State of Wisconsin

CORRESPONDENCE/MEMORANDUM

DATE: July 22, 2020 FILE REF: PORTAGE COUNTY E

TO: Mark Kaczorowski, CAFO Specialist, WDNR

FROM: Zoe McManama, CAFO Hydrogeologist, WDNR

SUBJECT: Gordondale Farms Groundwater Monitoring Recommendation

On June 17, 2020 I attended an on-site meeting at Gordondale Farms located on Hwy 161 in Nelsonville, Town of Amherst, Portage Co at the request of Mark Kaczorowski who was to undertake a routine inspection of the operation. In attendance were Gordondale Farms owner, Kyle Gordon, and Farm Manager Todd Stitely, Chad Gordon, and Austin Gordon. Gordondale Farms consists of three production sites covered under the WPDES permit; Main Farm, Home Farm, and Hog Farm. All three locations were visited during the July 17meeting, and the individual waste storage facilities viewed. In the report written subsequent to the inspection, Mr. Kaczorowski stated that the facility was in substantial compliance with the WPDES permit as issued, and no elements of concern were noted at either of the three sites.

The second purpose of the site assessment was to ascertain the value of installing a groundwater monitoring network at the Gordondale Farm operation to address nitrate levels in exceedance of the Wisconsin enforcement standard (ES) of 10 mg/L that had been detected in private drinking water wells in the Village of Nelsonville (herein Village). The installation of a groundwater monitoring network at Gordondale Farms, which borders the Village, had previously been recommended in an October 24, 2019 memo to Mr. Kaczorowski by Alex Edler, WDNR CAFO Hydrogeologist. The purpose of this memo is to communicate the decision-making elements surrounding groundwater monitoring at CAFO operations, discuss how these elements apply to Gordondale Farms, and to provide a recommendation based upon in-field observations and comprehensive review.

Groundwater Monitoring

Groundwater monitoring is a four-dimensional diagnostic tool that facilitates the acquisition of qualitative and quantitative data, at a fixed intercept between a lateral and vertical plane, at a discrete point in time for the purpose of analysis. Monitoring groundwater over a defined timeline produces individual snapshots which are compiled to form an image of the subsurface environment, groundwater behavior, water quality, and quantity. Just like a greater number of pixels per inch gives a clearer picture on a television, a higher frequency of sampling in a smaller area delivers a higher resolution image of a groundwater system and how it may be behaving. Groundwater monitoring alone neither prevents contamination from occurring nor removes contaminants that are present. Rather, it is commonly employed to assist in the detection or definition of a known or suspected contaminant in the groundwater system.

Under NR 243.15(7), Wisc. Admin. Code, groundwater monitoring may be required at a permitted CAFO with or without a known exceedance of a NR 140 preventative action limit (PAL) or enforcement standard (ES) if the Department determines that it is necessary. A groundwater monitoring network along with other actions may be required by the Department if a contaminant suspected to be generated by a specific operation is detected in a well that is not part of an existing network in exceedance of the NR 140 PAL and the Department is informed of the exceedance. Department considerations and resulting actions are outlined in NR 140.24, and a range of responses listed in NR 140 Table 5. Further actions may be required when a contaminant exceeds the NR 140 ES, and a range of responses outlined in Table 6.

NR140 Table 5

Range of Responses for Exceedances of a Preventive Action Limit for Indicator Parameters and Substances of Health or Welfare Concern

1. No action pursuant to s. NR 140.24 (5) and consistent with s. 160.23, Stats.
2. Require the installation and sampling of groundwater monitoring wells.
3. Require a change in the monitoring program, including increased monitoring.
4. Require an investigation of the extent of groundwater contamination.
5. Require a revision of the operational procedures at the facility, practice or activity.
6. Require a change in the design or construction of the facility, practice or activity.
7. Require an alternate method of waste treatment or disposal.
8. Require prohibition or closure and abandonment of a facility, practice or activity in accordance with sub. (6).
9. Require remedial action to renovate or restore groundwater quality.
10. Require remedial action to prevent or minimize the further discharge or release of the substance to groundwater.
11. Revise rules or criteria on facility design, location or management practices.
12. Require the collection and evaluation of data to determine whether natural attenuation can be effective to restore groundwater quality within a reasonable period of time, considering applicable criteria specified in ss. NR 140.24, 722.07 and 722.09 or 722.11, and require monitoring to determine whether or not natural attenuation is occurring in compliance with the response objectives in s.NR 140.24 (2).

NR 140 Table 6

Range of Responses for Exceedance of Enforcement Standards for Substances of Health or Welfare Concern

1. Require a revision of the operational procedures at a facility, practice or activity.
2. Require a change in the design or construction of the facility, practice or activity.
3. Require an alternate method of waste treatment or disposal.
4. Require prohibition or closure and abandonment of a facility, practice or activity.
5. Require remedial action to renovate or restore groundwater quality.
6. Require remedial action to prevent or minimize the further release of the substance to groundwater.
7. Revise rules or criteria on facility design, location or management practices.
8. Require the collection and evaluation of data to determine whether natural attenuation can be effective to restore groundwater quality within a reasonable period of time, considering applicable criteria specified in ss. NR 140.24, 722.07 and 722.09 or 722.11, and require monitoring to determine whether or not natural attenuation is occurring in compliance with the requirements of s. NR 140.26 (2) (a).

(b) If an activity or practice is not subject to regulation under subch. IV of ch. 283, Stats., ch. 289 or 291, Stats., and if the concentration of a substance in groundwater attains or exceeds an enforcement standard at a point of standards application, the department shall take the following responses unless it can be shown to the department that, to a reasonable certainty, by the greater weight of the credible evidence, an alternative response will achieve compliance with the enforcement standard at the point of standards application:

   1. Prohibit the activity or practice which uses or produces the substance; and
   2. Require remedial actions with respect to the specific site in accordance with this chapter.

As illustrated by Table 5 and 6, the installation of a groundwater monitoring network is one of several options to address groundwater contamination. Several factors are considered by CAFO engineers and hydrogeologists when assessing if groundwater monitoring network is the best way to address contamination issues associated with a WPDES-permitted facility. These include:

- **Generation and Source –** How the contaminant is being created, and structures or points where it is stored that may provide a point source.
- **Characterization** – What the chemical and physical properties, volume, behavior, and persistence of the contaminant is in the environment to which it is being released.
- **Activation –** How the contaminant may be released to the environment, and how it may move, or be transported around in the unsaturated and saturated subsurface. Geological and construction consideration are included in this assessment.
- **Receptors** – What vulnerable resources or populations may access the same aquifer at a point down gradient from the contaminant input.

The analysis of these factors allows regulators to gauge the risk that a facility poses to groundwater quality and quantity, and to assess if additional monitoring wells would provide added value. Also considered in what responses will be required are mitigation and protective measures in place to address known sources, contaminants, transport pathways, and vulnerable receptors.

Recommendation

NR 243.15(7) authority allows the Department to require groundwater monitoring when:

> "…*the department determines monitoring is necessary to evaluate impacts to groundwater and geologic or construction conditions warrant monitoring*."

Nitrates have been identified as a regional contaminant of concern throughout Portage County. The transport pathways through infiltration and groundwater are recognized, and the vulnerable receptors – private wells and the Tomorrow River watershed – have been identified. Subsequently, installing groundwater monitoring on a single facility would not glean data that would assist in further characterizing the chronic nitrate inputs in this region.

Generation and Source

Innumerable studies have demonstrated that agricultural activities contribute nitrate to the groundwater system through cropping, irrigation, and livestock rearing operations. These contributions may be chronic (e.g. land application of manure and fertilizers), or acute (e.g. spills). Historical aerial photos show agricultural activities to be well established in the area surrounding Nelsonville in 1938 (Photos 1 and 2), with little change in land use evident in contemporary aerial photographs from online mapping sites (Photo 3). This observation facilitates the assumption that agricultural nitrate inputs into the system in the region are chronic in nature.

Concerns have been raised about manure storage and operational sources of nitrate contamination. Groundwater monitoring network installations should not be used to address concerns regarding the fidelity of agricultural facilities such as pits, pipes, or storage units when engineering evaluations and corrective actions can be readily undertaken if problems are identified. Unlike other in situ waste storage facilities like landfills, waste can be removed from the facilities commonly found on-farm and in domestic locations, therefore enabling thorough inspections and assessments which do not require a groundwater ES to be exceeded and detected before initiating a response. Gordondale Farms is required under their WPDES permit to conduct such inspections and assessments as part of routine operation and maintenance.

While inspection, assessment, and mitigation activities will assist in reducing nitrate loading by agricultural storage facilities, it will not mitigate impacts from infiltration-type domestic septic systems which are not designed to reduce nitrate loading. A September 20, 2019 technical memorandum by Sand Creek Consultants (Appendix 1) addressed to the Nelsonville Village Board, and subsequently furnished to the Department, states that samples taken from eight private wells in the Village showed indicators of domestic impacts (as seen in septic systems), with four of those wells having two or more indicators. Infiltrating septic systems, such as drain fields and mounds are designed to deactivate pathogens in wastewaters, and do not provide nitrate removal functions without specific design and technological interventions. The installation of holding tanks or a municipal wastewater system may be options for addressing domestic nitrate inputs in the Village.

Characterization

Nitrate is a water-soluble nitrogen compound found in inorganic fertilizers, animal manure, and septic systems that is persistent in the groundwater environment. Nitrate concentrations in groundwater are prone to accumulate when application rates exceed the nutrient uptake capacity of plants present and the nutrient holding capacity of the soils on which it is being applied. This excess nitrate is readily mobilized and transported through the soils and bedrock to groundwater by the movement of water. Wisconsin's nitrate ES of 10mg/L references the maximum contaminant level (MCL) for nitrate-nitrogen in ground and surface waters as set by the U.S. Environmental Protection Agency. This limit is driven by human health concerns as the risk for infants developing methemoglobinemia (blue-baby syndrome) increases when potable water supplies exceed 10mg/L nitrate (U.S. Environmental Protection Agency, 2002).

Activation

Nitrate requires a saturated, permeable environment to effectively move around in the subsurface, therefore the greater the distance between the surface and saturated soil or bedrock, and the tighter or less permeable the soils and rocks, the slower the nitrate moves. According to the USDA Web Soil Survey, the agricultural fields around Nelsonville are predominantly on glacial moraines or drumlins, rolling hills of Rosholt sandy loams and Kennan sandy loams, both of which are well-drained and have a moderately-high to high permeability (0.6-6 inches per hour). Both soils are described as having layers of sand and gravel which if encountered would provide a zone of higher permeability where water could preferentially flow.

Nitrate concentrations in groundwater generally display a decreasing vertical concentration trend, meaning that deeper waters tend to have less nitrates in them. This trend may be disrupted if the soils and bedrock are highly permeable or have steep gradients, allowing water to move more rapidly through them, or if water is pulled through the substrates by pumping from irrigation or other high capacity wells. The addition of heavy precipitation or irrigation waters, which themselves may be an additional source of nitrate, may act to accelerate the nitrate transport process.

Groundwater monitoring of individual fields to address concerns about irrigation and the landspreading of manure has also been suggested. The installation of groundwater monitoring networks in areas where groundwater flow directions and water tables are seasonally manipulated through irrigation withdrawals and inputs may not provide results that are representative of individual field nitrate regimes. This means that data collected may not be useful for nitrate application management decisions. This is especially applicable to areas such as the Nelsonville area that have multiple high capacity wells, combined with a large percentage of irrigated fields. Gordondale Farms is required to account for all nitrate inputs through their Nutrient Management Plan, including commercial fertilizer, manure, and any other sources including their center pivot irrigation systems and dragline nutrient applications.

<u>Vulnerable Receptors</u>

The Gordondale Home Farm and adjacent fields are within the Village limits, with the remaining two farms located in the Town of Amherst. The Tomorrow River runs north to south through the Village and has been a Wisconsin DNR Priority Watershed, classified in stretches above Hwy 161 and below the village as a Class 1 trout stream and Outstanding Resource Water (Portage Co. 2019). Aerial photos taken by USDA in 1938 (Photo 1 and 2), and current-day aerial maps from Google show the area to the east and west of Nelsonville to be agricultural fields with some wooded tracts and parcels.

The technical memorandum by Sand Creek Consultants states that 77 private wells are located within the Village. The memorandum states that results obtained during a November 2018 sampling event of 60 wells in the Village showed that *"28 of the 60 samples had concentrations of nitrate-N above the 10mg/L…maximum contaminant level"*. Well construction logs contained in the memorandum show well depth of 14 nitrate-impacted, drilled wells to be between 42 and 80 feet total depth with static water level between 18 and 48ft. It is unknown as to the presence or number of sand point wells in the Village, and their construction. Correction for land surface elevation to provide individual well potentiometric data was not included in the memorandum.

The desired outcome for the Village of Nelsonville area is a reduction of nitrates to below the US EPA MCL and Wisconsin DNR ES of 10mg/L in groundwater sourced for potable use, and an improvement in the water quality of the tributaries and main channel of the Tomorrow River. To achieve these goals will require an active and sustained response by land users who contribute nitrates to the system by reducing nitrogen inputs. Even with a reduction of agricultural and domestic nitrate inputs into the system, the groundwater response will not be immediate, with nitrates entering the system today potentially taking upwards of 20 years to reach a discharge point, as demonstrated by the modeled groundwater residence times in a Technical Memorandum produced by Wisconsin Rural Water Association in May, 2020 (Appendix 2).

The options that exist for residents with nitrate exceedances to immediately access potable water with a reduced nitrate concentration may include:

1. The installation of deeper wells, potentially sharing wells between houses. This may have temporal limitations if sources of nitrate inputs are not reduced and nitrate contamination affects deeper waters.
2. The installation of a community system for Nelsonville, potentially requiring nitrate treatment.

The installation of point-of-use treatment systems is not encouraged due to the need for frequent maintenance and testing by the end user to ensure consistent operational efficacy. The WDNR recommends that all private wells in the state be tested annually for bacteria and nitrates as part of a maintenance schedule.

<u>Mitigation and Protective Measures</u>

The past, current, and future nitrate mitigation and protective measures of the Gordondale Farm operation are attached (Appendix 3). The status of septic systems in the Village is unknown. As recirculated nitrate from groundwater applied to crops by irrigation was shown to be more readily utilized by corn than commercial fertilizer in a field-calibrated modelling study in Nebraska (Martin, 1982), investigation into the nitrate contribution to irrigated fields would be advisable in fertilizer calculations, if not already utilized.

Conclusion

Nitrate contamination of groundwater in the Tomorrow River watershed is likely the result of chronic inputs from multiple sources, both agricultural and domestic. Impacts to drinking water supplies in Nelsonville are acknowledged, however, given the widespread distribution of nitrate-impacted wells throughout Portage County, the density of agricultural operations both generating and land applying nitrate products, and the presence of domestic septic systems, it is recommended that the approach to reducing nitrates in groundwater be a regional effort with all potential generators actively working to reduce their loadings to the system.

The geology and groundwater system in Portage County and the Tomorrow River watershed are well understood, and as such a groundwater monitoring network at a single facility – in this instance, Gordondale Farms – is unlikely to offer additional information that would aid in the active reduction of nitrates to the system. It is recommended that Gordondale Farms continue to develop and implement their operation-wide nitrate source identification, quantification, and nitrate mitigation process with the explicit goal of reducing their contributions to groundwater nitrate levels in the Tomorrow River watershed. These goals would not be significantly aided by the installation of a groundwater monitoring network at this facility.

Likewise, a regional-scale reduction of nitrate in groundwater will not be achieved by the installation of a single groundwater monitoring network, although a well-designed regional network could yield useful trend data over many years. Nitrate reduction on a regional scale is yet to be attempted in Wisconsin. It is of note that the defined margins and smaller size, combined with the high recreational, ecological, and economic value of the Tomorrow River watershed would make it an excellent candidate for a nitrogen source identification and reduction pilot focusing on the development and implementation of a comprehensive nitrogen budget targeting a net groundwater system nitrate loss.

Photo 1.
Aerial of Nelsonville – West of Tomorrow River
USDA September 24, 1938
Coordinates: 44.498, -89.327
Source: https://maps.sco.wisc.edu

Photo 2.
Aerial of Nelsonville – East of Tomorrow River
USDA September 24, 1938
Coordinates: 44.500, -89.287
Source: https://maps.sco.wisc.edu

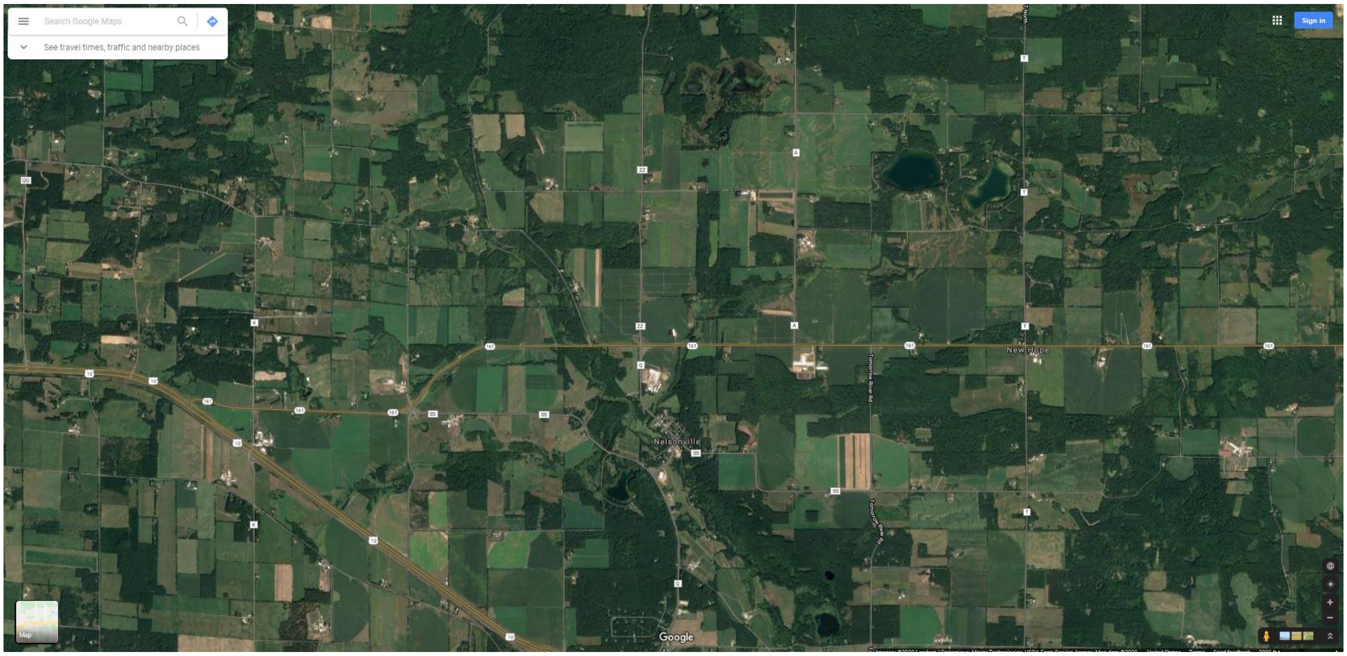

Photo 3.
Aerial of Nelsonville Area
Google Maps, accessed 07/01/2020
Coordinates: 44.5055175, -89.3098752,6812
www.google.com/maps

References

Portage County, 2019 State of the River Report: Tomorrow River, Portage County, Wisconsin. https://www.co.portage.wi.us/home/showdocument?id=24600

Martin, D.L., Watts D.G., Mielke L.N., Frank K.D., and Eisenhauer D.E. (1982) Evaluation of nitrogen and irrigation management for corn production using water high in nitrate. Soil Science Society of America Journal 46, 1056-1062.

USDA-NRCS, Web Soil Survey, https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx, accessed 06/30/2020.

U.S. Environmental Protection Agency, Onsite Wastewater Treatment Systems Manual, EPA/625/R-00/008 February 2002. https://www.epa.gov/sites/production/files/2015-06/documents/2004_07_07_septics_septic_2002_osdm_all.pdf Accessed 07/13/2020

Gordondale Farms, Inc.
History of Commitment to Sustainable and Environmentally responsible Farming Practices.

Submitted to the WDNR by Kyle Gordon on 06/29/2020

1970s - Award for Contour Farming
1981 - First Manure Pit to contain waste and protect the Marsh
1982 – Installed filter strips for brown water
1983 – Installed Settling Basin to Capture and filter Hog Lots
1984 – Discontinued pasturing of the marsh along the creek
1985 – Constructed Hog finishing Barn Manure pit, later converter for leachate control
1986 – Installed VTA for driveway Runoff
1987 – Installed VTA for Heifer Farm
1988 - Implemented Soil conservation practices to eliminate soil loss – 30% Residue
1989 – Abandoned Hogs At bobbies Location due to proximity to town
1990 – Constructed G-barn for Gestation sows, NRCS Engineered Pit, eliminating outside lots
1991- Removes settling basin because outside runoff from sow lot was eliminated
1992 – Experimentation with side-dressing hog manure on corn to feed growing crop
1993 – Began Soil sampling on 5-Acre grids
1995 – Constructed Shatters, NRCS Inspected and designed, Pit now used for heifers
1998 – Began Researching Annarobis Digestion and expanding to Cafo Size
2000 – Constructed Deere Ridge Dairy Moving all lactating cows to facility 2miles from town
2001 – Completed First Hard Covered mixed plug flow digester in North America
The digester continues to run presently and is awarded as such.
2004 – Began exit of hog industry, Over 2 years of selling sows and finishing hogs
Thus lowering animal units allowing pit to be used for 100% leachate
2008 – Constructed 220 days of storage at Deere Ridge Dairy with concrete lined DNR/NRCS
Approved plans and inspections during construction
2010 – Added Second screw press to further manure management and application efficiency
2012 – Constructed new heifer barn per DNR request to move to remove all heifers from dirt
With 100% containment
2013 – Completed 100% abandonment of boobies Heifer Farm per DNR request

2014 – Added winter wheat to crop rotation to further soil loss prevention and N loading
By adding flexibility to apply manure at different times of the year
2015 – Constructed 100% leachate control around feed pad
2017 – Added 100% containment to 3 rows of super hutches for rain events
2018 – Installations of Irrigation pivots to spoon feed Corn with N and Save/conserve Water

Nitrate Specific

-220 days of manure storage
-500 acres and increasing of cover crops
-100% leachate Control
-Conservation tillage practices
-Higher percentage of alfalfa in rotation and growing
-5 of 6yrs all alfalfa rotation within ½ mile of town, implemented in 2019
-Nitrogen Reduction in starter of 30% with delayed planting

-Tissue samples of crops to prevent over application of N
-Split applications of N to reduce possible leaching event
-Spoon feeding threw pivots to apply as little several gallons/acres per application
-Adding instinct to liquid manure and fertilizer to prevent leaching

Future Plans for nitrate reduction

-Plans for full compost facility and some effluent reduction
-Continue to replace old irrigation systems
-Plans to implement Side dressing Corn with liquid effluent from pit to drastically reduces fall spreading which we believe to be more risk of leaching
    -feeding a growing crop
    -utilization
    -timing
    -cost saving
    -organic matter
-research variable rate application
-utilize tissue samples on a larger scale
-Use Compost facility to make soil amendment to increase humas/organic matter/water retention characteristics of soil profile
-expand cover crop acres
-expand Alfalfa acres
-Continue to lower MUNS levels in manure through cow diets