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WATER USE IN CONFINED ANIMAL FEEDING OPERATIONS (CAFOS) IN MINNESOTA: WHO'S KEEPING TRACK?

Dara Meredith Fedrow

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WATER USE IN CONFINED ANIMAL FEEDING OPERATIONS (CAFOS) IN
MINNESOTA: WHO'S KEEPING TRACK?

By

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Water use in Confined Animal Feeding Operations (CAFOs) in Minnesota: Who's Keeping Track?

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Confined animal feeding operations (CAFOs) are highly concentrated feedlots that raise large numbers of livestock with an emphasis on efficiency and maximizing output. Hog and dairy feedlots in Minnesota are shrinking in number, yet growing in size. In hand with the rise of CAFOs, water scarcity is a growing concern as the effects of climate change worsen and the human population increases. Though Minnesota is a state of abundant water, it is not evenly distributed throughout the state raising concerns about sustainable water usage.

This paper describes and analyzes how Minnesota's water appropriation permit system is overseeing water usage in large CAFOs. By analyzing government documents and data, this study estimates the amount of water large dairy and hog CAFOs used in 2017 in Minnesota to be about 2.3 billion gallons. Geographic concentration of CAFO development was apparent, with large hog CAFOs being largely developed in south-central Minnesota and large dairy CAFOs largely developed in central Minnesota. As a result, Pomme de Terre River watershed was the most heavily used watershed for hog and dairy CAFO watering in 2017. The five most heavily used watersheds are all located in the Minnesota River Basin. Riverview LLP was the CAFO owner with the highest reported water use in 2017, using one quarter of all water use in large hog and dairy CAFOs. Ultimately, about 2/3 of large hog and dairy CAFOs did not have water appropriation permits so their water use is unknown. Using a guide to livestock watering use by Swine Extension Educator Sam Baidoo, this report estimates unreported water use could be about 1 billion gallons of water for 2017. More comprehensive and reliable data is needed to gain a clearer understanding of water use in this group. This research will inform the work of Land Stewardship Project (LSP), which is an advocacy nonprofit based in Minnesota, as well as state government agencies, water researchers, and local citizens.

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Executive Summary

The development of confined animal feeding operations (CAFOs) has been linked to environmental pollution and economic harm in rural communities. In Minnesota, large hog and dairy CAFOs are responsible for using large sums of water, more so than other livestock feedlots. The water appropriation permit program through the Minnesota Department of Natural Resources (DNR) is the main way water use is regulated on these farms. There are two types of water use permits for CAFOs, Individual Permits and General Permits, each regulating different amounts of water use. With both permits, farmers self-report water use totals to the State annually and pay a nominal fee. By merging datasets from the DNR on reported water use and the Minnesota Pollution Control Agency (MPCA) on CAFO size and primary livestock, this study estimates water use by large hog and dairy CAFOs.

Main findings:

- Pomme de Terre River watershed was the most heavily used watershed for hog and dairy CAFO livestock watering in 2017. The five most heavily used watersheds are all located in the Minnesota River Basin.
- Riverview LLP uses one quarter of the total water used by large hog and dairy CAFOs in 2017, with a reported use of 570 million gallons for 14 CAFOs. Christenson Family Farms and Feedlots used the second highest amount of water in 2017, using a reported 168 million gallons for 55 CAFOs.
- Geographic concentration of CAFOs is apparent. Large hog CAFOs are largely developed in south-central Minnesota, while large dairy CAFOs are largely developed in central Minnesota.
- The General Permit 2004-0275 allows large CAFO owners to use more water with less regulatory oversight and for less monetary compensation to the state over time. This is prevalent in large hog CAFOs because they use less water qualifying for general permits. Large hog CAFO companies have been issued multiple general permits in the same or adjoining counties, drawing on the same watersheds. This means one company's water use is being monitored incrementally rather than collectively, and in a less stringent way. CAFO companies are also paying a one-time fee for each of these general permits, when they could be paying yearly fees for individual permits. As a result, the state is losing money to conduct annual assessments on the safety of CAFO water use.
- About a third of large hog and dairy CAFOs, or 448 CAFOs, are obtaining water use permits. The remaining 2/3 of this group, or 871 large CAFOs, do not appear to have permits and water use is unknown.
- Using estimates of water requirements for livestock produced by Swine Extension Educator Same Baidoo, CAFOs that may require a water use permit, that did not obtain one, could be using about 1 billion gallons of water. This is about one half of the actual reported water use among large hog and dairy CAFOs in 2017, which was 2.3 billion gallons.

Main recommendations:

- **Fix the general permit loophole.** DNR should reform the general permit program to hold CAFOs accountable for the total water they use in a county and watershed, rather than assess each project individually. Limiting the number of general permits a landowner obtains in one county or from one watershed before requiring an individual permit is one solution. Raising permit fees would also allow the DNR to hire more staff members to address the need for more monitoring and closer inspection of water use reporting. More money to the program is ultimately needed to produce more accurate data and increase the number of CAFOs obtaining permits.
- **Generate general feedlot sizes that require a water appropriation permit.** Knowing the general size of CAFOs that require a permit would make enforcement of the program easier and give way for a more comprehensive understanding of CAFO water use. These estimates could not be made from current State water appropriation permit data because data is self-reported from CAFO owners and highly variable. Some researchers have attempted to create general livestock use standards, though more reliable and generalizable data is needed.
- **More communication between state agencies.** Government agencies regulating CAFOs should unify their data sets and expand on the work in this report. If state agencies, such as DNR and MPCA did so, a more comprehensive view of CAFOs and their impact to the land and communities could be assessed. More consistent feedlot registration data between the two agencies would make checking the size of feedlots and whether they have a permit easier. Also, collaboration with researchers at the Water Resources Center at University of Minnesota can help identify critical areas for protection and assess if capacity has been reached in certain aquifers.
- **Watch for areas of growing CAFO activity.** New areas of CAFO development should be watched closely to ensure CAFOs are obtaining the proper permits and for their impacts to the surrounding communities and watersheds. Hog CAFOs are reporting increasingly more water use in the south eastern part of Minnesota. This is particularly apparent in Mower and Steele Counties, corresponding to the Cannon River, Cedar River, and Upper Iowa River. Dairy CAFOs appear to be opening in Norman and Kandiyohi counties. Norman county corresponds to a large percent increase in use of the Wild Rice River.

CHAPTER ONE: INTRODUCTION

Rise of Concentrated Animal Feeding Operations

The agrifood system in the United States is increasingly more industrialized, reflecting a modernist worldview of scientific “progress” as inherently beneficial. Science and technology have greatly increased output and efficiency. Farmers are often on a “technological treadmill”, a concept coined by University of Minnesota professor Willard Cochrane, as they are forced to keep up with new technologies created to maximize efficiency and increase production (Lyson 2004:19). Food in this system is mass-produced and commodified. These commodities are valued from the prices attributed to them by the market, rather than their quality (Guptill, Copelton, and Lucal 2013:104-105). Political forces additionally influence the market prices of commodities, such as through the farm bill, which is vulnerable to the interests of corporate lobbyists. Market forces thus often dictate the monetary value of the food we eat.

The industrialization of the food system has made way for agribusiness corporations to dominate the market through concentration. Farmers are replacing open pastures for grazing with row crops as animals are moved off the land and into confined animal feedlots. Concentrated animal feeding operations (CAFOs) are highly industrialized feedlots that raise large numbers of livestock with an emphasis on efficiency and maximizing output. The Minnesota Pollution Control Agency (MPCA) defines an animal feedlot as “A lot or building, or combination of lots and buildings, intended for the confined feeding, breeding, raising, or holding of animals and specifically designed as a confinement area in which manure may accumulate” (MPCA 2007:2). As defined by the United States Department of Agriculture (USDA), a CAFO is distinguished from other animal feedlots as an animal feeding operation (AFO) “with more than 1,000 animal

units confined on site for more than 45 days during the year” and “that discharges manure or wastewater into a natural or man-made ditch, stream or other waterway” (United States Department of Agriculture 2018). Animal units (AU) are used to measure CAFO size. The MPCA defines animal units as a, “measure used to compare differences in the production of animal manure for an animal feedlot or manure storage area” (MPCA 2007:2). AUs are determined by multiplying a specific factor for each livestock species by the number of heads of animals. Dairy herd sizes are multiplied by a factor of 1.4 to determine animal units, while the number of hogs per farm is multiplied by a factor of 0.3 (MPCA 2017).

The definition of a CAFO varies depending on the government agency. Animal feedlots are considered large CAFOs in Minnesota when they exceed 700 or more dairy cows, or 980 animal units, and 2,500 or more finishing swines, or 750 animal units (MPCA 2015). This definition is more encompassing than the 1,000 animal unit threshold for CAFOs as defined by the USDA. Brands (2014: 245) sums up the definition of CAFOs based on the *Code of Federal Regulations*, as an animal feeding operation that “meets minimum thresholds for number of animals, discharge to surface water, or are otherwise determined to be a significant contributor to water pollution.” CAFOs are thus tricky to pin down to a single defining factor. My study will use the definition for a large CAFO set forth by the MPCA.

Consolidation

CAFOs in the U.S. are consolidating into fewer and larger operations. The four-firm concentration ratio (CR4), is a measure of market concentration found by adding up the market shares of the top four firms in a specific industry (Carolan 2012:41). For pork producers in 2012, the CR4 was 37.3 percent (Carolan 2012:41). A CR4 ratio that is 20 percent of a market is

considered concentrated, whereas a ratio that exceeds 60 percent is exemplary of a “significantly distorted market” (Carolan 2012: 41). Highly concentrated CR4 estimates also indicate horizontal concentration in an industry, where firms monopolize “one link in the food commodity chain” (Carolan 2012:42).

Concentration within the pork and dairy industries is particularly clear in Minnesota. Of the largest 20 pork producers in the United States, five have headquarters in the state (Freese 2018). These companies are Pipestone System, Christensen Farms, Schwartz Farms, Holden Farms, and New Fashion Pork. Minnesota-raised pork exports doubled from 1997 to 2007 (Brands 2014: 246), and Minnesota ranked number three in the country for market hog inventory in 2018 (National Agricultural Statistics Service 2018). Despite high rates of overall production, the number of hog farms has been decreasing over the past 35 years. According to the 2017 Minnesota Census of Agriculture, there were a reported 20,813 swine farms in Minnesota in 1982, 5,628 in 2002, 3,355 in 2012, and 3,225 in 2017 resulting in an 84 percent decrease from 1982 to 2017 (U.S. Department of Agriculture 2019:7). While the number of operations has been declining, the size of the remaining operations has increased. The number of hog farms raising 2,000-5,000 or more grew by 4 farms from 2012 to 2017 while the number of farms raising 1–1,999 hogs decreased by 134 farms (U.S Department of Agriculture 2019:23).

A similar trend has been happening among dairies. Minnesota ranked number seven in the country for milk cow inventory in 2018 (National Agricultural Statistics Service 2018). There were 24,178 dairies in the state in 1982, 6,474 in 2002, 4,746 in 2012, and 3,644 in 2017 resulting in an 85 percent decrease from 1982 to 2017 (U.S Department of Agriculture 2019:7). From 2012 to 2017, the number of dairies raising between 500-2,500 or more milk cows increased by 7 farms and the number of dairies raising between 1-499 cows decreased by 1,109

farms (U.S Department of Agriculture 2019:20). Minnesota is producing more livestock on larger, but fewer farms.

Water availability in Minnesota

Sustainable water use is an increasing concern for the state of Minnesota as the population grows and water use increases. Water scarcity is a “function of available water sources and human population” (Brown and Mattlock 2011: 1). According to University of Minnesota researcher Katherine Teiken (2012: 9-10), Minnesota water use increased by 77.6 billion gallons per year from 1999 through 2008. Accordingly, “Minnesota water use has increased by 24 percent over the last 20 years, as tracked by the Department of Natural Resources through the water permit program, while the population has increased 22 percent” (Teiken 2012: 10). Water use is outpacing the population in Minnesota, which can lead to water scarcity in some areas.

Groundwater is unequally distributed throughout Minnesota which can pose issues as agricultural groundwater use increases. Groundwater pumping is unsustainable in some parts of Minnesota and could deprive ecosystems and humans of water needed to survive (Freshwater Society Guardianship Council 2013: 2). Between 1988 and 2011, overall reported groundwater pumped increased by 31 percent, averaging around 251 billion gallons per year (Freshwater Society Guardianship Council 2013: 7). Livestock watering commonly uses groundwater for animal drinking water, animal cooling, and facility-equipment washing. Though some researchers found that water use in dairies has required 35% less water in 2007 than 1944 to produce the same 1 billion kilogram of milk (Capper, Cady, and Bauman 2009: 2160), large increases in number of animals supports a large increase in overall water use. Pumping

groundwater faster than it can recharge affects the water table and the sustainability of aquifers. Minnesota is a state of abundant water, though it is not evenly distributed around the state, nor is it limitless (Teiken 2012: 12). Farmers using over 1 million gallons of water a year, or 10,000 gallons of water day, must obtain a water appropriation permit from the Department of Natural Resources (DNR) though compliance with obtaining permits has been difficult for the DNR to enforce (Kennedy 2015). This lack of compliance could mean a great deal of data on CAFO water use is unknown. More efforts to conserve water as well as stricter regulatory control for better reporting of water use are increasingly needed.

Concentrated Animal Feeding Operations in Minnesota

CAFOs have gained negative attention for causing groundwater pollution (Centner and Mullen 2002; Burkholder et al. 2006; Centner 2011). When raised in confined buildings, livestock generates manure that becomes a liquid waste problem. In Minnesota CAFOs, manure is stored in earthen lagoons in dairies and in cement lagoons in hog operations. Hog lagoons must additionally be covered to avoid off-gassing lethal anaerobic gasses. Manure is then often spread onto surrounding agricultural land in liquid form. According to Burkholder et al. (2006: 308), “generally accepted livestock waste management practices do not adequately or effectively protect water resources from contamination with excessive nutrients, microbial pathogens, and pharmaceuticals present in waste.” Livestock waste has been documented in surface and groundwater supplies in the U.S and is a growing public concern (Burkholder et al. 2006:309). Scientists and residents have expressed particular concern regarding the development of CAFOs in south eastern Minnesota, also known as ‘karst country’. This region is abundant in karst

geology made of unusually porous rock and sink holes, which makes it easier for manure to seep into drinking water (Bjorhus 2018).

I learned about the negative impacts CAFOs have on Minnesota communities when I spent the summer of 2018 interning with the grassroots advocacy organization Northern Plains Resource Council based in Billings, Montana. I attended the Principles of Community Organizing (POCO) training in South Dakota hosted by Western Organization of Resource Councils. At this training, I met members of the organization Land Stewardship Project (LSP), which is a Minnesota-based advocacy organization. Members of LSP were attending the POCO training after significant successes standing up to CAFO development. Members were eager to learn how to effectively organize more of their neighbors around controlling the growth of CAFOs in their communities. I was inspired by these activists organizing to protect their local environment and health.

The Land Stewardship Project was founded in 1982 to foster an ethic of stewardship for farmland, to promote sustainable agriculture, and to develop healthy communities. LSP works to promote transformational change in our food and farming system. LSP members have been organizing to stop the development of factory farms as a way to protect the economic viability of rural economies and the environmental health of communities for decades (Land Stewardship Project 2018). LSP has organized members around Minnesota to fight factory farm development through local control by releasing guides teaching local communities how to regulate the placement of factory farms in their townships (Land Stewardship Project 2008b). LSP members have also worked at the state level to pass policies that hold factory farms accountable to stricter regulatory standards. For instance, LSP members tested hydrogen sulfide emissions near hog manure lagoons and proved, in some cases, that emissions were exceeding Minnesota health

standards. LSP soon after succeeded in passing a law through the Minnesota Legislature that enforced air quality standards for hydrogen sulfide emissions from animal feedlots (Land Stewardship Project 2008a).

I got in touch with LSP in the fall of 2018 to inquire if there was any research they needed to advance their factory farm campaign. They pointed out how a prominent concern in factory farms is water pollution, but LSP organizers had a growing concern about the *amount* of water these farms are using. Hog and dairy CAFOs, in particular, are increasingly moving into rural communities in Minnesota and are responsible for using large sums of water, more so than other livestock CAFOs. Information on the water use in these CAFOs is largely unseen to the public eye, though records of it exist in various government datasets that had not been previously analyzed together.

Conclusion

The focus of this paper is water *use* in large-scale hog and dairy feeding operations. This research will analyze what we know about water use from DNR water appropriation records. CAFOs raise thousands of animals, drawing millions of gallons of water annually from one geographic area. Though Minnesota is known as the “Land of 10,000 Lakes,” climate change and large-scale water consumption can impact reliable sources of water. With the threat of water scarcity becoming more possible in areas of the state, an accurate understanding of water use by CAFOs will help promote good management practices and natural resource protection.

Through my research, I interviewed DNR staff and reviewed Minnesota Statutes and Rules to describe and analyze how Minnesota’s water appropriation permit system functions to oversee water usage in large hog and dairy CAFOs. I also analyzed government data from the

MPCA on registered feedlots and DNR permit data on reported water use totals to estimate total water use in large hog and dairy CAFOs. From this analysis, I determined to what degree there is compliance with obtaining required water appropriation permits. I also looked at large hog and dairy CAFO water use by county, largest owners, and most appropriated watersheds to piece together water use trends from 2014 - 2017 and geographic concentrations. I ultimately generated conclusions and recommendations for more stringent control over CAFO water use. LSP will use this information to potentially push for regulatory reforms regarding water use by large CAFOs. This research is also intended to benefit the work of Minnesota's state government agencies and researchers at the Water Resources Center at University of Minnesota. And lastly, this work is ultimately for citizens looking to practice their democratic right in protecting their community's economic, social, and environmental health.

CHAPTER TWO: METHODOLOGY

Introduction

I began this study by visiting Minneapolis in November of 2018. I met with Land Stewardship Project (LSP) staff to go over the objectives for this research. While in town, I met with senior scientist, Ryan Noe, from the Water Resources Center at University of Minnesota to discuss areas of overlap between this research and their current research on at risk-aquifers in the state. Ryan shared literature on water scarcity in Minnesota and data on aquifers in the state. Additionally, I met with the two Department of Natural Resource (DNR) staffers in charge of issuing and monitoring water appropriation permits. I spoke with them about the livestock watering appropriations permitting process in Minnesota. Lastly, I spoke with Darell Gerber, a policy analyst at Minnesota Center for Environmental Advocacy. Darell informed me on ways to collect data on farm water use.

Using government data, this study estimates water usage by large hog and dairy CAFOs in Minnesota. This study used data from state agencies that are generally operating separately to regulate the functions of CAFOs in Minnesota. I joined the data together to analyze their relationship as a whole. The study is thus reliant on the quality of data government agencies are collecting and relying on to implement regulatory standards on CAFOs. I use this merged data to analyze CAFO water use by county, largest owners, and most heavily used watershed as well as to assess how many CAFOs appear to be getting water use permits.

Data Source Collection

The Minnesota Pollution Control Agency (MPCA) posts a dataset on their website covering all feedlots that have ever been registered or had a permit to operate in Minnesota. The

MPCA dataset covers fields such as farm address, owner, type of animals raised, number of animals, animal units, watershed name, county, as well as many other fields. I used this data set updated in January of 2019.

This study focuses on *large* hog and dairy CAFOs as defined by the MPCA. Animal feedlots are considered large CAFOs in Minnesota when they exceed 700 or more dairy cows, or 980 animal units. Feedlots with 2,500 or more finishing swines, or 750 animal units, are large hog CAFOs (MPCA 2015). Though there are multiple factors that go into defining a CAFO, these size thresholds specific to Minnesota made sense to use for the analysis.

Hog feedlots in the MPCA dataset are categorized into three weight categories: with hogs over 300 pounds; between 55 and 300 pounds; and under 55 pounds. I used data from a field of all of these combined for each feedlot. There are 1,230 active hog feedlots that meet the MPCA large CAFO threshold of being 750 animal units or above in 2017. There is also a field in the MPCA dataset that determines if the facility is considered a CAFO. About 130 of these 1,230 feedlots did not include a CAFO identification. I included these in my study however, because they fell within the size threshold for a CAFO as defined the MPCA.

Dairy operations are broken into four size categories in the MPCA dataset: feedlots with cows less than 1,000 pounds; heifers; calves; and cows over 1,000 pounds. I selected for feedlots that met the MPCA large dairy threshold for having over 980 animal units or above in each specific size category. There were 89 dairy feedlots that met this threshold.

Additionally, DNR staff provided a dataset on water appropriation permits for livestock watering with information on each permit granted of November of 2018. This dataset covered permit number, permitted volume, project name, landowner, county, unique well numbers,

reported water uses from 1988 to 2017, and other fields. Table one shows the field names in the two datasets that I used for my data analysis.

I focus my analysis section on self-reported water use totals between 2014-2017 from the DNR dataset. Updates in 2014 to the general water appropriation permitting process and the introduction of an online platform for applications greatly improved the water use data from this year to 2017, which is the most recent year with reported water data at this time.

Table 1. Field names from the two datasets I used for the data analysis.

Dataset Fields	
MPCA data on CAFOs	DNR data on water appropriation permits
<ul style="list-style-type: none"> - Name - Item ID number - Owner - HUC name (Minnesota DNR's watershed name for USGS 8-digit watershed) - Public Land Survey Information number; range, range direction, and section number - County - Primary livestock raised - Number of animals raised -AU of animals raised 	<ul style="list-style-type: none"> - Permit number - Permitted volume - Project name - Landowner - Legal description - County - Watershed name - Reported water use 1988-2107

Data Analysis

Dairy Merge

To merge the MPCA data on dairy CAFOs with the DNR water permit data, I first determined there were 776 total wells registered for all livestock watering types in DNR's dataset. There was no detail, however, regarding the primary livestock species for each water

permit or size of the feedlot registered for it. This information was in the MPCA dataset. Accordingly, to link water appropriation permits with their respective large dairy and hog CAFOs, I used a combination of two methods: “Legal Description Matching” and “GIS Buffer Capture”; both methods are explained below. I primarily used the Legal Description Matching for this merge and I used the findings from the GIS Buffer Capture to cross check my results.

Legal Description Matching Method

The legal description of the location of a CAFO is a field in the DNR data, which is a way to spatially locate a feedlot on a grid 6 miles by 6 miles, which is then further broken down into 1 square mile sections. The MPCA data included fields that make up a legal description, but they were separated into Public Land Survey Township number, Public Land Survey range, Public Land Survey range direction, and Public Land Survey section number. I used the concatenate function through Excel to combine cells and create a legal description that matched the DNR field. All legal descriptions were unique in the datasets so I used SPSS, a statistics software, to merge the two files based on legal description. Both datasets had fields covering farm name, landowner, county, and watershed. I manually checked the merge to make sure there was a match between the name or landowner field. I used county and watershed to check for accuracy.

Sixteen CAFOs did not have a recorded legal description in the datasets and a handful did not generate a match with a permit based on the legal description. I manually searched the name and landowner of each CAFO in the MPCA dataset within the DNR water permit data for these. I again used county and watershed to check for accuracy. If a CAFO in the MPCA data had a farm name or owner that matched with a permit in the DNR data and was in the same county or

within the same watershed, it was assumed to be a match. If the CAFO in the MPCA data did not match a farm name or owner to any DNR water permit data, then I assumed it was without a water permit. There were no cases of a CAFO having the same name and owner as a DNR permit in a different county.

GIS Buffer Capture Method

In addition, with the help of a graduate of the University of Michigan, Ember McCoy, I spatially merged the two files using GIS. The MPCA dataset included latitudes and longitudes of the feedlots. The DNR dataset included UTM x,y easting and northing coordinates of the wells registered for a water appropriation permit. McCoy mapped the two datasets and joined the two datasets spatially by using 0.5 mile circular unmerged buffers around the feedlots. She then selected and joined the pointfiles and associated table of the DNR dataset to all points from the water appropriation file that were within 0.5 mile of the feedlot point locations. This generated a list of permits that were within a 0.5 mile surrounding area of a large dairy CAFO.

Three permits were picked up from GIS that the Legal Description Matching method did not. This was because permits for livestock other than dairies were in the DNR dataset and fell within the .5 mile buffer. I removed these permits. The Legal Description Matching method also matched eleven permits that the GIS Buffer method did not. This is because using legal descriptions creates a larger and different buffer around a permit than does a .5 mile buffer. I determined it is possible for a CAFO to use water from a well that is farther than a .5 buffer and included these matches in my results.

Hog Merge

In order to merge the MPCA data on hog CAFOs with that on water use permits, I started with the 776 livestock watering DNR permits and removed the dairy permits from the list, based on the above process, as well as permits clearly associated with another livestock industry, such as poultry or beef cattle. After discarding 86 permits, 690 permits remained. Similarly to dairies, I used the concatenate function through Excel to create a legal description that matched the DNR field. I then merged the two files using SPSS based on legal description. I found 257 matches from this merge. However, this dataset had duplicating legal descriptions so I looked at each of the 127 duplicated cases. These duplicators were large CAFOs and water use permits that fell within the same township, range, and section. I manually matched the correct CAFO to the correct permit using name and landowner, as well as the relevant county and watershed. I found 44 matches through this process, for a total of 301 matched permits, and discarded some additional permits I discovered to be of a different industry upon closer look.

There were 313 DNR permits remaining that did not match to a hog CAFO based on legal description. I manually searched farm name and owner from the MPCA hog CAFO list. I used county and watershed again to assess for accuracy. I also used a map of Minnesota counties to look for adjacent counties in the event a permit or feedlot was on the edge of a county line. I found a total of 386 permits that matched hog CAFOs.

McCoy conducted the GIS Buffer method for the hog CAFOs and matched 368 permits to CAFOs through this, though a number of them were for other livestock industries. I manually combined 43 permits that were not in the .5 GIS buffer pool., meaning they were outside of the .5 buffer range.

Limitations

These methods are limited by the reliability of the government data to ensure there are no errors. When looking closely at the water use data for 2014, 2015, 2016, and 2017, it is clear that the 2014 data is less consistent with previous years, particularly amongst hog CAFOs. This was the first year DNR made significant changes to the general water appropriation permit program and could account for this variability.

Additionally, shared water use permits between CAFOs added a level of complexity that I accommodated for as best I could. Multiple registered feedlots can share one water appropriation permit and multiple permits can be issued for one registered feedlot. This means there can be shared permits between CAFOs as well as multiple permits for one CAFO. I accounted for this when there was a clear connection between DNR permits and MPCA registered CAFOs. This occurred when the DNR permit farm name or landowner matched with the MPCA feedlot farm name or landowner. DNR permits are issued to legal landowners and it is most common that a shared permit would be for multiple barns of the same owner. In that case, farm name was often the same for multiple feedlots that matched to one DNR permit. I was also able to use the item_ID field in the MPCA data, which is a unique ID for a feedlot. Farms with the same owner and location often had the same ID number with a 1 or a 2 on the end. If one farm in group of matching item_ID numbers had a water appropriation permit, I matched it to all these corresponding feedlots, making sure to only count the reported water use once.

Conclusion

This study analyzed existing government data to estimate water use in large hog and dairy CAFOs. Data on CAFO specifications and reported water use is collected from separate state agencies, which generally operate independently of one another to regulate CAFO activity. This study merges these data to look at the larger relationships and to piece together water use trends amongst large CAFOs in Minnesota.

Using a combination of matching legal descriptions, spatial mapping with GIS, and corresponding CAFO and water use permit registration information, I matched large hog and dairy CAFOs with their corresponding water use permits. These methods ensure that I have included permits for only hog and dairy CAFOs in my study. They also ensure I matched these permits with large hog and dairy CAFOs within a .5 mile buffer, with a matching legal description, or with a matching farm name or landowner in the same geographic area.

CHAPTER THREE: FINDINGS

WATER APPROPRIATION PERMITTING IN MINNESOTA

Introduction

Large CAFO water use is mainly regulated through the Department of Natural Resources (DNR) Water Appropriation Permit program. A general livestock feedlot permit was created in 2004 and is still undergoing systematic changes. Land Stewardship Project (LSP) organizers are interested in understanding how this new general permit works, so particular focus is on that permit process and the changes made to it since 2004. I visited with DNR staff in the St. Paul office for an interview on the permit process and additionally reviewed Minnesota Statutes and Rules. This chapter analyzes the context of the program, statutory requirements, and rulemaking process.

Water Law in Minnesota

Minnesota's riparian rights doctrine gives landowners certain "property rights arising from owning property abutting water" (DNR 2012:1). A landowner with property abutting water can use their share "for domestic and agricultural purposes, but cannot unreasonably interfere with another downstream user or affect the ecosystem" (Peters 2014a). It is the duty of riparian owners to reasonably use their rights so as to not harm ecosystems or interfere with the riparian rights of others (DNR 2012:1). If someone wants to use more than 1 million gallons a year, or more than 10,000 gallons in one day, from "waters of the state", a DNR water appropriation permit is needed. "Waters of the state" are defined as "any surface waters or underground waters, except those surface waters that are not confined but are spread and diffused over the land" (DNR 2012:2). These include all "lakes, ponds, wetlands, rivers, streams, ditches, springs, and

waters from underground aquifers regardless of their size or location” (DNR 2012:2). Patrick Sweeney, Research and Communications Director of the Freshwater Society, explains how under riparian rights, “we all share the right to use them [waters of the state] and to enjoy the benefits they provide to ecosystems” (Peters 2014a).

Minnesota also adheres to a correlative rights doctrine for ground water usage, which limits the rights of water users to a reasonable share (Peters 2014a). The DNR commissioner has the authority to allocate water for consumptive use in the event of water shortages. Minnesota Statute §103G.261 (2018) sets forth these priorities:

- (1) domestic water supply and power production that meets the contingency planning provisions;
- (2) consumption of less than 10,000 gallons of water per day;
- (3) agricultural irrigation and processing of agricultural products with consumption in excess of 10,000 gallons per day;
- (4) power production in excess of the use provided for in the contingency plan;
- (5) uses other than agricultural irrigation, processing of agricultural products, and power production, involving consumption in excess of 10,000 gallons per day;
- (6) nonessential uses.

Large hog and dairy CAFOs would generally qualify under priority number five, as they are using in excess of 10,000 gallons a day for reasons other than irrigation, agricultural product processing, and power production. Some could also qualify under priority number two, though, if using less than 10,000 gallons of water a day. Attorney Phil Kunkel explains to Minnesota Public Radio, “Whether surface or groundwater, this combination of riparian and correlative rights doctrines was designed to keep one person or organization from monopolizing a single water source to the point of depletion” (Peters 2014a). He goes on to add, “Though these models have worked for some time, the state is now reconsidering its approach because the water sources are not replenishing as quickly as we are using water” (Peters 2014a). A dynamic permit program

that addresses current shortcomings and inefficiencies is important to maintain these water law values.

The purpose of the water appropriation permit program is to “conserve and utilize the water resources of the state in the public interest” (DNR 2011). Minnesota law requires the DNR commissioner to manage water resources for long-term sustainable use. According to Minnesota Statute § 103G.265 (2018), the commissioner shall manage water resources to “assure an adequate supply to meet long-range seasonal requirements for domestic, municipal, industrial, agricultural, fish and wildlife, recreational, power, navigation, and quality-control purposes.”

Water appropriation permits

As noted above, water appropriation permits are needed when water use is in excess of 1 million gallons a year, or in excess of 10,000 gallons of water per day. According to a permit authorization form given to me by DNR staff, farmers appropriating surface or groundwater for the production of animals, poultry, or direct animal products qualify for a livestock watering permit, rather than other permit types such as irrigation, construction dewatering, or hydropower. Farmers using over the threshold for a water appropriation permit are eligible for one of two types of livestock watering permits; an Individual Permit or an Animal Feedlot and Livestock General Permit 2004-0275, or more commonly called a general permit. A general water appropriation permit is granted to farmers that appropriate surface water or groundwater between 1 and 5 million gallons of water per year for livestock watering and sanitation. Any feedlot operator using above 5 million gallons of water per year qualifies for an individual water appropriation permit. Exemptions to water appropriation permit requirements include:

- domestic uses that serve less than 25 persons for general residential purposes
- test pumping of a ground water source
- reuse of water already authorized by a permit
- certain agricultural drainage systems (DNR 2018b).

General Permits

DNR general permit 2004-0275 was created in 2004 as a less labor-intensive permit to apply for and for DNR staff to monitor. According to the DNR, “General permits are standardized permits established to cover more routine and lower impact projects and activities” (DNR 2011). These permits do not require as much review as individual permits and can be issued quicker than an individual permit. The standards for this permit are “very specific and time frames for issuance of the permits are very short” (DNR 2011). As stated by DNR Commissioner and staff in their 2011 Efficiency Report, general permits “allow DNR hydrologists to focus time on activities with greater environmental return, such as proactive water management or more complex or high impact projects” (DNR 2011). There is one other general water appropriation permit issued through the DNR, which is for temporary water appropriations for construction dewatering, landscaping, dust control, and hydrostatic testing of pipelines, tanks, and wastewater ponds.

Livestock feedlot operators are eligible for a general permit if: (1) operations have a minimal potential for causing environmental harm; (2) water appropriations are under 5 million gallons per year; (3) operators follow application requirements through the online platform MDNR Permitting and Reporting System (MPARS); (4) keep monthly records on water appropriation volumes and submitted to DNR on or before February 15th of each year; and (5) are in compliance with all MPCA and county feedlot program rules and regulations (DNR

2018b). General permits additionally differ from individual permits in that they do not require a public comment period. According to DNR staff in our interview, general permit authorizations do not have 30-day call for comments from local units of government, cities, counties, and watershed districts. This comment period is open for individual permit applications. Table one depicts the general similarities and difference between the individual and general water appropriation permit.

General Permit 2004-0275 has undergone changes since it was created in 2004. The original general permit allowed multiple users to be covered under one permit. This was created as an effort to reduce administrative time inputting data. DNR staff wanted to increase compliance in livestock feedlot owners obtaining a permit, so one general permit could serve multiple water users in an area as a general covering. In 2014, however, the DNR modified the general permit so that each registered well required a specific permit authorization. The *new* general permit required permit holders to register for a specific location, to verify wells, meet sustainability standards, and to report annually on their water use. DNR also upgraded their reporting system to the online platform MPARS during this year. This upgrade improved DNR’s ability to track livestock water use from 2014 to the present, though staff acknowledged compliance with obtaining a permit is still low.

Table 2. Major differences and similarities between DNR general and individual water appropriation permits

General Permit	Individual Permit
Using between 1-5 million gallons of water a year	Using over 5 million gallons of water a year or 10,000 gallons a day
\$100 application fee	\$150 application fee, \$140 yearly fee
No 30-day public comment period	30-day public comment period
Users report water use on or before February 15 th of each year	Users report water use on or before February 15 th of each year
Application review less stringent	Application review more stringent

Permit process

The following applies to both general and individual water use permits. To apply, farmers send application information to the DNR through their online platform, MPARS. As stated in Minnesota Statute §103G.287 (2018) , applicants must provide: (1) a water-well record with information on the subsurface geologic formations penetrated by the well and geologic information from test holes drilled to locate the site of the production well; (2) the maximum daily, seasonal, and annual pumpage rates and volumes being requested; (3) information on groundwater quality; (4) the results of an aquifer test; and (5) the results of any assessments conducted by the commissioner. Applicants do not specify which permit they are applying for at the time of application.

The permit application is reviewed by DNR hydrologists who then decide which type of permit the farmer qualifies for. DNR hydrologists review the application to determine if the proposed groundwater usage is sustainable and if it will cause harm to ecosystems. According to Minnesota Rule 6115.0670 (2018), permits are specifically considered for:

- “(1) the location and nature of the area involved and the type of appropriation and its impact on the availability, distribution, and condition of water and related land resources in the area involved;
- (2) the hydrology and hydraulics of the water resources involved and the capability of the resources to sustain the proposed appropriation based on existing and probable future use;
- (3) the probable effects on the environment including anticipated changes in the resources, unavoidable detrimental effects, and alternatives to the proposed appropriation;
- (4) the relationship, consistency, and compliance with existing federal, state, and local laws, rules, legal requirements, and water management plans;
- (5) the public health, safety, and welfare served or impacted by the proposed appropriation;
- (6) the quantity, quality, and timing of any waters returned after use and the impact on the receiving waters involved;
- (7) the efficiency of use and intended application of water conservation practices;

- (8) the comments of local and regional units of government, federal and state agencies, private persons, and other affected or interested parties;
- (9) the adequacy of state water resources availability when diversions of any waters of the state to any place outside of the state are proposed;
- (10) the economic benefits of the proposed appropriation based on supporting data when supplied by the applicant.”

Since general permits are reviewed less stringently than individual permits, these criteria seem to be assessed differently depending on the appropriation amount.

Once a user is granted a permit, Minnesota Rule 6115.0705 (2018) mandates permittees to “keep monthly and yearly records of the quantity of water used or appropriated at the point of taking from each source under a permit.” Permittees send in their yearly records to DNR on or before February 15th of each year. Permit holders are required to have a flow-meter or another pre-approved way of reporting water within 10% accuracy. Flow-meters were not required before 2014. The requirement for a flow-meter is a result of a 2014 DNR report to the Minnesota Legislature, where DNR staff reported receiving “systematically inaccurate information” and called for mandatory flow-meter installation (DNR 2014). This change has gone into effect, though there is no requirement for mandatory flow-meter maintenance, nor are there site checks by DNR staff. Instead, two DNR staff members generally monitor the self-reported data from about 10,000 permit holders in the state in all water appropriation categories for seemingly wrong records.

There is no expiration date on water appropriation permits. As long as permit holders comply with paying the annual permit fee and yearly reporting of water use to the DNR on or before February 15th of each year, the permit lasts indefinitely. According to DNR staff, it is infrequent that DNR would terminate or deny a permit. Staff mentioned it would likely only happen in the event a project was proven to be dangerous.

Permit holders can amend their permits or must apply for updated permits in the event of changes to their water use. According to Minnesota Rule 6115.0705 (2018), permit amendments can be made when there is a substantial increase or decrease in the rate and quantity of water withdrawn as well as a change in the source of appropriation. A new permit must be issued when there is a change in the water source, purpose of water appropriation, or when the change would pose conflict or well interference (Minnesota Rule 6115.0705, 2018).

Fees

Permit fees are collected for DNR staff to study project effects on surrounding neighbors, evaluate permit applications, and review annual reports. There is a \$100 application fee for a general permit and \$150 application fee for an individual permit. If granted a water appropriation permit, there is an additional \$140 yearly payment for individual permit holders and there is no annual fee for a general water appropriation permit. Permit holders that use above 50 million gallons of water a year must pay additional sliding scale fees. These fees range from \$3.50 for each million gallon of water used over 50 million gallons up to 100 million gallons, to \$8.00 for each million gallon over 500 million gallons. These sliding scale fees do not generally apply to livestock operations, since the largest appropriated volume for CAFOs has been for 125 million gallons a year. In all, the application fees, individual permit yearly fee, and sliding scale fees for using over 50 million gallons a year are all that large-scale water users pay to the state for their water use.

Minnesotans have fought to increase water use fees as a means of encouraging more conservation efforts. In 2014, The Freshwater Society endorsed a proposal by Governor Mark Dayton and DNR to “increase the state’s basic Water Use Reporting fee for groundwater use”

(Peters 2014b). The Freshwater Society recommended the fees were too low to discourage waste or over-use. This proposed fee increase was rejected by the Legislature, but a General Fund appropriation was provided to improve DNR management and regulation of groundwater (Peters, 2014b).

Penalties

Permit holders that fail to obtain a water appropriation permit and follow proper use of the permit are subject to administrative penalties. DNR gained more authoritative control for administering penalties since issuing an administrative penalty order in 2014 (DNR 2015). As stated in Minnesota Statute § 103G.299 (2018), the DNR commissioner may order administrative penalties based on the circumstance's "potential for harm and deviation from compliance." Violations that present a minor potential for harm and deviation from compliance will be issued a penalty of no more than \$1,000. Moderate violations of these factors will be issued a penalty of no more than \$10,000. Severe penalties of these factors can be fined no more than \$20,000. When issuing penalties, the commissioner may consider the potential for danger to public interests or natural resources, past violations, economic benefit gained by the violator, and other factors of justice specifically identified (Minnesota Statute §103G.299: 2018).

Conclusion

The DNR water appropriation permit program in Minnesota serves as the main regulatory oversight for large CAFO water use. After becoming aware that large-scale users were failing to obtain the necessary permits, DNR has worked to increase compliance through the Animal Feedlot and Livestock General Permit 2004-0275. This general permit is intended to cover

farmers using between 1-5 million gallons of water a year. General permit applications are significantly easier to get approved, being as they require less stringent review by DNR hydrologists and do not get opened to a 30-day comment period. General permit holders additionally pay a reduced application fee and no yearly fee. Major improvements to the general permit process since 2014 have improved DNR's ability to track water use more reliably, though there is a lack of monitoring for accuracy in reporting water use. Funding and staffing limitations restricts the ability for monitoring and enforcement of the program. Ultimately, concerns about low permit fees and low compliance for obtaining permits calls into question the effectiveness of the permit program to meet its goal of conserving water in the public interest.

ANALYSIS

Introduction

This analysis looks at water use trends in large hog and dairy CAFOs between the years 2014 - 2017. As mentioned earlier, DNR's ability to track and monitor livestock water use greatly increased with changes to the general permit program in 2014. As a result, reported water use data between these years is more reliable than previous years. I analyze water use in large dairy CAFOs separately from hogs CAFOs, and then look at both industries together. CAFOs are analyzed by permit data as well as water use by county, largest CAFOs, and watershed.

This analysis was particularly exciting to conduct because of the novelty of bringing these specific data together. Though no new data were collected, the State data have not been combined in this way before. What follows is a deeper look into the water use trends and patterns amongst large hog and dairy CAFOs in Minnesota.

Water Use Among Large Dairy CAFOs

Industry characterization

Of the 89 large dairy CAFOs in Minnesota in 2017; 71 raised primarily dairy cattle greater than 1,000 lbs; 11 raised primarily dairy cattle less than 1,000 lbs; 5 raised primarily heifers; and 2 raised primarily calves.

Permitted and Reported Water Use

The permitted volumes for all of the permits in 2017 totaled about 2 billion gallons. This was reportedly not fully used by these large dairy CAFOS. In 2017, their total sum of reported use was about 1.4 billion gallons. It is not clear why there is a gap in permitted use and reported

water use. Perhaps, CAFOs are using less water than they are registering their water use permits for. False reporting may be possible, given that they self-report their totals.

Of the 89 large dairy CAFOs identified in the MPCA data, only 62 (or 69 percent) had water appropriation permits listed by the DNR. This means we do not know the water use of the other 27 CAFOs. The 62 CAFOs with permits range in size from herds of 880 to 11,000 with an average herd size of 3,160. These 62 CAFOs have a collective total of 195,193 dairy cows. The 27 CAFOs without registered wells have a collective total of 58,862 dairy cows. These operations range in herd sizes from 750 to 9,350 animals with an average size of 2,180. Two of the 62 permits are general appropriation permits, while 60 of them are individual permits. In two cases, two registered feedlots shared one water appropriation permit.

The total sum of reported water use increased by 20 percent from 2014 to 2017. The reported sum was: 1.21 billion gallons in 2014; 1.27 billion gallons in 2015; 1.36 billion gallons in 2016; and 1.46 billion gallons in 2017. An increase in total sum of reported water use could be because the number of CAFOs obtaining water appropriation permits has increased or more large dairy CAFOs were started during this time. Average water use in 2017 per CAFO was 27 million gallons, while average herd size was about 2,862 dairy cows. These numbers reflect that dairy CAFOs are using about 26 gallons of water a day per dairy cow. This estimate, however, is limited in its reliability since data was highly variable in water use among CAFOs. This is likely because State water use data is self-reported and open to errors. This estimate also does not account for the different growth stages of livestock, which use varying amounts of water.

Water use characterization

County

Looking at the number of CAFOs by county, about one third are located in just five counties. These are Stearns, Morrison, Swift, Stevens, and Nicollet counties, which are all geographically in the central part of the state. Stearns County has the most number of CAFOs, with ten in the county. Morrison, Swift and Stevens counties has five CAFOs.

Figure one shows where in Minnesota the five counties with the highest reported water use in 2017 are located. Figure two shows the reported water use totals in these counties as well as the change in water use during this time. Water use has been highest in Stevens County for this entire time span. There are five Riverview dairies in this county, three of which have permits. Stearns County has a lower reported water use than Stevens County, though there are double the number of CAFOs in Stearns County. This is likely because seven of the ten CAFOs in Stearns county did not have water appropriation permit. This speaks to the enormity of Riverview Dairies as well as the lack of reported water use.

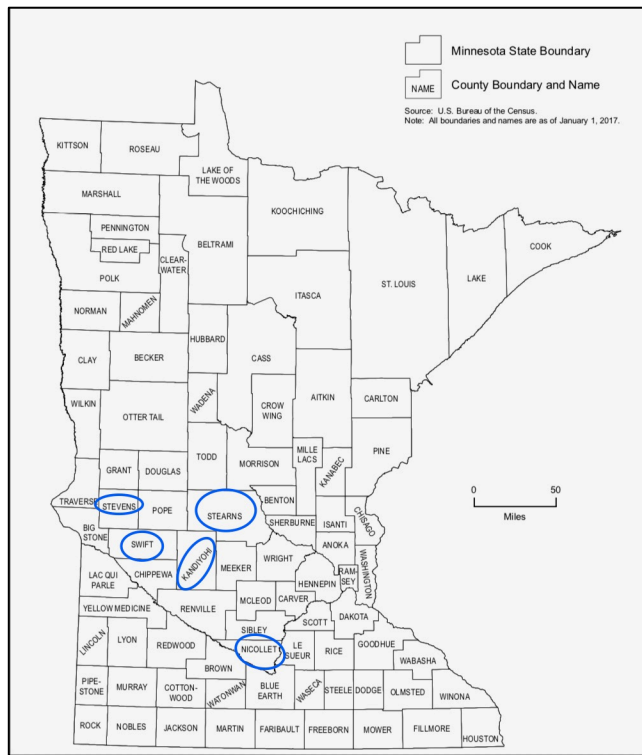


Figure 1. Five counties with the highest reported water use by large dairy CAFOs in 2017.

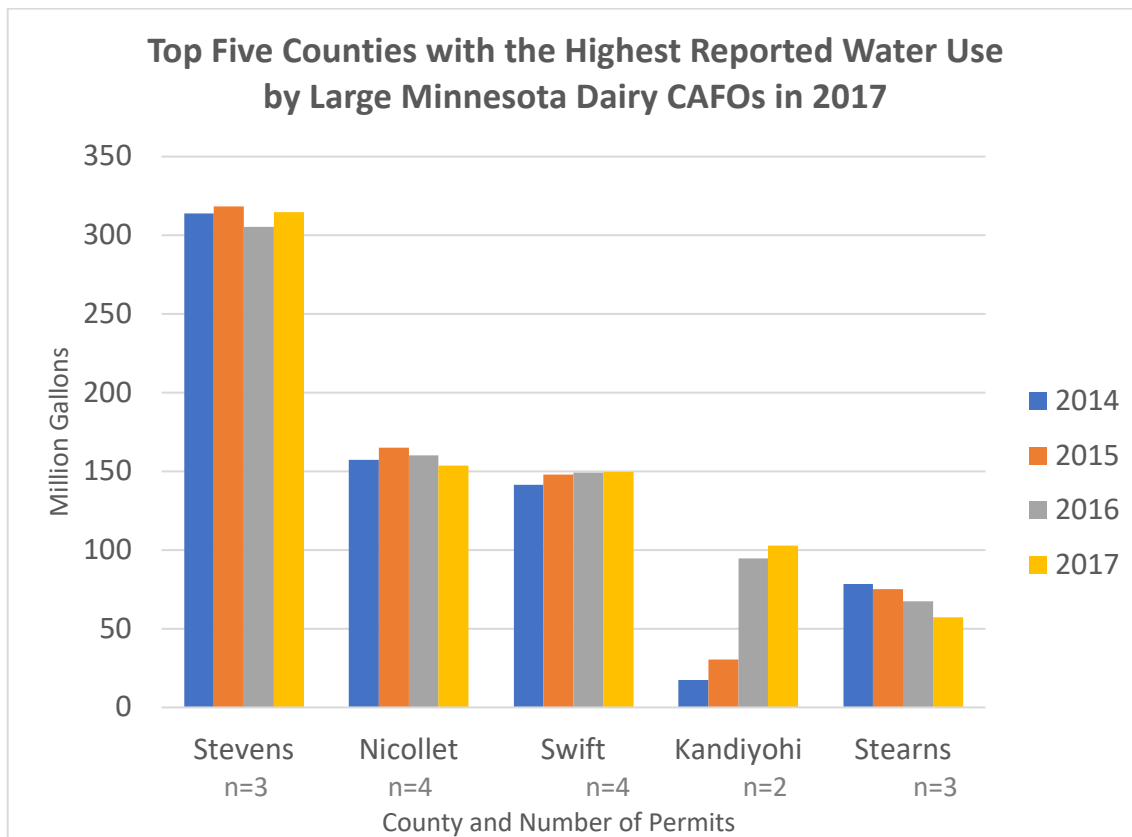


Figure 2. Total reported water use by CAFOs in five Minnesota counties with the highest water use in 2017. This graph also shows the change of water use over time in these counties.

When looking at the percent change in water use by county, Kandiyohi and Norman Counties experienced significant increases between 2014 - 2017. Total reported water use in Kandiyohi went from 17 million gallons in 2014 to 102 million gallons in 2017, resulting in more than a tenfold increase. This is likely because Riverview LLP opened their 8,800 cow Meadow Star Dairy in the County, which started reporting water use in 2015. Kandiyohi is adjacent to Swift and Stearns County, which is an area with high CAFO development. Total reported water use in Norman County went from 7 million gallons in 2014 to 29 million gallons in 2017, about 4 times higher. Norman County is where the 3,300 cow Greenstreak Dairy is operated, owned by Silverstreak Dairies LLC. This dairy has been reporting higher yearly appropriations since 2015. Norman County is in northern Minnesota and could be a place to watch for increasing CAFO activity.

Water use by largest CAFOs

Riverview LLP, Davis Family Dairies, and Daley Farms LLP used the highest reported water use in 2017, respectively. These three companies used 52 percent of the total water used by large dairy CAFOs in 2017. Table three shows the reported water use totals of these owners as well as the total number of dairy cows in all of their operations combined, total number of CAFOs, number of registered wells with the DNR, and percent of total water use. Riverview LLP is the largest dairy owner in the state and uses significantly more water than any other CAFO owner. They operate 14 large dairy CAFOs with a total of 107,408 total dairy cows. Riverview LLP has 12 registered wells with the DNR.

Davis Family Dairies was the second highest reported user of water. This company owns three CAFOs that are registered under names including New Sweden Dairy LLC

High Island Dairy, LLC, and Northern Plains Dairy, LLP. Davis Family Dairies has 8,245 dairy cows and 3 registered wells. Daley Farms LLP reported the third highest use of water in 2017.

They have three feedlots with a total of 2,476 dairy cows and two registered wells with the DNR, with two of these CAFOs sharing a well. All of these owners had individual water appropriation permits and no general permits.

Table 3. Sum of reported water use for the top three registered large dairy CAFO owners, as well as the total number of dairy cows in all of their combined operations, total number of CAFOs, and total number of registered wells. (Note all CAFOs had individual water appropriation permits).

DNR Water Appropriations Permit Registered Landowner	Sum of Reported Water Use 2017 (Gallons)	Total Number of Dairy Cows	Total number of CAFOs	Total Number of DNR Individual Water Appropriation Permits	Percent of Total Water Use in Dairy CAFOs in 2017 (%)
Riverview LLP	570,200,000	107,408	14	12	40
New Sweden Dairy LLC	139,180,000	8,245	3	3	9
Daley Farms LLP	51,900,000	2,476	3	2	3

Watershed

Due to the trend of large dairy CAFOs generally concentrating in the central part of the state, Pomme de Terre River watershed was the most drawn upon watershed in 2017. Three

Riverview dairies are concentrated in this area as well one New Horizon Dairy. A total of 355 million gallons of water was reportedly used from Pomme de Terre River watershed in 2017.

Riverview reported using a total of 314 million gallons of water from Pomme de Terre watershed in 2017. Pomme De Terre River watershed was used double the amount than the second highest used watershed, the Chippewa River watershed, where 176 million gallons were reportedly used in 2017. Figure three depicts the five watersheds drawn upon most heavily by large dairy CAFOs

in 2017 in million gallons, specifically: Pomme de Terre River, Chippewa River, Minnesota River Mankato, Minnesota River Yellow Medicine, and Zumbro River.

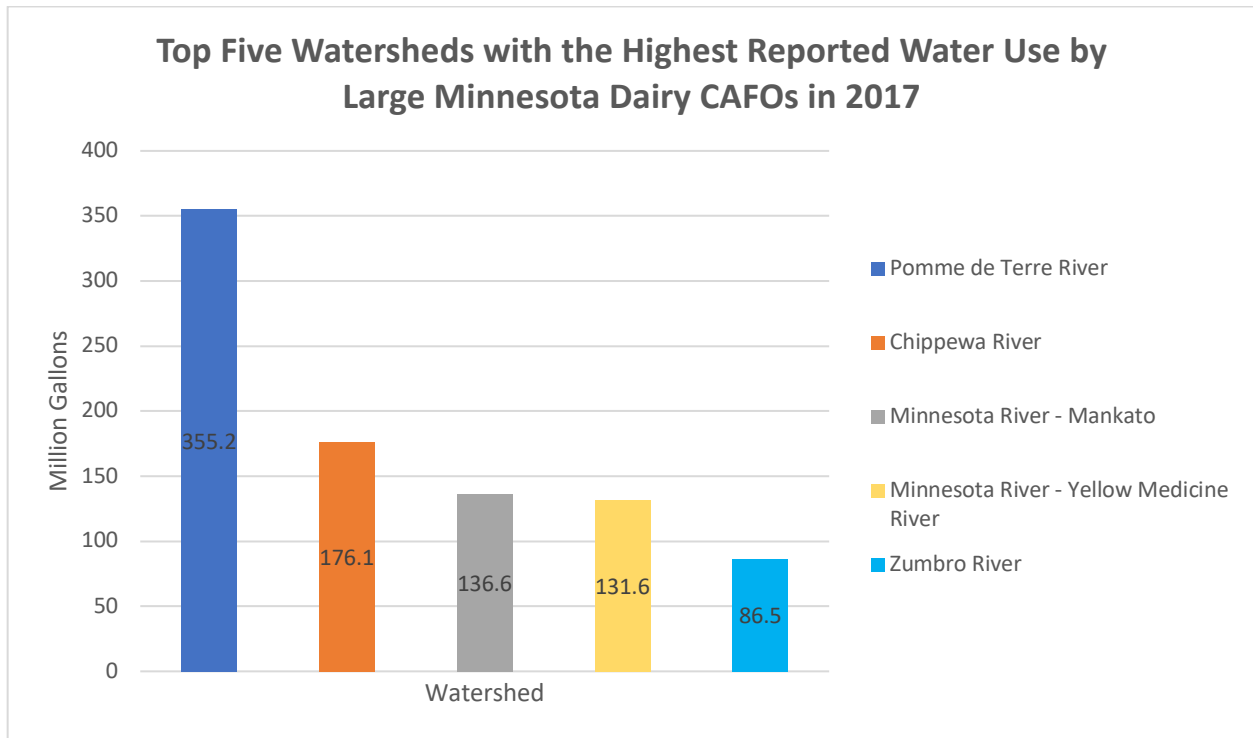


Figure 3. The five watersheds drawn upon most heavily by 62 large dairy CAFOs with water appropriation permits in 2017.

Looking at the percent change in watershed use shows which watersheds have the greatest increase in use. The Wild Rice River watershed had the highest percent increase in reported water use between 2014 to 2017. Total reported water use was 7 million gallons in 2014 and 29 million gallons in 2017, about four times higher. The Wild Rice River is in the same geographic area as Norman County, which likely corresponds to the Greenstreak Dairy operating in this area. The Minnesota River-Yellow Medicine River watershed had the second highest reported percent change. Total reported water use was 39 million gallons in 2014 and 131

million gallons in 2017. There are just two CAFOs permitted to use water from the Minnesota River-Yellow Medicine River watershed, both with over 1,000 dairy cows. Clearly, the opening of just one or two large dairy CAFOs in a county or watershed can have tremendous impacts to water use.

Water Use among Large Hog CAFOs

Industry characterization

Of the 1, 230 large hog CAFOs identified from MPCA data in 2017: 1,047 feedlots raised hogs primarily 55-300 lbs, 178 raised hogs primarily greater than 300 lbs, and 5 raised hogs primarily less than 55 lbs.

Permitted and Reported Water Use

The total sum of permitted water use for 2017 totaled about 2 billion gallons of water. Large hog CAFOs fell well within this volume, using a reported total of 858 million gallons in 2017. Hog CAFOs generally tended to report using less than 5 million gallons a year.

Of the 1, 230 hog CAFOs, 386 had water appropriation permits, or 31 percent. Of these 386 permits issued, 291 are general permits. CAFOs with permits ranged in size from 750 AU to 3,936 AU. Two thirds of the CAFOs in my group did not have a well registered for a water appropriation permit, which limits our understanding of water use in this group. CAFOs without permits ranged in size from 750 AU to 5,539 AU, with an average size of 1,181 AU. There were CAFOs with 750 AU that both had and did not have water use permits, making it tricky to determine the point at which a CAFO uses 1 million gallons.

Total reported water use in large hog CAFOs increased by 131 percent between 2014 - 2017. Total reported water use was 370 million gallons in 2014; 589 million gallons in 2015; 835 million gallons in 2016; 858 million gallons in 2017. An increase in total reported water use could be due to more CAFOs obtaining water appropriation permits or more hog CAFOs being developed. Average water use for large hog CAFOs 2017 was about 2.5 million gallons per year per CAFO, while the average number of pigs in a CAFO was 4,053. This data reflects that hog CAFOs are using about 1.6 gallons a day per pig, though this estimate is limited to the same reason mentioned above for dairies.

Water use characterization

County

Counties with the most CAFOs were generally located in the central-southern part of Minnesota. Martin County had more than double the number of hog CAFOs than any other county, with 156 CAFOs. Nobles County had the second highest number of CAFOs, with 76 registered CAFOs. When looking at reported water use from 2014 - 2017, Martin County also reported the most water use with an increase in water use over this time. Though Martin County has 156 CAFOs, there are only 59 water use permits issued. Thus, 97 CAFOs in Martin County do not report their water use. Figure four shows where in Minnesota the five counties with the highest reported water use in 2017 are located. Figure five shows total reported water use in these counties as well as the change in water use in these counties from 2014-2017. These counties all experienced growth in water use during this time.

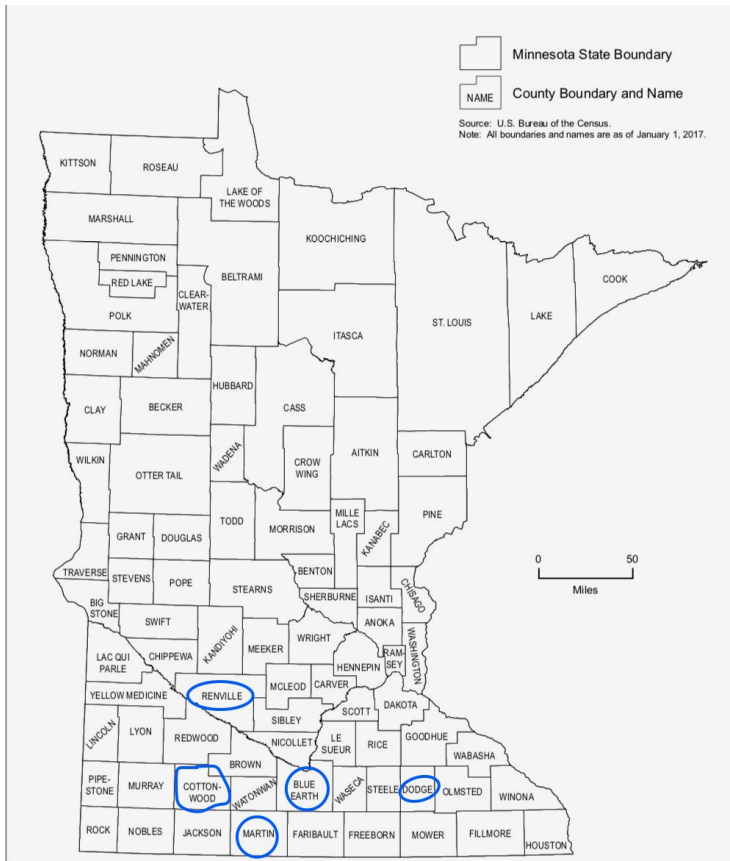


Figure 4. Five counties with the highest reported water use by large hog CAFOs in 2017.

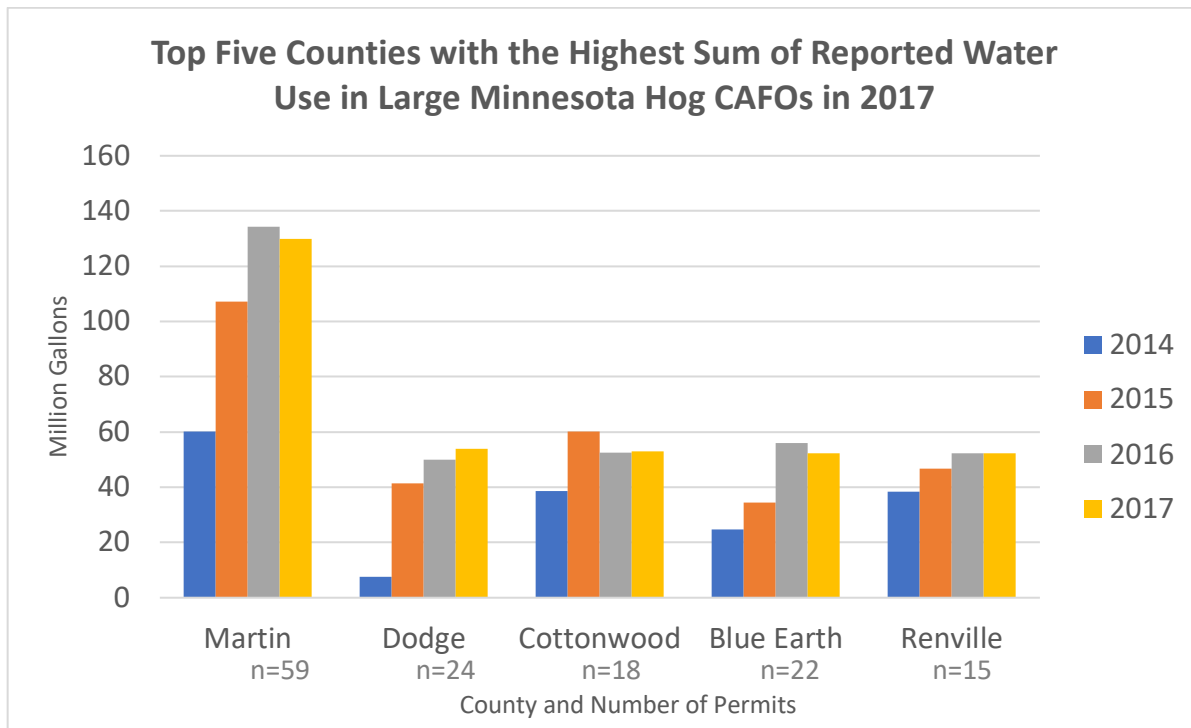


Figure 5. Total reported water use for the top five counties in 2017. This graph also shows the change in water use for each county from 2014 - 2017.

Looking at percent increase in water use between 2014 - 2017, Mower and Steele Counties saw the most significant increases. Total reported water user in Mower County went from 1.4 million gallons in 2014 to 36 million gallons in 2017, resulting in a 25-fold increase over this time span. Mower has 27 large hog CAFOs, 12 of them with water permits. These 12 permit holders all began reporting water between 2014 - 2016. Steele county saw a 12-fold increase in water use from 2014 – 2017, with 2 million gallons reportedly used in 2014 and 24 million gallons in 2017. Steele County also has 27 large hog CAFOs, 18 of which have water appropriation permits. These permit holders all similarly started reporting water use between 2014 - 2016. Hog CAFOs are seemingly growing in number in this southern area of the state. Also, water use could be higher in these counties since not all registered CAFOs have water appropriation permits.

Water use by largest CAFOs

Christenson Family Farms and Feedlots, Schwartz Farm Inc., and New Fashion Pork reported using the most water in 2017, respectively. Together they use about a third of the total water used by large hog CAFOs in 2017. Table four shows the sum of each company's water use in 2017, as well as the total number of hogs in their combined operations, total number of CAFOs, number of registered wells, and percent of total water use. These companies were not always clearly associated with each of their CAFOs, since contracting out to independent farmers is a common practice in the industry. CAFOs directly registered under these larger companies are included here. This means water use and total number of hogs for these companies could potentially be bigger.

Christenson Family Farms and Feedlots was clearly linked to operating 55 large hog CAFOs with a total of 242,220 hogs. They are registered for 52 registered wells with the DNR. Schwartz Farms Inc. used the second highest sum of water in 2017, which was just 44 percent of Christenson Family Farm and Feedlot’s yearly reported use. Schwartz Farms Inc. was clearly identified with owning 40 hog CAFOs with around 157,347 hogs. They are registered for 32 wells with DNR. New Fashion Pork was not always as clearly associated with each feedlot they own, though 32 CAFOs can be directly linked to their ownership. These 32 CAFOs have a total of 118,784 hogs. They are registered for 32 wells with the DNR.

DNR Water Appropriation Permit Registered Landowner	Sum of Reported Water Use in 2017 (Gallons)	Total Number of Hogs	Total Number of CAFOs	Total Number of DNR Water Appropriation Permits	Percent of Total Water Use in Hog CAFOs in 2017 (%)
Christensen Family Farms & Feedlots	167,800,000	242,220	55	27 general permits 25 individual permits	19
Schwartz Farms Inc.	73,700,000	157,347	40	25 general permits 7 individual permits	8
New Fashion Pork, LLP	48,600,000	118,784	32	32 general permits	5

Table 4. Top three large hog CAFO owners with DNR water appropriation permits with the largest sum of reported water use in 2017, as well as total number of hogs in all of their combined operations, total number of CAFOs, number of registered wells, and percent of total water use.

Watershed

The most heavily used watersheds correspond to the concentration of CAFOs in the south-central part of the state. Figure six shows the total reported water uses in 2017 by watershed. The Blue Earth River watershed had the most reported water use in 2017, with 131 million gallons diverted for hog CAFO watering. Minnesota River- Yellow Medicine watershed had the second highest reported water use in 2017 with 95 million gallons used. Watonwan River watershed was the third highest used and the Zumbro River watershed was the fourth highest used watershed, which was also a largely used watershed by dairy CAFOs.

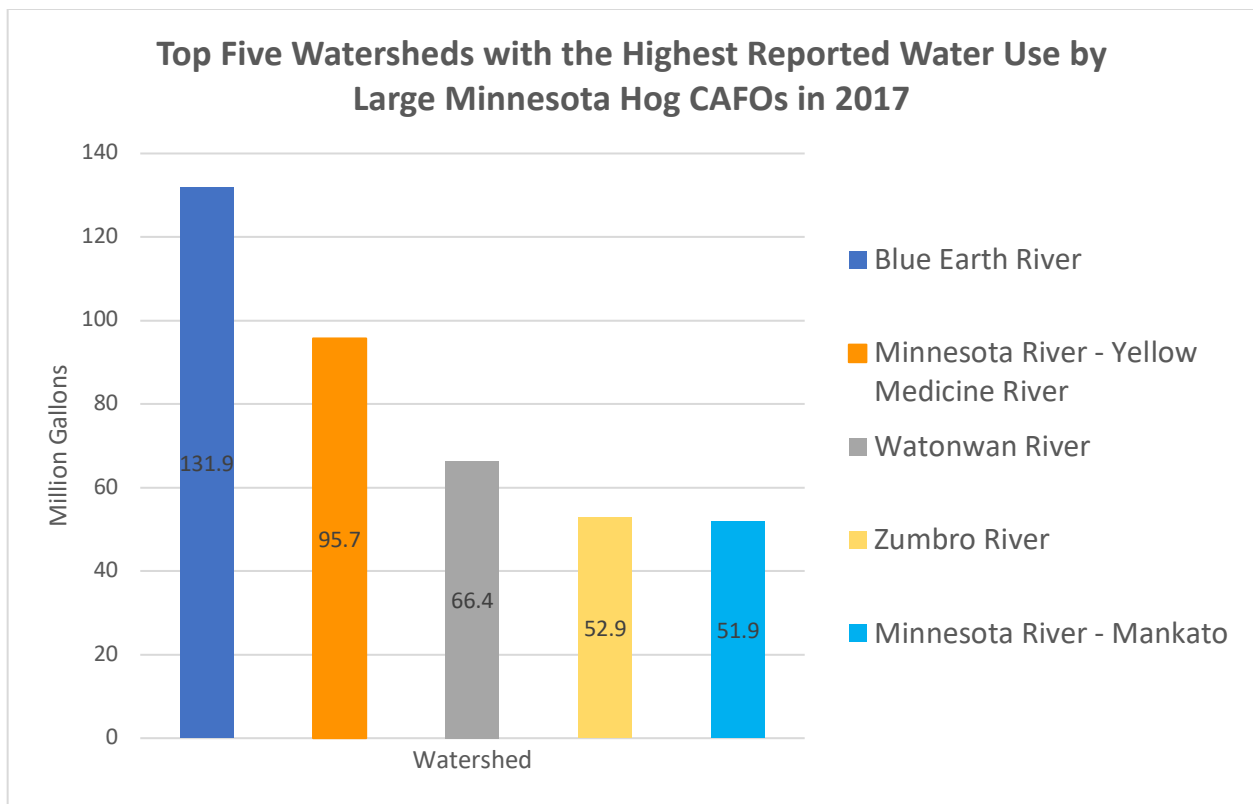


Figure 6. Total reported water use by large hog CAFOs in the most heavily used watersheds in 2017.

Most of the permits in the highest used watersheds tend to be general permits considering hog CAFOs often use below five million gallons of water a year. Table five shows the concentration of general permits issued to large hog agribusiness and the counties they are registered in. When looked at collectively, the five largest hog agribusinesses are using a large amount of water in a concentrated area. Since most of the water used among hog CAFOs is being monitored by DNR in small increments through general permits, it is concerning whether there can be proper oversight of water use.

Areas of concentrated general permits were particularly clear in Blue Earth River and Watonwan River. In Blue Earth River, 53 water appropriation permits are issued, 42 of which are general permits. About half of these general permits are held by large agribusinesses, including New Fashion Park, Wakefield Pork, and Christensen Family Farms and Feedlots. Nine of these general permits are registered to New Fashion Pork with a total reported use of 11 million gallons, seven are registered to Christensen Family Farms and Feedlots who reported using 9 million gallons, and three to Wakefield Pork who reported using 9 million gallons. In the Watonwan River, 34 water appropriation permits were issued, 13 of which belong to Schwartz Farm Inc. Of these 13 permits, 9 are general permits, which totaled a combined reported used a of 6 million gallons of water. Large agribusinesses with multiple general permits in one county and watershed are using amounts of water worthy of requiring individual permits.

When looking at percent change, Cannon River, in the south eastern part of the state, experienced a 30-fold increase in water use between 2014 – 2017. Total reported water use was 1 million gallons in 2014 and 29 million gallons in 2017. This watershed appears to have 17 water appropriation permits issued within this four-year time span, 16 of which are general permits. Cedar River experienced the next highest percent increase in reported water use, which was 4

million gallons in 2014 and 43 million gallons in 2017, resulting in a 10-fold increase. CAFO water use is growing near these watersheds, which are all located in the south eastern part of the state where vulnerable karst topography is abundant.

Table 5. DNR general water appropriation permits and their concentration in highly appropriated watersheds. Included is the number of general permits issued to each owner for these watersheds, along with the counties these general permits are issued in. Total permitted volumes for general permits in a watershed are also given, which were all each issued for 5 million gallons of water a year.

Watershed For Livestock Watering	DNR Water Appropriation Permit Registered Landowner	Number of General Permits	General Permits Issued by County	Total DNR Permitted Volumes of Water for General Permits Combined (MG)
Blue Earth River	Christensen Family Farms & Feedlots	7	7 in Martin	35
Blue Earth River	New Fashion Pork	9	4 in Martin 5 in Jackson	45
Blue Earth River	Wakefield Pork	4	2 in Martin 2 in Blue Earth	20
Watonwan River	Schwartz Farm Inc.	9	5 in Watonwan 1 in Martin 3 in Cottonwood	45
Watonwan River	Christensen Family Farms & Feedlots	4	1 in Martin 1 in Cottonwood 1 in Watonwan 1 in Jackson	20

Water Use in Hog and Dairy CAFOs Combined

Permitted and Reported Water Use

The total sum of permitted water use for both industries was 4.2 billion gallons while total reported water use was just under half of that at 2.3 billion gallons. Of the 1,319 total large hog and dairy CAFOs, 448 had a permit, at just 34 percent. Of these 448 permits, 293 were general permits and 155 were individual permits. The remaining 871 CAFOs, or 66 percent, did not match to any water use permits. The water use in these operations is thus unknown. Total water use for hog and dairy CAFOs combined increased by 50 percent from 2014 -2017. The total sum of reported water used was: 1.5 billion gallons in 2014; 1.8 billion gallons in 2015; 2.1 billion gallons in 2016; 2.3 billion gallons in 2017.

Water use characterization

County

The five counties with the largest number of CAFOs are in order of Martin, Nobles, Blue Earth, Jackson, and Wagonwheel. Table six shows the number of CAFOs in each county. These counties are all located close together in the southern part of the state. These figures appear to be largely made up of hog CAFOs because there are significantly more of them than dairy CAFOs. There is a noticeable trend, however, of hog and dairy CAFOs concentrating close together, particularly in the central and southern part of Minnesota.

Table 6. Five Minnesota Counties with the most large dairy and hog CAFOS in 2019

County	Number of CAFOs
Martin	156
Nobles	76
Blue Earth	64
Jackson	63
Watonwan	57

Water use by largest CAFOs

Riverview LLP uses one quarter of the total water used by large hog and dairy CAFOs in 2017. Figure seven shows the five owners that reported using the most water in 2017. Riverview LLP stands out for using more than three times the amount of water used by the second largest owners, Davis Family Dairies. Riverview LLP has more total animals in their operations and stands out for the enormity of the company. It is also noteworthy that dairies generally use more water than hog feedlots, though two of the top five users of water are hog producers. This speaks to the large number of hog CAFOs and how their impacts can magnify on a larger scale.

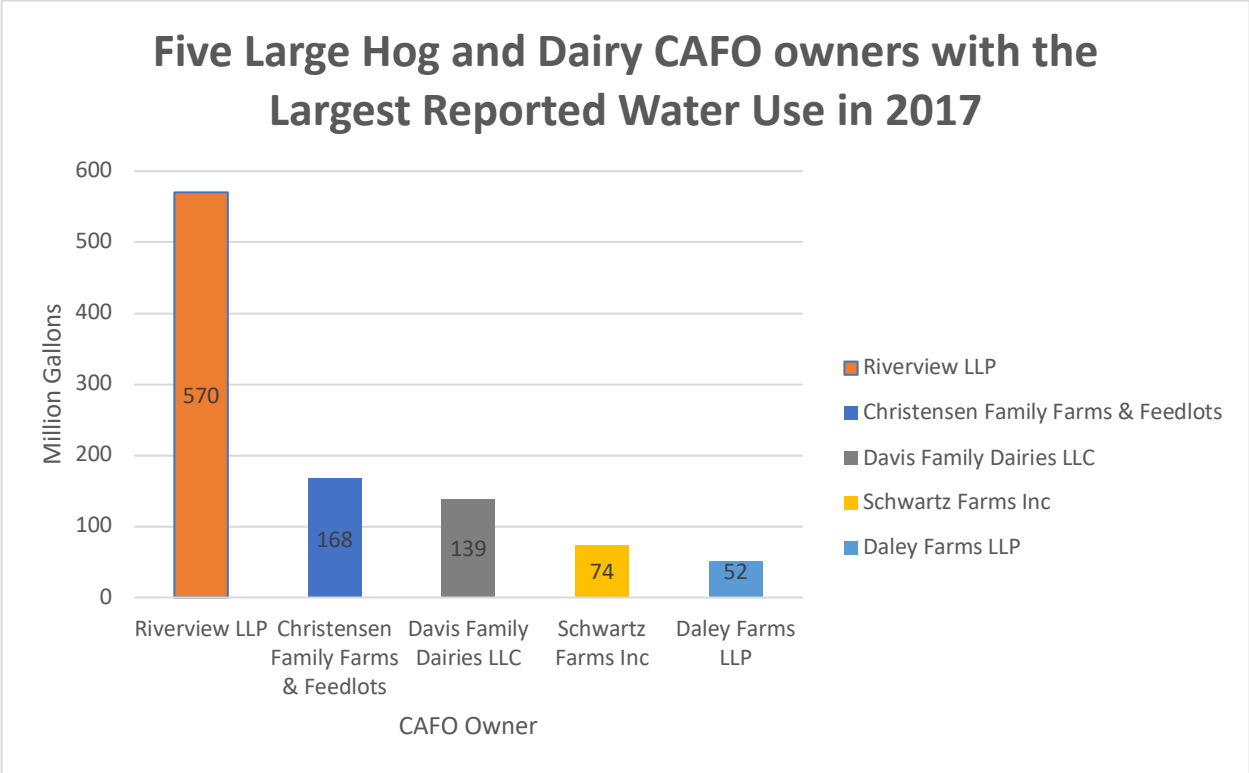


Figure 7. Total sum of reported water use among the top five highest using owners with hog and dairy CAFOs combined.

Watershed

The highest total reported water use in 2017 came out of the Pomme de Terre River watershed, with 356 million gallons reported. Minnesota River- Yellow Medicine River watershed had the second highest reported use with 227 million gallons in 2017. Figure eight shows the total sum of reported water use from the five most heavily used watersheds in 2017. These watersheds are all adjacent to each other in the south western part of Minnesota and are all located in the Minnesota River Basin. Considering that not all CAFOs are getting water appropriation permits, these consumption totals could be higher. Further research into the sustainability or vulnerability of these watersheds will be important to look at. The Water Resources Center at the University of Minnesota is currently researching at risk aquifers around

the state of Minnesota. When completed, this research would be helpful to assess the sustainability of livestock watering use patterns.

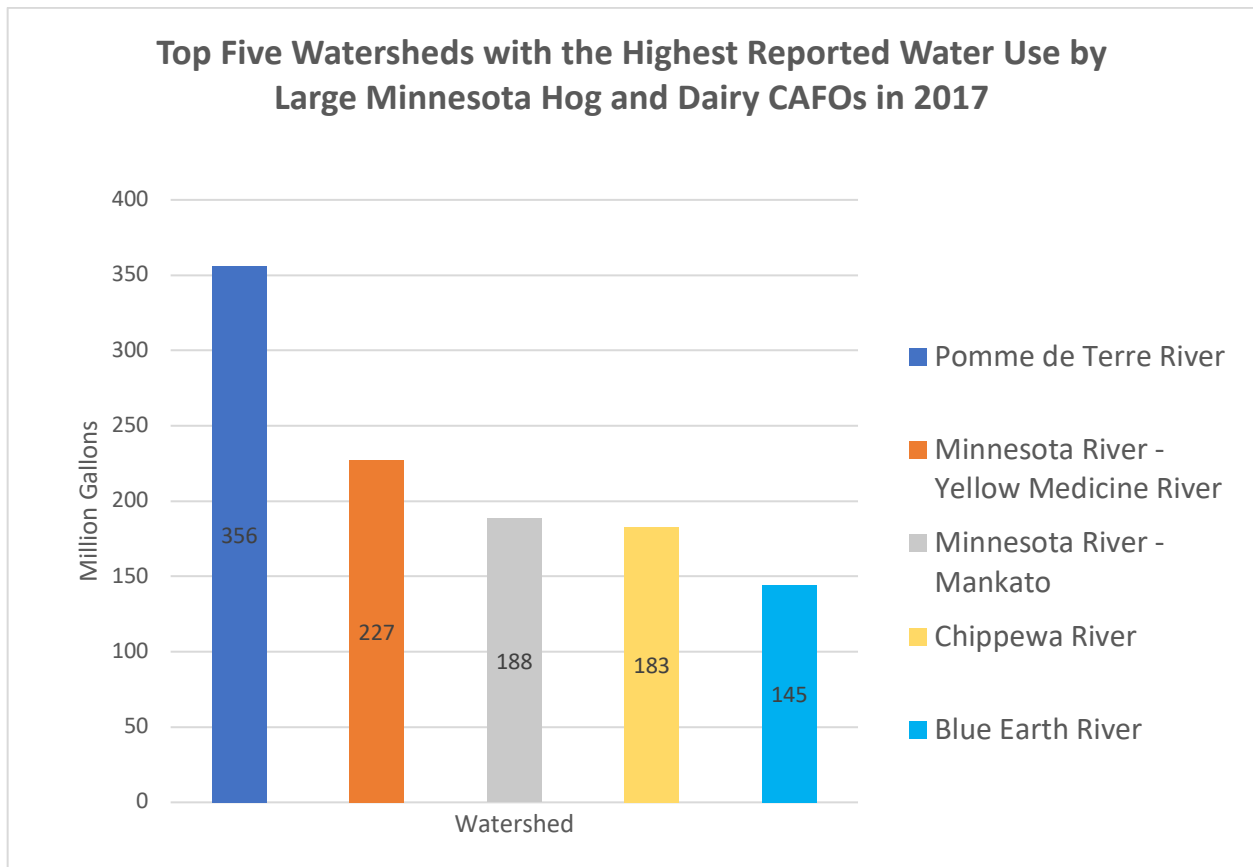


Figure 8. Total reported water use by large hog and dairy CAFOs in the most heavily used watersheds in 2017.

Percent change in watershed appropriations was the greatest in The Upper Iowa River watershed from 2014 – 2017. Total reported water use was 1 million gallons in 2014 and 13 million gallons in 2017. This is in the south eastern part of the state, where karst vulnerability is a growing concern. Mustinka River had the second highest percent change, with a five-fold increase. Total reported water use was 7 million gallons in 2014 and 35 million gallons in 2017. This is adjacent to Pomme De Terre River watershed, perhaps indicating a growth in the concentration of CAFOs in this area.

Estimating Unknown Water Use

This analysis estimates that about 66 percent of large hog and dairy CAFOs do not obtain water use permits. As a result, water use in these CAFOs is unknown. It is also unknown if these CAFOs use over 1 million gallons of water a year, requiring them to obtain a water use permit. This is because the size at which a CAFO is expected to use one million gallons of water or more is unclear. DNR only knows the water use of these large users when they self-report their usage to maintain a permit

One way, however, to determine when a CAFO needs to obtain a permit and to estimate unreported use is to draw upon existing information on the water requirements of livestock. Research into water use per livestock species in CAFOs is often complex and hard to generalize to all operations. Sam Baidoo (2017:3), Swine Extension Educator at University of Minnesota, estimates that farms raising: nursery hogs use around .40 gallons of water a day per pig; grow to finish operations use 1.05 gallons of water a day per pig; wean to finish operations use .83 gallons of water a day per pig; and weaning to finish operations use around 4.26 gallons of water a day per pig. Muhlbauer et al. (2010: 7) used a literature review and producer survey to estimate whole site water consumption for U.S. swine production. He estimated operation owners use 1 gallon per pig per day for nursery herds, 1.5 gallons per pig per day for finishing herds, and 6 gallons of water per pig per day for breeding herds. These estimates are variable and broken down into different growth stage categories making it hard to generalize the data. Researchers have come up with more streamlined estimates among water use per dairy cow, though it still hard to generalize to large operations with various growth stages of dairy cows. Baidoo (2017:3) estimates a milking cow can use up to 30.40 gallons of water a day. Ohio State University researchers found more specific results from collecting water flow data and cow numbers

obtained from farmers (Brugger 2007:2). These researchers analyzed water used per milk cow by month and distinguished between the use of waste water and drinking water. Waste water in the industry is commonly reused to clean equipment and facilities. Brugger (2007:2) found dairies use about 20.1 gallons of water a day per cow in January with 7.1 gallons of this use consisting of waste water. In July, dairies use about 36 gallons of water a day per cow with 6 gallons of this number being from waste water.

The most relevant research available to Minnesota CAFOs comes from Baidoo, who provides a guide indicating the number of animals that would require a water use permit (Baidoo 2017:4). Table seven reproduces this guide. Baidoo estimates the sizes of dairy operations that would use 1 million gallons of water a year to be: 1,004 dairy calves, 413 heifers, 90 milking cows, and 248 dry cows. Accordingly, all heifer, milking cow, and dry cow operations that are a large dairy CAFO would use enough water to require an application for a water appropriation permit. The MPCA dataset I used breaks dairy operations into slightly different weight categories than Baidoo, though generally, 87 of the large dairy CAFOs would fit Baidoo's groups being heifers, dairy cattle less than 1,00 pounds, and dairy cattle greater than 1,000 pounds. There were 26 CAFOs without permits that should theoretically use at minimum 1 million gallons of water a year. This would mean 26 million gallons could be added to the total reported water used by large dairy CAFOs in 2017, which was 1.46 billion gallons. Thus, we can generate a conservative estimate of total use for large dairy CAFOs in 2017 at nearly 1.49 billion gallons of water.

Table 7. Number of Animals Required Based on Water Usage (Reproduction of Baidoo 2017)

Species	Number of Animals	
	Per 1,000,000 Gallons	Per 5,000,000 Gallons
Swine		
Nursery (15- 50 lb)	6,850	34,250
Grow-Finish (50-280 lb)	2,609	13,046
Wean- Finish (15-280 lb)	3,322	16,611
Sow Breed - Wean	1,010	5,050
Dairy		
Dairy Calves	1,004	5,020
Heifers	413	2,067
Milking Cows	90	450
Dry Cows	248	912

For hog feedlots, Baidoo estimates the sizes of hog operations that would use 1 million gallons of water a year to be: nursery operations raising hogs between 15-50lbs. with 6,850 hogs; grow to finishing operations raising hogs between 50-280 lbs with 2,609 hogs; and wean to finishing operations raising hogs between 15-280 lbs with 3,322 hogs. Of the large hog CAFOs identified in the MPCA dataset, 994 CAFOs primarily raising hogs between 55-300 pounds and 179 raising hogs over 300 lbs in my study group meet Baidoo’s estimate. After speaking with Baidoo, we concluded the CAFOs raising livestock between 55-300 pounds are grow – finish operations, while the operations raising livestock over 300 pounds are sow breed- wean operations (Baidoo 2019). Only 371 of these CAFOs have water appropriation permits. Assuming the remaining 802 large hog CAFOs of this size use at least 1 million gallons of water, 802 million gallons may be used by large hog CAFOs, but have gone unreported. When added to the 858 million gallons actually reported in 2017, a total of about 1.6 billion gallons of water could have been used. Between large hog and dairy CAFO water use combined, around 3.1 billion gallons of water may have been used in 2017, though only about 2.3 billion gallons of water usage was reported to the DNR. Reported water use could be short almost 1 billion gallons of water.

Conclusion

This analysis maps out water use among large CAFOs in the state of Minnesota. Clearly, water use is increasing in both hog and dairy CAFOs, however, the exact reason is underminable from this data. It could be from more CAFOs obtaining the required permits. Though the size at which a CAFO uses enough water to require a water use permit is uncertain, CAFOs of all sizes had permits in this study. Regardless, about 69 percent of the 89 large dairy CAFOs studied here have water use permits, and 30 percent of the 1,230 large hog CAFOs have permits. Combined, we do not know the reported water use in 66 percent of large hog and dairy CAFOs. Water use could be more than double what this study estimates. Using estimated water requirements of livestock created by researcher Sam Baidoo, large hog and dairy CAFOs that likely use one million gallons or more which did not obtain water appropriation permits may have used around 1 billion gallons of water in 2017. This unreported 1 billion gallons of water is not being studied nor monitored by DNR hydrologists

Additionally, CAFOs are geographically concentrating in specific parts of the state, with large dairy CAFOs in central Minnesota and large hog CAFOs in south-central Minnesota. As seen in Kandiyohi and Norman County, the influx of just a couple large dairy CAFOs can cause enormous increases in water use in the county. Large hog CAFOs are clustering specifically in Martin County, where more than double the sum of water was reportedly being used than the second highest reported total water use in Dodge County in 2017. As a result, watersheds are unevenly being drawn upon. Pomme de Terre River watershed was the most heavily used watershed in 2017 for both CAFO livestock industries combined. General permits were issued mostly to large hog CAFOs, which are particularly concentrated in the Blue Earth River.

Water use was also highest among the largest CAFO owners. While this is to be expected, this study revealed just how big the water use is for some of these operations. Riverview LLP reported using the highest totals of water in 2017, using more than double the second highest using owner, Christenson Family Farms and Feedlots.

CHAPTER 4: CONCLUSION

Introduction

CAFO development is expanding in Minnesota and is largely being met by the voices of concerned citizens. This study analyzed public government data to see how the state's regulatory agencies are overseeing the largest agribusinesses and to observe water use trends among large CAFOs. The conclusions and recommendations in this chapter come from the previous chapter's analysis on water use data among large hog and dairy CAFOs, research into Minnesota's water appropriation permit program, and conversations with LSP staff and members. These findings are intended for the Land Stewardship Project team to better understand water use among CAFOs in their state. These results are also intended for government agency staff working to ensure waters are protected for sustainable long-term use as well as researchers at the University of Minnesota studying the sustainability of water use in the state. Lastly, these findings are of concern to anyone looking to improve the way we raise our livestock, so we give back to the land more than we take from it.

Analysis of Major Findings

Geographic concentration of CAFOs

Geographic concentration is apparent in large hog and dairy CAFOs in Minnesota. Large hog CAFOs are largely developed in south-central Minnesota, while large dairy CAFOs are largely developed in central Minnesota. Growing clusters of CAFOs are exploding in certain counties, such as Martin County with 156 hog CAFOs and Nobles County with 76 large hog CAFOs. Large dairy CAFOs are abundant in Stearns County, with 10 CAFOs, which is double the number of CAFOs than the next highest concentration of CAFOs in Morrison, Swift and

Stevens Counties. As a result, CAFOs are drawing more heavily upon some watershed than others, such as Pomme de Terre River watershed and Minnesota River-Yellow Medicine River watershed. Though livestock watering is not included in the top five water-using entities in the state (DNR 2018c), it is concerning that it is largely concentrated in very specific areas.

General permit loophole

Though the general water appropriation permit seems to be helping livestock water users obtain permits, the program appears to be creating a loophole for CAFOs. The general permit allows large CAFO companies to use more water with less regulatory oversight and for less monetary compensation to the state over time. This is more prevalent in large hog CAFOs than large dairy CAFOs since hog operations use less water and qualify for general permits. The largest hog CAFO companies have been issued multiple general permits in the same or adjoining counties, drawing on the same watersheds. The appropriated volumes of these clustered general permits for each company adds up to appropriations well over 5 million gallons, which means they are worthy of more stringent review as is conducted on individual permits. These CAFOs are thus paying a one-time fee of \$100 for each of these general permits, when they should be paying for individual permits which require yearly fees of \$140. As a result, the state is losing money to conduct annual assessments of the safety of CAFO water use. General permits also do not require a 30-day hearing period, so these companies are avoiding public comment on their projects. This raises concerns about whether the impacts of these projects can be adequately reviewed by DNR hydrologists. The effects of CAFOs are magnified when they are geographically concentrated together, which the general permit program needs to explicitly analyze.

Uncertainty in total water use

I had known going into this study that there was low compliance among CAFOs obtaining water use permits. Various community groups and news articles have reported on this issue in the past. Looking at the data confirms low compliance with obtaining water use permits, however, we can now speak more specifically about the degree to which non-compliance is a problem. This study found that only about a third of large hog and dairy CAFOs are obtaining water use permits. As a result, the water use among 2/3 of this group, or 871 large CAFOs, is unknown. Using estimates of water requirements of livestock produced by Swine Extension Education Same Baidoo, I estimated CAFOs that theoretically may require a water use permit, that did not obtain one, could be using about 1 billion gallons of water. This is about one half of the actual reported water use among large hog and dairy CAFOs in 2017. This raises concerns about overusing resources without proper monitoring, possible affects to residential water supplies, fairness to those landowners obtaining the proper permits, and protecting the public's right to the state's water sources.

Recommendations

Fix the general permit loophole

DNR should reform the general permit program to hold CAFOs accountable for the total water they use in a county and watershed, rather than asses each project individually. General permit reform needs to adequately assess the impact of the high concentration of CAFOs in a given area and discourage users from drawing too heavily upon one area without fair compensation. Limiting the number of general permits a landowner can obtain in one county or

from one watershed before requiring an individual permit would address this issue. Raising permit fees would also allow the DNR to hire more staff members to address the need for more monitoring and closer inspection of water use reporting. This report ultimately showed how state water use data needs to cover more water users and be more reliably reported. More money to the program is needed to produce more accurate data.

Generate general feedlot sizes that require a water appropriation permit

When looking at my data, I could not reliably pull out a pattern for size of CAFO, growth stage of livestock species, and amount of water used. I came up with conservative estimates for average water use per livestock in 2017, though the data was highly variable in the water use of each CAFO ultimately limiting its reliability. This is likely because data is self-reported. Sam Baidoo's guide proved helpful, but CAFOs in size categories below Baidoo's guide had water appropriation permits in the dataset. It is difficult to estimate water use among CAFOs because of the variability in operation size and growth stages of livestock species. Data is also only available to the public when landowners obtain a permit and self-report their use. The uncertainty around what size a CAFO is required to obtain a water use permit makes it tricky to hold CAFOs accountable for their water use. More reliable and generalizable data on the size of operations that generally require a permit would make water use permit enforcement easier for DNR staff. This could take off some of the regulatory enforcement off of DNR staff and put the accountability onto the CAFO owners.

More communication between state agencies

Government agencies regulating CAFOs should unify their data sets and expand on the work in this report. I needed to do a significant amount of work merging the MPCA dataset with the DNR dataset in order to come up with the estimates on water use in large CAFOs. Farmer registration information with the MPCA was commonly different from DNR registration information for a water appropriation permit. In some cases, farm names were similar but not identical. Additionally, landowners between the two datasets were sometimes relatives with different first names. This made it time consuming to sift through the different categories for matching information. If feedlot information was more consistent between the two agencies, than checking the size of feedlots and whether they have a permit or not could be incredibly easier. Both of these agencies are working to regulate CAFOs, though their work appears to be largely separated. If state agencies unified their data, a more comprehensive view of CAFOs and their impact to the land and communities could be assessed. Collaboration with researchers at the Water Resources Center at University of Minnesota can also help identify critical areas for protection and assess if capacity has been reached in certain aquifers.

Watch for areas of growing CAFO activity

Specific areas of Minnesota appear to be increasing in reported CAFO water use. Hog CAFOs are reporting increasingly more water use in the south eastern part of Minnesota. This is particularly apparent in Mower and Steele Counties, corresponding to the Cannon River, Cedar River, and Upper Iowa River. Dairy CAFOs seem to be opening in counties previously untouched. These are Norman and Kandiyohi Counties. Norman county corresponds to a large percent

increase in use of the Wild Rice River. These areas should be watched closely to monitor CAFO development and to ensure CAFOs are obtaining the proper permits.

Conclusion

More farmers are turning to highly industrialized CAFO models to raise their livestock. Though this model allows for more animals to be raised in smaller areas, influxes of manure become toxic pollutants, which harm ecosystems and rural communities. While much attention has been given to the pollution tied to CAFOs, this report aimed to look at the *amount* of water CAFOs are using. State government agencies in Minnesota are regulating different functions of CAFOs largely separate from one another. This separation makes it difficult for community organizers and those closely impacted by CAFOs to hold them accountable for their impact to the land and Minnesotan communities. This study merged government data from the MPCA on large hog and dairy CAFOs with DNR data on reported water use to get a better understanding of the trends in water use by county, watershed, and largest CAFO owners.

The DNR water appropriation permit program is the main regulatory oversight of CAFO water use in Minnesota. The DNR has put effort into getting large feedlot users to obtain the necessary permits because many are currently not. General permits were one method DNR staff came up with to streamline the water appropriation permit process for smaller users. My data reflects an oversight into this general permit program and a need for more reliable data. What was intended to be an easy way to get water users to obtain permits, has turned into a loophole for CAFOs to use more water in a given area with less oversight and less monetary compensation to the state. My data also reflects a geographic concentration of CAFOs in the central and southern part of the state. As a result, some counties are having exorbitant amounts of water

being reportedly used by CAFOs, while others are being swamped by the sheer number of them. Ultimately though, more than half of the CAFOs in my study did not have a water use permit, which means the total picture of water use in Minnesotan large hog and dairy CAFOs is not yet clear.

Citizens reviewing and using public records keeps our government data reliable and relevant to deal with forthcoming problems. This report proves how critical it is to ensure government agencies are working in our best interest, which means ensuring agribusinesses are taking their fair share of our natural resources and that they are compensating the public when they do not. With water scarcity becoming a growing threat in Minnesota, the core values of Minnesota water law will be important to protect water resources for the public good, and to prevent one entity from monopolizing its use. Minnesotans must decide if agribusinesses are indeed using a reasonable share of the state's water supply as defined by Minnesota water law. It is thus essential for our public officials and local citizenry to hold large water users accountable for their effects to ecosystems and local communities as well as to gain a clearer picture of what water use looks like in the state. Together, we can shape livestock agriculture into a process that works with nature rather than against it in order to sustain our communities and the ecosystems around us.

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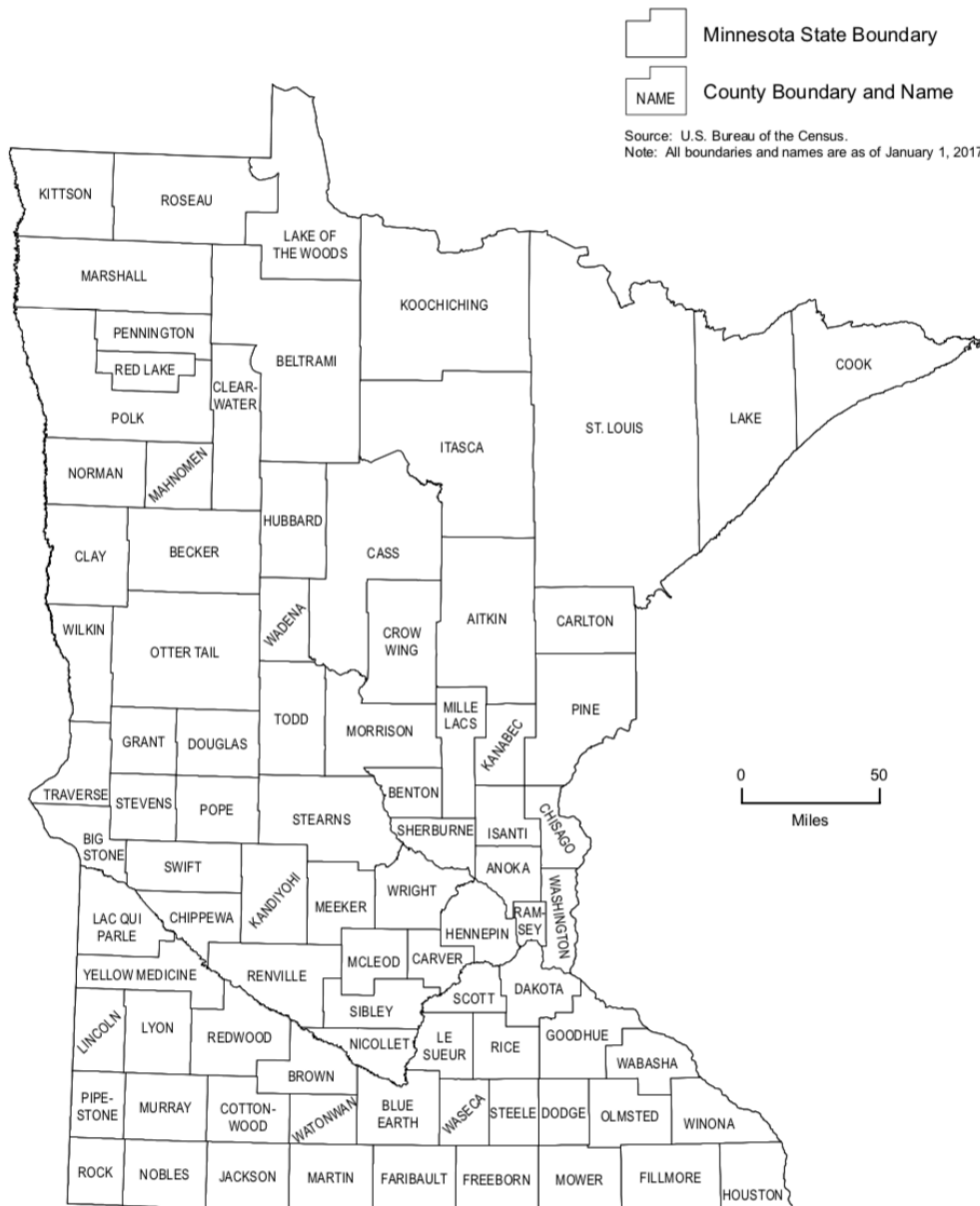
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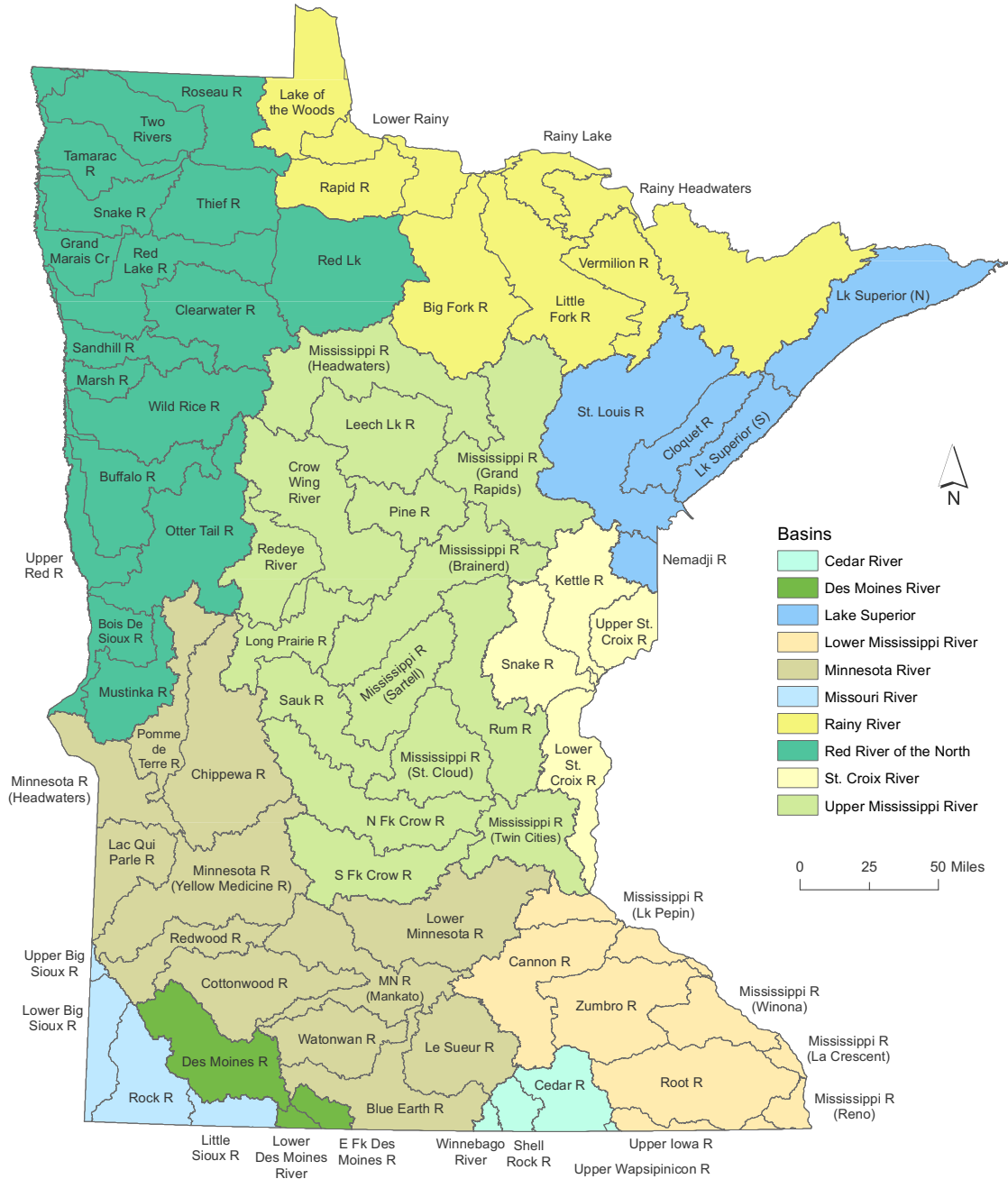
APPENDIX A: Maps of Minnesotan Counties and Watersheds

These maps are provided as a reference for the analyses on large hog and dairy CAFO water use by county and watershed.

Minnesota County Map, U.S. Bureau of the Census



Basins and Major Watersheds in Minnesota



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