

The Debate about Farm Nitrates and Drinking Water

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High nitrate levels in groundwater are impacting and restricting use of municipal water supplies in some locations. Nitrogen is a primary nutrient necessary for plant growth. Nitrogen is also a primary component of crop fertilizers, but when nitrogen is not used by crop plants, it can convert to nitrates and move with groundwater in the soil. Nitrates can contribute to pollution of lakes, rivers, and streams. Community groups and municipalities are filing citizen lawsuits under federal laws to restrict the use of manure and fertilizers that elevate nitrate concentrations in water supplies. While the federal water and pollution laws have exemptions for field application of livestock wastes and field runoff, the community groups and municipalities are charging that those exemptions do not apply in cases of nutrient application resulting in polluted drinking water. In new applications of federal law, their arguments are convincing courts to assess nitrate liability to farmers and restrict farming operations. When nitrate concentrations exceed the drinking water standard, community groups, and municipalities are looking to the courts for relief. A federal court in Washington State ruled that manure application that resulted in nitrates leaching into groundwater was the same as open dumping of garbage, holding the dairy farm liable for the nitrate contamination of ground water (United States District Court, Eastern District of Washington, 2015).

A recent federal case filed by the Des Moines Water Works (Water Works case) alleges that drainage of farmland accelerates nitrate pollution, which costs the municipal water supply almost a million dollars a year to treat (United States District Court, Northern District of Iowa-Western Division, 2015). While farming practices are considered by many to be exempt from regulation under the Federal Water Pollution Control Act,

The Minnesota Example

Minnesota and many other agricultural states have groundwater and surface waters in agricultural areas that have high nitrate concentrations (MPCA, 2013). Currently, in Minnesota, it is reported that 45 communities are trying to slow or reverse excessive levels of nitrates in their public water systems, 16 community water supplies have violated nitrate drinking water standards, and seven municipalities are operating nitrate removal systems (Kennedy, 2015a). Government agencies and the press are citing farming practices as the cause of nitrate pollution. The Minneapolis Star Tribune reported that the debate over feedlots is the rising concern about nitrate pollution in Minnesota waters (Kennedy, 2015b). A study led by the Minnesota Pollution Control Agency (MPCA, 2013) showed elevated nitrate levels in many rivers and streams, particularly in southern Minnesota. The primary source of nitrates is cropland agriculture, the study said, but concentrated animal feeding operations (CAFOs) also can contribute because of manure spills and misapplication of manure on fields. Similar articles reported that “Nitrogen fertilizer is leaching into groundwater from farm fields, contaminating wells and costing taxpayers millions of dollars a year” and “taxpayers spent nearly \$125 million last year to clean up Minnesota lakes, streams and groundwater contaminated by farming that highlights agriculture’s increasingly prominent role as a source of water pollution.” In 2016, the Minnesota Pollution Control Agency (MPCA, 2016) found that up to 60% of groundwater monitoring wells sampled in central Minnesota are contaminated with nitrates well beyond the safe drinking water standard.

known as the Clean Water Act (CWA), this case alleges that the conveyance of fertilizer-polluted sub-surface water or groundwater through tile and ditches is in fact subject to permits and regulation under the CWA to eliminate that pollution (CWA, 2011).

Many farmers might believe that cases in other states do not affect them, but a review of two recent cases brought under federal law shows that common livestock waste and fertilizer practices are being reviewed in detail by the federal courts and clean water objectives are being upheld over customary farming practices which were thought by many to be exempt from federal pollution laws. Restricting crop nutrients and holding farmers liable for nitrates that leave the farm may negatively impact crop yields. Consequently, it is valuable to proactively consider possible policy alternatives in light of the court's findings.

Land Application of Manure

The land application of manure was ruled subject to the same laws as the open dumping of garbage in a recent case. On January 2015, a federal judge in Washington, ordered judgment against a dairy farm, Cow Palace LLC, and its operators (Dairy Farm), for violating the federal Resource Conservation and Recovery Act (RCRA) in its storage and application of manure to farmland.

The RCRA governs the treatment, storage, and disposal of solid and hazardous waste to minimize the present and future threat to human health and the environment. The RCRA prohibits the disposal of solid waste (including agricultural waste) or garbage that is "open dumping" and prohibits actions from causing or contributing to the creation of an imminent and substantial endangerment to human health or the environment. The RCRA is commonly used by government agencies to regulate hazardous waste and garbage, but the act also has a provision where citizens can bring a lawsuit. The Community Association for Restoration of the Environment, Inc. and the Center for Food Safety, Inc. filed actions against the Dairy Farm and three other dairy farms after the Environmental Protection Agency had conducted studies and directed certain actions under a consent order that were not as rigorous as the remedies under the RCRA (United States District Court, Eastern District of Washington, 2015). The federal court order upholding the plaintiff groups was surprising because livestock operations have generally been considered exempt from regulation under a provision that states the RCRA does not apply to agricultural wastes, including manure, returned to the soil as fertilizers or soil conditioners. The RCRA agricultural-waste exemption was limited by the court, which held that manure is to be regulated as a solid waste similar to garbage if it is "handled and used in a manner that its usefulness as a fertilizer is eliminated."

The court found that the Dairy Farm applied more manure to its agricultural fields than crops could use as a fertilizer and that the application was made without a specific determination of the fertilizer needed by the soil for the crops planted. In other words, applying at agronomic rates or as a fertilizer required the Dairy Farm to test the manure and the soil just prior to application, calculate five-year average crop uptake rates and to only apply manure in amounts for which the nutrients would be in the soil for the average uptake by crops to be planted. The court found that the Dairy Farm did not make all of the tests and calculations and noted that the manure lagoon was pumped out until empty. The court concluded that the Dairy Farm's application of manure was discarding the manure and therefore it is a solid waste under the RCRA. The court found that samples taken below crop root zones, that is at soil depths where no crop roots are present to use manure constituents as fertilizer, showed high nitrate and phosphate concentrations and were evidence of the manure being discarded, because there was no beneficial purpose of the manure to crops below the root zone. While the Dairy Farm argued there were other sources of nitrates, the court noted that dairy pharmaceuticals were present in the water samples with high nitrate concentrations.

The Dairy Farm stored manure in lagoons, which were purported to have been constructed under NCRS guidelines. The court found that seepage from the lagoons, converts a beneficial product, stored manure, into a solid waste (the discarded, constituents of manure) under the RCRA because the manure is knowingly abandoned into the underlying soil. The court similarly found that the manure in the Dairy Farm's unlined composting area was knowingly abandoned when manure nutrients leach into the soil. The consequence of preparing manure in an unlined area for later use, while not actually using it for its beneficial use as a fertilizer, resulted in the composted manure being classified as a solid waste.

Elevated nitrate concentrations above the federal drinking water standard were present in the groundwater beyond the Dairy Farm property. The court emphasized that a party violates the RCRA if its actions “may” be endangering public health, welfare, or the environment. Proof of actual, immediate harm is not necessary. Evidence only needs to show threatened or potential harm. The court concluded that the Dairy Farm operations may present an imminent and substantial endangerment to the public which consumes the contaminated water.

Field Tiling and Point Source Pollution

In another federal court case, farm drainage in tiles and ditches were alleged to be point source pollution requiring permits. The Des Moines Water Works (Water Works) recently sued county drainage districts more than 100 miles away, claiming that higher nitrates in groundwater runoff threaten Des Moines drinking-water customers.

The Water Works sampled groundwater in tiles and ditches controlled by drainage districts and found levels of nitrates exceeding the federal drinking water standard. The suit alleges that drainage districts collect water in pipes and ditches and those pipes and ditches become “point sources” subject to permits and regulation under the federal Clean Water Act. This case was recently filed as a citizen suit.

The CWA requires point source discharges of pollution to have a National Pollution Discharge Elimination System (NPDES) permit. The CWA (2011) identifies a point source as “any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged.” The Water Works charges that drainage pipes, tile, and ditches carry nitrates from farm fields to its sources of drinking water and are point sources subject to regulation.

Farming operations have been considered exempt under the CWA because there is a farming exemption for “agricultural stormwater discharge” and “return flow from irrigated agriculture”. The Water Works complaint goes into considerable detail describing how underground drainage systems remove water from the soil, which accelerates nitrate removal from the soil root zones of farm fields, and that nitrate-polluted water is concentrated in pipes, tiles, and ditches. The complaint distinguishes stormwater runoff from cropland which would be exempt from the CWA in that the stormwater runoff does not have the higher concentrations of nitrates, and claims that stormwater runoff that mixes with groundwater dilutes the nitrate-laden groundwater. This case is destined to be a detailed scientific examination of the soil-groundwater nitrogen cycle that was not contemplated when the CWA or its agricultural stormwater exemption was enacted.

The Water Works asks the court to order the drainage districts to take all action necessary to eliminate nitrate pollution; compensate the Des Moines Water Works for all damages resulting from the nitrate pollution and current treatment costs which are in excess of \$900,000 per year; and award the Water Works all of its costs in bringing the action. The Water Works has announced in May 2015 that nitrate treatment costs had set a record for the prior year and that the two river water sources had elevated nitrate levels. The Water Works has stated that rising nitrate levels may require a treatment plant upgrade costing \$76 to \$183.5 million by 2020.

If the Water Works prevails, the drainage districts will need to restrict nitrates and assess costs back to the land. The costs and time to implement remedies to restrict excess nitrates are large. In Iowa under its Nutrient Reduction Strategy, nitrogen and phosphorus are to be reduced by 45% in the state’s waterways (Helmer and Castellano, 2015). Iowa State scientists utilized one scenario to meet those goals which require 60% of all corn and soybean acres planted with cover crops, 27% of all agricultural land drained into wetlands and 60 percent of the drained land treated with bioreactors. Such a plan would require 6,000 wetlands, 90,000 bioreactors, and 12 million acres of cover crops. Officials estimated it would take \$1.2 billion annually over 50 years to implement these practices to meet the strategy goals, which is \$100 per acre per year or \$5,000 per acre for the entire program.

The RCRA and the CWA both have stated purposes of preventing pollution and protecting waters, and many states have studies showing waters in agricultural areas with nitrate levels above, and in some cases, significantly above, drinking water standards. The level of detail in the Dairy Farm case and the nitrate leaching and the farm

tile and drainage hydrology supporting the Water Works case point to a debate between infrastructure and farming practices being reviewed under new scientific criteria. The 111-page Dairy Farm decision reviewed an extensive set of facts regarding manure handling and land application. In each area that was challenged, the court reviewed the facts and concluded that under federal law, nutrients such as nitrate from manure that migrate deeper than the root zone confirm that the manure was being discarded or disposed of as a solid waste rather than being applied as a beneficial fertilizer (United States District Court, Eastern District of Washington, 2015). The focus was on the nitrogen that was not used by crops, which eliminated the exemption.

The RCRA allows citizen suits, like the Dairy Farm case, to force appropriate parties to clean up solid and hazardous waste contamination. The RCRA remedies include civil penalties, injunctive relief (court orders to stop a particular practice), and attorneys' fees for the citizen plaintiffs who bring these actions. The remedies in Dairy Farm included sealing all areas where manure is generated, stored, handled, or composted from seeping into the soil or groundwater, sealing lagoons with impermeable barriers separately agreed to by the Dairy Farm, testing and record keeping of nutrient levels of manure, the capacity of the soil and crops to utilize the manure, groundwater testing and monitoring, and payment for bottled water and water filtering of contaminated wells.

These court actions carry new costs and risks to dairy and livestock operations, particularly those in areas of nitrate pollution of ground and surface water. If manure and fields are thoroughly tested prior to manure application, land application of manure may be precluded during extended periods due to nutrient concentrations, weather, soil temperature and moisture variability until the soil has the capacity to carry additional nutrients in a manner that minimizes or under a strict reading of RCRA, prevents leaching to groundwater. In the Dairy Farm case, the court essentially shifted the burden to the farm or livestock operation to show that manure is only being applied to land as a beneficial fertilizer to be used by crops in the root zone.

Minnesota Agricultural Water Quality Certification Program

Minnesota offers its farmers the opportunity to participate in the Minnesota Agricultural Water Quality Certification Program (MAWQCP). Farmers who meet the requirements of MAWQCP are deemed in compliance with all state water regulations for a period of up to 10 years, unless it can be proven that the farmers are not maintaining their agreed upon practices. The Program encourages water quality conservation and provides farmers certainty within an ever-changing regulatory environment.

The Program requires interested farmers to first complete an application containing a list of five individual state and federal rules and regulations—Minnesota Administrative Rules on Feedlots (if applicable); Minnesota Wetlands Conservation Act; Minnesota's Subsurface Sewage Treatment Systems requirements; the Federal Insecticide, Fungicide, and Rodenticide Act (and applicable Minnesota statutes); and current state rules pertaining to shoreland and riparian protection. A farmer must meet the requirements of these rules and regulations before being considered for MAWQCP.

Assuming the farmer is fully compliant with the enumerated rules and regulations, the MAWQCP Assessment Tool, based on the NRCS Water Quality Index, assigns a score to the farmer on a field by field and crop by crop basis. Ranging from 0-10, farmers need at least an 8.5 to be eligible; farmers with a score below that threshold may receive help from MAWQCP officials to help meet the minimum. Finally, the farmer's claims are verified and the farmer is subject to random audits throughout the agreement period.

After the verification process, the farmer signs a personalized contract—the State of Minnesota Agricultural Water Quality Certification Agreement—and must maintain compliance and keep regular records. The state provides the farmer with a Data Collection Worksheet in which the farmer records information first, on aspects such as soil type, slope, organic matter content, and other related things. Also included is information on quantity of nitrogen and phosphorous applied, their source, timing, and placement; and questions on certain practices, for example, planted seed depth, use of cover crops, planter and tiller type.

The Water Works lawsuit has attracted considerable attention. Iowa's high organic soils are a prime factor in crop productivity. Problems occur in the spring and fall when there are no plants to soak up the nitrates. Drainage tiles, which move water about 150 times faster than undisturbed pre-settlement soils, move water and nitrates into waterways. These federal cases do not analyze the complex nitrogen cycle. The focus is on the actions of farmers applying manure and fertilizers and the result of groundwater above the safe drinking water standard for nitrates (United States District Court, Eastern District of Washington, 2015)

Implications for Public Policy

Crops need nitrogen for growth. Compliance with regulations or court ordered restrictions will likely result in reduced yields because farmer liability could focus on excess, not adequate, nitrogen for crops. It is not always clear whether excess nitrates in a field can be linked with a specific well on a property. Regulatory and court-ordered solutions will reduce productivity and increase costs for farmers and the farm economy. To achieve maximum productivity, adequate nutrients need to be present in the soil root zone and available for plant growth. Similarly, adequate drainage to remove soil water quickly assures better yields in many years when the soil profile in the root zone would have too much moisture or water. Adequate nutrients for maximum yields and rapid drainage of excess water can transfer nutrients and water off the farmer's land. In the past, states authorized drainage districts to improve farming and food production because for farmers, excess water in the field and in the root zone was historically the "common enemy."

Monitoring of key nitrogen-cycle parameters, fertilizer application technology, and groundwater runoff need to be reviewed and optimized for crop production and reducing excess nitrates. Structural solutions and financing to treat water supply use areas or at areas where subsurface runoff is concentrated may need to be utilized. Significant advances have been made in treatment systems. For example, algae production systems were recently used in a test project to remove 90% of the nitrogen in the City of Houston's wastewater. Scientists at Western Michigan University are developing nutrient "scrubbers" made with 3D printers for farm sized systems to grow algae to remove nutrients from farm runoff. In both cases, the algae would be a feedstock for biofuel production.

What are Producers Currently Doing?

The U.S. Department of Agriculture's Natural Resource Conservation Service (NRCS) supports nutrient management that includes the type of testing and analysis that should minimize or eliminate nitrogen below the root zone. Independent crop consultants and NRCS, as well as the NPDES permitting process for CAFO suggests, and in many cases, requires this type of nutrient management analysis. Farmers who test the manure and soil before and after application and apply manure at prescribed agronomic rates are a condition of CAFO. However, it should be noted the court's decision held that nitrates migrating below the root zone is a concluding factor for regulation of manure application as a solid waste and assigning liability for the resulting nitrate pollution. The RCRA finding would mean that these operations could be punished even though they meet CWA requirements.

The efficiency of applying nutrients to the soil has improved, and crop yields have increased, but with more seeds and plants per acre and more fertilizer per acre required to produce greater yields per acre, the removal of water and nutrients such as nitrates from farm fields has increased. The Dairy Farm and Water Works cases seek to make farmers responsible for externalities from livestock and cropping operations. Externalities are the nitrate laden water that leaves the farm and becomes a drinking water supply. In essence, notwithstanding the farming exemptions in the RCRA and the Clean Water Act, federal courts are determining drinking water standards outweigh longstanding economic farming practices and are holding farmers liable for the externalities of livestock waste handling and application and cropping practices.

Manure is not a "solid waste" subject to open dumping under the RCRA if the manure, instead of being applied to land, is used as a beneficial animal byproduct feedstock for further processing. Animal byproducts have more uses than as a fertilizer and soil conditioner. They can also be used as a feedstock for aerobic digestion, and even to make ethanol. There are new developments in the production of bio-based chemicals that can use manure as a feedstock. For example, methane from anaerobic digestion can be used as a bio-based gas feedstock.

Proprietary organisms have been identified and propagated to convert manure into chemical platforms that can be further processed. Collected organic materials should not be considered “wastes,” but feedstocks for bio-processing into chemicals, plastics, renewable natural gas, and fuels. Livestock producers can be a necessary supplier of “animal byproducts” rather than trying to manage manure in an unforgiving federal regulatory regime designed to prevent open dumping of garbage and hazardous waste.

States have used tax credits in the past and could provide a producer credit for animal byproduct feedstocks that are converted to energy and other products. A significant credit would jumpstart a change in field application of manure to utilizing “animal byproducts” to produce energy and other products. The credit could be funded from the tax attributable to the energy or products produced.

For More Information

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