.6	J+	<1	J
	6	7	5/20/2020	15:10		-	-	-	-	-		-		-		-		-		-		-		38	J	2	J	9.8	J+	12	J+	<1	J
	7	8	5/20/2020	15:12		-	-	-	-	-		-		-		-		-		-		-		<30	J	2	J	8.3	J+	15	J+	<1	J
	8	9	5/20/2020	15:14		-	-	-	-	-		-		-		-		-		-		-		<30	J	1	J	8.6	J+	13	J+	<1	J
	9	10	5/20/2020	15:16		-	-	-	-	-		-		-		-		-		-		-		50	J	5	J	9.7	J+	9.8	J+	<1	J
SMD-L1	2.8	3.1	5/20/2020	11:40		42	41	17	L	8.1		21.4	J	12.8	J	16.8	J	6.40	J	9.4		7.08		4550	J	730	J	2.8	J+	170	J	13	J+
	3.1	5	5/20/2020	11:45		48	43	9	L	8.4		6.02	J	1.33	J+	10.2	J	2.06	J	0.3		3.16		467	J	28	J	236	J+	40	J	1	J+
	6	8	5/20/2020	11:50		50	41	9	L	8.2		11.0	J	2.12	J+	6.53	J	1.60	J	0.2		3.80		637	J	4	J	500	J+	<1.0	J	<1	J
SMD-L2	3	5	5/20/2020	13:05		66	28	6	SL	8.1		6.40	J	1.81	J+	5.55	J	0.979	J	<0.2		2.64		374	J	9	J	344	J+	59	J	<1	J
	5	7.4	5/20/2020	13:10		38	54	8	SiL	8.1		13.1	J	4.23	J+	2.03	J	0.914	J	<0.2		3.39		442	J	2	J	344	J+	<1.0	J	<1	J
	7.4	10	5/20/2020	13:15		-	-	-	-	-		-		-		-		-		-		-		133	J	2	J	76	J+	<1.0	J	<1	J
SMD-L3-02	4.5	6.4	5/20/2020	12:07		52	38	10	L	8.4		12.1	J	4.15	J+	5.12	J	1.83	J	<0.2		3.68		433	J	9	J	305	J+	<1.0	J	<1	J
	6.4	10	5/20/2020	12:15		54	38	8	SL	8.2		15.6	J	4.55	J+	0.806	J	1.06	J	<0.2		3.66		44	J	1	J	29	J+	1.8	J+	<1	J

< indicates below detection
- indicates the sample was not analyzed for this constituent
mg/kg indicates milligram per kilogram
s.u. indicates standard units
meq/100 g indicates milliequivalents per 100 grams

Si indicates silt
S indicates sand
L indicates loam
SiL indicates silty loam
SL indicates sandy loam

Q - Data validation qualifier

- J Estimated
- J+ Overestimated
- UJ Estimated Non-Detect
- J- Underestimated
- R Unusable

Exhibit B – WET Groundwater Data

Sample ID	Date	Time	Sample type	Total Dissolved Solids		Total Alkalinity as $CaCO_3$		Chloride		Biochemical Oxygen Demand		Ammonia as N		Nitrogen (Kjeldahl, Total)		Nitrate		Nitrate + Nitrite		Nitrite		Orthophosphate		Phosphorus (Total)	
				mg/L	Q	mg/L	Q	mg/L	Q	mg/L	Q	mg/L	Q	mg/L	Q	mg/L	Q	mg/L	Q	mg/L	Q	mg/L	Q	mg/L	Q
DBD-1-B-discrete	05/21/2020	11:00	Natural	753	J	1300	J	33	J	-		0.36	J-	16.2	J-	5.98	J-	6.32	J-	0.34	J	-		51.0	J-
DBD-CA-139-01	05/20/2020	10:05	Natural	740	J	510	J	52	J	<4	UJ	0.47	J-	3.0	J-	5.25	J-	5.58	J-	0.33	J-	0.322	J	20.4	J-
DBD-CA-176-02	05/22/2020	12:10	Natural	760	J	450	J	50	J	<4	UJ	0.08	J	0.5	J	6.81	J	7.01	J	0.20	J	0.076	J	0.82	J+
SMD-05-01	05/21/2020	09:54	Natural	-		-		-		-		0.25	J-	8.9	J-	-		29.1	J-	-		-		40.4	J-
SMD-L1	05/20/2020	15:40	Natural	-		-		-		-		1.61	J-	26.5	J-	-		76.5	J-	-		-		44.5	J-
SMD-L3	05/20/2020	14:21	Natural	2700	J	2000	J	472	J	<4	UJ	~~<0.05~~	R	79	J-	~~<0.01~~	R	0.05	J-	0.05	J-	0.019	J-	0.65	J
SMD-05-20-20	05/20/2020	14:50	Field Blank	<10	UJ	<4	UJ	<1	UJ	<2	UJ	<0.05	UJ	<0.5	UJ	<0.01	UJ	<0.01	UJ	<0.01	UJ	<0.005	UJ	<0.01	UJ
1RX-052020	05/20/2020	17:30	Rinsate Blank	<10		<4		<1		<2		<0.05		<0.5		<0.01		<0.01		<0.01		<0.005		<0.01	

Exhibit C – Farallon Soil Data

Farallon Soil Analytical Results

Station ID	Depth (ft bgs)	pH, sat. paste	Calcium, Extractabl	Magnesium, Extractable	Potassium, Extractable	Sodium, Extractable	Organic Matter	Lime as CaCO3	Nitrogen, Kjeldahl, Total as N	Phosphorus, Olsen	Ammonia as N, KCL Extract	Nitrate as N, KCL	Nitrite as N, KCL
	Start	s.u.	mg/kg	mg/kg	mg/kg	mg/kg	%	%	mg/kg	mg/kg	mg/kg	mg /kg-dry	mg/kg
FMW-01	2.5												
	5												
	10												
	15		17000	7300	1700	290			290	920	73.9	72	<0.26
	20												
	25												
	30												
	35		15000.0	8400	2400	350			200	820	44.8	9.6	<0.26
	40												
	45												
	50												
FMW-03	5												
	10												
	15												
	20												
FMW-04	2.5												
	5		15000	6600	1900	510			380	880	78.6	<0.59	<0.23
	15												
FMW-05	2.5												
	5		17000	6900	1700	570			160	770	54.1	4.2	<0.26
	15												
FMW-06	2.5												
	5		12000	7100	1500	320			200	870	41.7	36	<0.25
	15												
	20												
FMW-07	2.5												
	5		11000	6800	1800	270			330	790	48.1	47	<0.26
	15												
	20												
FMW-08	2		9700	6300	3500	360			560	890	557	<0.63	<0.25
	5												
	10												
	15												
	20												
FMW-09	2.5		14000	7200	5400	450			250	1100	63.6	<0.64	<0.26
	5		14000	6800	5600	390			390	1000	279	<0.65	<0.26
	10												
	15												
	20												
	2												
	5		9500	6900	1000	350			56	910	30.2	42	<0.23

FMW-10	10												
	15												
	20												

< indicates below detection
- indicates the sample was not analyzed for this constituent
mg/kg indicates milligram per kilogram
s.u. indicates standard units
meq/100 g indicates milliequivalents per 100 grams

Q - Data validation qualifier

J	Estimated
J+	Overestimated
UJ	Estimated Non-Detect
J-	Underestimated
R	Unusable

Exhibit D – Farallon Groundwater Data

FMW-10-20210629	06/29/2021	12:35	Natural	970		410		91		3.8		0.72		3.68		40		n/a		0.69		0.91		0.74	
FMW-08-20210629	06/29/2021	13:35	Natural	2100		1600		310		190		89		95.7		11		n/a		0.15		0.065		0.42	
FMW-09-20210629	06/29/2021	15:35	Natural	1800		710		420		12		95		85.2		32		n/a		1.3		0.65		0.99	
FMW-06-20210629	06/29/2021	16:40	Natural	560		330		36		2.9		0.11		1.46		5.4		n/a		1.9		0.014		0.036	
FMW-04-20210629	06/30/2021	5:55	Natural	640		400		33		3.0		0.12		1.96		4.1		n/a		1.1		0.14		0.18	
FMW-05-20210629	06/30/2021	6:55	Natural	640		460		14		4.2		<0.050		1.28		5.0		n/a		1.2		0.043		0.048	
FMW-03-20210629	06/30/2021	8:00	Natural	3700		1000		540		5.8		0.30		5.84		210		n/a		1.0		0.11		0.36	
FMW-07-20210629	06/30/2021	10:00	Natural	840		280		85		2.0		0.84		2.13		62		n/a		1.9		0.040		0.061	
FMW-01-20210629	06/30/2021	11:00	Natural	2400		630		200		2.9		0.62		2.14		200		n/a		0.70		0.25		0.32	
FMW-02-20210629	06/30/2021	12:20	Natural	770		320		46		2.9		<0.050		1.78		12		n/a		0.77		0.089		0.089	

Exhibit E – Curriculum Vitae

David J. Erickson, PG, CPG
President/Hydrogeologist
Water & Environmental Technologies, PC
480 East Park, Suite 200
Butte, MT 59701
(406)782-5220
derickson@waterenvtech.com

Education

- Bachelor of Science, Geological Engineering, Montana College of Mineral Science & Technology 1988
- Continuing Education Credits – 1990, 1991

Professional History

- *Water & Environmental Technologies*; Butte, MT, President/Hydrogeologist, August 2000 – present
- *Atlatl, Inc*., Butte; MT, Principal Hydrogeologist/Project Manager, May 1994 – August 2000
- *Special Resource Management, Inc.;* Butte, MT, Geological Engineer/Hydrogeologist, 1990-1994
- *Woodward-Clyde Consultants;* Houston, Texas, Staff Geological Engineer/Hydrogeologist, 1989-1990
- *Petroleum Testing Service;* Houston, Texas, Geological Technician, 1988-1989

Representative Experience

Project Manager and Hydrogeologist responsible for the characterization and remediation of a dissolved solvent plume from a county landfill. Remediation consists of in-situ air sparging and a funnel-and-gate capture and in-situ treatment system. The sites complex fractured bedrock and extremely complex ground water flow characteristics required innovative investigation technology to understand the water and contaminant interaction between the bedrock and the alluvial aquifers and ground water and surface water. Project highlights include:

- The use of geophysical method to characterize the bedrock topography and the connection and interaction between aquifers,
- The use of direct push subsurface investigation methods to characterize site conditions and identify contaminant transport pathways,
- Ground water flow and contaminant transport modeling to describe site conditions and test remedial options,
- The installation of source specific remedial methods to control landfill leachate impacts,
- Long term responsibility for all surface water, ground water, remediation, and reporting requirements for the site, and
- Presentation of site characteristics, model results, and site remediation costs in District Court.

Project Hydrogeologist and Lead Expert for the investigation and characterization of geologic, hydrogeologic, and contaminant migration characteristics of solvent and fuel contamination impacting a residential neighborhood. The goal of the investigation work was to determine the source of contamination and identify the responsible party. Geophysical methods (soil conductivity logging) and depth specific profile sampling was used to identify perchloroethylene migration and degradation in multiple production zones within the alluvial aquifer. This subsurface investigation established a connection between historical lagoon leakage and residential supply wells.

Project Manager and Lead Expert conducting a site investigation to assess the impact of historical mining and milling activities on ground water and stream water quality. Dissolved metals concentrations impacting a small town public water supply system prompted a complaint against the Mining Company. Tailings investigations and in stream tracer testing established a direct connection between stream water contamination and spring contamination.

Project Hydrogeologist/Manager for the investigation and remediation of many UST and Hazardous Waste Sites. Contaminants include fuels, solvents, wood treating compounds, metals, pesticides, herbicides, fungicides, and fertilizers.

Project Manager/Hydrogeologist responsible for the design, installation, and monitoring of various types of remedial technologies or remedial methods including (air stripping, air sparging, vapor extraction, bioventing, bio-cell treatment, biostimulation (ORC), NAPL recovery, in-situ & ex-situ bioremediation, natural attenuation, excavation & off-site disposal).

Project Manager responsible for the investigation and remediation of 29 sites in Montana and North Dakota where pesticides, herbicides, fungicides, fuels and fertilizers were spilled.

Project Manager and Hydrogeologist for extensive study and ground water modeling of contaminant effects from ash disposal ponds on an arid Wyoming drainage. The study involved:

- Prediction of contaminant transport,
- Simulation of remedial options,
- Design, installation, optimization and operation of remediation system,
- Permitting of facility expansion,
- Extensive presentations and negotiations with regulatory agencies, and
- Dispute resolution between the facility and potentially effected parties.

Project Engineer responsible for the design and permitting of a double-lined hazardous and non-hazardous repository with leachate collection and ground water relief system.

Project Engineer and Project Manager responsible for the design of ground water monitoring systems and subsurface geological, hydrogeological, and geotechnical investigation.

Project Hydrogeologist studying ground water fluctuations at a RCRA Part B TSD (Hazardous Waste Disposal Facility) in Oregon. Both hydrogeologic and contaminant transport characteristics were very complex.

Project Hydrologist responsible for sediment transport and stream water quality modeling for mine tailing disposal project in Malasia.

Project Hydrogeologist responsible for re-permitting several industrial landfills for large coal-fired electric generating plants in Wyoming. Projects involved investigation of water quality degradation from fly ash disposal activities and characterization of the potential health risks. A statistical evaluation of the water quality was completed to identify potential impacts.

Project Hydrogeologist for evaluation water chemistry changes resulting from the use of wastewater for irrigation at a research farm in Utah.

Project Hydrogeologist for yearly monitoring data analysis at several industrial plants with ponds or landfills in Wyoming and Utah.

Project Hydrogeologist performing final phase of landfill siting study for new RCRA Subtitle D Municipal Solid Waste Landfill

Project Hydrogeologist/Manager for the investigation and remediation of many UST and Hazardous Waste Sites. Contaminants include fuels, solvents, wood treating compounds, metals, pesticides, herbicides, fungicides, and fertilizers.

Project Manager/Hydrogeologist responsible for the design, installation, and monitoring of various types of remedial technologies or remedial methods including (air stripping, air sparging, vapor extraction, bioventing, bio-cell treatment, biostimulation (ORC), NAPL recovery, in-situ & ex-situ bioremediation, natural attenuation, excavation & off-site disposal).

Project Manager responsible for the investigation and remediation of 29 sites in Montana and North Dakota where pesticides, herbicides, fungicides, fuels and fertilizers were spilled.

Expert Witness/Litigation Support Experience

- *Park County v. Burlington Northern Santa Fe Railway Company, Montana Sixth Judicial District Court, Park County, Cause No. DV 97-75, July, 1999.*

- *C&P Packing v. Burlington Northern Santa Fe Railway Company*, Park County, January 2001.
- *Hepp v. Conoco Inc. et. al.*, ADV-2003-14
- *Town of Sunburst v. Texaco et. al.*, CDV-01-179 (a)
- *Town of Superior v. Asarco Incorporated*, US District Court, Missoula Division
- *Aguiar v. Burlington Northern, United States District Court, Great Falls Division*
- *Schammel et. al. v.CR Kendall Corporation, United States District Court, Great Falls Division.*
- *Van Haur v. CR Kendal Corp United States District Court, Great Falls Division*
- *Weiss et. al. v. HCI Dyce Chemical Company, CV-00-123-BLG-JDS*
- *Sieben Livestock Company v. Harp Line Contractors.*
- *Cool Breeze Inc. v. Flying J Inc., Maxim Technologies Inc.*
- *Cause No. ADV-04-984*
- *Friends of the Little Bitterroot v. Commissioners of Flathead County Cause No.: DV-06-560*
- *Mapleton City Corporation v. The Ensign-Bickford Company*, Case No. 020404933
- *Bergren v. BNSF*: CV-03-120-BLG-RFC
- *Devries v. BNSF:* CV-03-121-BLG-RFC
- *Outlook Enterprises v. BNSF*: CV-03-139-BLG-RFC
- *Hallett Minerals v. BNSF* Cause No. CV-03-161-BLG-RFC
- *Ruggles Excavation v. BNSF* Cause No. CV-03-160-BLG-RFC
- *Burley, Nelson, Meridith v. BNSF*
- *Anderson et. al. v. BNSF, Cause No. ADV-2008-101*
- *Kerfoot v. Texaco et. al. Cause No BDV-08-1276*
- *City of Livingston et. al. V. BNSF, Cause No. DV07-141*
- *Graham et, al.v. BNSF, Cause No. CV-12-145-M-DVM*
- *CARE, Inc. and Center for Food Safety, Inc. v. Cow Palace, LLC, Docket No. 2:13-cv-3016-TOR*
-
- *Lockman v. Pioneer Natural Resources, Cause No. CV-20-67-BMM-JTJ*

Professional Development

- Hazardous Waste and Geotech Sampling Seminar
- Monitoring Well Installation Seminar
- Analytical Laboratory Seminar (ENSECO)
- Design & Construction of RCRA Final Covers
- Enhanced Bioremediation (EPA)
- Ground Water Pollution & Hydrogeology, Princeton
- Geostatistical Analysis in Hazardous Waste Site Evaluation
- Ground Water Summit 2008
- Montana Water Law Conference 2007
- Landfill Gas Extraction & Ground Water Corrective Measures (presenter)
- National Ground Water Association Annual Conference – heterogeneity
- Environmental Geochemistry of Metals

- Environmental Isotopes in Ground Water Resource and Environmental Contamination
- Environmental Forensics: Methods & Applications
- 2004 NGWA Water & Environmental Law Conference
- Agrochemical Transport and Fate 2022

Certifications

Professional Geologist, Wyoming PG-3101
Professional Geologist, Utah PG-2250
Certified Professional Geologist, American Institute of Professional Geologists, CPG#9402
OSHA 29 CFR 1910.120 Health & Safety
OSHA 29 CFR Certified Waste Site Supervisor
Certified Monitoring Well Constructor

Affiliations

Association of Ground Water Scientists & Engineers
National Ground Water Association
American Institute of Professional Geologist
American Chemical Society
International Society of Environmental Forensics

Awards

Montana Tech Distinguished Alumni Recognition Award, 2003