

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin

**A report submitted to the
International Joint Commission by the
Great Lakes Water Quality Board**

September 2019

Acknowledgements

The Legacy Issues Work Group gratefully acknowledges the contributions of the work group and Water Quality Board membership and the IJC staff support of Antonette Arvai, Victor Serveiss, Paul Allen and former staff Cindy Warwick. The work group also wishes to recognize the work of the consultants who produced the report used to inform the recommendations of the work group. Great appreciation is extended to those who provided expert review and valuable input on the consultant's report. Finally, a special thank you is extended to the participants at the workshop who provided their valuable time and input, both during the workshop itself as well as in the review of the workshop report.

Water Quality Board - Legacy Issues Work Group Members

US Members

Karen Sands (Work Group Co-Lead)

Sandy Bihn (Project Lead)

Anne Cook (former member)

Jessica Dexter

Tinka Hyde (former member)

Brandon Hofmeister

Joe Tomandl III

Dale Phenicie (IJC Science Advisory Board – Science Priority Committee)

Michael Murray (IJC Science Advisory Board – Science Priority Committee)

Canadian Members

Gayle Wood (Work Group Co-Lead)

John Jackson

Mark Wales

Consultant Team

BluMetric Environmental Inc.

Tiffany Svensson

Muriel Kim-Brisson

Don Hilborn (Senior Technical Advisor)

NTH Consultants Ltd.

Karen Okanta

Table of Contents

Acknowledgements	i
Table of Contents	ii
List of Tables	iii
List of Acronyms	iv
Executive Summary	1
1.0 Project Background.....	3
1.1 Project origin and purpose	3
1.2 Methodology	5
2.0 State of Manure Management of Animal Feeding Operations in the Great Lakes Basin	7
2.1 Trends and challenges	7
2.2 Regulatory oversight	9
3.0 Findings and Recommendations	15
3.1 Recommendations for future study	20
4.0 Conclusion	21
5.0 Appendices	21

List of Tables

Table 1: USEPA Regulatory Definitions of Large, Medium and Small CAFOs	10
Table 2: Soil Phosphorus Threshold Values and Associated Runoff Management Recommendations	13

List of Acronyms

4R	Right Source, Right Rate, Right Time and Right Place
BMP	best management practice
CAFO	concentrated animal feeding operation
GLWQA	Great Lakes Water Quality Agreement
IJC	International Joint Commission
MDS	minimum distance separation
NMA	Nutrient Management Act (Canada)
NPDES	National Pollutant Discharge Elimination System (US)
NRCS	Natural Resources Conservation Service
NU	Nutrient Units
P	phosphorus
P-Index	Phosphorus Index
ppm	parts per million
USDA	US Department of Agriculture
USEPA	US Environmental Protection Agency
WQB	Water Quality Board

Executive Summary

Runoff from manure on agricultural fields—both surface and via field tiles—contributes significantly to nutrient loadings to the Great Lakes and is making the problem of harmful algal blooms more serious. The situation is of even greater concern because of the increasing trend toward concentrated feeding of livestock and other farm animals rather than pasturing or free range. Information on the numbers of animals and the manure produced and how big an impact it is having is not readily available. Governments, agriculture and citizens need to work together aggressively to get a better understanding of the magnitude of the manure problem and how to address it.

This report presents the recommendations of the Great Lakes Water Quality Board (WQB) to the International Joint Commission (IJC) on the topic of manure management for confined animal feeding operation practices and policies in the state and provincial jurisdictions in the Great Lakes. The recommendations below have been identified as priority actions for strengthening the governmental manure management/regulatory frameworks. The recommendations are intended to be applicable to permitted large and medium sized facilities as defined by the US Environmental Protection Agency (USEPA) and permitted facilities greater than 300 nutrient units in Ontario.

Recommendation 1: Each Great Lakes state and Ontario should conduct an in-depth assessment of permitting rules and requirements and of the actual implementation of each state/province's respective manure management framework to identify successes and challenges in achieving reduced nutrient runoff goals. Federal governments and/or state/provincial governments should establish a set of guidelines and regulations for mid and large size animal feeding operations to be incorporated by all states/provinces to ensure an equivalent implementation framework which includes the coordination and oversight of manure management among federal and provincial/state regulators. Such guidelines and regulations should include:

- 1.1 Developing a manure management plan permitting framework for mid and large size animal feeding operations (USEPA definition). Currently most midsize operations have no permitting requirements. The framework should have consistent permitting requirements including comprehensive nutrient guidelines, consideration of management plans by a qualified professional that are consistent for all nutrient sources, and a framework that requires assessment and compliance with federal and provincial/state policies and recommendations. The Province of Ontario's manure management framework, which includes nutrient management plans, should be used as a model.
- 1.2 Requiring systematic testing of manure nutrient soil content and developing a template of best management practices (BMPs) and recommended standards for optimal nutrient application which minimizes nutrient runoff. This policy should consider testing results and

cost. The Ontario template of BMPs should provide a process for evaluating the effectiveness of the Nutrient Management Plan and include an adaptive management component. Ontario's ban on the use of high trajectory irrigation guns to apply manure (unless containing more than 99 percent water) should be considered.

- 1.3 Eliminating the practice in US Great Lakes states that allow animal feeding operations to subdivide adjoining operations, physically located in the same area, to bypass the requirement for a permit and thus bypass permit requirements.
- 1.4 Developing a binational, central Great Lakes information center that shares new and evolving technology for manure treatment/reuse (potentially through the US Great Lakes Observing System Data Portal).

Recommendation 2: The US Great Lakes states and Ontario, if not already doing so, should create rules and policies for manure applications that include:

- 2.1 Developing a systematic approach that requires dedicated minimum acreage for the amount of land needed per animal unit for manure application. This should include factors such as livestock types, soil phosphorous levels and a requirement for manure storage needed per animal unit. Ontario's Nutrient Management Act provides an example of how this can be accomplished. The minimum acreage requirement should apply to onsite and offsite manure applications in the region the facility is located in. Reduction of land needed should be given when the manure is transported outside the facility region with reporting of destination required.
- 2.2 Developing a land base registry in each state and province that is reported to the national/federal government or equivalent tracking system and includes the number of animals, manure application agreements, parcel identification where manure is applied, the manure application dates and the manure amounts.
- 2.3 Developing an assessment of liquid and other manure applications and runoff (including field tile) and requirements for the permissible timing and amount of manure applications (e.g., not on frozen ground and not when there are forecasts for heavy rains) that is applicable to both onsite and offsite locations and to animal feeding operations that are both permitted and unpermitted. Bans on frozen ground can be date specific or on a definition of frozen ground. Determinations should also be made as to when manure is a waste and when it is a fertilizer.
- 2.4 Developing requirements that all property owners and residents within a certain radius of a facility seeking a permit for a new or expanding animal feeding operation be notified and have the opportunity to comment, using Alberta's approach as a model.
- 2.5 Developing a more established, standardized process by which Indigenous communities are notified, engaged and consulted on new or expanding animal feeding operations within a certain radius of their communities.

Recommendation 3: The federal Canadian and US governments, along with Great Lakes states and the province of Ontario, should provide funding dedicated to assisting agriculture for manure management including reuse and treatment technologies. Funding should also assist existing animal feeding operations to make necessary changes to meet recommended standards and best management practices.

Recommendation 4: With federal funding from Canada and the United States, a Canadian and US panel of experts should report on the international management policies, tools, technologies, reporting and recordkeeping practices of the Netherlands and Denmark, who have a long history with manure management that can inform on lessons learned and may have application in the Great Lakes basin. Additionally, there should be a comprehensive assessment of manure management impacts on the Indigenous community.

This report provides detail on the problem presented and the basis for the recommendations. The WQB urges the IJC to take swift action on this report and provide advice to the Canadian and US governments on how to proceed to address this problem. The IJC should also inform the public about this matter.

1.0 Project Background

1.1 Project origin and purpose

The IJC was created by the 1909 Boundary Waters Treaty, and serves as an independent and objective advisor to the Canadian and US governments. The IJC provides advice and recommendations to help resolve disputes and prevent problems along the entire transboundary region. Under the 2012 Great Lakes Water Quality Agreement (GLWQA) the IJC is responsible for providing advice on matters related to protecting and restoring the physical, chemical and biological integrity of the Great Lakes. The governments may consider IJC's advice and recommendations in their efforts to achieve the purpose and objectives of the GLWQA. Under the GLWQA, the WQB serves as the principal advisor to the IJC by recommending strategies to prevent and resolve challenges facing the lakes and advice on the role of the relevant jurisdictions in implementing these strategies.

All the Great Lakes are experiencing water quality issues related to nutrients, caused in part by runoff of excess nutrients originating from agricultural land use (commercial fertilizers and manure), which is intensified during snowmelt, winter rainfall and extreme storm events. Runoff of nutrients is a major source for harmful algae blooms that has been plaguing many areas in the Great Lakes such as western Lake Erie, the Green Bay/Fox River (Lake Michigan), Saginaw Bay (Lake Huron) and the Thames River (Lake St. Clair/Lake Erie). The phosphorus contribution

from manure to the Maumee/western Lake Erie watershed has been approximated to be almost 25 percent.¹ Many Lake Erie nutrient reports rely on numbers of cows, swine and poultry from permitted concentrated animal feeding operations as the manure phosphorous determinant rather than including the number of manure producing animals. The number of animals not accounted for in the United States is unknown, with estimated unreported animals to be approximately 77 percent.²

In its First Triennial Assessment of Progress,³ the IJC found that the water quality of western and central Lake Erie remained unacceptable; one of the major nonpoint sources of phosphorus to western Lake Erie was identified as agricultural operations, including the application of fertilizers and manure to land. Manure from the management of concentrated animal feeding operations can contribute nutrients to the lakes depending on the amounts that are land-applied, the rainfall and runoff. Further to this, in 2018 the IJC released a report on “Fertilizer Application Patterns and Trends and Their Implications for Water Quality in the Western Lake Erie Basin,” which notes that fertilizer is considered a nonpoint agricultural release and recognized to be the largest single source of excess nutrients to western Lake Erie.

The Canadian and US governments, under Annex 4 (Nutrients) of the GLWQA, commit to coordinating binational actions to manage phosphorus concentrations and loadings, and other nutrients if necessary, in the Great Lakes. In 2016, the governments released binational targets for reducing phosphorus load to Lake Erie, including a 40 percent reduction in total phosphorus entering the western and central basins of Lake Erie. In 2018, the governments released Domestic Action Plans that outline strategies and actions to meet the binational targets. The US Action Plan for Lake Erie 2018-2023 includes identifying the need for oversight of animal feeding operations and the management of manure and recommends taking actions such as reducing nutrient application on snow covered or saturated soils and prior to significant rain events, the use of BMPs (the 4Rs: the Right Source, the Right Rate, the Right Time and the Right Place), soil testing and other nutrient reduction measures.⁴ The Canada-Ontario Lake Erie Action Plan includes actions such as implementing 4R practices, encouraging wide-spread adoption of cover crops, considering further restrictions on nutrient application during non-

¹ Don Scavia et al., April 2016, “Informing Lake Erie Agriculture Nutrient Management via Scenario Evaluation,” University of Michigan, accessible at:

graham.umich.edu/media/pubs/InformingLakeErieAgricultureNutrientManagementviaScenarioEvaluation.pdf.

² Environmental Working Group and Environmental Law and Policy Center, April 2019, “Investigation: Manure from Unregulated Factory Farms Fuels Lake Erie’s Toxic Algae Blooms,” accessible at:

ewg.org/release/investigation-manure-unregulated-factory-farms-fuels-lake-erie-s-toxic-algae-blooms.

³ IJC, November 2017, “First Triennial Assessment of Progress on Great Lakes Water Quality Final Report,” accessible at: ijc.org/sites/default/files/2018-08/TAP.pdf.

⁴ USEPA, February 2018, “U.S. Action Plan for Lake Erie: 2018-2023 Commitments and Strategy for Phosphorus Reduction,” pg. 16, accessible at: epa.gov/sites/production/files/2018-03/documents/us_dap_final_march_1.pdf.

growing season (e.g., on frozen ground) and building soil health to increase infiltration and reduce nutrient loss.⁵

In 2017, the WQB identified a priority topic related to the oversight of animal feeding operations for manure management⁶ in the Great Lakes basin. The overall goal of the project is to provide advice and recommendations to the IJC, and ultimately governments, via a baseline of comparable information to assist decision makers in establishing regulations and policies to manage manure from animal feeding operations for the protection of the waters of the Great Lakes. The project identifies opportunities to potentially reduce the frequency and intensity of harmful algae blooms by strengthening manure management practices to reduce nutrient runoff. Finally, this report is intended to add to the overall discussion of fertilizer and manure management.

1.2 Methodology

To accomplish the goals of this project, several phases were undertaken including the development of a consultant report, expert review of the consultant report, development of a draft report and convening of an expert workshop.

A consultant team was contracted from September 2017 to March 2018 to identify and evaluate how existing regulations, rules, policies and practices in the Great Lakes basin are applied to the use, management, storage and disposal of manure from animal feeding operations. The consultants undertook their work with oversight from, and close consultation with, the Legacy Issues Work Group of the WQB. This assessment was undertaken for Canadian and US federal, state and provincial jurisdictions within the Great Lakes basin including Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Ontario, Pennsylvania and Wisconsin. An assessment of regulations was also undertaken for jurisdictions outside the basin that have established agricultural sectors with a significant livestock component, including Alberta, Denmark, Iowa, Maryland, North Carolina, Saskatchewan and the Netherlands, to determine if any models or approaches may be applicable to the Great Lakes region.

The contracted assessment of manure management oversight occurred in two phases. In phase one, detailed information was collected regarding specific characteristics of manure management

⁵ Environment and Climate Change Canada and the Ontario Ministry of the Environment and Climate Change, February 2018, “Canada-Ontario Lake Erie Action Plan: Partnering on Achieving Phosphorus Loading Reductions to Lake Erie from Canadian Sources,” pg. 47-50, accessible at: canada.ca/content/dam/eccc/documents/pdf/great-lakes-protection/dap/action_plan.pdf.

⁶ The term “manure management” is used generally to refer to the use, storage and disposal of manure, unless described otherwise.

in each given jurisdiction and compiled into a review matrix.⁷ In phase two, the jurisdictions were scored on several evaluation categories (e.g., regulatory requirements, compliance, monitoring & enforcement, public input, et cetera) according to a list of defined criteria⁸ and compiled in an evaluation matrix.⁹ Information was primarily collected from publicly-available sources as well as consultation with select personnel from state and provincial agencies and other experts.

The contracted study examined manure management at a high level, and did not evaluate the success with which each jurisdiction implements their regulatory framework. While the focus was on the regulatory aspect of manure management, it is recognized that many voluntary, nonregulatory programs play an important role in helping animal operations minimize environmental risks—such as nutrient runoff—related to manure handling, storage and land application. Additionally, while effort was made, within a limited budget and timeline, for a straightforward, consistent comparison by jurisdiction for manure management, the process was challenged by extremely complex rules and regulations.

In March 2018, the consultants' report was sent for expert review by staff members from key federal, state and provincial government agencies as well as nongovernment organizations and agricultural organizations. The reviewers' comments were used to make corrections of a factual nature to the consultants' report as well as considered in the development of the work group's draft recommendations. The revised consultants' report, provided as Appendix A, was used as the basis for the development of a draft work group report with draft recommendations.

In November 2018, a workshop was held that brought together a diverse group of approximately 25 experts from manure management interests from both Canada and the United States. The goal of the workshop was to draw upon the participants' knowledge and expertise to gain feedback on the work group's draft report and the recommendations contained therein. The outcomes of the workshop were used in developing the work group's final report and recommendations. The workshop report is provided as Appendix B.

⁷ BluMetric Environmental Inc. and NTH Consultants Ltd., February 2018, "Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin," submitted to the IJC WQB, see Appendix A.

⁸ Ibid, Table 1, pg. 7-9.

⁹ Ibid, Appendix B.

2.0 State of Manure Management of Animal Feeding Operations in the Great Lakes Basin

2.1 Trends and challenges

In general, there are two major forms of fertilizer, commercial (or synthetic) and manure. Fertilizer is defined by the US Department of Agriculture (USDA) as any organic or inorganic material of natural or synthetic origin which is added to soil to provide nutrients, including nitrogen, phosphorus, and potassium, necessary to sustain plant growth. Phosphorous and nitrogen in commercial fertilizer come from a manufactured process which is marketed through a crop consultant. Phosphorous and nitrogen in manure come from the excrement of animals (manure). Farmers buy commercial fertilizer and farmers get manure from concentrated animal feeding operations. Over the last 20 years, in the western Lake Erie basin, the amount of phosphorous from commercial fertilizer applied to soil has been decreasing while the phosphorus generated from manure has remained relatively constant.¹ However, in the Maumee River watershed particularly, the amount of phosphorous production from manure has increased by 67 percent from 2005 to 2018.² Manure can be a valuable resource as a natural fertilizer. However, if not managed properly, manure can degrade environmental quality, particularly surface water and ground water resources. Runoff of excess nutrients from agricultural use of commercial fertilizer and manure for crops has resulted in harmful algae blooms in areas in all of the Great Lakes.

In the Great Lakes, there is inconsistency in reporting the number of animals (generally cows, swine and poultry) required for a permit and the amount of land needed for manure nutrient applications (the most common use of manure). This is mainly due to a lack of reliable, publicly available information about where and how many of these operations exist and the amount of manure and phosphorus they produce.

Over the past several decades in the United States there has been a shift in approach to livestock operations, from pasturing of animals to today's increased use of concentrated animal feeding operations (CAFOs), which has impacted manure production and management. Large volumes of manure are produced at CAFOs, requiring manure to be stored and collected in lagoons and piles, to be transported for land application. One of the challenges in the United States is knowing how much phosphorous from manure is being applied to the land. This is due to a lack of data on the number of cows (dairy and cattle), swine and poultry raised in concentrated animal

¹ IJC, February 2018, "Fertilizer Application Patterns and Trends and Their Implications for Water Quality in the Western Lake Erie Basin," accessible at: ijc.org/sites/default/files/2019-01/IJC_FertReport.pdf.

² Environmental Working Group and Environmental Law and Policy Center, April 2019, "Investigation: Manure from Unregulated Factory Farms Fuels Lake Erie's Toxic Algae Blooms," accessible at: ewg.org/release/investigation-manure-unregulated-factory-farms-fuels-lake-erie-s-toxic-algae-blooms.

feeding operations in unpermitted facilities, which is unknown. Animal operations above a certain size threshold (e.g., number of animals) are subject to regulation/permitting by government agencies. However, many operations are below this threshold and therefore do not need to apply for a permit that would provide more detailed information about the location, number of animals and other data. As a result, academics and agency officials have had little detailed information about the scope of livestock production in the watershed. These challenges have been highlighted in a number of reports.

A 2013 report from the USEPA discusses the changes in livestock management and the need to address manure management:

Over the past 60 years in the United States (U.S.), farm operations have become fewer in number but larger in size. This has been particularly true in livestock and poultry production. Since the 1950s, the production of livestock and poultry in the U.S. has more than doubled; however, the number of operations has decreased by 80%. Food animal production has shifted to more concentrated facilities with animals often raised in confinement. Production has also become more regionally concentrated. This has been done, in part, to meet the demands for meat and animal products from a growing human population in the U.S. and abroad.³

A report released in April 2019 by the Environmental Working Group and Environmental Law and Policy Center shows an increase in animals, and thus manure, from 2005 to 2018 in the Maumee River basin of western Lake Erie.⁴ In 2005, 545 animal feeding operations were present in the Maumee River Basin. This included 178 swine, 153 cattle, 109 dairy and 105 poultry facilities. Between 2005 and 2018, 230 animal feeding operations were constructed in the Maumee basin, equating to an average of 18 facilities added each year. The majority of growth was seen in poultry and swine, with 71 poultry facilities (31 percent of all new facilities) and 120 swine facilities (52 percent of all new facilities) constructed during this 13-year period.

A 2017 report to a committee of the Ohio Department of Agriculture showed that 77 percent of the over two million swine in Ohio were in unpermitted facilities. Furthermore, a 2016 USEPA report shows decreasing numbers of permits for confined animal feeding operations with discharge permits via the US Clean Water Act National Pollutant Discharge Elimination System (NPDES) permit requirements.⁵ As an example, Ohio had 221 concentrated animal feeding operation disposal permits which decreased to 36 in 2016.

Furthermore the USDA's 2007 Census of Agriculture data, which estimates beef and dairy cattle, swine and poultry production, estimated 2.2 billion head of livestock and poultry generated

³ USEPA, July 2013, "Literature Review of Contaminants in Livestock and Poultry Manure and Implications for Water Quality," pg. v, accessible at: nepis.epa.gov/Exe/ZyPDF.cgi/P100H2NI.PDF?Dockey=P100H2NI.pdf.

⁴ Environmental Working Group and Environmental Law and Policy Center, April 2019, "Investigation: Manure from Unregulated Factory Farms Fuels Lake Erie's Toxic Algae Blooms."

⁵ USEPA, "NPDES CAFO Regulations Implementation Status Reports," accessible at: epa.gov/npdes/npdes-cafo-regulations-implementation-status-reports.

approximately 1.1 billion tons of manure.⁶ The increasing concentration of animal production can lead to concentrations of manure that exceed the beneficial needs of the farmland where it was produced. A 2001 report from the USDA's Economic Research Service found that 60 to 70 percent of the manure nitrogen and phosphorus may not be able to be assimilated by the farmland on which it was generated.⁷ Additionally, manure for dairy and swine is managed in lagoons and applied to the fields as a liquid, estimated at 95 percent water, which increases mobility.

These reports underscore the challenges encountered from changes in livestock management practices and the resulting importance of manure management to surface waters in the Great Lakes watershed.

2.2 Regulatory oversight

Oversight and definitions of animal feeding operations differ between the Canadian province of Ontario and the US jurisdictions in the basin. In Canada, oversight is under the jurisdiction of provincial ministries (and specifically Ontario in the Great Lakes basin), in contrast to the United States where the regulatory framework is derived from specific federal legislation. The USEPA has delegated authority for the permitting program to individual states, allowing them to perform the permitting, administrative and enforcement aspects as well as create stricter requirements based on individual state needs. In the United States, animal feeding operations that meet certain animal number thresholds (large animal feeding operation) or that discharge manure or process wastewater to a waterway are deemed as a CAFO and regulated by the USEPA's NPDES program. The USEPA definition of "Large CAFOs," "Medium CAFOs" and "Small CAFOs" are provided in Table 1 on the next page. Some states, in addition to administering the federal NPDES program, also administer their own state permit program. For example, Indiana uses animal threshold numbers similar to the USEPA medium animal feeding operation definition for permit requirements.

⁶ USDA, February 2009, "2007 Census of Agriculture: United States Summary and State Data," accessible at: nass.usda.gov/Publications/AgCensus/2007/Full_Report/Volume_1,_Chapter_1_US/usv1.pdf.

⁷ USDA Economic Research Service, June 2001, "Confined Animal Production and Manure Nutrients," accessible at: ers.usda.gov/publications/pub-details/?pubid=42412.

Table 1: USEPA Regulatory Definitions of Large, Medium and Small CAFOs⁸

Animal Category	Size Threshold (number of animals)		
	Large CAFOs	Medium CAFOs*	Small CAFOs**
Cattle	≥ 1,000	300 – 999	< 300
Dairy cattle	≥ 700	200 – 699	< 200
Veal calves	≥ 1,000	300 – 999	< 300
Swine (>55 pounds)	≥ 2,500	750 – 2,499	< 750
Swine (<55 pounds)	≥ 10,000	3,000 – 9,999	< 3,000
Horses	≥ 500	150 – 499	< 150
Sheep	≥ 10,000	3,000 – 9,999	< 3,000
Turkeys	≥ 55,000	16,500 – 54,999	< 16,500
Laying hens (liquid manure handling system)	≥ 30,000	9,000 – 29,000	< 9,000
Laying hens (other than liquid manure handling system)	≥ 82,000	25,000 – 81,999	< 25,000
Nonlaying hens	≥ 125,000	37,500 – 124,999	< 37,500
Ducks (liquid manure handling system)	≥ 5,000	1,500 – 4,999	< 1,500
Ducks (other than liquid manure handling system)	≥ 30,000	10,000 – 29,999	< 10,000

*Must also meet one of discharge criteria to be defined as a CAFO or may be designated by permit authority.

**Never a CAFO by regulatory definition, but may be designated as a CAFO by permit authority.

The Nutrient Management Act, 2002 (NMA)⁹ is used in Ontario to manage nutrients from manure and is jointly administered by Ontario Ministry of Agriculture, Food and Rural Affairs and Ontario Ministry of the Environment, Conservation and Parks. The NMA uses Nutrient Units (NU) to develop legislative thresholds that includes the amount of land needed for manure application. Nutrient Units are calculated based upon number and type of animal. Animal farm operations with greater than 300 NU are required to have a Nutrient Management Plan (application of manure and fertilizer to land) and a Nutrient Management Strategy (address generation, transfer and storage of manure). Farms greater than 5 NU are required to have only a Nutrient Management Strategy. For a perspective of the number of animals that have permit requirements, in Ontario a Nutrient Management Plan is required for livestock farms with more

⁸ USEPA, 33 U.S.C. Part 122, The Clean Water Act, “EPA Administered Permit Programs: The National Pollutant Discharge Elimination System,” accessible at: epa.gov/sites/production/files/2015-08/documents/cafo_final_rule2008_comp.pdf.

⁹ Ontario Nutrient Management Act, 2002, accessible at: ontario.ca/laws/statute/02n04.

than 300 NU, which for dairy operations is approximately 210 dairy cows.¹⁰ Most US states require permits when there are large feeding operations that have 700 or more dairy cows. In Ontario, a Nutrient Management Strategy report is required when there are 5 NU, which is the equivalent of about three dairy cows.¹¹ In the United States, most states have no reporting requirements for operations with less than 700 dairy cows (USEPA's threshold for a large animal feeding operation).¹² Another major difference in manure management between Ontario and the United States is that Ontario forbids the application of manure through aerators, whereas this practice is allowed in the United States. Using aeration for the application of liquid manure in the United States requires that the application be 95 percent water.¹³

The US federal CAFO rules require that any permit issued include a requirement to implement a nutrient management plan that establishes protocols for assessing the potential for nutrient transport from the land application of manure to ensure appropriate agricultural utilization of the nutrients in the manure. However, there are no federal rules that specify particular methods or tools to conduct these assessments, but the USEPA does provide guidance on methods such as the Soil Phosphorus Threshold Level and the Phosphorus Index (P-Index). The agronomic soil phosphorous threshold level in the US Great Lakes states is generally up to 40 parts per million (ppm), which is based on crop need. The P-Index level in the US Great Lakes states is generally 150 ppm, which is based on the soil holding capacity for phosphorous.

At the US federal level the Natural Resources Conservation Service (NRCS) has developed Conservation Practice Standards to provide guidance related to nutrient management and some states have incorporated these into their state CAFO rules. Some US state universities have also developed nutrient application recommendations, which have been incorporated into state CAFO rules. Commercial fertilizer rules are determined by the agronomic/crop need to maximize fertilizer use and minimize cost. The P-Index, commonly used by many states, uses source and transport factors, rather than just crop need, to estimate the level of runoff risk and guide management actions to mitigate these risks. In most US states the P-Index is used to determine soil phosphorous amounts for manure applications. Depending on the state the rules for commercial fertilizer and manure application differ. Ontario's NMA for Nutrient Management Plans includes the same phosphorous requirements for application of manure and fertilizer to land, with phosphorus threshold values outlined in agronomy guidelines for crops. The soil phosphorous thresholds and recommended management actions to minimize nutrient runoff from application of commercial fertilizer and manure are provided in Table 2 (starting on page 13) for the Great Lakes states and Ontario. The table shows that the manure soil phosphorus (P) allowance on Ontario is 25 ppm which is the average agronomic rate for commercial fertilizer

¹⁰ OMAFRA, Nutrient Management Protocol for Ontario Regulation 267/03 under NMA 2002 Part 3, "Nutrient Units: How Farmers Determine Whether Their Farm Units Are Subject to the Regulation," see Table 3.2.1 and 3.2.3, accessible at: omafra.gov.on.ca/english/nm/regs/nmpro/nmpro03-jun03.htm.

¹¹ Ibid.

¹² USEPA, 33 U.S.C. Part 122, The Clean Water Act, "EPA Administered Permit Programs: The National Pollutant Discharge Elimination System."

¹³ Marjan Janžekovič et al., May 2005, "Use of machines for liquid manure aerating and mixing," *J. Mater. Process. Technol.*, 162, pg. 744-750, accessible at: doi.org/10.1016/j.jmatprotec.2005.02.215.

while agronomic rates for manure can be slightly higher depending on P-Index values. Whereas in the United States the soil P allowance can be as high as 200 ppm far exceeding the agronomic rate used for commercial fertilizer.

The western Lake Erie watershed agricultural community is adopting the 4Rs, recognizing it as the gold standard for nutrient/phosphorous management.¹⁴ The 4Rs maximize the crop yield and limit phosphorous applications to the crop need. The “Right Rate” in the 4Rs is determined by the agronomic rate/crop need for commercial fertilizer in the United States and for both commercial fertilizer and manure in Ontario. The “Right Rate” for manure in the US Great Lakes states is based on the P-Index, which is generally more than the agronomic/crop need amount. For example, in Ohio the rules for phosphorous from commercial fertilizer are up to 40 ppm, while phosphorous rules from manure are at 150 ppm or more (see Table 2 starting on the next page).

¹⁴ CropLife, May 2015, “4R Nutrient Stewardship Certification: 5 Groups That Play A Key Role in Its Success,” accessible at: croplife.com/management/stewardship/4r-nutrient-stewardship-certification-5-groups-that-play-a-key-role-in-its-success/.

Table 2: Soil Phosphorus Threshold Values and Associated Runoff Management Recommendations Note: Agronomic threshold values are average values; actual values can vary with soil and crop type.¹⁵

Jurisdiction	Soil P Threshold Values (ppm)		Soil P Test Method	Recommended management actions to minimize runoff	Commercial Fertilizer vs. Manure application
	Commercial Fertilizer (Agronomic)	Manure (Environmental)			
Ontario ¹⁶	25	Use P-Index	Olsen	Use P-Index to guide selection of BMPs (e.g., reducing application rates of fertilizer and manure, reduce erosion potential, buffer strips) and setback distances.	Values/P-Index ratings are the same for fields receiving manure and fertilizer.
Indiana ¹⁷	50	200	Bray-1	> 200 ppm: no manure P application	No fertilizer applied above agronomic threshold value. Environmental threshold is for application of manure.
Ohio ¹⁸	40	150	Bray-1	> 150 ppm: no manure P application	No fertilizer applied above agronomic threshold value. Environmental threshold is for application of manure.
Michigan ¹⁹	40	75, 150	Bray-1	75-150 ppm: Added P not to exceed crop removal > 150 ppm: Apply no manure or fertilizer P	Environmental threshold values account for both fertilizer and manure application
Illinois ²⁰	30-35	25, 150, 200	Bray-1	> 25 ppm: manure P application must maintain or lower the soil test P > 150 ppm: manure P application must not exceed amount of P removed by crop > 200 ppm: no application of manure P	Agronomic threshold applicable to fertilizer application. Environmental threshold values applicable to manure application

¹⁵ Every effort has been made to accurately present the material in this table, which reflects information obtained from direct communication with state/provincial agencies as well as relevant government codes, standards and/or guidance manuals.

¹⁶ OMAFRA, "Agronomy Guide for Field Crops - Publication 811," accessible at: <http://www.omafra.gov.on.ca/english/crops/pub811/p811toc.html>.

¹⁷ IN Administrative Code, Title 327 Article 19, "Confined Feeding Operations" accessible at: [in.gov/legislative/iac/T03270/A00190.pdf](http://www.in.gov/legislative/iac/T03270/A00190.pdf) and NRCS Code 590, "Nutrient Management (Indiana)," accessible at: efotg.sc.egov.usda.gov/references/public/IN/590_Nutrient_Management.pdf.

¹⁸ OH Administrative Code 901:10-2-14, "Contents of a manure management plan: land application methods," accessible at: codes.ohio.gov/oac/901:10-2-14 and Appendix E Table 2 of Rule 901:10-2-14, "Phosphorus Soil Test Risk Assessment Procedure," accessible at: [codes.ohio.gov/pdf/oh/admin/2018/901\\$10-2-14_PH_FF_A_APP14_20140529_1419.pdf](http://codes.ohio.gov/pdf/oh/admin/2018/901$10-2-14_PH_FF_A_APP14_20140529_1419.pdf).

¹⁹ MI "Generally Accepted Agricultural and Management Practices for Manure Management and Utilization," accessible at: michigan.gov/documents/mdard/2018_MANURE_GAAMPs_616506_7.pdf and "Generally Accepted Agricultural and Management Practices for Nutrient Utilization," accessible at: michigan.gov/documents/mdard/2018_NUTRIENT_UTILIZATION_GAAMPs_616508_7.pdf.

²⁰ IL Administrative Code, Title 35, Subtitle E, Chapter I, Section 502.615, "Permits: Nutrient Transport Potential," accessible at: ilga.gov/jcar/admincode/035/035005020F06150R.html and "Illinois Agronomy Handbook," accessible at: extension.cropsciences.illinois.edu/handbook/.

Table 2 (continued)

Jurisdiction	Soil P Threshold Values (ppm)		Soil P Test Method	Recommended management actions to minimize runoff	Commercial Fertilizer vs. Manure application
	Commercial Fertilizer (Agronomic)	Manure (Environmental)			
New York ²¹	20	Use P-Index	Morgan	P – Index Rating <50: Nitrogen based management 50-74: Nitrogen based management with BMPs 75-99: P applications limited to crop removal 100+: No P application	Threshold values/index ratings the same for fertilizer and manure
Wisconsin ²²	30	50, 100, 200	Bray-1	50-100 ppm: P application not to exceed crop removal 100-200 ppm: use P Index (>6 manure application prohibited; <6 manure application limited based on crop P removal) > 200ppm: Manure P application prohibited	No fertilizer applied above agronomic threshold value. Environmental thresholds/P-Index ratings for manure application.
Pennsylvania ²³	50	200	Mehlich-3	Use P-Index Rating: ≤59: Nitrogen based management 60-79: Nitrogen based management with BMPs 80-99: P applications limited to crop removal 100+: No P application	If only fertilizer is applied, not required to follow P-based plans. If manure produced and/or applied, commercial fertilizer also accounted for.
Minnesota ²⁴	20	75 (in protection area) 21 (in protection area and/or within 300 ft. of waters) 150 (outside of protection area)	Bray-1	21 ppm (In protection area/within 300 ft. of waters): >300 animal units: manure applied so P does not increase over any six-year period >1000 animal units: manure P applied during any six-year period not exceed crop P removal in same period 75 ppm (in protection area) or 150 ppm (outside of protection area): >300 animal units: manure management plan with actions to minimize P runoff >1000 animal units: manure application rates must not exceed crop P removal	No regulatory threshold for fertilizer application. Environmental threshold values applicable to manure application.

²¹ NRCS, Code 590 “Nutrient Management” (NY) accessible at: efotg.sc.egov.usda.gov/references/public/NY/nyps590.pdf, and Cornell University Extension “Agronomy Fact Sheet Series (Fact Sheet #10): How to Calculate the NY Phosphorus Index,” accessible at: nmsp.cals.cornell.edu/publications/factsheets/factsheet10.pdf.

²² WI Administrative Code, Chapter NR 243 “Animal Feeding Operations,” accessible at: docs.legis.wisconsin.gov/code/admin_code/nr/200/243 and NRCS Code 590 “Nutrient Management” (WI), accessible at: datcp.wi.gov/Documents/NM590Standard2015.pdf.

²³ PA Code Title 25, Chapter 83, “Subchapter D Nutrient Management,” accessible at: pcode.com/secure/data/025/chapter83/subchapDtoc.html.

²⁴ Minnesota does not have regulatory thresholds for application of commercial fertilizer. However the University of Minnesota recommends an agronomic threshold of 20 ppm Bray, see: extension.umn.edu/phosphorus-and-potassium/agronomic-and-environmental-management-phosphorus, and for manure, see: MN Administrative Rules Chapter 7020, Animal Feedlots (7020.2225 Land Application of Manure), revisor.mn.gov/rules/7020/.

3.0 Findings and Recommendations

It is important to state at the outset that it is challenging to compare government management of manure by states and provinces because the rules and regulations for manure are usually in multiple areas of codes with no consistent framework for reporting. While many similarities exist, the management frameworks also appear to be tailored to each jurisdiction's unique context, potentially the result of interjurisdictional differences in land use, economics and environmental mandates. A summary of the assessment of the regulatory and permitting requirements for manure management for all jurisdictions reviewed in this study can be found in [Table B-1](#) and [Table B-2](#) of Appendix A, and graphically in [Figure 2](#) of Appendix A.

Of all the jurisdictions considered in this study, the most comprehensive regulatory requirements for manure management were found to be in the Netherlands, which are defined from the requirements of the European Union Nitrates Directive and further refined by the Dutch Manure Policy. Particular focus is placed on regulation of manure disposal due to the relatively insufficient land base of the country, with strict requirements for recordkeeping, tracking of shipments and reporting.

The most comprehensive requirements of all the jurisdictions studied, surrounding compliance, monitoring and enforcement were observed in Ontario. Ontario has a straightforward nutrient unit requirement for each type of animal and a corresponding amount of acreage that is dedicated for manure application for each permitted facility. Compliance with permitting requirements is verified by random inspections and complaint-triggered inspections. The Ontario Ministry of the Environment, Conservation and Parks has a range of enforcement actions at their disposal based on the severity of the infraction, ranging from orders to cease and/or clean up the activity, to fines and jail time. The participation of the Ontario Ministry of Agriculture, Food and Rural Affairs may be sought to mediate nuisance issues.

Alberta was observed to have the most comprehensive process for public participation. Affected parties are notified and have the opportunity to comment on proposals to create or expand animal feeding operations; a larger radius of residents and landowners are to be notified for operations with higher animal units. The provincial approval authority considers the comments received on an application before making a decision on the application, and affected parties have the opportunity to appeal the decision. Applications and the decisions are made publicly accessible on the approval authority's website.

No jurisdiction stood out as being exemplary with respect to definitions, quantifications and standards for manure management permitting purposes. Similarly, while most jurisdictions had some kind of general funding available for agricultural operations to implement BMPs, few specialized in helping operations meet and exceed regulatory requirements specific to manure management.

Based on the work undertaken by the consultants, and considering input from expert reviewers and workshop participants the following recommendations are provided to strengthen manure management in the Great Lakes. It should be noted that these recommendations are applicable to permitted large and medium sized facilities as defined by the USEPA and permitted facilities greater than 300 nutrient units in Ontario.

Recommendation 1: Each Great Lakes state and Ontario should conduct an in-depth assessment of permitting rules and requirements and of the actual implementation of each state/province's respective manure management framework to identify successes and challenges in achieving reduced nutrient runoff goals. Federal governments and/or state/provincial governments should establish a set of guidelines and regulations for mid and large size animal feeding operations to be incorporated by all states/provinces to ensure an equivalent implementation framework which includes the coordination and oversight of manure management among federal and provincial/state regulators. Such guidelines and regulations should include:

- 1.1 Developing a manure management plan permitting framework for mid and large size animal feeding operations (USEPA definition). Currently most midsize operations have no permitting requirements. The framework should have consistent permitting requirements including comprehensive nutrient guidelines, consideration of management plans by a qualified professional that are consistent for all nutrient sources, and a framework that requires assessment and compliance with federal and provincial/state policies and recommendations. The Province of Ontario's manure management framework, which includes nutrient management plans, should be used as a model.
- 1.2 Requiring systematic testing of manure nutrient soil content and developing a template of best management practices (BMPs) and recommended standards for optimal nutrient application which minimizes nutrient runoff. This policy should consider testing results and cost. The Ontario template of BMPs should provide a process for evaluating the effectiveness of the Nutrient Management Plan and include an adaptive management component. Ontario's ban on the use of high trajectory irrigation guns to apply manure (unless containing more than 99 percent water) should be considered.
- 1.3 Eliminating the practice in US Great Lakes states that allow animal feeding operations to subdivide adjoining operations, physically located in the same area, to bypass the requirement for a permit and thus bypass permit requirements.
- 1.4 Developing a binational, central Great Lakes information center that shares new and evolving technology for manure treatment/reuse (potentially through the US Great Lakes Observing System Data Portal).

A nutrient management plan is designed to effectively utilize nutrients produced by animal waste on a farm. A comprehensive nutrient management plan takes into account other types of management practices and incorporates recordkeeping and land treatment practices along with other important areas. The states within the Great Lakes basin that currently require the use of a

comprehensive nutrient management plan are Michigan and New York. Plans should require information on soil and manure characterization, nutrient budgets, soil erosion controls, runoff controls, odor controls and crop rotations/yields, and should be site specific. Plans for the utilization of manure should account for all nutrient sources, including fertilizers and nutrients from other inputs (e.g., biosolids, called Non Agricultural Source Materials in Ontario). A phosphorus index should be considered, especially when nutrients are applied in close proximity to surface water and tile drain inlets. The addition of phosphorus-based fertilizer should be limited to crop removal when phosphorus soil levels are high, unless the phosphorus index shows a low risk.

Authorized government agencies should develop comprehensive nutrient management plan templates to assist farms with compliance and ensure consistency with the implementation of CAFO regulatory requirements. The plans should include similar BMPs as recommended by USEPA NPDES and NRCS permit guidelines to assure adequate storage capacity, proper management, diversion of clean water from production areas, and preventing animals from contacting waters of the state. Plans should be site specific and required to be approved by the authorized state agency before implementation, or certified by professional engineer or other qualified/certified personnel. To increase the effectiveness of the plan, a science-based adaptive management process, that evaluates the actual nutrient loading in runoff, should be included. The establishment of basinwide or regional standards for optimal nutrient application, factoring in crop type, soil type, climatic conditions, precipitation and irrigation, and updated on an annual basis, should be explored.

A distinctive feature of Iowa is the requirement to be a certified applicator in order to apply manure to land. For the Great Lakes basin, a subject that could be explored further is whether such certification would improve rates of compliance with regulatory requirements.

In Canada, the supply management system has rules that make it difficult or impossible to subdivide a dairy or poultry operation for whatever purpose. The quota must be utilized on one site as one farm operation. Ontario's nutrient management legislation does not allow for intentional subdivision of operations in order to circumvent the rules. In addition, the scale and size of the typical animal confinement operation is much smaller than in the United States; thus there is little reason to subdivide.

Recommendation 2: The US Great Lakes states and Ontario, if not already doing so, should create rules and policies for manure applications that include:

- 2.1 Developing a systematic approach that requires dedicated minimum acreage for the amount of land needed per animal unit for manure application. This should include factors such as livestock types, soil phosphorous levels and a requirement for manure storage needed per animal unit. Ontario's Nutrient Management Act provides an example of how this can be accomplished. The minimum acreage requirement should apply to onsite and offsite manure applications in the region the facility is located in. Reduction of land needed should be given when the manure is transported outside the facility region with reporting of destination required.

- 2.2 Developing a land base registry in each state and province that is reported to the national/federal government or equivalent tracking system and includes the number of animals, manure application agreements, parcel identification where manure is applied, the manure application dates and the manure amounts.
- 2.3 Developing an assessment of liquid and other manure applications and runoff (including field tile) and requirements for the permissible timing and amount of manure applications (e.g., not on frozen ground and not when there are forecasts for heavy rains) that is applicable to both onsite and offsite locations and to animal feeding operations that are both permitted and unpermitted. Bans on frozen ground can be date specific or on a definition of frozen ground. Determinations should also be made as to when manure is a waste and when it is a fertilizer.
- 2.4 Developing requirements that all property owners and residents within a certain radius of a facility seeking a permit for a new or expanding animal feeding operation be notified and have the opportunity to comment, using Alberta's approach as a model.
- 2.5 Developing a more established, standardized process by which Indigenous communities are notified, engaged and consulted on new or expanding animal feeding operations within a certain radius of their communities.

Most of the States within the Great Lakes basins are lacking the requirements involving the amount of land required for manure application. The USEPA does not provide information or regulations regarding acreage requirements. Of the states researched, the only state that has some sort of regulation pertaining to acreage is Indiana. Indiana has set up a framework for farmers to use to calculate how much acreage is needed for the manure produced by a specific number of animals; however there is little to no information about how this regulation is being enforced. Regulation of acreage needed is vital to ensure that farmers are not overloading land with nutrients and increasing the risk of nutrient run off. In Ontario, if a nutrient management plan is not required, applicants are required to show the destination and area of land receiving manure in a nutrient management strategy and a reasonable land base is required to be available for the number of nutrient units generated on the farm unit. A land base registry or equivalent tracking system should be used to determine whether sufficient land is available to accommodate increased manure production from operations proposing to expand and/or modernize.

A significant piece of regulation lacking from most states is on the transfer of manure from an operation to an offsite location. While most states require documentation on the amount of manure transferred, Indiana, Michigan and Ohio are the only states within the Great Lakes basin with more stringent regulations pertaining to manure transfer. Regulation involving manure transfer is also not included in the USEPA guidelines for NPDES permits. Specific requirements for transfer of manure should be required, as moving manure from one facility that has proper and permitted storage structures, to a location that potentially does not have appropriate storage or BMPs, could pose a greater risk of runoff and contamination to surface/groundwater.

There are also no distinct processes that were identified in either Canadian or US legislation for notifying, consulting and engaging Indigenous communities regarding animal feeding operations. However, both Canada and the United States, at the federal level, have mandates to consult with Indigenous communities when the government's actions may affect tribal interests (United States), First Nations (Canada) or Indigenous Treaty rights. The jurisdictions in the Great Lakes basin generally scored low with regards to consultation with, and input from, Indigenous communities specific to animal feeding operations.

Public access to data and comment is lacking in some jurisdictions, such as Minnesota and New York, but accessible via databases in other states such as Michigan, Ohio, Pennsylvania and Wisconsin. In addition to lack of access to data/information, the jurisdictions in the basin also generally scored low with regard to public input on animal feeding operations. Ontario has a process where parts of approvals are available to the public, but there is not any public engagement. Also, Ontario uses minimum distance separations (MDS) as a land use planning tool, which applies to new builds or expansions for livestock facilities and new house construction. Before issuing a building permit, or a severance for the purpose of building something, an MDS must be calculated. The rules have been around for some time, and have seen some evolution. The MDS 1 was the original and required at least 1,000 feet between livestock facilities and homes. The MDS 2 came later and required 2,000 feet and does not always apply. While this is a provincewide rule, it is administered by municipal governments. The Ontario Planning Act requires the enforcement of the distances when allowing homes to be built near existing livestock barns or new or expanding livestock barns near existing homes.

Alberta has the most extensive public notification and consultation requirements of the jurisdictions outside the Great Lakes basin, and has the greatest emphasis on public transparency and accessibility to records. There is a prescribed consultation process, and affected parties may comment on applications for new or expanded feeding operations. Notices and complete applications are made publicly available.

Recommendation 3: The federal Canadian and US governments, along with Great Lakes states and the province of Ontario, should provide funding dedicated to assisting agriculture for manure management including reuse and treatment technologies. Funding should also assist existing animal feeding operations to make necessary changes to meet recommended standards and best management practices.

In addition to federal funding, which is available to all operations in any state that meet the requirements of the funding program, some states within the Great Lakes basin offer some statewide funding incentive either in the form of grants or tax credits, while others do not. It would be beneficial to offer more grants, on a statewide level, specific for CAFOs to assist with implementing their manure management program while accounting for phosphorous reduction. Voluntary environmental review programs should be developed for agricultural operations in the Great Lakes basin that will assist them in implementing BMPs for improving nutrient management. This type of program exists in Ontario in the form of the Environmental Farm Plan, which is voluntary, but is also a requirement for eligibility for many funding programs.

The Environmental Farm Plan (started in 1992) is an example of a cost-share funding program. Funding over the years has been inconsistent and often temporary. The Environmental Farm Plan started with a maximum grant of CDN\$1,500 per farm then grew to CDN\$30,000 per farm before being severely restricted around 2011, and dedicated funding eliminated in 2013 so that since then farmers could still do an Environmental Farm Plan but had to compete for funding against farmers doing innovative projects in other areas of agriculture.

3.1 Recommendations for future study

Recommendation 4: With federal funding from Canada and the United States, a Canadian and US panel of experts should report on the international management policies, tools, technologies, reporting and recordkeeping practices of the Netherlands and Denmark, who have a long history with manure management, that can inform on lessons learned and may have application in the Great Lakes basin. Additionally, there should be a comprehensive assessment of manure management impacts on the Indigenous community.

Of the jurisdictions assessed, the Netherlands was found to have the most comprehensive regulatory requirements for manure management. This includes limits on the total numbers of pigs and chickens that can be commercially owned and strict regulation of manure transportation and disposal. In addition, the annual reporting and recordkeeping requirements of the Netherlands and Denmark should be further investigated, to identify potential opportunities to apply a similar approach in the Great Lakes basin. There is a national reporting system for declaring and documenting manure and fertilizer activities, in which agricultural operations must report their production, use, storage and disposal of manure on an annual basis. One area of focus should be the strategies for optimizing the efficiency of the reporting process for the benefit of both the agricultural operators and the regulators. As the demographics, land use pressures and water quality conditions in the Great Lakes basin differ from those occurring in the Netherlands and Denmark any proposed annual reporting framework should be tailored to the context of the Great Lakes basin.

4.0 Conclusion

Agricultural runoff in many Great Lakes watersheds is a significant source of phosphorous/nutrient runoff. The sources of phosphorous from agricultural runoff are commercial fertilizer and manure. While the phosphorous applied to fields from commercial fertilizer has been generally tracked and documented for decades, phosphorous applied to fields from manure has not been assessed and is mainly documented from permitted animal feeding operations and the self-reporting USDA agricultural census. Over the past decades commercial phosphorous fertilizer use has decreased in part because of increasing costs and most recently precision technology that applies the amount of phosphorous needed by acre. The livestock production that produces manure has changed primarily from widespread pastured locations to confined, mid and large size concentrated animal operations where, to be economical, manure application is applied as close as possible to the operations. The change in this practice has required the use of lagoons for manure from cows and swine, resulting in liquid application, as well as changes in poultry manure management. Also, dairy cows produce more milk than decades ago, and other animals require less time to grow before going to market. Knowing the number of animals and their manure/phosphorous/nutrient production will help to account for manure phosphorous contributions and the management needed to reduce phosphorous/nutrient runoff from manure. To address these changes in practices, this report recommends manure management policies and assessments that require careful consideration of runoff and impacts on the waters of the Great Lakes. Improved manure management can be achieved by adopting the recommendations in this report. The adoption of these manure management recommendations will help to reduce nutrient runoff from manure that results in harmful algae blooms.

5.0 Appendices

Appendix A – Consultant Report on Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin.

Appendix B – Workshop Report

Appendix A - Consultant Report on Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin



NTH Consultants, Ltd.

Infrastructure Engineering
and Environmental Services

OVERSIGHT OF ANIMAL FEEDING OPERATIONS FOR MANURE MANAGEMENT IN THE GREAT LAKES BASIN

Submitted to:

**International Joint Commission
Great Lakes Regional Office
Great Lakes Water Quality Board – Legacy Issues Work Group**
100 Ouellette Avenue, 8th Floor
Windsor, ON N9A 6T3

Prepared by:

BluMetric Environmental Inc.
171 Victoria Street North
Kitchener, ON N2H 5C5

And

NTH Consultants, Ltd.
41780 Six Mile Road
Northville, MI 48168

BluMetric Project Number: 170641
Submission Date: 16 February 2018

OVERSIGHT OF ANIMAL FEEDING OPERATIONS FOR MANURE MANAGEMENT IN THE GREAT LAKES BASIN

Submitted to:



International Joint Commission Great Lakes Regional Office
Great Lakes Water Quality Board – Legacy Issues Work Group
100 Ouellette Avenue, 8th Floor
Windsor, ON N9A 6T3

Prepared by:



BluMetric Environmental Inc.
171 Victoria Street North
Kitchener, ON N2H 5C5

And



NTH Consultants, Ltd.
41780 Six Mile Road
Northville, MI 48168

Project Number: 170641

Submission Date: 16 February 2018

EXECUTIVE SUMMARY

The International Joint Commission (IJC) was created by the Boundary Waters Treaty in 1909, and serves as an independent and objective advisor to the Canadian and U.S. governments. The IJC provides recommendations to the governments to help achieve the purpose and objectives of the *Great Lakes Water Quality Agreement* (GLWQA), signed in 1972 and amended via the Great Lakes Water Quality Protocol of 2012. Under the GLWQA, the Water Quality Board serves the IJC in an advisory capacity, and includes the Legacy Issues Work Group. The Legacy Issues Work Group identified the oversight of animal feeding operations and their management of manure in the Great Lakes Basin as a priority topic.

The overall goal of this report is to identify and evaluate how existing regulations, rules, policies and practices in the Great Lakes Basin are applied to the use, management, storage and disposal of manure from animal feeding operations. This is to be accomplished by:

1. Identifying how animal feeding operations are defined among the various jurisdictions in the Great Lakes Basin;
2. Compiling existing policies, regulations and rules relevant to the use, management, storage and disposal of manure from animal feeding operations in the Great Lakes Basin and selected areas outside the basin;
3. Comparing and contrasting the policies/regulations among the various jurisdictions, and identifying opportunities for the strengthening of policies in the Great Lakes;
4. Comparing and contrasting processes for public notification and input in the permitting process for animal feeding operations, including properties within close proximity of the proposed permit; and
5. Identifying opportunities for Great Lakes jurisdictions to learn from other jurisdictions or models that may be applicable to the Great Lakes.

The information gathered in this study is intended to assist the Work Group and the Water Quality Board in their role of advising the IJC: first, by providing them with an assessment of the adequacy of the current regulatory framework for manure management at animal feeding operations for the protection of the waters in the Great Lakes. Second, this report aims to provide the Work Group and Board with recommendations for their consideration in order to advise and help lead efforts in strengthening manure management practices and reduce nutrient runoff.



The compilation and assessment of regulatory and permitting requirements related to manure production, use, storage, and disposal were conducted for all jurisdictions overlapping with the Great Lakes Basin:

- Ontario, Canada
- New York, U.S.
- Pennsylvania, U.S.
- Ohio, U.S.
- Indiana, U.S.
- Illinois, U.S.
- Michigan, U.S.
- Wisconsin, U.S.
- Minnesota, U.S.

The following jurisdictions outside the Great Lakes Basin, as selected for study by the IJC's Great Lakes Water Quality Board – Legacy Issues Work Group, were also subject to the same compilation and assessment of regulatory and permitting requirements:

- Maryland, U.S.
- Iowa, U.S.
- North Carolina, U.S.
- Alberta, Canada
- Saskatchewan, Canada
- Netherlands
- Denmark

The assessment of manure management oversight of jurisdictions within and outside the Great Lakes Basin occurred in two main phases. In phase 1, detailed information was collected regarding specific characteristics of manure management in each given jurisdiction and compiled into a review matrix. In phase 2, the jurisdictions were scored on several evaluation categories (regulatory requirements, compliance, monitoring & enforcement, etc.) according to a list of defined criteria.

Of the jurisdictions considered in this study, the most comprehensive regulatory requirements for manure management were found to be in the Netherlands, which are defined from the requirements of the European Union Nitrates Directive and further refined by the Dutch Manure Policy. Particular focus is placed on regulation of manure disposal due to the relatively insufficient land base of the country, with strict requirements for record-keeping, tracking of shipments and reporting.



The most comprehensive requirements surrounding compliance, monitoring and enforcement were observed in Ontario. Compliance with permitting requirements is verified by random inspections and complaint-triggered inspections. The Ontario Ministry of the Environment and Climate Change has a range of enforcement actions at their disposal based on the severity of the infraction, ranging from orders to cease and/or clean up the activity, to fines and jail time. The participation of the Ontario Ministry of Agriculture may be sought to mediate nuisance issues.

Alberta was observed to have the most comprehensive process for public participation. Affected parties are notified and have the opportunity to comment on proposals to create or expand animal feeding operations; a larger radius of residents and landowners are to be notified for operations with higher animal units. The provincial approval authority considers the comments received on an application before making a decision on the application, and affected parties have the opportunity to appeal the decision. Applications and the decisions are made publicly accessible on the approval authority's website.

No jurisdiction stood out as being exemplary with respect to definitions, quantifications and standards for manure management permitting purposes. Similarly, while most jurisdictions had some kind of general funding available for agricultural operations to implement best management practices, few specialized on helping operations meet and exceed regulatory requirements specific to manure management.

The following recommendations are offered for improving the existing manure management frameworks, exploring long-term opportunities and addressing the main challenges with respect to manure management in the Great Lakes Basin:

No.	Topic	Recommendation
1	Existing framework	Conduct an in-depth assessment of the actual implementation of each jurisdiction's respective manure management framework to identify successes and challenges in achieving their intended goals.
2	Regulators	Establish a set of guidelines and regulations to be incorporated by all states/provinces to ensure a uniform implementation framework; coordinate the oversight of manure management among federal, provincial/state and municipal regulators, and assign jurisdiction based on the size of the animal feeding operation.
3	Regulatory thresholds	Facilities should not be able to subdivide their operations to avoid exceeding regulatory thresholds.
4	Quantifiable standards	Develop a systematic approach for quantifying minimum acreage requirements for manure application, accounting for factors such as livestock types and numbers, and requirements for manure storage.



No.	Topic	Recommendation
5	Application tracking	Develop a land base registry or equivalent tracking system for overseeing manure application agreements.
6	Manure transfers	Develop requirements for the permissible timing and volumes of manure transfers from an operation to an offsite location, applicable to both permitted and unpermitted animal feeding operations.
7	Reporting and record-keeping	Investigate the nation-wide reporting and record-keeping practices of the Netherlands and Denmark and opportunities for application in the Great Lakes Basin.
8	Nutrient management planning	Comprehensive Nutrient Management Plans should be required for medium- and large-scale facilities, prepared by a qualified professional, and account for all nutrient sources.
9	Standards and best management practices	Create a comprehensive template of best management practices and recommended standards for optimal nutrient application. The template should provide a process for evaluating the effectiveness of the plan, and include an adaptive management component.
10	Soil and manure testing	Testing of manure nutrient content and field nutrient values should be uniformly required and evaluated for medium- to large-sized facilities.
11	Incentives and support	Provide dedicated funding for promoting proper manure management, by assisting existing animal feeding operations to make necessary changes to meet recommended standards and best management practices.
12	Public and Indigenous Notification and Engagement	Public and indigenous input should be required if a proposed small- or medium-sized facility does not meet municipal zoning criteria. Public input should be required for new, expanding and/or renewals of large-scale operations.



LIST OF ACRONYMS

AEM	Agricultural Environmental Management
AFO	Animal Feeding Operation
AOPA	Agricultural Operation Practices Act
AU	Animal unit
BMP	Best Management Practices
CAFF	Confined Animal Feeding Facility
CAFO	Concentrated Animal Feeding Operation
CFO	Confined Feeding Operations
CNMP	Comprehensive Nutrient Management Plan
CWA	Clean Water Act (U.S.)
CWIA	Clean Water Infrastructure Act (New York)
DAP	Domestic Action Plan
DMR	Discharge Monitoring Reports
DNR	Department of Natural Resources
EPA	Environmental Protection Agency (U.S.)
EQIP	Environmental Quality Incentive Program
EU	European Union
FIV	Fertility Index Value
GLWQA	Great Lakes Water Quality Agreement
IDA	Illinois Department of Agriculture
IDEM	Indiana Department of Environmental Management
IDNR	Indiana Department of Natural Resources
IEPA	Illinois Environmental Protection Agency
IJC	International Joint Commission
ILO	Intensive Livestock Operations
LARE	Lake and River Enhancement
LMFA	Livestock Management Facilities Act
MAEAP	Michigan Agriculture Environmental Assurance Program
MAFO	Maryland Animal Feeding Operations
MDA	Minnesota Department of Agriculture
MDARD	Michigan Department of Agriculture and Rural Development
MDEQ	Michigan Department of Environmental Quality
MOECC	Ontario Ministry of the Environment and Climate Change
MPCA	Minnesota Pollution Control Agency
MMP	Manure Management Plan
N	Nitrogen
NGO	Non-governmental organization



LIST OF ACRONYMS (continued)

NMA	Nutrient Management Act (Ontario)
NMP	Nutrient Management Plan
NOITC	Notice of Intent to Construct
NPDES	National Pollutant Discharge Elimination System
NRCB	Natural Resources Conservation Board
NU	Nutrient unit
NYSDEC	New York State Department of Environmental Conservation
ODA	Ohio Department of Agriculture
ODNR	Ohio Department of Natural Resources
OISC	Office of Indiana State Chemist
OWDA	Ohio Water Development Authority
P	Phosphorus
PADEP	Pennsylvania Department of Environmental Protection
PMT	Phosphorus Management Tool
PTI	Permit to Install
REAP	Resource Enhancement and Protection
SDS	State Disposal System
SPDES	State Pollution Discharge Elimination System
U.S.	United States
USDA	United States Department of Agriculture
WI DATCP	Wisconsin Department of Agriculture, Trade, and Consumer Protection
WI DNR	Wisconsin Department of Natural Resources
WPCLF	Water Pollution Control Loan Fund
WPDES	Wisconsin Pollution Discharge Elimination Systems
WQM	Water Quality Management
WSRLA	Water Supply Revolving Loan Account



UNITS

ft	feet
ft ²	square feet
ft ³	cubic feet
gal	gallons
ha	hectare
kg	kilogram
km	kilometre
km ²	square kilometre
L	litre
lb	pound
m	metre
m ²	square metres
m ³	cubic metres
ppm	parts per million



TABLE OF CONTENTS

EXECUTIVE SUMMARY	i
LIST OF ACRONYMS.....	i
UNITS	iii
1. INTRODUCTION.....	1
1.1 REPORT OBJECTIVE.....	2
1.2 IJC ROLE AND BACKGROUND	2
1.3 PROJECT TEAM	3
2. METHODOLOGY	3
2.1 APPROACH/METHODOLOGY FOR INFORMATION GATHERING.....	4
2.1.1 Review matrix of regulatory and permitting requirements in the selected jurisdictions within and outside the Great Lakes Basin – Approach and Methodology	4
2.1.2 Evaluation of the regulatory and permitting requirements in the selected jurisdictions – Approach and Methodology	7
2.2 CHALLENGES AND LIMITATIONS OF THE INVENTORY AND EVALUATION.....	9
3. COMPILATION OF REGULATORY AND PERMITTING REQUIREMENTS.....	10
3.1 FEDERAL-LEVEL LEGISLATION AND POLICIES GUIDING PERMITTING REQUIREMENTS FOR MANURE USE, MANAGEMENT, STORAGE AND DISPOSAL – SIGNATORIES TO THE GREAT LAKES WATER QUALITY AGREEMENT	10
3.1.1 Canada	10
3.1.2 United States	14
3.2 LEGISLATION AND POLICIES GUIDING PERMITTING REQUIREMENTS FOR MANURE USE, MANAGEMENT, STORAGE AND DISPOSAL – WITHIN THE GREAT LAKES BASIN.....	27
3.2.1 Ontario.....	27
3.2.2 New York	29
3.2.3 Pennsylvania	30
3.2.4 Ohio	32
3.2.5 Indiana.....	34
3.2.6 Illinois	36
3.2.7 Michigan.....	37
3.2.8 Wisconsin.....	40
3.2.9 Minnesota.....	42
3.3 LEGISLATION AND POLICIES GUIDING PERMITTING REQUIREMENTS FOR MANURE USE, MANAGEMENT, STORAGE AND DISPOSAL – OUTSIDE THE GREAT LAKES BASIN.....	43
3.3.1 Saskatchewan, Canada	43
3.3.2 Alberta, Canada	45
3.3.3 Maryland, United States.....	47
3.3.4 Iowa, United States	49
3.3.5 North Carolina, United States.....	51
3.3.6 Netherlands	52
3.3.7 Denmark.....	54



TABLE OF CONTENTS (continued)

4.	ASSESSMENT OF REGULATORY AND PERMITTING REQUIREMENTS.....	55
4.1	ASSESSMENT OF STRENGTHS, WEAKNESSES AND SIMILARITIES OF REGULATORY AND PERMITTING REQUIREMENTS ACROSS JURISDICTIONS	55
4.1.1	State/Provincial Level – Within the Great Lakes Basin	56
4.1.2	Jurisdictions outside the Great Lakes Basin.....	65
4.2	PUBLIC AND INDIGENOUS NOTIFICATION AND ENGAGEMENT.....	70
4.2.1	Within the Great Lakes Basin.....	71
4.2.2	Outside the Great Lakes Basin.....	72
4.3	COMPARISON OF THE JURISDICTIONS INSIDE VS. OUTSIDE THE GREAT LAKES BASIN	72
4.3.1	Within North America – Jurisdictions Inside vs. Outside the Great Lakes Basin.....	72
4.3.2	Jurisdictions Inside the Great Lakes Basin vs. Overseas (Netherlands & Denmark) .	73
4.3.3	Lessons Learned Outside the Great Lakes Basin – Opportunities for the Great Lakes Basin	74
5.	MANURE MANAGEMENT APPROACH AND STRATEGY CONSIDERATIONS FOR THE GREAT LAKES BASIN BASED ON RESEARCH FINDINGS.....	75
5.1	SUMMARY OF THE CURRENT STRENGTHS AND WEAKNESSES OF MANURE MANAGEMENT IN THE GREAT LAKES BASIN	75
5.2	RECOMMENDATIONS	75
5.2.1	Regulatory Requirements and Oversight.....	76
5.2.2	Policies and Best Management Practices.....	79
5.2.3	Incentives and Support for Animal Feeding Operations	80
5.2.4	Public and Indigenous Notification and Engagement	82
6.	CLOSING.....	82
7.	REFERENCES.....	85



LIST OF TABLES

Table 1:	Rating Codes and criteria for the evaluation of manure management oversight in jurisdictions within and outside the Great Lakes Basin	7
Table 2:	Select data from the 2016 Census of Agriculture on farms, manure application and livestock.....	11
Table 3a:	Select data from the 2012 Census of Agriculture on farms, manure application and livestock (U.S. states within the Great Lakes Basin)	15
Table 3b:	Select data from the 2012 Census of Agriculture on farms, manure application and livestock (U.S. states outside the Great Lakes Basin)	19
Table 4:	Overview of the definitions and standards related to animal feeding operations and manure management in the subject jurisdictions within and outside the Great Lakes Basin.....	22
Table 5:	Recommendations for the oversight of animal feeding operations for manure management in the Great Lakes Basin	83

LIST OF FIGURES (AT END OF REPORT)

Figure 1:	Subject Jurisdictions
Figure 2:	Assessment of the Regulatory and Permitting Requirements of the Subject Jurisdictions

LIST OF APPENDICES

Appendix A:	Oversight of Animal Feeding Operations for Manure Management – Review Matrices
	Appendix A-1 Jurisdictions within the Great Lakes Basin – Review Matrices
	Appendix A-2 Jurisdictions outside the Great Lakes Basin – Review Matrices
Appendix B:	Oversight of Animal Feeding Operations for Manure Management – Evaluation Matrices



1. INTRODUCTION

The Great Lakes, shared by Canada and the United States, contain almost 20 percent of the world's surface freshwater, support 4,000 species of animals and vegetation, and their basins are home to more than 40 million people. Following a legacy of pollution to the Great Lakes, the U.S.–Canada *Great Lakes Water Quality Agreement*, first signed in 1972, established Areas of Concern in 1987, which are locations where environmental impairments resulting from local human activities are preventing certain uses of the lakes. Among the fourteen “Beneficial Use Impairments” is eutrophication, which occurs when excess nutrients cause oxygen depletion. The water quality problems typically manifest themselves as nuisance or harmful algal blooms. More recently, the Nutrients Annex (Annex 4) of the *Great Lakes Water Quality Agreement* (Amendment of 2012) set six Lake Ecosystem Objectives related to nutrients, such as minimizing the extent of hypoxic zones in the Waters of the Great Lakes and maintaining algal species consistent with healthy aquatic ecosystems in the nearshore Waters of the Great Lakes.

With the exception of Lake Superior, all Great Lakes are experiencing significant water quality issues related to nutrients, caused in part by runoff of excess nutrients originating primarily from agricultural land use (fertilizers and manure), and exacerbated during snowmelt, winter rainfall and extreme storm events (ECCC and MOECC, 2018), and by increasing heavy rains in the spring/early summer (Lake Erie Waterkeeper, pers. comm.). The increase in harmful algal blooms continues to be a challenge for the Great Lakes, and is particularly pronounced in the Western Lake Erie Basin. A well-known instance of harmful algal blooms occurred in 2014, which resulted in a three-day “do-not-drink” advisory for approximately 500,000 people in the greater Toledo Ohio area. In its First Triennial Assessment of Progress on Great Lakes Water Quality (IJC, 2017), the IJC found that the water quality of western and central Lake Erie remained unacceptable; one of the major nonpoint sources of phosphorus to Lake Erie was identified as agricultural operations, including the application of fertilizers and manure to land.

General Objective 6 of the *Great Lakes Water Quality Agreement* states that “the Waters of the Great Lakes should be free from nutrients that directly or indirectly enter the water as a result of human activity, in amounts that promote growth of algae and cyanobacteria that interfere with aquatic ecosystem health, or human use of the ecosystem.” Annex 4 of the *Agreement* includes provisions for the Canadian and U.S. governments to undertake the necessary research to further the understanding of issues surrounding nutrient distribution, sources and movement within the Great Lakes. Additionally, in order to help achieve the Lake Ecosystem Objectives of Annex 4, the Annex 4 Objectives and Targets Task Team recommended revisions to phosphorus target concentrations and loads (EPA, 2017), including:

- A 40 percent reduction in total phosphorus entering the Western Basin and Central Basin of Lake Erie;



- A 40 percent reduction in spring total and soluble reactive phosphorus loads from watersheds where localized algae was identified as problem;
- A 40 percent reduction in spring total and soluble reactive phosphorus loads from the Maumee River in the United States.

In order to provide advice to the Canadian and U.S. governments for addressing nutrient-related impacts in the Great Lakes, several initiatives have been planned, including an examination by the Water Quality Board of policies related to confined animal feeding operations, which is the subject of the present report.

1.1 REPORT OBJECTIVE

The overall goal of this report is to identify and evaluate how existing regulations, rules, policies, and practices in the Great Lakes Basin are applied to the use, management, storage and disposal of manure from animal feeding operations. This is to be accomplished by:

1. Identifying how animal feeding operations are defined among the various jurisdictions in the Great Lakes Basin;
2. Compiling existing policies, regulations and rules relevant to the use, management, storage and disposal of manure from animal feeding operations in the Great Lakes Basin and selected areas outside the basin;
3. Comparing and contrasting the policies/regulations among the various jurisdictions, and identifying opportunities for the strengthening of policies in the Great Lakes;
4. Comparing and contrasting processes for public notification and input in the permitting process for animal feeding operations, including properties within close proximity of the proposed permit; and
5. Identifying opportunities for Great Lakes jurisdictions to learn from other jurisdictions or models that may be applicable to the Great Lakes.

1.2 IJC ROLE AND BACKGROUND

The International Joint Commission (IJC) was created by the Boundary Waters Treaty in 1909, and serves as an independent and objective advisor to the Canadian and U.S. governments. The IJC provides recommendations to the governments to help achieve the purpose and objectives of the *Great Lakes Water Quality Agreement* (GLWQA), signed in 1972 and amended via the Great Lakes Water Quality Protocol of 2012. Under the GLWQA, the Water Quality Board serves the IJC in an advisory capacity, and includes the Legacy Issues Work Group.

The Legacy Issues Work Group identified the oversight of animal feeding operations and their management of manure in the Great Lakes Basin as a priority topic.



1.3 PROJECT TEAM

The Project Team, consisting of BluMetric Environmental Inc. (BluMetric™), NTH Consultants, Ltd., and Mr. Don Hilborn, was retained by the IJC to prepare this evaluation and assessment. The Project Team has extensive familiarity with manure management, associated regulations and policies in various jurisdictions across Canada, the U.S. and Europe. The Project Team included both Canadian and American consultants resulting in a broad and intimate understanding of and familiarity with their respective legislation.

The information gathered in this study is intended to assist the Work Group and the Water Quality Board in their role of advising the IJC: first, by providing them with an assessment of the adequacy of the current regulatory framework for manure management at animal feeding operations for the protection of the waters in the Great Lakes. Second, this report aims to provide the Work Group and Board with recommendations for their consideration in order to advise and help lead efforts in strengthening manure management practices and reduce nutrient runoff.

2. METHODOLOGY

The compilation and assessment of regulatory and permitting requirements related to manure production, use, storage, and disposal were conducted for all jurisdictions overlapping with the Great Lakes Basin:

- Ontario, Canada
- New York, U.S.
- Pennsylvania, U.S.
- Ohio, U.S.
- Indiana, U.S.
- Illinois, U.S.
- Michigan, U.S.
- Wisconsin, U.S.
- Minnesota, U.S.

The following jurisdictions outside the Great Lakes Basin, as selected for study by the IJC's Great Lakes Water Quality Board – Legacy Issues Work Group, were also subject to the same compilation and assessment of regulatory and permitting requirements:

- Maryland, U.S.
- Iowa, U.S.
- North Carolina, U.S.



- Alberta, Canada
- Saskatchewan, Canada
- Netherlands
- Denmark

The researched jurisdictions are illustrated on Figure 1, which includes an overlay of the extent of the Great Lake Basin with respect to federal, provincial and state boundaries.

Throughout this report, the term “manure management” is used in a general sense to refer to the use, management, storage, and disposal of manure, unless explicitly described otherwise.

2.1 APPROACH/METHODOLOGY FOR INFORMATION GATHERING

The assessment of manure management oversight of jurisdictions within and outside the Great Lakes Basin occurred in two main phases. In phase 1 (described in subsection 2.1.1), detailed information was collected regarding specific characteristics of manure management in each given jurisdiction and compiled into a review matrix. In phase 2 (subsection 2.1.2), the jurisdictions were scored on several evaluation categories (regulatory requirements, compliance, monitoring & enforcement, etc.) according to a list of defined criteria.

Information was collected primarily from publicly-available sources online, including:

- Federal, provincial/state and municipal legislation;
- Guidance material from regulator, academic, industry and non-governmental organization websites;
- News articles;
- Consultation with Ontario government staff involved with the development of legislation and approval of legislative requirements;
- Consultation with selected personnel from state regulatory agencies, department of agriculture, state farm bureau, and NRCS state representatives.

2.1.1 Review matrix of regulatory and permitting requirements in the selected jurisdictions within and outside the Great Lakes Basin – Approach and Methodology

The information collected on manure management oversight is divided into the following seven broad topics:

- Regulators and legislation
- Definitions, quantifications, etc. for permitting purposes
- Regulatory requirements
- Input from Public Stakeholders and Indigenous Communities



- Compliance, Monitoring and Enforcement
- Funding
- Other

Within each broad topic, information was sought on a number of specific characteristics in order to develop a thorough profile of manure management oversight in each jurisdiction. Information obtained for each jurisdiction was summarized in review matrices (Tables A-1.1 to A-1.10, and A-2.1 to A-2.7) provided in Appendix A. This phase of the study sought to answer the following questions for each jurisdiction:

Regulators, legislation:

- Who are the agencies responsible for regulatory and enforcement oversight?

Definitions, quantifications, etc. for permitting purposes:

- How are manure requirements defined within the jurisdiction, including scale of farm, definition of animal/livestock units?
- How are manure volumes estimated, including estimates of animal turnover and weights?
- How do manure volume and nutrient content among livestock type and stages of livestock vary?

Regulatory Requirements:

- What are the regulatory triggers/criteria for manure to be subject to regulation/permitting? These may include both internal factors (e.g., numbers of animal/livestock units) or external factors (e.g., proximity to a water body).
- What are the regulatory requirements for storage, including monitoring and inspection? (e.g., minimum storage capacity, design requirements, contingency requirements)
- What are the regulatory requirements for land application of manure? How do these requirements differ for manure compared to commercial fertilizer?
- Are there restrictions for land application of manure? (e.g., during winter on frozen grounds, rainfall events, ground slope, proximity to water body).
- How are acreage requirements defined for the land application of manure?
- What are the required procedures and protocols for testing of manure and soil? Must test results be submitted to a regulatory authority?
- What are the regulatory requirements for manure disposal?
- What requirements are there for the preparation of nutrient management plans?
- Are there requirements to identify and implement Best Management Practices (BMPs)?



Compliance, Monitoring and Enforcement:

- How are permitting requirements enforced? Are there categories of enforcement action (e.g., fines, stop orders)?
- Who is responsible for conducting inspections? What are the triggers for an inspection and the frequency of inspections?
- To whom must complaints against an animal feeding operation be directed, and what is the protocol following the submission of a complaint?

Input from Public Stakeholders and Indigenous Communities:

- What is the notification and/or consultation process for a proposed new animal feeding operation?
- Is there a distinct process for notifying and engaging indigenous communities? *(Note: in the Great Lakes region, indigenous peoples include First Nations, Métis, and Tribes. For the purposes of this report, the term “indigenous”, as currently used by the United Nations (e.g., Office of the United Nations High Commissioner for Human Rights, 2013), was considered an appropriate approach to refer to one or more of these peoples).*
- What is the role of indigenous people in regulatory and enforcement oversight, and how do regulatory agencies coordinate with indigenous people?
- Are records relating to animal feeding operations publicly available?

Funding:

- Is there funding and/or incentives for manure management? What are the sources, goals, and eligible applicants for such programs?

Other:

- Are there non-government nutrient management programs that include manure application elements (e.g., organized voluntary efforts, best practices guidelines, farm assistance programs, etc.)?
- Are nutrient release reduction targets related to manure being developed by individual and collective state/provincial water quality management agencies?
- Are there permit requirements that indirectly impact manure production, storage, management and application? (e.g., prohibitions against discharges and impacts to waterways, water-taking permits)



2.1.2 Evaluation of the regulatory and permitting requirements in the selected jurisdictions – Approach and Methodology

Following the compilation of information regarding manure management, each jurisdiction was evaluated and assigned a score between 1 and 4 for each of the seven broad topics described in Section 2.1.1 above. Table 1 describes the rating codes used for the evaluation.

Table 1: Rating Codes and criteria for the evaluation of manure management oversight in jurisdictions within and outside the Great Lakes Basin

Regulators, Legislation	
1	Only federal level regulators are involved. No provincial/state or municipal regulators involved in oversight, permits, approval and/or enforcement. Or different levels of the regulatory framework are not well coordinated or aligned.
2	Mainly federal level regulators are involved. Minimal provincial/state or municipal regulators involved in oversight, permits, approval and/or enforcement. Or different levels of the regulatory framework are not well coordinated or aligned.
3	Both federal and provincial/state levels are involved in oversight, permits, approvals and/or enforcement and there is some coordination between the different regulatory agencies.
4	Federal, provincial/state and municipal levels are all involved in oversight, permits, approvals and/or enforcement and the process and framework are well coordinated and aligned.
Definitions, Quantifications, etc. for Permitting Purposes	
1	There are limited or only high level definitions and standards with respect to manure requirements scale of farm with respect to animal/livestock units, estimation of manure volumes and nutrient content.
2	There are definitions and standards that have some general data to support manure requirements, scale of farm with respect to animal/livestock units, estimation of manure volumes and nutrient content.
3	There are definitions and standards that are based on defensible data that include consideration of animal turnover, weights, type of livestock and age to support manure requirements, scale of farm with respect to animal/livestock units, estimation of manure volumes and nutrient content.
4	There are definitions and standards that are based on defensible data that include consideration of animal turnover, weights, type of livestock and age to support manure requirements, scale of farm with respect to animal/livestock units, estimation of manure volumes and nutrient content. Detailed analytical processes including location specific Phosphorous Index (P-index) are embedded in the analysis.



Table 1: Rating Codes and criteria for the evaluation of manure management oversight in jurisdictions within and outside the Great Lakes Basin (continued)

Regulatory Requirements	
1	Limited to no regulatory requirements including set trigger levels for siting livestock operations, manure storage and manure applications. Largely voluntary initiatives and a reactive regulatory response to environmental issues that arise.
2	Broadly based or flexible regulatory requirements around the issues of siting livestock operations, manure storage including monitoring and inspection, land application and disposal of manure including acreage, agronomic demand, manure and soil testing.
3	Prescribed regulatory requirements including third party ¹ review around the issues of siting livestock operations, manure storage including monitoring and inspection, land application and disposal of manure including acreage, agronomic demand, manure and soil testing. Some discretionary interpretation (i.e. gaps) exists with respect to the regulatory requirements.
4	Comprehensive prescribed regulatory requirements for both new and existing animal feeding operations including third party ¹ review around the issues of siting livestock operations, manure storage including monitoring and inspection, land application and disposal of manure including acreage, agronomic demand, manure and soil testing.
Input from Public Stakeholders and Indigenous Communities	
1	No input from stakeholders and/or Indigenous communities. No or very limited public access to records.
2	No input from stakeholders and/or Indigenous communities. Some records are made available to the public.
3	There are limited and/or undefined requirements around consultation related to the siting of proposed new or expanding animal feeding operations. No or limited public access to records.
4	There is a prescribed consultation process that includes defined groups of stakeholders. The process is transparent and records are made available to the public for review.
Compliance, Monitoring and Enforcement	
1	Very limited enforcement activities.
2	Enforcement only occurs retroactively, for example, after a spill or fish kills occurs.
3	In addition to enforcement after spills, some enforcement related to building permits and construction standards.
4	Comprehensive enforcement of all management aspects of existing and new animal feeding operations including building permit requirements, on-going nutrient management requirements and strong enforcement if/when spills occur.



Table 1: Rating Codes and criteria for the evaluation of manure management oversight in jurisdictions within and outside the Great Lakes Basin (continued)

Funding	
1	No funding of any kind at the federal, provincial/state or municipal level.
2	Limited funding available from one agency.
3	Limited or some funding is available, typically cost sharing and/or incentives to implement BMPs or meet new regulatory requirements.
4	Fully funded programs or interest free loans to help animal feeding operations meet regulatory requirements.
Other	
1	Limited to no related non-governmental organization (NGO) programs or extension work that may impact animal feeding operations.
2	Limited to no related NGO programs or extension work that may impact animal feeding operations. Public groups are involved to review effectiveness of manure management of large livestock facilities.
3	Some voluntary initiatives to help meet overall targets not necessarily specific to animal feeding operations.
4	There are a number of related initiatives and regulatory requirements that need to be considered in the operation of an animal feeding facility.

¹ For the purposes of this report, a “third party” may include a Professional Engineer, Professional Geoscientist, etc. who was retained by an animal feeding operation to design and/or sign off on a study or plan. Though retained by the animal feeding operation, they are treated here as a third party as they remain accountable first and foremost to their professional organization.

2.2 CHALLENGES AND LIMITATIONS OF THE INVENTORY AND EVALUATION

In light of the purpose, scope and methodology required for this study, the following limitations should be recognized when reviewing the findings:

- The sources consulted may not reflect recent (or soon to be implemented) changes in manure management requirements, legislation and/or practices. Also, the sources consulted may not fully describe how the actual processes are undertaken in the field, and their knowledge of the topics of interest may be limited by the scope of their regulatory authority;
- This study examined manure management at a high level, and therefore is not intended to evaluate the success with which each jurisdiction implements their regulatory framework, or the practical challenges faced by regulators and agricultural operations in implementing and/or meeting the requirements (financially and/or in terms of resources required);
- The availability of useful information in English regarding manure management in the Netherlands and Denmark was limited, so online sources in Dutch and Danish were reviewed using Google Chrome’s in-browser translation application as well as translation websites.



3. COMPILATION OF REGULATORY AND PERMITTING REQUIREMENTS

The following section details the information that was compiled on manure management oversight in the nine provincial/state jurisdictions within the Great Lakes Basin, and the seven jurisdictions outside the Great Lakes Basin. Canadian and U.S. federal requirements for manure management that are applicable to all provinces and all states (respectively) are presented first in Section 3.1; the requirements of individual jurisdictions within the Great Lakes Basin follow in Section 3.2. The requirements of seven jurisdictions outside the Great Lakes Basin, which include two Canadian provinces, three States and two European countries, are presented in Section 3.3.

As discussed previously, detailed information addressing the topics listed in Section 2.1.1 is presented in the form of review matrices (Tables A-1.1 to A-1.10 and Tables A-2.1 to A-2.7 provided in Appendix A). The following subsections provide a summary of salient information for each jurisdiction; they are not intended to duplicate the information in the matrices and should therefore be read in conjunction with the tables in Appendix A.

3.1 FEDERAL-LEVEL LEGISLATION AND POLICIES GUIDING PERMITTING REQUIREMENTS FOR MANURE USE, MANAGEMENT, STORAGE AND DISPOSAL – SIGNATORIES TO THE GREAT LAKES WATER QUALITY AGREEMENT

3.1.1 Canada

From the most recent Census of Agriculture, conducted in 2016 by Statistics Canada, 193,492 farms were counted in Canada in 2016, averaging approximately 820 acres (332 hectares (ha)) per farm. Approximately 93.4 million acres (37.8 million ha) are dedicated to cropland in the country (Statistics Canada, 2017a). The same census reported 66,227 farms to be applying manure on their agricultural operations (Statistics Canada, 2017b), although no information was available on the volumes, rates or spatial distribution of the manure application. Census data regarding farms, manure application and livestock for Canada, as well as Ontario, Saskatchewan and Alberta (the Canadian provinces discussed in this report) are summarized in Table 2 below. As regulation and permitting of manure-related activities are under the jurisdictions of the individual provinces, no consolidated information was identified regarding the total numbers of agricultural operations requiring permits for manure management in Canada.



Table 2: Select data from the 2016 Census of Agriculture on farms, manure application and livestock

	Canada	Ontario	Saskatchewan	Alberta
Number of farms	193,492	49,500	34,523	40,638
Total farm area	158.7 million acres (64.2 million ha)	12.3 million acres (5 million ha)	61.5 million acres (24.9 million ha)	50.3 million acres (20.3 million ha)
Average farm area	820 acres (332 ha)	249 acres (101 ha)	1,784 acres (722 ha)	1,237 acres (501 ha)
Land use				
No. of farms reporting land in crop ¹ (% of all farms within the jurisdiction)	163,431 (84%)	43,631 (88%)	31,947 (93%)	33,866 (83%)
Total area of land in crop	93.4 million acres (37.8 million ha)	9.0 million acres (3.7 million ha)	40.5 million acres (16.4 million ha)	25.3 million acres (10.2 million ha)
Manure application				
No. of farms applying manure (% of all farms within the jurisdiction)	66,227 (34%)	22,215 (45%)	6,394 (19%)	10,153 (25%)
Cumulative area of manure application	7 million acres (2.8 million ha)	1.8 million acres (746,000 ha)	821,000 acres (332,000 ha)	1.2 million acres (489,000 ha)
Selected livestock ² – cattle				
Total cattle and calves	12,530,730	1,623,710	2,592,277	5,206,999
Average no. of cattle and calves per farm	166	93	192	261
No. of farms reporting cattle and calves (% of all farms within the jurisdiction)	75,307 (39%)	17,452 (35%)	13,497 (39%)	19,914 (49%)
Selected livestock ² – pigs				
Number of pigs	14,091,503	3,534,104	1,033,778	1,462,247
Average no. of pigs per farm	1,677	1,280	1,548	1,207
No. of farms reporting pigs (% of all farms within the jurisdiction)	8,402 (4.3%)	2,760 (5.6%)	668 (1.9%)	1,211 (3.0%)



Table 2: Select data from the 2016 Census of Agriculture on farms, manure application and livestock (continued)

	Canada	Ontario	Saskatchewan	Alberta
Selected livestock ² – sheep and lambs				
Number of sheep and lambs	1,054,260	321,495	110,015	195,511
Average no. of sheep and lambs per farm	112	103	126	117
No. of farms reporting sheep and lambs (% of all farms within the jurisdiction)	9,390 (4.9%)	3,119 (6.3%)	871 (2.5%)	1,677 (4.1%)
Selected livestock ² – hens and chickens				
Number of hens and chickens	145,519,566	50,759,994	5,842,590	14,125,401
Average no. of hens and chickens per farm	6,086	6,156	3,443	3,651
No. of farms reporting hens and chickens (% of all farms within the jurisdiction)	23,910 (12%)	8,246 (17%)	1,697 (5%)	3,869 (10%)

¹ Other categories of land use recorded in the Census of Agriculture included summer fallow land, tame or seeded pasture, and “all other land”.

² Other categories of livestock recorded in the Census of Agriculture included horses and ponies, goats, wild boars, mink, fox, bison, llamas and alpacas, deer, elk and turkeys.

Source: Statistics Canada, 2017a, 2017b, 2017c

At the federal level, existing legislation affecting manure management in Canada is largely limited to the *Fisheries Act*, the *Fertilizers Act*, and their respective regulations. The manufacture, proper use, and safe disposal of manure are controlled by provincial and municipal rules and regulations (Canadian Food Inspection Agency, 2017).

The *Fisheries Act* has indirect implications for manure management, as any spills of manure into waterbodies may be considered a contravention of Section 36 (Prohibition against depositing deleterious substances into waters frequented by fish). A recent example is an incident in 2014, in which a hog farm in Alberta was fined \$50,000 for spilling hog manure into a nearby creek, resulting in the death of numerous fish (Government of Canada, 2015). The spill was determined to have occurred when the owner pumped liquid hog manure from one lagoon into another, which then overflowed over land before impacting the creek. The requirements of the *Fisheries Act* therefore constitute reactive protection measures by levelling penalties against spills of



manure into water bodies frequented by fish, rather than imposing requirements for spill prevention and mitigation at the planning and operation stages.

The *Fertilizers Act*, administered by the Canadian Food and Inspection Agency, regulates fertilizers and supplements that are imported and sold in Canada. The *Fertilizers Act* and its regulations require that all regulated fertilizer and supplement products be made safe for humans, plants, animals and the environment, and that they be properly labelled to ensure safe and appropriate use. The *Fertilizers Act* defines fertilizers as any substance or mixture of substances, containing nitrogen, phosphorus, potassium or other plant food that are manufactured, sold or represented for use as a plant nutrient. Manure is described in the *Fertilizers Act* as dried and group excreta of birds or other animals with or without litter, containing not less than 50 percent organic matter. Per Section 3 of the *Fertilizers Regulations* (“Exemptions Generally”), animal and vegetable manures are exempt from the *Act* and *Regulations* provided they are sold in their natural condition, and comply with Section 11 of the *Regulations* (prohibitions against fertilizers and supplements that may be harmful to living organisms or the physical environment).

As will be discussed in greater detail in Sections 3.2.1 (Ontario), 3.3.1 (Saskatchewan) and 3.3.2 (Alberta), and in the review tables in Appendix A, oversight of animal feeding operations for manure management is under the jurisdiction of provincial ministries, rather than the departments and agencies at the federal level. In contrast to the United States (Section 3.1.2), the provincial legislative and regulatory requirements concerning animal feeding operations are not derived from specific federal legislation, and therefore the three provinces considered in this study vary in their approaches for defining animal feeding operations and animal/nutrient units, and establishing quantifiable standards for manure production and nutrient content relative to livestock age/type/etc. For example, regulated farm sizes in Ontario are defined on the basis of Farming Units, whereas legislative requirements in Saskatchewan and Alberta are defined for “Intensive Livestock Operations” and “Confined Feeding Operations”, respectively. A summary of the definitions and standards related to animal feeding operations and manure management in the Canadian and American jurisdictions within and outside the Great Lakes Basin is provided in Table 4, at the end of Section 3.1.2.

No other federal level requirements impacting manure management in Canada were identified.



3.1.2 United States

The National Pollutant Discharge Elimination System (NPDES) permit program was created in 1972 by the *Clean Water Act* (CWA) as a way to address water pollution by regulating point sources that discharge pollutants into the waters of the United States. Under the CWA, the United States Environmental Protection Agency (U.S. EPA) has authorized the NPDES permit program to individual states, allowing them to perform many of the permitting, administrative, and enforcement aspects of the program, while the U.S. EPA retains oversight of all responsibilities. Currently 46 states and the U.S. Virgin Islands are authorized to implement the NPDES permit program. The four states that do not implement the NPDES permit program are Idaho, Massachusetts, New Hampshire, and New Mexico.

An animal feeding operation (AFO) is any operation where animals are confined for at least 45 days during any 12 month period. The 45 days of confinement do not have to be consecutive, but the 12 month period does. Another characteristic of AFOs is that no crops, forage growth, or other vegetation is grown in the areas where animals are confined. AFOs that meet the regulatory definition of a concentrated animal feeding operation (CAFO) are regulated under the NPDES permitting program. For an AFO to be deemed a CAFO, the AFO must meet a certain animal size threshold, or discharge manure or process wastewater into a natural or man-made ditch, stream, or other form of waterway. Both medium and large sized CAFOs are required to obtain an NPDES permit if they discharge. There are roughly 257,000 animal feeding operations in the United States today, approximately 15,500 of which are classified as CAFOs (Ohio EPA website).

Table 3a summarizes data from the 2012 Census of Agriculture related to farms, manure application, and livestock for the states that lie within the Great Lakes Basin. The 2012 Census data for Maryland, Iowa and North Carolina (the states outside the Great Lakes Basin also considered in this study) are summarized in Table 3b. In 2012, the U.S. had over 2.1 million farms (hobby farms, CAFOs, crop farms, etc.), averaging 434 acres (176 ha) per farm. As shown on Table 3a, in the Great Lakes Basin, there were a little over 500,000 farms averaging around 230 acres per farm. Of those farms, roughly 110,000 (or 22 percent) of them apply manure to land. Note that the census data does not include information on the volumes, rates or spatial distribution of the manure application.



**Table 3a: Select data from the 2012 Census of Agriculture on farms, manure application and livestock
(U.S. states within the Great Lakes Basin)**

	U.S. (total)	New York	Pennsylvania	Ohio	Indiana	Illinois	Michigan	Wisconsin	Minnesota
Number of farms	2,109,303	35,537	59,309	75,462	58,695	75,087	52,194	69,754	74,542
Total farm area	914.5 million acres 370 million ha	7.2 million acres (2.9 million ha)	7.7 million acres (3.1 million ha)	14.0 million acres (5.6 million ha)	14.7 million acres (6.0 million ha)	26.9 million acres (10.9 million ha)	9.9 million acres (4.0 million ha)	14.6 million acres (5.9 million ha)	26.0 million acres (10.5 million ha)
Average size of farm	434 acres (176 ha)	202 acres (82 ha)	130 acres (53 ha)	185 acres (75 ha)	251 acres (102 ha)	359 acres (145 ha)	191 acres (77 ha)	209 acres (85 ha)	349 acres (141 ha)
Median size of farm	80 acres (32 ha)	93 acres (38 ha)	68 acres (28 ha)	69 acres (28 ha)	57 acres (23 ha)	100 acres (40 ha)	60 acres (24 ha)	96 acres (39 ha)	142 acres (57 ha)
Cropland									
Farms reporting harvested cropland (% of all farms within the jurisdiction)	1,288,875 (61%)	26,569 (75%)	42,981 (72%)	55,844 (74%)	41,965 (71%)	53,155 (71%)	37,479 (72%)	52,083 (75%)	53,891 (72%)
Total area of harvested cropland	315.0 million acres (127.5 million ha)	3.8 million acres (1.5 million ha)	4.0 million acres (1.6 million ha)	10.1 million acres (4.0 million ha)	12.1 million acres (4.9 million ha)	22.4 million acres (9.1 million ha)	7.1 million acres (2.9 million ha)	9.1 million acres (3.7 million ha)	19.8 million acres (8.0 million ha)
Manure application									
No. of farms applying manure (% of all farms within the jurisdiction)	275,420 (13%)	8,902 (25%)	19,373 (33%)	15,886 (21%)	10,403 (18%)	8,535 (11%)	9,149 (18%)	21,062 (30%)	16,582 (22%)



**Table 3a: Select data from the 2012 Census of Agriculture on farms, manure application and livestock
(U.S. states within the Great Lakes Basin) (continued)**

	U.S. (total)	New York	Pennsylvania	Ohio	Indiana	Illinois	Michigan	Wisconsin	Minnesota
Manure application									
Cumulative area of manure application	22.1 million acres (8.9 million ha)	0.97 million acres (0.39 million ha)	1.2 million acres (0.51 million ha)	0.82 million acres (0.33 million ha)	0.64 million acres (0.26 million ha)	0.55 million acres (0.22 million ha)	0.76 million acres (0.31 million ha)	2.0 million acres (0.79 million ha)	1.6 million acres (0.64 million ha)
Selected livestock - cattle and calves									
Total cattle and calves	89,994,614	1,419,365	1,626,374	1,242,293	821,265	1,127,630	1,130,477	3,494,084	2,412,684
No. of farms reporting cattle and calves (% of all farms within the jurisdiction)	913,246 (43%)	13,559 (38%)	25,189 (42%)	25,501 (34%)	17,370 (30%)	16,550 (22%)	13,626 (26%)	29,908 (43%)	23,702 (32%)
Average no. of cattle and calves per farm	99	105	65	49	47	68	83	117	102
Selected livestock – hogs and pigs									
Number of hogs and pigs	66,026,785	74,671	1,134,957	2,058,503	3,747,352	4,630,796	1,099,478	311,651	7,606,785
No. of farms reporting hogs and pigs (% of all farms within the jurisdiction)	63,246 (3%)	1,912 (5%)	3,097 (5%)	3,494 (5%)	2,757 (5%)	2,045 (3%)	2,198 (4%)	2,270 (3%)	3,355 (3%)
Average no. of hogs and pigs per farm	1,044	39	366	589	1,359	2,264	500	137	2,267



**Table 3a: Select data from the 2012 Census of Agriculture on farms, manure application and livestock
(U.S. states within the Great Lakes Basin) (continued)**

	U.S. (total)	New York	Pennsylvania	Ohio	Indiana	Illinois	Michigan	Wisconsin	Minnesota
Selected livestock – sheep and lambs									
Number of sheep and lambs	5,364,844	86,286	96,648	111,972	52,169	54,675	86,503	80,081	126,506
No. of farms reporting sheep and lambs (% of all farms within the jurisdiction)	88,338 (4%)	2,017 (6%)	3,590 (6%)	3,568 (5%)	2,109 (4%)	1,751 (2%)	2,312 (4%)	2,590 (4%)	2,171 (3%)
Average no. of sheep and lambs per farm	61	43	27	31	25	31	37	31	58
Selected livestock – Broilers and other meat-type chickens									
Number of broilers and other meat-type chickens	1,506,276,846	591,576	29,248,115	12,194,024	6,238,623	115,927	1,125,601	7,818,682	7,765,172
No. of farms reporting broilers and other meat-type chickens (% of all farms within the jurisdiction)	42,226 (2%)	1,105 (3%)	1,761 (3%)	1,595 (2%)	942 (2%)	507 (1%)	1,366 (3%)	1,724 (2%)	1,287 (2%)
Average no. of broilers and other meat-type chickens per farm	35,672	535	16,609	7,645	6,623	229	824	4,535	6,034



**Table 3a: Select data from the 2012 Census of Agriculture on farms, manure application and livestock
(U.S. states within the Great Lakes Basin) (continued)**

	U.S. (total)	New York	Pennsylvania	Ohio	Indiana	Illinois	Michigan	Wisconsin	Minnesota
Selected livestock – layer chickens									
No. of layers	350,715,978	5,208,831	25,147,630	28,312,692	25,587,222	4,327,311	12,676,021	5,413,563	9,693,648
No. of farms reporting layers (% of all farms within the jurisdiction)	198,272 (9%)	5,686 (16%)	9,539 (16%)	8,548 (11%)	5,584 (10%)	3,725 (5%)	6,783 (13%)	7,348 (11%)	4,501 (6%)
Average no. of layers per farm	1,769	916	2,636	3,312	4,582	1,162	1,869	737	2,154

Source: United States Department of Agriculture, 2014



Table 3b: Select data from the 2012 Census of Agriculture on farms, manure application and livestock (U.S. states outside the Great Lakes Basin) le

	U.S. (total)	Maryland	Iowa	N. Carolina
Number of farms	2,109,303	12,256	88,637	50,218
Total farm area	914.5 million acres 370 million ha	2.0 million acres (0.82 million ha)	30.6 million acres (12.4 million ha)	8.4 million acres (3.4 million ha)
Average size of farm	434 acres (176 ha)	166 acres (67 ha)	345 acres (140 ha)	168 acres (68 ha)
Median size of farm	80 acres (32 ha)	50 acres (20 ha)	136 acres (55 ha)	51 acres (21 ha)
Cropland				
Farms reporting harvested cropland (% of all farms within the jurisdiction)	1,288,875 (61%)	7,530 (61%)	63,214 (71%)	32,802 (65%)
Total area of harvested cropland	315.0 million acres (127.5 million ha)	1.3 million acres (0.52 million ha)	24.5 million acres (9.9 million ha)	4.4 million acres (1.8 million ha)
Manure application				
No. of farms applying manure (% of all farms within the jurisdiction)	275,420 (13%)	2,634 (21%)	19,443 (22%)	7,427 (15%)
Cumulative area of manure application	22.1 million acres (8.9 million ha)	0.20 million acres (84,405 ha)	2.3 million acres (0.95 million ha)	0.45 million acres (0.18 million ha)
Selected livestock – cattle and calves				
Total cattle and calves	89,994,614	194,524	3,893,683	829,717
No. of farms reporting cattle and calves (% of all farms within the jurisdiction)	913,246 (43%)	3,499 (29%)	26,827 (30%)	19,548 (39%)
Average no. of cattle and calves per farm	99	56	145	42
Selected livestock – hogs and pigs				
Number of hogs and pigs	66,026,785	19,869	20,455,666	8,901,434
No. of farms reporting hogs and pigs (% of all farms within the jurisdiction)	63,246 (3%)	333 (3%)	6,266 (7%)	2,217 (4%)
Average no. of hogs and pigs per farm	1,044	60	3,265	4,015



Table 3b: Select data from the 2012 Census of Agriculture on farms, manure application and livestock (U.S. states outside the Great Lakes Basin) (continued)

	U.S. (total)	Maryland	Iowa	N. Carolina
Selected livestock – sheep and lambs				
Number of sheep and lambs	5,364,844	19,265	165,815	29,224
No. of farms reporting sheep and lambs (% of all farms within the jurisdiction)	88,338 (4%)	663 (5%)	2,904 (3%)	1,311 (3%)
Average no. of sheep and lambs per farm	61	29	57	22
Selected livestock – broilers and other meat-type chickens				
Number of broilers and other meat-type chickens	1,506,276,846	64,192,426	1,948,950	148,251,469
No. of farms reporting broilers and other meat-type chickens (% of all farms within the jurisdiction)	42,226 (2%)	785 (6%)	730 (1%)	2,022 (4%)
Average no. of broilers and other meat-type chickens per farm	35,672	81,774	2,670	73,319
Selected livestock – layer chickens				
No. of layers	350,715,978	2,364,942	52,218,870	12,748,275
No. of farms reporting layers (% of all farms within the jurisdiction)	198,272 (9%)	1,544 (13%)	3,821 (4%)	4,996 (4%)
Average no. of layers per farm	1,769	1,532	13,666	2,552

Source: United States Department of Agriculture, 2014

The U.S. EPA sets specific standards and procedures for the NPDES permit program for the states authorized to implement the program; however, authorized states are allowed to refine these guidelines and create stricter requirements based on their individual state's needs. The U.S. EPA requires states to include specific guidelines in their NPDES permitting program for the construction of manure storage structures and development of a Nutrient Management Plan (NMP). In particular, all manure storage structures be built to withstand a 25-year, 24-hour rainfall event, or for new poultry, veal, and swine operations, a 100-year, 24-hour rainfall event. The program also requires that manure be tested once a year and soil where manure is placed be tested at least once every 5 years (USDA U.S. EPA – Unified National Strategy for AFO). CAFO rules do not require the use of lagoon covers, but do require the installation of depth markers if an operation chooses to use a lagoon for manure storage.



The federal rules require that a CAFO develop and implement a nutrient management plan that incorporates specific requirements based on a field-specific assessment of the potential for nitrogen and phosphorus transport from a land application field. For states authorized to administer the NPDES program, the federal rules require development of technical standards that include a field-specific assessment of the potential for nitrogen and phosphorus transport from the field to surface waters. The U.S. EPA's NPDES Permit Writers Manual for CAFOs includes discussion of three methods for phosphorus runoff assessment, one method being the use of the P-Index, commonly used by a number of states. The P-Index is utilized to assess the risk of phosphorus (P) delivery to surface waters. The P-index uses source and transport factors to approximate the amount of P loads to the surface water, and arranges the source factors into three components that represent main transport mechanisms. The three components are erosion (sediment loss), runoff (water loss), and subsurface drainage (water movement through tile and/or coarse subsoil/substrata). The index sums the three components to get an overall estimate of P delivery to surface water, which is then placed into five risk classes, ranging from very low to very high. The P-Index allows soil phosphorus concentrations of up to 150 parts per million (ppm) while only allowing commercial fertilizer to a limited agronomic rate of up to 40 ppm (USDA NRCS – Phosphorus Assessment Tool).

The United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) provides technical, and in many cases, financial assistance, for adoption of practices that will protect the country's natural resources. NRCS offers the Environmental Quality Incentive Program (EQIP) financial assistance program for the storage, treatment, and implementation of conservation practices to CAFO/AFOs. The program is federally administered and offered to all operations across the nation. Many other financial programs are offered to CAFOs/operations through individual states or local organizations to minimize potential runoff and damage to the Great Lakes.

U.S EPA Region 5 states, Indiana, Illinois, Michigan, Minnesota, Ohio, and Wisconsin, define medium CAFOs, similar to the federal regulations, as an animal feeding operation that not only has animal numbers within a specific range, but for which pollutants are discharged either directly to a water or are discharged through a man-made conveyance. The definition for a large CAFO does not include the requirement that the facility discharges pollutants.

A summary of the definitions and standards used by jurisdictions considered in this study, both within and outside the Great Lakes Basin, is included in Table 4.



Table 4: Overview of the definitions and standards related to animal feeding operations and manure management in the subject jurisdictions within and outside the Great Lakes Basin

Jurisdiction	Regulated feeding operations	Animal numbers/nutrient units	Manure volume by livestock type/stage	Nutrient content by livestock type/stage
Ontario	<ul style="list-style-type: none">Under Ontario Regulation 267/03 within the Nutrient Management Act, the regulated farm size is based on a Farming Unit, which includes all livestock facilities within a farming operation, as declared by the farmer. The farming unit can include more than one deed, but never be less than a deed, and can include fields with no livestock.	<p>Nutrient Units (NU) are defined as “the amount of nutrients that give the fertilizer replacement value of the lower of 43 kg of nitrogen or 55 kg of phosphate”. A NU approximately fertilizes one acre of land (varies depending on fertilizer use and crop type and yield). E.g.,</p> <ul style="list-style-type: none">one beef-brood cow (including calves until weaning): 1 NUone dry sow/boar: 0.3 NUone meat ewe/ram (including unweaned offspring and replacements): 0.125 NU150 laying hens: 1 NU	<p>A detailed chart in NMA (http://www.omafra.gov.on.ca/english/nm/regs/nmp/ro/nmtabtc-12.htm) categorizes nutrient units and manure volume calculations based on type of animal (e.g., a chicken), subtype of animal (e.g., a laying hen) and housing condition (e.g., high rise with manure stored in barn). Column 2 of this chart gives an average weight of a specific subtype of animal. The user can edit this for a specific operation however edits must be justified to be approved. When manure volume is calculated, additional inputs such as rainwater or cleaning water (example, milk house waste) must be taken into account.</p>	<p>A detailed chart in NMA (http://www.omafra.gov.on.ca/english/nm/regs/nmp/ro/nmtabtc-12.htm) categorizes nutrient units and manure volume calculations based on type of animal (e.g., a chicken), subtype of animal (e.g., a laying hen) and housing condition (e.g., high rise with manure stored in barn). Column 2 of this chart gives an average weight of a specific subtype of animal. The user can edit this for a specific operation however edits must be justified to be approved. When manure volume is calculated, additional inputs such as rainwater or cleaning water (example, milk house waste) must be taken into account.</p>
United States	<ul style="list-style-type: none">Large CAFO – 700 mature dairy cows, milked or dry - 1,000 veal calves - 1,000 cattle, other than veal or dairy; 2,500 swine 55lb+ or 10,000 swine less than 55lb; 500 horses; 10,000 sheep/lamb; 55,000 turkeys; 30,000 laying hens, liquid manure handling system - 125,000 chickens (other than laying hens), other than liquid manure; 82,000 laying hens, other than liquid manure handling system; 30,000 ducks liquid manure - 5,000 ducks other than liquid manureMedium CAFO – 200-699 mature dairy cows, milked or dry - 300-999 veal calves - 300-999 cattle, other than veal or dairy; 750-2,499 swine 55lb+ or 3,000-9,999 swine less than 55lb; 150-499 horses; 3,000-9,999 sheep/lamb; 16,500-54,999 turkeys; 9,000-29,999 laying hens, liquid manure handling system - 37,500-124,999 chickens (other than laying hens), other than liquid manure; 25,000-81,999 laying hens, other than liquid manure; 10,000-29,999 ducks liquid manure - 1,500-4,999 ducks other than liquid manure	<p>The standard unit used in calculating the relative grazing impact of different kinds and classes of livestock is defined as 1000lb (450kg) beef cow with or without a nursing calf, with a daily dry matter forage requirement of 26lb (11.8kg) – below are a selection of conversion factors</p> <ul style="list-style-type: none">Brood cows and slaughter/feeder cattle (1.0)Milking dairy cows (1.4)Swine weighing over 55lb (0.4)Sheep, lambs, or goats (0.1)Laying hens/broilers (0.005)Laying hens/broilers (0.01) – if facility has continuous overflow wateringLaying hens/broilers (0.03) – if facility has liquid manure handling system	<p>Beef cow – 75lb/day Dairy cow – 120lb/day Finishing pig (200lb) – 13.1lb/day Chickens (layers) – 0.21lb/day Chickens (broilers) – 0.14lb/day</p>	<p>Beef cow – 65lb of Nitrogen and 65lb of Phosphorus Dairy cow – 55lb of Nitrogen and 70lb of Phosphorus Finishing pig (200lb) – 10lb of Nitrogen and 10lb of Phosphorus Chickens (layers) – 0.5lb of Nitrogen and 0.5lb of Phosphorus Chickens (broilers) – 0.35lb of Nitrogen and 0.35lb of Phosphorus ** lb per year</p>
New York	<ul style="list-style-type: none">Large and medium CAFO same as federal – small is anything less than medium CAFO’s criteria.The following CAFO owner/operators are eligible for coverage under this general permit if they fully implement all required practices identified in the CNMP and are complying with the terms of this general permit: new and existing small, medium, or large CAFO’s or existing small or medium CAFO expanding into medium or large CAFO	Same as federal (see row for United States)	Same as federal (see row for United States)	Same as federal (see row for United States)
Pennsylvania	Only farms that fall within the classification of medium or large CAFO are required to obtain a permit. Small farms could still be required to obtain a permit depending on the proximity to state waters and the amount of discharge/runoff coming from the facility.	<p>Pennsylvania State University Extension defines an Animal Equivalent Unit (AEU) as “1,000 pounds of live weight of any animal on an annual basis.” The AEU can be calculated as the following = [average number of animals on a typical day that the animals are there x animal weight (lb) ÷ 1,000] x [number of days the animals are on the operation per year ÷ 365]</p>	Same as federal (see row for United States)	Same as federal (see row for United States)
Ohio	Farms that fall within the classification of medium or large CAFO are required to obtain a permit. In Ohio, an animal feeding facility that has a total design capacity for a specified number of animals is considered a concentrated animal feeding facility (CAFF). CAFF’s are required to obtain a permit to install (PTI) and permit to operate (PTO) from the Ohio Department of Agriculture. CAFF’s that discharge must obtain an NPDES permit. Small farms could still be required to obtain a permit depending on the proximity to state waters and the amount of discharge/runoff coming from the facility.	Same as federal (see row for United States)	Same as federal (see row for United States)	Same as federal (see row for United States)



Table 4: Overview of the definitions and standards related to animal feeding operations and manure management in the subject jurisdictions within and outside the Great Lakes Basin (continued)

Jurisdiction	Regulated feeding operations	Animal numbers/nutrient units	Manure volume by livestock type/stage	Nutrient content by livestock type/stage
Indiana	An animal feeding operation with at least 300 cattle, 600 swine or sheep, 30,000 poultry, or 500 horses in confinement is a Confined Feeding Operation (CFO). A person must request and receive IDEM approval before operating a CFO, starting construction of a CFO, or starting expansion of a CFO to increase animal capacity or manure containment capacity. CFO and CAFOs have different size requirements. The CFO program is a state program and is not the same as the NPDES program which Indiana administers. Currently, there are no CAFOs with an NDPEs permit in Indiana.	Same as federal (see row for United States)	Same as federal (see row for United States)	Same as federal (see row for United States)
Illinois	Farms that fall within the classification of medium or large CAFOs or AFOs that are designed as CAFOs, are required to obtain a permit. Small farms could still be required to obtain a permit depending on the proximity to state waters and the amount of discharge/runoff coming from the facility.	The Illinois Department of Agriculture sets calculation standards for animal number thresholds. <ul style="list-style-type: none">• Mature dairy cow (1.4)• Dairy heifers and calves (0.6)• Feeder cows (1.0)• Swine over 55 lb (0.4)• Swine under 55 lb (0.03)• Laying hens/broilers – liquid manure system (0.03)• Ducks (0.02)	Same as federal (see row for United States)	Same as federal (see row for United States)
Michigan	Michigan follows the criteria set forth by the U.S. EPA when categorizing CAFOs. All Michigan livestock farms that meet the U.S. EPA criteria for “large” CAFO must obtain a Michigan NPDES CAFO permit. An AFO, which is a medium CAFO, may be required to obtain an individual or general NPDES permit if it meets the following: has been designated by the MDEQ as a CAFO under R 323.2196(3), discharges pollutants from the production area into waters of the state through a manmade ditch, pipe, or similar manmade conveyance, or discharges pollutants directly into waters of the state from the production area which originate outside of and pass over, across, or through the facility. Small farms could still be required to obtain a permit depending on the proximity to state waters, the amount of discharge/runoff coming from the facility, or if they meet requirements specified in state laws.	Michigan DEQ sets a threshold of animal units for groundwater permits as follows: <ul style="list-style-type: none">• Slaughter/feeder cattle (including heifers and veal) – 5,000 animals• Mature dairy cattle – 3,500 animals• Hogs over 55 lb – 12,500 animals• Laying hens or broilers – 150,000 animals• Turkeys – 275,000 animals	Michigan Generally Accepted Agricultural and Management Practices (GAAMPS) have calculations outlining manure and manure nutrients produced by different livestock species. For example, a heifer weighing 970lb would produce 48.0 lb of total wet manure a day and 8.2 lb of total solid manure a day.	GAAMPS also has calculations outlining the amount of nutrients produced per day by different livestock types. According to the calculations, a 970 lb heifer would produce 0.26 lb N, 0.101 lb P ₂ O ₅ and 0.132 lb of K ₂ O a day.
Wisconsin	The WI DNR administers the NPDES permit program for the state of Wisconsin. CAFO with an animal number of 1,000 or more is a large CAFO and is required to apply for and obtain a WPDES permit. The WI DNR may designate a smaller scale animal feeding operation (fewer than 1,000 AU) as a CAFO if it has pollution discharges to navigable waters through a man-made conveyance or contaminates a well. A permit application shall be submitted before any such discharge.	The WI DNR sets thresholds for calculating animal/nutrient unit as: <ul style="list-style-type: none">• Heifers over 800 lb (1.4)• Heifers under 800 lb (1.1)• Bulls (1.4)• Steer or cows – 400 lb to market (1.0)• Veal calves (0.5)• Horse (2.0)• Sows (0.4)• Boars (0.5)	*lb/day/1,000-lb animal unit (nracs.usda.gov) Beef – 59.1 Dairy – 80.0 Hogs/pigs – 63.1 Chickens (layers) – 60.5 Chickens (broilers) – 80.0	*lb/day/1,000-lb animal unit (nracs.usda.gov) Beef – 0.31 N and 0.11 P Dairy – 0.45 N and 0.07 P Hogs/pigs – 0.42 N and 0.16 P Chickens (layers) – 0.83 N and 0.31 P Chickens (broilers) – 1.10 N and 0.34 P



Table 4: Overview of the definitions and standards related to animal feeding operations and manure management in the subject jurisdictions within and outside the Great Lakes Basin (continued)

Jurisdiction	Regulated feeding operations	Animal numbers/nutrient units	Manure volume by livestock type/stage	Nutrient content by livestock type/stage
Minnesota	<p>A State Disposal System (SDS) permit is a state run program and is required for any facility that currently has capacity or is proposing to have capacity for a total of 1,000+ animal. Similar to federal regulations, Minnesota regulation provides that no CAFO may discharge without a permit authorizing discharge. A facility that is required to obtain an SDS permit may choose to obtain an NPDES permit in lieu of the SDS permit.</p>	<p>The Minnesota Department of Agriculture sets the threshold for animal unit calculation as follows:</p> <ul style="list-style-type: none">• Slaughter steer or stock cow (1.0)• Mature dairy cows (1.4)• Swine weighing over 300 lb (0.4)• Swine between 55-300 lb (0.3)• Sheep and lambs (0.1)• Laying hen/broiler – liquid manure system (0.033)• Chicken over 5 lb – dry manure system (0.005)	<p>Minnesota Department of Agriculture along with the University of Minnesota Extension have created guidelines outlining the annual manure production and nutrient excretion from livestock. The annual manure production per 1,000 lb if animal weight is as followed:</p> <ul style="list-style-type: none">• Beef cow - 16.8 tons/year• Dairy heifer – 11.0 tons/year• Veal – 4.8 tons/year• Boar – 3.8 tons/year• Finishing swine – 9.0 tons/year• Layer chicken – 9.1 tons/year• Broiler chicken – 17.3 tons/year	<p>The nutrient excretion for nitrogen annually is given in lb/tons and is as follows:</p> <ul style="list-style-type: none">• Beef cow – 7• Dairy heifer – 11• Finishing swine – 16• Broiler chicken – 46• Layer chickens – 34
Saskatchewan	<ul style="list-style-type: none">• Under the <i>Agricultural Operations Act</i> (AOA), an “intensive livestock operation” (ILO) means the confining of animals (poultry, hogs, sheep, goats, cattle, horses and any other prescribed animals), where the space per animal unit is less than 370 square metres.• Minister approval of a waste storage plan and a waste management plan are required for ILOs that: 1) contain an earthen manure storage area or a lagoon; 2) involves the rearing, confinement or feeding of 300 or more animal units for more than 10 days in any 30-day period; or 3) involves the rearing, confinement or feeding of more than 20 animal units but less than 300 animal units, for more than 10 days in any 30-day period, and any part of which is located within 300 m of surface water or 30 m of a domestic water well not controlled by the operator of the ILO.	<p>Animal units are defined by the Agricultural Operations Regulations; e.g.,</p> <ul style="list-style-type: none">• one cow or bull: 1 AU• one boar or sow: 0.33 AU• one ram or ewe: 0.14 AU• one hen: 0.01 AU	<p>The AOA does not prescribe specific approaches for estimating manure volumes, animal turnover and weights. However, such information must be estimated using accepted standard values or specific management practices, and included in the operation’s waste management plan for review and approval by the Minister of Agriculture.</p>	<p>The AOA does not prescribe specific approaches for estimating how manure volumes and nutrient content vary among livestock type and stage. However, such information must be estimated using accepted standard values or specific management practices, and included in the operation’s waste management plan for review and approval by the Minister of Agriculture.</p>
Alberta	<ul style="list-style-type: none">• “Confined feeding operation” (CFO) is defined in the Agricultural Operation Practices Act (AOPA) as “fenced or enclosed land or buildings where livestock are confined for the purpose of growing, sustaining, finishing or breeding by means other than grazing and any other building or structure directly related to that purpose but does not include residences, livestock seasonal feeding and bedding sites, equestrian stables, auction markets, race tracks or exhibition grounds”.• Larger CFOs (e.g. 200+ lactating cows) require approvals; smaller CFOs (e.g. 50 - 199 lactating cows) require registrations; operations falling below the threshold for smaller CFOs do not require any permits, but may be subject to municipal requirements. Threshold levels by category of livestock (beef, poultry, etc.) and type of livestock (species, age, function, etc.) are listed in Schedule 2 of the Part 2 Matters Regulation.• Manure storage facilities and manure collection areas require authorizations.• Per Section 28 of the AOPA Standards and Administration Regulation, CFOs and anyone who handles 500 tonnes or more per year of manure must keep records for a minimum of 5 years.	<p>Animal units for various types of livestock are listed in Schedule 1 of the Part 2 Matters Regulation, e.g.,</p> <ul style="list-style-type: none">• one dry cow: 1 AU• one feeder swine or boar: 0.2 AU• one ewe or ram: 0.2 AU• one breeder chicken: 0.01 AU	<p>The Manure Characteristics and Land Base Code under the AOPA outlines, for various types of livestock, estimates of the daily, monthly, 9-month and yearly production of liquid and solid manure in gallons, litres and cubic feet; e.g.,</p> <ul style="list-style-type: none">• Liquid manure production of a free stall dry cow: 43 L / 9.5 gal / 1.5 ft³ per day; 1,290 L / 284 gal / 46 ft³ per month; 11.8 m³ / 2,593 gal / 416 ft³ per 9 months; 15.7 m³ / 3,454 gal / 554 ft³ per year.• Liquid manure production of one feeder swine or boar: 7.1 L / 1.6 gal / 0.25 ft³ per day, etc.• Liquid manure production of 100 layer chickens: 27.1 L / 6.0 gal / 0.95 ft³ per day, etc.	<p>The Manure Characteristics and Land Base Code under the AOPA provides estimates of crop-available nitrogen for various livestock types, e.g.,</p> <ul style="list-style-type: none">• one cow: 6.5 lbs of crop-available N per ton of manure• one swine: 3.1 lbs of crop-available N per ton of liquid manure• one ewe or ram: 7.2 lbs of crop-available N per ton of manure• one layer chicken: 7.5 lbs of crop-available N per ton of liquid manure



Table 4: Overview of the definitions and standards related to animal feeding operations and manure management in the subject jurisdictions within and outside the Great Lakes Basin (continued)

Jurisdiction	Regulated feeding operations	Animal numbers/nutrient units	Manure volume by livestock type/stage	Nutrient content by livestock type/stage
Iowa	<ul style="list-style-type: none">• A “small animal feeding operation” is an animal feeding operation which has an animal unit capacity of 500 or fewer animal units.• A “confinement feeding operation” is an animal feeding operation in which animals are confined to areas which are totally roofed and includes every feeding operation that is not an “open feedlot operation”.• An “open feedlot operation” is an unroofed or partially roofed animal feeding operation if crop, vegetation or forage growth or residue is not maintained as part of the animal feeding operation during the period that animals are confined in the animal feeding operation.• The definitions above are defined under rules 567—65.1 (459,459B) and 567—65.100 (455B,459,459A) of the Iowa Administrative Code.	<p>Animal units are defined under rules 567—65.1 (459,459B) and 567—65.100 (455B,459,459A) of the Iowa Administrative Code; e.g.</p> <ul style="list-style-type: none">• one slaughter and feeder cattle or immature dairy cattle: 1 AU• one butcher or breeding swine weighing more than 55 lbs: 0.4 AU• one sheep or lamb: 0.1 AU• one broiler or layer chicken weighing 3 lbs or more: 0.01 AU.	<p>Table 5 of Chapter 65 (Animal Feeding Operations) of the Iowa Administrative Code lists the manure production for various livestock types and stages; e.g.,</p> <ul style="list-style-type: none">• one mature cow produces 12.23 tons of solid manure per year• one grow-finish swine (150 lbs) produces 2.05 tons of solid manure per year• 1000 layer chickens produce 10.5 tons of dry manure per year	<p>Tables 3 and 3a of Chapter 65 (Animal Feeding Operations) of the Iowa Administrative Code lists the annual pounds of nitrogen and annual pounds of phosphorus (as P₂O₅), respectively produced by various types and stages of livestock, e.g.,</p> <ul style="list-style-type: none">• one mature cow produces 147 lbs of nitrogen and 73 lbs of phosphorus in solid manure• one grow-finish swine (150 lbs) produces 29 lbs of nitrogen and 18 lbs of phosphorus in solid manure• 1000 layer chickens produce 367 lbs of nitrogen and 840 lbs of phosphorus in solid manure
Maryland	<ul style="list-style-type: none">• An Animal Feeding Operation (AFO) is an operation that confines livestock for at least 45 days per year and does not grow crops or forage where the animals are confined.• Thresholds for determining the size of an AFO vary by type of livestock, and are defined in the Code of Maryland Regulations (Sec. 26.08.03.09. Animal Feeding Operations); e.g., Large AFO: greater than or equal to 1,000 cattle, 2,500 swine greater than 55 lbs, 10,000 sheep/lambs, or 30,000 chickens with liquid manure handling; Medium AFO: 300-999 cattle, 750-2,499 swine greater than 55 lbs, 3,000-9,999 sheep/lambs, or 9,000-29,999 chickens with liquid manure handling; Small AFO: less than 300 cattle, less than 750 swine greater than 55 lbs, less than 3,000 sheep/lambs, or less than 9,000 chickens with liquid manure handling.• A Confined Animal Feeding Operation (CAFO) is a medium or large AFO which may discharge manure, litter or process wastewater to surface waters of the State during wet weather events.• A Maryland Animal Feeding Operation (MAFO) is a large AFO that does NOT discharge manure, litter or process wastewater to surface waters of the State during wet weather events.• All medium chicken (other than laying hens) AFOs that are not designed, constructed, operated and maintained such that a discharge could occur, not categorized as a CAFO or MAFO and with a total house capacity of 75,000 to 100,000 ft² are required to submit a Certification of Conformance prior to operation.	<ul style="list-style-type: none">• One animal unit is equivalent to 1,000 lbs of live animal weight.	<p>Manure volumes are estimated using the USDA NRCA’s “Agricultural Waste Management Field Handbook, Part 651” (March 2008). E.g.,</p> <ul style="list-style-type: none">• one dry cow produces 85 lbs of manure per day;• one 440-lb boar produces 8.4 lbs of manure per day;• 1000 lbs live weight of lamb produce 40 lbs of manure per day;• one layer chicken produces 0.19 lbs of manure per day.	<p>Manure nutrient content is estimated using the USDA NRCA’s “Agricultural Waste Management Field Handbook, Part 651” (March 2008). E.g.,</p> <ul style="list-style-type: none">• one dry cow produces 0.50 lbs of nitrogen, 0.07 lbs of phosphorus and 0.16 lbs of potassium in its manure each day;• one 440-lb boar produces 0.061 lbs of nitrogen, 0.021 lbs of phosphorus and 0.039 lbs of potassium in its manure each day;• 1000 lbs live weight of lamb produce 0.45 lbs of nitrogen, 0.07 lbs of phosphorus, and 0.30 lbs of potassium in their manure each day;• one layer chicken produces 0.0035 lbs of nitrogen, 0.0011 lbs of phosphorus and 0.0013 lbs of potassium in its manure each day.
North Carolina	<p>A State Nondischarge General Permit is required for animal operations. Per North Carolina General Statute 143-215.10B:</p> <ul style="list-style-type: none">• An “animal operation” is any agricultural feedlot activity involving 250 or more swine, 100 or more confined cattle, 75 or more horses, 1,000 or more sheep, or 30,000 or more confined poultry with a liquid animal waste management system, or any agricultural feedlot activity with a liquid animal waste management system that discharges to the surface waters of the State.• An “Animal waste management system” means a combination of structures and non-structural practices serving a feedlot that provide for the collection, treatment, storage, or land application of animal waste. <p>Larger animal operations (with 1,000 animal units or more) have the options of being permitted under the NPDES General Permit or the State Nondischarge General Permit.</p>	<p>1,000 animal units are equivalent to:</p> <ul style="list-style-type: none">• 2,500 swine greater than 55 lbs• 1,000 cattle• 700 mature dairy cows• 30,000 poultry with a liquid waste system	<p>The North Carolina Department of Agriculture and Conservation Services outlines the estimated manure production in gallons or tons per animal per year; e.g.,</p> <ul style="list-style-type: none">• One brood cow produces 3.0 tons per year;• For anaerobic lagoon liquid, one farrow-to-finish sow produces 10,478 gallons of manure per year;• one milk cow produces 7,749 gallons of manure per year;• For anaerobic lagoon liquid, 1,000 layer chickens produce 25,373 gallons per year.	<p>The North Carolina Department of Agriculture and Conservation Services outlines nutrient content for various livestock, e.g.,</p> <ul style="list-style-type: none">• For anaerobic lagoon liquid, 1,000 gallons of manure from farrow-to-finish swine contains 3.6 lbs of nitrogen, 1.4 lbs of phosphorus (as P₂O₅), and 8.3 lbs of potassium (as K₂O).• For beef (scraped manure), each ton of manure contains 13.0 lbs of nitrogen, 8.3 lbs of phosphorus (as P₂O₅), and 13.6 lbs of potassium (as K₂O).



Table 4: Overview of the definitions and standards related to animal feeding operations and manure management in the subject jurisdictions within and outside the Great Lakes Basin (continued)

Jurisdiction	Regulated feeding operations	Animal numbers/nutrient units	Manure volume by livestock type/stage	Nutrient content by livestock type/stage
Netherlands	<ul style="list-style-type: none">• Under the Dutch Manure Policy, all agricultural operations must be registered with the Netherlands Enterprise Agency, and must maintain records on the production, supply, disposal and use of fertilizers, including manure.• Small companies are exempted from the record-keeping and registration requirements of the Dutch manure policy. A small company is one that does not produce or supply more than 350 kg of nitrogen in animal fertilizers per year, and consists of less than 3 hectares of agricultural land in a given year.• The EU Nitrates Directive sets a usage standard for the use of animal manure at a maximum of 170 kg of nitrogen per hectare. Member States may obtain a derogation to exceed the limit, under strict conditions. In the Netherlands, for the period 2014 - 2017, a farm may register to increase the application limit to 230 or 250 kg of nitrogen per hectare, provided it meets the conditions for derogation; e.g. preparation of a fertilization plan, a minimum of 80 percent of the total area of agricultural land must consist of grassland, etc.	<p>“Pig units” and “poultry units” listed in Table 11 of the Dutch Manure Policy, assign a numerical value to pigs and poultry based on age and size. Younger/smaller individuals are generally worth a smaller number of pig/poultry units compared to older/larger individuals. E.g.,</p> <ul style="list-style-type: none">• One piglet: 0.36 pig units• One pig raised for meat (approx. 125 kg): 1 pig unit• One breed sow including piglets younger than 6 weeks: 1.97 pig units.• One hen/rooster (6 weeks and older): 1 poultry unit• One breeding turkey: 2.94 poultry units• One layer chicken (younger than 6 weeks): 0.4 poultry units	<p>Table 4 of the Dutch Manure Policy outlines manure production for various types of livestock, estimated as volume of manure produced during the period August 1 - March 1 (the standard used to calculate the required manure storage capacity). E.g.,</p> <ul style="list-style-type: none">• One bull (1 year and older): 7.6 m³• One sheep: 0.5 m³• One pig raised for meat: 0.71 m³• One broiler chicken (20 weeks or older): 0.018 m³	<p>Table 4 of the Dutch Manure Policy outlines manure production in kilograms of nitrogen and kilograms of phosphate, for various types of livestock. E.g.,</p> <ul style="list-style-type: none">• One bull (1 year and older): 72.2 kg N and 25.9 kg phosphate per day• One sheep: 9.9 kg N, 3.3 kg phosphate per day• One pig raised for meat: 11.1 kg N per day• One broiler chicken (20 weeks or older): 0.45 - 0.68 kg N per day
Denmark	<ul style="list-style-type: none">• The Danish Nitrates Action Programme is derived from the European Union's 1991 Nitrates Directive.• The Danish “harmony rules” aim to achieve a balance between the use of manure and fertilizer with the size of the land application area. The rules apply to commercial livestock operations, or operations that use and/or store manure from a commercial livestock operation. Minimum size requirements to be considered a commercial livestock operation are defined for various species (e.g. 30 chickens, 4 horses with accompanying foals, etc.).	<p>One livestock unit (LU) is equivalent to 100 kg of nitrogen in livestock manure in the best modern production system with the lowest ammonia emission.</p>	<p>Nationally-defined standards are used to estimate manure volumes. Operations are required to report the livestock types and headcounts and land application areas on an annual basis through the Fertilizer Accounting System, which then calculates manure volumes and nutrient application limits for a given operation. Details on the standard manure volumes by livestock type were not readily available.</p>	<p>Livestock types, ages and functions, and housing systems are taken into account in the nationally defined standards of nitrogen and phosphorus content in manure (Table 5 of the Guidance on Fertilizer and Harmony Rules). E.g.,</p> <ul style="list-style-type: none">• One cow (over 600 kg): 22.7 - 72.1 kg of nitrogen, 0.9 - 7.7 kg of phosphorus, and 15.2 - 90.6 kg of potassium per year.• 10 pigs: 24.3-25.9 kg of nitrogen, 6.35-6.37 kg of phosphorus, and 13.9-14.2 kg of potassium per year.• One sheep: 14.6 kg of nitrogen, 3.1 kg of potassium, and 30.5 kg of phosphorus per year.• 100 chickens: 5.48-5.68 kg of nitrogen, 2.59-2.82 kg of phosphorus, and 3.64-4.09 kg of potassium per year.



3.2 LEGISLATION AND POLICIES GUIDING PERMITTING REQUIREMENTS FOR MANURE USE, MANAGEMENT, STORAGE AND DISPOSAL – WITHIN THE GREAT LAKES BASIN

3.2.1 Ontario

Ontario's agricultural industry accounts for almost 25 percent of Canada's agricultural production, and about one-third of the Ontario portion of the Great Lakes Basin is used for agricultural purposes (OMAFRA, 2016a). Ontario's 49,500 farms are concentrated heavily in the Great Lakes Basin (Statistics Canada, 2017d), and approximately 45 percent of the province's farms are reported to be applying manure (Statistics Canada, 2017b; see also Table 2). Approximately 19,400 of the province's 49,500 farms support livestock (Statistics Canada, 2017e).

In the case of Dairy and Poultry, the Canadian Supply Management system results in smaller sized farm units. For example, in the case of Dairy, in order to sell milk, a farming operation requires a quota, which typically has been in the cost range of \$22-25,000 dollars per cow. Thus, a 100-cow herd would potentially require up to \$2.5 million in quota. In addition for dairy, there are limitations to obtaining quota which reduces the potential of larger herds in a farming operation.

Thirty percent of Ontario's livestock farms are in areas classified as high density (>80 AU per square kilometre (km^2) (> 32 AU/acre) (an AU is one beef cow)). These highly concentrated areas are primarily located in the middle of southwestern Ontario, which is within the Great Lakes Basin (Beaulieu et al., 2001).

Additionally, approximately 8.5 million Canadians live within the Great Lakes Basin (Canadian Geographic, undated). Treated nutrients from human activities (such as from wastewater treatment facilities and food waste composting facilities) are also utilized in this watershed.

The main legislative process in Ontario used to manage nutrients from livestock is the *Nutrient Management Act* (NMA) and its associated regulations and protocols. The NMA splits manure management into two processes. The first process, called the Nutrient Management Strategy, addresses generation, transfer, storage, and destination of manure from the farm unit. The second process, called the Nutrient Management Plan, specifies criteria for the application of manure and fertilizer within the field. It takes into account soil test information, anticipated crop yield and long term crop rotation. Both Nutrient Management Strategies and Nutrient Management Plans must be prepared by a certified person, and the Ontario Ministry of Agricultural, Food and Rural



Affairs carries out oversight of the certified preparers and has an active progressive compliance program which can and does impose sanctions to preparers who do not meet expectations.

The NMA uses a term called Nutrient Unit (NU) to compare manure production from animals and to develop legislative thresholds. In most cases, a NU is approximately equivalent to an Animal Unit in other jurisdictions.

The NMA requires that all expanding farms greater than 5 NU or existing farms greater than 300 NU have a provincial government approved Nutrient Management Strategy completed before construction commences. The local building official ensures that manure storages are constructed following the strategy. This Strategy must be updated every 5 years or when changes occur. As of April 24, 2018 there are 6,285 Farm Units with an NMS (information obtained via email communication with Matt Wilson, Nutrient Management Program Lead, Ontario Ministry of Agriculture, Food and Rural Affairs).

The NMA requires all farms with over 300 NU to follow an ongoing Nutrient Management Plan developed by a trained consultant (there is not a government pre-approval of this plan). This plan must address all nutrient applications on fields. It takes into account soil tests levels, crop type and yield and crop rotation. In addition, all Farm Units with land within 100 meters of a municipal well must have a Nutrient Management Plan.

A standardized software program called NMan is used for both the strategy and plan portions.

Inspections and enforcements of both strategies and plans are completed by Ontario Ministry of the Environment and Climate Change (MOECC) staff. There are a number of compliance tools that can be used in cases where corrective action is required (OMAFRA, 2016b).

Taking water for livestock use is exempt from needing a Permit to Take Water under the *Ontario Water Resources Act* as long as water is not taken into storage for that purpose and the amount of water taken is always less than 379,000 litres per day.

Commercial fertilizer application is identified when applied on land within a farm operation that requires a Nutrient Management Plan. Nutrients from the fertilizer must be taken into account in the Plan and there are some minimum setbacks associated with fertilizer application.

Normally, the largest area that can be represented by a single soil sample is ten hectares (25 acres). Larger fields should be divided, where possible, according to previous field boundaries. Failing this, divisions should be made according to distance from existing or previous barns or manure storages, or according to topography or soil type. A single representative



composite sample for fields larger than 10 hectares, up to a maximum of 20 hectares (50 acres), may be permitted where there is evidence to show that the nutrient content of the field is uniform (within 15 percent of the mean value), and that the management of the field is uniform.

On February 22, 2018, Canada and Ontario released the final Lake Erie Action Plan for achieving phosphorus reductions in Lake Erie from Canadian sources. The development of the draft Canada-Ontario Lake Erie Action Plan was led by five federal and provincial government agencies: Environment and Climate Change Canada, Agriculture and Agri-Food Canada, Ontario Ministry of the Environment and Climate Change, Ontario Ministry of Agriculture, Food and Rural Affairs, and Ontario Ministry of Natural Resources and Forestry. It sets a target of 40 percent phosphorus load reduction by 2025 (from 2008 levels), using an adaptive management approach, for the Ontario portion of the western and central basins of Lake Erie, as well as an aspirational interim goal of a 20 percent reduction by 2020.

3.2.2 New York

New York is located within two Great Lake Basins, Lake Erie Basin and Lake Ontario Basin. Approximately 27 percent, or 9.7 million acres (39,255 km²), of the state is currently used for agricultural purposes or for raising livestock (Farmland Information Centre). New York has around 36,000 farms and more than 500 CAFOs, the majority of which are dairy farms with 300 or more cows (NYDEC). Of the more than 500 CAFOs, only 248 have NPDES permits (U.S. EPA End year 2016 NPDES CAFO Permitting Status Report). Since the 2012 Census, shown in table 3a, the amount of farms in New York has remained relatively constant. The Census also states that roughly 25 percent of all the state's farms apply manure to the land.

The New York State Department of Environmental Conservation (NYSDEC) regulates and distributes State Pollution Discharge Elimination System (SPDES) permits for CAFOs. SPDES follow the guidelines of the NPDES permit set forth by the U.S. EPA, as well as provide regulations and requirements specific to New York. SPDES permits limit manure application by prohibiting the application of manure on soils that are already saturated with liquid, either manure or precipitation, and restricts the spreading of manure on soils that are frozen or that are covered with snow. NYSDEC requires soil tests to be conducted every three years by laboratories successfully meeting the requirements and performance standards of either the North American Proficiency Testing (NAPT) program or the Agricultural Laboratory Proficiency (ALP) program. The tests must include analyses pertinent to monitoring or amending the annual nutrient budget, which includes pH, soil organic matter, phosphorus, and potassium. NYSDEC allows withdrawal of water up to 100,000 gallons (378,541 litres (L)) of water per day in any consecutive 30-day period. NYSDEC does not require operations to use the P-Index, but include it as a nutrient management BMP, as recommended by the U.S. EPA.



New York Agriculture and Markets Law states that commercial fertilizer cannot be used on impervious surfaces and cannot be applied between December 1st and April 1st. Fertilizer use is restricted and cannot be applied within 20 feet (ft) (6 metres (m)) of any surface water of the state and fertilizer containing phosphorus cannot be applied to turf. The use of phosphorus on residential lawns is prohibited; municipalities are authorized to implement stricter laws on the sale and use of lawn fertilizers. However, agricultural lands and productions are exempted from these restrictions.

NYSDEC requires all medium and large CAFOs to obtain an SPDES permit if there is a potential for discharge. The permit requires the CAFO to have a comprehensive nutrient management plan (CNMP) that is developed, reviewed, and certified by an Agricultural Environmental Management (AEM) certified planner. The AEM certified planner is required to review the plan annually, and the owner of the operation is required to keep records of the annual review as well as an updated copy of the CNMP on site, however, the plans are not made available to the public.

NYSDEC monitors permitted facilities by reviewing and analyzing quarterly discharge monitoring reports (DMR) and by performing routine inspections. Inspections typically happen annually and are performed by either the commissioner of the NYSDEC, the U.S. EPA Regional Administrator, or a duly authorized agent. If violations occur, NYSDEC require corrective action to minimize negative impacts, and if necessary, pursues enforcement through the Office of General Counsel or Division of Law Enforcement.

In 2017, the state passed the *Clean Water Infrastructure Act* (CWIA), a \$2.5 billion investment for drinking water infrastructure, clean water infrastructure, and water quality protection. It provides a total of \$50 million in grants to farmers to ensure proper management and storage of manure. Additional resources are available to assist with implementation of the program. For example, Cornell University has created guidelines for farmers such as winter/wet weather manure spreading, and guidelines for limestone bedrock/karst areas. Likewise, the Watershed Agricultural Council Guidance offers assistance in planning and implementing BMPs for the storage, handling, and application of manure.

3.2.3 Pennsylvania

The northwest corner of Pennsylvania is located in the Lake Erie Basin. The state has approximately 59,000 farms, which occupy about a quarter of the state's land. Dairy cows are the most commonly raised livestock with roughly 6,650 dairy operations in the commonwealth. Beef cattle are the second most common livestock raised. The U.S. EPA reports that there are 394 CAFOs in Pennsylvania, of which 381 have NPDES permits. Since the 2012 Census, shown in



table 3a, the amount of farms in Pennsylvania has remained relatively constant and about 33 percent of all of the state's farms apply manure to land.

Pennsylvania Department of Environmental Protection (PADEP) is the governing state agency responsible for issuing NPDES permits and enforcing the requirements of the permit. The PADEP requires all medium and large sized CAFOs to seek permitting under the NPDES permit if they discharge. PADEP requires a notice of intent form be completed before any construction begins on a farm considered a CAFO, whether it be new construction or expansion of an existing operation. PADEP requires CAFOs to obtain a Water Quality Management (WQM) permit, along with an NPDES permit, if the storage facility for manure is located at an animal operation with over 1,000 AUs or if the storage capacity is 1 to 2.5 million gallons (3.8 to 9.5 million L) and proposes to discharge to groundwater. A WQM permit can be obtained from the Regional Clean Water programs under Pennsylvania's Clean Streams Law. WQM permits do not replace NPDES permits and are required to be obtained alongside the NPDES permit. Winter application of manure is limited to 5,000 gallons per acre (46,770 L/ha) for liquid manure, 20 tons per acre (44,834 kg/ha) for dry non-poultry manure, and 3 tons per acre (6,725 kg/ha) for dry poultry manure. PADEP defines winter as the time between December 15th and February 28th. The soils at the operation and in the field that have manure applied to them are required to be sampled and tested once every five years.

The P-Index is used as a field evaluation tool to identify areas that have a high risk of P loss to bodies of surface waters. The phosphorus source indicators used in the Pennsylvania P-Index are the Mehlich 3 Soil Test, fertilizer application rates/methods, and manure application rates/methods. Manure at an operation is required to be collected and analyzed for nitrogen and phosphorus once a year. The guidelines state that manure samples should be taken and sampled as close to the time of manure land application as possible. PADEP restricts water withdrawal to an average rate of 100,000 gallons (378,541 L) per day during any 30-day period.

CAFO operators that are seeking an NPDES permit must keep an updated nutrient management plan (NMP) on site. NMPs are not made readily available to the public. The NMP is reviewed annually and renewed every three years. All amendments, revisions, or new NMPs must be submitted to the PADEP for approval. CAFOs with over 1,000 AUs are inspected annually. For those CAFOs, PADEP also requires that a Pennsylvania registered Professional Engineer certify the structural integrity of manure storage facilities and that this information be included with each renewal application for an NPDES permit. Regardless of whether a permit is required or not, all liquid and semi-solid manure storage facilities must have design prepared, construction overseen, and certification done by a Professional Engineer.



The state of Pennsylvania offers incentive for proper management of CAFOs through the Resource Enhancement and Protection (REAP) program; farmers, landowners, and businesses earn tax credits for implementing BMPs that will enhance farm production and protect natural resources. The program is administered by the State Conservation Commission, and the tax credits are awarded by the Pennsylvania Department of Revenue. Additional information is available to the public through Pennsylvania State University, which provides a nutrient management program, information about the Pennsylvania *Nutrient Management Act*, and other associated technical guidance for the public and operation owners.

PADEP finalized the Pennsylvania Lake Erie Phosphorus Reduction Domestic Action Plan (DAP) to assist in the elimination of nutrient pollution in Lake Erie. The DAP addresses the General and Specific Objectives in Article 3 of the GLWQA and placed special emphasis on the Lake Erie Ecosystem Objectives and Phosphorus Substance Objectives developed with guidance from Annex 2 and Annex 4.

3.2.4 Ohio

The northern one quarter of Ohio lies within the Lake Erie Basin. Approximately 50 percent, or 14 million acres (56,656 km²), of the state's land is used for agricultural purposes. Ohio has 74,500 farms and roughly 150 of those farms are considered large CAFOs (Ohio EPA). The U.S. EPA has identified 221 CAFOs (medium and large) in Ohio, of which 36 have NPDES permits (US EPA NPDES CAFO Permitting Status Report – End year 2016). Ohio's most common livestock are hogs and dairy cows. As indicated on Table 3a, since the 2012 Census, the amount of farms in Ohio has decreased slightly in the past few years. The Census also states that roughly 21 percent of all of the farms in the state are applying manure to the land.

In the state of Ohio, the Ohio Environmental Protection Agency (Ohio EPA) has been delegated by the U.S. EPA to implement the NPDES permit. However, Ohio has petitioned to the U.S. EPA to transfer the CAFO permitting program to the Ohio Department of Agriculture (ODA). Ohio EPA requires that medium and large sized CAFOs obtain an NPDES permit if they discharge or propose to discharge from the operation (Ohio EPA's website). Small CAFOs may be regulated if there is an actual discharge from the facility. All permits proposed for issuance are subject to a 30-day public notice period during which citizens can request a hearing. In Ohio, an animal feeding facility that has a total design capacity for a specified number of animals is considered a concentrated animal feeding facility (CAFF). The ODA requires that a permit to install (PTI) and permit to operate (PTO) be submitted as a notice to the public of any new proposed CAFFs. CAFFs that propose to discharge are also required to obtain an NPDES permit. A listing of permitted livestock farms is available on ODA Livestock Environmental Permitting website.



Additionally, the public may register with ODA on their “interested party list” to receive information on livestock permitting applications.

Ohio EPA has established restrictions on manure application in addition to requirements and regular inspections of the production and land application areas. Manure is not to be applied to cropland with a slope of 15 percent or greater, or to pasture/hay land with a slope of 20 percent or greater unless there is immediate incorporation/injection. Winter applications are not recommended, but if it cannot be avoided, manure cannot be applied to more than 20 contiguous acres (8.1 ha) with a required break of at least 200 ft (61 m). In the western Lake Erie basin, application on frozen ground is prohibited. ODA Division of Soil and Water Resources administers penalties for application of manure on frozen ground. (Agronomic Crops Network – OSU Extension)

Legislation has been passed to further protect the western Lake Erie basin. *The Water Quality Bill* became effective in July of 2015 and requires that major publicly owned treatment works conduct technical and financial capability studies to achieve 1.0 mg/L total phosphorus. The bill designates the director of the Ohio EPA as coordinator of harmful algae management and response and requires the director to implement actions to protect the western Lake Erie basin from cyanobacteria. The bill also prohibits sewage sludge, fertilizer and manure from being applied to frozen grounds located within the western Lake Erie basin. *The Agriculture Water Quality Bill* became effective in August of 2014 and requires fertilizer applicators to become certified and educated on the handling and proper application of fertilizers.

Ohio EPA requires that soil be tested once every three years and analyzed for pH, phosphorous, potassium, calcium, magnesium, and cation exchange capacity. Soil also should be tested 6 months after any application of manure. Ohio EPA recommends either the P-Index or the P soil test as a planning tool designed to help assess and identify fields or areas of fields that have a higher or lower risk of phosphorus runoff from manure/organic materials. Any owner of a facility with the capacity to withdraw water at a quantity greater than 100,000 gallons (378,541 L) per day is required to register such facility with the Ohio Department of Natural Resources Division of Water through the Water Withdrawal Facility Registration Program (WWFR). The WWFR provides information both to the public and with those registered (Ohio DSWR WWFR).

Fertilizer use is restricted in the western Basin of Lake Erie. A person cannot apply fertilizer that contains nitrogen and phosphorus under the following conditions: when the ground is snow covered or frozen, when the top two inches of soil are saturated, or when there is a 50 percent or greater chance of precipitation. These limitations do not apply if the fertilizer can be applied if it is injected into the ground, incorporated within 24 hours of surface application, or if it is



applied onto a growing crop. Small and medium agricultural operations may apply to the chief of the ODA Division of Soil and Water Resources for temporary exemption from the restrictions.

Ohio EPA requires all CAFOs to have an updated manure management plan (MMP) on site at all times. MMPs are also required for CAFFs to obtain a PTO. The MMP should include a nutrient budget based on targeted crop yields as well as manure characteristics and soil characteristics. All new MMPs or changes made to an existing MMP have to be approved by the Ohio EPA and should be conducted periodically to reflect the current design and practices of the CAFO. The Ohio EPA Division of Surface Water operates an enforcement and compliance program that provides technical assistance, as well as handles complaints and inspections. Inspections can be unannounced, random, routine, or due to a tip or complaint. ODA also conducts inspections of CAFFs on a regular basis. If manure runoff causes fish kills, then the ODNR is responsible for handling inspections, violations, and further enforcement. Ohio EPA along with the Ohio Water Development Authority (OWDA) administers the Water Pollution Control Loan Fund (WPCLF) and the Water Supply Revolving Loan Account (WSRLA). These loans offer financial and technical assistance to applicants who are planning, designing, or constructing projects to improve or protect Ohio's water resources, as well as offer assistance to projects that address human health concerns. Additional resources are available through Ohio State University, which provides information and guidelines for manure management, nutrient management, application, and processing. The Ohio Lake Erie Commission and the State of Ohio have completed the Ohio Domestic Action Plan (DAP) 1.0 to reduce phosphorus entering Lake Erie under the binational Great Lakes Water Quality Agreement with a goal of reducing phosphorus loading to Lake Erie by 40 percent by 2025.

3.2.5 Indiana

The northwest corner of Indiana is located within the Lake Michigan Basin and the northeast corner of Indiana is located within the western Lake Erie Basin. Approximately two-thirds of the state's 23 million acres (93,078 km²) are used for agricultural purposes. Indiana is ranked 5th in the nation for swine production (pork.org) and according to the Indiana State Board of Animal Health, the state is ranked 3rd in the nation for egg production. The 2012 Census of Agriculture (see Table 3a in Section 3.1.2), states that Indiana had roughly 58,700 farms (hobby farms, livestock farms, etc.) statewide, with 18 percent of these farms directly applying manure to the land. U.S. EPA reports that Indiana has 758 CAFOs, of which none has an NPDES permit (US EPA NPDES CAFO Permitting Status Report – End year 2016).

The Indiana Department of Environmental Management (IDEM) is the governing state agency responsible for implementing and regulating permits for confined feeding operations (CFOs) and NPDES CAFO permit program. The CFO program requirements have been established under



state authority. An AFO with at least 300 cattle, 600 swine/sheep, or 30,000 poultry in confinement is considered a CFO. Generally speaking, a CAFO is a very large CFO. Approximately 620 of the 2,260 CFOs in Indiana are defined as CAFOs. CFOs are required to have a CFO permit or a NPDES CAFO Individual permit, but not both. All new solid and liquid manure storage structures must be designed, constructed, and maintained with a combined storage capacity of at least 180 days of storage for all materials entering the storage structure, including manure and bedding. The use of underground steel storage tanks is prohibited; tanks must be above ground and made of plastic or fiberglass. Manure cannot to be applied to areas with highly erodible soils unless the field has either 40 percent residue protection or crop cover. A CFO with 120 days or less of manure storage may request approval from IDEM to apply manure to frozen/snow covered ground, within limitations. Manure is required to be tested annually for ammonium nitrogen, total nitrogen, and phosphorus. Soil is required to be tested every four years and the soil phosphorus Bray P1/Mehlich 3 Test must be used. Composite sampling and average test results can be used for both manure and soil sampling (IDEM Guidance Manual for Indiana's CFO Program). Land application rates are determined by soil P levels and are restricted to soils with less than or equal to 200 ppm P. Manure may not be applied within 500 ft. of a public water supply well or public water supply surface water intake. Other setbacks for property lines, surface water, tile inlets, sink holes, wells and roads varies based on conservation practices used at the land application site. A Significant Water Withdrawal Facility registration is required if more than 100,000 gallons (378,541 L) of water is withdrawn in a given day. Indiana Department of Natural Resources (IDNR) regulates water withdrawal and requires submittal of annual water use reports.

The Office of Indiana State Chemist (OISC) sets guidelines for fertilizer application for both commercial and organic (manure). These restrictions apply to 40 cubic yards of solid or 1000 gallons of liquid fertilizer material applied in any in a calendar year. These standards would apply to manure that is marketed and/or distributed from CFOs to growers. Many of OISC's guidelines include similar setbacks required by regulated farms under the CFO program. Exception are the OISC allows manure application on frozen and snow covered ground as long it is applied: 200 ft from surface water; not within a floodway; at 50% the agronomic rate of planned crop; and not on land with greater than 2% slope unless it has at least 40% crop residue or ground cover. The OISC also regulates manure staging at the field of application. Staged manure must be covered or bermed 72 hours after and is placed 300 ft. from surface water, water wells, or drainage inlets. Setbacks include 100 ft. from roads and property lines and 400 ft. from residences and must be land applied in 90 days from being staged. No manure may be staged in a waterway or floodway. All manure from a CFO/CAFO must be land applied by an OISC category 14 certified applicator. Records of manure transfer from the facility are to be maintained on site.



A MMP must be kept for all CFOs and is required to include procedures for manure or soil testing, soil survey maps, alternate methods for manure management, and any other applicable information. MMPs should be updated and submitted with the NPDES renewal application each time the operation seeks renewal of their permit. The updated MMP is reviewed by IDEM along with the application renewal. The public does not have direct access to MMPs. The public can access all CFO permits that have been approved through the IDEM webpage. IDEM is responsible for handling enforcement, inspections, and complaints regarding CFO/CAFOs. Inspectors are required to make reasonable efforts to contact the owner/operator at least 24 hours before routine or follow up inspections. Inspections involving complaints or spills are unannounced.

Indiana has developed a Domestic Action Plan (DAP) to assist in meeting nearshore and open water phosphorous objectives and loading targets for Lake Erie. The focus of Indiana's DAP is a 40 percent reduction goal for the Maumee River, which drives hazardous algal blooms and contributes to central basin hypoxia.

Indiana offers incentives for proper management of operations through funding programs such as Lake and River Enhancement (LARE) grant funding, which is administered by the IDNR. Grants are provided for projects that reduce non-point sediment and nutrient pollution of surface waters, such as erosion control and projects that enhance aquatic habitat and water quality. In 2016, the IDNR awarded a total of almost \$1.3 million in grants, ranging from \$8,000 to \$100,000. Purdue University offers free publications to both farmers and the public on information related to CFOs, such as manure sampling and soil sampling.

3.2.6 Illinois

A small portion of northeastern Illinois is located within the Lake Michigan Basin. Approximately 75 percent of the land in the state is used for agricultural purposes, the leading livestock being swine (Illinois.gov). Based on the 2012 Census of Agriculture (see Table 3a in Section 3.1.2), Illinois had roughly 4.6 million hogs and 1.1 million total cattle and calves. According to the 2016 State Agriculture Overview of Illinois, the state is currently home to 5.1 million hogs and almost 2 million cows, including beef cattle, dairy cows, and calves. The U.S. EPA has identified 279 CAFOs in Illinois, of which 36 have NDPEs permits (US EPA NDPEs CAFO Permitting Status Report – End year 2016).

Illinois Environmental Protection Agency (IEPA) is the authorized agency responsible for implementing and regulating CAFO permits in Illinois. Farms that fall within the classification of CAFOs or AFOs that are designed as a CAFO or deemed significant contributors of pollutants to waters of the state are required to obtain a permit. A Notice of Intent to Construct (NOITC) is required whenever any new construction or expansion is proposed, whether it is manure storage



or facilities to house animals, and requires information be provided regarding the project's location, size, type, and compliance with setback requirements. The *Livestock Management Facilities Act* (LMFA), which was passed in 1996 and is administered by the Illinois Department of Agriculture (IDA), requires an NMP be developed if the facility has more than 1,000 AUs and plans to apply manure to land. The public does not have direct access to these records. Manure cannot be applied to land during a rainfall or when a rain event is forecasted and cannot be applied to soils that are frozen, have a snow covering, or are already saturated with manure, precipitation, or some other liquid, unless approved by the IEPA. Records of manure transfer from the facility are to be maintained on site. Manure is required to be sampled and tested yearly. Sampling must be performed under the supervision of a Certified Livestock Manager. Laboratory analysis must include total nitrogen, ammonium nitrogen; total phosphorus, total potassium, and percent total solids. Soil is required to be sampled once every four years, from the same field at the same time of year to maintain consistency. Soil and manure samples can be composite samples. The Illinois State Water Survey provides guidance for water intake and requires that no more than 100,000 gallons (378,541 L) are used per day and that annual reports of water withdrawal be submitted.

The state of Illinois has specific restriction on the application of phosphorus-containing fertilizers; however, these restrictions do not apply to the application of fertilizer on property used in the operation of a commercial farm or lands classified as agricultural lands.

Illinois requires operations to have a NMP and that must be kept on file at the facility for the term of the NPDES permit, and for five years after the expiration of the permit. IEPA approves all new NMPs as well as any updates or revisions to existing NMPs. The NMP has to provide adequate erosion and runoff control, as well as odor control and manure application records. IEPA is responsible for all enforcement, handling citations, inspections, and complaints. Citations can be noncompliance advisory, violation notices, and requests for injunctive relief. Inspections happen annually, usually with a 24-hour notice before the inspection; however, they can be random. The state of Illinois does not provide any specific funding for CAFO operations but operations do have access to funding through Federal incentive programs, such as the Environmental Quality Incentive Program (EQIP). The University of Illinois provides step by step instructions for creating a MMP and information to help farms stay in compliance with the IEPA, IDA, and the Illinois Natural Resources Conversation Service.

3.2.7 Michigan

The entire state of Michigan is located within the Great Lakes Basin, specifically in four basins: Lake Erie, Lake Michigan, Lake Huron, and Lake Superior. Roughly 50 percent of Michigan's land is currently being used for agriculture. As indicated on Table 3a, there are over 52,000 farms in



the state, of which approximately 300 are registered CAFOs. Of the registered CAFOs, 271 have NPDES permit (US EPA NDPEs CAFO Permitting Status Report – End year 2016). Since the 2012 Census, the amount of farms in Michigan has remained relatively constant, with roughly 18 percent of all of the farms in the state applying manure to the land, as shown on Table 3a.

The Michigan Department of Environmental Quality (MDEQ) is the authorized agency responsible for implementing and regulating CAFO permits in Michigan, and requires all large sized CAFOs to obtain an NPDES permit. Medium and small CAFOs can be required to obtain an NPDES permit if the operation has a history of discharges. The Michigan NPDES permit includes the standard General Permit and Individual Permits. Michigan's CAFO permit holders may also request an exemption from permitting, based on a determination of "no-potential-to-discharge." All permits proposed for issuance are subject to a 30-day public notice period, and are available on MDEQ's website database. In addition, citizens can request a hearing during the public notice period.

Manure cannot be applied within 100 ft (30.5 m) of any surface waters or applied to frozen/snow covered ground, unless it is unavoidable or it is injected/incorporated within 24 hours. A 35-foot (10.7 m) vegetated buffer may be utilized in lieu of the 100 ft setback. Daily applications of manure must be recorded and kept on site as well as submitted annually to MDEQ. Michigan allows manure to be transferred from facilities to recipients. Technical Standards when applying CAFO waste during January through March must be followed for all manure application, by both the manure generator and the recipient of the manure. In addition, the generator must provide the manure analysis to the recipient, a manifest form detailing the destination and volume of manure transferred. The recipient must complete the manifest form, which includes acreage and land application rate, weather conditions, and incorporation rate. Manure is required to be sampled at the time of any application, or as close as practicable. Soil from an operation is required to be tested once every three years for soil fertility, dependent on the crop growth, crop rotation, soil texture, and approach/method used for sampling. Fields in a facility's CNMP are to be assessed for the suitability to receive manure applications. A field map is to be used for the assessment and should include the slopes, soil types, locations of tile outlets, tile risers, conservation practices, and offsite conditions, such as buffers and distance from surface waters. Within 48 hours prior to land application of manure, fields must be evaluated for suitability, including soil cracking, precipitation forecast, condition of buffers, etc. Soil testing should include analysis for phosphorus among other immobile nutrients. The NPDES permit requires that all waste streams at the facility be sampled annually to determine nutrient content and that these values be used in determining land application of waste. The Michigan Department of Agricultural and Rural Development (MDARD) requires all agricultural operations with a capacity to withdraw over 100,000 gallons (378,541 L) per day to report annually to the state the amount of water withdrawn as well as water conservation practices used on the farm.



New high capacity water withdrawals in Michigan must use the MDEQ Water Withdrawal Assessment Tool.

A NMP must be developed such that it identifies appropriate site-specific conservation practices as well as appropriate soil and manure sampling protocols. The NMP is required to be kept on site and made available to the public as requested. Any revisions or modifications made to the NMP must be approved by the MDEQ, and an annual report is required to be submitted to the MDEQ. The annual report includes number/types of animals, estimated amount of total manure produced or land applied, total number of acres used for land application, and actual crops planted along with actual yield. A CNMP applicable to both the production and land applications areas, must also be developed to meet the requirements of the NMP, and approved by a Certified CNMP Provider. CNMP Providers offer additional services, such as notifying farms when weather conditions prohibit manure spreading, assistance with preparing field application maps, helping facilities to obtain engineering and other contracted services, and assistance in arranging soil samplings. The MDEQ responds to complaints regarding CAFOs with the exception of odor and nuisance complaints which are directed to MDARD. If MDARD's review indicates a violation of the facility's permit, the MDEQ may take the lead in enforcement actions. Inspections are conducted at least three times every 5 years, per the MDEQ. One inspection is a complete inspection which includes an interview, records review, production site inspection, and field application inspection. The other two inspections are reconnaissance inspections, which typically are unannounced and have a more limited focus on a site-specific concern or statewide issue. Public records and information relating to CAFOs are available on MiWaters, MDEQ's online database. This information includes the CNMP, permit application, inspection reports, enforcement actions, public notice documents, and submittals required by the NPDES permit, among others. The public may also request a public hearing, in which they may offer verbal or submit written comments and provide supporting documentation regarding the specific CAFO.

Michigan State University provides assistance with CAFO requirements including NPDES permit compliance requirements through informational articles and documents, which are available to the public, CAFOs and other farm operators. They also provide access to the EnviroImpact Tool, which is an online tool that farmers can use to help reduce the amount of nutrients in runoff from their farms. The Michigan EnviroImpact tool shows daily runoff risk across Michigan using National Weather Service information about precipitation, temperature, soil moisture, and landscape characteristics. The Michigan Agriculture Environmental Assurance Program (MAEAP) is a comprehensive, voluntary, proactive program designed to reduce farmer's legal and environmental risks. Through the MAEAP program, an operation can take the corrective steps to reduce pollutant risks and become environmentally assured. The state of Michigan does not have any specific funding available for farming operations, but operators are able to obtain funding



through Federal funding incentives such as EQIP and AgSTAR. Other funding is provided through local conservation organizations, where available.

Michigan's Departments of Agriculture and Rural Development, Environmental Quality, and Natural Resources, have developed a Domestic Action Plan for Lake Erie with a targeted approach for improving water quality and helping to prevent algal blooms. Michigan's Domestic Action Plan establishes procedures for the state to reduce the amount of phosphorus entering Lake Erie by 40 percent by 2025.

3.2.8 Wisconsin

Wisconsin is located within two Great Lakes Basins: Lake Superior Basin and Lake Michigan Basin. More than 20 percent of the state's land area lies within these two Great Lakes Basins. Approximately 14.4 million acres (58,275 km²) are used for farming, which is roughly 40 percent of the state's land (Wisconsin Blue Book, 2015-2016). Approximately two-thirds of all farms in Wisconsin are rural residences, such as hobby farms or retirement farms. The Wisconsin Milk Marketing Board conducted a review of the Wisconsin dairy industry in 2017 and discovered that the majority of CAFO operations are dairy farms, with 9,520 operations and more than 1.28 million dairy cows. The U.S. EPA has identified 288 CAFOs registered in Wisconsin, of which 279 have NPDES permits.

The Wisconsin Department of Natural Resources (WI DNR) has been authorized to regulate CAFOs as well as handle permitting and enforcement. WI DNR requires all CAFOs to obtain an NPDES permit based on if the operation is going to store manure or process wastewater or will land apply manure/process wastewater. WI DNR may designate a smaller-scale animal feeding operation (fewer than 1,000 animal units) as a CAFO if it has pollutant discharges to navigable waters or contaminates a well. At least 90 days before beginning construction on either a new or existing operation, proposed CAFOs must submit plans and specifications for reviewable construction projects to WI DNR. Wisconsin requires that the operation begin applying for a Wisconsin Pollution Discharge Elimination Systems (WPDES) permit 12 months before an operation becomes a CAFO. The WPDES permit requires that quarterly inspections be conducted on production areas including outdoor animal pens, barnyards, and raw material storage. The WI DNR describes six different options for Surface Water Quality Management Areas, such as areas within 1,000 ft (305 m) of lakes or ponds or within 300 ft (91 m) of perennial rivers or streams. Manure applications in these areas are restricted to injection or immediate incorporation of manure and limited to more than 25 ft (7.6 m) of navigable water. Soil is required to be tested for phosphorus once every four years. The use of the P-Index is required for fields with soil test P levels less than 50 ppm and not at optimum P levels for the highest P demanding crop.



WI DNR does not require permitting for water withdrawal as long as it does not exceed 100,000 gallons (378,541 L) per day for any 30-day period.

The Wisconsin Department of Agriculture, Trade, and Consumer Protection (WI DATCP) administers the Livestock Siting Law. Under this law, local governments do not have to require permits for new or expanding livestock operations. However, if they choose to require conditional use or other permits, the livestock siting law sets standards and procedures that they must follow. The law limits exclusion of livestock facilities from agricultural zones (datcp.wi.gov).

The application of lawn fertilizer containing phosphorus is prohibited except in limited circumstances. The application of fertilizer on frozen grounds or impervious surfaces is also prohibited. However, agricultural lands and productions are exempted from these limitations. Records of the amount of manure transferred from a facility must be maintained on site.

The NMP must be field specific and phosphorus based. The plan is required to outline the amounts, timing, locations, methods, and other aspects related to land application of manure. The plan also requires information such as field testing reports, field soil erosion, and phosphorus delivery to surface water calculations. All CAFOs are required to submit annual and daily spreading information, monitoring reports and all like documents and records. Records are made available to the public through Open Record Requests via the WI DNR webpage. WI DNR releases copies of records for the fee. CAFOs are also required to submit updated and revised NMPs to the WI DNR annually. However, public notices are required by law to alert interested members of the public of the DNR's intentions to authorize a WPDES permit. A member of the public may submit written comments or request that the department hold a public informational meeting. All comments and requests must be submitted within 30 days from the date of the public notice.

The WI DNR is responsible for all enforcement, inspections and complaints pertaining to CAFOs. WI DNR requires that CAFO operators follow a compliance calendar, which states what inspections are to be conducted by the operator and their frequency. A quarterly summary of inspections is required to be submitted with the annual report along with a copy of compliance calendar properly completed. The compliance calendar requires quarterly inspections of all production areas (outdoor animal pens, raw material storage areas, etc.) along with weekly inspections of stormwater controls and runoff controls. Additionally, the Runoff Management rules (NR 151) administered by WI DNR include performance standards and prohibitions related to the management and storage of manure.



The State of Wisconsin provides \$20 million annually for farm conservation cost share grants. Approximately \$14 million is used for “hard practices” such as manure storage systems, barnyard runoff controls, and buffer strips. The remaining \$6 million is used for “soft practices” such as nutrient management, conservation tillage, and crop coverage. The WI DATCP created the Farmland Preservation Program which helps farmers and local governments preserve farmland, protect soils and water, and minimize land conflict. Through the program, landowners who meet the soil and water standards become eligible to claim income tax credits. The WI DATCP also provides Nutrient Management Farmer Education grants to local organizations to teach farmers to develop their own NMPs. The University of Wisconsin is part of a three-way partnership with the USDA and Bayfield County, Wisconsin, to provide generalized information on CAFOs and recommendations for staying in compliance with regulatory requirements.

3.2.9 Minnesota

A small portion of northeast Minnesota is located in the Lake Superior Basin. Approximately 51 percent, or 26 million acres (105,218 km²), of Minnesota’s land is used for agricultural purposes and comprises of about 74,500 farms mainly located in the southern part of the state (Farmland Information Center). The 2012 Census of Agriculture, data located in table 3a, showed that Minnesota farms had 7.6 million hogs and 2.4 million cattle, showing a steady increase in livestock production. As of 2015, Minnesota’s livestock had increased with roughly 10 million pigs, 56 million birds (turkeys and chickens) and 3 million cattle (Pioneer Press, 2015). The U.S. EPA has identified 1,300 registered CAFOs in Minnesota, of which 598 have NPDES permits.

The Minnesota Pollution Control Agency (MPCA) is the governing agency responsible for implementing and enforcing NPDES CAFO permits in Minnesota. The MPCA requires facilities that meet the federal large-sized CAFO threshold and discharges to waters of the state to obtain an NPDES permit. In order for an operation to apply manure to land, it must manage all manure to prevent pollution to waters, follow maximum nutrient rate limits, maintain setbacks from sensitive features, develop and maintain a MMP, and keep land application records on site. The MMP must be updated at least once a year. Application to road ditches is prohibited and application rates must be limited so that the estimated plant available nitrogen from all nitrogen sources does not exceed expected crop nitrogen needs for non-legume crops and expected nitrogen removal from legumes.

Manure from each source of storage that contains over 100 AUs of manure must be tested yearly for the first three years and then tested once every four years. Testing of manure is required to be conducted by laboratories certified by the MPCA or Minnesota Department of Agriculture. Manure testing requires an analysis for phosphorous and nitrogen. Soil sampling and testing is required by the permit. For phosphorus testing, the sample must be taken from the upper



6 inches of the soil and sampling must happen once every four years. Analysis for phosphorus in soil samples should be done using Bray P1 or Olsen test. Owners of feedlots with more than 300 AU must apply for an interim permit and submit an MMP if manure is applied onto soils where phosphorus levels exceed 75 ppm within 300 ft (91 m) of surface water or 150 ppm if further than 300 ft (91 m) from surface waters. Records of the amount of manure transferred from a facility must be maintained on site. The Minnesota Department of Natural Resources restricts the withdrawal of state water. For surface and groundwater intake, a permit is required if it is anticipated that more than 10,000 gallons (37,854 L) per day or 1,000,000 gallons (3.8 million L) per year is to be withdrawn.

The application of phosphorus fertilizer is restricted on established turf. Lawn fertilizer use is restricted to 0 percent phosphate content and the use of public water for filling or cleaning fertilizer equipment is prohibited. Agricultural lands and productions are exempted from these restrictions.

The MMP is required to include field maps, crop rotations, livestock and manure information, sensitive area identification and management, as well as operation and maintenance guidance. MPCA is responsible for all enforcement, inspections and complaints involving CAFOs and feedlots. The Agriculture Best Management Loan Program works with counties, the MDA, and Soil and Water Conservation Districts to identify current and future financial needs of farmers. The University of Minnesota provides recommendations on many aspects of the NPDES permit, such as soil testing and information on runoff.

3.3 LEGISLATION AND POLICIES GUIDING PERMITTING REQUIREMENTS FOR MANURE USE, MANAGEMENT, STORAGE AND DISPOSAL – OUTSIDE THE GREAT LAKES BASIN

3.3.1 Saskatchewan, Canada

The Province of Saskatchewan is home to more than 40 percent of Canada's farmland, 30 percent of the country's bison herd, and is also the second largest beef cattle producer in the country (Saskatchewan Ministry of Agriculture, undated). Of the 34,523 farms surveyed in Saskatchewan in the 2016 Census of Agriculture, 6,394 farms were reported to be applying manure on their operations, over a cumulative area of 821,000 acres (332,000 ha) (see also Table 2 in Section 3.1.1) (Statistics Canada, 2017a, 2017b).

Legislation and regulations surrounding manure management in Saskatchewan are primarily focused on water protection, in that manure use must be planned in a manner that avoids water contamination. In contrast to most of the other jurisdictions assessed in this study, the requirements for manure management are more results-based rather than being prescriptive: the



legislative authorities (Ministry of the Environment and the Ministry of Agriculture) define the expected environmental outcomes, but the specific methods on achieving the outcomes are left to the regulated parties. The province's management framework provides agricultural operators with a certain amount of flexibility in planning the production, use, storage and disposal of manure, provided that it does not result in water contamination.

Manure management in Saskatchewan is overseen predominantly by the Ministry of Agriculture, which administers the *Agricultural Operations Act (Act)*, first established in 1995. The *Act* outlines the regulatory requirements for "intensive livestock operations" (ILOs), which are defined as the confining of animals (poultry, hogs, sheep, goats, cattle, horses and any other prescribed animals), where the space per animal unit is less than 370 square metres (m²) (3,983 ft²). Minister approval of a waste storage plans and/or waste management plans are required for ILOs that: 1) contain an earthen manure storage area or a lagoon; 2) involves the rearing, confinement or feeding of 300 or more animal units for more than 10 days in any 30-day period; or 3) involves the rearing, confinement or feeding of more than 20 animal units but less than 300 animal units, for more than 10 days in any 30-day period, and any part of which is located within 300 m (984 ft) of surface water or 30 m (9.8 ft) of a domestic water well not controlled by the operator of the ILO. Data on the current numbers and historical trends of ILOs were not readily available.

The *Agricultural Operations Act* is generally not prescriptive with regards to estimating manure volumes, land application requirements, etc. However, ILOs requiring approval must prepare a waste management plan and/or waste storage plan that would incorporate such details, and the plans may be approved or rejected by the Minister.

No regulatory requirements for testing of soils or manure were identified. However, per the Agricultural Operations Regulations, the Minister of Agriculture may require an operation's waste management plan to include additional information as he/she deems appropriate, which in turn must be implemented as a condition of approval. Requirements for testing soil may be introduced in this manner.

Liquid manure spills of greater than 1,000 L that occur onsite, or greater than 500 L that occur offsite, must be reported to the Ministry of Environment and to the Agricultural Operations Unit of the Ministry of Agriculture. The Ministry of Environment does not specifically regulate animal feeding operations, but the ministry administers the provincial Environmental Code, which is adopted by other environmental legislation such as the *Environmental Management and Protection Act, 2010*. Per the definitions in Chapter B.1.5 section 1-4 of the Environmental Code, manure is considered an industrial waste from an agricultural operation.



No distinct regulatory requirements surrounding the application of commercial fertilizer were identified.

No requirements were identified to make approval records, applications and plans publicly available, nor were any public online repositories of ILOs and manure storage areas identified. Access to such records may only be possible if they are voluntarily disclosed by the operator and/or through requests made under the *Freedom of Information and Protection of Privacy Act*.

3.3.2 Alberta, Canada

Alberta is an agriculture-intensive province with the largest reported cattle herd in Canada in 2016 with 5.2 million cattle and calves, accounting for 41.6 percent of the national total (see also Table 2 in Section 3.1.1) (Statistics Canada, 2017c, d). The 5.2 million cattle and calves are distributed over 19,914 of the 40,638 farms in the province (Statistics Canada, 2017c). Of the 40,638 farms surveyed in Alberta in the 2016 Census of Agriculture, 10,153 farms were reported to be applying manure on their operations, over a cumulative area of 1.2 million acres (489,000 ha) (Statistics Canada, 2017a, 2017b). The importance of agriculture is reflected in the provincial *Water Act*, one of whose many key features include the protection of existing traditional agricultural uses of water through a grandfather clause.

Legislation regulating Confined Feeding Operations (CFOs) and manure management standards came into effect on January 1, 2002, with the creation of the *Agricultural Operation Practices Act* (AOPA); prior to 2002, municipalities had jurisdiction over manure management issues, and there were over 60 sets of rules across the province. Under the AOPA, “Confined Feeding Operations” are defined as:

“fenced or enclosed land or buildings where livestock are confined for the purpose of growing, sustaining, finishing or breeding by means other than grazing and any other building or structure directly related to that purpose but does not include residences, livestock seasonal feeding and bedding sites, equestrian stables, auction markets, race tracks or exhibition grounds.”

Under the AOPA, seasonal feeding and bedding sites are described as over-wintering sites where livestock are fed and sheltered.

Pre-existing CFOs were grandfathered in, such that they were deemed to already have a permit under the AOPA. A key component of the AOPA is the “right to farm” legislation in Part I, which defines how nuisance issues (odour, dust, noise, smoke, etc.) resulting from agricultural activities are addressed.



Under the *AOPA*, approvals are required for larger CFOs, registrations are required for smaller CFOs, and authorizations are required for the construction of manure storage facilities and manure collection areas. Threshold levels for determining whether a registration or approval is required are listed in Schedule 2 of the Part 2 Matters Regulation; the threshold levels are listed by category of livestock (beef, poultry, etc.) and type of livestock (species, age, function, etc.). For example, for a livestock operation comprised of lactating cows, registration is required for 50 – 199 individuals, and approval is required for 200 or more individuals. An operation with fewer than 50 lactating cows do not require any permits under the *AOPA*, but may be subject to municipal requirements. Between 2012 and 2016, an average of 40 approvals were issued per year for larger operations, peaking in 2016 with 68 approvals issued. During this same time period, between 4 (in 2014) and 17 (in 2016) registrations were issued for smaller operations, and between 36 (in 2013) and 50 (in 2016) authorizations were issued for manure storage facilities (NRCB, 2017).

Regulation of the *AOPA* is appointed to the Natural Resources Conservation Board (NRCB), an arm's length board reporting to the provincial Minister of Environment and Parks. Under the *AOPA*, the NRCB fulfills applications and compliance responsibilities, administers and advances policies, and conducts board reviews for CFOs. The NRCB has a chair and two members who are recruited by open competition, and appointed by the Lieutenant Governor-in-Council for terms not exceeding five years (NRCB, undated). A multi-stakeholder Policy Advisory Group provides advice related to the effective delivery of the *AOPA*, and, per its Terms of Reference and Mandate, draws its membership from provincial ministries, environmental non-governmental organizations, urban municipalities, confined feeding industries and the NRCB (Policy Advisory Group, 2011). A Technical Advisory Group manages the development of technical guidelines to clarify *AOPA* objectives, and per its Terms of Reference, draws its membership from provincial ministries, the NRCB and industry (Technical Advisory Group, 2014).

The *AOPA*, its Regulations and the Manure Characteristics and Land Base Code include extensive guidelines and requirements for manure management in the province. For example, estimates of the daily, monthly, 9-month and yearly production of liquid and solid manure for various types and life stages of livestock are detailed in the Manure Characteristics and Land Base Code, and prescriptive requirements for manure storage can be found in the *AOPA* Regulations. A nutrient management plan may be required as part of a permit application for operations that cannot meet the requirements of the Manure Characteristics and Land Base Code and the *AOPA* Standards and Administration Regulation.



Per Section 25(1) of the *AOPA* Standards and Administration Regulation, if a person intends to apply more than 500 tonnes of manure annually, the soil must have been tested within the previous 3 years in accordance with Schedule 3 of the Regulation. In contrast, no requirements for the testing of manure itself were identified.

The *AOPA* provides guidelines and requirements for public notification and consultation for proposed new or expanded feeding operations, and allows directly affected parties to appeal a decision made by the NRCB on an application. The NRCB's Operational Policy 2016-7 (Approvals) emphasizes the Government of Alberta's commitment to public transparency, and includes provisions for posting notices of CFO applications on the NRCB website, along with the applications themselves and the written reasons for permitting decisions.

3.3.3 Maryland, United States

Agriculture is the largest commercial industry sector in Maryland, and represents the largest single land use (Government of Maryland, 2017). Approximately 2 million acres (8,094 km²), or roughly 32 percent of the total land area, was used for farming in 2016 (Government of Maryland, 2017). Along with Delaware, District of Columbia and Virginia, Maryland is a state bordering the Chesapeake Bay, for which agriculture is the largest source of pollution. Approximately one-quarter of the nitrogen and phosphorus pollution feeding "dead zones" in the Chesapeake Bay is reportedly attributed to runoff from manure (Washington Post, 2010). In particular, the large numbers of chicken farms in the Chesapeake Bay area of Maryland have presented environmental challenges associated with manure runoff (Modern Farmer, 2015).

The Maryland Department of the Environment oversees the distribution of General Discharge Permits and permits for Maryland Animal Feeding Operations (MAFOs) (Maryland Department of Agriculture, undated ("MDE/Federal Permits")). As with Confined Animal Feeding Operations (CAFOs), MAFOs are animal feeding operations exceeding specified thresholds (for example, 750 or more swine weighing more than 55 pounds (25 kg)); the difference between MAFOs and CAFOs is that MAFOs do not discharge manure, litter or process wastewater. If such discharges could or do occur, the operation is considered a CAFO. Historical trends in the numbers of MAFOs and CAFOs were not readily available; however, U.S. EPA 2016 end year report identified 600 CAFOs in Maryland with 575 having NPDES permits.

The Maryland Department of Agriculture oversees nutrient management application requirements on Maryland farms. All farmers grossing \$2,500 a year or more, or livestock producers with 8,000 pounds (3,629 kg) or more of live animal weight (8 animal units or more), are required to follow nutrient management plans when fertilizing crops and managing animal manure (Maryland Department of Agriculture, 2017); in 2014, 5,426 farms met the criteria for



requiring a nutrient management plan (EPA, 2015). Nutrient management plans must be prepared by University of Maryland Extension advisors, private consultants who are certified by the Department of Agriculture or farmers who are certified to develop plans solely for their own operations. Most plans are written for one to three years, and the plans must be updated before they expire. Farmers who are certified to write their own nutrient management plans are required to take six hours of continuing education credits every three years. Farmers who apply nutrients to 10 or more acres of cropland are required to attend a two-hour nutrient applicator training course once every three years.

Soil and manure testing are also required components of nutrient management plans in Maryland, with soil tests needing to be conducted at least once every three years, and manure analyzed for nutrient content at least every other year.

The Department of Agriculture conducts on-farm audits to verify compliance with its Nutrient Management Program requirements. In the 2014 fiscal year, on-farm audits were conducted at 733 of the 5,426 regulated farms (approximately 13.5 percent) (EPA, 2015). It was determined that approximately 66 percent of the farms were in compliance; the majority of the violations were for expired or out of date nutrient management plans. The Department of Agriculture issued 211 warnings to correct major violations identified during the on-farm audits, and issued \$21,450 in fines against 33 farmers for failing to take corrective actions in a timely manner.

The nutrient management plans of AFOs applying for coverage under the General Discharge Permit for AFOs (GD Permit), State Discharge Permit No. 14AF or National Pollutant Discharge Elimination System (NPDES) Discharge Permit No. MDG01 can be viewed by the public on the Department of the Environment's AFO directory (Department of the Environment, undated). The plans do not appear to be publicly available after the 30-day public comment period.

If an AFO has applied for coverage under the General Discharge Permit for AFOs (GD Permit), State Discharge Permit No. 14AF or National Pollutant Discharge Elimination System (NPDES) Discharge Permit No. MDG01, a Notice of Preliminary Approval is posted on the MDE's website, along with deadlines for requesting a hearing and for submitting written comments, and the applicant's Notice of Intent and nutrient management plan. The public may provide written comment to the Department of Environment within a 30-day comment period.

Maryland's Phosphorus Management Tool (PMT) regulations came into effect on June 8, 2015. Nutrient management planning in Maryland previously used the Phosphorus Site Index, a Phosphorus Index tailored specifically to Maryland's soils, agricultural management practices, climate, topography, hydrology and surface water characteristics (University of Maryland Extension, 2005). A process is in place for farmers to transition from the Phosphorus Site Index to



the PMT, which is an updated tool for identifying the potential risk of phosphorus loss from farm fields, and to prevent the additional buildup of phosphorus in already-saturated soils. Use of the PMT only applies to farm fields with high soil phosphorus levels, with Fertility Index Values (FIV) exceeding 150 (unitless value), as determined by laboratory testing; a level between 51 to 100 is considered “optimum” for crop production, while FIV levels above 100 indicate that the soil contains more phosphorus than the crop needs. Fields with the greatest risk for phosphorus runoff into nearby waterways, as indicated by a FIV of 500 or greater, are banned from receiving additional phosphorus until the PMT is fully implemented in 2022. After 2022, potential phosphorus applications on these fields will be determined by the PMT. In such cases, the farms receive priority for cost-share assistance to relocate excess manure.

3.3.4 Iowa, United States

Over 85 percent of Iowa’s land is used for agriculture, and the state has a significant livestock population; about 22.4 million hogs (almost one-third of the population of hogs in the United States) are located in Iowa, which is also home to 3.9 million cattle, 175,000 sheep and 60 million chickens, and which produced more than 11.7 million turkeys in 2016 (AITC, 2017). Iowa is authorized to implement the NPDES program within its boundaries.

Manure management and animal feeding operations in Iowa are regulated by the Department of Natural Resources (DNR), while the Department of Agriculture generally oversees the commercial/business aspects of agricultural operations (Iowa Department of Agriculture, undated; Iowa DNR, undated (“Animal Feeding Operations”)). Iowa has two types of animal feeding operations that are regulated by the DNR: confinements and open feedlots. For both types, animals are confined and fed for 45 days or more per year in a lot, yard, corral, building or other area, and the operation includes manure storage structures. Confinements confine animals to areas that are totally roofed, whereas open feedlots are unroofed or partially roofed with no vegetation. Historical trends of the numbers of confinements and open feedlots were not readily available; however, U.S. EPA identified 3,505 CAFOs, of which only 170 have NPDES permits.

Of note is that under state law, producers who remove and land apply manure from a confinement feeding operation with an animal unit capacity of more than 500 animal units must be certified, or use a commercial manure applicator (Iowa DNR, undated (“Manure Applicator Certification”)). Tables 3, 3a, 4, 4a and 5 of Chapter 65 (Animal Feeding Operations) of the Iowa Administrative Code provides estimates of manure production and nutrient content for various livestock types and stages, and the rates at which nitrogen and phosphorus are used by various types of crops. A confinement feeding operation must not apply manure in excess of the nitrogen use levels necessary to obtain optimum crop yields or in excess of the rates determined in conjunction with the phosphorus index. These thresholds can be determined by using the



tables in Chapter 5, from actual testing of samples, or from credible sources reviewed and approved by the DNR.

No acreage requirements for the land application of manure were identified. However, land application must be at least 150 ft (45.7 m) from surface water bodies, at least 200 ft (61 m) from a residence outside of the operator's property, and cannot be applied in a flood zone. Confinement feeding operations with more than 500 animal units cannot legally apply liquid manure on snow-covered ground from December 21 to April 1, or on frozen ground from February 1 to April 1, except in an emergency. Per Chapter 65 Section 3(5) of the Iowa Administrative Code, which lists recommended practices for manure application, it is recommended that application be avoided during active runoff events or when weather conditions (including rainfall) are predicted that could cause snowmelt or runoff.

Under rule 567—65.16(459,459B) of the Iowa Administrative Code, a manure management plan must be submitted to the DNR for confinement feeding operations that are not small animal feeding operations; a plan must also be submitted if manure that was produced from a confinement feeding operation (other than a small operation) located outside of Iowa will be applied within state boundaries. Updated manure management plans must be submitted on an annual basis, reflecting all amendments that may have been made since the submission of the previous plan. The manure management plan must report, among other factors, the estimated total nitrogen and total phosphorus to be produced from the confinement feeding operations, the land area required for manure application, application methods, locations and timing, and the phosphorus index of each field where manure is to be applied.

Soil samples must be obtained from each field in the manure management plan at least once every four years, analyzed for phosphorus and pH, and the sampling protocol must meet the requirements outlined in subrule 65.17(16) of the Iowa Administrative Code (e.g. at least ten soil cores per composite, at least the top six inches of the soil profile in each core, maximum one sample per ten acres, etc.).

Permits for new animal feeding operations must be submitted to the DNR with a Manure Management Plan, whether it is a new operation, expanding or modifying. The DNR has 60 days to approve or deny the MMP and give a start date for manure application. There is no listed information on whether the public/neighboring landowners are notified about animal feeding operations.



3.3.5 North Carolina, United States

The state of North Carolina has approximately 49,500 farms, occupying a cumulative total of approximately 8.4 million acres (33,994 km²) of land; it is the second largest pork producer in the United States, and ranks second in cash receipts for poultry and eggs (Farm Flavor, 2015). Agricultural statistics from 2016 estimate the population of hogs and broiler chickens in the state to be 9.3 million and 818.7 million, respectively (USDA, 2017). During the 2012 agricultural census (see also Table 3b in Section 3.1.2), approximately 7,427 of the 50,218 farms in the state, with a land base of approximately 0.45 million acres (0.18 million ha), were reported to be applying manure (USDA, 2014). However, no information is available on the rates, volumes and spatial distribution of manure application.

North Carolina is authorized to implement the NPDES program within its boundaries. In April 2016, the North Carolina Department of Environmental Quality listed 2,614 animal feeding operations as being permitted within the state (North Carolina DEQ, 2016). Of these, 291 consisted of cattle AFOs, 2,292 consisted of swine AFOs, and the remaining 31 facilities were for wet and dry poultry, horses, and other unspecified animals. An animal feeding operation requires a permit if it contains 250 or more swine, 100 or more confined cattle, 75 or more horses, 1,000 or more sheep, or 30,000 or more confined poultry with a liquid animal waste management system (North Carolina General Statute 143-215.10B). U.S. EPA identified 1,222 CAFOs in North Carolina as of end year 2016, of which only 14 had NPDES permits.

The North Carolina Department of Agriculture generally oversees the commercial/business aspects of agricultural operations, and appears to have little if any direct regulatory role with respect to animal feeding operations and manure management (Department of Agriculture, undated).

Permitted operations cannot apply manure during rainfall events or on land that is flooded, saturated with water, frozen or snow-covered at the time of land application. Land application of manure must also cease within 4 hours of the time that the National Weather Service issues a Hurricane Warning, a Tropical Storm Warning, or a Flood Watch (North Carolina State University, 2017). There is not a similarly prescriptive requirement for smaller rainfall events, but the permittee is required to “consider” pending weather conditions when planning the land application of manure, and weather conditions at the time of each land application must be documented in annual reporting.



North Carolina claims to have the strongest permit program for concentrated animal feeding operations in the country and to be the one of the only states to require annual inspections of every facility (Department of Environmental Quality, undated). By submitting a permit application for an animal feeding operation, the land owner/renter agrees to allow a representative from the Department of Environmental Quality to enter the site at least once a year. Inspectors check for any violations of water quality standards, compliance with animal waste management plans, and compliance with all other plan conditions; additional investigations may be conducted as needed to follow up on corrective actions or to investigate complaints (North Carolina State University, 2017). Any violations of the permit and/or the animal waste management plan may result in a requirement to revise the waste management plan, a cessation of land application of manure, the removal of animals from the facility, or the permit being reopened and modified, revoked and reissued, and/or terminated.

Records, mapping and a list of Animal Feeding Operations in North Carolina can be found on the Department of Environmental Quality's website. Few other details regarding public notification and engagement opportunities were identified.

3.3.6 Netherlands

The Netherlands is one of the smallest countries in the European Union (EU), with a total surface area of over four million hectares, more than half of which is used for agricultural purposes (Ministry of Agriculture, Nature and Food Quality, 2010). It is also one of the most densely populated countries in the world, with an average of 488 inhabitants/km² (approximately 1,264 inhabitants per square mile).

Approximately 80 percent of Dutch environmental legislation is derived from EU legislation, as the latter has a major impact on national policy (Government of the Netherlands, undated). Of direct relevance to manure management is the EU's 1991 Nitrates Directive, whose formal objective is the reduction of water pollution caused or induced by nitrates from agricultural sources and preventing further such pollution (European Commission, 2010). The Nitrates Directive was established due to nitrates being a major source of water pollution in Europe, where farming is responsible for over 50 percent of the total nitrogen discharges into surface waters. The Nitrates Directive sets a nutrient application limit of 170 kilograms (kg) of nitrogen per hectare (152 lbs/acre) per year; however, Member States may apply for "derogation", allowing them to exceed the application limit under strict conditions. The Netherlands successfully applied for a derogation of nitrogen inputs from manure to a maximum of 230 kg per hectare (205 lbs/acre) on dairy farms where at least 80 percent of land is in use as grasslands. This derogation applies to almost half of the Dutch agricultural land and is the most extensive derogation in the EU (Van Grinsven et al., 2016).



The Netherlands oversees manure management via the Dutch Manure Policy, which outlines requirements for land application, storage, transport and testing of manure, as well as annual reporting requirements. Small companies, which do not produce or supply more than 350 kg (772 lbs) in animal fertilizers per year and consisting of less than 3 hectares (7.4 acres) of agricultural land in a given year, are exempted from the record-keeping and registration requirements of the Dutch Manure Policy (Rijksdienst voor Ondernemend Nederland, undated). Further information on the number of exempted companies was not readily available. However, the Dutch Environmental Data Compendium (Compendium voor de Leefomgeving, 2016) reports that the average cultivation area per farm increased from 13.9 ha (34 acres) in 1980 to 28.9 ha (71 acres) in 2015, and that a similar increase in scale also occurred for livestock farming. It is therefore likely that a relatively small minority of livestock operations are exempted from the requirements of the Dutch Manure Policy.

Based on recent estimates of manure production in the country (Statistics Netherlands (CBS), 2018a), approximately 76 billion kg (168 billion lbs) of manure was produced, containing approximately 500 million kg (1.1 billion lbs) of nitrogen and 167.9 million kg (370 million lbs) of phosphate. Based on the available area of agricultural land, approximately 135 million kg (298 million lbs) of phosphate could be applied on land without exceeding fertilizing standards. There were an estimated 4.1 million heads of cattle, 722,000 sheep and 12.4 million pigs in 2016 (Statistics Netherlands (CBS), 2018b, 2018c); the most recent available data on poultry estimates 99.4 million poultry in 2013 (Statistics Netherlands (CBS), 2014).

Due to the relatively low availability of land area in the Netherlands for the application of manure, exports of manure are an important business in the country. Dutch livestock farms currently use approximately half of their manure production (expressed in phosphate) on their own land, whereas the remaining manure needs to be disposed of outside the farm; approximately one quarter of the manure produced in the country ends up outside of Dutch agriculture, mostly abroad (Van Grinsven & Bleeker, 2017). Net exports in 2015 were approximately 33 million kg (73 million lbs) of phosphate (Van Grinsven & Bleeker, 2017). The estimate cost of manure removal in the country ranged between 250 and 300 million euros per year during the 2006 – 2016 period, with an average pig farm spending over 40,000 euros per year (in 2015) and an average dairy farm spending 6,000 euros per year (in 2016) for manure removal (Van Grinsven & Bleeker, 2017). The cost of proper manure disposal is high, making “manure fraud” a pervasive issue in the country, one that is also identified a possible contributor to nutrient exceedances in groundwater in the southern region. Manure fraud is defined as deliberately disposing of less manure than is legally required and fertilizing the land well above the legal application standard (Van Grinsven & Bleeker, 2017).



3.3.7 Denmark

The agricultural sector of Denmark occupies roughly two-thirds of the Danish land mass, and has a very large livestock production (University of Aarhus, undated), as demonstrated by the fact that it supports four swine for every human (Yale Environment 360, 2015). As with the Netherlands, much of Denmark's environmental legislation derives from EU legislation. It implements the EU's 1991 Nitrates Directive through the Danish Nitrates Action Programme.

A key component of the Danish Nitrates Action Programme is the "harmony rules", which aim to achieve a balance between the use of manure and fertilizer with the size of the land application area. The rules apply to commercial livestock operations, or operations that use and/or store manure from a commercial livestock operation. Denmark was approved for derogation in 2002, allowing individual operations to apply up to 230 kg of nitrogen per hectare (205 lbs/acre) of land per year, under strict conditions.

In addition to the application limit for nitrogen, fertilizer standard quotas are determined on an annual basis. A Standards Committee, consisting of representatives from the Ministry of Environment and Food, Aarhus University and from agriculture, determines the economically optimal nutrient application standard, and the Board of Agriculture determines how much fertilizer should be supplied to each type of crop (Miljø- og Fødevareministeriet Landbrugsstyrelsen, 2018). The total use of livestock manure, chemical fertilizers and other fertilizers on a farm must not exceed the standard nitrogen and phosphorus quota.

The majority of agricultural operations must participate in the national Register of Fertilizer Accounts, where they report details of their operations on an annual basis. Registrants input details on the livestock types and headcounts and the land application areas into the system, which then calculates the manure volumes and nutrient application limits for the operation in question. Other information that is documented in the Register include the origins of any imported fertilizer and manure, use and storage volumes, and soil test results for operations approved for derogation. Operations that are not required to register in the Register of Fertilizer Accounts make up approximately 3.9 percent of the agricultural area in the country.

The Danish Agricultural Agency ensures compliance with the harmony rules through reviews of submitted fertilizer accounts and/or inspections. All submitted fertilizer accounts undergo an automated review according to a predefined set of risk criteria. Violations of legislation or the conditions of an approval are punishable by fines, and may escalate to imprisonment of up to 2 years for significant offences that were committed intentionally and/or through gross negligence.



When a new livestock operation is proposed, the applicable municipality notifies the public and other affected authorities of the proposal and of the public consultation process. The decision of the Danish Environmental Protection Agency to approve or reject a livestock operation's environmental impact assessment can be appealed by the public.

Fertilizer accounts are published online after the submitted information is processed, and remains online for a period of 5 years. Manure transfer agreements are not published.

4. ASSESSMENT OF REGULATORY AND PERMITTING REQUIREMENTS

In the following section, the subject jurisdictions both within and outside the Great Lakes Basin are evaluated in terms of their regulatory and permitting requirements with respect to manure management, as well as the opportunities for input from the public and indigenous communities, compliance, monitoring and enforcement, and funding. The nine jurisdictions within the Great Lakes Basin and the eight jurisdictions outside the Great Lakes Basin are discussed in Sections 4.1.1 and 4.1.2, respectively. An overall assessment of public and indigenous consultation and engagement is discussed in Section 4.2. Comparisons between jurisdictions are presented in Section 4.3.

The results of the evaluation using the ratings codes presented in Table 1 (Section 2.1.2) are presented in Tables B-1 and B-2 in Appendix B, and are also summarized as a graphic in Figure 2.

4.1 ASSESSMENT OF STRENGTHS, WEAKNESSES AND SIMILARITIES OF REGULATORY AND PERMITTING REQUIREMENTS ACROSS JURISDICTIONS

Of the jurisdictions considered in this study, the most comprehensive regulatory requirements for manure management were found to be in the Netherlands, which are defined from the requirements of the European Union Nitrates Directive and further refined by the Dutch Manure Policy. Particular focus is placed on regulation of manure disposal due to the relatively insufficient land base of the country, with strict requirements for record-keeping, tracking of shipments and reporting.

The most comprehensive requirements surrounding compliance, monitoring and enforcement were observed in Ontario. Compliance with permitting requirements is verified by random inspections and complaint-triggered inspections. The Ontario Ministry of the Environment and Climate Change has a range of enforcement actions at their disposal based on the severity of the infraction, ranging from orders to cease and/or clean up the activity, to fines and jail time. The participation of the Ontario Ministry of Agriculture may be sought to mediate nuisance issues.



Of the jurisdictions considered for this study, Alberta has the most comprehensive process for public participation. Affected parties are notified and have the opportunity to comment on proposals to create or expand animal feeding operations; a larger radius of residents and landowners are to be notified for operations with higher animal units. The NRCB considers the comments received on an application before making a decision on the application, and affected parties have the opportunity to appeal the NRCB's decision. Applications and the NRCB's decisions are made publicly accessible on the NRCB's website.

No jurisdiction stood out as being exemplary with respect to definitions, quantifications and standards for manure management permitting purposes. Similarly, while most jurisdictions had some kind of general funding available for agricultural operations to implement best management practices, few specialized on helping operations meet and exceed regulatory requirements specific to manure management.

In the following subsections, the strengths and weaknesses of the various jurisdictions, as compared to the evaluation criteria established in Table 1 in Section 2.1.2, are discussed.

4.1.1 State/Provincial Level – Within the Great Lakes Basin

4.1.1.1 Ontario

The following strengths were identified in Ontario's approach for manure management:

- Ontario has a standardized approach that affects, or will affect, most livestock operations. For small to medium sized operations, it is taking effect as farmsteads expand or modernize. This reduces the need for funding programs since this is a normal cost associated with building a barn. For all larger operations (>300 NU), it took effect in 2007. Significant funding was made available at that time to complete farmstead changes necessary to meet regulations (mostly manure storage construction and clean water diversion);
- Since all new and renovated livestock facilities greater than 5 NU (5 cows) must meet the requirements of the *Nutrient Management Act* to obtain a building permit, livestock facilities in Ontario are typically incorporating many environmental components. This in turn has gradually transformed the Ontario landscape in terms of how manure is managed in the province of Ontario. For example, all liquid manure operations must be engineered to have 2 levels of protection and typically 240 days of manure storage is required as part of the building permit. In addition, concrete manure storages are used in almost all cases and all liquid from solid manure storages and livestock must be either eliminated (covered) or properly managed;



- The regulation uses a “farm unit” approach. Livestock numbers are counted within this farm. Since a “farm unit” can never be less than a deed, this reduces the chances of farm operations being split up into small parts to stay under prescribed thresholds;
- A secure review process has been set up for Nutrient Management Strategies. This helps ensure issues are dealt with prior to the construction of the facility (it is much easier to resize a tank before it is poured in concrete);
- Canada and Ontario have recently finalized the Lake Erie Action Plan for achieving phosphorus reductions in Lake Erie from Canadian sources. The Plan sets a target of 40 percent phosphorus load reduction by 2025, and an aspirational interim goal of a 20 percent reduction by 2020.

Most of the weaknesses with Ontario’s process are with the field application regulatory process:

- NMPs for field application are only required for farm units with more than 300 NU and/or which are located within 100 m of a municipal well. While there is an argument that for smaller operations, field nutrient management planning is effectively managed by BMP approaches, this could be seen as a weakness in Ontario’s legislative approach especially for areas where the concentration of livestock is high;
- There is a gap in the Ontario legislation that when manure is transferred out of the “farm unit” (and not onto another regulated “farm unit”), it no longer has to be applied following a regulated nutrient management plan. Especially in areas with high livestock densities, this may result in eventual difficulties in finding fields to properly (and economically) manage the manure;
- NMPs for field application are not reviewed by government staff prior to facility approval; they are only subject to inspection by Ministry of the Environment and Climate Change staff. In comparison to the review process for Nutrient Management Strategies, this reduces opportunities to catch any issues prior to development of a livestock facility (although there is an argument this is not as important since parameters can be changed more easily).

4.1.1.2 New York

The following strengths were identified in New York’s approach for manure management:

- NYSDEC works within the guidelines set by the U.S. EPA as to what defines the difference between a large and medium CAFO;
- NYSDEC strongly enforces SPDES permits by monitoring facilities through their periodic DMRs and performing annual inspections, both routine and random.



- NYSDEC also sets firm regulations regarding manure application. Manure cannot be applied on soils that are already saturated with some form of precipitation or manure that is frozen or has a snow covering, and single manure application rates are not to exceed 20,000 gallons per acre (187,079 L/ha) cumulatively within any 7-day period;
- The State of New York also has a very strong funding program for farms. The CWIA is a \$2.5 billion investment targeted towards drinking water, water quality, and clean water infrastructure. This act provides \$50 million in grants with a maximum award amount per proposal of \$385,000, which includes funding for things such as waste storage and waste transfer system program.

The following weaknesses with New York's manure management were identified:

- NYSDEC does not have regulations in place regarding specific acreage requirements for manure application nor does it define manure testing protocols or manure transfer restriction;
- NYSDEC does not offer readily available public access to CAFO permits, has no regulations pertaining to consultation with indigenous communities, and has limited non-governmental organization involvement.

4.1.1.3 Pennsylvania

Strengths:

- PADEP works within the guidelines set by the U.S. EPA as to what defines the difference between a large and medium CAFO;
- PADEP assures compliance of CAFO permit requirements by performing annual inspections and requiring CAFOs with 1,000 AU to have a PA-registered Professional Engineer's certification of structural integrity for all manure storage facilities on site;
- Pennsylvania provides funding for farm operations through the REAP program, which gives between 50 percent to 75 percent tax credits to eligible applicants for projects that cost up to \$150,000;
- A new plan for nutrient release reduction has been developed by PADEP, Pennsylvania Departments of Agriculture, Conservation, and Natural Resources, and State Conservation Commission. The goal of the plan is to reduce nitrogen by 31.4 million pounds (14.2 million kg), phosphorus by 1 million pounds (0.45 million kg), and sediments by 648 million pounds (294 million kg) by 2025;
- Pennsylvania developed a Domestic Action Plan (DAP) to assist in the elimination of nutrient pollution in Lake Erie. The DAP addresses the General and Specific Objectives in Article 3 of the GLWQA and placed special emphasis on the Lake Erie Ecosystem Objectives and Phosphorus Substance Objectives developed with guidance from Annex 2 and Annex 4.



Weaknesses:

- PADEP does not elaborate on the regulations set forth by the U.S. EPA on soil or manure testing protocols and procedures, nor does it have any regulations regarding manure transfer or required acreage for manure application;
- PADEP does not have any formalized public participation or involvement with permits/permitting CAFOs;
- There are also no regulations regarding indigenous communities in Pennsylvania.

4.1.1.4 Ohio

Strengths:

- Ohio EPA works within the guidelines set by the U.S. EPA as to what defines the difference between a large and medium CAFO, and requires both medium and large CAFOs to seek permitting if the operation has a potential to discharge. Ohio EPA has a database where the public can access information on permitted CAFOs;
- ODA makes PTIs available to the public as a notice for new construction of CAFFs through an “interested parties list” available from the Ohio Division of Livestock and Environmental Permitting;
- The Ohio EPA Division of Surface Water operates the enforcement and compliance program. Violations can be a Notice of Violation, or for more serious violators, possible penalties including imprisonment and fines of up to \$25,000 per day of violation. If fish kills occur due to manure spreading, then the ODNR is responsible for all enforcement;
- The Ohio EPA and OWDA offer two different loan opportunities with the Water Supply Revolving Loan Account and Water Pollution Control Loan Fund, which can be utilized by both public and private applicants. Ohio also takes advantage of the P-Index, using it as a tool to help identify areas that have high and low risks of phosphorus runoff;
- Ohio has a DAP in place that has a focus of reducing the levels of phosphorus in the western Lake Erie basin by 40 percent;
- In the western Lake Erie basin, application on frozen ground is prohibited for all facility sizes;
- Ohio requires that manure from a permitted facility be handled by a certified livestock manager;
- Ohio recently passed legislation that includes limitations on the application of fertilizers on agricultural land.



Weaknesses:

- Ohio EPA does not set forth any more regulations involving manure storage, acreage requirements for land application, sampling procedures and protocols for manure, or manure transfer, and instead follows regulations established by the US EPA;
- The amount of farms in the state of Ohio is slowly decreasing, along with amount of NPDES CAFO permits, but the number of animals being raised is not decreasing.

4.1.1.5 Indiana

Strengths:

- IDEM works within the guidelines set by the U.S. EPA as to what defines the difference between a large and medium CAFO. IDEM issues permits for medium and large CFOs, elaborating on various aspects of the U.S. EPA guidelines;
- IDEM has created a framework for acreage needed for manure application based on the number of animals, per acre, per year. This framework helps CFO operators from overloading their land with nutrients from manure. IDEM allows manure to be sold or given away. The owner/operator is responsible for providing an information sheet about the manure to the recipient of the manure, and is responsible for retaining this information on site for inspections;
- The public can access all CFO and CAFO permits that have been approved;
- A new CFO approval, or an existing CFO seeking approval of expansion, must notify all residences within a half-mile radius from the proposed CFO. Written public comment about CFO proposals is allowed for up to 33 days following the date of the initial proposal;
- Land application in the state for CFO/CAFO is determined by soil P \leq 200 ppm; soils >200 ppm are prohibited from applying P;
- Manure sold or given away by a CFO must be applied by a Category 14 Applicator;
- Funding is available through LARE grant funding, which is administered by the IDNR;
- Indiana has a DAP in place that has a focus of reducing the levels of phosphorus in the western Lake Erie basin by 40%.

Weaknesses:

- IDEM has no regulations pertaining to indigenous communities;
- There are no specifications on inspection frequency or types of violations enforced;
- The CFO regulations lacked specific requirements needed for MMPs or NMPs beyond what is already stated in the U.S. EPA's regulations for CAFOs.



4.1.1.6 Illinois

Strengths:

- IEPA, with some assistance from the IDA, works within the guidelines set by the U.S. EPA as to what defines the difference between a large and medium CAFO;
- The Illinois LMFA requires waste management plans for facilities with over 1,000 AUs as well as NMPs for all facilities that have or are seeking to obtain an NPDES permit; both need approval by either the IEPA or IDA prior to operation;
- Permit regulations provide methods that clearly state the proper way to sample manure as well as soil for testing;
- IEPA handles all enforcement and inspections concerning CAFOs. Citations that can be issued for violations are noncompliance advisories, violations notices, and requests for injunctive relief;
- NOITC is required before any construction can start. Filing of a NOITC is a five step process that takes about 90 days;
- Public information meetings can be requested whenever a new livestock management or waste handling facility is proposed that either houses more than 1,000 AU or uses an earthen lagoon to handle animal wastes.

Weaknesses:

- IEPA has no regulations regarding acreage requirements for manure application, nor does it have any specific regulations involving the transfer of manure from CAFOs to an offsite location;
- No state specific funding is offered, but CAFOs have the ability to receive federal funding through various programs.

4.1.1.7 Michigan

Strengths:

- MDEQ works within the guidelines set by the U.S. EPA as to what defines the difference between large and medium CAFOs;
- MDEQ requires CAFOs to have Storage Structure Plans in place and for structures to be inspected weekly, year round, to ensure there are no leaks or deficiencies with the structures;
- Daily land application records are required to be kept and available on site at all times, and are to be made available to the public upon request, as long as the MDEQ is in possession of them;
- CAFO permitting regulations set forth by the MDEQ provide proper sampling methods to be used for manure sampling and handling;



- Michigan requires that a certified provider approve the CNMP;
- Michigan has multiple organizations and tools supporting environmental initiatives for agriculture including Michigan State University, MAEAP, and EnviroImpact Tool;
- MDEQ does offer a 24-hour hotline for citizens to report any discharges or any other environmental problems;
- MDEQ's MiWaters webpage provides information on the location of CAFOs in the state and include the results of inspections completed. Enforcement of CAFOs is handled by MDEQ;
- Michigan developed a DAP for Lake Erie, which establishes procedures for the state to reduce the amount of phosphorus entering Lake Erie by 40 percent by 2025.

Weaknesses:

- MDEQ does not have any regulations regarding acreage required for manure application, however, the permit does require that manure applications be based on nutrient use, field assessments, and appropriate land application of CAFO waste and that the farm account for the upcoming 12 months of manure production;
- There was no information available about possible state funding or grants available to farmers for projects or proposals involving CAFOs, however operations in Michigan do have the opportunity to obtain funding through federal funding programs.

4.1.1.8 Wisconsin

Strengths:

- WI DNR works within the guidelines set by the U.S. EPA as to what defines the difference between a large and medium CAFO;
- WI DNR does use the P-Index and requires the use of it for fields with soil test P levels less than 50 ppm and not at optimum P levels for the highest P demanding crop;
- NMPs are required by the CAFO permits and all plans are phosphorus based to help reduce the potential for phosphorus runoff;
- All concerns and complaints involving CAFOs or potential spills can be reported to a 24-hour hotline. Ample funding is made available to all farmers/farm operators of the state. The State of Wisconsin provides approximately \$20 million annually for farm conservation cost share grants. The funds are split between "hard practices" and "soft practices" and are divided among the state's 72 counties.



Weaknesses:

- WI DNR does not implement more regulations beyond what is set forth by the U.S. EPA regarding application of manure to land, nor are there more regulations pertaining to acreage needed for application, protocols for manure testing, manure transfer to offsite locations, or specifications for BMPs that need to be implemented;
- WI DNR does not specify frequency of inspections;
- WI DNR is currently understaffed, resulting in backlogs of permit renewals, and lack of routine inspections being conducted. Roughly one-third of CAFOs in the state are operating on an expired permit. Over the past 11 years, there were 41 incidents in which it took the WI DNR six or more years to renew an expired permit.

4.1.1.9 Minnesota

Strengths:

- MPCA works within the guidelines set by the U.S. EPA as to what defines the difference between a large and medium CAFO;
- MPCA requires a State Disposal System (SDS) permit for any facility that has the capacity for over 1,000 AUs;
- Manure sampling is required to be conducted by feedlot owner and must be analyzed by MDA or MPCA certified laboratories. Soil is required to be tested using the Bray P1 or Olsen test;
- MMP as well as NMP are required by the permit to be kept onsite and updated annually;
- The AgBMP Loan Program is available to agricultural operations and rural Minnesota.

Weaknesses:

- There are no further regulations beyond what is set forth by the U.S. EPA for offsite manure transfer, minimum acreage requirements for land application, and BMP requirements for NMPs, and there are minimal additions to the U.S. EPA's set guidelines for general manure application to land;
- There is no specific information regarding inspections of CAFOs and no direct opportunities for the public to comment on the construction of new or expanding CAFOs.

4.1.1.10 Comparison among the Different State/Provincial Jurisdictions

There are many similarities in the regulation and permitting requirements for each state as identified previously. On a state level, most follow U.S. EPA guidance with differences noted in the level of oversight, inspection, and enforcement, as described previously.



In evaluating all the jurisdictions using the rating codes described in Section 2.1.2, all the jurisdictions within the Great Lakes Basin scored the same (3 out of 4) for the categories dealing with Regulators & Legislation, and Definitions, Quantifications, etc. for permitting purposes (refer to Table B-1 in Appendix B, and the graphic representation of the evaluation results in Figure 2). It was generally observed that two levels of regulators were involved in the oversight, permitting, approval and/or enforcement of manure management, with some level of coordination between the different regulatory agencies. For the American jurisdictions, both federal and state level regulations applied. In contrast, in Ontario (Canada), provincial and municipal involvement was comprehensive, but federal involvement was limited.

It was observed that all jurisdictions within the Great Lakes Basin have a regulatory framework in place for overseeing manure management, though there was some variation in the degree to which the requirements were prescriptive as opposed to being broadly-based and/or flexible. It was also observed that support for agricultural operations (e.g. funding, extension work, guidance) is sometimes provided by a different regulatory body, or even a non-governmental organization, from the one responsible for the actual enforcement of manure management requirements. This may be advantageous in terms of governance and process in particular when practical solutions to meet regulatory requirements may not be obvious.

Compliance, monitoring and enforcement practices were highly variable. Ontario was identified as having the most comprehensive practices for all aspects of animal feeding operations, including building permit requirements, nutrient management requirements and enforcement for spills. In contrast, limited information was available regarding some state's approach for handling violations, and the frequency of and triggers for inspections.

The level of input from public stakeholders and indigenous communities were variable, with most jurisdictions ranking low (rating of 1 or 2). Public notification and engagement for animal feeding operations ranged from opportunities to comment on a proposed confined feeding operation (e.g., in Indiana), to the availability of online mapping of CAFOs (e.g., New York). No guidance or requirements for consultation with indigenous communities, specific to animal feeding operations, were identified at the provincial/state level.

With the exception of Michigan, some level of funding opportunities is available for agricultural operations in the Great Lakes Basin to improve manure management practices. Most of the Great Lakes Basin also has various non-governmental and/or voluntary initiatives to help animal feeding operations meet targets and review their effectiveness, although few such opportunities were identified in Indiana.



4.1.1.11 Summary and Conclusions – Regulatory and Permitting Requirements within the Great Lakes Basin

As described above, all the jurisdictions within the Great Lakes Basin have some sort of framework in place for overseeing manure management practices. While many similarities exist, the management frameworks also appear to be tailored to each jurisdiction's unique context, potentially the result of interjurisdictional differences in land use, economics, and environmental mandates. As such, what may sometimes appear as a lack of consistency could potentially be the result of a series of adjustments and improvements carried out over the years.

There generally appears to be a consistent level of interest and concern with addressing manure-related impacts to soil and water quality, as exemplified by the availability of funding for agricultural operations to improve their practices. Funding and incentives dealing indirectly or directly with manure management are available in most jurisdictions.

The jurisdictions in the Great Lakes Basin generally scored low with regards to input from public stakeholders and indigenous communities. While not an ideal situation from the perspective of transparency and accountability, further study would be required to determine if and how this may be holding back improvements to the existing manure management frameworks.

4.1.2 Jurisdictions outside the Great Lakes Basin

4.1.2.1 Saskatchewan, Canada

Saskatchewan's results-based approach to manure management distinguishes it from the other jurisdictions considered in this report. Whether this constitutes a strength or a weakness cannot be fairly assessed solely from a desktop review of its regulations, rules, policies and practices. A results-based approach may be advantageous if sufficient guidance and support is available to show agricultural operations how to successfully avoid negatively impacting soil and water resources in the context of their specific operations. Using a results-based approach may prove less effective if it relied too heavily on reactive measures (e.g., penalizing operators for manure spills after they occur).

The Ministry of Agriculture does nonetheless maintain regulatory oversight of manure management in the province by requiring livestock operations to develop and submit for approval a waste storage plan and/or waste management plan, by seeking comment on the plans from other parties and requiring proponents to revise their plans as deemed appropriate. The *Agricultural Operations Act* therefore does provide some safeguards against high risk and/or untested practices even if the latter have not yet caused serious environmental impacts.



The generally non-prescriptive nature of manure management requirements in Saskatchewan may present a challenge to agricultural operations if the ministry reviewer of waste storage plans and waste management plans has specific expectations that are not well communicated to the applicants. A review of the approval process and consultation with agricultural operations and the Ministry of Agriculture would be required to assess the effectiveness and efficiency of Saskatchewan's manure management framework.

4.1.2.2 Alberta, Canada

In sharp contrast to its neighboring province of Saskatchewan, Alberta's manure management framework consists of many prescriptive requirements and quantifiable standards, which could arguably be seen as its key strength. While there are many mandatory aspects of the permitting process, the Natural Resources Conservation Board (NRCB) is also provided with a level of discretion for establishing permitting procedures and for making decisions on permit applications. Approval officers' use of discretion is guided by the principles established by the Operational Policy.

Alberta also has comprehensive processes in place for notifying and consulting the public regarding proposed new animal feeding operations, and for handling complaints. As such, it scored the highest in that category out of all jurisdictions examined in this study.

Of interest is the fact that, while approval officers are required to reject applications that are inconsistent with the land use provisions in the local municipal development plan, the NRCB is not bound by these provisions. The NRCB can and has, on numerous occasions, reviewed application decisions and directed the approval officer to issue the permit. This arrangement may have been intended to address situations where a municipality did not intend to prohibit future animal feeding operations, but perhaps also indicates a need to make adjustments to the *Agricultural Operation Practices Act* and its regulations.

Funding and incentive programs for promoting proper manure management practices are available as part of the Confined Feeding Operation Stewardship in the Growing Forward 2 program for the period 2013-2018. However, due to the large numbers of applications received compared to the amount of funding available, the Stewardship program had to stop accepting new applications in February 2017. Renewal of the program should be considered as indicated by its popularity.



4.1.2.3 Maryland, United States

The Maryland Department of the Environment generally works within the guidelines set by the U.S. EPA as to what defines an AU and the size differences between a large and medium CAFO. One manner in which the NPDES was adapted to the environmental context of Maryland was through the categorization of select animal feeding operations as Maryland Animal Feeding Operations (MAFOs). In contrast to Confined Animal Feeding Operations, MAFOs do not discharge manure, litter, or process wastewater to surface waters of the state during wet weather events.

A distinctive component of Maryland's manure management framework is its Manure Transport Program, which helps livestock producers comply with their nutrient management plans. In particular, producers with high soil phosphorus levels and/or an insufficient land base may apply for cost-share grants to transport manure. This is in addition to other programs offering cost-sharing for the implementation of BMPs, financial incentives to plant cover crop, and land rental rates to take environmentally sensitive cropland out of production.

Another distinctive element is the transition of the state's use of the Phosphorus Site Index to the Phosphorus Management Tool (PMT), which is also accompanied by a temporary ban on phosphorus application onto fields with a Fertility Index Value exceeding 500. Farms that are subject to the ban receive priority for cost-share assistance to relocate the excess manure, such as the Manure Transport Program noted above. Following the end of the transition period in 2022, an assessment of the transition to the PMT, including its effects on phosphorus content in saturated soil and the challenges faced in its implementation, will be of interest in order to identify opportunities for similar programs in other jurisdictions.

No information could be identified on public notification and engagement processes for proposed new animal feeding operations, nor on public access to records of such operations in Maryland.

4.1.2.4 Iowa, United States

The Iowa Department of Natural Resources works within the guidelines set by the U.S. EPA as to what defines an AU and the size differences between a large and medium CAFO. The requirement for manure or commercial land fertilizers to be applied by a certified applicator appears, in principle, to be one of the strengths of the state's manure management framework. An evaluation of the effectiveness and practicality of this approach is beyond the scope of this study, but would be of interest in a future assessment; specifically of interest would be whether there is demonstrable evidence showing that manure-related impacts to soil and water are



reduced through the use of certified manure applicators, and whether such an approach does not impose an unnecessary burden on agricultural operations and regulators.

No information could be identified on public notification and engagement processes for proposed new animal feeding operations in Iowa. The state does, however, have a 24-hour Environmental Reporting Hotline where complaints can be directed.

4.1.2.5 North Carolina, United States

The North Carolina Department of Environmental Quality works within the guidelines set by the U.S. EPA as to what defines an AU and the size differences between a large and medium CAFO. Prescriptive regulatory requirements exist for developing Certified Animal Waste Management Plans, using certified manure haulers, designing storage facilities, and for testing soil and manure; a specific requirement exists to sample and test manure within 60 days of the time of application. The state provides estimates of manure production volumes and manure nutrient content by livestock type that can be used by animal feeding operations.

North Carolina is reportedly one of the only states in the country that requires annual inspection of every facility. The ability of other jurisdictions to similarly conduct annual inspections of each facility would likely be limited by its existing manpower and budgetary restrictions; whether there would be a significant benefit to conducting annual inspections should be carefully assessed prior to following North Carolina's approach.

No information could be identified on public notification and engagement processes for proposed new animal feeding operations in North Carolina. The state does, however, maintain a publicly-accessible list and map of permitted animal feeding operations.

4.1.2.6 Netherlands

Of the jurisdictions assessed for this study, the Netherlands has the most comprehensive regulatory requirements for manure management, and obtained the highest evaluation rating (4 on a scale of 1 to 4) in that category. The strict oversight of manure management likely arose out of necessity due to the country's small land area, agriculture-intensive land use, and population density. Due to the pervasiveness of manure fraud, the analytical testing, transport and disposal of manure is strictly monitored and documented.



From a North American perspective, a number of the Dutch regulatory requirements for manure management appear quite extensive and prescriptive. Within the context of EU legislative requirements, the Netherlands appears to be facing significant challenges in controlling its nutrient production to meet the European production ceiling, resulting in a need to set targets for reducing its livestock population. Reports suggest that if the Netherlands cannot find a way to manage its manure production, EU environmental rules may require up to half a million cows to be culled (Quartz Media, 2017).

No information could be identified about public notification and consultation requirements dealing specifically with new or expanding animal feeding operations in the Netherlands. The country does not have an indigenous population that is distinct from and which was historically colonized by the existing Dutch population (Brinkel, 2002), so indigenous consultation is not an applicable consideration for this jurisdiction.

4.1.2.7 Denmark

As with the Netherlands, one of the most notable features of Denmark's manure management framework is its national reporting system for declaring and documenting manure and fertilizer activities, in which agricultural operations must report their production, use, storage and disposal of manure on an annual basis. However, overall, the regulatory requirements for manure management were not as comprehensive as those of the Netherlands, particularly with regards to manure testing and disposal requirements.

Fertilizer standard quotas are determined on an annual basis, and also appear to be fairly comprehensive as they take into account criteria such as soil type, crop type, climate and irrigation. As one of the considerations in setting the standards is the protection of the aquatic environment, and the quotas are updated regularly, its long-term contribution to the control of nutrient impacts to water quality would be worth monitoring.

No information was identified to indicate that manure fraud is an issue in Denmark as is the case in the Netherlands, despite the two EU Member States being relatively similar in size. This may be attributed in part to the significantly lower population density of Denmark (136 people per square kilometre (km²), or 352 people per square mile) compared to the Netherlands (505 people/km², or 1,308 people per square mile) (World Bank Group, 2017).

Denmark allows for public notification and consultation for proposed new animal feeding operations, and fertilizer accounts are published online on government websites. A process exists for addressing nuisance-related complaints, but details regarding the protocol following the submission of the complaint could not be identified. Consultation and engagement with



indigenous communities is not applicable to mainland Denmark, as the country's only recognized indigenous group, the Inuit, are located in Greenland where livestock agriculture does not exist to any significant extent.

4.1.2.8 Summary and Conclusions – Regulatory and Permitting Requirements Outside the Great Lakes Basin

As can be expected from the diversity of jurisdictions considered, with varying soil, demographics, history and land use, the regulatory and permitting requirements of the subject jurisdictions are quite varied (see Table B-2 in Appendix B, and Figure 2). This is illustrated in the results-based approach to manure management used by Saskatchewan, Canada, compared to the comprehensive and prescriptive approach used in the Netherlands. A large variation can also be seen with regards to public consultation, in which a very prescribed process is used in Alberta, Canada, compared to the general lack of identified public consultation processes for the other jurisdictions.

Most of the jurisdictions have two levels of government coordinating manure management requirements, e.g., federal and state regulators, or provincial and municipal regulators. The exception was in the Netherlands, where regulation occurs predominantly at the federal level, with municipal and provincial authorities only being involved with managing complaints against animal feeding operations.

All the jurisdictions outside the Great Lakes Basin that were considered for this study have established agricultural sectors, of which livestock is a major component. Perhaps as a result of this, these jurisdictions also all have regulatory frameworks in place for managing manure on their lands, as well as having processes in place for ensuring compliance, monitoring and enforcement.

General and/or defensible data are available for permitting purposes for most jurisdictions, although limited definitions and standards were identified for Iowa.

4.2 PUBLIC AND INDIGENOUS NOTIFICATION AND ENGAGEMENT

As noted in Section 2.1.1 above, indigenous peoples in the Great Lakes region include First Nations, Métis and Tribes. For the purposes of this report, the term “indigenous”, as currently used by the United Nations (e.g., Office of the United Nations High Commissioner for Human Rights, 2013), was considered an appropriate approach to refer to one or more of these peoples.



The following subsections summarize the public and indigenous notification and engagement processes that exist for the jurisdictions within and outside the Great Lakes Basin.

4.2.1 Within the Great Lakes Basin

Ontario has a process where parts of approvals are available to the public, but there is not any engagement. The livestock facilities are being developed in areas where they are zoned for that use, and they are properly sited following Minimum Distance Setback regulations. In Ontario, having proper engagement processes for over 6,000 Nutrient Management Strategy applications would be a very difficult, expensive and time consuming process. Questions to consider include whether it is better to develop a thorough, standardized approval process in which developers know what is needed to achieve approval, and whether the engagement process should be limited to larger facilities. Members of the public may, however, access information on approvals, nutrient management strategies, etc. by filing a Freedom of Information request with the provincial ministries.

There are also no distinct processes that were identified in Canadian provincial legislation for notifying, consulting and engaging Indigenous communities regarding animal feeding operations. However, the Crown, at all levels, has a constitutional Duty to Consult Indigenous Communities when it contemplates conduct that might adversely impact potential or established Aboriginal or Treaty rights. The Crown must determine whether issuing an approval would adversely impact Aboriginal or Treaty rights, and where appropriate, provide accommodations, such as making adjustments to project plans, developing mitigation measures, attaching terms and conditions to permits or authorizations, etc.

Public notification and engagement requirements varied among the American jurisdictions in the Great Lakes Basin. The public does not have direct access to permits in New York and Minnesota, whereas they can access records in Ohio, Michigan, Wisconsin, and Pennsylvania via databases and authorized government agencies. In Indiana, an owner/operator applying for a new CFO or making changes to an existing CFO must make reasonable effort to notify landowners/occupants of land adjoining the property of the proposed or existing CFO, as well as all residents within half a mile radius of the CFO. The public has 33 days after the CFO has submitted an application for construction or expansion to comment on the proposal. In Illinois, public informational meetings can be requested if a new livestock management or waste handling facility is proposed that either has more than 1,000 AUs or proposes to use an earthen lagoon to handle animal waste.



Within the American jurisdictions in the Great Lakes Basin, no states have any regulations specific to animal feeding operations and Indigenous communities. However, in a similar fashion to the Crown's Duty to Consult in Canada, the U.S. EPA's Policy on Consultation and Coordination with Indian Tribes mandates them to consult on a government-to-government basis with federally-recognized tribal governments when the Agency's actions and decisions may affect tribal interests (EPA, 2011). The EPA's policy is intended to implement Executive Order 13175, issued in 2009, in which agencies were directed to develop an accountable process to ensure meaningful and timely input by tribal officials in the development of regulatory policies that have tribal implications.

4.2.2 Outside the Great Lakes Basin

Requirements for public consultation in the jurisdictions outside the Great Lakes Basin varied widely. Alberta had the most extensive public notification and consultation requirements of the jurisdictions outside the Great Lakes Basin, and had the greatest emphasis on public transparency and accessibility to records. In contrast, requirements for public consultation in the Netherlands appeared to be minimal, if not non-existent.

As is the case for the jurisdictions within the Great Lakes Basin, the North American jurisdictions outside the Great Lakes Basin do not have indigenous consultation and engagement requirements specific to animal feeding operations. The requirements to consult and engage with indigenous communities arise from the Crown's Duty to Consult and the U.S. EPA's Policy on Consultation and Coordination with Indian Tribes.

No equivalent exists in Denmark and the Netherlands for consulting with indigenous communities. The Netherlands do not have an indigenous population that is distinct from, or was ever colonized by, the existing Dutch population (Brinkel, 2002). Denmark's only recognized indigenous group, the Inuit, is located in Greenland, which is outside the scope of the present study.

4.3 COMPARISON OF THE JURISDICTIONS INSIDE VS. OUTSIDE THE GREAT LAKES BASIN

4.3.1 Within North America – Jurisdictions Inside vs. Outside the Great Lakes Basin

As described in Sections 3.2 and 3.3, all the jurisdictions examined in this study are agriculture-intensive, and all have defined approaches for handling manure and addressing manure-related impacts from permitted facilities. Unpermitted facilities are still subject to legislation for environmental protection (e.g. Canadian *Fisheries Act* prohibiting the deposit of deleterious substances into waterways containing fish, and the U.S. *Clean Water Act* prohibiting the discharge



of pollutants into water of the U.S. without a permit). However, in not requiring permits, comparatively little information is available about such facilities and their manure management practices until after a contravention occurs, at which point the regulatory authority becomes involved. All the jurisdictions have also experienced problems associated with harmful algal blooms, though the magnitude of these issues and the specific contribution of manure runoff, as compared to agricultural fertilizer, to the harmful algal blooms have not been examined in depth. Recent studies indicate that about 85 percent of the phosphorus entering Lake Erie from the Maumee River watershed comes from fertilizers and manure. Of the estimated more than 58,000,000 kg of total phosphorus applied in the western Lake Erie basin from both Canada and the U.S., approximately 28 percent is attributed to manure (Nutrient Mass Balance Study for Ohio Rivers).

Most of the total annual phosphorus loading to Lake Erie comes from a few major tributaries: the Maumee, Detroit, and Sandusky Rivers in the U.S. and the Thames and Grand Rivers in Ontario. These loads can be highly variable from year to year. On average, runoff from nonpoint sources are estimated to account for approximately 72 percent of the total phosphorus load entering Lake Erie each year (U.S. EPA, 2018). In the western basin, nonpoint sources are estimated to contribute upwards of 89 percent of the annual total phosphorus load in that portion of the lake's tributaries.

There are no particular aspects of manure management that are unique to the Great Lakes Basin, in the same way that there are no aspects of manure management that are distinct to areas outside the Great Lakes Basin. This would perhaps point to a lack of a coordinated effort among the jurisdictions in the Great Lakes Basin to specifically address manure-related impacts to soil and water quality, e.g., through the establishment of targets and objectives in Annex 4 of the *Great Lakes Water Quality Agreement*. It is also worth considering whether improvements to water quality in the Great Lakes Basin are contingent on all jurisdictions adopting a unified approach to handling manure management, or if separate management frameworks, unique to each jurisdiction, can be equally successful.

4.3.2 Jurisdictions Inside the Great Lakes Basin vs. Overseas (Netherlands & Denmark)

The Netherlands and Denmark, being member states of the European Union (EU), are directed to implement the 1991 Nitrates Directive, with the goal of reducing and preventing further water pollution caused or induced by nitrates from agricultural sources. The 1991 Nitrates Directive is one example of a coordinated approach among multiple jurisdictions to address nutrient-related impacts from sources including livestock manure. The Directive allows for some flexibility in its implementation, as seen from the differences between the two countries with respect to regulatory requirements, public input, etc. Further study is warranted to evaluate the success of



the Nitrates Directive, the potential application of a similar approach in the Great Lakes Basin, and whether targets imposed by higher levels of government risk being unfeasible or contentious (e.g., suggested reports that EU environmental rules requiring up to half a million cows to be culled in the Netherlands (Quartz Media, 2017)).

4.3.3 Lessons Learned Outside the Great Lakes Basin – Opportunities for the Great Lakes Basin

The striking contrast in manure management approaches between Alberta and Saskatchewan warrants closer examination for potential opportunities for the Great Lakes Basin. As described previously, the regulatory requirements in Alberta are very prescriptive, especially compared to the results-based approach used in the neighbouring province of Saskatchewan. Should a less prescriptive approach (i.e., by establishing clear targets, but allowing for flexibility in the manner in which the targets are to be met) prove to be effective in encouraging compliance and producing demonstrable improvements in soil and water quality, similar approaches could be considered within the Great Lakes Basin. In addition, aspects of Alberta's public consultation process and public availability of records could be adopted in the Great Lakes Basin, where several jurisdictions were a bit lacking in those regards.

Maryland, Iowa and North Carolina implement the NPDES program on behalf of the U.S. EPA, so their manure management approaches do not deviate significantly (either positively or negatively) from those of the U.S. states within the Great Lakes Basin. However, a distinctive feature of Iowa is the requirement to be a certified applicator in order to apply manure to land; for the Great Lakes Basin, a subject that could be explored further is whether such certification would improve rates of compliance with regulatory requirements.

Land use pressures in the Great Lakes Basin are not nearly as significant as those observed in the Netherlands, but the latter's experience to date with manure management may provide valuable insight into potential challenges that may face the Great Lakes Basin in the long term. The Dutch record-keeping practices for manure storage and transport can provide valuable insight into the potential benefits or drawbacks of harmonizing records and reporting across the basin. There would also be value in understanding the challenges faced by the Netherlands with respect to "manure fraud", and identifying potential warning signs for similar issues that may arise in the future within specific jurisdictions of the Great Lakes Basin.



5. MANURE MANAGEMENT APPROACH AND STRATEGY CONSIDERATIONS FOR THE GREAT LAKES BASIN BASED ON RESEARCH FINDINGS

5.1 SUMMARY OF THE CURRENT STRENGTHS AND WEAKNESSES OF MANURE MANAGEMENT IN THE GREAT LAKES BASIN

As detailed in Sections 3.2 and 4.1.1 above, the Canadian side (Ontario) of the Great Lakes Basin was observed to have well-defined regulatory oversight and legislation directing manure management through the Ontario *Nutrient Management Act* and its associated regulations. Regulatory oversight and legislation on the American side was variable and generally weaker in comparison.

The level of input from public stakeholders and the accessibility of records concerning animal feeding operations were variable throughout the basin, and somewhat lacking for several jurisdictions. In comparison, there generally appeared to be a stronger focus on enforcement, compliance and monitoring, with a complaints process in place in each jurisdiction.

The importance of addressing water and soil quality impacts associated with agricultural operations and manure use appears to be acknowledged throughout the basin, as the majority of jurisdictions had some level of funding and academic research available, aimed at optimizing the production and use of manure in agriculture and promoting BMPs.

In light of the strengths and weaknesses observed in the Great Lakes Basin, a series of recommendations were developed for improving and refining manure management, which are discussed in Section 5.2 below.

5.2 RECOMMENDATIONS

Following the assessment of the jurisdictions both within and outside the Great Lakes Basin, a series of recommendations were identified for improving the existing manure management frameworks, exploring long-term opportunities and addressing the main challenges with respect to manure management in the basin. The recommendations are presented in the following section, and summarized in Table 5.

Recommendation #1: Conduct an in-depth assessment of the actual implementation of each jurisdiction's respective manure management framework to identify successes and challenges in achieving their intended goals.



The present study examined manure management in various jurisdictions at a high level, though it was not intended to evaluate the actual implementation of each jurisdiction's management framework. An in-depth assessment of these management frameworks is strongly recommended, as these may provide valuable insight for the jurisdictions within the Great Lakes Basin by:

- Identifying what policies appear promising in principle but which are challenging to implement for regulators and/or agricultural operators;
- Determining whether measurable improvements in soil and water quality were observed after adopting new policies and practices to improve manure management;
- Identifying logistical challenges with respect to enforcement, compliance and monitoring of other jurisdictions' regulations;
- Evaluating the implications of tighter or more lenient regulatory requirements to individual agricultural operations, etc.

5.2.1 Regulatory Requirements and Oversight

Recommendation #2: Establish a set of guidelines and regulations to be incorporated by all states/provinces to ensure a uniform implementation framework; coordinate the oversight of manure management among federal, provincial/state and municipal regulators, and assign jurisdiction based on the size of the animal feeding operation.

Very small operations that do not require federal, state or provincial permits should be covered by municipal-based regulations. Provincial/state government approval should be uniformly required for the installation, expansion and renewal of medium- and large-sized facilities.

It should be noted that quantitative thresholds for small, medium and large feeding operations are best determined by the individual jurisdictions, rather than applying the exact same thresholds for the entire Great Lakes Basin. The thresholds should be determined based on the statistical norms of a given jurisdiction, and may require consideration of the existing market (e.g., supply-managed vs. open market) that may influence how operations plan and choose their livestock sizes and densities. In qualitative terms, a small animal feeding operation should generally be considered to be the size of a lifestyle/hobby farm, while a medium animal feeding operation should be the size of a traditional family farm, and anything larger should be considered a large animal feeding operation.

Following the installation of medium- and large-sized facilities, municipalities should conduct an on-site inspection to verify that their construction was in compliance with approved plans. Subsequent and regularly scheduled on-site inspections of the facilities' operations should be conducted by provincial/state governments, to ensure the manure is being utilized properly.



Recommendation #3: Facilities should not be able to subdivide their operations to avoid exceeding regulatory thresholds.

All facilities within a farming operation should be considered part of the operation; that is, there should be no ability to subdivide an operation into smaller parts, especially within a single deed, to avoid permitting requirements. Additionally, livestock numbers should be counted based on planned building footprint and facility type.

Recommendation #4: Develop a systematic approach for quantifying minimum acreage requirements for manure application, accounting for factors such as livestock types and numbers, and requirements for manure storage.

Most of the States within the Great Lakes Basins are lacking in requirements involving acreage needed for manure application. The U.S. EPA does not provide information or regulations regarding acreage requirements. Of the states researched, the only state that has some sort of regulation pertaining to acreage is Indiana. Indiana has set up a framework for farmers to use to calculate how much acreage is needed for the manure produced by a specific number of AUs; however there is little to no information about how this regulation is being enforced. Regulation of acreage needed is vital to ensure that farmers are not overloading land with nutrients and increasing the risk of nutrient run off.

Small operations should have approved manure storage facilities at their disposal along with a specified land base, as determined by an established number of animal units (or nutrient units) per unit area. Alternatively, the operations should have a manure removal agreement in place for proper disposal of the manure.

Medium- and large-sized facilities should have proper manure storage and full runoff control. Either a specified land base (as determined from an established number of AU/NU per unit area) or a nutrient management plan would be needed to demonstrate proper nutrient utilization.

Recommendation #5: Develop a land base registry or equivalent tracking system for overseeing manure application agreements.

A land base registry or equivalent tracking system should be developed to track manure application agreements. Such a tracking system should be used to determine whether sufficient land is available to accommodate increased manure production from operations proposing to expand and/or modernize.



Recommendation #6: Develop requirements for the permissible timing and volumes of manure transfers from an operation to an offsite location, applicable to both permitted and unpermitted animal feeding operations.

A significant piece of regulation lacking from most states is on the transfer of manure from an operation to an offsite location. While most states require documentation on the amount of manure transferred, Michigan, Ohio, and Indiana are the only states within the Great Lakes Basin with more stringent regulations pertaining to manure transfer. Michigan prohibits the transfer of manure from January to March unless the recipient follows the winter application standards set by the MDEQ for large CAFOs. Ohio requires that manure from a permitted facility be handled by a certified livestock manager. Indiana allows manure to be sold or given away as long as the person receiving the manure is supplied with an information sheet detailing the address of the CAFO and a statement indicating unlawful applications of manure. Regulation involving manure transfer is also not included in the U.S. EPA guidelines for NPDES permits. Specific requirements for transfer of manure should be required, as moving manure from one facility that has proper and permitted storage structures, to a location that potentially does not have appropriate storage or BMPs, could pose a greater risk of runoff and contamination to surface/groundwaters. Standards and requirements for off-site manure transfers should be developed and be applicable to permitted and unpermitted animal feeding operations alike.

Recommendation #7: Investigate the nation-wide reporting and record-keeping practices of the Netherlands and Denmark and opportunities for application in the Great Lakes Basin.

The annual reporting and record-keeping requirements of the Netherlands and Denmark should be further investigated, to identify potential opportunities to apply a similar approach in the Great Lakes Basin. One area of focus should be the strategies for optimizing the efficiency of the process for the benefit of both the agricultural operators and the regulators. As the demographics, land use pressures and water quality conditions in the Great Lakes Basin differ from those occurring in the Netherlands and Denmark; any proposed annual reporting framework should be tailored to the context of the Great Lakes Basin.



5.2.2 Policies and Best Management Practices

Recommendation #8: Comprehensive Nutrient Management Plans should be required for medium- and large-scale facilities, prepared by a qualified professional, and account for all nutrient sources.

A NMP is designed to effectively utilize nutrients produced by animal waste on a farm. The terms Nutrient Management Plans and Manure Management Plans are used interchangeably when dealing with NPDES CAFO permits. A CNMP takes into account other types of management practices and incorporates record keeping and land treatment practices along with other important areas. The states within the Great Lakes Basin that requires the use of a CNMP are Michigan and New York. New York requires that the plan be developed and certified by an AEM certified planner and kept on site for 5 years from the date it was created. The state of Michigan's MAEAP voluntary program also utilizes the CNMP. CNMP's in Michigan must be approved by Certified CNMP Providers and shall apply to both production areas and land application areas. All other states within the Great Lakes Basin require the use of NMP/MMPs. Regardless of farm size, plans should require information on soil and manure characterization, nutrient budgets, soil erosion and runoff controls, odor controls, and crop rotations/yields, and should be site specific.

Plans for the utilization of manure should account for all nutrient sources, including fertilizers and nutrients from other inputs (e.g., biosolids, called Non Agricultural Source Materials in Ontario). A phosphorus index should be considered, especially when nutrients are applied in close proximity to surface water and tile drain inlets. The addition of phosphorus-based fertilizer should be limited to crop removal when phosphorus soil levels are high, unless the phosphorus index shows a low risk.

Recommendation #9: Create a comprehensive template of best management practices and recommended standards for optimal nutrient application. The template should provide a process for evaluating the effectiveness of the plan, and include an adaptive management component.

Authorized government agencies should develop NMP/MMPs/CNMP templates to assist farms with compliance and ensure consistency with the implementation of CAFO regulatory requirements. The plans should include similar BMPs as recommended by U.S. EPA NPDES permit guidelines to assure adequate storage capacity, proper management, diversion of clean water from production areas, and preventing animals from contacting waters of the state. Plans should be site specific and required to be approved by the authorized state agency before implementation, or certified by a professional engineer (P.E.) or other qualified/certified



personnel. To increase the effectiveness of the plan, a science-based adaptive management process, that evaluates the actual nutrient loading in runoff, should be included.

The establishment of basin-wide or regional standards for optimal nutrient application, factoring in crop type, soil type, climatic conditions, precipitation and irrigation, and updated on an annual basis, should be explored. While the Danish fertilizer standard quotas are enforceable under their legislation, a template of recommended standards that can be used at the discretion of the individual jurisdictions should be considered. The standards should be developed with the aim of reducing total phosphorus loading into water bodies and helping to achieve the phosphorus reduction targets of Annex 4 of the *Great Lakes Water Quality Agreement*.

Recommendation #10: Testing of manure nutrient content and field nutrient values should be uniformly required and evaluated for medium- to large-sized facilities.

Databases should be compiled and made available to assist with planning prior to construction. Such databases could be used to provide aggregated soil test results correlated to yield on a township or county scale (i.e., within an area of similar climate conditions). The databases could also be used to compare and verify that a given operation's laboratory-analyzed nutrient results are within a normal range for the area.

Manure and field nutrient databases would also help small operations with agronomically optimizing their nutrient applications.

5.2.3 Incentives and Support for Animal Feeding Operations

Recommendation #11: Provide dedicated funding for promoting proper manure management, by assisting existing animal feeding operations to make necessary changes to meet recommended standards and best management practices.

The U.S. EPA offers some support to CAFOs through the AgStar Program, which is a joint initiative between U.S. EPA, the U.S. Department of Energy, and the U.S. Department of Agriculture. The program shows dairy and swine producers ways to manage manure properly while protecting the environment. It also offers technical support and funding for operations. Another funding program available to all states is the Environmental Quality Incentives Program (EQIP), which provides financial and technical assistance to agricultural producers in order to address natural resource concerns as well as improve water and air quality. The Great Lakes Restoration Initiative (GLRI) was launched in 2010 to accelerate efforts to protect and restore the Great Lakes. GLRI funding of more than \$1.6 million was provided by the NRCS in 2017 to reduce phosphorus runoff and sediment pollution in priority watersheds in the Great Lakes Basin.



Specifically for the western Lake Erie Basin, funding is available through the Regional Conservation Partnership Program, which is a 7-year, \$17.5 million program funded by the USDA NRCS. The goal of the program is to reduce nutrients from entering the western basin's waterways to lessen harmful algal blooms.

In addition to federal funding, which is available to all operations in any state that meet the requirements of the funding program, some states within the Great Lakes Basin offer some sort of statewide funding incentive either in the form of grants or tax credits, while others do not. It would be beneficial to offer more grants, on a statewide level, specific for CAFOs to assist with implementing their program and minimize the potential for runoff to waterways of the states.

Additional support is available to farmers in all states located within the Great Lakes Basin. Also, within each jurisdiction, there is a university with an agricultural extension service that assists both farm operators/owners, as well as provides information to the public. These universities offer information on manure handling and application, as well as technical support and assistance with NMP/MMP development.

Voluntary environmental review programs should be developed for agricultural operations in the Great Lakes Basin that will assist them in implementing BMPs for improving nutrient management. This type of program exists in Ontario in the form of the Environmental Farm Plan, which is voluntary, but is also a requirement for eligibility for many funding programs. Similarly, the Michigan Agriculture Environmental Assurance Program (MAEAP) is a comprehensive, voluntary, proactive program designed to reduce farmer's legal and environmental risks. Through the MAEAP program, an operation can take the corrective steps to reduce pollutant risks and become environmentally assured. A similar approach should be explored for all jurisdictions in the Great Lakes Basin, coupled with increased accessibility to funding in order to incentivize participation.

Livestock operations that are expanding or modernizing are typically required to have proper manure transfer and storage, proper wash water and feed storage runoff management, and clean water diversion. Operations that are not expanding or modernizing, and which would otherwise not trigger these requirements, should nonetheless be encouraged and/or be eligible for funding to achieve these standards.



5.2.4 Public and Indigenous Notification and Engagement

Recommendation #12: Public and indigenous input should be required if a proposed small- or medium-sized facility does not meet municipal zoning criteria. Public input should be required for new, expanding and/or renewals of large-scale operations.

None of the states researched, nor does the U.S. EPA, have regulations or guidance on indigenous communities and their involvement with CAFO operations. Public access and comment is lacking in some jurisdictions, such as New York and Minnesota. There is no direct access to permits available, but it is assumed that if one was to contact the authorized agency, some information may be obtained. Wisconsin, Ohio, and Pennsylvania offer public information via the internet through either databases or state maps outlining locations of CAFOs. Information is either limited, not updated or only offers a fraction of the CAFOs that are permitted in that specific jurisdiction. Indiana offers public access to CFO/CAFO permits through the IDEM but also has specific regulations regarding public notice of new or proposed expansions of CFOs. Illinois offers similar public access to CAFO permits through the IEPA and also has regulations involving NOITCs and proposed CAFOs. The public of Illinois also has the opportunity to request formalized meetings for new livestock and waste handling facilities, as does the public in Ohio. Michigan offers access to records and permits through MiWaters, which is operated and updated by the MDEQ.

It is recommended that a more established process be developed throughout the Great Lakes Basin to solicit and incorporate public and indigenous input on animal feeding operations. Such input should be required if a proposed small- or medium-sized facility does not meet municipal zoning criteria, and for any proposals to construct, expand and/or renew large-scale operations.

6. CLOSING

The present study sought to identify and evaluate how existing regulations, rules, policies and practices in the Great Lakes Basin are applied to the use, management, storage and disposal of manure from animal feeding operations. The International Joint Commission's Great Lakes Water Quality Board's Legacy Issues Work Group identified the oversight of animal feeding operations and their management of manure as a priority topic in the basin.



The present study assessed the provincial and state jurisdictions in the Great Lakes Basin in terms of their respective manure management frameworks, including factors such as the regulatory requirements, their approaches for defining animal feeding operations, and the processes for public and indigenous community input. Assessments were also conducted for select jurisdictions outside the Great Lakes Basin, both in North America and in the European Union.

The management framework for overseeing animal feeding operations and livestock manure in the Great Lakes Basin were determined to be fairly robust in Ontario, but variable and weaker overall for the American jurisdictions. Based on the identified strengths and weaknesses of these jurisdictions, compared to the approaches used in jurisdictions outside the Great Lakes Basin, recommendations were provided for addressing the current challenges to water quality in the basin and improving existing management practices, summarized in Table 5.

Table 5: Recommendations for the oversight of animal feeding operations for manure management in the Great Lakes Basin

No.	Topic	Recommendation
1	Existing framework	Conduct an in-depth assessment of the actual implementation of each jurisdiction's respective manure management framework to identify successes and challenges in achieving their intended goals.
2	Regulators	Establish a set of guidelines and regulations to be incorporated by all states/provinces to ensure a uniform implementation framework; coordinate the oversight of manure management among federal, provincial/state and municipal regulators, and assign jurisdiction based on the size of the animal feeding operation.
3	Regulatory thresholds	Facilities should not be able to subdivide their operations to avoid exceeding regulatory thresholds.
4	Quantifiable standards	Develop a systematic approach for quantifying minimum acreage requirements for manure application, accounting for factors such as livestock types and numbers, and requirements for manure storage.
5	Application tracking	Develop a land base registry or equivalent tracking system for overseeing manure application agreements.
6	Manure transfers	Develop requirements for the permissible timing and volumes of manure transfers from an operation to an offsite location, applicable to both permitted and unpermitted animal feeding operations.



Table 5: Recommendations for the oversight of animal feeding operations for manure management in the Great Lakes Basin (continued)

No.	Topic	Recommendation
7	Reporting and record-keeping	Investigate the nation-wide reporting and record-keeping practices of the Netherlands and Denmark and opportunities for application in the Great Lakes Basin.
8	Nutrient management planning	Comprehensive Nutrient Management Plans should be required for medium- and large-scale facilities, prepared by a qualified professional, and account for all nutrient sources.
9	Standards and best management practices	Create a comprehensive template of best management practices and recommended standards for optimal nutrient application. The template should provide a process for evaluating the effectiveness of the plan, and include an adaptive management component.
10	Soil and manure testing	Testing of manure nutrient content and field nutrient values should be uniformly required and evaluated for medium- to large-sized facilities.
11	Incentives and support	Provide dedicated funding for promoting proper manure management, by assisting existing animal feeding operations to make necessary changes to meet recommended standards and best management practices.
12	Public and Indigenous Notification and Engagement	Public and indigenous input should be required if a proposed small- or medium-sized facility does not meet municipal zoning criteria. Public input should be required for new, expanding and/or renewals of large-scale operations.

Respectfully submitted,



Tiffany Svensson, M.Sc., P.Geo.
Agricultural Lead
BluMetric Environmental Inc.



Karen W. Okonta, B.A.
Project Professional
NTH Consultants, Ltd.

Per: 

Donald Hilborn, M.Sc., P.Eng.
Senior Technical Advisor



7. REFERENCES

Federal

Canada-United States Collaboration for Great Lakes Water Quality, undated. *Nutrients (Annex 4)*. <https://binational.net/annexes/a4/>. Accessed 18 January 2018.

Canadian Food Inspection Agency, 2017. *Fertilizer Program Overview*. <http://www.inspection.gc.ca/plants/fertilizers/program-overview/eng/1330891097865/1330891293225>. Accessed 31 October 2017.

Code of Federal Regulations (United States). 40 CFR 122.21 – Application for a permit. Accessed 3 November 2017.

Code of Federal Regulations (United States). 40 CFR 122.42 – Additional conditions applicable to specified categories of NPDES permits. Accessed 3 November 2017.

Code of Federal Regulations (United States). 40 CFR 412.37 – Additional measures. Accessed 3 November 2017.

ECCC (Environment and Climate Change Canada) and MOECC (Ontario Ministry of the Environment and Climate Change), 2018. Canada-Ontario Lake Erie Action Plan.

Environmental Protection Agency (U.S.), 2004. Managing Manure Nutrients at Concentrated Animal Feeding Operations.

Environmental Protection Agency (U.S.), 2011. EPA Policy on Consultation and Coordination with Indian Tribes.

Environmental Protection Agency (U.S.), 2017. *Recommended Binational Phosphorus Targets – Recommended Binational Phosphorus Targets to Combat Lake Erie Algal Blooms*. <https://www.epa.gov/glwqa/recommended-binational-phosphorus-targets>. Accessed 17 January 2018.

Federal Register (United States), 2011. Proposed Rules. Vol. 76, No. 204.



Government of Canada, 2015. *Hog farm to pay \$50,000 for manure release into creek.* <https://www.canada.ca/en/environment-climate-change/services/environmental-enforcement/notifications/hog-farm-manure-release-creek.html>. Accessed 31 October 2017.

Great Lakes Commission, 2017. *New 2017 GLRI Awards Announced.* <https://keepingitontheland.net/2017/08/10/2017-glri-awards-announced/>. Accessed 29 January 2018.

State & Local Climate Change Program, 2000. Manure Management.

Statistics Canada, 2017a. Table 004-0002 – Census of Agriculture, total area of farms and use of farm land, Canada and provinces, every 5 years (number unless otherwise noted), CANSIM (database). Accessed 17 January 2018.

Statistics Canada, 2017b. Table 004-0207 – Census of Agriculture, manure application in the year prior to the census, every 5 years, CANSIM (database). Accessed 17 January 2018.

Statistics Canada, 2017c. Table 004-0004 – Census of Agriculture, selected livestock and poultry data, Canada and provinces, every 5 years (number), CANSIM (database).

U.S. Environmental Protection Agency, 2012. NPDES Permit Writers' Manual for Concentration Animal Feeding Operations.

U.S. Environmental Protection Agency, 2018. U.S. Action Plan for Lake Erie.

United States Department of Agriculture Natural Resources Conservation Service, undated. *Comprehensive Nutrient Management Planning.* https://www.nrcs.usda.gov/wps/portal/nrcs/detail/md/technical/?cid=nrcs144p2_025683. Accessed 16 January 2018.

United States Department of Agriculture Natural Resources Conservation Service, 1995. Animal Manure Management. RCA Issue Brief #7 December 1995. https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/technical/nra/rca/?cid=nrcs143_014211. Accessed 16 November 2017.

United States Department of Agriculture Natural Resources Conservation Service, 2005. Technical Notes – Water Quality No. 5. Phosphorus Transport Risk Assessment: A Phosphorus Assessment Tool.



United States Department of Agriculture, 2014. 2012 Census of Agriculture. United States Summary and State Data. Volume 1, Geographic Area Series, Part 51.

References for Jurisdictions within the Great Lakes Basin

Ontario

Beaulieu, M.S., F. Bedard and P. Lanciault, 2001. Distribution and Concentration of Canadian Livestock. Agriculture and Rural Working Paper Series, Working Paper No. 47. Statistics Canada, Agriculture Division.

Canadian Geographic, undated. *The Great Lakes*.

http://www.canadiangeographic.com/atlas/themes.aspx?id=watersheds&sub=watersheds_flow_thegreatlakes&lang=En. Accessed 13 December 2017.

Office of the United Nations High Commissioner for Human Rights, 2013. *The United Nations Declaration on the Rights of Indigenous Peoples: A Manual for National Human Rights Institutions*.

OMAFRA (Ontario Ministry of Agriculture, Food and Rural Affairs), 2016a. *Agriculture in the Great Lakes Basin – Stewardship and Innovation*. http://www.omafra.gov.on.ca/english/environment/facts/gl_basin.htm. Accessed 24 April 2018.

OMAFRA (Ontario Ministry of Agriculture, Food and Rural Affairs), 2016b. *Compliance Tools for Nutrient Management*. <http://www.omafra.gov.on.ca/english/nm/approvals/tools.htm>. Accessed 15 January 2018.

Statistics Canada, 2017d. *Thematic maps from the Census of Agriculture. Number of census farms by census division (CD), 2016*. <https://www.statcan.gc.ca/pub/95-634-x/2017001/article/54899/catm-ctra-001-eng.htm>. Accessed 24 April 2018.

Statistics Canada, 2017e. Table 004-0200 – Census of Agriculture, farms classified by the North American Industry Classification System (NAICS), every 5 years (number), CANSIM (database). Accessed 24 April 2018.



New York

Cornell University College of Agriculture and Life Sciences, undated. *Dairy Environmental Systems – Links*. <http://www.manuremanagement.cornell.edu/Pages/Links.html>. Accessed 27 November 2017.

Natural Resources Conservation Service, 2013. Conservation Practice Standard, Nutrient Management, Code 590.

Natural Resources Conservation Service, 2014. Conservation Practice Standard, Waste Storage Facility, Code 313.

New York Department of Agriculture and Markets & Department of Environmental Conservation, undated. Frequently Asked Questions Regarding Manure Storage in New York State.

New York Department of Environmental Conservation, undated. Agricultural Water Withdrawals.

New York Department of Environmental Conservation, 2016. SPDS Compliance and Enforcement. SFY 2015/2016 Annual Report.

New York Department of Environmental Conservation, 2017. *Confined Animal Feeding Operations*. <http://www.dec.ny.gov/permits/6285.html>. Accessed 13 November 2017.

New York Department of Environmental Conservation, 2017. New York State Department of Environmental Conservation ECL SPDES General Permit for Concentrated Animal Feeding Operations (CAFOs). Permit No. GP-0-16-001.

New York State, 2017. Governor Cuomo Announces \$50 Million Available to Support Water Quality Protection Projects on New York Livestock Farms.

U.S. Environmental Protection Agency, 2015. New York State Animal Agriculture Program Assessment.

Watershed Agricultural Council, undated. East of Hudson Program Handbook.

Watershed Agricultural Council, undated. Guide to Nutrient Management Planning.



Watershed Agricultural Council, 2017. *Resources & Downloads*.

<http://www.nycwatershed.org/agriculture/resources-downloads/>.

Accessed 27 November 2017.

Pennsylvania

Chesapeake Bay Foundation, 2015. Pennsylvania Milestones 2014-15 Interim Progress.

Commonwealth of Pennsylvania. The Pennsylvania Code. § 91.36. Pollution control and prevention at agricultural operations. Current as of October 7, 2017.

Penn State Extension, undated. *Pennsylvania Nutrient Management Program*.

<https://extension.psu.edu/programs/nutrient-management>. Accessed 16 November 2017.

Pennsylvania Department of Environmental Protection, undated. *Water Use Registration and Reporting*.

http://www.dep.pa.gov/Business/Water/PlanningConservation/State_Water_Plan/Pages/Water-Use-Registration-and-Reporting.aspx. Accessed 6 December 2017.

Pennsylvania Department of Environmental Protection, 1999. *Bureau of Water Supply and Wastewater Management Final Strategy For Meeting Federal Requirements for Controlling the Water Quality Impacts of Concentrated Animal Feeding Operations*.

http://www.dep.state.pa.us/dep/deputate/watermgt/wqp/forms/CAFO_Stratg.htm.

Accessed 21 November 2017.

Pennsylvania Department of Environmental Protection, 2007. Implementation Guidance for NPDES CAFO Permits and Water Quality Management Permits for Manure Storage Facilities. 390-2100-001.

Pennsylvania Department of Environmental Protection, 2011. Land Application of Manure. A supplement to Manure Management for Environmental Protection. Manure Management Plan Guidance 361-0300-002.

Pennsylvania Department of Environmental Protection, 2013. PAG-12 Authorization to Operate Under the National Pollutant Discharge Elimination System (NPDES) General Permit for Concentrated Animal Feeding Operations. Fact Sheet.



Pennsylvania Landscape & Nursery Association, 2013. *Fertilizer Bill Introduced... Finally!*
<http://www.plna.com/news/144438/Fertilizer-Bill-Introduced-Finally.htm>.
Accessed 15 December 2017.

Pennsylvania Pressroom, 2016. Pennsylvania Unveils Comprehensive Strategy to Improve Water Quality in state and Chesapeake Bay Watershed.

Pennsylvania State University, 2007. The Pennsylvania Phosphorus Index. Version 2.

U.S. Environmental Protection Agency, 2005. Permitting for Environmental Results (PER). NPDES Profile: Pennsylvania.

U.S. Environmental Protection Agency, 2017. EPA Interim Evaluation of Pennsylvania's 2016-2017 Milestones.

Ohio

Natural Resources Conservation Service, 2004. Iowa Technical Note No. 25, Iowa Phosphorus Index.

Ohio AgriBusiness Association, undated. *Funding Available to Ohio Western Lake Erie Basin Farmers to Improve Water Quality*.
http://www.oaba.net/aws/OABA/pt/sd/news_article/146190/_PARENT/layout_details/false. Accessed 29 January 2018.

Ohio Department of Agriculture, undated. Concentrated Animal Feeding Facility size changed from animal unit definition to small, medium, large and major. Fact Sheet.

Ohio Department of Agriculture, undated. *Livestock Environmental Permitting*.
<http://www.agri.ohio.gov/divs/DLEP/dlep.aspx>. Accessed 17 November 2017.

Ohio Department of Natural Resources Division of Water Resources, 2017. *Water Withdrawal Facilities Registration*. <http://water.ohiodnr.gov/water-use-planning/water-withdrawal-facilities-registration>. Accessed 6 December 2017.

Ohio Environmental Protection Agency, undated. *Concentrated Animal Feeding Operations*.
<http://www.epa.ohio.gov/dsw/cafo/index>. Accessed 8 November 2017.



Ohio Environmental Protection Agency, undated. PART VII – Production Area Monitoring and Inspections and Land Application Requirements.

Ohio Environmental Protection Agency, 2011. Authorization to Discharge Under the National Pollutant Discharge Elimination System. Application No. OH0137944.

Ohio Environmental Protection Agency, 2013. Ohio EPA Livestock Operation Inspections What to Expect. Fact Sheet.

Ohio Environmental Protection Agency, 2014. Ohio Nutrient Reduction Strategy. Ohio Water Environment Association Watershed Workshop, October 30, 2014.

Ohio Environmental Protection Agency, 2015. CAFO NPDES Permit – General Overview of Federal Regulations. Fact Sheet.

Ohio Environmental Protection Agency, 2016. Nutrient Mass Balance Study for Ohio's Major Rivers.

Ohio Lake Erie Commission, undated. *The Ohio Domestic Action Plan 2018*.
<http://lakeerie.ohio.gov/LakeEriePlanning/OhioDomesticActionPlan2018.aspx>. Accessed 27 November 2017.

Ohio Lake Erie Commission, 2017. State of Ohio's Draft Domestic Action Plan 1.0.

Ohio Legislative Service Commission, 2009. *Bill Analysis, H.B. 363, 128th General Assembly*.
<https://www.lsc.ohio.gov/documents/gaDocuments/analyses128/h0363-i-128.pdf>. Accessed 24 April 2018.

Ohio State University College of Food, Agricultural and Environmental Sciences, 2015. *Ohio Fertilizer and Manure Application – New Legislative Criteria*.
<https://agcrops.osu.edu/newsletter/corn-newsletter/2015-20/ohio-fertilizer-and-manure-application-new-legislative-criteria>. Accessed 24 April 2018.

Ohio State University College of Food, Agricultural and Environmental Sciences, 2017. *Manure Management*. <https://ocamm.osu.edu/manure-management>. Accessed 9 November 2017.



Ohio State University Extension, 2014. *Manure Regulation in Ohio*.

<https://farmoffice.osu.edu/blog/tue-09302014-849am/manure-regulation-ohio>.

Accessed 8 November 2017.

Ohio State University Extension, 2015. Ohio's New Fertilizer and Manure Application

Restrictions and in Effect. <https://farmoffice.osu.edu/blog/mon-07062015-722pm/ohios-new-fertilizer-and-manure-ap>. Accessed 9 November 2017.

Ohio State University Extension, 2017. *Ohio Supreme Court rules that landowners can challenge CAUV values before the Board of Tax Appeals*. <https://farmoffice.osu.edu/blog/mon-07062015-722pm/ohios-new-fertilizer-and-manure-a>.

Accessed 15 December 2017.

Toledo Blade, 2017. Local State department finishes dead fish investigation.

<http://www.toledoblade.com/local/2017/10/10/State-department-finishes-dead-fish-investigation.html>. Accessed 16 January 2018.

U.S. Environmental Protection Agency, 2002. Ohio's CAFO Program. Compendium of State AFO Programs.

Indiana

Indiana Department of Environmental Management, 2013. Solid Manure Staging. Fact Sheet.

Indiana Department of Environmental Management, 2014. Guidance Manual for Indiana's Confined Feeding Program.

Indiana Department of Natural Resources, undated. *Significant Water Withdrawal Facility (SWWF) Registration – Indiana Code 14-25-7-15*.

<https://www.in.gov/dnr/water/4847.htm>. Accessed 6 December 2017.

Indiana Department of Natural Resources, 2016. Grants announced for 33 Indiana Lake and River Enhancement (LARE) projects.

http://www.in.gov/activecalendar_dnr/EventList.aspx?view=EventDetails&eventidn=1097. Accessed 18 January 2018.

Indiana Department of Natural Resources, 2018. *Significant Water Withdrawal Facility Data*.

<https://www.in.gov/dnr/water/4841.htm>. Accessed 24 April 2018.



Indiana State Board of Animal Health, 2018. *Indiana Poultry Production Data*.
<https://www.in.gov/boah/2715.htm>. Accessed 24 April 2018.

Indiana State Department of Agriculture, 2017. *Indiana's Great Lakes Water Quality Agreement (GLWQA) Domestic Action Plan (DAP) for the Western Lake Erie Basin (WLEB)*.
<http://www.in.gov/isda/3432.htm>. Accessed 18 January 2018.

Indiana State Department of Agriculture and Indiana Department of Environmental Management, 2016. *Indiana's State Nutrient Reduction Strategy*. Version 4.

Office of Indiana State Chemist, 2017. *Fertilizer Application Regulations for Growers*.

Pork Checkoff, 2016. *State Rankings by Hogs and Pigs Inventory – 2015*.
<https://www.pork.org/facts/stats/structure-and-productivity/state-rankings-by-hogs-and-pig>. Accessed 24 April 2018.

Purdue University Extension, undated. *What is a CFO, CAFO?* ID-350.

U.S. Environmental Protection Agency, 2002. *Indiana's CAFO Program*. Compendium of State AFO Programs.

Illinois

Illinois Administrative Code. Title 8: Agriculture and Animals, Chapter I: Department of Agriculture, Subchapter t: Waste Management, Part 900 Livestock Management Facility Regulations.

Illinois Council on Best Management Practices, 2015. *Winter Manure Application: Best Practices and Rules*. <http://illinoiscbmp.org/Blog/Posts/20/Tips-for-Farmers/2015/11/Winter-Manure-Applicati>. Accessed 9 November 2017.

Illinois Department of Agriculture, 2017. *Facts about Illinois Agriculture*.
<https://www2.illinois.gov/sites/agr/About/Pages/Facts-About-Illinois-Agriculture.aspx>. Accessed 17 January 2018.

Illinois Department of Agriculture, 2017. *Livestock Management Facilities Program*.
<https://www2.illinois.gov/sites/agr/Animals/LivestockManagement/Pages/default.aspx>. Accessed 8 November 2017.



Illinois Department of Agriculture & Illinois Environmental Protection Agency, 2015. Illinois Nutrient Loss Reduction Strategy.

Illinois Environmental Protection Agency, undated. *What to Expect from an Illinois EPA Livestock Facility Inspection*. <http://www.epa.illinois.gov/topics/water-quality/watershed-management/cafos/what-to-expect/index>. Accessed 16 November 2017.

Illinois Environmental Protection Agency, 2009. Manure Test. Pearl City Elevator.

Illinois Environmental Protection Agency, 2009. NPDES Permit No. ILA01. General NPDES Permit for Concentrated Animal Feeding Operations.

Illinois Livestock Management Facilities Act, Section 900.803. Considerations for Manure Application Setbacks.

Illinois Soybean Association, 2008. State Summary: Illinois.

Illinois State Water Survey, undated. Illinois Water Inventory Program Agricultural Irrigation Reporting Handbook.

U.S. Department of Agriculture, 2018. *2016 State Agricultural Overview, Illinois*. https://www.nass.usda.gov/Quick_Stats/Ag_Overview/stateOverview.php?state=ILLINOIS. Accessed 17 January 2018.

Michigan

Code of Federal Regulations (United States). Part 122 – EPA Administered Permit Programs: The National Pollutant Discharge Elimination System. §122.21 Application for a permit.

Government of Michigan, undated. Concentrated Animal Feeding Operation (CAFO) Groundwater Permit Fact Sheet – When is a DEQ Groundwater Permit Required?

Michigan Department of Agriculture and Rural Development, 2016. Generally Accepted Agricultural and Management Practices for Manure Management and Utilization.

Michigan Department of Environmental Quality, 2016. Michigan's Implementation Plan, Western Lake Erie Basin Collaborative. January 14, 2016.



Michigan Department of Environmental Quality, 2017. *Concentrated Animal Feeding Operations (CAFO)*. http://www.michigan.gov/deq/0,4561,7-135-3307_29894_5959-208359--,00.html. Accessed 31 October 2017.

Natural Resources Conservation Service, 2014. Conservation Practice Standard, Waste Storage Facility. Code 313.

North Central Regional Extension Publication, 1995. Management Practices: How to Sample Manure for Nutrient Analysis.

Northcott, W. 2010. Michigan Water Use Regulations. NRCS Irrigation Training, Feb 2-3 and 9-10, 2010.

State of Michigan Department of Agriculture and Rural Development, 2012. Untitled letter to unnamed agricultural water users, November 9, 2012.

State of Michigan Department of Environmental Quality, 2015. National Pollutant Discharge Elimination System Wastewater Discharge General Permit, Concentrated Animal Feeding Operations. Permit No. MIG010000.

United States Department of Agriculture, undated. Regional Conservation Partnership Program – Investing in Michigan.

U.S. Environmental Protection Agency, 2002. Michigan's CAFO Program. Compendium of State AFO Programs.

Wisconsin

Center for Land Use Education, 2010. Wisconsin Land Use Megatrends. Agriculture.

State of Wisconsin Department of Agriculture, Trade and Consumer Protection, undated. *Farmland Preservation Program*. https://datcp.wi.gov/Pages/Programs_Services/FarmlandPreservation.aspx. Accessed 24 April 2018.

State of Wisconsin Department of Agriculture, Trade and Consumer Protection, undated. *Livestock Siting*. https://datcp.wi.gov/Pages/Programs_Services/LivestockSiting.aspx. Accessed 24 April 2018.



State of Wisconsin Department of Agriculture, Trade and Consumer Protection, 2017. *Wisconsin Agricultural Statistics*. <https://datcp.wi.gov/Pages/Publications/WIAgStatistics.aspx>. Accessed 11 December 2017.

U.S. Environmental Protection Agency, 2002. Wisconsin's CAFO Program. Compendium of State AFO Programs.

University of Wisconsin-Extension, undated. 2017 CAFO Compliance Calendar.

University of Wisconsin-Extension, undated. 2018 CAFO Compliance Calendar.

University of Wisconsin-Extension, undated. How much fertilizer do your animals produce? (A3601).

Wisconsin Department of Agriculture, Trade and Consumer Protection, undated. Nutrient Management Plan Checklist.

Wisconsin Department of Natural Resources, undated. CAFO Applications and Phosphorus-Based Nutrient Management Plans.

Wisconsin Department of Natural Resources, 2012. Animal Unit Calculation Form 3400-025A.

Wisconsin Department of Natural Resources, 2017. *First-time CAFO WPDES permit applications*. <http://dnr.wi.gov/topic/AgBusiness/CAFO/FirstTimeApplicants.html>. Accessed 10 November 2017.

Wisconsin Department of Natural Resources, 2018. WPDES Permits on public notice. <http://dnr.wi.gov/topic/wastewater/publicnotices.html>. Accessed 18 January 2018.

Wisconsin Land and Water Conservation Association, 2016. Wisconsin Farm Conservation Standards and Cost-Sharing: An Overview.

Wisconsin Legislative Reference Bureau, 2015. State of Wisconsin 2015 – 2016 Blue Book. Chapter 8: Statistics – Agriculture.

Wisconsin Legislature, 2017. Chapter NR 151 Runoff Management.

Wisconsin Milk Marketing Board, undated. 2017 Dairy Data – A Review of the Wisconsin Dairy Industry.



Wisconsin State Journal, 2016. State audit finds DNR ignoring own rules on water pollution.
http://host.madison.com/wsj/news/local/govt-and-politics/state-audit-finds-dnr-ignoring-own-rules-on-water-pollution/article_b4471e0f-538d-5a4e-938e-2972a65d071f.html.
Accessed 22 January 2018.

Minnesota

Farmland Information Center, 2018. Minnesota Statistics.
<http://www.farmlandinfo.org/statistics/minnesota>. Accessed 17 January 2018.

Minnesota Department of Agriculture, 2015. Minnesota Agricultural Profile.

Minnesota Department of Agriculture, 2017. *Local Government Information for the AgBMP Loan Program*.
<http://www.mda.state.mn.us/grants/loans/agbmploan/localgovernment.aspx>.
Accessed 27 November 2017.

Minnesota Department of Natural Resources, 2017. *Water use permits*.
http://www.dnr.state.mn.us/waters/watermgmt_section/appropriations/permits.html.
Accessed 6 December 2017.

Minnesota Pollution Control Agency, undated. *How does the MN P index relate to MPCA policies?*
<https://www.swac.umn.edu/sites/swac.umn.edu/files/pindexandfeedlotrules.pdf>.
Accessed 30 November 2017.

Minnesota Pollution Control Agency, 2009. Feedlot Construction Setbacks from Open Water and Wells. Water Quality/Feedlots #8.30.

Minnesota Pollution Control Agency, 2011. Land Application of Manure: Minimum State Requirements.

Minnesota Pollution Control Agency, 2011. Manure Management Plan Requirements and Checklist – Feedlot Program.

Minnesota Pollution Control Agency, 2012. Manure Application Rate Guide.

Minnesota Pollution Control Agency, 2015. NPDES and SDS permits for feedlots.



Minnesota Pollution Control Agency, 2015. State of Minnesota General Animal Feedlot Permit, Authorization to Construct and Operate an Animal Feedlot and/or Manure Storage Area Under the State Disposal System (SDS) Permit (NPDES) MNG450000.

Minnesota Pollution Control Agency, 2016. State of Minnesota General Animal Feedlot NPDES Permit, Authorization to Construct and Operate a Concentrated Animal Feeding Operation Under the National Pollutant Discharge Elimination System Permit (NPDES) MNG440000.

Minnesota Statutes, 2017. Chapter 18C. Fertilizer, Soil Amendment, and Plant Amendment.

Pioneer Press, 2015. Interactive: Where Minnesota's farm animals live.
<https://www.twincities.com/2015/08/11/interactive-where-minnesotas-farm-animals-live/>. Accessed 17 January 2018.

State of Minnesota, 2003. Minnesota Administrative Rules. 7020.2025 Animal Feedlot or Manure Storage Area Closure.

State of Minnesota, 2014. Minnesota Administrative Rules. 7020.2003 Water Quality Discharge Standards.

State of Minnesota, 2014. Minnesota Administrative Rules. 7020.2100 Liquid Manure Storage Areas.

State of Minnesota, 2014. Minnesota Administrative Rules. 7020.2225 Land Application of Manure.

State of Minnesota, 2014. The Minnesota Nutrient Reduction Strategy.

U.S. Environmental Protection Agency, 2002. Minnesota's CAFO Program.
Compendium of State AFO Programs.

University of Minnesota Extension, 2015. Minnesota Water Law Basics. Farm Legal Series.

References for Jurisdictions outside the Great Lakes Basin

Saskatchewan

The Agricultural Operations Act, 1995.



The Agricultural Operations Regulations, 1996.

Ministry of Environment, 2014. Changing How We Do Business – An Introduction to Results-Based Regulations and the Saskatchewan Environmental Code.

Government of Saskatchewan, undated. Guidelines for Public Participation in Livestock Development.

Government of Saskatchewan, undated. *Regulation of Intensive Livestock Operations in Saskatchewan*. <https://www.saskatchewan.ca/business/agriculture-natural-resources-and-industry/agribusiness-farmers-and-ranchers/livestock/livestock-and-the-environment/regulation-of-intensive-livestock-operations-in-saskatchewan>. Accessed 29 October 2017.

Government of Saskatchewan, 2014. Saskatchewan Environmental Code Quick Reference Guide.

Saskatchewan Ministry of Agriculture, undated. Growing Forward 2 Program Overview.

Saskatchewan Water Security Agency, undated. *Ground Water Approval Process*. <https://www.wsask.ca/Permits-and-Approvals/Regulatory-Info/Ground-Water-Approval-Process/>. Accessed 8 November 2017.

Alberta

Agricultural Operation Practices Act, current as of 2014.

Agricultural Operation Practices Act, Agricultural Operations, Part 2 Matters Regulation, 2017.

Agricultural Operation Practices Act, Agricultural Operations, Standards and Administration Regulation, 2017.

Alberta, 2006. *Agricultural Operation Practices Act*, Manure Characteristics and Land Base Code.

Alberta Agriculture and Forestry, 2017. *Beneficial Management Practices: Environmental Manual for Crop Producers in Alberta – Nutrient Management*. [http://www1.agric.gov.ab.ca/\\$department/deptdocs.nsf/all/agdex9349](http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex9349). Accessed 2 November 2017.



Alberta Agriculture and Forestry, 2017. *Agricultural Operation Practices Act*.
[http://www1.agric.gov.ab.ca/\\$department/deptdocs.nsf/all/epw12498](http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/epw12498). Accessed 2
November 2017.

Government of Alberta, 2008. Reference Guide, *Agricultural Operation Practices Act* (AOPA).
Environmental Standards for Alberta's Livestock Industry.

Natural Resources Conservation Board, undated. *Confined Feeding Operations*.
<https://cfo.nrcb.ca/>. Accessed 1 November 2017.

Natural Resources Conservation Board, undated. *Board*.
<https://www.nrcb.ca/AboutUs/Whatwedo/Board.aspx>. Accessed 18 January 2018.

Natural Resources Conservation Board, 2016. Operational Policy 2016-1, Amending Municipal
Permit Conditions, *Agricultural Operation Practices Act*.

Natural Resources Conservation Board, 2016. Operational Policy 2016-7, Approvals. *Agricultural
Operation Practices Act*.

Natural Resources Conservation Board, 2017. Statistical Update January – December 2017.
Agricultural Operation Practices Act (AOPA).

Policy Advisory Group, 2011. *Agricultural Operation Practices Act Policy Advisory Group (PAG)
Terms of Reference and Mandate*.

Statistics Canada, 2017d. Alberta has the most beef cattle in Canada and the second largest total
farm area. Catalogue no. 95-640-X.

Technical Advisory Group, 2014. *Agricultural Operation Practices Act Technical Advisory Group
Terms of Reference*.

Maryland

Government of Maryland, 2017. *Maryland at a Glance – Agriculture*.
<http://msa.maryland.gov/msa/mdmanual/01glance/html/agri.html>. Accessed 14
December 2017.

Lichtenberg, E., S. Lane & D. Parker, 2010. Policy Analysis Report. Best Management Practice use
and Nutrient Management in Maryland: A 2010 Snapshot. University of Maryland
Center for Agricultural & Natural Resource Policy.



Maryland Department of Agriculture, undated. *About Maryland's Nutrient Management Program*.
http://mda.maryland.gov/resource_conservation/Pages/nutrient_management.aspx.
Accessed 15 November 2017.

Maryland Department of Agriculture, undated. *Conservation Grants*.
http://mda.maryland.gov/resource_conservation/pages/financial_assistance.aspx.
Accessed 15 November 2017.

Maryland Department of Agriculture, undated. *Regulatory Information Center*.
<http://mda.maryland.gov/pages/regulatory-information-center.aspx>. Accessed 15
November 2017.

Maryland Department of Agriculture, undated. Agricultural Nutrient Management Program, Step into Compliance with Maryland's Nutrient Management Regulations, A Checklist for Farm Operators.

Maryland Department of Agriculture, undated. MDE/Federal Permits.
http://mda.maryland.gov/plants-pests/Pages/mde_federal_permit.aspx. Accessed 22
January 2018.

Maryland Department of Agriculture, 2017. Farming with Your Nutrient Management Plan: A Comprehensive Guide to Maryland's Nutrient Management Regulations and Requirements.

Maryland Department of Agriculture & Maryland Department of the Environment, 2011. MDA & MDE Agricultural Nutrient Management Record Keeping Requirements.

Maryland Department of the Environment, undated. *Status of Animal Feeding Operations (AFO) Applications*.
<http://mde.maryland.gov/programs/land/RecyclingandOperationsprogram/Pages/CAFO.aspx>. Accessed 23 January 2018.

Maryland Department of the Environment, 2010. Title 26 Department of The Environment, Subtitle 08 Water.

Maryland Department of the Environment, 2016. Facts About Animal Feeding Operations (AFOs) Permitting Process Frequently Asked Questions.



Modern Farmer, 2015. *Solving One of Maryland's Biggest Problems: Chicken Poop*.
<https://modernfarmer.com/2015/04/solving-one-of-marylands-biggest-problems-chicken-poop/>. Accessed 14 December 2017.

University of Maryland Extension, 2005. Soil Fertility Management – The Maryland Phosphorus Site Index: An Overview.

U.S. Environmental Protection Agency, 2015. Maryland Animal Agriculture Program Assessment.

Washington Post, 2010. *Perdue, poultry farm sued for polluting Chesapeake Bay*. March 2, 2010. <http://www.washingtonpost.com/wp-dyn/content/article/2010/03/02/AR2010030202408.html>. Accessed 14 December 2017.

Iowa

AITC (Agriculture in the Classroom), 2017. A Look at Iowa Agriculture.

Iowa Department of Agriculture, undated. License, Permit and Regulation Forms.
<http://www.iowaagriculture.gov/departmentsForms.asp>. Accessed 19 January 2018.

Iowa Department of Natural Resources (DNR), 2006. The Iowa Phosphorus Index and Manure Management Plans for Confinements.

Iowa Department of Natural Resources (DNR), undated. Animal Feeding Operations.
<http://www.iowadnr.gov/Environmental-Protection/Land-Quality/Animal-Feeding-Operations>. Accessed 22 November 2017.

Iowa Department of Natural Resources (DNR), undated. Manure Applicator Certification.
<http://www.iowadnr.gov/Environmental-Protection/Land-Quality/Animal-Feeding-Operations/Applicator-Certification>. Accessed 22 November 2017.

Iowa Department of Natural Resources (DNR), undated. *Environmental Field Offices*.
<http://www.iowadnr.gov/fieldoffice>. Accessed 22 November 2017.

Iowa Department of Natural Resources (DNR), undated. Water Allocation & Use. Accessed 6 December 2017.



Iowa State University Extension and Outreach, 2016. *IMMAG – Iowa Manure Management Action Group*. <http://www.agronext.iastate.edu/immag/homepage.html>. Access 22 November 2017.

Iowa State University Extension and Outreach, 2016. Using Manure Nutrients for Crop Production.

North Carolina

Department of Environmental Quality (North Carolina), undated. *AFO Program Summary*. <https://deq.nc.gov/about/divisions/water-resources/water-resources-permits/wastewater-branch/animal-feeding-operation-permits/afo-program-summary>. Accessed 29 November 2017.

Department of Environmental Quality (North Carolina), undated. *Animal Facility Map*. <https://deq.nc.gov/cafo-map>. Accessed 14 December 2017.

Farm Flavor, 2015. *North Carolina Agriculture*. <https://www.farmflavor.com/north-carolina/north-carolina-ag-products/north-carolina-agriculture/>. Accessed 14 December 2017.

National Geographic, 2014. *What to Do About Pig Poop? North Carolina Fights a Rising Tide*. <https://news.nationalgeographic.com/news/2014/10/141028-hog-farms-waste-pollution-methane-north-carolina-environment/>. Accessed 23 January 2018.

North Carolina Department of Agriculture, undated. *Licenses and Permits*. <http://www.ncagr.gov/htm/license.htm>. Accessed 23 January 2018.

North Carolina Department of Environmental Quality, 2016. *List of Permitted Facilities – 11-04-2016*. <https://files.nc.gov/ncdeq/NC%20Permitted%20Animal%20Facilities-11-04-2016.xls>. Accessed 14 December 2017.

North Carolina State University, 2017. *Manure Nutrient Content*. <http://nutrients.soil.ncsu.edu/manures/nutrients.htm>. Accessed 29 November 2017.

North Carolina State University, 2017. *Manure Production (Volume & Weights)*. <http://nutrients.soil.ncsu.edu/manures/production.htm>. Accessed 29 November 2017.



U.S. Department of Agriculture, 2017. *2016 State Agricultural Overview, North Carolina*.
https://www.nass.usda.gov/Quick_Stats/Ag_Overview/stateOverview.php?state=NORTH%20CAROLINA. Accessed 23 January 2018.

Netherlands

Brinkel, T., 2002. *The Status of Indigenous and Minority People in the Netherlands*. Electronic Journal of Comparative Law, vol. 6.4. <https://www.ejcl.org/64/art64-1.html>. Accessed 24 November 2017.

Compendium voor de Leefomgeving, 2016. *Land- en tuinbouw: ruimtelijke spreiding, grondgebruik en aantal bedrijven, 1980-2015*. <http://www.clo.nl/indicatoren/nl2119-agrarisch-grondgebruik->. Accessed 13 December 2017. Translated via Google Chrome.

European Commission, 2010. The EU Nitrates Directive.
Government of the Netherlands, undated. *EU Legislation*.
<https://www.government.nl/topics/environment/roles-and-responsibilities-of-central-government/eu-legislation>. Accessed 8 November 2017.

Ministry of Agriculture, Nature and Food Quality, 2010. Facts and Figures. The Dutch agricluster in a global context.

Quartz Media, 2017. 500,000 Dutch dairy cows are staring down death because of the amount of dung they produce. <https://qz.com/882223/500000-dutch-dairy-cows-are-staring-down-death-because-of-the-amount-of-dung-they-produce/> Accessed 22 November 2017

Rijksdienst voor Ondernemend Nederland, undated. *Vrijstelling kleine bedrijven en hobbydieren*. <https://www.rvo.nl/onderwerpen/agrarisch-ondernemen/mest/mest/mestadministratie-en-registratie/administratie-agrarische-bedrijven/vrijstelling>. Accessed 13 December 2017. Translated via Google Chrome.

Statistics Netherlands (CBS), 2014. *Livestock manure; production, transport and use; key figures, 1950-2013*.
<https://opendata.cbs.nl/statline/#/CBS/en/dataset/80408ENG/table?ts=1516894788164>. Accessed 25 January 2018.



Statistics Netherlands (CBS), 2018a. *Livestock manure; production, transport and use; key figures*.
<https://opendata.cbs.nl/statline/#/CBS/en/dataset/82504ENG/table?ts=1516892117993>.
Accessed 25 January 2018.

Statistics Netherlands (CBS), 2018b. *Agriculture; crops, livestock and land use by general farm type, region*.
<https://opendata.cbs.nl/statline/#/CBS/en/dataset/80783eng/table?ts=1516894372820>.
Accessed 25 January 2018.

Statistics Netherlands (CBS), 2018c. *Livestock pigs*.
<https://opendata.cbs.nl/statline/#/CBS/en/dataset/7373eng/table?ts=1516894404053>.
Accessed 25 January 2018.

Van Grinsven H.J.M. and A. Bleeker, 2017. Evaluation of the Manure and Fertilisers Act 2016: Synthesis Report. PBL Netherlands Environmental Assessment Agency, The Hague.

Van Grinsven, H.J.M, A. Tiktak and C.W. Rougoor, 2016. Evaluation of the Dutch implementation of the nitrates directive, the water framework directive and the national emission ceilings directive. Wageningen Journal of Life Sciences 78 (2016) 69–84.

Denmark

Miljø- og Fødevareministeriet Landbrugsstyrelsen, 2017. *Gødning*.
<http://lbst.dk/landbrug/goedning/>. Accessed 27 November 2017. Translated via Google Chrome.

Miljø- og Fødevareministeriet Landbrugsstyrelsen, 2017. *Kontrol – jordbrug*.
<http://lbst.dk/tvaergaende/kontrol/kontrol-jordbrug/>. Accessed 28 November 2017.
Translated via Google Chrome.

Miljø- og Fødevareministeriet, 2017. Vejledning om gødskningsog harmoniregler Planperioden 1. august 2017 til 31. juli 2018.

Miljø- og Fødevareministeriet Landbrugsstyrelsen, 2018. *Generelt om gødningsnormer*.
<http://lbst.dk/landbrug/goedning/kvaelstofregulering/generelt-om-goedningsnormer/>.
Accessed 25 January 2018.



Ministry of Environment and Food of Denmark, Environmental Protection Agency, 2017.
Overview of the Danish regulation of nutrients in agriculture & the Danish Nitrates
Action Programme.

Ministry of Environment and Food of Denmark, Environmental Protection Agency, undated.
Implementation of the Nitrates directive in Denmark.
<http://eng.mst.dk/trade/agriculture/nitrates-directive/implementation-in-denmark/>.
Accessed 29 November 2017.

Ministry of Food, Agriculture and Fisheries in Denmark, 2015. Fertilizer accounts in Denmark.
HELCOM workshop, Oldenburg.

Organisation for Economic Co-operation and Development, 2015. Policies to Manage
Agricultural Groundwater Use – Denmark.

University of Aarhus, National Environmental Research Institute, undated. Cleaner water in
Denmark: Danish water management from the 1970s until today.

World Bank Group, 2017. *Population density (people per sq. km of land area)*.
<https://data.worldbank.org/indicator/EN.POP.DNST>. Accessed 15 December 2017.

Yale Environment 360, 2015. *With Too Much of a Good Thing, Europe Tackles Excess Nitrogen*.
http://e360.yale.edu/features/with_too_much_of_a_good_thing_europe_tackles_excess_nitrogen. Accessed 16 November 2017.



FIGURES





LEGEND

- Great Lakes Basin
- Within the Great Lakes Basin Jurisdictions
- Outside the Great Lakes Basin
- Great Lakes

1				
REV.	DESCRIPTION	YY/MM/DD	BY	CHK

REFERENCES

PROPRIETARY INFORMATION MAY NOT BE REPRODUCED OR DIVULGED WITHOUT PRIOR WRITTEN CONSENT OF BLUMETRIC ENVIRONMENTAL INC. DO NOT SCALE DRAWING. THIS DRAWING MAY HAVE BEEN REDUCED. ALL SCALE NOTATIONS INDICATED ARE BASED ON 11"x17" FORMAT DRAWINGS.

CLIENT

INTERNATIONAL JOINT COMMISSION

PROJECT

OVERSIGHT OF ANIMAL FEEDING OPERATIONS FOR MANURE MANAGEMENT IN THE GREAT LAKES BASIN

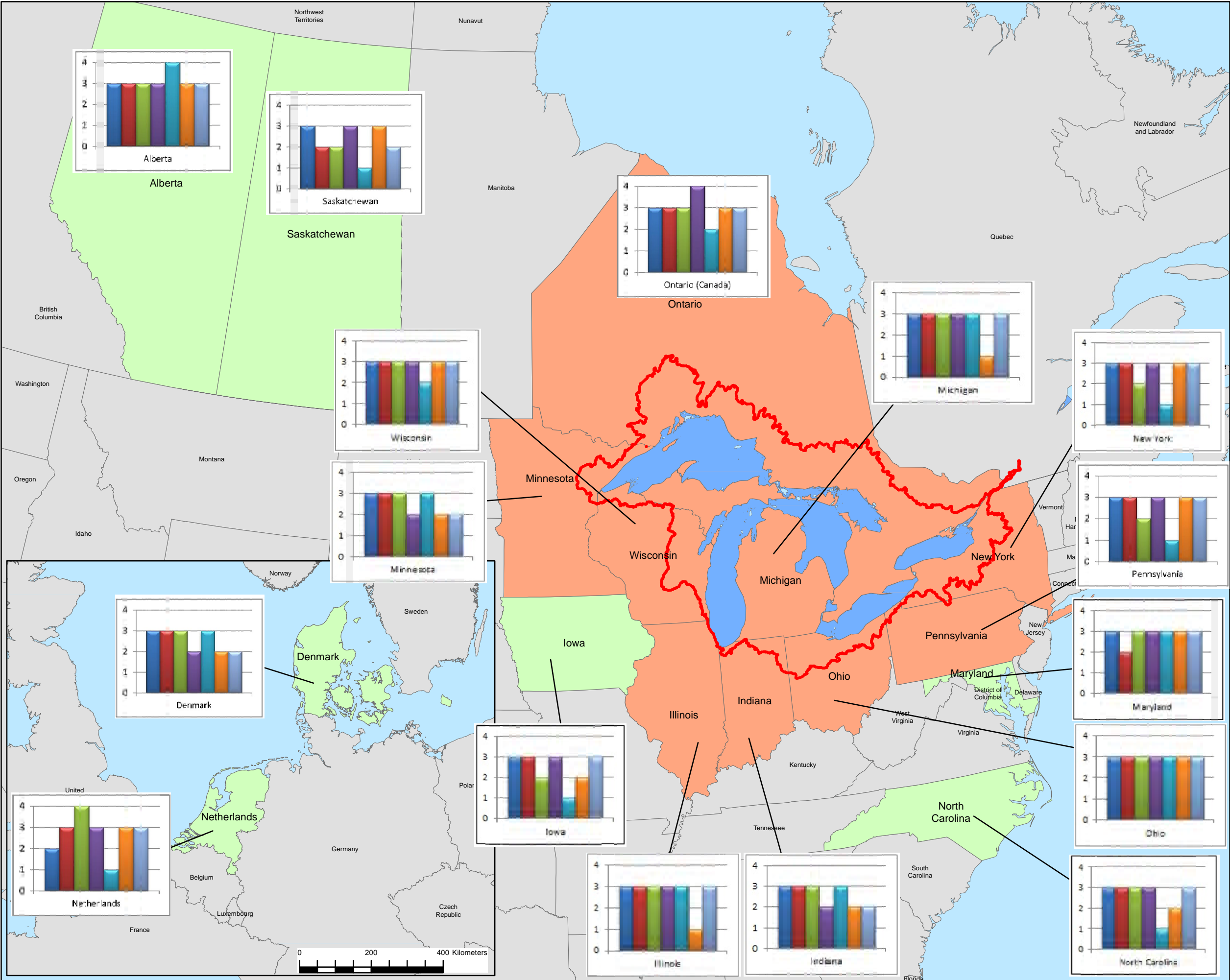
TITLE

SUBJECT JURISDICTIONS

Blumetric™
Environmental

3108 Carp Road PO Box 430
Ottawa, Ontario K0A 1L0
TEL: (613) 839-3053
FAX: (613) 839-5376
Email: info@blumetric.ca
Web: <http://www.blumetric.ca>

PROJECT # 170641		DATE December 08, 2017	
DRAWN IB	CHECKED MKB	FIG NO. 01	REV 0



LEGEND

- Great Lakes Basin
- Within the Great Lakes Basin Jurisdictions
- Outside the Great Lakes Basin
- Great Lakes

Evaluation Categories:

- Regulators, legislation
- Definitions, quantifications, etc. for permitting purposes
- Regulatory requirements
- Compliance, Monitoring and Enforcement
- Input from Public Stakeholders and Indigenous Communities
- Funding
- Other

1				
REV.	DESCRIPTION	YY/MM/DD	BY	CHK

REFERENCES

PROPRIETARY INFORMATION MAY NOT BE REPRODUCED OR DIVULGED WITHOUT PRIOR WRITTEN CONSENT OF BLUMETRIC ENVIRONMENTAL INC. DO NOT SCALE DRAWING. THIS DRAWING MAY HAVE BEEN REDUCED. ALL SCALE NOTATIONS INDICATED ARE BASED ON 11"x17" FORMAT DRAWINGS.

0 100 200 400 Kilometers

CLIENT

INTERNATIONAL JOINT COMMISSION

PROJECT

OVERSIGHT OF ANIMAL FEEDING OPERATIONS FOR MANURE MANAGEMENT IN THE GREAT LAKES BASIN

TITLE

ASSESSMENT OF THE REGULATORY AND PERMITTING REQUIREMENTS OF THE SUBJECT JURISDICTIONS

Blumetric™
Environmental

3108 Carp Road PO Box 430
Ottawa, Ontario K0A 1L0
TEL: (613) 839-3053
FAX: (613) 839-5376
Email: info@blumetric.ca
Web: <http://www.blumetric.ca>

PROJECT # 170641		DATE June 15, 2018	
DRAWN IB	CHECKED MKB	FIG NO. 02	REV 0

APPENDIX A

Oversight of Animal Feeding Operations for Manure Management – Review Matrices



APPENDIX A-1

Jurisdictions Within the Great Lakes Basin – Review Matrices



Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin
Review Matrix Table A-1.1: Ontario, Canada

Regulators, legislation	
Agencies responsible for regulatory and enforcement oversight	Provincial Government has primary role. A municipal government issues building permits based on provincial regulations and approvals (via Nutrient Management Act). Provincial Government completes all enforcement except for direct enforcement of building permit requirements by municipalities or some limited federal enforcement (primarily in proximity to significant watercourses). The provincial Ministry of the Environment and Climate Change (MOECC) is responsible for compliance, investigations, and prosecutions, while the Ontario Ministry of Agriculture and Rural Affairs is responsible for Education and outreach, training and certification, approval of Nutrient Management Strategies, and certain Non-Agricultural Source Materials Plans. Policy and program development is undertaken jointly by both ministries.
Definitions, quantifications, etc. for permitting purposes	
How are manure requirements defined within the jurisdiction, including scale of farm, definition of animal/livestock units	Almost all requirements are the result of provincial legislation via Ontario Regulation 267/03 within the Nutrient Management Act (NMA) (https://www.ontario.ca/laws/regulation/030267). NMA requirements trigger on Nutrient Units (NU) defined as "the amount of nutrients that give the fertilizer replacement value of the lower of 43 kg of nitrogen or 55 kg of phosphate". A NU approximately fertilizes one acre of land (varies depending on fertilizer use and crop type and yield). The 8th column in this linked chart gives the numbers of different types (and subtypes) of animals in a NU (http://www.omafra.gov.on.ca/english/nm/regs/nmpro/nmtab01-12.htm). For example, one beef-brood cow (including calves until weaning) is one nutrient unit. Regulated farm size is based on a Farming Unit. This includes all livestock facilities within a farming operation (declared by farmer). The farming unit can include more than one deed but never be less than a deed, and can include fields with no livestock.
How are manure volumes estimated, including estimates of animal turnover and weights	Manure volumes for the Nutrient Management Strategy (which specifies manure storage sizing) and the initial Nutrient Management Plan are based on regulatory standards specified in the 3rd to 7th columns of Nutrient Management Charts embedded in the NMA (http://www.omafra.gov.on.ca/english/nm/regs/nmpro/nmtab01-12.htm). These columns specify utilization (% of time the barn is being used), liquid amount generated, expected dry matter content of liquid material, "solid" manure generated and expected dry matter content of "solid" manure. For ongoing nutrient management plans manure volumes can be based on actual measured volumes. Nutrient content is based on averaged representative manure tests or actual manure tests.
How manure volume and nutrient content among livestock type and stages of livestock vary	A detailed chart in NMA (http://www.omafra.gov.on.ca/english/nm/regs/nmpro/nmtabtc-12.htm) categorizes nutrient units and manure volume calculations based on type of animal (example, a chicken), subtype of animal (example, a laying hen) and housing condition (example, high rise with manure stored in barn). Column 2 of this chart gives an average weight of a specific subtype of animal. The user can edit this for a specific operation however edits must be justified to be approved. When manure volume is calculated, additional inputs such as rainwater or cleaning water (example, milk house waste) must be taken into account.
Regulatory requirements	
Regulatory triggers - criteria for manure to be subject to regulation/permitting	The NMA has some general rules for all livestock operations (for example high trajectory manure application systems can't be used for manure with more than 1% Dry Matter Content). Most NMA requirements for manure storages and nutrient management plans are based on a building permit trigger and/or size of Farm Unit in NUs. Triggers are 5 NU (requirement for an approved Nutrient Management Strategy (focused on farmstead)) and 300 NU (requirement for a Nutrient Management Plan (focused on application fields)). External factors such as distance to a watercourse will affect nutrient management plan requirements and manure storage requirements (for example a flow path of a certain distance is required between a manure storage (or feed lot) and a watercourse). All Farm Units with land within 100 meters of a municipal well must have a nutrient management plan. (http://www.omafra.gov.on.ca/english/engineer/facts/10-035.htm).

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin
Review Matrix Table A-1.1: Ontario, Canada

Regulatory requirements for storage, including monitoring and inspection	240 days of manure storage is the base requirement. In some cases this can be lowered if a farmer can justify land will always be available for application. Rainwater entry (either direct or indirect (ie from a pad flowing into a storage)) must be included in the sizing capacity. Freeboard of 0.3 meters (12") is required for uncovered liquid storages. All liquid manure storages and larger solid manure storages must be engineered. 2 layers of protection (example is reinforced concrete and surrounding soil with adequate clay content) must be proved for liquid storages. In addition, engineers must be involved with any manure transfer systems. A contingency plan is required which must address options if more nutrients than the the storage design capacity (Nutrient Management Protocol for Ontario Regulation 267/03).
Regulatory requirements for land application of manure	The application is limited by phosphate (P2O5) limits (http://www.omafra.gov.on.ca/english/nm/regs/nmpro/nmtabtc-12.htm), section 92). Total P2O5 application (both fertilizer and manure) is limited by the greater of crop production guidelines (plus 85 kg/ha over 5 years) or crop removal (plus 390 kg/ha over 5 years). Fertilizer application is only included when it is applied on fields requiring a regulated Nutrient Management Plan.
Restrictions for land application of manure	No legislated requirements related to specified rainfall (there are BMPs). NMA specifies limits for field slope, setback distances from different types of wells (3 to 100 m) and setbacks from surface water (13 meters if not incorporated or applied to living crop). A 3 m buffer strip is required beside watercourses. Winter application includes additional setbacks from surface water and incorporation requirements (http://www.omafra.gov.on.ca/english/engineer/facts/10-073.htm). Note farming operations without a required NMP are exempt from winter application rules.
Regulatory requirements for land application - acreage requirements	If a nutrient management plan is required, the acreage requirement is primarily based on phosphorous needs or net phosphorous removal of the crop after commercial fertilizer is applied. Manure can't be applied within specified distances from waterbodies or when land exceeds a certain slope. If a nutrient management plan is not required, applicants are required to show the destination and area of land receiving manure in a nutrient management strategy and the ministry requires a reasonable land base be available for the number of nutrient units generated on the farm unit.
Regulatory requirements for land application - procedures and protocols for testing of manure	When a nutrient management plan is required, either manure sampling must be completed for N, P, K or average values as specified in NMA tables must be used (http://www.omafra.gov.on.ca/english/nm/regs/nmpro/nmtabtc-12.htm). If manure samples are used additional justification is required if samples are more than 20% below values in NMA tables.
Regulatory requirements for land application - procedures and protocols for testing of soils on which manure is applied	Either sampling must be completed for plant available phosphorous and plant available potassium or high default levels are used (101 mg/l for P and 251 mg/l for K). Sampling must be completed in accordance with the Sampling and Analysis Protocol made under the Nutrient Management Act. Analysis must be completed by an OMAFRA accredited lab or a lab meeting International Standards ISO/IEC 17025 (http://www.omafra.gov.on.ca/english/nm/regs/sampro/samprotc-12.htm).
Regulatory requirements for manure disposal	A nutrient transfer agreement is required when the generating farm requires a nutrient management strategy (NMS) and the receiver is a farm that requires a nutrient management plan (NMP) or a non-agricultural source material plan (NASM plan). At a minimum, a transfer agreement must identify: <ul style="list-style-type: none"> • The name of the generator • The name of the person/company to whom the material is transferred • The type and quantity of material to be transferred, as well as the time of the expected transfer

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin
Review Matrix Table A-1.1: Ontario, Canada

Nutrient management plans	<p>A farm is required to have a NMP when:</p> <ul style="list-style-type: none"> • livestock numbers are equal to or greater than 300 NU or • a phased-in farm unit is located within 100 m of a municipal well. <p>The plans do not have to be reviewed however they are subject to audit. Plans are typically generated using Nutrient Management Software (NMan) provided by the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA). This software will display red flags when legislative requirements are exceeded. Plans are not publicly available. An Ontario specific Phosphorous Index is calculated as part of the software package. At this time it is only used as a BMP.</p> <p>Nutrient Management Plans and Nutrient Management Strategies must be prepared by a certified planner trained by OMAFRA.</p>
Best management practices	No specific requirement for BMPs to be identified. NMan software includes many BMP processes (identified with yellow flags when exceedances occur). BMPs embedded in the software include maximum rates, enhanced setbacks to watercourse and indexes to flag when high Nitrogen or Phosphorous losses can occur.
Compliance, Monitoring and Enforcement	
How are permitting requirements enforced	Permitting requirements for new, expanded or modified livestock facilities including manure storages are administered by the Chief Building Official in each municipality. Before a building permit is issued, this official is required to ensure that (if required) a nutrient management strategy (NMS) approved by OMAFRA is completed for the project. In addition any engineering requirements identified in the NMS must be designed and signed off by a professional engineer before the permit is issued. This official also needs to ensure livestock facility is constructed according to specifications in the building permit and NMS. A stop order can be issued by the official if the project is non-compliant. Once a building permit is issued for a livestock facility, Ontario's Ministry of the Environment and Climate Change do complete risk based inspections. Actions can also occur because of a complaint. In addition, any spill must be declared by an Operator.
Inspections	Staff from Ontario's Ministry of the Environment and Climate Change do complete risk-based inspections. Actions can also occur because of a complaint. Any spill must be declared by an Operator.
Complaints	Complaints are directed to the Ministry of the Environment and Climate Change (MOECC). There is no requirement to copy the farm operator on the complaint. If a serious issue (for example, a spill or high probability of a spill) MOECC will deal with it directly. If serious, MOECC has the enforcement powers including stoppage of activity, cleanup of activity and issuance of fines or jail time. If less serious, they have abatement staff to address situation. If more of a nuisance issue, staff at Ministry of Agriculture and Rural Affairs (OMAFRA) may be asked to be involved. Nuisance issues may be addressed by the Food and Farm Protection Act administrated by OMAFRA.
Input from Public Stakeholders and Indigenous Communities	
Notification of a proposed new animal feeding operation	If livestock facility meets proper zoning there is not a notification. Note livestock facilities must meet Minimum Distance Separation (MDS) requirements. This program sets buildings away from conflicting uses. If the livestock facility wants a variance, neighbours will be notified.
Indigenous communities	There is no requirement under the Nutrient Management Regulations.

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin
Review Matrix Table A-1.1: Ontario, Canada

Role of Indigenous people in regulatory and enforcement oversight, and how regulatory agencies coordinate with Indigenous people	No direct role.
Public access to records	Record of Approval is available to public on request. This document includes: <ul style="list-style-type: none"> • Name of Farm Operation • Owner • Developer • Properties in farm unit • Days of storage • Proportion of nutrients applied versus portion of nutrients transferred out • Engineers Requirement Form or Commitment Certificate (ref https://www.oboa.on.ca/events/2012/sessions/files/219.pdf)
Funding	
Funding and/or incentives for manure management	There has been a series of broad based funding programs especially for manure storages for existing facilities. Now funding for manure storages is focused on specific areas. Generally broader based funding is available for nutrient management planning.
Other	
Are there non-government nutrient management programs that include manure application elements (organized voluntary efforts, best practices guidelines, farm assistance programs, etc.)	Ontario has Farm Environmental Farm Plan (EFP). This program initiated in mid 90's has a farmer self determine BMPs to improve his/her farming operation. The process is set up to determine key changes that should be completed to best address the environmental objectives. Completion of the program is often a prerequisite to enrol into funding programs. The EFP is organized by the Ontario Soil and Crop Improvement Association and supported by most (if not all) farming associations. Staff from the Ministry of Agriculture and Rural Affairs assist in the development of the program. In addition, local conservation authorities have initiated funding and support programs for farmers in their local watershed.
Nutrient release reduction targets related to manure being developed by individual and collective state/provincial water quality management agencies	Individual conservation authorities will have voluntary targets. Direct nutrient release is forbidden under the Water Resources Act or Environmental Protection Act. In 2016, Ontario adopted a target of 40 percent phosphorus load reduction by 2025 for the western and central basins of Lake Erie, and an interim reduction goal of 20 percent reduction by 2020. By 2018, the Canada-Ontario Action Plan for Lake Erie will be developed to meet phosphorus reduction targets, reduce algal blooms, and help restore Lake Erie. (https://www.ontario.ca/page/canada-ontario-great-lakes-agreement)
Are there permit requirements that indirectly impact manure produce, storage, management and application	<ul style="list-style-type: none"> • In Ontario, taking water for livestock use is exempt from needing a Permit to Take Water under the Ontario Water Resources Act, as long as water is not taken into storage for that purpose and the amount of water taken is always less than 379,000 litres per day (https://www.ontario.ca/page/permits-take-water). Any other activity (such as dilution of manure tanks) may be subject to water taking permits. • The deposit/discharge of deleterious substances into a water body frequented by fish is prohibited under Section 36 of the federal Fisheries Act.

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin
Review Matrix Table A-1.2: U.S. (Federal)

Regulators, legislation	
Agencies responsible for regulatory and enforcement oversight	<ul style="list-style-type: none"> Federal EPA – requires NPDES permits for Concentrated Animal Feeding Operations (CAFO) which are agricultural operations where animals are kept and raised in confined situations. An CAFO is a lot or facility where animals have been, or will be stabled/confined and fed or maintained for a total of 45 days or more in any 12 month period.
Definitions, quantifications, etc. for permitting purposes	
How are manure requirements defined within the jurisdiction, including scale of farm, definition of animal/livestock units	<ul style="list-style-type: none"> Large CAFO – federal definition <ul style="list-style-type: none"> 700 mature dairy cows, milked or dry - 1,000 veal calves - 1,000 cattle, other than veal or dairy 2,500 swine 55lb+ or 10,000 swine less than 55lb 500 horses 10,000 sheep/lamb 55,000 turkeys 30,000 laying hens, liquid manure handling system - 125,000 chickens (other than laying hens), other than liquid manure 82,000 laying hens, other than liquid manure handling system 30,000 ducks liquid manure - 5,000 ducks other than liquid manure Medium CAFO – federal definition <ul style="list-style-type: none"> 200-699 mature dairy cows, milked or dry - 300-999 veal calves - 300-999 cattle, other than veal or dairy 750-2,499 swine 55lb+ or 3,000-9,999 swine less than 55lb 150-499 horses 3,000-9,999 sheep/lamb 16,500-54,999 turkeys 9,000-29,999 laying hens, liquid manure handling system - 37,500-124,999 chickens (other than laying hens), other than liquid manure 25,000-81,999 laying hens, other than liquid manure 10,000-29,999 ducks liquid manure - 1,500-4,999 ducks other than liquid manure
How are manure volumes estimated, including estimates of animal turnover and weights	<ul style="list-style-type: none"> The United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) breaks down the estimated total amount of manure, phosphorus, and nitrogen produced by each type of livestock (lb/day/1,000-lb animal threshold). The table can be found in the USDA NRCS Agricultural Waste Management Handbook (1992). Livestock included in the table are beef cattle (based on a high forage diet), dairy cows (lactating), hogs and pigs (grower), layer chickens, broiler chickens, and turkeys.

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin
Review Matrix Table A-1.2: U.S. (Federal)

How manure volume and nutrient content among livestock type and stages of livestock vary	<p>The standard unit used in calculating the relative grazing impact of different kinds and classes of livestock is defined as 1000lb (450kg) beef cow with or without a nursing calf, with a daily dry matter forage requirement of 26lb (11.8kg) – below are a selection of conversion factors:</p> <ul style="list-style-type: none"> • Brood cows and slaughter/feeder cattle (1.0) • Milking dairy cows (1.4) • Young dairy stock (0.6) • Swine weighing over 55lb (0.4) • Swine weighing under 55lb (0.03) • Sheep, lambs, or goats (0.1) • Horses (2.0) • Turkeys (0.02) • Laying hens/broilers (0.005) • Laying hens/broilers (0.01) – if facility has continuous overflow watering • Laying hens/broilers (0.03) – if facility has liquid manure handling system • Ducks (0.02)
Regulatory requirements	
Regulatory triggers - criteria for manure to be subject to regulation/permitting	<ul style="list-style-type: none"> • A NPDES permit must be applied for by a medium or large CAFO if they discharge or propose to discharge. A CAFO proposes to discharge if it is designed, constructed, operated or maintained in such a way that a discharge will occur. • Small farms will be notified if they are required to get a NPDES permit and if they fall into the CAFO category.
Regulatory requirements for storage, including monitoring and inspection	<ul style="list-style-type: none"> • The production area is designed, built, operated, and maintained to handle all of the manure, litter, and process wastewater, including runoff and direct precipitation from all normal rainfall events up to a 25-year, 24-hour rainfall event (or 100-year, 24-hour storm event for new veal, poultry, and swine facilities) • It is recommended that solid manure and litter stockpiles that are not stored under a roof be covered to exclude precipitation whenever possible. • Floor of a solid manure storage area should be constructed of compact clay, concrete, or other material designed to minimize the leaching of wastes beneath storage area. Floors should be sloped toward a collection area or sump so that runoff or leachate can be collected and transferred to a liquid manure storage structure or treatment system. • Large CAFOs shall conduct weekly visual inspections of all manure, litter, and process wastewater impoundments. All other CAFO operators can decide the frequency of inspections based on factors such as system size/complexity, types of mechanical devices, etc. There are no specifications as to the requirements for engineer/professional design or specifications for days of storage or freeboard needs.
Regulatory requirements for land application of manure	<ul style="list-style-type: none"> • There are no specific differences in crop nutrients under the Federal EPA – specific field assessments are conducted to determine soils ability to transport and move nutrients (specifically nitrogen and phosphorus) through the soil or potentially to water sources – address the form, source, amount, timing, and method of application of nutrients on each field to achieve realistic production goals – appropriate flexibility for a CAFO • Minimum setback for manure application of 100ft from surface waters – or substitute with 35ft vegetated buffer
Restrictions for land application of manure	<ul style="list-style-type: none"> • EPA CAFO rules require CAFOs to determine and implement site-specific nutrient application rates that comply with the technical standards for nutrient management established by the permitting authority. The permitting authority is to implement restrictions and regulations for land application based off what is best for the specific state.
Regulatory requirements for land application - acreage requirements	<ul style="list-style-type: none"> • EPA does not have acreage requirements based on manure volume or nutrient content. There are no specifications for how much acreage a CAFO needs to operate based on manure production or amount of animals on the property.

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin
Review Matrix Table A-1.2: U.S. (Federal)

Regulatory requirements for land application - procedures and protocols for testing of manure	<ul style="list-style-type: none"> • Manure is to be collected and analyzed for nitrogen and phosphorus a minimum of once per year (412.4(c)(3)). Samples should be collected from all manure storage areas, both liquid and dry, as well as any wastewater or storm water storage areas, in order to obtain representative test results. Ideally, CAFOs should sample manure each time it is removed from the production area. Collect samples as close to the time of land application as possible, leaving sufficient time between sampling and land application to obtain and interpret the results of the analyses. • CAFOs should sample each form of animal waste storage on site not only because the composition of each will be different, but because they often are applied to the land separately from each other.
Regulatory requirements for land application - procedures and protocols for testing of soils on which manure is applied	<ul style="list-style-type: none"> • Soil sampling for phosphorus should happen (at a minimum) every 5 years (and is required for large cattle/poultry/swine CAFO) • It is recommended that soil samples consist of 15-20 cores taken at random locations throughout one field/management unit. Various cores will be used to form one composite sample to be submitted to lab for analysis. • For samples intended for analysis of phosphorus or other immobile nutrients, samples should be collected at the same depth at which the field is tilled (usually 6-8in). • Results from sampling is to be kept on file at the CAFO. • Not specified as to whom is to conduct the sampling and procedures are not strictly defined.
Regulatory requirements for manure disposal	<ul style="list-style-type: none"> • CAFO's may transfer manure to other operations for spreading or other uses. No other disposal requirements or regulations are stated by EPA.
Nutrient management plans	<ul style="list-style-type: none"> • The Phosphorus Index is a tool used to assess the potential for Phosphorus to move from agricultural fields to surface water and was developed by Iowa State University, but adopted by the EPA and many other state governing agencies. NRCS Standard 590 allows operations to not use the P-Index if they plan to only use the Soil Test Phosphorus Strategy. The EPA allows states to regulate whether or not CAFOs in their state need to use the P-Index. • The federal rules require that a CAFO develop and implement a nutrient management plan that incorporates specific requirements based on a field-specific assessment of the potential for nitrogen and phosphorus transport from a land application field. For states authorized to administer the NPDES program, the federal rules require development of technical standards that include a field-specific assessment of the potential for nitrogen and phosphorus transport from the field to surface waters. The U.S. EPA's NPDES Permit Writers Manual for CAFOs includes discussion of three methods for phosphorus runoff assessment, one method being the use of the P-Index, commonly used by a number of states. • Annual report to include: number/type of animals, estimated total manure/litter/process wastewater generated in previous 12 months, total number of acres for land application covered by NMP, total number of acres under control of CAFO that were used for land application, summary of all discharges, actual crops planted and actual yields.
Best management practices	<ul style="list-style-type: none"> • BMPs that are to be implemented in a CAFO's NMP are as follows: adequate storage capacity, proper management, diverting clean water from the production area, preventing animals from contacting waters of the state, proper chemical handling, implementing conservation practices to control nutrient loss, testing manure, litter, process wastewater, and soil, methods for land application of manure, and proper record keeping.

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin
Review Matrix Table A-1.2: U.S. (Federal)

Compliance, Monitoring and Enforcement	
How are permitting requirements enforced	<ul style="list-style-type: none"> Enforcement is done by the specified state government agency that the EPA has authorized to regulate CAFOs.
Inspections	<ul style="list-style-type: none"> Inspections for animal feeding operations (AFO) or CAFO's are typically compliance evaluations, in which the facility is being inspected to determine whether it is complying with requirements of the CAFO Regulations under the Clean Water Act (CWA) – are conducted by the regulating agency and are typically annual. Inspections may be conducted for any of the following: routine inspection, follow up on citizen complaint/tip, for case development support after a violation has been identified, a follow-up inspection to ensure that the permittee has implemented required controls or best management practices, or compliance inspection to ensure compliance with settlement requirements.
Complaints	<ul style="list-style-type: none"> All complaints are to be made/submitted to the appropriate government agency authorized to handle the CAFO permitting in the specific state.
Input from Public Stakeholders and Indigenous Communities	
Notification of a proposed new animal feeding operation	<ul style="list-style-type: none"> Each authorized agency for a given state implements rules and regulations regarding notification of a proposed new animal feeding operation based on best interest for the given state. Federal EPA does not have any specific regulations.
Indigenous communities	<ul style="list-style-type: none"> Each authorized agency for a given state implements rules and regulations regarding indigenous communities and the notification process when involving tribal lands based on best interest for the given state. Federal EPA does not have any specific regulations.
Role of Indigenous people in regulatory and enforcement oversight, and how regulatory agencies coordinate with Indigenous people	<ul style="list-style-type: none"> Each authorized agency for a given state implements rules and regulations involving the role of indigenous people in regulatory enforcement, oversight and coordination based on best interest for the given state. Federal EPA does not have any specific regulations.
Public access to records	<ul style="list-style-type: none"> Each authorized agency for a given state implements rules and regulations involving public access to records based on best interest for the given state. Federal EPA does not have any specific regulations.
Funding	
Funding and/or incentives for manure management	The federal AgSTAR Program, a joint initiative of the U.S. Environmental Protection Agency, the U.S. Department of Energy, and the U.S. Department of Agriculture, shows dairy and pork producers how to manage manure profitably while protecting the environment. AgSTAR provides technical support, software tools, and information on biogas digesters and has supported the development of national standards for commercial-scale anaerobic digestion systems.
Other	
Are there non-government nutrient management programs that include manure application elements (organized voluntary efforts, best practices guidelines, farm assistance programs, etc.)	<ul style="list-style-type: none"> Each state has non-governmental NMP programs and groups that are specific to the state and its CAFO rules and regulations. There are no specific NMP programs for the Federal EPA.

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin
Review Matrix Table A-1.2: U.S. (Federal)

Nutrient release reduction targets related to manure being developed by individual and collective state/provincial water quality management agencies	<ul style="list-style-type: none"> • The Federal EPA does not have any specific targets as for nutrient release reductions for CAFOs. The EPA delegates each state to create and manage its own nutrient release reduction programs. The EPA monitors reports from these programs and takes action if an individual state is not reducing its nutrient release enough/program is not working.
Are there permit requirements that indirectly impact manure produce, storage, management and application	<ul style="list-style-type: none"> • No person may legally discharge to the waters of the state without a NPDES permit issued by their respective state and discharging can still be prohibited depending on the production facility and amount/type of discharge. • EPA regulates CAFOs/operations to withdraw 100,000 gallons a day per any 30-day period. EPA allows delegated state agencies to enforce stricter requirements where they see fit.

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin
Review Matrix Table A-1.3: New York, U.S.

Regulators, legislation	
Agencies responsible for regulatory and enforcement oversight	<ul style="list-style-type: none"> • New York State Department of Environmental Conservation (NYSDEC or DEC) has renewed two types of State Pollution Discharge Elimination System (SPDES) general permits for CAFOs. These new permits were developed with input from the agricultural and environmental community help to ensure proper management of nutrients while increasing water quality protection. These permits provide farmers with more certainty regarding their compliance with state and federal laws and regulations by better defining permit terms and conditions • Developed renewal drafts after nearly two years of outreach and communication with stakeholders.
Definitions, quantifications, etc. for permitting purposes	
How are manure requirements defined within the jurisdiction, including scale of farm, definition of animal/livestock units	<ul style="list-style-type: none"> • Large and medium CAFO same as federal – small is anything less than medium CAFO's criteria. • The following CAFO owner/operators are eligible for coverage under this general permit if they fully implement all required practices identified in the CNMP and are complying with the terms of this general permit: new and existing small, medium, or large CAFO's or existing small or medium CAFO expanding into medium or large CAFO
How are manure volumes estimated, including estimates of animal turnover and weights	<ul style="list-style-type: none"> • The United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) breaks down the estimated total amount of manure, phosphorus, and nitrogen produced by each type of livestock (lb/day/1,000-lb animal threshold). The table can be found in the USDA NRCS Agricultural Waste Management Handbook (1992). • Livestock included in the table are beef cattle (based on a high forage diet), dairy cows (lactating), hogs and pigs (grower), layer chickens, broiler chickens, and turkeys.
How manure volume and nutrient content among livestock type and stages of livestock vary	Same as federal
Regulatory requirements	
Regulatory triggers - criteria for manure to be subject to regulation/permitting	<ul style="list-style-type: none"> • New York State law requires an SPDES permit for constructing or using an outlet or discharge pipe that discharges wastewater into the surface waters or ground waters of the state, when constructing or operating a disposal system such as a sewage treatment plant, or when modifying, transferring, and renewing your permit.
Regulatory requirements for storage, including monitoring and inspection	<ul style="list-style-type: none"> • Roof structures for storage are to be designed and certified by a Professional Engineer licensed in the State of New York. Roof structures must be designed to prevent waste located under the roof from becoming a pollution problem. • Storage tanks must be designed with or without covers. The opening in covered tanks must be designated to accommodate equipment for loading, agitating, and emptying materials. These opening must be equipped with grills or secure covers for safety, and for odor and vector control. • All structures must be underlain by free draining material or must have footing located below the anticipated frost depth. Waste storage facilities should be located as close to the source of waste/polluted runoff as practicable. Freeboard for waste storage tanks should be considered. • Temporary manure piles are intended to be used by farms with minor seasonal constraints for manure application – manure is not to be stacked higher than 4ft with a 4:1 angle of repose. Temporary piles are to be 300ft away from wells and soils are to be evaluated for their potential to leach contaminants before and after the manure pile.
Regulatory requirements for land application of manure	<ul style="list-style-type: none"> • Manure may be applied at a rate equal to the recommended phosphorus application, or estimated phosphorus removal in harvested plant biomass for crop rotation, or multiple years in the crop sequence at one time.

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin
Review Matrix Table A-1.3: New York, U.S.

Restrictions for land application of manure	<ul style="list-style-type: none"> • Applications cannot be made on saturated soils (either fluid saturated or frozen saturated soil conditions) and applications may not be made at a rate that creates or causes the soil to become fully saturated at the time of the application. • Limit applications during frozen/snow covered conditions to daily production amounts – apply only solid manure – prioritize applications to fields with significant residue and to fields with longer flow distances to water, mild slopes, and/or fewer to no concentrated flows. • A comprehensive Nutrient Management Plan (CNMP) is required for farms seeking federal or state cost-sharing to construct a manure storage structure, however a CNMP can be developed and implemented by any livestock farm seeking to maximize production, while efficiently managing their natural resources and protecting the environment. • Single manure application rates must be specifically identified on a per field basis in the CNMP and shall not exceed 20,000 gallons per acre cumulatively within any 7-day period.
Regulatory requirements for land application - acreage requirements	<ul style="list-style-type: none"> • NYSDEC does not have acreage requirements based on manure volume or nutrient content. There are no specifications for how much acreage a CAFO needs to operate based on manure production or amount of animals on property
Regulatory requirements for land application - procedures and protocols for testing of manure	<ul style="list-style-type: none"> • NYSDEC follows Federal EPA regulation requirements when it comes to sampling procedures and protocols of manure (both liquid and dry).
Regulatory requirements for land application - procedures and protocols for testing of soils on which manure is applied	<ul style="list-style-type: none"> • Soil tests must be taken at least every 3 years, not to extend beyond the spring of the fourth crop year. Tests must include analyses pertinent to monitoring or amending the annual nutrient budget (e.g. pH, soil organic matter, phosphorus, potassium). • Soil tests must be performed by laboratories successfully meeting the requirements and performance standards of the North American Proficiency Testing Program (NAPT) or Agricultural Laboratory Proficiency Program (ALP).
Regulatory requirements for manure disposal	<ul style="list-style-type: none"> • CAFO's may transfer manure to other operations for spreading or other uses. Records of the amount of manure transferred from a facility must be maintained on site.
Nutrient management plans	<ul style="list-style-type: none"> • The CNMP must be developed, reviewed, and certified by an AEM certified planner. Any amendments or changes shall be done under the guidance of the AEM certified planner. CNMP must be updated annually. • An Agricultural Environmental management (AEM) certified planner [or an associate working under the direct supervisor of the AEM certified planner] must conduct an annual onsite review of the CNMP with the CAFO manure applicator staff. Review must include a planner-led discussion of farm-specific high risk field features and management, including; concentrated flow paths, surface water, wellheads, subsurface drainage systems, and karst features (where present). Owner must maintain a record of the annual review and of the updated CNMP on site. • Shall install a rain gauge and all rain events in excess of 0.3in shall be measured, recorded and kept as part of the CNMP recordkeeping. All CNMP records are to be kept for at least 5 years from the date they were reported.
Best management practices	<ul style="list-style-type: none"> • Generic best management practices for the SPDES permit are as follows: prohibition of unauthorized substances, proper operation and maintenance requirements, and field setback requirements. • BMP waste application requirements are as follows: adverse weather emergency application, protection of groundwater and artificial drainage flows, food processing waste/containing salt, and waste without benefits.
Compliance, Monitoring and Enforcement	
How are permitting requirements enforced	<ul style="list-style-type: none"> • NYSDEC monitors SPDES-permitted facilities through receiving/analyzing periodic discharge monitoring reports (DMR), performing routine facility inspections, responding to complaints, requiring certification, and analyzing facility specific reports.

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin
Review Matrix Table A-1.3: New York, U.S.

Inspections	<ul style="list-style-type: none"> • The owner/operator shall allow the Commissioner of the Department (DEC), the USEPA Regional Administrator, or his/her designee, or any duly authorized agent thereof, upon the presentation of credentials to enter the premises of the CAFO or where the records are kept. • Authorized personnel are allowed to have access and copy any records, inspect at reasonable times, and sample or monitor any substance or parameter at any location. • Inspections typically to happen annually unless there is reason for an inspection to happen (complaint, violation...)
Complaints	<ul style="list-style-type: none"> • Complaints are to be made to NYSDEC. NYSDEC investigates all complaints to determine any impact upon the environment or public health. If staff determine there is a violation, NYSDEC seeks corrective action to minimize negative impacts, and if necessary, pursues enforcement through the Office of General Counsel or Division of Law Enforcement.
Input from Public Stakeholders and Indigenous Communities	
Notification of a proposed new animal feeding operation	<ul style="list-style-type: none"> • There are no regulations from NYSDEC stating that a new CAFO has to notify any specific agency or the public upon construction/proposal of construction.
Indigenous communities	<ul style="list-style-type: none"> • There are no distinct processes for notifying indigenous communities of information pertaining to CAFOs.
Role of Indigenous people in regulatory and enforcement oversight, and how regulatory agencies coordinate with Indigenous people	<ul style="list-style-type: none"> • NYSDEC does not specify the role of indigenous people in regulatory or enforcement oversight of CAFO's. There is no specification stating how or if NYSDEC coordinates with indigenous people involving CAFOs.
Public access to records	<ul style="list-style-type: none"> • The general public of New York do not have direct access to the permits of CAFOs but there is a map on NYSDEC's website that shows where all large and medium CAFOs are located throughout the state. The public does have the opportunity to comment on permits as they are being drafted.
Funding	
Funding and/or incentives for manure management	<ul style="list-style-type: none"> • Clean Water Infrastructure Act of 2017 – CWIA is a \$2.5 billion investment in drinking water infrastructure, clean water infrastructure and water quality protection - \$50 million in grants available, over three consecutive application rounds, is being offered to farmers to ensure proper management and storage of nutrients such as manure on farms. County Soil and Water Conservation Districts can apply for the CAFO Waste Storage and Transfer System Program on behalf of eligible farmers. The maximum award amount per proposal is \$385,000, which includes funding for engineering and construction expenses. The Department plans to launch a second and third application period for an additional \$15 million in both 2018 and 2019.
Other	
Are there non-government nutrient management programs that include manure application elements (organized voluntary efforts, best practices guidelines, farm assistance programs, etc.)	<ul style="list-style-type: none"> • Cornell University – create guidelines for composting animal mortalities, winter and wet weather manure spreading, manure management guidelines for limestone bedrock/karst areas, and manure and groundwater guidelines. • Watershed Agricultural Council Guidance – offers help in planning/implementing BMPs, operation and maintenance implementation, farmer education, and further resources about things such as rotational grazing, or NMPs.

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin
Review Matrix Table A-1.3: New York, U.S.

Nutrient release reduction targets related to manure being developed by individual and collective state/provincial water quality management agencies	Waterbody-specific nutrient reduction and allocation strategies, known as Total Maximum Daily Load (TMDL) plans, have been developed for Long Island Sound, Lake Champlain, waters of the Croton River watershed and a number of lake watersheds.
Are there permit requirements that indirectly impact manure produce, storage, management and application	<ul style="list-style-type: none"> • NYSDEC requires that CAFOs discharge all of their process wastewater to a publicly owned sanitary sewer system which discharges in accordance with an SPDES permit. • NYSDEC is responsible for water uptake regulations and requires a permit for any agricultural facility that did not register or report usage prior to February 15, 2012 and withdraws water equal to or in excess of an average of 100,000 gallons per day in any thirty-day consecutive period (3 million gallons per 30 day period).

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin
Review Matrix Table A-1.4: Pennsylvania, U.S.

Regulators, legislation	
Agencies responsible for regulatory and enforcement oversight	<ul style="list-style-type: none"> • Pennsylvania Department of Environmental Protection (PADEP) – PADEP is the governing state agency responsible for issuing permits to CAFO's, and enforcing requirements of the permits.
Definitions, quantifications, etc. for permitting purposes	
How are manure requirements defined within the jurisdiction, including scale of farm, definition of animal/livestock units	<ul style="list-style-type: none"> • Large and medium regulations same as federal - small farms not required to seek permitting from NPDES
How are manure volumes estimated, including estimates of animal turnover and weights	<ul style="list-style-type: none"> • The United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) breaks down the estimated total amount of manure, phosphorus, and nitrogen produced by each type of livestock (lb/day/1,000-lb animal threshold). The table can be found in the USDA NRCS Agricultural Waste Management Handbook (1992). • Livestock included in the table are beef cattle (based on a high forage diet), dairy cows (lactating), hogs and pigs (grower), layer chickens, broiler chickens, and turkeys.
How manure volume and nutrient content among livestock type and stages of livestock vary	<p>Pennsylvania State University Extension defines an Animal Equivalent Unit (AEU) as "1,000 pounds of live weight of any animal on an annual basis." The AEU can be calculated as the following</p> $= [\text{average number of animals on a typical day that the animals are there} \times \text{animal weight (lb)} \div 1,000] \times [\text{number of days the animals are on the operation per year} \div 365]$
Regulatory requirements	
Regulatory triggers - criteria for manure to be subject to regulation/permitting	<ul style="list-style-type: none"> • A NPDES permit must be applied for by a medium or large CAFO if they discharge or propose to discharge. A CAFO proposes to discharge if it is designed, constructed, operated or maintained in such a way that a discharge will occur.
Regulatory requirements for storage, including monitoring and inspection	<ul style="list-style-type: none"> • Manure storage facilities shall be designed, constructed, operated, and maintained in accordance with current engineering and agronomic practices to ensure that the facility is structurally sound, water-tight, and located/sized appropriately to prevent pollution of surface water and groundwater, including a design to prevent discharges to surface waters during a storm up to and including a 25-year/24-hour storm. • A water quality management (WQM) permit is required if the storage facility is located at an animal operation with an animal threshold over 1,000 or if the storage capacity is between 1-2.5 million gallons. • For agricultural operations with an animal threshold over 1,000 that is a new or expanded operation, a minimum 24-in freeboard is required, except for enclosed facilities that are not exposed which must have a minimum freeboard of 6-in. For all other operations, a minimum 12-in freeboard for manure storage facilities that are ponds and a minimum 6-in freeboard for all other manure storage facilities. • Daily inspections should be made of drinking water and cooling water lines and weekly recording of liquid level in manure storage.
Regulatory requirements for land application of manure	<ul style="list-style-type: none"> • All application must be done in accordance with a plan that includes manure and soil testing, as well as calculation of proper levels of nitrogen and phosphorus, or a WQM permit/DEP approval required. • Weather conditions during land application of manure and for 24 hours prior to and following the application should be recorded and kept at the facility.

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin
Review Matrix Table A-1.4: Pennsylvania, U.S.

Restrictions for land application of manure	<ul style="list-style-type: none"> • No mechanical manure application within 100 feet of streams, lakes, ponds, existing open sinkholes, and private/public drinking water. Setback from streams, lakes and ponds can be reduced to 35 feet if there is a permanent vegetated buffer or 50 feet if there is current soil tests within the last 3 years, no-till practices are used, cover crops are planted, and phosphorus levels are less than 200ppm. • Maximum application rate for winter seasons is 5,000 gal per acre of liquid manure, 20 tons per acre of dry non-poultry manure per acre, or 3 tons of dry poultry manure per acre. Winter is considered the time between December 15th to February 28th or anytime the ground is frozen at least 4in or covered in snow. • Manure may not be applied to fields with slopes greater than 15%
Regulatory requirements for land application - acreage requirements	<ul style="list-style-type: none"> • PA DEP does not have acreage requirements based on manure volume or nutrient content. There are no specifications for how much acreage a CAFO needs to operate based on manure production or amount of animals on property
Regulatory requirements for land application - procedures and protocols for testing of manure	<ul style="list-style-type: none"> • Manure shall be tested annually for each manure type generated within the operation, otherwise PA DEP follows Federal EPA regulation requirements when it comes to sampling procedures and protocols of manure (both liquid and dry).
Regulatory requirements for land application - procedures and protocols for testing of soils on which manure is applied	<ul style="list-style-type: none"> • PA DEP follows Federal EPA regulation requirements when it comes to sampling procedures and protocols of soils (for both nitrogen and phosphorus).
Regulatory requirements for manure disposal	<ul style="list-style-type: none"> • CAFO's may transfer manure to other operations for spreading or other uses. Records of the amount of manure transferred from a facility must be maintained on site.
Nutrient management plans	<ul style="list-style-type: none"> • The P source indicators used in the PA P-index are the Mehlich 3 Soil Test, fertilizer application rates/methods, and manure application rates/methods. In order to use the P-index, one must develop an N-based nutrient management plan for a crop management unit (CMU) and then evaluate this plan using the P-index. • Copies of new, amended or revised NMPs shall be submitted to DEP within 30 days and maintained on site for 5 years. The NMP shall be reviewed annually and must be renewed at least once every 3 years. • Plan shall include a description of the operation, identification of operator, determination of all available nutrient sources, BMPs to control soil erosion, runoff, and manure management, identification of storage areas, plan implementation schedule, and certification signed by operator.
Best management practices	<ul style="list-style-type: none"> • BMPs shall be adopted for manure management to protect surface and groundwater including measures around barnyard and feed lot areas and manure storage facilities based on standards in the "Penn. Technical Guide." • BMP also adopted to control soil erosion and runoff to address critical runoff areas.
Compliance, Monitoring and Enforcement	
How are permitting requirements enforced	<ul style="list-style-type: none"> • DEP is responsible for assuring compliance with CAFO permit requirements. All inspections, follow ups, and violations are given by the PA DEP.
Inspections	<ul style="list-style-type: none"> • At a minimum, DEP will inspect all CAFOs with an animal threshold over 1000 annually. For those CAFOs, the DEP will also require that a PA registered Professional Engineer's certification of structural integrity of manure storage facilities be included with each renewal application for an NPDES permit. • No other specifications or inspection requirements are stated by the PA DEP.
Complaints	<ul style="list-style-type: none"> • PA DEP to handle and investigate all complaints, conduct all inspections, and administer all violations if necessary.

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin
Review Matrix Table A-1.4: Pennsylvania, U.S.

Input from Public Stakeholders and Indigenous Communities	
Notification of a proposed new animal feeding operation	<ul style="list-style-type: none"> PA DEP requires a notice of intent (NOI) form be completed for any existing or new construction of a farm that will be considered a CAFO. There is no specification if NOI is available to the public or if there is any public hearing involved with new construction.
Indigenous communities	<ul style="list-style-type: none"> There are no distinct processes for notifying indigenous communities of information pertaining to CAFOs.
Role of Indigenous people in regulatory and enforcement oversight, and how regulatory agencies coordinate with Indigenous people	<ul style="list-style-type: none"> PA DEP does not specify the role of indigenous people in regulatory or enforcement oversight of CAFO's. There is no specification stating how or if OEPA coordinates with indigenous people involving CAFOs.
Public access to records	<ul style="list-style-type: none"> PA DEP will publish in the PA Bulletin all permits, applications, and NOIs on receipt and when a final determination is made. Otherwise, there is no formalized public participation involved with permits for CAFOs.
Funding	
Funding and/or incentives for manure management	Through the Resource Enhancement and Protection (REAP) Program, farmers, landowner, and businesses earn tax credits for implementing "Best Management Practices" (BMPs) that will enhance farm production and protect natural resources. REAP is a first-come, first-served program – no rankings. The program is administered by the State Conservation Commission (Commission) and the tax credits are awarded by the Pennsylvania Department of Revenue. Eligible applicants receive between 50% and 75% of project costs in the form of State tax credits for up to \$150,000 per agricultural operation. The tax credits can be used incrementally (as needed) for up to 15 years to pay PA state income tax. Farmers and landowners can elect to sell the tax credits after 1 year.
Other	
Are there non-government nutrient management programs that include manure application elements (organized voluntary efforts, best practices guidelines, farm assistance programs, etc.)	<ul style="list-style-type: none"> Penn. State Extension – nutrient management program provides a comprehensive source of information about Pennsylvania Nutrient Management Act (act 38) and associated technical guidance and educational information. It also provides limited information concerning related programs.
Nutrient release reduction targets related to manure being developed by individual and collective state/provincial water quality management agencies	<ul style="list-style-type: none"> A new plan for nutrient release reduction has been developed jointly by the Pennsylvania departments of Agriculture, Conservation, and Natural Resources (DCNR) and Environmental Protection (DEP) as well as the State Conservation Commission. The comprehensive plan focuses on six elements: put high impact, low cost BMPs on the ground and quantify undocumented BMPs in watersheds impaired by agriculture/stormwater – improve reporting, record keeping, and data systems – address nutrient reduction by meeting EPA's goals of inspecting 10% of farms in the watershed – identify legislative, programmatic, or regulatory changes – obtain additional resources for water quality improvements – establish a Chesapeake Bay office to coordinate the development, implementation, and funding of the commonwealth's Chesapeake Bay efforts. The state must reduce nitrogen by 31.4 million pounds, phosphorus by 1 million pounds, and sediment by 648 million pounds by the TMDL's 2025 target.
Are there permit requirements that indirectly impact manure produce, storage, management and application	<ul style="list-style-type: none"> A new or expanded farming operation with more than 1000 AEUs, a new, expanded, or existing CAO with more than 300 AEUs located in a special protection watershed and any farming operation with a direct discharge to surface waters will be required to obtain an individual NPDES permit. A direct discharge from a feed lot or manure storage facility during a storm event of less than a 25 year/24 hour storm must obtain an individual NPDES permit. All existing CAOs with more than 300 AEUs, all existing farming operations with more than 1000 AEUs and all new or expanded CAOs between 301 and 1000 AEUs will be authorized to operate under a general NPDES permit. The PA DEP restricts water uptake to 100,000 gallons per day (an average rate) per day in any 30-day period.

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin
Review Matrix Table A-1.5: Ohio, U.S.

Regulators, legislation	
Agencies responsible for regulatory and enforcement oversight	<ul style="list-style-type: none"> OEPA - In the state of Ohio, Ohio Environmental Protection Agency (OEPA) has been delegated from the Federal EPA to implement the NPDES permit program – Ohio has petitioned USEPA to transfer the CAFO NPDES permit program to the Ohio Department of Agriculture (ODA) and that petition is under review
Definitions, quantifications, etc. for permitting purposes	
How are manure requirements defined within the jurisdiction, including scale of farm, definition of animal/livestock units	<ul style="list-style-type: none"> Farms that fall within the classification of medium or large CAFO are required to obtain a permit. In Ohio, an animal feeding facility that has a total design capacity for a specified number of animals is considered a concentrated animal feeding facility (CAFF). CAFF's are required to obtain a permit to install (PTI) and permit to operate (PTO) from the Ohio Department of Agriculture. CAFF's that discharge must obtain an NPDES permit. Small farms could still be required to obtain a permit depending on the proximity to state waters and the amount of discharge/runoff coming from the facility.
How are manure volumes estimated, including estimates of animal turnover and weights	<ul style="list-style-type: none"> The United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) breaks down the estimated total amount of manure, phosphorus, and nitrogen produced by each type of livestock (lb/day/1,000-lb animal threshold). The table can be found in the USDA NRCS Agricultural Waste Management Handbook (1992). Livestock included in the table are beef cattle (based on a high forage diet), dairy cows (lactating), hogs and pigs (grower), layer chickens, broiler chickens, and turkeys.
How manure volume and nutrient content among livestock type and stages of livestock vary	Same as federal
Regulatory requirements	
Regulatory triggers - criteria for manure to be subject to regulation/permitting	<ul style="list-style-type: none"> A NPDES permit must be applied for by a medium or large CAFO if they discharge or propose to discharge. A CAFO proposes to discharge if it is designed, constructed, operated or maintained in such a way that a discharge will occur. Small farms will be notified if they are required to get a NPDES permit and if they fall into the CAFO category. For large CAFOs, discharges from land application fields under the control of the CAFO that do not meet the agricultural storm water exemption require coverage by an NPDES permit. There is no exemption for large storm events – a discharge at any level or occurrence of precipitation needs a permit.
Regulatory requirements for storage, including monitoring and inspection	<ul style="list-style-type: none"> OEPA follows the regulatory requirements set forth by the Federal EPA for manure storage, including monitoring and inspection.
Regulatory requirements for land application of manure	<ul style="list-style-type: none"> For injection application and surface application followed by incorporation within 24hrs, shall not be applied closer than 100ft – for surface application not followed by incorporation within 24hrs, shall not be applied closer than 300ft. Field is established and managed in contour strips with alternated strips in grass and legume Stockpiling manure shall be a minimum of 300ft from surface water, public/private wells, sinkholes and agricultural drainage – 1,500ft from public drinking water surface intakes – slope of 0-6% only – prohibited in flood plains/floodways Manure regulations and commercial fertilizer regulations are connected with one another and restrict similar activities such as placement of manure/fertilizer on top of frozen ground but allows injection of fertilizer/manure into frozen ground

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin
Review Matrix Table A-1.5: Ohio, U.S.

Restrictions for land application of manure	<ul style="list-style-type: none"> • No discharge of pollutants to state waters – notify Ohio EPA following the first knowledge of a spill/discharge • Shall not be applied closer than 100ft to surface water or seasonal salmonid and cold water habitats [unless a 35ft vegetated buffer has been established] and shall not be applied closer than 300ft of a spring • Shall not be applied to cropland over 15% slope or to pasture/hay land over 20% slope unless immediate incorporation/injection with operations done on the contour, unless the field has 80% ground cover (residue or canopy) or split applications are made with single applications not exceeding 5,000 gallons per acre for liquid manure or 10 wet tons per acre for solid manure or applications are timed during periods of low runoff/rainfall • Prevent/avoid application of frozen or snow covered ground – if not possible to avoid, shall not be applied to more than 20 contiguous acres (breaks of at least 200ft) • In the western Lake Erie basin, application on frozen ground is prohibited. ODA Division of Soil and Water Resources administers penalties for application of manure on frozen ground. (Agronomic Crops Network – OSU Extension) • Manure phosphate applications exceeding 250lb per acre is prohibited
Regulatory requirements for land application - acreage requirements	<ul style="list-style-type: none"> • OEPA does not have acreage requirements based on manure volume or nutrient content. There are no specifications for how much acreage a CAFO needs to operate based on manure production or amount of animals on property
Regulatory requirements for land application - procedures and protocols for testing of manure	<ul style="list-style-type: none"> • OEPA follows Federal EPA regulation requirements when it comes to sampling procedures and protocols of manure (both liquid and dry).
Regulatory requirements for land application - procedures and protocols for testing of soils on which manure is applied	<ul style="list-style-type: none"> • Soil is to be analyzed for pH, phosphorus, potassium, calcium, magnesium, and cation exchange capacity • A site that receives manure shall be soil tested once every 3 years – for any land application site used by the owner or operator the land application site shall be sampled at least six months following application. No specifications as to whom conducts the sampling and sampling procedures are not strictly defined. All results to be kept on site.
Regulatory requirements for manure disposal	<ul style="list-style-type: none"> • CAFO's may transfer manure to other operations for spreading or other uses. Records of the amount of manure transferred from a facility must be maintained on site.
Nutrient management plans	<ul style="list-style-type: none"> • The use of the P-index will allow higher rates of phosphorus application than the Phosphorus Soil Test Risk Assessment Procedure – OEPA uses the P-index as a planning tool designed to help identify fields/areas of fields that have a higher or lower risk of phosphorus runoff from manure/organic materials. OEPA does not require the use of the P-index but does recommend it. • OEPA requires all CAFO's to use a Manure Management Plan (MMP) • Nutrient budget – based on targeted crop yields based on actual crop yields, soil productivity, historical yields, realistic yields. • Manure characterization – analyzed annually for total nitrogen, ammonium nitrogen, organic nitrogen, phosphorus, potassium, and percent total solids. • Soil characterization – analyzed for pH, phosphorus, potassium, calcium, magnesium, and cation exchange capacity – tested once every 3 years • MMP to be approved by OEPA and be kept on site. MMPs are also required for CAFFs to obtain a PTO.
Best management practices	<ul style="list-style-type: none"> • The MMP requires best management practices (BMP) to minimize odors. The BMPs that can be used include – remove/transfer/land apply manure at optimum temperature and humidity – remove/transfer/ land apply manure when wind direction is less likely to affect neighboring residents – promptly inject or incorporate manure – if manure is applied by spray irrigation, use appropriate pressures and nozzles

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin
Review Matrix Table A-1.5: Ohio, U.S.

Compliance, Monitoring and Enforcement	
How are permitting requirements enforced	<ul style="list-style-type: none"> Currently Ohio EPA Division of Surface Water operates an enforcement and compliance program that provides technical assistance, conducts inspections, investigates complaints, and takes enforcement actions to help protect surface waters from pollution. If violations are found, Ohio EPA may issue a notice of violation (NOV) or can conduct a criminal investigation, depending on how severe the violation is. For the most serious violators, possible penalties include imprisonment and fines of up to \$25,000 per day of violation.
Inspections	<ul style="list-style-type: none"> Ohio EPA routinely conduct unannounced inspections of livestock operations to evaluate compliance – inspectors may arrive at facility without prior notice and are authorized to enter private or public property at reasonable times to inspect/investigate conditions and potentially to collect samples of any discharges. Inspections can be random, routine, or because of a tip/complaint. ODA also conducts inspections of CAFFs on a regular basis.
Complaints	<ul style="list-style-type: none"> Ohio EPA to handle and investigate all complaints, conduct all inspections, and administer all violations if necessary.
Input from Public Stakeholders and Indigenous Communities	
Notification of a proposed new animal feeding operation	<ul style="list-style-type: none"> The ODA requires through the Division of Livestock Environmental Permitting (DLEP) that a permit to install (PTI) be submitted as a notice to the public. All PTI are made available to the public through the ODA website. All permits proposed for issuance are subject to a 30-day public notice period during which citizens can request a hearing. In Ohio, an animal feeding facility that has a total design capacity for a specified number of animals is considered a concentrated animal feeding facility (CAFF).
Indigenous communities	<ul style="list-style-type: none"> There are no distinct processes for notifying indigenous communities of information pertaining to CAFOs.
Role of Indigenous people in regulatory and enforcement oversight, and how regulatory agencies coordinate with Indigenous people	<ul style="list-style-type: none"> OEPA does not specify the role of indigenous people in regulatory or enforcement oversight of CAFO's. There is no specification stating how or if OEPA coordinates with indigenous people involving CAFOs.
Public access to records	<ul style="list-style-type: none"> ODA has a database on their webpage that allows the public to look up permitted CAFOs. The database gives the name of the farm, the species of animals currently at the farm, the type of permit(s), the county, the number of animals currently at the farm, and if there are any publications.
Funding	
Funding and/or incentives for manure management	<ul style="list-style-type: none"> OEPA along with the Ohio Water Development Authority (OWDA) administer the Water Pollution Control Loan Fund (WPCLF) and the Water Supply Revolving Loan Account (WSRLA). Through the WPCLF, financial and technical assistance is offered to public and private applicants for planning, design, and construction of a wide variety of projects to protect or improve the quality of Ohio's water resources. The WSRLA offers assistance to applications with projects that address human health and failing drinking water infrastructure needs.
Other	
Are there non-government nutrient management programs that include manure application elements (organized voluntary efforts, best practices guidelines, farm assistance programs, etc.)	<ul style="list-style-type: none"> Ohio State University (OSU) – Ohio Composting and Manure Management (OCAMM) – provides resources and guides for manure management, nutrient management, application, processing, etc.

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin
Review Matrix Table A-1.5: Ohio, U.S.

<p>Nutrient release reduction targets related to manure being developed by individual and collective state/provincial water quality management agencies</p>	<ul style="list-style-type: none"> • Achieve a 40% total spring load reduction in the amount of total and dissolved reactive phosphorus entering Lake Erie's western basin by the year 2025 with an aspirational goal of a 20% reduction by 2020. This goal applies to priority tributary watersheds to the Western Basin of Lake Erie in Ohio as identified by the Objectives and Targets Task Team of the Annex 4 Subcommittee under the GLWQA, which include the Maumee, Toussaint, and Portage Rivers. Ohio is also including spring targets for the Sandusky River to protect water quality in Sandusky Bay. Ohio EPA will continue to develop a process to identify and recommend additional priorities within these watersheds at the HUC 12 level, with a focus on the Maumee River watershed. • Achieve a 40% total annual load reduction in the amount of total phosphorus entering Lake Erie's central basin by the year 2025 with an aspirational goal of a 20% reduction by 2020. This goal applies to priority tributary watersheds to the Central Basins of Lake Erie in Ohio as identified by the Objectives and Targets Task Team of the Annex 4 Subcommittee under the GLWQA, which include the Sandusky, Huron, Vermilion, Cuyahoga, and Grand Rivers.
<p>Are there permit requirements that indirectly impact manure produce, storage, management and application</p>	<ul style="list-style-type: none"> • No discharges of manure, litter, or wastewater from the production area of a CAFO may enter waters of the states. Discharges are allowed only when a production area is designed, built, operated, and maintained to handle all manure, litter, and process wastewater, including runoff and direct precipitation from all normal rainfall events up to a 25-year, 24-hour rainfall event or when the discharge consists of only overflows caused by a rainfall event (dry weather discharges are not allowed). All records of any discharge must be kept by the operator. • Any owner of a facility with the capacity to withdraw water at a quantity greater than 100,000 gallons (378,541 L) per day is required to register such facility with the Ohio Department of Natural Resources Division of Water through the Water Withdrawal Facility Registration Program (WWFR). The WWFR provides information both to the public and with those registered (Ohio DSWR WWFR).

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin
Review Matrix Table A-1.6: Indiana, U.S.

Regulators, legislation	
Agencies responsible for regulatory and enforcement oversight	<ul style="list-style-type: none"> Indiana Department of Environmental Management (IDEM) administers rules and regulations regarding animal farms/confined feeding operations (CFO).
Definitions, quantifications, etc. for permitting purposes	
How are manure requirements defined within the jurisdiction, including scale of farm, definition of animal/livestock units	<ul style="list-style-type: none"> An animal feeding operation with at least 300 cattle, 600 swine or sheep, 30,000 poultry, or 500 horses in confinement is a CFO. A person must request and receive IDEM approval before operating a CFO, starting construction of a CFO, or starting expansion of a CFO to increase animal capacity or manure containment capacity. CFO and CAFO's have different size requirements. The CFO program is a state program and is not the same as the NPDES program which Indiana administers. Currently, there are no CAFOs with an NPDES permit in Indiana.
How are manure volumes estimated, including estimates of animal turnover and weights	<ul style="list-style-type: none"> The United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) breaks down the estimated total amount of manure, phosphorus, and nitrogen produced by each type of livestock (lb/day/1,000-lb animal threshold). The table can be found in the USDA NRCS Agricultural Waste Management Handbook (1992). Livestock included in the table are beef cattle (based on a high forage diet), dairy cows (lactating), hogs and pigs (grower), layer chickens, broiler chickens, and turkeys.
How manure volume and nutrient content among livestock type and stages of livestock vary	Same as federal
Regulatory requirements	
Regulatory triggers - criteria for manure to be subject to regulation/permitting	<ul style="list-style-type: none"> CFO's in Indiana are required to have either a CFO Permit or a NPDES CAFO Individual Permit, but not both. A CFO or CAFO-sized CFO that do not discharge manure/pollutant-bearing water need a CFO Approval under 327 IAC 19 - a CFO Approval will have slightly different requirements for a CFO versus a CAFO based on the rule requirements that apply specifically for CAFOs.
Regulatory requirements for storage, including monitoring and inspection	<ul style="list-style-type: none"> All new solid and liquid manure storage structures must be designed, constructed and maintained with a combined storage capacity of at least 180 days of storage for all materials entering the storage structure including manure and bedding. 6in freeboard is required as well. Underground steel storage tanks may not be used for manure storage – plastic or fiberglass tanks and above ground steel tanks must meet the following requirements: watertight, must have sufficient strength to withstand design load, and must have protective shut-off valves for all inlet and outlet pipes.
Regulatory requirements for land application of manure	<ul style="list-style-type: none"> The Office of Indiana State Chemist (OISC) set guidelines for fertilizer application for both commercial and organic (manure). These restrictions apply to 40 cubic yards of solid or 1000 gallons of liquid fertilizer material applied in any in a calendar year. These standards would apply to manure that is marketed and/or distributed from CFOs to growers. Many of OISC's guidelines include similar setbacks required by regulated farms under the CFO program. Exception are the OISC allows manure application on frozen and snow covered ground as long it is applied: 200 ft from surface water; not within a floodway; at 50% the agronomic rate of planned crop; and not on land with greater than 2% slope unless it has at least 40% crop residue or ground cover. The OISC also regulates manure staging at the field of application. Staged manure must covered or bermed 72 hours after and is placed 300 ft. from surface water, water wells, or drainage inlets. Setbacks include 100 ft. from roads and property lines and 400 ft. from residences and must be land applied in 90 days from being staged. No manure may be staged in a waterway or floodway. All manure from a CFO/CAFO must be land applied by an OISC category 14 certified applicator.

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin
Review Matrix Table A-1.6: Indiana, U.S.

Restrictions for land application of manure	<ul style="list-style-type: none"> • Manure must not be applied to highly erodible ground unless the field has either 40% residue protection or crop cover, or the manure is applied in accordance with a Conservation Plan. The land application of manure is prohibited from a public road as well as when the ground is saturated. • Land application rates are determined by soil P levels and are restricted to soils with less than or equal to 200 ppm P. Manure may not be applied within 500 ft. of a public water supply well or public water supply surface water intake. Other setbacks for property lines, surface water, tile inlets, sink holes, wells and roads varies based on conservation practices used at the land application site.
Regulatory requirements for land application - acreage requirements	<ul style="list-style-type: none"> • IDEM has developed a framework to help farmers establish how much acreage is needed for land application of manure based on the number of animals, based on a per acre per year basis and also based on the type of manure (solid, liquid or lagoon). • Take the number of one animal type on the CFO, divide it by the recommended amount of animal waste per acre and the final value is the number of acres needed for that land application of manure for that many animals.
Regulatory requirements for land application - procedures and protocols for testing of manure	<ul style="list-style-type: none"> • The manure shall be tested every year – manure tests shall provide adequate information to calculate the appropriate manure application rate. At a minimum, the tests must include ammonium nitrogen, total nitrogen, and phosphorus. Samples can be composite manure samples from barns with similar animals raised with similar diets and manure handling systems. CFO rules require a sample from each unique production area.
Regulatory requirements for land application - procedures and protocols for testing of soils on which manure is applied	<ul style="list-style-type: none"> • Soil shall be tested every four years – phosphorus is the only element required in a soil test to comply with CFO rules. The soil phosphorus Bray P1/Mehlich 3 test must be used and soil phosphorus levels reported in parts per million (ppm). Nitrogen is not a required element in soil tests for CFO permits. • Composite sampling and average test results can be used within areas up to 20 acres. • On sites intended for a manure storage structure, the applicant must use soil boring or test holes determine the soil characteristics and the presence or absence of a seasonal high water table. • Category 14 - commercial for hire fertilizer applicators and businesses using commercial fertilizer or manure from a CFO in production of crops. Any person handling, applying, or transporting manure for hire for purposes of producing crops must be one of the following - certified and licensed by the Office of Indiana State Chemist (OISC) in Category 14, be trained/supervised by a Category 14 applicator, or be working for a licensed Category 14 fertilizer business. • Sampling must be conducted by a certified soil scientist, geologist, or engineer who is a certified by Category 14 - per OISC regulation. Sampling must follow guidance in the NRCS national engineering manual.
Regulatory requirements for manure disposal	<ul style="list-style-type: none"> • Manure is allowed to be sold or given away. Owner/operator of manure must provide an information sheet to the person who receives the manure that includes the following: name/address of CFO, statement indicating that it is unlawful to allow the manure to enter the state's waters, nutrient content information of the manure, and manure application requirements in the rule. All manure transfer records must be kept on site. • The owner/operator must retain information that includes the name/address of the person receiving the manure, the amount of manure distributed to that person, and a copy of the information sheet – this information must be available for review during an inspection.
Nutrient management plans	<ul style="list-style-type: none"> • MMP must include procedures for soil and manure testing, legible soil survey maps of manure application areas, a waiver to the requirement for access to land application acreage, alternative method proposed for managing manure, if applicable. No specific requirements for P-index.
Best management practices	<ul style="list-style-type: none"> • Anyone staging and land applying manure shall follow these BMPs: manure applied to the land must be applied at an agronomic rate for the crop that is being grown or is to be planted and must pay attention to the weather forecasts prior to applying manure to avoid applying prior to forecasted rainfall events [to help prevent runoff]. • The following BMPs are recommended to be implemented by IDEM: the use of insecticides to help control vectors such as flies and beetles may be beneficial at staged manure sites in populated areas and to apply manure at a time when the existing or planned crops can best use the nutrients.

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin
Review Matrix Table A-1.6: Indiana, U.S.

Compliance, Monitoring and Enforcement	
How are permitting requirements enforced	<ul style="list-style-type: none"> • IDEM is responsible for enforcing all regulations and rules concerning CFOs or CAFOs. There are no specified categories of enforcement action.
Inspections	<ul style="list-style-type: none"> • Inspectors will make a reasonable effort to contact the owner/operator at least 24 hours before routine or follow up inspections. The inspector should communicate the specific date and approximate time of the inspection, however an investigation of a complaint or a spill requires no prior notification.
Complaints	<ul style="list-style-type: none"> • IDEM to handle and investigate all complaints, conduct all inspections, and administer all violations if necessary.
Input from Public Stakeholders and Indigenous Communities	
Notification of a proposed new animal feeding operation	<ul style="list-style-type: none"> • An owner/operator applying for a new CFO approval or an existing CFO seeking approval to construct additional confinement structures/manure storage structures must make a reasonable effort to notify by mail each land owner/occupant of land adjoining the property on which the CFO is/will be located, each owner/occupant of land within ½ mile of the proposed/existing waste storage structures, and the office of commissioners of the county in which the CFO is/will be located. • Written notification must be completed by the owner/operator no more than 10 days after submitting the application. IDEM will notify the following parties once the application is received: the applicant, the county health department for the affected areas, mayors of any affected cities, and the town council presidents of the affected towns. IDEM will accept written public comment for at least 33 days following the date of the applicant mailing to the notified parties.
Indigenous communities	<ul style="list-style-type: none"> • There are no distinct processes for notifying indigenous communities of information pertaining to CAFOs.
Role of Indigenous people in regulatory and enforcement oversight, and how regulatory agencies coordinate with Indigenous people	<ul style="list-style-type: none"> • IDEM does not specify the role of indigenous people in regulatory or enforcement oversight of CAFO's. There is no specification stating how or if IDEM coordinates with indigenous people involving CAFOs.
Public access to records	<ul style="list-style-type: none"> • The public can access all CFO and CAFO permits that have been approved off the IDEM webpage. The information includes the farm ID, county, project type, date received/issued, operation name, section, township, range, and the amount of animals on the farm. The public can also access the pending permits off the IDEM webpage.
Funding	
Funding and/or incentives for manure management	<p>Lake and River Enhancement (LARE) Grant Funding Administered by IDNR - grant projects that reduce non-point sediment and nutrient pollution of surface waters to a level that meets or surpasses state water quality standards projects.</p>
Other	
Are there non-government nutrient management programs that include manure application elements (organized voluntary efforts, best practices guidelines, farm assistance programs, etc.)	<ul style="list-style-type: none"> • Purdue Extension – offers free publications on all things related to CFOs including, but not limited to, manure sampling and soil sampling. Publications are offered for free to the general public as well as farmers and can be found online.

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin
Review Matrix Table A-1.6: Indiana, U.S.

Nutrient release reduction targets related to manure being developed by individual and collective state/provincial water quality management agencies	Minimal water quality criteria, no numeric criteria
Are there permit requirements that indirectly impact manure produce, storage, management and application	<ul style="list-style-type: none"> • CFO permits place limits on the amount of pollutants that may be discharged to waters of the state by each discharger – limits are set at levels protective of both aquatic life in the waters which receive the discharge and protective of human health. All CFOs with potential/intent to discharge must seek approval from the State of Indiana before discharging. • Significant Water Withdrawal Facility Registration (SWWF) – uptake of water allotted up to 100,000 gallons of groundwater, surface water, or a combination of both in one day. Annual water use reports are required.

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin
Review Matrix Table A-1.7: Illinois, U.S.

Regulators, legislation	
Agencies responsible for regulatory and enforcement oversight	<ul style="list-style-type: none"> • IEPA - The CAFO Program is administrated by the Illinois EPA (IEPA) as part of the delegation agreement for the National Pollutant Discharge Elimination System (NPDES) by the Federal EPA – in Illinois the rule will affect all CAFO's that discharge and require CAFO's to apply for NPDES permit, submit annual reports, and develop/implement a manure and wastewater handling plan (otherwise known as Nutrient Management Plan)
Definitions, quantifications, etc. for permitting purposes	
How are manure requirements defined within the jurisdiction, including scale of farm, definition of animal/livestock units	<ul style="list-style-type: none"> • Farms that fall within the classification of medium or large CAFOs or AFOs that are desiganted as CAFOs, are required to obtain a permit. Small farms could still be required to obtain a permit depending on the proximity to state waters and the amount of discharge/runoff coming from the facility.
How are manure volumes estimated, including estimates of animal turnover and weights	<ul style="list-style-type: none"> • The United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) breaks down the estimated total amount of manure, phosphorus, and nitrogen produced by each type of livestock (lb/day/1,000-lb animal threshold). The table can be found in the USDA NRCS Agricultural Waste Management Handbook (1992). • Livestock included in the table are beef cattle (based on a high forage diet), dairy cows (lactating), hogs and pigs (grower), layer chickens, broiler chickens, and turkeys.
How manure volume and nutrient content among livestock type and stages of livestock vary	<p>The Illinois Department of Agriculture sets calculation standards for animal number thresholds.</p> <ul style="list-style-type: none"> • Mature dairy cow (1.4) • Dairy heifers and calves (0.6) • Feeder cows (1.0) • Swine over 55 lb (0.4) • Swine under 55 lb (0.03) • Laying hens/broilers – liquid manure system (0.03) • Ducks (0.02)
Regulatory requirements	
Regulatory triggers - criteria for manure to be subject to regulation/permitting	<ul style="list-style-type: none"> • NPDES permit required if CAFO is discharging or proposing to discharge waste or wastewater into the surface waters of the state.
Regulatory requirements for storage, including monitoring and inspection	<ul style="list-style-type: none"> • Temporary manure stacks shall be constructed/established and maintained to prevent runoff/leachate – shall be located greater than 100ft from water wells, 200ft of portable water supply wells, and 75ft from private water supply wells. Shall not be located within 400ft of community water supply wells. • Annual reports are to be submitted by March 15th and include things such as (but not limited to): quantity of livestock waste generated/transferred, max number of animals and type, total number of acres for land application of livestock waste, summary of all livestock waste discharges, etc. • Annual reports shall be submitted to IEPA for revision and retained on file for at least 3 years –retain these records for inspection and corrective action • Shall inspect all livestock management facilities and livestock waste handling facilities weekly – shall inspect subsurface drainage systems of the livestock waste land application area within 24 hours prior to and 24 hours after application. • Conduct weekly inspections of stormwater diversions, roof guttering, downspouts, channels, etc. • Shall conduct daily inspections and maintain/repair water supply lines in the livestock management facilities and like facilities. • No required specifications for engineer/professional design – no required specifications as to who conducts monitoring and inspections

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin
Review Matrix Table A-1.7: Illinois, U.S.

Regulatory requirements for land application of manure	<ul style="list-style-type: none"> • LMFA (Livestock Management Facilities Act) requires a waste management plan be developed if the facility has an animal threshold of 1,000 or more and plan on applying manure to land – facilities with an animal threshold between 1,000-4,999 must maintain a copy of the plan onsite and certify to IDA that they have one in place – those with an animal threshold of 5,000 or more must submit the plan to IDA for review and approval prior to operation • Records must be maintained for 5 years and should include (but are not limited too) – soil test results/recommendations, amounts/analyses/source of nutrients applied, dates/methods, crop rotations, planting/harvesting dates, yields, crop residues removed, dates of review, etc. • No surface application allowed on frozen, snow/ice covered ground unless there is no alternative and there must be a winter application plan in place. One must also notify the IEPA in writing by the 1st of December that their storages are insufficient to make it 120 days (the end of winter) – similar with current fertilizer regulations in place in Illinois
Restrictions for land application of manure	<ul style="list-style-type: none"> • Waste application shall not be permitted on land with a pond and shall avoid application to frozen or snow covered soils. • Shall not be applied to land with slopes over 15% • Shall not be applied to soils that are frequently flooded or 10 yr floodplain • Shall not be applied during rainfall or to saturated soils.
Regulatory requirements for land application - acreage requirements	<ul style="list-style-type: none"> • IEPA does not have acreage requirements based on manure volume or nutrient content. There are no specifications for how much acreage a CAFO needs to operate based on manure production or amount of animals on property
Regulatory requirements for land application - procedures and protocols for testing of manure	<ul style="list-style-type: none"> • Manure should be sampled and tested yearly. Liquid manure should be well agitated before being sampled. Collect composite samples, mixed and poured into a quart-sized plastic container, filling 2/3 of the way full. If liquid manure cannot be agitated, collect a sample from first, middle, and last load. • Collect solid manure samples when manure is being loaded for spreading or from several locations in the manure stack. Mix and place the composite sample in a gallon-sized plastic bag, twist and secure close, and then place into another bag. • If samples (liquid or solid) cannot be sent to a laboratory immediately, samples shall be frozen. Sampling shall be performed under the direction of a Certified Livestock Manager. Manure shall be sampled prior to and during land application process. • Laboratory analysis shall include (but is not limited to) total nitrogen, ammonium nitrogen, total phosphorus, total potassium, and percent total solids.
Regulatory requirements for land application - procedures and protocols for testing of soils on which manure is applied	<ul style="list-style-type: none"> • Soils shall be tested every four years – to improve consistency from previous testing, sample at the same time of year, from the sample locations within the same field, after the same crop, and at the same depth. • Sample should be taken from a depth of 7in – a 1in diameter soil probe is the preferred sampling tool. One composite sample (consisting of 5 cores) from every 2.5 acres is suggested. If considerable variation in test values over short distances in the field is suspected, collect one composite sample for every 1.1 acres. Summer or fall are the best recommended time for soil sampling.
Regulatory requirements for manure disposal	<ul style="list-style-type: none"> • CAFO's may transfer manure to other operations for spreading or other uses. Records of manure transfer from the facility are to be maintained on site.
Nutrient management plans	<ul style="list-style-type: none"> • Nutrient Management Plan is a condition of the NPDES permit and is to be kept on file at the facility for the term of the permit and for five years after the expiration of the permit • Wastes applied to soils shall not exceed a practical limit as determined by soil type, condition of soil, slope of the land, cover mulch, proximity to surface waters, rates of soil erosion, potential to contaminate groundwater... • Shall practice odor control methods during livestock waste removal and field application so as not to affect a neighboring residence/populated area. • Provide adequate erosion and runoff control to prevent discharge of livestock waste into waters of state • Shall provide off-site recipients of livestock waste a copy of the laboratory analysis sheet of the most recent nutrient analysis, representative of the livestock waste • Plan and any future modifications shall be submitted to the Illinois EPA Field Operations Section for agency approval. No specific requirements for P-index.

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin
Review Matrix Table A-1.7: Illinois, U.S.

Best management practices	<ul style="list-style-type: none"> There are no required BMPs but it is advised that permit holders incorporate BMP's into their NMP/MMP. IEPA provides fact sheets that identify BMP practices for both dairy production and pork production that will help improve operations, cut down odors, and reduce possible contamination to ground/surface waters. These fact sheets can be found on the IEPA webpage.
Compliance, Monitoring and Enforcement	
How are permitting requirements enforced	<ul style="list-style-type: none"> IEPA is in charge of all enforcement requirements – IEPA is authorized to issue violations to CAFOs as necessary after inspections. Some violations that can be distributed by the IEPA are noncompliance advisory, violation notices, and request for injunctive relief.
Inspections	<ul style="list-style-type: none"> Illinois EPA is to perform follow up inspections from prior violations or if there are complaints against the farm – allowed to conduct random inspections at any time but usually give 24hrs notice before inspections
Complaints	<ul style="list-style-type: none"> All complaints submitted to IEPA – form under Citizen Pollution Complaint
Input from Public Stakeholders and Indigenous Communities	
Notification of a proposed new animal feeding operation	<ul style="list-style-type: none"> Notice of intent to construct (NOITC) provides information regarding a project's location, size, type, and possible compliance with the setback provisions and is to be sent to IEPA prior to construction – filing of NOITC is a five step process which takes about 90 days Public informational meetings can be requested whenever a new livestock management or waste handling facility is proposed that will either a) house an animal threshold of 1,000 or more or b) use an earthen lagoon to handle animal waste.
Indigenous communities	<ul style="list-style-type: none"> There are no distinct processes for notifying indigenous communities of information pertaining to CAFOs as there are no federally recognized Tribes in Illinois.
Role of Indigenous people in regulatory and enforcement oversight, and how regulatory agencies coordinate with Indigenous people	<ul style="list-style-type: none"> IEPA does not specify the role of indigenous people in regulatory or enforcement oversight of CAFO's as there are no federally recognized Tribes in Illinois.
Public access to records	<ul style="list-style-type: none"> All CAFO's that are covered under the general permit can be found on IEPA's website. The information given is the name of the facility, county it is located in, NPDES Number, type (of animals), containment method, and the date posted.
Funding	
Funding and/or incentives for manure management	The Environmental Quality Incentives Program (EQIP) provides financial and technical assistance to agricultural producers in order to address natural resource concerns and deliver environmental benefits such as improved water and air quality (federal program)
Other	
Are there non-government nutrient management programs that include manure application elements (organized voluntary efforts, best practices guidelines, farm assistance programs, etc.)	<ul style="list-style-type: none"> The University of Illinois (UI) – MMP step by step instructions that help farms comply with Illinois Department of Agriculture (IDA), Illinois Natural Resources Conservation Service (INRCS), and IEPA. UI Manure Share – manure exchange program between farmers who do not have enough acreage to properly spread manure over land and gardeners/landscapers who are searching for organic materials. AGDAILY - An app for calculating manure application rate.

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin
Review Matrix Table A-1.7: Illinois, U.S.

Nutrient release reduction targets related to manure being developed by individual and collective state/provincial water quality management agencies	<ul style="list-style-type: none"> • Illinois Nutrient Loss Reduction Strategy (NLRs) – the strategy will direct efforts to reduce nutrients from point and non-point sources in a coordinated, primarily voluntary, and cost-effective manner. The strategy described a comprehensive suite of BMPs for reducing loads from wastewater treatment plants and urban/agricultural runoff. These practices will help the state reduce its phosphorus load by 25% and its nitrate-nitrogen load by 15% by 2025. The eventual target is a 45% reduction in the loss of these nutrients to the Mississippi River.
Are there permit requirements that indirectly impact manure produce, storage, management and application	<ul style="list-style-type: none"> • No discharge at all is permitted in the state of Illinois – with or without a permit – only clean water is allowed to be discharged from a farm/CAFO into the waters of the state • The Illinois State Water Survey (ISWS) provides guidance for water intake, and states that 100,000 gallons are allowed to be used per day (70 gallons per minute). Annual reports on water uptake are to be submitted to ISWS.

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin
Review Matrix Table A-1.8: Michigan, U.S.

Regulators, legislation	
Agencies responsible for regulatory and enforcement oversight	<ul style="list-style-type: none"> Michigan Department of Environmental Quality (MDEQ) – issues Concentrated Animal Facility Operator (CAFO) general permit under the NPDES – permits require implementation of a comprehensive nutrient management plan (CNMP).
Definitions, quantifications, etc. for permitting purposes	
How are manure requirements defined within the jurisdiction, including scale of farm, definition of animal/livestock units	<ul style="list-style-type: none"> Michigan follows the criteria set forth by the U.S. EPA when categorizing CAFOs. All Michigan livestock farms that meet the U.S. EPA criteria for “large” CAFO must obtain a Michigan NPDES CAFO permit. An AFO, which is a medium CAFO, may be required to obtain an individual or general NPDES permit if it meets the following: has been designated by the MDEQ as a CAFO under R 323.2196(3), discharges pollutants from the production area into waters of the state through a manmade ditch, pipe, or similar manmade conveyance, or discharges pollutants directly into waters of the state from the production area which originate outside of and pass over, across, or through the facility. Small farms could still be required to obtain a permit depending on the proximity to state waters, and the amount of discharge/runoff coming from the facility, or if they meet requirements specified in state laws.
How are manure volumes estimated, including estimates of animal turnover and weights	<ul style="list-style-type: none"> The United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) breaks down the estimated total amount of manure, phosphorus, and nitrogen produced by each type of livestock (lb/day/1,000-lb animal threshold). The table can be found in the USDA NRCS Agricultural Waste Management Handbook (1992). Livestock included in the table are beef cattle (based on a high forage diet), dairy cows (lactating), hogs and pigs (grower), layer chickens, broiler chickens, and turkeys.
How manure volume and nutrient content among livestock type and stages of livestock vary	<p>Michigan DEQ sets a threshold of animal for groundwater permits as follows:</p> <ul style="list-style-type: none"> Slaughter/feeder cattle (including heifers and veal) – 5,000 animals Mature dairy cattle – 3,500 animals Hogs over 55 lb – 12,500 animals Laying hens or broilers – 150,000 animals Turkeys – 275,000 animals <p>Michigan Generally Accepted Agricultural and Management Practices (GAAMPS) has calculations outlining manure and manure nutrients produced by different livestock species. For example, a heifer weighing 970lb would produce 48.0 lb of total wet manure a day and 8.2 lb of total solid manure a day.</p> <p>GAAMPS also has calculations outlining the amount of nutrients produced per day by different livestock types. According to the calculations, 970 lb heifer would produce 0.26 lb N, 0.101 lb P2O5 and 0.132 lb of K2O a day.</p>
Regulatory requirements	
Regulatory triggers - criteria for manure to be subject to regulation/permitting	<ul style="list-style-type: none"> NPDES permit requires if a CAFO is discharging or proposing to discharge waste or wastewater in to the surface waters of the state. NPDES permit required for all large CAFO that apply manure to land, small and medium CAFO can opt out as long as discharge from facility is not occurring

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin
Review Matrix Table A-1.8: Michigan, U.S.

Regulatory requirements for storage, including monitoring and inspection	<ul style="list-style-type: none"> • Storage tanks shall be able to contain all CAFO waste generated from the operation in a six-month or greater time period with additional design capacity of a minimum of 12in of freeboard for storage structures that are subject to precipitation caused runoff. For storage structures not subject to precipitation caused runoff, the freeboard shall be a minimum of 6in. • New structures are to be constructed in accordance with NRCS 313 2014 • Storage Structure Inspection Plan and inspection of CAFO waste storage structures a minimum of one time weekly year round. Inspection plan shall be included in CNMP – shall keep records for 5 years, on site. • Inspections should be looking for cracking in structure, leaks, evidence of overflow, seepage, erosion, slumping, and overall condition of liner... Also should inspect depth of waste and available operating capacity as indicated by depth gauge. • Field by field assessment of all land application areas – identify fields or portions of fields that will be used for surface application of CAFO waste without incorporation to frozen or snow covered ground.
Regulatory requirements for land application of manure	<ul style="list-style-type: none"> • Daily land application records are to be kept (time, date, method location, weather description at time of application and 24 hours prior, statement if land was frozen or not, and application rate for each location at which CAFO wastes are applied) and kept available on site. • Annual report form (crop, realistic yield goal and actual yield for each location, methodology and calculations, total amount of nitrogen and phosphorus actually applied to each field) to be submitted to MDEQ and kept on site for review and inspection. • The NPDES permit requires that all waste streams at the facility be sampled annually to determine nutrient content and that these values be used in determining land application of waste.
Restrictions for land application of manure	<ul style="list-style-type: none"> • Application of manure on frozen/snow covered soils should be avoided but if necessary, a) only be applied to areas where slopes are 6% or less and b) liquid manures should only be applied to soils where slopes are 3% or less and is injected/incorporated within 24 hours. • Manure should not be applied within 100ft of surface waters of the state
Regulatory requirements for land application - acreage requirements	<ul style="list-style-type: none"> • MDEQ does not have acreage requirements based on manure volume or nutrient content. There are no specifications for how much acreage a CAFO needs to operate based on manure production or amount of animals on property.
Regulatory requirements for land application - procedures and protocols for testing of manure	<ul style="list-style-type: none"> • Sample manure at time of land application or as close as possible to application. • Hand and bag method – place one gallon freezer bag turned inside out over hand – grab handful of manure – use free hand to turn bag right side out and seal close. • Use catch basins to collect manure from spreader out in field. Thoroughly mix manure before collecting sample and mix all subsamples together to obtain one sample to send off to laboratory. Send to laboratory as soon as possible – if not, freeze within a couple hours to prevent loss of nutrients • Not specified as to whom is to do the sampling or analysis.
Regulatory requirements for land application - procedures and protocols for testing of soils on which manure is applied	<ul style="list-style-type: none"> • Soil fertility testing should be done once every one to four years depending on fertilizer and manure additions, sampling is dependent on a) how closely one wants to track soil nutrient changes b) crop grown c) crop rotation d) soil texture e) approach/method used for sampling • Results to be maintained on file and readily available – not specified as to whom is to conduct the sampling and sampling procedures are not strictly defined
Regulatory requirements for manure disposal	<ul style="list-style-type: none"> • CAFO's may transfer manure to other operations for spreading, however transfer of manure from January to March is prohibited unless the recipient of the manure follows the winter spreading technical standard set by MDEQ for large CAFOs. • Michigan allows manure to be transferred from facilities to recipients. Technical Standards when applying CAFO waste during January through March must be followed for all manure application, by both the manure generator and the recipient of the manure. In addition, the generator must provide the manure analysis to the recipient, a manifest form detailing the destination and volume of manure transferred. The recipient must complete the manifest form, which includes acreage and land application rate, weather conditions, and incorporation rate.

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin
Review Matrix Table A-1.8: Michigan, U.S.

Nutrient management plans	<ul style="list-style-type: none"> • A CNMP applicable to both the production and land applications areas, must also be developed to meet the requirements of the NMP, and approved by a Certified CNMP Provider. CNMP Providers offer additional services, such as notifying farms when weather conditions prohibit manure spreading, assistance with preparing field application maps, helping facilities to obtain engineering and other contracted services, and assistance in arranging soil samplings. The MDEQ responds to complaints regarding CAFOs with the exception of odor and nuisance complaints which are directed to MDARD. If MDARD's review indicates a violation of the facility's permit, the MDEQ may take the lead in enforcement actions. • Fields in a facility's CNMP are to be assessed for the suitability to receive manure applications. A field map is to be used for the assessment and should include the slopes, soil types, locations of tile outlets, tile risers, conservation practices, and offsite conditions, such as buffers and distance from surface waters
Best management practices	<ul style="list-style-type: none"> • BMP shall be included in NMP and include: conservation practices – divert clean water – prevent direct contact of animals with waters of the state – animal mortality – chemical disposal – inspection, proper operation and maintenance
Compliance, Monitoring and Enforcement	
How are permitting requirements enforced	<ul style="list-style-type: none"> • MDEQ handles all enforcement of the farm and disciplinary actions.
Inspections	<ul style="list-style-type: none"> • Inspections are conducted at least three times every 5 years, per the MDEQ. One inspection is a complete inspection which includes an interview, records review, production site inspection, and field application inspection. The other two inspections are reconnaissance inspections, which typically are unannounced and have a more limited focus on a site-specific concern or statewide issue.
Complaints	<ul style="list-style-type: none"> • Nuisance complaints on farms, and odor complaints on permitted farms, should be directed to MDARD. • Complaints regarding discharges, permitted facilities and enforcement should be directed to the appropriate MDEQ district office for the county where the problem exists. May also call the 24hr Pollution Emergency Alert System (PEAS) at 500-292-4706
Input from Public Stakeholders and Indigenous Communities	
Notification of a proposed new animal feeding operation	<ul style="list-style-type: none"> • All permits proposed for issuance are subject to a 30-day public notice period, and are available on MDEQs website database. In addition, citizens can request a hearing during the public notice period.
Indigenous communities	<ul style="list-style-type: none"> • There are no distinct processes for notifying indigenous communities of information pertaining to CAFOs.
Role of Indigenous people in regulatory and enforcement oversight, and how regulatory agencies coordinate with Indigenous people	<ul style="list-style-type: none"> • MDEQ does not specify the role of indigenous people in regulatory or enforcement oversight of CAFO's. There is no specification stating how or if MDEQ coordinates with indigenous people involving CAFOs.
Public access to records	<ul style="list-style-type: none"> • Public records and information relating to CAFOs are available on MiWaters, MDEQ's online database. This information includes the CNMP, permit application, inspection reports, enforcement actions, public notice documents, and submittals required by the NPDES permit, among others. The public may also request a public hearing, in which they may offer oral verbal or submit written comments and provide supporting documentations regarding the specific CAFO.
Funding	
Funding and/or incentives for manure management	No funding information could be found for Michigan.

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin
Review Matrix Table A-1.8: Michigan, U.S.

Other	
Are there non-government nutrient management programs that include manure application elements (organized voluntary efforts, best practices guidelines, farm assistance programs, etc.)	<ul style="list-style-type: none"> • Michigan State University (MSU) Extension – provides articles explaining different aspects of CAFOs, for example, explains the laws and regulations for manure spreading as well as what classifies as a CAFO. • MAEAP - is a comprehensive, voluntary, proactive program designed to reduce farmers' legal and environmental risks through a three-phase process: 1) education; 2) farm-specific risk assessment and practice implementation; and 3) on-farm verification that ensures the farmer has implemented environmentally sound practices. • The Michigan EnviroImpact tool shows daily runoff risk across Michigan using National Weather Service information about precipitation, temperature, soil moisture, and landscape characteristics.
Nutrient release reduction targets related to manure being developed by individual and collective state/provincial water quality management agencies	No specific goals listed but Michigan DEQ states that it intends to work with the EPA to set load-reduction goals for prioritized watersheds and reduce nutrient loadings through a combination of point-source and nonpoint source reduction activities.
Are there permit requirements that indirectly impact manure produce, storage, management and application	<ul style="list-style-type: none"> • The permittee is authorized to discharge the following, provided that the discharge does not cause or contribute to an exceedance of Michigan's water quality standards: CAFO wastewater overflow from the storage structures when the following conditions are met 1) structures are properly designed, constructed, operated, and maintained 2) precipitation events cause an overflow of the storage structure to occur 3) the production area is operated in accordance with the requirements of the permit. • The permit does not authorized discharge of any kind into the groundwaters. Such discharges may be authorized by a groundwater discharge permit issued pursuant to the Michigan Act. • The Michigan Department of Agriculture and Rural Development (MDARD) requires agricultural operations with the capacity to withdraw over 100,000 gallons per day to report to the state the water withdrawals and water conservation practices used on the farm. Reports are due annually. New high capacity water withdrawals in Michigan must use the MDEQ Water Withdrawal Assessment Tool.

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin
Review Matrix Table A-1.9: Wisconsin, U.S.

Regulators, legislation	
Agencies responsible for regulatory and enforcement oversight	<ul style="list-style-type: none"> • Wisconsin Department of Natural Resources (WI DNR) – WI DNR is in charge of distribution Wisconsin Pollution Discharge Elimination System (WPDES) permits for Wisconsin concentrated animal feeding operations (CAFO)
Definitions, quantifications, etc. for permitting purposes	
How are manure requirements defined within the jurisdiction, including scale of farm, definition of animal/livestock units	<ul style="list-style-type: none"> • WI DNR requires all CAFOs to obtain an NPDES permit based on if the operation is going to store manure or process wastewater or will land apply manure/process wastewater. WI DNR may designate a smaller-scale animal feeding operation (fewer than 1,000 animal threshold) as a CAFO if it has pollutant discharges to navigable waters or contaminates a well.
How are manure volumes estimated, including estimates of animal turnover and weights	<ul style="list-style-type: none"> • The United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) breaks down the estimated total amount of manure, phosphorus, and nitrogen produced by each type of livestock (lb/day/1,000-lb animal threshold). The table can be found in the USDA NRCS Agricultural Waste Management Handbook (1992). • Livestock included in the table are beef cattle (based on a high forage diet), dairy cows (lactating), hogs and pigs (grower), layer chickens, broiler chickens, and turkeys.
How manure volume and nutrient content among livestock type and stages of livestock vary	<p>The Wisconsin Department of Natural Resources sets thresholds for calculating animal/nutrient unit as:</p> <ul style="list-style-type: none"> • Heifers over 800 lb (1.4) • Heifers under 800 lb (1.1) • Bulls (1.4) • Steer or cows – 400 lb to market (1.0) • Veal calves (0.5) • Horse (2.0) • Sows (0.4) • Boars (0.5) <p>*lb/day/1,000-lb animal unit (nracs.usda.gov)</p> <p>Beef – 59.1 Dairy – 80.0 Hogs/pigs – 63.1 Chickens (layers) – 60.5 Chickens (broilers) – 80.0</p> <p>*lb/day/1,000-lb animal unit (nracs.usda.gov)</p> <p>Beef – 0.31 N and 0.11 P Dairy – 0.45 N and 0.07 P Hogs/pigs – 0.42 N and 0.16 P Chickens (layers) – 0.83 N and 0.31 P Chickens (broilers) – 1.10 N and 0.34 P</p>

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin
Review Matrix Table A-1.9: Wisconsin, U.S.

Regulatory requirements	
Regulatory triggers - criteria for manure to be subject to regulation/permitting	<ul style="list-style-type: none"> • 12 months before an operation becomes a CAFO it must begin the WPDES permit application - there is a “zero” discharge standard for runoff to navigable waters from CAFO animal production areas – WI DNR must review and approve plans and specifications for facilities (manure and process water storage, handling systems...) • Must create Emergency Response Plan (EMP) that is designated to address all unauthorized discharges/spills, and shall be amended/reviewed as necessary. • The Wisconsin Department of Agriculture, Trade, and Consumer Protection (WI DATCP) administers the Livestock Siting Law. Under this law, local governments do not have to require permits for new or expanding livestock operations. However, if they choose to require conditional use or other permits, the livestock siting law sets standards and procedures that they must follow. The law limits exclusion of livestock facilities from agricultural zones (datcp.wi.gov).
Regulatory requirements for storage, including monitoring and inspection	<ul style="list-style-type: none"> • 6 months of liquid manure storage is required [with some exceptions]. • Daily inspections of water lines that could come in contact with pollutions or drain to storage, containment structures, or runoff control structures. Weekly inspections of storm water controls, runoff controls, storage/containment (specifically liquid), and the depth marker [making sure to record level above/below the margin of safety]. • Quarterly inspections are to be conducted on production areas including outdoor animal pens, barnyards, and raw material storage; quarterly summary to be submitted with the annual report. Other inspections may include periodically calibrating land spreading equipment and checking for leaks. • No specific requirements for engineer/professional design or as to whom are to conduct inspections/compose reports and keep records.
Regulatory requirements for land application of manure	<ul style="list-style-type: none"> • Manure spread on land must be set back from drinking water wells, sinkholes, and fractured bedrock. • WI DNR follows all regulatory requirements for land application of manure set forth by the Federal EPA.
Restrictions for land application of manure	<ul style="list-style-type: none"> • Operators shall not spread liquid manure on frozen or snow-covered ground unless its injected or immediately incorporated into the soil, or there is an emergency outside of the operators controls. • Manure should never be mechanically applied to areas within 50ft of a potable drinking water well. • Surface Water Quality Management Area - has six different options one is as follows - an area within 1,000ft of lakes and ponds, or within 300ft of perennial rivers and streams. SWQMA land application restrictions are as follows: shall not apply manure within 25ft of navigable waters and to inject/incorporate manure immediately after application in all other areas of the SWQMA. • May apply if a filter strip (a minimum of 21ft wide) is constructed between navigable waters and is designed in accordance with NRCS Standard 393 and ground has a 30% crop residue at the time of application and the hydraulic application rate is limited and the manure is injected/immediately incorporated. • Manure may be applied to frozen ground if there is less than one inch to four inches of snow present on the area where manure is to be applied (may surface apply or immediately incorporate). If there is more than 4 inches of snow, incorporation of manure is prohibited but permittee shall be able to surface apply in compliance with regulations
Regulatory requirements for land application - acreage requirements	<ul style="list-style-type: none"> • WI DNR does not have acreage requirements based on manure volume or nutrient content. There are no specifications for how much acreage a CAFO needs to operate based on manure production or amount of animals on property.
Regulatory requirements for land application - procedures and protocols for testing of manure	<ul style="list-style-type: none"> • WI DNR follows all federal regulatory requirements for procedures and protocols for testing of manure.

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin
Review Matrix Table A-1.9: Wisconsin, U.S.

Regulatory requirements for land application - procedures and protocols for testing of soils on which manure is applied	<ul style="list-style-type: none"> • Shall test soil for phosphorus using method specified in NRCS 590. If permittee applies manure on fields with soil test levels greater than 100ppm, the permittee shall apply with the following requirements; for fields with levels of phosphorus between 100ppm and 200ppm, permittee shall calculate the planned average phosphorus index value for the crop rotation or for the next 4 years [which ever is shorter]. If the calculated value is greater than 6, manure application is prohibited. If the calculated value is less than 6, then application is allowed as long as the cumulative application of phosphorus from manure does not exceed 50% of the cumulative annual crop phosphorus removal over the rotation/next 4-year period. • For fields with levels over 200ppm, application is prohibited unless permittee can prove application will not significantly increase phosphorus delivery to surface waters/wetlands – the calculated value for average phosphorus index is under 6 – the cumulative application of phosphorus from manure will not exceed 50% of the cumulative annual crop phosphorus removal over the rotation/4-year period. • No specifications as to whom is responsible for conducting calculations/sampling or the chain of custody.
Regulatory requirements for manure disposal	<ul style="list-style-type: none"> • CAFO's may transfer manure to other operations for spreading or other uses. Records of the amount of manure transferred from a facility must be maintained on site.
Nutrient management plans	<ul style="list-style-type: none"> • Use of the P-index is required for fields with soil test P levels less than 50 ppm and not at optimum P Levels for the highest P demanding crop that are adjacent to or that the WI DNR determines to have a high potential to deliver phosphorus to impaired, outstanding, or exception resource waters. The P-index is to be used on fields with soil test P levels between 100-200ppm, manure and process wastewater applications are limited to 50% of the cumulative annual crop P-need over the rotation or next four years [whichever is less] – the application may not result in a P-index value over 6 averaged over the rotation or next 4 years, whichever is less. Finally, the P-index must be used for fields with P levels of 200ppm or more, the permittee is not to apply manure or wastewater to their fields without prior WI DNR approval. • WI Department of Agriculture (DA) has a checklist available on their site or on WI DNR site that can be used to ensure compliance with the WI NCRS 590 Standard. Form is to be submitted back to WI DA with a copy of the NMP. • NMP is to be field specific and phosphorus based and is to outline the amounts, timing, locations, methods and other aspects related to land application. The plan requires field soil testing reports, planned/application rates, methods and timing for manure application, field soil erosion and phosphorus delivery to surface water calculations, nutrient crediting, maps showing field-specific spreading restrictions, soils, reports, and procedures and a detailed plan narrative. • All CAFO permittees are required to submit annual and daily spreading information, monitoring reports and all like documents/records. The annual reporting is broken up into 2 sections: the annual report is due by Jan 31st of each year and the NMP update is due March 31st of each year. An annual report checklist can be located on the WI DNR website to ensure compliance. • Any substantial revisions to CAFO NMP are required to be public noticed and are posted for 14 days for public comment.
Best management practices	<ul style="list-style-type: none"> • WI DNR does not have any specifications for BMPs outside the regulatory BMPs set forth by the Federal EPA.
Compliance, Monitoring and Enforcement	
How are permitting requirements enforced	<ul style="list-style-type: none"> • WI DNR is responsible for enforcing all regulations and rules concerning CAFOs. There are no specified categories of enforcement action.
Inspections	<ul style="list-style-type: none"> • WI DNR requires that CAFO operators follow a compliance calendar, which states what inspections are to be conducted by the operator and their frequency. A quarterly summary of inspections is required to be submitted with the annual report along with a copy of compliance calendar properly completed. The compliance calendar requires quarterly inspections of all production areas (outdoor animal pens, raw material storage areas, etc.) along with weekly inspections of stormwater controls and runoff controls. Additionally, the Runoff Management rules (NR 151) administered by WI DNR include performance standards and prohibitions related to the management and storage of manure.
Complaints	<ul style="list-style-type: none"> • All concerns/complaints should be reported to the WI DNR and can be reported directly to the local DNR Agricultural Runoff Management Specialists. If an individual wishes to remain anonymous, concerns should be reported through the DNR tip hotline (800) 847-9367

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin
Review Matrix Table A-1.9: Wisconsin, U.S.

Input from Public Stakeholders and Indigenous Communities	
Notification of a proposed new animal feeding operation	<ul style="list-style-type: none"> At least 90 days before beginning construction, proposed CAFOs must submit plans and specifications for reviewable construction projects to the WI DNR for approval. Approval from the WI DNR is a requirement of the Wisconsin Pollutant Discharge Elimination System (WPDES – same as NPDES). There are no specifications if these plans are made available to the public. Plans can be submitted via paper copies or online – forms are available on WI DNR website.
Indigenous communities	<ul style="list-style-type: none"> There are no distinct processes for notifying indigenous communities of information pertaining to CAFOs.
Role of Indigenous people in regulatory and enforcement oversight, and how regulatory agencies coordinate with Indigenous people	<ul style="list-style-type: none"> WI DNR does not specify the role of indigenous people in regulatory or enforcement oversight of CAFO's. There is no specification stating how or if WI DNR coordinates with indigenous people involving CAFOs.
Public access to records	<ul style="list-style-type: none"> Records are made available to the public through Open Record Requests via the WI DNR webpage. WI DNR releases copies of records for the fee.
Funding	
Funding and/or incentives for manure management	<p>The State of Wisconsin provides approximately \$20 million annually for farm conservation costshare grants, including grants for practices needed to comply with state farm conservation standards. This total does not include Farmland Preservation tax credits.</p> <p>Of the \$20 million total, approximately \$14 million consists of bond revenue funding for “hard practices” such as manure storage systems, barnyard runoff control systems, buffer strips, and other engineered practices. About \$6 million in segregated funding is provided for “soft practices” such as nutrient management, conservation tillage, cover crops, and other agronomic practices. These state funds are divided among 72 counties pursuant to an annual DATCP/DNR joint allocation plan (the state also provides some funding for county staff). Some counties also provide their own appropriations for farm conservation cost-share grants. USDA-NRCS provides significant cost-share funding for farm conservation practices in Wisconsin (USDA-FSA also provides funding for CRP and other set-aside programs). However, USDA does not enforce any mandatory farm conservation standards, except those to which farmers voluntarily agree in their cost-share contracts. Participation in USDA programs is entirely voluntary, and USDA administers the programs on a confidential basis. USDA cost-share funds are not available to counties to facilitate county implementation of Wisconsin conservation standards. Unlike USDA and most other states, Wisconsin does have mandatory farm conservation standards for farms, subject to cost-sharing. However, counties typically rely on voluntary cost-share sign-ups, and seldom take enforcement actions against violators who decline targeted cost-share offers. The Wisconsin Department of Agriculture, Trade and Consumer Protection provides Nutrient Management Farmer Education (NMFE) grants to local organizations to teach farmers to develop their own nutrient management plans. In their recent budget request (2017-2019), the DNR requested to reallocate 4.0 FTE to increase its CAFO program staff. Under a new federal-state “adaptive management” program, sewerage districts in phosphorus-impaired watersheds can avoid costly phosphorus treatment projects by funding farm conservation practices that reduce phosphorus runoff by an equivalent amount.</p>
Other	
Are there non-government nutrient management programs that include manure application elements (organized voluntary efforts, best practices guidelines, farm assistance programs, etc.)	<ul style="list-style-type: none"> The University of Wisconsin (UW) Extension – a part of a three-way partnership with United States Department of Agriculture, and Bayfield County. UW Extension provides generalized information on CAFOs and recommendations for following regulatory requirements for permits. UW Extension offers a cooperate extension along with the regular extension. Bayfield County offers information about CAFOs as well. The WI DATCP created the Farmland Preservation Program which helps farmers and local governments preserve farmland, protect soils and water, and minimize land conflict. Through the program, landowners who meet the soil and water standards become eligible to claim income tax credits.

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin
Review Matrix Table A-1.9: Wisconsin, U.S.

Nutrient release reduction targets related to manure being developed by individual and collective state/provincial water quality management agencies	Wisconsin's Nutrient Reduction Strategy was developed to not only meet the federal Gulf of Mexico hypoxia nutrient reduction goals, but to meet intra-state needs for Wisconsin's lakes and streams and groundwater. It also includes needs for the Great Lakes consistent with Annex 4 of the Great Lakes Water Quality Agreement of 2012. By continuing to implement existing state and federal programs, Wisconsin can meet the 45 percent reduction goal for the Mississippi River Basin. No phosphorus or nitrogen load reduction goal has been identified for Lake Michigan.
Are there permit requirements that indirectly impact manure produce, storage, management and application	<ul style="list-style-type: none"> • No person may legally discharge to the waters of the state without a permit issued under the WI DNR and discharging can still be prohibited depending on the production facility and amount/type of discharge. • WI DNR does not require permitting for water withdraw as long as it does not exceed 100,000 gallons per day for any 30-day period.

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin
Review Matrix Table A-1.10: Minnesota, U.S.

Regulators, legislation	
Agencies responsible for regulatory and enforcement oversight	<ul style="list-style-type: none"> Minnesota Pollution Control Agency (MPCA) administers rules regulating livestock feedlots in Minnesota. In addition, MPCA may delegate counties to administer the program for feedlots that are not required to have a state or federal operating permit.
Definitions, quantifications, etc. for permitting purposes	
How are manure requirements defined within the jurisdiction, including scale of farm, definition of animal/livestock units	<ul style="list-style-type: none"> A State Disposal System (SDS) permit is a state-run program and is required for any facility that currently has capacity or is proposing to have capacity for a total of 1,000+ animals. Similar to federal regulations, Minnesota regulation provides that no CAFO may discharge without a permit authorizing discharge. A facility that is required to obtain an SDS permit may choose to obtain an NPDES permit in lieu of the SDS permit.
How are manure volumes estimated, including estimates of animal turnover and weights	<ul style="list-style-type: none"> The United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) breaks down the estimated total amount of manure, phosphorus, and nitrogen produced by each type of livestock (lb/day/1,000-lb animal threshold). The table can be found in the USDA NRCS Agricultural Waste Management Handbook (1992). Livestock included in the table are beef cattle (based on a high forage diet), dairy cows (lactating), hogs and pigs (grower), layer chickens, broiler chickens, and turkeys.
How manure volume and nutrient content among livestock type and stages of livestock vary	<p>The Minnesota Department of Agriculture sets the threshold for animal unit calculation as follows:</p> <ul style="list-style-type: none"> Slaughter steer or stock cow (1.0) Mature dairy cows (1.4) Swine weighing over 300 lb (0.4) Swine between 55-300 lb (0.3) Sheep and lambs (0.1) Laying hen/broiler – liquid manure system (0.033) Chicken over 5 lb – dry manure system (0.005) <p>Minnesota Department of Agriculture along with the University of Minnesota Extension have created guidelines outlining the annual manure production and nutrient excretion from livestock. The annual manure production per 1,000 lb of animal weight is as followed:</p> <ul style="list-style-type: none"> Beef cow - 16.8 tons/year Dairy heifer – 11.0 tons/year Veal – 4.8 tons/year Boar – 3.8 tons/year Finishing swine – 9.0 tons/year Layer chicken – 9.1 tons/year Broiler chicken – 17.3 tons/year <p>The nutrient excretion for nitrogen annually is given in lb/tons and is as follows:</p> <ul style="list-style-type: none"> Beef cow – 7 Dairy heifer – 11 Finishing swine – 16 Broiler chicken – 46 Layer chickens – 34

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin
Review Matrix Table A-1.10: Minnesota, U.S.

Regulatory requirements	
Regulatory triggers - criteria for manure to be subject to regulation/permitting	<ul style="list-style-type: none"> NPDES and SDS permits are construction and operation permits issued to the large feedlots in Minnesota that have the potential to discharge into the waters of the state.
Regulatory requirements for storage, including monitoring and inspection	<ul style="list-style-type: none"> Liquid manure storage area (LMSA) is to be capable of holding at least nine months of manure (based on manure production at specific farm). Non-concrete lined manure storage areas (such as composite lined storage areas) are to be designed and constructed to achieve a maximum theoretical seepage rate of no more than 1/56in per day throughout the design life of the manure storage area. Concrete lined storage areas must be designed and constructed with water stops/joint sealant materials all at construction joints. The floor of a concrete lined manure storage area should have a thickness of no less than 5in of poured concrete. The MPCA does not have any specific requirements outside the Federal EPA's for dry/solid waste storage.
Regulatory requirements for land application of manure	<ul style="list-style-type: none"> In order for an operation to apply manure to land, the operation must follow the requirements set forth by MPCA. The requirements are as follows: manage manure to prevent pollution of waters, follow maximum nutrient rate limits, maintain setbacks from sensitive features, test manure for nitrogen and phosphorus content, develop and maintain a manure management plan, and keep land application records.
Restrictions for land application of manure	<ul style="list-style-type: none"> Manure application into road ditches is prohibited and manure shall not be applied in a manner that could result in a discharge to the waters of the state. Manure application is allowed onto seasonally saturated soils that are seeded to annual farm crops or crop rotations of perennial grasses/legumes. Manure application rates must be limited so that the estimated plant available nitrogen from all nitrogen sources does not exceed expected crop nitrogen needs for non-legume crops and expected nitrogen removal from legumes.
Regulatory requirements for land application - acreage requirements	<ul style="list-style-type: none"> MPCA does not have acreage requirements based on manure volume or nutrient content. There are no specifications for how much acreage a CAFO needs to operate based on manure production or amount of animals on property.
Regulatory requirements for land application - procedures and protocols for testing of manure	<ul style="list-style-type: none"> Manure from each source of storage that contains an animal threshold of over 100, manure should originally be tested yearly for the first 3 years and then tested once every 4 years (or whenever feeding/management changes significantly) to create a "rolling" average for an SDS permit. For an NPDES permit, manure sampling should happen annually. Sampling is to be done by feedlot owner and testing is to be done by laboratories certified by the MDA or MPCA approved on-farm sampling and analysis. A list of laboratories providing manure testing services can be obtained at the MDA website. Manure is to be retested following changes in conditions affecting manure nutrient content including unusual climatic conditions, or changes in manure storage and handling, livestock types, or livestock feed.
Regulatory requirements for land application - procedures and protocols for testing of soils on which manure is applied	<ul style="list-style-type: none"> For phosphorus testing, the sample must be taken from the upper 6in once every four years and analyzed for phosphorus using the Bray P1 or Olsen test. Bray P1 is used for soils with a pH less than 7.4 and Olsen is used for test a broad range of soil pH. Owners of feedlots with an animal threshold that is more than 300must apply for an interim permit and submit a MMP if manure is to be applied onto soils where soil phosphorus levels exceed 75ppm (Bray P1) or 60ppm (Olsen) within 300ft of lakes, streams, DNR protected wetlands, drainage ditches, or open tile intakes or if soil phosphorus levels exceed 150ppm (Bray P1) or 120 (Olsen) outside of the 300ft zone from any of the above water areas.
Regulatory requirements for manure disposal	<ul style="list-style-type: none"> CAFO's may transfer manure to other operations for spreading or other uses. Records of the amount of manure transferred from a facility must be maintained on site.

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin
Review Matrix Table A-1.10: Minnesota, U.S.

Nutrient management plans	<ul style="list-style-type: none"> • The MPCA does not have very many instances where there is a direct regulatory connection with the P-Index and do not foresee moving to incorporate the P-index further into regulations in the near future. • MPCA requires a Manure Management Plan (MMP). MMP requiring the following: field maps, crop rotations, livestock and manure information, sensitive area identification and management, operation and maintenance guidance, planned nutrient application and nutrient budgets, and field and farm specific records. • Additional items to satisfy the NRCS are: plans/fields without manure, potassium, soil and water conservation practices, additional sensitive areas, and field risk assessments.
Best management practices	<ul style="list-style-type: none"> • MPCA does not have any specifications for BMPs outside the regulatory BMPs set forth by the Federal EPA.
Compliance, Monitoring and Enforcement	
How are permitting requirements enforced	<ul style="list-style-type: none"> • The MPCA is responsible for writing and enforcing rules to protect the environment in Minnesota. If violations occur, MPCA may administer Administrative Penalty Orders (APO), Stipulation Agreements (Stips), Supplemental Environmental Projects (SEP), and field citations.
Inspections	<ul style="list-style-type: none"> • MPCA conducts onsite inspections. There is no specification as to frequency of inspections or triggers for inspections.
Complaints	<ul style="list-style-type: none"> • If a citizen has a complaint, they are to use the Citizen Complaint form to report the incident to the MPCA. The form is available on their website, along with the contact number for Greater Minnesota.
Input from Public Stakeholders and Indigenous Communities	
Notification of a proposed new animal feeding operation	<ul style="list-style-type: none"> • The MPCA is to be notified of new construction of proposed farms or of additions/expansions of existing farms. Applications are to be submitted online. There is no specifications about public notice.
Indigenous communities	<ul style="list-style-type: none"> • There are no distinct processes for notifying indigenous communities of information pertaining to CAFOs.
Role of Indigenous people in regulatory and enforcement oversight, and how regulatory agencies coordinate with Indigenous people	<ul style="list-style-type: none"> • MPCA does not specify the role of indigenous people in regulatory or enforcement oversight of CAFO's. There is no specification stating how or if MPCA coordinates with indigenous people involving CAFOs.
Public access to records	<ul style="list-style-type: none"> • The County Feedlot Program is a cooperative arrangement between MPCA and county government to administer Minnesota's feedlot rule. There are roughly 25,000 registered feedlots in Minnesota, about 18,000 are in operation. The MPCA has a map available to the public with each counties delegated officer and how many feedlots are in that county. • MPCA also has all of its public notices available online (both current and archived) – all documents are available in PDFs.
Funding	
Funding and/or incentives for manure management	<ul style="list-style-type: none"> • AgBMP Loan Program – part of the Minnesota Department of Agriculture Finance and Budget Division, works with counties, Soil and Water Conservation Districts (SWCDs) and local water planners to identify current and future financial needs, modifying the program to meet changing trends in agriculture and rural Minnesota.

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin
Review Matrix Table A-1.10: Minnesota, U.S.

Other	
Are there non-government nutrient management programs that include manure application elements (organized voluntary efforts, best practices guidelines, farm assistance programs, etc.)	<ul style="list-style-type: none"> • The University of Minnesota Extension – provides recommendations on testing of soils, information on runoff, storage, and generalized CAFO requirements/limitations. All information is available to the public.
Nutrient release reduction targets related to manure being developed by individual and collective state/provincial water quality management agencies	<ul style="list-style-type: none"> • Minnesota major basin-wide nutrient reduction goals are as follows: Lake Superior, to maintain 1979 conditions for phosphorus and nitrogen goals are qualitative (site specific NMP) – Lake Winnipeg, reduce phosphorus and nitrogen by 10% compared to the 2003 conditions – Mississippi River, reduce phosphorus and nitrogen by 45% based on the average 1980-1996 conditions – Statewide groundwater/source water, no specific reduction goals for phosphorus, and for nitrogen reduction to meet the degradation prevention goal of the Minnesota Groundwater Protection Act.
Are there permit requirements that indirectly impact manure produce, storage, management and application	<ul style="list-style-type: none"> • MPCA does not allow direct discharge of manure/process wastewater into surface waters of the state. Permit requires that CAFOs take apprehensive and cautionary steps to reduce the risk of discharge such as requiring feedlots to have full containment systems to prevent runoff of nutrients. • Minnesota Department of Natural Resources (MDNR) restricts the intact of water. For surface water and ground water, a permit is required and if the anticipated use is more than 10,000 gallons a day or 1,000,000 gallons a year.

APPENDIX A-2

Jurisdictions outside the Great Lakes Basin – Review Matrices



Oversight of Animal Feeding Operations for Manure Management Outside the Great Lakes Basin
Review Matrix Table A-2.1: Saskatchewan, Canada

Regulators, legislation	
Agencies responsible for regulatory and enforcement oversight	<ul style="list-style-type: none"> Manure management in Saskatchewan is regulated through the Agricultural Operations Act, administered by the Ministry of Agriculture. The Ministry may require a livestock operation to develop, and submit for approval, a waste storage plan and/or waste management plan for its storage and/or use of manure. The Minister may refer the application, the plan and any associated reports to other provincial or federal ministries/agencies, municipalities, organizations or person as he/she considers appropriate, for their examination and comment. Rural municipalities have sole authority for land use decisions and defining areas where intensive livestock operations may be sited.
Definitions, quantifications, etc. for permitting purposes	
How are manure requirements defined within the jurisdiction, including scale of farm, definition of animal/livestock units	<ul style="list-style-type: none"> Provincial manure management requirements are defined predominantly through the Agricultural Operations Act (AOA) and its regulations. Under the AOA, an "intensive livestock operation" (ILO) means the confining of animals (poultry, hogs, sheep, goats, cattle, horses and any other prescribed animals), where the space per animal unit is less than 370 square metres. Animal units are defined in the Agricultural Operations Regulations. Ex.: one cow or bull is 1 animal unit, one bison calf is 0.25 animal unit, and one hen is 0.01 animal unit. Approval requirements for ILOs vary depending on the number of animal units and proximity to water sources (discussed further in <i>Regulatory triggers - criteria for manure to be subject to regulation/permitting</i> below).
How are manure volumes estimated, including estimates of animal turnover and weights	<ul style="list-style-type: none"> The AOA does not prescribe specific approaches for estimating manure volumes, animal turnover and weights. However, such information must be estimated using accepted standard values or specific management practices, and included in the operation's waste management plan for review and approval by the Minister of Agriculture.
How manure volume and nutrient content among livestock type and stages of livestock vary	<ul style="list-style-type: none"> The AOA does not prescribe specific approaches for estimating how manure volumes and nutrient content vary among livestock type and stage. However, such information must be estimated using accepted standard values or specific management practices, and included in the operation's waste management plan for review and approval by the Minister of Agriculture.
Regulatory requirements	
Regulatory triggers - criteria for manure to be subject to regulation/permitting	<ul style="list-style-type: none"> Minister approval of a waste storage plan and a waste management plan are required for ILOs that: 1) contain an earthen manure storage area or a lagoon; 2) involves the rearing, confinement or feeding of 300 or more animal units for more than 10 days in any 30-day period; or 3) involves the rearing, confinement or feeding of more than 20 animal units but less than 300 animal units, for more than 10 days in any 30-day period, and any part of which is located within 300 m of surface water or 30 m of a domestic water well not controlled by the operator of the ILO.
Regulatory requirements for storage, including monitoring and inspection	<ul style="list-style-type: none"> Earthen manure storage areas and lagoons must have a minimum freeboard of 60 cm A holding pond for controlling contaminated runoff from livestock facilities and solid manure storage areas must have a minimum freeboard of 30 cm A liquid manure storage tank must have a minimum freeboard of 15 cm The AOA and its regulations do not prescribe requirements for minimum storage capacity, nor do they explicitly require an engineering professional to design the storage containment; however, these details must be incorporated into a waste storage plan that in turn is subject to review and approval by the Minister of Agriculture. The Minister may also require the applicant to include additional information in the plan as he/she sees fit, e.g. a groundwater monitoring program or mitigation measures against water contamination.
Regulatory requirements for land application of manure	<ul style="list-style-type: none"> The AOA does not provide explicit requirements for the land application of manure. However, the management and land application of manure must be carried out in accordance with a waste management plan that was reviewed and approved by the Minister of Agriculture. No regulatory requirements surrounding the land application of fertilizer were identified.

Oversight of Animal Feeding Operations for Manure Management Outside the Great Lakes Basin
Review Matrix Table A-2.1: Saskatchewan, Canada

Restrictions for land application of manure	<ul style="list-style-type: none"> The AOA does not explicitly restrict the land application of manure during winter or during/after rainfall events. However, the waste management plan must specify the method and season of manure application, and the plan is in turn reviewed and approved or rejected by the Minister of Agriculture.
Regulatory requirements for land application - acreage requirements	<ul style="list-style-type: none"> The AOA does not prescribe specific acreage requirements for the land application of manure. However, details such as the land area available for the annual application of manure, the method and season of application and the expected crop nutrient requirements must be reported in the operation's waste management plan, which in turn is reviewed and approved or rejected by the Minister of Agriculture.
Regulatory requirements for land application - procedures and protocols for testing of manure	<ul style="list-style-type: none"> No regulatory requirements for testing of manure was identified. However, per the Agricultural Operations Regulations, the Minister of Agriculture may require an operation's waste management plan to include additional information as he/she deems appropriate, which in turn must be implemented as a condition of approval. Requirements for testing manure may be introduced in this manner.
Regulatory requirements for land application - procedures and protocols for testing of soils on which manure is applied	<ul style="list-style-type: none"> No regulatory requirements for testing of soils was identified. However, per the Agricultural Operations Regulations, the Minister of Agriculture may require an operation's waste management plan to include additional information as he/she deems appropriate, which in turn must be implemented as a condition of approval. Requirements for testing soil may be introduced in this manner.
Regulatory requirements for manure disposal	<ul style="list-style-type: none"> If manure is to be spread on lands not controlled by the operator of the ILO, the waste management plan must include written agreements from other landowners for spreading the manure on their land. A map identifying the locations of these other lands must also be provided.
Nutrient management plans	<ul style="list-style-type: none"> The creation and operation of intensive livestock operations and liquid manure storage may require the preparation of a waste management plan and a waste storage plan for review and approval by the Minister of Agriculture (per the Saskatchewan Environmental Code, manure is considered an industrial waste from an agricultural operation). Requirements for these plans are outlined in the Agricultural Operations Regulations.
Best management practices	<ul style="list-style-type: none"> No requirements for the preparation or implementation of best management practices were identified. The Government of Saskatchewan offers many guidelines and recommendations for implementing best management practices (or beneficial management practices).
Compliance, Monitoring and Enforcement	
How are permitting requirements enforced	<ul style="list-style-type: none"> On the recommendation of an inspector, the Minister of Agriculture may suspend or cancel an approval, or order corrective action, if it is found that the operator is failing to comply with the requirements of the approved waste storage or waste management plan, or if there is an immediate danger of pollution of surface or ground waters. Failure to comply with the provisions of a plan or an order from the minister is considered an offence and may be punishable with a fine.
Inspections	<ul style="list-style-type: none"> Section 23 of the AOA permits inspectors to inspect any ILOs at any reasonable time for the purpose of enforcing the provisions of the Act. The Agricultural Operations Review Board may order an inspection of the agricultural operation that is directly or indirectly involved in a nuisance complaint.

Oversight of Animal Feeding Operations for Manure Management Outside the Great Lakes Basin
Review Matrix Table A-2.1: Saskatchewan, Canada

Complaints	<ul style="list-style-type: none"> • Complaints of nuisance may be directed to the Agricultural Operations Review Board for a determination as to whether the disturbance arises from a normally accepted agricultural practice, and if not, what action should be taken to achieve compliance with normally accepted agricultural practices. • Section 3 of the AOA protects owners/operators of agricultural operations from complaints of nuisance, provided that the operation is being carried out in accordance with normally accepted agricultural practices. • If the Agricultural Operations Review Board is unable to resolve a dispute between a complainant and an agricultural operation, and the Board determines that the nuisance is not caused by a normally accepted agricultural practice, the Board may recommend that the operator cease the practice causing the disturbance, or modify the practice in such a manner that it becomes consistent with normally accepted agricultural practices. If the operation does not comply with the recommendation, the owner/operator may lose protection against future nuisance claims (i.e. may be held liable for the nuisance or may be prevented by injunction or court order from carrying out its operations). • Liquid manure spills of greater than 1,000 L that occur onsite, or greater than 500 L that occur offsite, must be reported to the Ministry of Environment and to the Agricultural Operations Unit of the Ministry of Agriculture.
Input from Public Stakeholders and Indigenous Communities	
Notification of a proposed new animal feeding operation	<ul style="list-style-type: none"> • No provincial requirements were identified for notifying neighbours and the broader public regarding the construction, operation or expansion of ILOs and manure management practices. However, the Ministry of Agriculture encourages developers to implement a public consultation process.
Indigenous communities	<ul style="list-style-type: none"> • No distinct process was identified in provincial legislation for notifying, consulting and engaging Indigenous communities regarding an animal feeding operation. However, the Crown, at all levels, has a constitutional Duty to Consult Indigenous Communities when it contemplates conduct that might adversely impact potential or established Aboriginal or Treaty rights. • The Crown must determine whether issuing an approval would adversely impact Aboriginal or Treaty rights, and where appropriate, provide accommodations, such as making adjustments to project plans, developing mitigation measures, attaching terms and conditions to permits or authorizations, etc.
Role of Indigenous people in regulatory and enforcement oversight, and how regulatory agencies coordinate with Indigenous people	<ul style="list-style-type: none"> • No distinct process was identified in provincial legislation for the role and involvement of Indigenous communities in regulatory and enforcement oversight. However, the Crown, at all levels, has a constitutional Duty to Consult Indigenous Communities when it contemplates conduct that might adversely impact potential or established Aboriginal or Treaty rights.
Public access to records	<ul style="list-style-type: none"> • No requirements were identified to make approval records, applications and plans publicly available, nor were any public online repositories of ILOs and manure storage areas identified. Access to such records may only be possible if they are voluntarily disclosed by the operator and/or through requests made under the <i>Freedom of Information and Protection of Privacy Act</i>.
Funding	
Funding and/or incentives for manure management	<ul style="list-style-type: none"> • The Government of Saskatchewan is participating in a federal-provincial-territorial partnership called Growing Forward 2. Under the province's Farm Stewardship Program, livestock operations can apply for a rebate on the purchase of specialized equipment or for modifying existing equipment for improved manure application. The program is intended to help increase nutrient retention and utilization, and reduce odour, volatilization and emissions, and reduce the risk of nutrient run-off. The Program also offers funding for the development of infrastructure that will minimize environmental risks and/or increase manure storage capacity to match current production and to prevent winter spreading.

Oversight of Animal Feeding Operations for Manure Management Outside the Great Lakes Basin
Review Matrix Table A-2.1: Saskatchewan, Canada

Other	
Are there non-government nutrient management programs that include manure application elements (organized voluntary efforts, best practices guidelines, farm assistance programs, etc.)	<ul style="list-style-type: none"> • Environmental Farm Plans (EFPs) are voluntary, confidential self-assessment tools that may be used by producers in order to learn about environmental risks and opportunities for their operations, such as improvements to environmental management practices. EFPs also allow farmers' stewardship efforts to be given public recognition. • Completion of an EFP is also a requirement for some cost-sharing funding for implementing environmentally beneficial management practices.
Nutrient release reduction targets related to manure being developed by individual and collective state/provincial water quality management agencies	<ul style="list-style-type: none"> • No nutrient release reduction targets related to manure were identified.
Are there permit requirements that indirectly impact manure produce, storage, management and application	<ul style="list-style-type: none"> • Under the provincial Water Act, agricultural industrial water users, including ILOs, are exempt from water use charges. • No approval is required for any person who owns or occupies land which adjoins a body of surface water, provided the water is used for domestic or livestock purposes on the land and the annual use is less than five cubic decameters (four acre-feet). Otherwise, an Approval to Construct, leading to a Water Right and Approval to Operate, will be required for any works where water is to be diverted or impounded from or within its natural channel or bed. • ILOs require a Water Rights Licence for the use of groundwater. A Permit to Conduct Ground Water Investigation and Approvals to Construct and Operate are required for any works where groundwater is to be used. • The deposit/discharge of deleterious substances into a water body frequented by fish is prohibited under Section 36 of the federal Fisheries Act.

Oversight of Animal Feeding Operations for Manure Management Outside the Great Lakes Basin
Review Matrix Table A-2.2: Alberta, Canada

Regulators, legislation	
Agencies responsible for regulatory and enforcement oversight	<ul style="list-style-type: none"> • Manure management in Alberta is regulated through the <i>Agricultural Operation Practices Act</i> (AOPA) and its regulations, administered by Alberta Agriculture and Forestry. • The Natural Resources Conservation Board (NRCB), an arm's length board reporting to the provincial Minister of Environment and Parks, is responsible for permitting new and expanding confined feeding operations (CFOs). • The NRCB consults regularly with the Policy Advisory Group, a multi-stakeholder advisory body for policy issues related to confined feeding operations. • Other responsibilities for the NRCB include reviewing appeals under the <i>Agricultural Operation Practices Act</i>, administering and advancing policies, and responding to public complaints lodged against a confined feeding operation. • Municipalities historically had jurisdiction over intensive livestock operations within their boundaries until 2002, when the province established province-wide manure management standards. Currently, municipalities have jurisdiction over operations not listed in the AOPA, and CFOs with animal numbers below the registration size threshold.
Definitions, quantifications, etc. for permitting purposes	
How are manure requirements defined within the jurisdiction, including scale of farm, definition of animal/livestock units	<ul style="list-style-type: none"> • Manure management requirements are defined predominantly through the provincial <i>Agricultural Operation Practices Act</i> (AOPA). • "Confined feeding operation" (CFO) is defined in the AOPA as "fenced or enclosed land or buildings where livestock are confined for the purpose of growing, sustaining, finishing or breeding by means other than grazing and any other building or structure directly related to that purpose but does not include residences, livestock seasonal feeding and bedding sites, equestrian stables, auction markets, race tracks or exhibition grounds". • Under the AOPA, permitting requirements are defined by the size of the CFO (discussed further in <i>Regulatory triggers - criteria for manure to be subject to regulation/permitting</i> below). • Animal units for various types of livestock are listed in Schedule 1 of the Part 2 Matters Regulation (AOPA). Ex.: one dry cow is 1 animal unit, one deer is 0.2 animal unit, one breeder chicken is 0.01 animal unit.
How are manure volumes estimated, including estimates of animal turnover and weights	<ul style="list-style-type: none"> • The Manure Characteristics and Land Base Code under the AOPA outlines, for various types of livestock, estimates of the daily, monthly, 9-month and yearly production of liquid and solid manure in gallons, litres and cubic feet. • Animal turnover can be accounted for by regularly (e.g. annually) updating the estimated manure production rates as the livestock headcount changes. • Differences in production rates by an animal's weight are accounted for in the Code for select species (e.g. horses, beef). • It is noted in the Code that the volumes and weights in the tables are averages expected from typical livestock housing systems in Alberta, and that adjustments should be made where appropriate to account for variables such as bedding, mechanical drying and treatment, dilution, etc.
How manure volume and nutrient content among livestock type and stages of livestock vary	<ul style="list-style-type: none"> • The Manure Characteristics and Land Base Code under the AOPA provides estimates of manure production rates and crop-available nitrogen for various livestock types. • The Code accounts for differences in manure production by life stage, but only for select livestock types. • Per Section 5 of the AOPA Part 2 Matter Regulation, if a type of livestock does not fall within any category of livestock identified in the Schedules of the Regulation, an approval officer or the NRCB may, based on the livestock type's manure production, determine the relevant factors, units and other measurements required to apply the regulations.

Oversight of Animal Feeding Operations for Manure Management Outside the Great Lakes Basin
Review Matrix Table A-2.2: Alberta, Canada

Regulatory requirements	
Regulatory triggers - criteria for manure to be subject to regulation/permitting	<ul style="list-style-type: none"> • Under the AOPA, approvals are required for larger CFOs, registrations are required for smaller CFOs, and authorizations are required for the construction of manure storage facilities and manure collection areas. Threshold levels for determining whether a registration or approval is required are listed in Schedule 2 of the Part 2 Matters Regulation; the threshold levels are listed by category of livestock (beef, poultry, etc.) and type of livestock (species, age, function, etc.). Ex.: for a livestock operation comprised of lactating cows, registration is required for 50 - 199 individuals, and approval is required for 200 or more individuals. An operation with fewer than 50 lactating cows do not require any permits under the AOPA, but may be subject to municipal requirements. • Per Section 28 of the AOPA Standards and Administration Regulation, CFOs and anyone who handles 500 tonnes or more per year of manure must keep records for a minimum of 5 years.
Regulatory requirements for storage, including monitoring and inspection	<ul style="list-style-type: none"> • Per the AOPA Part 2 Matters Regulation, an authorization is required to construct a manure storage facility that is not part of a CFO, if the manure storage facility contains (or is to contain) a total of 500 tonnes or more of manure for 7 months or more in any calendar year. If the manure storage facility is part of a CFO for which approval or registration was already obtained for its construction, expansion or modification, a separate authorization for the manure storage facility is not required. • Per Section 5 of the AOPA Standards and Administration Regulation, an area where solid manure is stored for a short term (a cumulative total of less than 7 months over a period of 3 years) is not considered a manure storage facility, and therefore does not require authorization. However, the storage area is subject to the same or similar setback requirements as manure storage facilities (see below). • Manure storage facilities are subject to setback requirements outlined in the AOPA Standards and Administration Regulation. The facilities must not be located within 100 m from a spring, 100 m from a water well, or 30 m from a common body of water. Exceptions may be granted if the applicant can demonstrate to an approval officer that these features will not be impacted by the manure storage facility. • Manure storage facilities must not be located in an area that floods. Per Section 8 of the AOPA Standards and Guidelines Regulation, the 1:25 year maximum flood level must not be less than one metre below any part of the facility where run-on can come into contact with the stored manure. • The minimum distance separating a new manure storage facility and the nearest residence must be the greater of 150 m or the Minimum Distance Separation, as calculated using the equations in Schedule 1 of the AOPA Standards and Administration Regulation. • A manure storage facility must have either a protective layer or a liner meeting the requirements of Section 9 of the AOPA Standards and Regulations, separating the facility and the uppermost groundwater resource below the site. • A solid manure storage facility must have positive drainage to prevent the collection of water (AOPA Standards and Regulations section 9(8)). • The owner/operator of a CFO must construct manure storage facilities that are sufficient to store all of the manure produced by the operation over a period of at least 9 consecutive months. A storage capacity of fewer consecutive months requires approval of a manure handling plan submitted by the owner/operator. Alternately, if the CFO operates such that only short term storage is required (fewer than 7 consecutive months over a period of 3 years), the construction of manure storage facilities is not required (AOPA Standards and Regulations section 10). • An open liquid manure storage facility must have a freeboard of at least 0.5 m when the facility is full, and must have a system of secondary containment if there is a reasonable possibility of liquid manure being discharged into a common body of water (AOPA Standards and Regulations section 11). • An earthen liquid manure storage facility must meet the side slope requirements of section 14 of the AOPA Standards and Regulations. • The AOPA Standards and Regulations also require that: manure storage facilities be constructed such that they will be protected from erosion and damage; liquid manure storage facilities be filled from the bottom and their liners be appropriately sealed to prevent leaks. • An approval officer may require that a liquid manure storage facility be equipped with leakage detection system and be monitored for leaks (AOPA Standards and Regulations section 18). • An approval officer may require that the owner or operator of a long term storage facility construct a catch basin meeting the capacity and freeboard requirements of section 19 of the AOPA Standards and Regulations.

Oversight of Animal Feeding Operations for Manure Management Outside the Great Lakes Basin
Review Matrix Table A-2.2: Alberta, Canada

Regulatory requirements for land application of manure	<ul style="list-style-type: none"> Land application of manure must meet the requirements of sections 24 and 25 of the AOPA Standards and Administration Regulation, e.g. having a sufficient land base to accommodate application based on soil nitrate-nitrogen limits and salinity limits, and meeting minimum setback requirements from water bodies/sources based on slope. Liquid manure must not be applied on a crop that is grown for human consumption and intended to be eaten uncooked. Per Section 28 of the AOPA Standards and Regulation, records must be kept of the production, application, and transfer of manure for five years. Few regulatory requirements concerning the land application of fertilizer, as opposed to manure, were identified. Section 28(5) of the AOPA Standards and Regulation requires that records be kept of the applicator rates of manure, composting materials or compost nutrients and fertilizer by field and by year, if these applied substances total more than 500 tonnes per year and are applied to land under the person's control. No other requirements of the AOPA and its regulations specifically identify fertilizer.
Restrictions for land application of manure	<ul style="list-style-type: none"> Spreading manure on snow-covered or frozen ground is prohibited by the AOPA unless specifically authorized on a case by case basis by the NRCB. If authorized, application must occur at least 150 m away from any residence or other building/structure occupied by people, in addition to any other conditions imposed by the NRCB.
Regulatory requirements for land application - acreage requirements	<ul style="list-style-type: none"> Per Section 24 of the AOPA Standards and Administration Regulation, an applicant for approval or registration must demonstrate that they have access to sufficient land to meet the land base requirements determined in accordance with the Manure Characteristics and Land Base Code, and to not exceed the application limits for nitrate-nitrogen in Schedule 3 of the Regulation. If the operations will not meet these requirements, the applicant must develop a nutrient management plan and/or nutrient handling plan for reducing or eliminating the need to meet the land base requirements (e.g. establishing agreements with other parties to accept manure from the CFO). The Manure Characteristics and Land Base Code identifies, for various livestock types, the land base requirements based on the livestock type and head count and the type of soil (e.g. the application of manure from 100 bison onto black soil requires a land base of at least 3 hectares). The Code also includes a table of the nutrient content of typical agricultural livestock manures (moisture content, nitrogen content), and a table of assumed crop nutrient requirements (in kilograms of nitrogen per hectare) for various soil types. The Code also provides the assumed crop nutrient requirements (nitrogen only) for determining land base guidelines (e.g. 112 kg of nitrogen required per hectare of irrigated soil).
Regulatory requirements for land application - procedures and protocols for testing of manure	<ul style="list-style-type: none"> No requirements for testing of manure identified.
Regulatory requirements for land application - procedures and protocols for testing of soils on which manure is applied	<ul style="list-style-type: none"> Per Section 25(1) of the AOPA Standards and Administration Regulation, if a person intends to apply more than 500 tonnes of manure annually, the soil must have been tested within the previous 3 years in accordance with Schedule 3 of the Regulation. Per Schedule 3 of the AOPA Standards and Administration Regulation, soil testing and sampling must be conducted according to the most recent edition of the Manual on Soil Sampling and Methods of Analysis, published by the Canadian Society of Soil Science. Standard laboratory procedures must be used for the soil analysis, and the information must be referenced in the operation's records. Soil testing must include extractable nitrate-nitrogen, soil salinity and texture.
Regulatory requirements for manure disposal	<ul style="list-style-type: none"> Removal of manure produced on site may be necessary if the operations cannot meet the requirements of the AOPA and its regulations; a manure handling plan must then be approved by the NRCB. Transfer of manure off-site must be documented, including the date, volume, and recipient (section 28 of the AOPA Standards and Administration Regulation).
Nutrient management plans	<ul style="list-style-type: none"> A nutrient management plan may be required as part of a permit application for operations that cannot meet the requirements of the Manure Characteristics and Land Base Code and the AOPA Standards and Administration Regulation.

Oversight of Animal Feeding Operations for Manure Management Outside the Great Lakes Basin
Review Matrix Table A-2.2: Alberta, Canada

Best management practices	<ul style="list-style-type: none"> • No requirements for the preparation or implementation of best management practices were identified. Best management practices (or beneficial management practices) are voluntary and are intended to take manure operations beyond the basic requirements of the AOPA.
Compliance, Monitoring and Enforcement	
How are permitting requirements enforced	<ul style="list-style-type: none"> • Section 39 of the AOPA outline the enforcement powers of the NRCB with respect to a manure-related operation. Enforcement orders may take the form of stop orders, directions to prepare and implement management plans, implement specific measures, or suspensions of a permit. Enforcement orders may be issued if the NRCB is of the opinion that the party is creating a risk to the environment or an inappropriate disturbance, or is/has contravened the terms and conditions of a permit, the AOPA or its regulations. • If an inspector is of the opinion that a release of manure has, may or will cause an immediate and significant risk to the environment, he may issue an emergency order to the responsible party to implement measures the inspector considers necessary. Such orders may be issued regardless of whether the release is in compliance with a permit. • If a party fails to comply with an enforcement or emergency order, the NRCB may take measures such as applying to the Court of Queen's Bench for a court order. • A contravention of the AOPA may also result in fines, the amount of which may vary depending on whether or not the contravention was knowingly committed (Sections 34 - 36 of the AOPA).
Inspections	<ul style="list-style-type: none"> • Inspections are typically triggered by complaints to the NRCB. • An inspector may also return to an operation to follow up on complaints and compliance issues.
Complaints	<ul style="list-style-type: none"> • Complaints of nuisance related to manure can be filed by phoning the NRCB's Response Line. • The Response Line will forward the complaint to a NRCB Inspector for follow-up. • The inspector will investigate the complaint and determine whether the operation is in compliance with all regulatory requirements. Enforcement and/or emergency orders may be issued if a contravention is identified. • If a party is dissatisfied with the inspector's decision, the NRCB may consider requests for a review of the decision. • If a nuisance (e.g. odour, dust, noise) is not the result of a contravention, the Minister of Agriculture and Forestry may refer the matter to a practices review committee, who may make recommendations or serve as a mediator between the complainant and the farming operations.
Input from Public Stakeholders and Indigenous Communities	
Notification of a proposed new animal feeding operation	<ul style="list-style-type: none"> • Notification requirements of a proposed new or expanded feeding operation are outlined in Sections 19 and 21 of the AOPA. The affected parties to be notified are determined by the nature of the proposal (CFO vs. storage facility), the proximity of the proposed CFO to a water body and the number of animal units on the CFO (a larger radius of residents/land owners must be notified for CFOs with higher animal units). • Notices of applications for CFOs may be posted online on the NRCB's website for a 20 working-day state statement of concern response period. The complete applications may be viewed online or at a specified NRCB office. • Affected parties who are concerned with the application may submit a statement of concern to the NRCB. If they are not already considered a directly affected party under the AOPA, they may wish to also submit a rationale for why they should be considered a directly affected party. • After a decision is made on the application, only directly affected parties may apply to the NRCB to request a review of the decision.
Indigenous communities	<ul style="list-style-type: none"> • No distinct process was identified in the AOPA and its regulations for notifying, consulting and engaging Indigenous communities regarding an animal feeding operation. However, the Crown, at all levels, has a constitutional Duty to Consult Indigenous Communities when it contemplates conduct that might adversely impact potential or established Aboriginal or Treaty rights. • The Crown must determine whether issuing an approval, registration or authorization would adversely impact Aboriginal or Treaty rights, and where appropriate, provide accommodations, such as making adjustments to project plans, developing mitigation measures, attaching terms and conditions to permits or authorizations, etc.

Oversight of Animal Feeding Operations for Manure Management Outside the Great Lakes Basin
Review Matrix Table A-2.2: Alberta, Canada

Role of Indigenous people in regulatory and enforcement oversight, and how regulatory agencies coordinate with Indigenous people	<ul style="list-style-type: none"> • In the AOPA, Métis settlements are described as having similar powers and jurisdictions as municipalities, in that animal feeding operations within the boundaries of a Métis settlement may be subject to its land use by-laws. • No distinct process was identified in the AOPA and its regulations for the role and involvement of Indigenous communities in regulatory and enforcement oversight. However, the Crown, at all levels, has a constitutional Duty to Consult Indigenous Communities when it contemplates conduct that might adversely impact potential or established Aboriginal or Treaty rights.
Public access to records	<ul style="list-style-type: none"> • Per NRCB's Operational Policy 2016-7 Approvals, applications for CFOs are posted on the NRCB's Notice of Applications webpage. The written reasons for permitting decisions are also posted on the NRCB's website. • As the NRCB considers all applications and any supporting documentation to be public records, these records can be accessed via the <i>Freedom of Information and Protection of Privacy Act</i>. Exceptions may be made if the party submitting the record requests that all or part of the record be treated as confidential. • The location of manure application must be identified on the permit application form for CFOs, under Part 2 - Technical Requirements. Complete applications are available for public viewing on NRCB's website.
Funding	
Funding and/or incentives for manure management	<ul style="list-style-type: none"> • The Government of Alberta is participating in a federal-provincial-territorial partnership called Growing Forward 2, for the period 2013 - 2018. The mandate of the partnership is to drive an innovative, competitive and profitable Canadian agriculture and agri-food sector. One of the programs included the Confined Feeding Operation (CFO) Stewardship, which supported CFOs with cost share grant funding and technical assistance for implementing management practices or infrastructure changes, with the goal of reducing the risk of agricultural contaminants entering surface and groundwater supplies. Manure storage and management was identified as one of the greatest risks associated with intensive livestock operations. Due to the large numbers of applications received compared to the amount of funding available, the CFO Stewardship program stopped accepting new applications as of February 15, 2017.
Other	
Are there non-government nutrient management programs that include manure application elements (organized voluntary efforts, best practices guidelines, farm assistance programs, etc.)	<ul style="list-style-type: none"> • The Alberta Environmental Farm Plan (EFP) program is currently managed by the Agricultural Research & Extension Council, a producer-run not-for-profit organization. The program works with agricultural industry associations to encourage their members to complete EFPs. An EFP is a voluntary self-assessment tool for helping producers identify their environmental risks and develop mitigation plans. The goal of EFPs is to meet or exceed regulatory requirements of, for example, the AOPA with regards to manure use and storage.
Nutrient release reduction targets related to manure being developed by individual and collective state/provincial water quality management agencies	<ul style="list-style-type: none"> • No nutrient release reduction targets related to manure were identified.
Are there permit requirements that indirectly impact manure produce, storage, management and application	<ul style="list-style-type: none"> • The withdrawal, diversion and use of water are primarily regulated under the Water Act (2000); administered by Alberta Environment and Parks. • Applicants have the option of coupling their application for a CFO permit (to be reviewed by an approval officer) with an application for a Water Act licence (to be reviewed by Alberta Environment & Parks). Applicants will receive both the permit and licence at the same time (or will receive neither). • The deposit/discharge of deleterious substances into a water body frequented by fish is prohibited under Section 36 of the federal Fisheries Act.

Oversight of Animal Feeding Operations for Manure Management Outside the Great Lakes Basin
Review Matrix Table A-2.3: Maryland, U.S.

Regulators, legislation	
Agencies responsible for regulatory and enforcement oversight	<ul style="list-style-type: none"> • Maryland Department of the Environment (MDE) is in charge of distribution of General Discharge Permits (GD Permits under COMAR 26.08.04.09N) and permits for MDE Animal Feeding Operations (MAFO). These permits satisfy the regulatory requirements of the National Pollutant Discharge Elimination System (NPDES), established under the Federal Act. Specific records and the agencies that require them can be found here: https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs144p2_025483.pdf • The Maryland Department of Agriculture (MDA) oversees nutrient management application requirements on Maryland farms, including the requirement for farmers to follow nutrient management plans when fertilizing crop and managing animal manure.
Definitions, quantifications, etc. for permitting purposes	
How are manure requirements defined within the jurisdiction, including scale of farm, definition of animal/livestock units	<ul style="list-style-type: none"> • The MDE defines an Animal Feeding Operation (AFO) as an operation that confines livestock for at least 45 days per year and does not grow crops or forage where the animals are confined. • An AFO is considered a Confined Animal Feeding Operation (CAFO) or a Maryland Animal Feeding Operation (MAFO) once specified thresholds are exceeded (e.g. 750 or more swine weighing more than 55 pounds each). • A MAFO is an AFO that does not discharge manure, litter or process wastewater to surface waters of the State during wet weather events; if such discharges could or does occur, the AFO is a CAFO. • All medium chicken (other than laying hens) AFOs that are not designed, constructed, operated and maintained such that a discharge could occur, not categorized as a CAFO or MAFO and with a total house capacity of 75,000 to 100,000 ft² are required to submit a Certification of Conformance prior to operation. • One animal unit is equivalent to 1,000 lbs of live animal weight. Livestock producers with 8 animal units or more are required to follow a nutrient management plan for managing animal manure.
How are manure volumes estimated, including estimates of animal turnover and weights	<p>Manure volumes are estimated using the USDA NRCA's "Agricultural Waste Management Field Handbook, Part 651" (March 2008). E.g.,</p> <ul style="list-style-type: none"> • one dry cow produces 85 lbs of manure per day; • one 440-lb boar produces 8.4 lbs of manure per day; • 1000 lbs live weight of lamb produce 40 lbs of manure per day; • one layer chicken produces 0.19 lbs of manure per day.
How manure volume and nutrient content among livestock type and stages of livestock vary	<p>Manure nutrient content is estimated using the USDA NRCA's "Agricultural Waste Management Field Handbook, Part 651" (March 2008). E.g.,</p> <ul style="list-style-type: none"> • one dry cow produces 0.50 lbs of nitrogen, 0.07 lbs of phosphorus and 0.16 lbs of potassium in its manure each day; • one 440-lb boar produces 0.061 lbs of nitrogen, 0.021 lbs of phosphorus and 0.039 lbs of potassium in its manure each day; • 1000 lbs live weight of lamb produce 0.45 lbs of nitrogen, 0.07 lbs of phosphorus, and 0.30 lbs of potassium in their manure each day; • one layer chicken produces 0.0035 lbs of nitrogen, 0.0011 lbs of phosphorus and 0.0013 lbs of potassium in its manure each day.
Regulatory requirements	
Regulatory triggers - criteria for manure to be subject to regulation/permitting	<ul style="list-style-type: none"> • NPDES permit required if CAFO is discharging or proposing to discharge waste or wastewater in the surface water of the state. Maryland law requires all farmers grossing \$2,500 a year or more, or livestock producers with 8,000 pounds or more of live animal weight (8 animal units or more), to follow nutrient management plans when fertilizing crops and managing animal manure.

Oversight of Animal Feeding Operations for Manure Management Outside the Great Lakes Basin
Review Matrix Table A-2.3: Maryland, U.S.

Regulatory requirements for storage, including monitoring and inspection	<ul style="list-style-type: none"> • Design covers and grating over openings such that livestock or humans cannot accidentally displace them and fall into the facility. • Design pipelines with a water-sealed trap and vent, or similar device, if there is a potential for gases from the pipe to accumulate in confined spaces. Place a fence around impoundments and uncovered tanks which have exposed walls less than 5 feet above ground surface. Use the NRCS CPS Fence (Code 382) for design of a fence that will prevent accidental entry by people or animals likely to be onsite. Post universal warning signs to prevent children and others from entering liquid waste storage structures. • Roofs and Covers: Use NRCS CPS Roofs and Covers (Code 367) for design of waste storage facility covers or roofs, as needed. <p>Additional Criteria for Liquid Waste Storage Impoundments:</p> <ul style="list-style-type: none"> • Use liners which meet or exceed NRCS CPS Pond Sealing or Lining (Codes 520, 521, or 522). • Perform subsurface investigations for all waste storage impoundments sufficient in detail and analysis to support the design in accordance with NRCS NEM, Part 531, Geology. • For the design of a liner on a site located in a floodplain and other locations where there is potential for uplift, include an evaluation of all potential buoyant uplift forces on the liner. Limit projected uplift head under clay liners to a gradient of less than 0.5 ft/ft in the clay liner. • Design Bottom Elevation: Locate the impoundment bottom elevation a minimum of 2 feet above the seasonal high water table unless special design features are incorporated that address buoyant forces, impoundment seepage rate and non-encroachment of the water table by contaminants. The water table may be lowered by use of drains to meet this requirement. • Outlet: An outlet that can automatically release stored material is not permitted except for flouts in septic tanks that feed a treatment system such as a waste treatment strip or leaching field or outlets leading to another storage facility with adequate capacity. Design a permanent outlet that will resist corrosion and plugging. Provide a backflow prevention measure for an outlet that pumps wastewater to secondary storage located at a higher elevations. • Embankments: For an impoundment with greater than one acre of surface area and where wave action is a concern, increase the embankment height to account for calculated wave height. In all cases, increase the constructed embankment height by at least 5 percent to allow for settlement. Stabilize all embankments to prevent erosion or deterioration.
Regulatory requirements for land application of manure	<p>Land application requirements for both manure and fertilizer are determined by nutrient content, which levels are determined through soil and manure testing. If on site manure has above the approved nutrient levels, the farmer may haul to a different site and "share" manure. Manure volumes must be preapproved by the Department of the Environment.</p>
Restrictions for land application of manure	<ul style="list-style-type: none"> • Nutrient applications are prohibited from December 16 to February 28 for farmers with 50 or more animal units; starting on March 1, 2020, smaller farms with 50 animal units or less will also have to comply with this restriction. • Nutrient application must occur at least 10 feet away from surface waters. • Temporary field stockpiling (staging) shall be located 100ft from any surface water, or 35ft if vegetation buffer is in place, 100ft from wells, springs, and wetlands (if the well is down gradient it must be 300ft), 200ft from residence outside operator's property, and can not reside in a flood zone. • Poultry litter may be applied in spring and fall for an existing crop or crops planted for the upcoming season, as long as it is applied following University of Maryland recommendations. • Applying nitrogen in the fall is prohibited on small grains if a fall nitrate test indicates levels greater than 10 parts per million for wheat or 15 parts per million for barley • Manure, biosolids and other organic nutrient sources must be injected or incorporated into the soil within 48 hours of application. • Nutrient application is prohibited on saturated soil.

Oversight of Animal Feeding Operations for Manure Management Outside the Great Lakes Basin
Review Matrix Table A-2.3: Maryland, U.S.

Regulatory requirements for land application - acreage requirements	<ul style="list-style-type: none"> • No acreage requirements were listed based on volume or nutrient content. • Farmers who apply nutrients to 10 or more acres of cropland are required to attend a two-hour nutrient applicator training course once every three years.
Regulatory requirements for land application - procedures and protocols for testing of manure	<ul style="list-style-type: none"> • Farmers are required to submit copies of their initial nutrient management plans to MDA. Before manure application can occur, sampling and testing takes place to ensure soils already high in nutrients aren't overloaded. If manure is too high in nutrients for the designated farm, the manure can be sold and transported to a different area or farm. Manure nutrient levels must be included in the Annual Implementation Reports (AIRs). These include documentation on manure nutrient levels, volumes applied, date and times applied, and goals of reduction for the following year. AIRs must be filed with MDA by March 1. Compliance with the Nutrient Management Program is a requirement. • Farmers who apply manure must have it tested at least every other year.
Regulatory requirements for land application - procedures and protocols for testing of soils on which manure is applied	Farmers are required to submit copies of their initial nutrient management plans to MDA, update plans before they expire, take new soil samples a minimum of once every three years and submit Annual Implementation Reports (AIRs) documenting how they implemented their plans during the previous year. AIRs must be filed with MDA by March 1. Compliance with the Nutrient Management Program is a requirement. Must take samples of manure prior to application as well as after application has occurred.
Regulatory requirements for manure disposal	<ul style="list-style-type: none"> • Maryland has implemented a Manure Transport Program to help poultry, dairy, beef and other livestock producers with manure comply with their nutrient management plans. • Animal producers with high soil phosphorus levels or not enough land to handle all their manure, may apply for cost-share grants to transport manure within their own operations, to other farms, or to alternative use facilities that can use the product in an environmentally safe manner. • Manure must be analyzed and tested prior to transportation to determine phosphorus and nitrogen levels. The receiving farm must be approved to receive those phosphorus and nitrogen levels, must apply within 48 hours of delivery or create an approved temporary stockpile.
Nutrient management plans	<ul style="list-style-type: none"> • Nutrient Management Plan, a condition of NPDES permit, is to be kept on file at the facility for the term of the permit. Farmers must also must submit Annual Implementation Reports (AIRs) every year, must submit samples every three years showing phosphorus and nitrogen content, and must keep all records including accumulation, storage volumes, application volumes and dates, and record of any volume of manure transported off site for 5 years • Farmers will have to practice odor control methods during livestock waste removal and field application so as not to affect a neighboring residence/populated area. • Shall provide off-site recipients of livestock waste a copy of the laboratory analysis sheet of the most recent nutrient analysis, representative of the livestock waste. • As of June 8, 2015, farmers are to transition from the Phosphorus Site Index to the Phosphorus Management Tool (PMT), an updated tool for identifying the potential risk of phosphorus loss from farm fields and to prevent the additional build-up of phosphorus in already-saturated soils.
Best management practices	<ul style="list-style-type: none"> • Best management practices were identified in sections of the permits or application process for both nutrient management plans and animal feeding operations. These traditionally implemented practices and new innovative practices and technologies include reducing loads to the land, managing the nutrients within the manure, and improve nutrient application rate, timing and methods to maximize crop uptake and minimize nutrient runoff.
Compliance, Monitoring and Enforcement	
How are permitting requirements enforced	The Maryland Department of Agriculture's field specialists and local soil conservation district staff work jointly with the Maryland Department of the Environment to assess farm management complaints and take action against polluters when necessary. Typically these involve concerns about odors, sediment pollution or manure management and livestock issues. In 2016, the department conducted 739 random on-farm audits and 283 targeted audits of farms with suspected violations for a total of 1,022 audits. This represents 19 percent of the state's 5,340 regulated farm operators. The targeted audits on farms can be based on failure to submit initial or updated nutrient management plans, incorrect data submitted for nutrient management plans, or reports submitted to the Department of Agriculture. http://mda.maryland.gov/pages/regulatory-information-center.aspx

Oversight of Animal Feeding Operations for Manure Management Outside the Great Lakes Basin
Review Matrix Table A-2.3: Maryland, U.S.

Inspections	The targeted audits on farms can be based on failure to submit initial or updated nutrient management plans, incorrect data submitted for nutrient management plans, or reports submitted to the Department of Agriculture. The investigation is completed by the Maryland Department of Agriculture and the Department of the Environment.
Complaints	<ul style="list-style-type: none"> • The Maryland Department of Agriculture should be contacted when conditions exist that are likely to pollute or have resulted in inadvertent water pollution. Examples include erosion problems or questionable manure management practices. • The Maryland Department of the Environment's Water Management Administration should be contacted when chronic or willful mismanagement of agricultural resources or activities places wastes, soils, or agricultural fertilizers into waters of the state. • The Maryland Department of the Environment's Land Management Administration should be contacted to report pollution problems with feedlots/animal feeding operations including Concentrated Animal Feeding Operations (CAFOs) and Maryland Animal Feeding Operations (MAFOs). The failure of a waste storage system falls into this category.
Input from Public Stakeholders and Indigenous Communities	
Notification of a proposed new animal feeding operation	<ul style="list-style-type: none"> • The MDE provides notification to the public of AFOs that have applied for covered under the General Discharge Permit for AFOs (GD Permit), State Discharge Permit No. 14AF and National Pollutant Discharge Elimination System (NPDES) Discharge Permit No. MDG01. • When an AFO's application has been reviewed and preliminarily approved, a Notice of Preliminary Approval is posted on the MDE's website, along with deadlines for requesting a hearing and for submitting written comments, and the applicant's Notice of Intent and nutrient management plan. • Any written comments concerning the preliminary approval must be received within 30 calendar days of the publication of the Notice of Preliminary Approval. • A public hearing may be held at MDE's discretion for MAFOs, or upon request for CAFOs. • If no comments are received during the 30 calendar day public comment period, the preliminary approval becomes a final approval and the AFO is registered. The MDE will prepare and provide notice of its final approval if any comments objecting to the preliminary approval were previously received, and/or if the final approval is substantially different from the preliminary approval. • A person may appeal the MDE's final approval by requesting a Contested Case Hearing within 15 days. • A second public comment period may be scheduled if the MDE determines it was necessary to make substantial modifications to the required plan. The same procedure will be followed as if it was a Preliminary Approval.
Indigenous communities	No distinct process was identified for notifying, consulting and engaging Indigenous communities regarding an animal feeding operation.
Role of Indigenous people in regulatory and enforcement oversight, and how regulatory agencies coordinate with Indigenous people	No distinct process was identified regarding the role and involvement of Indigenous communities in regulatory and enforcement oversight.
Public access to records	<ul style="list-style-type: none"> • The Department of the Environment maintains an online database of AFOs in the state. General information can be viewed on an AFO, such as farm designation (CAFO or MAFO), location, number of animals, primary animal type. During the Notice of Intent public participation period, project documentation is available for download and review. Permitting records do not appear to be publicly available after this period.

Oversight of Animal Feeding Operations for Manure Management Outside the Great Lakes Basin
Review Matrix Table A-2.3: Maryland, U.S.

Funding	
Funding and/or incentives for manure management	The Maryland Agricultural Water Quality Cost-Share Program provides farmers with grants that cover up to 87.5% of the cost to install BMPs on their farms to control soil erosion, manage nutrients and safeguard water quality in streams, rivers and the Chesapeake Bay. Approximately 30 BMPs are currently eligible for funding. The Cover Crop Program provides farmers with grants to plant small grains on their fields in the fall to conserve nutrients, control soil erosion and protect water quality. The Conservation Reserve Enhancement Program--a federal-state partnership program--pays landowners attractive land rental rates to take environmentally sensitive cropland out of production for 10 to 15 years and install conservation practices that protect water quality and provide wildlife habitat. A Manure Transport Program and Matching Service is available to help animal producers transport excess manure off their farms. Farmers who purchase certain types of conservation equipment may qualify for a Maryland Income Tax Subtraction Modification on their state tax returns. To help farmers comply with Maryland's nutrient management regulations, cost-share grants for Manure Injection and Incorporation are offered in the spring and fall. Low Interest Loans for Agricultural Conservation (LILAC) are offered to help supplement federal and state cost-share payments. The department also offers grants for the development of Innovative Animal Waste Technologies.
Other	
Are there non-government nutrient management programs that include manure application elements (organized voluntary efforts, best practices guidelines, farm assistance programs, etc.)	<ul style="list-style-type: none"> • No NGO manure management programs were identified in Maryland.
Nutrient release reduction targets related to manure being developed by individual and collective state/provincial water quality management agencies	For agricultural sources, the Tributary Strategy identifies nutrient load reductions based upon a variety of Best Management practices (BMPs). Maryland Department of Agriculture intends to help meet its obligation to reduce agricultural loads to the Chesapeake Bay through a combination of regulatory and voluntarily application of agronomic and Best Management Practices. The target is to reduce phosphorous levels 60% from 2005 to 2025.
Are there permit requirements that indirectly impact manure produce, storage, management and application	<ul style="list-style-type: none"> • Applicants have the option of coupling their application for a permit for MDE Animal Feeding Operations (MAFO) with a General Discharge Permit (GD Permits under COMAR 26.08.04.09). Applicants will receive both the permit and licence at the same time (or will receive neither). • Withdrawals of surface and/or groundwater for agricultural use are exempted from requiring a permit if less than 10,000 gallons/day are withdrawn.

Oversight of Animal Feeding Operations for Manure Management Outside the Great Lakes Basin
Review Matrix Table A-2.4: Iowa, U.S.

Regulators, legislation	
Agencies responsible for regulatory and enforcement oversight	<ul style="list-style-type: none"> The NPDES Section of Iowa's Department of Natural Resources (DNR) issues NPDES permits and storm water permits to animal feeding operations. Authority to issue these federal permits has been delegated to the Iowa DNR by the U.S. Environmental Protection Agency. Iowa law requires certain confinement feeding operations to develop and obtain DNR approval of a manure management plan (MMP), to apply manure in accordance with the plan, to submit annual updates of the manure management plan, to pay an annual compliance fee and to provide copies of the manure management plan to the counties where the operation is located and where manure is applied.
Definitions, quantifications, etc. for permitting purposes	
How are manure requirements defined within the jurisdiction, including scale of farm, definition of animal/livestock units	<ul style="list-style-type: none"> A "small animal feeding operation" is an animal feeding operation which has an animal unit capacity of 500 or fewer animal units. A "confinement feeding operation" is an animal feeding operation in which animals are confined to areas which are totally roofed and includes every feeding operation that is not an "open feedlot operation". An "open feedlot operation" is an unroofed or partially roofed animal feeding operation if crop, vegetation or forage growth or residue is not maintained as part of the animal feeding operation during the period that animals are confined in the animal feeding operation. The definitions above are defined under rules 567—65.1 (459,459B) and 567—65.100 (455B,459,459A) of the Iowa Administrative Code.
How are manure volumes estimated, including estimates of animal turnover and weights	<p>Table 5 of Chapter 65 (Animal Feeding Operations) of the Iowa Administrative Code lists the manure production for various livestock types and stages; e.g.,</p> <ul style="list-style-type: none"> one mature cow produces 12.23 tons of solid manure per year one grow-finish swine (150 lbs) produces 2.05 tons of solid manure per year 1000 layer chickens produce 10.5 tons of dry manure per year
How manure volume and nutrient content among livestock type and stages of livestock vary	<ul style="list-style-type: none"> Tables 3 and 3a of Chapter 65 (Animal Feeding Operations) of the Iowa Administrative Code lists the annual pounds of nitrogen and annual pounds of phosphorus (as P₂O₅), respectively produced by various types and stages of livestock Iowa State University released an article in conjunction with the Department of Natural Resources to release expected estimates of nutrient availability for different animal manure sources. This is shown in Table 1 of the article "Using Manure Nutrients for Crop Production"
Regulatory requirements	
Regulatory triggers - criteria for manure to be subject to regulation/permitting	Iowa has two types of DNR-regulated animal feeding operations (AFOs): confinements and open feedlots. Both AFO types are confined (kept and fed for 45 days or more per year) in a lot, yard, corral, building or other area. Both types include manure storage structures, but do not include livestock markets. A confinement feeding operation confines animals to areas that are totally roofed. Confinement feeding operations in Iowa must retain all manure. An open feedlot is unroofed or partially roofed with no vegetation or residue ground cover while the animals are confined. Large open feedlots with a national pollutant discharge elimination system (NPDES) permit are allowed to discharge to a water of the state under certain conditions listed in the permit, such as during a storm event larger than the 25-year, 24-hour storm.
Regulatory requirements for storage, including monitoring and inspection	DNR's AFO Construction Permitting Section reviews applications for construction permits for animal feeding operations. An engineer coordinates this review with the applicant, the applicant's engineer and other DNR staff to assure that all requirements are met before a permit is issued.
Regulatory requirements for land application of manure	Application of manure or commercial land fertilizers must be applied by a certified applicator. Land application requirements for both manure and fertilizer are based on nutrient content (nitrogen and phosphate), not volumes or weight of manure and fertilizer.
Restrictions for land application of manure	Confinement feeding operations with more than 500 animal units cannot legally apply liquid manure on snow-covered ground from December 21 to April 1, or on frozen ground from February 1 to April 1 except in an emergency.

Oversight of Animal Feeding Operations for Manure Management Outside the Great Lakes Basin
Review Matrix Table A-2.4: Iowa, U.S.

Regulatory requirements for land application - acreage requirements	No acreage requirements were listed based on volume or nutrient content. Land application must be 150ft from surface water bodies, 200ft from residence outside operator's property, and can not reside in a flood zone.
Regulatory requirements for land application - procedures and protocols for testing of manure	An actual manure sample may be used to determine the nutrient content of manure in lieu of using the values provided in Chapter 65 of the Iowa Administrative Code. If actual samples are to be used, they must be taken in accordance with Iowa State University extension publication PM 1558 "Management Practices: How to Sample Manure for Nutrient Analysis".
Regulatory requirements for land application - procedures and protocols for testing of soils on which manure is applied	<ul style="list-style-type: none"> • Soil samples must be obtained from each field in the manure management plan at least once every four years. • Each soil sample must be analyzed for phosphorus and pH. • The soil sampling protocol must meet all of the requirements of subrule 65.17(16) of the Iowa Administrative Code, e.g. each sample must be a composite of at least ten soil cores from the sampling area, with each core containing soil from the top six inches of the soil profile; each sample is to represent no more than ten acres; the analysis must be performed by a lab enrolled in the Iowa department of agriculture and land stewardship (IDALS) soil testing certification program, etc.
Regulatory requirements for manure disposal	<ul style="list-style-type: none"> • Manure must be applied to fields by a certified applicator and require a permit for the specific land before application. • If manure is to be applied off-site, written agreement must be obtained from the applicable land owners, and copies of the agreement(s) must be included in the manure management plan.
Nutrient management plans	<ul style="list-style-type: none"> • Manure Management Plans (MMPs) must be submitted to the DNR. Copies must also be submitted to the county where the facility is located, and to each county where manure will be applied. A copy must be maintained within 30 miles of the operation; it is recommended that one copy be kept for the manure applicator. • MMP require proof of reducing nutrient actions, however the requirements do not specify which practices to use. For suggested practices see the Nutrient Release Reduction Targets section below. • Confinements requiring a MMP must also use the Iowa Phosphorus Index (as specified by the USDA NRCS Iowa Technical Note No. 25) to determine application rates.
Best management practices	Manure Management Plans (MMP) require proof of reducing nutrient actions, however the requirements do not specify which practices to use. For suggested practices see the Nutrient Release Reduction Targets section below.
Compliance, Monitoring and Enforcement	
How are permitting requirements enforced	<ul style="list-style-type: none"> • Investigations are started through suspected incorrect information submitted to receive permits/ incorrect information in Manure Management plans. The complaint may be filed with the Department of Natural Resources according to procedures required by the department or with the county board of supervisors in the county where the violation is alleged to have occurred, according to procedures required by the board. The county auditor may accept the complaint on behalf of the board. • If the county board of supervisors receives a complaint, it shall conduct a review to determine if the allegation contained in the complaint constitutes a violation, without investigating whether the facts supporting the allegation are true or untrue. • If the county board of supervisors determines that the allegation does not constitute a violation, it shall notify the complainant, the animal feeding operation which is the subject of the complaint, and the department, according to rules adopted by the department. • If the county board of supervisors determines that the allegation constitutes a violation, it shall forward the complaint to the Department of Agriculture which shall investigate the complaint. • Air quality and water quality violations will result in a civic penalty. Habitual violators may receive penalties including fines, stop orders, and deny future permits and permit renewals.

Oversight of Animal Feeding Operations for Manure Management Outside the Great Lakes Basin
Review Matrix Table A-2.4: Iowa, U.S.

Inspections	<ul style="list-style-type: none"> • The DNR may inspect a confinement feeding operation at any time during normal working hours and may inspect the manure management plan and any records required to be maintained. • The DNR relies on interested and concerned individuals to report conditions that might be a threat to people or the environment. • Environmental complaint investigations are a part of each field inspector's job and staff respond to many complaints each year. Reports to local Field Office if the following are observed: <ul style="list-style-type: none"> - Fish kill – Report as soon as possible including numbers, sizes and species involved - Chemical spills - Note location, date and time and party responsible, if known - Strange color or odor in stream or river - Report as soon as possible with a description. Note if aquatic life or fish seem stressed or are dead Improper disposal of hazardous substances - Note if drums, cans or plastic buckets, etc. are present - Open dumping - Open burning
Complaints	24 Hour Environmental Reporting Hotline- 515-725-8694 or to IOWA DNR Field Office for the specific region the complaint is in. A manure release, including actual, imminent or probable discharge of manure from an animal feeding operation structure, must be reported to the DNR within six hours after it occurred or was discovered. Releases that must be reported include any that go to surface water, groundwater, a drainage tile line or intake, or to a designated area resulting from storing, handling, transporting or land-applying manure.
Input from Public Stakeholders and Indigenous Communities	
Notification of a proposed new animal feeding operation	Permits for new animal feeding operations must be submitted to the DNR with a Manure Management Plan, whether it is a new operation, expanding or modifying. The DNR has 60 days to approve or deny the MMP and give a start date for manure application. There is no listed information on whether the public/neighboring landowners are notified about animal feeding operations.
Indigenous communities	No distinct process was identified for notifying, consulting and engaging Indigenous communities regarding an animal feeding operation.
Role of Indigenous people in regulatory and enforcement oversight, and how regulatory agencies coordinate with Indigenous people	No distinct process was identified regarding the role and involvement of Indigenous communities in regulatory and enforcement oversight.
Public access to records	The online Animal Feeding Operations database lets you access information about DNR's regulated livestock and poultry facilities. You can look up locations, animal numbers, construction reviews, environmental or geological reviews; and details about manure management plans, production areas, manure storage structures and treatment systems.

Oversight of Animal Feeding Operations for Manure Management Outside the Great Lakes Basin
Review Matrix Table A-2.4: Iowa, U.S.

Funding	
Funding and/or incentives for manure management	<p>Low interest loans are available for purchase of equipment or construction of manure control structures and implementation of management practices that can improve water quality protection for livestock operations. These loans are available through many local banks and the Iowa Agricultural Development Authority. The maximum interest rate is 3 percent and there are no loan fees.</p> <p>Almost any kind of equipment or runoff control structure is eligible for funding. The primary purpose of the loan must be to improve water quality protection, which also often results in better use of livestock manure for fertilization of crop production. Currently cattle confinement facilities that also act as manure storage, such as deep bedded barns, are not eligible. Rule changes are being explored that would allow them as replacements for existing open feedlots or to encourage their construction in lieu of new open lots.</p> <p>One limiting factor is the livestock operation cannot be a Concentrated Animal Feeding Operation or CAFO. There is often confusion in determining if an operation is a CAFO if the operation has both confinement and open feedlot facilities and more than one species, such as swine and beef cattle.</p>
Other	
Are there non-government nutrient management programs that include manure application elements (organized voluntary efforts, best practices guidelines, farm assistance programs, etc.)	The Iowa Manure Management Action Group, a part of Iowa State University outreach program, provides information about submitting reports, buying and selling manure, permits and regulations, as well as news topics and updates. It offers suggestions for best management practices and is willing to send a consultant to a farm in order to determine the best actions to take.
Nutrient release reduction targets related to manure being developed by individual and collective state/provincial water quality management agencies	The Department of Agriculture and Land Stewardship lists manure nutrient practices in its article "Reducing Nutrient Loss: Science Shows That it Works". Using a mix of management, land-use, and edge-of-field practices the nutrient loss to waterways would be reduced. Management practices include reduction of application rates, use of nitrification inhibitor, sidedressing nitrogen, avoiding areas where Soil-Test P (STP) are above optimum levels and the use of cover crops. Land-use practices include extended rotation cycles and using high energy crops to replace row crops. Edge-of-field practices include, but are not limited to, installation of wetlands, bioreactors, and vegetation buffers.
Are there permit requirements that indirectly impact manure produce, storage, management and application	<ul style="list-style-type: none"> Any animal feeding operation that plans to discharge from the production area or land application area must have coverage under an Animal Waste National Pollution Discharge Elimination System Permit. A Water Use Permit is required of any person or entity that withdraws at least 25,000 gallons in a 24-hour period during any calendar year.

Oversight of Animal Feeding Operations for Manure Management Outside the Great Lakes Basin
Review Matrix Table A-2.5: North Carolina, U.S.

Regulators, legislation	
Agencies responsible for regulatory and enforcement oversight	<ul style="list-style-type: none"> The State of North Carolina Department of Environmental Quality Division of Water Resources require Animal Feeding Operations Permits, divided into cattle, swine, and poultry permits, which include Certified Animal Waste Management Plan (CAWMP), Waste Utilization Plan (WUP), and the amount of Plant Available Nitrogen (PAN) produced and utilized by the facility. The state also require a National Pollution Discharge Elimination System General Permit - Existing Animal Waste Operations, which must include Waste Utilization Plan (WUP), Plant Available Nitrogen (PAN), and Phosphorus Loss Assessment Tool (PLAT).
Definitions, quantifications, etc. for permitting purposes	
How are manure requirements defined within the jurisdiction, including scale of farm, definition of animal/livestock units	<p>A State Nondischarge General Permit is required for animal operations. Per North Carolina General Statute 143-215.10B:</p> <ul style="list-style-type: none"> An “animal operation” is any agricultural feedlot activity involving 250 or more swine, 100 or more confined cattle, 75 or more horses, 1,000 or more sheep, or 30,000 or more confined poultry with a liquid animal waste management system, or any agricultural feedlot activity with a liquid animal waste management system that discharges to the surface waters of the State. An “Animal waste management system” means a combination of structures and nonstructural practices serving a feedlot that provide for the collection, treatment, storage, or land application of animal waste. <p>Larger animal operations (with 1,000 animal units or more) have the options of being permitted under the NPDES General Permit or the State Nondischarge General Permit.</p>
How are manure volumes estimated, including estimates of animal turnover and weights	<p>The North Carolina Department of Agriculture and Conservation Services outlines the estimated manure production in gallons or tons per animal per year; e.g.,</p> <ul style="list-style-type: none"> One brood cow produces 3.0 tons per year; For anaerobic lagoon liquid, one farrow-to-finish sow produces 10,478 gallons of manure per year; one milk cow produces 7,749 gallons of manure per year; For anaerobic lagoon liquid, 1,000 layer chickens produce 25,373 gallons per year.
How manure volume and nutrient content among livestock type and stages of livestock vary	<p>The North Carolina Department of Agriculture and Conservation Services outlines nutrient content for various livestock, e.g.,</p> <ul style="list-style-type: none"> For anaerobic lagoon liquid, 1,000 gallons of manure from farrow-to-finish swine contains 3.6 lbs of nitrogen, 1.4 lbs of phosphorus (as P2O5), and 8.3 lbs of potassium (as K2O). For beef (scraped manure), each ton of manure contains 13.0 lbs of nitrogen, 8.3 lbs of phosphorus (as P2O5), and 13.6 lbs of potassium (as K2O).
Regulatory requirements	
Regulatory triggers - criteria for manure to be subject to regulation/permitting	<p>Criteria for Manure and Wastewater Handling and Storage is to provide adequate collection, storage, and/or treatment of manure and organic by-products that allows land application in accordance with NRCS Nutrient Management Policy and the conservation practice standards for Nutrient Management (Code 590) and Waste Utilization (Code 633). Collection, storage, treatment, and/or transfer practices shall meet the minimum requirements as addressed in the following NRCS conservation practice standards contained in Section IV of the NRCS FOTG, as appropriate:</p> <ul style="list-style-type: none"> Waste Storage Facility (Code 313) Waste Treatment Lagoon (Code 359) Manure Transfer (Code 634)

Oversight of Animal Feeding Operations for Manure Management Outside the Great Lakes Basin
Review Matrix Table A-2.5: North Carolina, U.S.

Regulatory requirements for storage, including monitoring and inspection	<ul style="list-style-type: none"> • Storage facilities must be designed, constructed, operated and maintained to contain all waste plus the runoff from a 25-year, 24-hour rainfall event for the location of the facility. • All earthen lagoon/storage ponds requires a protective vegetative cover on their embankments (outside toe of embankment to maximum liquid level), berms, pipe runs, and diversions to surface waters or wetlands. • Waste collection, treatment and storage structures and runoff control structures are to be inspected and documented at a frequency to insure proper operation, but at least monthly and after all storm events of greater than 1 inch in 24 hours. • Waste levels in a lagoon/storage pond must be maintained below a freeboard of 12 inches from the top of the dam (or as specified in the lagoon/storage pond design). • Temporary manure stacks must be constructed/established and maintained to prevent runoff/leachate. Storage areas must be located greater than 100ft from water wells, 200ft of portable water supply wells, and 75ft from private water supply wells. Shall not be located within 400ft of community water supply wells. Certification of design must be signed off by a technical specialist.
Regulatory requirements for land application of manure	<ul style="list-style-type: none"> • Land application of manure must be in accordance with the operation's Certified Animal Waste Management Plan. Any violation of the Plan is considered a violation of the permit and is subject to enforcement actions. • Land application rates cannot exceed the agronomic rate of the nutrient of concern for the receiving crop, and cannot result in excessive ponding or any runoff during any given application event. • If manure or sludges are applied on conventionally tilled bare soil, the waste must be incorporated into the soil within 2 days after application or prior to the next rainfall event, whichever occurs first. • Land application requirements for both manure and fertilizer are largely the same, as these requirements centre around the amounts of nitrogen and phosphate that may be applied, rather than volumes or weight of manure and fertilizer.
Restrictions for land application of manure	<ul style="list-style-type: none"> • Waste shall not be applied on land that is flooded, saturated with water, frozen or snow-covered at the time of land application. • Application is prohibited during precipitation events. The permittee shall consider pending weather conditions in making the decision to land apply waste and shall document weather conditions at the time of land application. • Land application of manure must cease within 4 hours of the time that the National Weather Service issues a Hurricane Warning, a Tropical Storm Warning, or a Flood Watch. • Manure cannot be applied directly onto crops for direct human consumption that do not undergo further processing (e.g., strawberries, melons, lettuce, etc.).
Regulatory requirements for land application - acreage requirements	<p>No acreage requirements based on manure volume or nutrient content were identified.</p> <p>However, land application rates cannot exceed the agronomic rate of the nutrient of concern for the receiving crop, and must be in accordance with the operation's approved Certified Animal Waste Management Plan.</p>
Regulatory requirements for land application - procedures and protocols for testing of manure	<p>An analysis of a representative sample of animal waste to be applied shall be sampled and tested close to the time of application and at least within 60 days of the date of application.</p>
Regulatory requirements for land application - procedures and protocols for testing of soils on which manure is applied	<p>A representative Standard Soil Fertility Analysis, including pH, phosphorus, copper, and zinc shall be conducted on each application field receiving animal waste, and analysis shall be conducted every three years, sampled by a certified technician, and tested by an accredited lab.</p>

Oversight of Animal Feeding Operations for Manure Management Outside the Great Lakes Basin
Review Matrix Table A-2.5: North Carolina, U.S.

Regulatory requirements for manure disposal	Manure must be applied to fields by a certified applicator and require a permit for the specific land before application. A certified manure hauler is required for transport of manure from one site to another for application, treatment, or disposal.
Nutrient management plans	Certified Animal Waste Management Plan (CAWP) requires the applicant's livestock numbers, technical specialist certifications, certification of installation of animal feeding operation infrastructure, and emergency plans. The infrastructure and animal feeding operations plans must be approved by a technical specialist before submission, and will be followed by an onsite visit before approval. These plans are site specific and are not available online.
Best management practices	The State of North Carolina Department of Environmental Quality Division of Water Resources lists four nutrient BMPs. These are referred to as the 4Rs—Right rate, Right timing, Right source, and Right placement. Additional BMPs should be used to control nutrients as they move from application area to the water resource. Put together, these BMPs form a system to avoid, control, and trap nutrients. These BMP are voluntary and are not required for submission of permits.
Compliance, Monitoring and Enforcement	
How are permitting requirements enforced	<ul style="list-style-type: none"> • When submitting an application for the Animal Feeding Operations permit, the land owner/renter agrees to let a representative of the State of North Carolina DEQ Division of Water Resources on site at a minimum of once a year; • Any violations of the permit and/or the animal waste management plan may result in a requirement to revise the waste management plan, a cessation of land application of manure, the removal of animals from the facility, or the permit being reopened and modified, revoked and reissued, and/or terminated.
Inspections	<ul style="list-style-type: none"> • Inspections of each facility are conducted once per year. • Inspectors check for any violations of water quality standards, compliance with animal waste management plans, and compliance with all other plan conditions; • Additional investigations may be conducted as needed to follow up on corrective actions or to investigate complaints.
Complaints	Environmental complaints about odour, noise, water quality, or soil quality issues should be directed to the North Carolina Department of Environmental Quality.
Input from Public Stakeholders and Indigenous Communities	
Notification of a proposed new animal feeding operation	No requirements were identified regarding the notification and consultation with nearby landowners or the broader public.
Indigenous communities	No distinct process was identified for notifying, consulting and engaging Indigenous communities regarding an animal feeding operation.
Role of Indigenous people in regulatory and enforcement oversight, and how regulatory agencies coordinate with Indigenous people	No distinct process was identified regarding the role and involvement of Indigenous communities in regulatory and enforcement oversight.
Public access to records	Records of Animal Feeding Operations can be found online at the North Carolina Department of Environmental Quality Website https://deq.nc.gov/cafo-map . A map and list of permitted animal facilities are listed. Does not disclose manure application areas.

Oversight of Animal Feeding Operations for Manure Management Outside the Great Lakes Basin
Review Matrix Table A-2.5: North Carolina, U.S.

Funding	
Funding and/or incentives for manure management	The North Carolina Department of Agriculture and Consumer Services has an Agriculture Cost Share Program (ACSP) to provide farmers with 75% cost coverage for implementing Best Management Practices specific to this program. Eligible recipients must own or rent an existing agricultural operation for more than 3 years. There are some cost share and acreage restrictions depending on the BMPs used, the type of operation involved, or policy set by the local soil and water conservation district or the N.C. Soil and Water Conservation Commission. Cost share incentive payments are also available to encourage the use of certain agronomic management practices. The BMPs for Manure Management can be found under Waste Management Measures in the list.
Other	
Are there non-government nutrient management programs that include manure application elements (organized voluntary efforts, best practices guidelines, farm assistance programs, etc.)	The Agricultural Water Resources Assistance Program (AgWRAP) was authorized through Session Law 2011-145. The program is administered by the NC Soil and Water Conservation Commission through local soil and water conservation districts. The purposes of the AgWRAP are to identify opportunities to increase water use efficiency, availability and storage, implement best management practices (BMPs) to conserve and protect water resources, increase water use efficiency, and increase water storage and availability for agricultural purposes.
Nutrient release reduction targets related to manure being developed by individual and collective state/provincial water quality management agencies	No nutrient release reduction targets related to manure were identified.
Are there permit requirements that indirectly impact manure produce, storage, management and application	<ul style="list-style-type: none"> Any animal feeding operation that plans to discharge from the production area or land application area must have coverage under an Animal Waste National Pollution Discharge Elimination System Permit. Most other facilities with certain threshold animal numbers will require coverage under an Animal Waste State Permit. Both of these permits help to protect waters of the state through compliance with state and federal water quality laws regarding direct discharges of wastewater. A Water Withdrawal & Transfer Registration is required for agricultural water user who withdraws more than 1 million gallons of groundwater or surface water in any given day, or who transfers 1 million gallons or more of surface water in any given day from one river basin to another. Water usage must be reported directly to the Department of Environment and Natural Resources.

Oversight of Animal Feeding Operations for Manure Management Outside the Great Lakes Basin
Review Matrix Table A-2.6: Netherlands

Regulators, legislation	
Agencies responsible for regulatory and enforcement oversight	<ul style="list-style-type: none"> The Ministry of Infrastructure and the Environment is responsible for developing policies for manure production, use, storage and disposal. Occurs predominantly at the federal level. The municipalities have the power and financial means to develop, implement, and enforce local policy on spatial planning and the environment.
Definitions, quantifications, etc. for permitting purposes	
How are manure requirements defined within the jurisdiction, including scale of farm, definition of animal/livestock units	<ul style="list-style-type: none"> Approximately 80% of Dutch environmental legislation derives from legislation established by the European Union (EU). Requirements under the country's manure policy surrounding manure livestock operations and manure management derive from the EU's 1991 Nitrates Directive, whose objective is the reduction and prevention of water pollution caused or induced by nitrates from agricultural sources. Under the Dutch Manure Policy, all agricultural operations must be registered with the Netherlands Enterprise Agency, and must maintain records on the production, supply, disposal and use of fertilizers, including manure. Small companies are exempted from the record-keeping and registration requirements of the Dutch manure policy. A small company is one that does not produce or supply more than 350 kg of nitrogen in animal fertilizers per year, and consists of less than 3 hectares of agricultural land in a given year. "Pig units" and "poultry units" assign a numerical value to pigs and poultry based on age and size. Younger/smaller individuals are generally worth a smaller number of pig/poultry units compared to older/larger individuals.
How are manure volumes estimated, including estimates of animal turnover and weights	<p>Table 4 of the Dutch Manure Policy outlines manure production for various types of livestock, estimated as volume of manure produced during the period August 1 - March 1 (the standard used to calculate the required manure storage capacity). E.g.,</p> <ul style="list-style-type: none"> One bull (1 yr and older): 7.6 m³ One sheep: 0.5 m³ One pig raised for meat: 0.71 m³ One broiler chicken (20 weeks or older): 0.018 m³
How manure volume and nutrient content among livestock type and stages of livestock vary	<ul style="list-style-type: none"> Livestock operations can have the nutrient content (nitrogen and phosphate) measured by an accredited laboratory, or use Table 5 of the Dutch Manure Policy to determine how many kilograms of nitrogen and kilograms of phosphate are in each ton of manure for various livestock types. <p>Table 4 of the Dutch Manure Policy outlines manure production in kilograms of nitrogen and kilograms of phosphate, for various types of livestock. E.g.,</p> <ul style="list-style-type: none"> One bull (1 yr and older): 72.2 kg N and 25.9 kg phosphate per day One sheep: 9.9 kg N, 3.3 kg phosphate per day One pig raised for meat: 11.1 kg N per day One broiler chicken (20 weeks or older): 0.45 - 0.68 kg N per day
Regulatory requirements	
Regulatory triggers - criteria for manure to be subject to regulation/permitting	<ul style="list-style-type: none"> Operations producing or supplying less than 350 kg of nitrogen in animal fertilizers per year, and which consists of less than 3 hectares of agricultural land in a given year, is exempted from the record-keeping and registration requirements of the Dutch manure policy.

Oversight of Animal Feeding Operations for Manure Management Outside the Great Lakes Basin
Review Matrix Table A-2.6: Netherlands

Regulatory requirements for storage, including monitoring and inspection	<ul style="list-style-type: none"> • Operations that store manure must be registered with the Netherlands Enterprise Agency. The registration must include details such as the storage capacity of the storage structures. • There are structural regulations for manure storage tanks, the details of which vary depending on the type of manure basin. The regulations are centered around controlling ammonia and odour emissions and soil contamination. • For each storage area, records must be maintained of the origin of the manure and the destination after its removal, the dates and volumes of manure transferred in and out of each storage area, and the size of the storage areas. Records must be maintained for at least 5 years. • The provincial or municipal authority must be notified of soil remediation procedures if contaminated soil exceeding 50 m³, or contaminated groundwater exceeding 1,000 m³ is identified.
Regulatory requirements for land application of manure	<ul style="list-style-type: none"> • The EU Nitrates Directive sets a usage standard for the use of animal manure at a maximum of 170 kg of nitrogen per hectare. Member States may obtain a derogation to exceed the limit, under strict conditions. In the Netherlands, for the period 2014 - 2017, a farm may register to increase the application limit to 230 or 250 kg of nitrogen per hectare, provided it meets the conditions for derogation; e.g. preparation of a fertilization plan, a minimum of 80% of the total area of agricultural land must consist of grassland, etc. The Dutch government is seeking a renewed derogation for the period 2018 - 2021. • Land application requirements for both manure and fertilizer are largely the same, as these requirements centre around the amounts of nitrogen and phosphate that may be applied, rather than volumes or weight of manure and fertilizer.
Restrictions for land application of manure	<ul style="list-style-type: none"> • Organic fertilizers, including manure, cannot be spread between September 1 and January 31. Exemptions may be granted for research purposes. • Manure may not be applied on soil that is frozen and/or covered with soil, saturated, or on a gradient exceeding 7% (for cultivated land, land affected by channel erosion and uneven crop cover) or 18% (for arable land).
Regulatory requirements for land application - acreage requirements	<ul style="list-style-type: none"> • The maximum amount of manure that can be applied per hectare of arable farmland depends on: whether or not the operation applied for derogation; the soil's existing nutrient content (nitrogen or phosphorus); the soil type and the crop type. • Livestock operations must calculate their available usage space, which excludes areas such as non-arable land (paved areas, manure storage facilities, etc.), recreational areas, manure-free zones along watercourses, etc.
Regulatory requirements for land application - procedures and protocols for testing of manure	<ul style="list-style-type: none"> • The requirement to test manure arises when the manure is to be transported. • As of October 1, 2017, manure sampling must be performed by organizations accredited by the Dutch Accreditation Council and recognized by the Netherlands Enterprise Agency. Analysis of the samples must also be conducted by accredited and recognized laboratories. • The sampling organization must maintain records such as the date and location of the sampling, the person who conducted the sampling, sample numbers, and sampling methodology. The data must be archived for at least 5 years. • Laboratories must submit analytical results of manure samples to the Netherlands Enterprise Agency. The results are also provided to the producer and hauler of the manure. Samples are maintained at the laboratory for at least 14 days after submitting the analytical data.
Regulatory requirements for land application - procedures and protocols for testing of soils on which manure is applied	<ul style="list-style-type: none"> • If a business activity (such as livestock operations) may result in the release of contaminants to the soil, a baseline soil quality survey must be conducted prior to the activity taking place. Another soil quality survey must be conducted at the end of the activity. Should the results indicate that the soil was impaired or contaminated as a result of the business activity, remedial action must be taken. Soil contamination or impairment must be reported to provincial and municipal authorities.

Oversight of Animal Feeding Operations for Manure Management Outside the Great Lakes Basin
Review Matrix Table A-2.6: Netherlands

Regulatory requirements for manure disposal	<ul style="list-style-type: none"> • Due to insufficient land area in the Netherlands compared to the volume of manure produced, "manure fraud" is a pervasive issue, and the trade and transport of manure is strictly regulated. • Manure haulers must be registered with the Netherlands Enterprise Agency. Trucks transporting manure must have obtained a "consignment note" from the Agency, and the vehicles must be equipped with GPS and Automatic Data Registration Equipment. Details regarding hauling activities must be reported on an annual basis to the Agency. • Records must be maintained documenting the origin, destination, use, quantity and nitrogen and phosphate content of the hauled manure. The information must be produced upon request. • If manure is to be transported out of the Netherlands, the manure must be sampled during loading. If it is to be transported within the country, the manure must be sampled upon unloading. • Manure producers may need to pay the receiving landowner(s) to accept their surplus manure. • Identification of disposal methods, volumes, etc. must occur prior to transport of excess manure, but does not appear to be required at earlier stages (e.g. when applying to start an agricultural business).
Nutrient management plans	<ul style="list-style-type: none"> • Farms that are approved for derogation (increasing the nitrogen application limit above 170 kg/ha) must prepare a fertilization plan, that demonstrates how the application standards for the use of manure and fertilizer will be met. • Fertilization plans may be prepared by the proponent or by a specialized consultant. The plans do not need to be submitted for review and approval, but must be retained for at least five years. • No requirements were identified for making the fertilization plans publicly available.
Best management practices	<ul style="list-style-type: none"> • Per the requirements of the 1991 Nitrates Directive, Member States must develop a code of good agricultural practices, which farmers may apply on a voluntary basis. Annex II of the Nitrates Directive list the minimum requirements of a Member State's code, such as the identification of periods when land application of fertilizer is inappropriate, land application near watercourses, and the capacity and construction requirements of manure storage vessels.
Compliance, Monitoring and Enforcement	
How are permitting requirements enforced	<ul style="list-style-type: none"> • Livestock operations are responsible for maintaining proper records. The Netherlands Enterprise Agency and the Dutch Food and Consumer Product Safety Authority conduct random checks and/or site visits to verify the operation's compliance with the manure policy. Contraventions are reported to the Netherlands Enterprise Agency; if the livestock operation disputes the conclusion that a contravention occurred, they may appeal the report. • Fines may be issued if application standards are exceeded. The size of the fine will vary depending on the severity of the exceedance. Failure to pay a fine may result in the operation's registration being suspended until payment is made. • Significant fraud cases may be subject to criminal investigations. • Applications to register a manure hauling service or a storage facility may be refused if the Netherlands Enterprise Agency considers the risk of contraventions to be too great. An existing registration may similarly be revoked if a contravention has occurred.
Inspections	<ul style="list-style-type: none"> • Inspections are conducted by the Netherlands Enterprise Agency and the Netherlands Food and Consumer Product Safety Authority. Over 4,000 inspections were carried out in 2016, which resulted in 527 administrative fines and the issuance of 124 criminal law reports.
Complaints	<ul style="list-style-type: none"> • Odour nuisances can be reported to the municipality and/or through the provincial environmental complaints line. No further information was identified on the protocol following the submission of a complaint.

Oversight of Animal Feeding Operations for Manure Management Outside the Great Lakes Basin
Review Matrix Table A-2.6: Netherlands

Input from Public Stakeholders and Indigenous Communities	
Notification of a proposed new animal feeding operation	<ul style="list-style-type: none"> • No requirements were identified regarding the notification and consultation with nearby landowners or the broader public.
Indigenous communities	<ul style="list-style-type: none"> • Not applicable; the Netherlands do not have an indigenous people that is distinct from, and historically colonized by, the Dutch.
Role of Indigenous people in regulatory and enforcement oversight, and how regulatory agencies coordinate with Indigenous people	<ul style="list-style-type: none"> • Not applicable; the Netherlands do not have an indigenous people that is distinct from, and historically colonized by, the Dutch.
Public access to records	<ul style="list-style-type: none"> • No information was identified regarding the public access to permit records, operations, etc.
Funding	
Funding and/or incentives for manure management	<ul style="list-style-type: none"> • As of March 2017, as one of several strategies for bringing the country's phosphate production under the European production ceiling, dairy farms are assigned a target every other month for reducing the number of cows at their operations. Those who fail to meet the targets would be required to pay a penalty, while those who meet the targets are offered a bonus. Additionally, producers who voluntarily leave the dairy farming business are eligible for a bonus paid through a grant scheme.
Other	
Are there non-government nutrient management programs that include manure application elements (organized voluntary efforts, best practices guidelines, farm assistance programs, etc.)	<ul style="list-style-type: none"> • In 2009, the agricultural industry, NGOs, the Dutch government and research institutes committed to the Implementation Agenda for Sustainable Livestock, with the goal of making Dutch livestock production fully sustainable by 2023. One of the focus areas involves the improved and environmental safe use of manure.
Nutrient release reduction targets related to manure being developed by individual and collective state/provincial water quality management agencies	<ul style="list-style-type: none"> • The Dutch manure policy sets a limit of 50 mg of nitrate per litre in groundwater. • The Dutch Phosphate Reduction Plan, approved by the European Commission in February 2017, is targeting the reduction of phosphate emissions by 10.8 million kg through various measures such as decreasing phosphorus content in livestock feed, reducing herd sizes, and incentivizing the export of cattle out of the country. The Phosphate Reduction Plan was developed in order to allow the Netherlands to retain its derogation under the Nitrates Directive for 2017.
Are there permit requirements that indirectly impact manure produce, storage, management and application	<ul style="list-style-type: none"> • A water permit is required for extracting groundwater, and for discharging waste water directly into surface water. Operation of a manure treatment plant can be expected to require a water permit.

Oversight of Animal Feeding Operations for Manure Management Outside the Great Lakes Basin
Review Matrix Table A-2.7: Denmark

Regulators, legislation	
Agencies responsible for regulatory and enforcement oversight	<ul style="list-style-type: none"> • The Danish Agricultural Agency, an agency under the Ministry of Environment and Food, has jurisdiction over the regulation of nutrients in agriculture, including the implementation and enforcement of the Danish Nitrates Action Programme. • Municipalities have a role in approving or rejecting livestock operations, and imposing terms and conditions on the approval. • The Danish Environmental Protection Agency reviews and approves or rejects environmental impact assessments for proposed new or expanded livestock operations.
Definitions, quantifications, etc. for permitting purposes	
How are manure requirements defined within the jurisdiction, including scale of farm, definition of animal/livestock units	<ul style="list-style-type: none"> • The Danish Nitrates Action Programme is derived from the European Union's 1991 Nitrates Directive. • The Danish "harmony rules" aim to achieve a balance between the use of manure and fertilizer with the size of the land application area. The rules apply to commercial livestock operations, or operations that use and/or store manure from a commercial livestock operation. Minimum size requirements to be considered a commercial livestock operation are defined for various species (e.g. 30 chickens, 4 horses with accompanying foals, etc.). • One livestock unit (LU) is equivalent to 100 kg of nitrogen in livestock manure in the best modern production system with the lowest ammonia emission.
How are manure volumes estimated, including estimates of animal turnover and weights	<ul style="list-style-type: none"> • Nationally-defined standards are used to estimate manure volumes. Operations are required to report the livestock types and headcounts and land application areas on an annual basis through the Fertilizer Accounting System, which determines manure volumes and nutrient application limits for a given operation.
How manure volume and nutrient content among livestock type and stages of livestock vary	<ul style="list-style-type: none"> • The Danish Food and Agricultural Package identifies phosphorus application limits in kg P/ha for select types of livestock operations (poultry, mink, slaughter pigs, sows and piglets, and cattle). • Every year, the Danish Agricultural Agency publishes guidelines to farmers, including nitrogen fertilization standards for different crop types, the standard nitrogen and phosphorus contents in the manure of different livestock types, and the efficiency rate of various types of manure for nitrogen fertilization. The guidelines are used to determine the maximum amount of nitrogen and phosphorus that may be used on a farm within a cropping season. • Livestock types, ages and functions, and housing systems are taken into account in the nationally defined standards of nitrogen and phosphorus content in manure (Table 5 of the Guidance on Fertilizer and Harmony Rules). E.g., <ul style="list-style-type: none"> - One cow (over 600 kg): 22.7 - 72.1 kg of nitrogen, 0.9 - 7.7 kg of phosphorus, and 15.2 - 90.6 kg of potassium. - 10 pigs: 24.3-25.9 kg of nitrogen, 6.35-6.37 kg of phosphorus, and 13.9-14.2 kg of potassium. - One sheep: 14.6 kg of nitrogen, 3.1 kg of potassium, and 30.5 kg of phosphorus. - 100 chickens: 5.48-5.68 kg of nitrogen, 2.59-2.82 kg of phosphorus, and 3.64-4.09 kg of potassium.

Oversight of Animal Feeding Operations for Manure Management Outside the Great Lakes Basin
Review Matrix Table A-2.7: Denmark

Regulatory requirements	
Regulatory triggers - criteria for manure to be subject to regulation/permitting	<ul style="list-style-type: none"> • The establishment, expansion or modification of a livestock operation must give notice or receive a permit complying with the Environmental Approval Act of Livestock Holdings. The Act sets minimum thresholds for ensuring environmental protection in terms of odour and ammonia emissions from livestock animal housing systems. • The establishment of catch crops may be required for operations using manure if they are located in the catchment areas of "Natura 2000" areas (designated nature protection areas in the EU). • The majority of agricultural holdings are required to register with the Fertilizers Accounting System and report their phosphorus and nitrogen production, use, storage and transfer on an annual basis. Registration is mandatory for a large proportion of agricultural operations in the country and is voluntary for others, depending on annual monetary turnover and the amount of livestock manure at the farm level (i.e. farms with more than 10 animal units, a density of 1 animal unit/ha or more, or that receive more than 25 tonnes/yr of manure or other organic fertilizer must register). Farms that are not required to be registered are generally small and have insignificant nitrates emissions; they farm approximately 3.9% of the total agricultural area in the country, and have an average size of approximately 9.3 ha. • All livestock holdings with more than 3 livestock units (LU) are subject to the requirements of the Danish Order, which regulates all relevant environmental issues concerning the storage of manure. The threshold of 3 LU applies regardless of the acreage of the holding and regardless of whether or not the holding is registered in the Fertilizers Accounting System.
Regulatory requirements for storage, including monitoring and inspection	<ul style="list-style-type: none"> • Manure storage facilities must have a minimum capacity equivalent to 6 months of storage, and meet other specifications outlined in the Danish Act on Livestock and the Use of Fertilizers. • Storage of livestock manure must be reported on an annual basis in the Fertilizers Accounting System. • Farms with a slurry tank with a capacity greater than 100 m³ must have their tank inspected at least once every 10 years by an authorized inspector. The frequency of inspection is increased to every 5 years if the tank is located within 100 m of a water body.
Regulatory requirements for land application of manure	<ul style="list-style-type: none"> • The Danish "harmony rules" establish the minimum area that a livestock operation must have available for spreading the manure produced by said operation. The requirement is defined as a limitation in livestock units per hectare. From 2002 to 2017, the harmony rules set a limit of 1.4 LU/ha for holdings producing pigs, poultry and fur-bearing animals. In 2017, the harmony rules were relaxed in order to align it with the requirements of the Nitrates Directive, such that the new limit became 170 kg N/ha (equivalent to 1.7 LU/ha). • EU Member States may obtain a derogation to exceed the limit of 170 kg N/ha, under strict conditions. Denmark was approved for a derogation in 2002, allowing individual operations to apply up to 230 kg N/ha if more than 2/3 of the manure is cattle manure, and more than 70% of the area is covered by grass, and the increased application poses no additional environmental risk. The current derogation expires on December 31, 2018. • In 2017, new land acreage requirements were established for the phosphorus content in fertilizers and manure. The limits range from 30 to 43 kg P/ha, depending on the type of livestock (e.g. for poultry, 43 kg of phosphorus can be applied per hectare. The limit is 35 kg P/ha for cattle). • Land application requirements for both manure and fertilizer are largely the same, as these requirements centre around the amounts of nitrogen and phosphate that may be applied, rather than volumes or weight of manure and fertilizer.
Restrictions for land application of manure	<ul style="list-style-type: none"> • Per the Danish Nitrates Action Programme (2017), manure cannot be applied to soil that is saturated, flooded, frozen or snow-covered. • Liquid manure cannot be applied between the time of harvest and February 1 (March 1 for perennial crops). Solid manure cannot be applied from harvest to October 20; winter application of solid manure is only permitted for winter crop. • Manure cannot be applied on sloping soils if there is a risk of runoff into lakes and watercourses. • On flat terrain, a buffer of at least 2 m must be maintained between the area of manure application and water bodies; the buffer increases to at least 20 m if applying manure on sloping soils. • Manure must be incorporated into the soil within 6 hours of application.

Oversight of Animal Feeding Operations for Manure Management Outside the Great Lakes Basin
Review Matrix Table A-2.7: Denmark

Regulatory requirements for land application - acreage requirements	<ul style="list-style-type: none"> The maximum amount of manure that can be applied on land is determined as a maximum mass in kg of nitrogen or phosphorus that can be applied per hectare of land. This value depends in part on crop type, soil type, climatic conditions, precipitation, irrigation methods (if used), and whether the farm is approved for derogation.
Regulatory requirements for land application - procedures and protocols for testing of manure	<ul style="list-style-type: none"> Testing of manure may occur as part of the Danish Agricultural Agency's inspections of large farms registered in the Fertilizers Accounting System. No other requirements for manure testing were identified.
Regulatory requirements for land application - procedures and protocols for testing of soils on which manure is applied	<ul style="list-style-type: none"> Permission to increase the phosphorus application limit may be obtained for soils with a low existing phosphorus content. The low phosphorus content must be demonstrated through the analysis of soil samples that are no more than 5 years old and which were collected at least every 5 hectares. Farms that are approved for derogation (i.e. allowed to apply up to 230 kg N/ha) must have their soil tested for nitrogen and phosphorus content every 3 years.
Regulatory requirements for manure disposal	<ul style="list-style-type: none"> If fertilizer is to be transferred to another agricultural operation, the transfer agreement, signed by the supplier and receiver, must include details such as the phosphorus ceiling limits of the farm of origin, and the total amount of phosphorus in the transferred fertilizer.
Nutrient management plans	<ul style="list-style-type: none"> Operations that are registered in the Fertilizers Accounting System must prepare a fertilizer plan before the start of the growing season. The purpose of the plan is to calculate an operation's nitrogen quota, the phosphorus requirement and the area with mandatory crops. The plan must therefore indicate which fields and crops are to be cultivated. Plans must be updated on an as-need basis. Fertilizer plans must be maintained for 5 years. Operations that are registered in the Fertilizers Accounting System must submit an annual report that documents the amounts of nitrogen and phosphorus that were produced, received, stored, delivered, etc. in the past year. Operators input information such as the number and types of animals, animal housing facilities, storage and transfer of manure, etc., based on which the Accounting System determines the amounts of nitrogen and phosphorus involved. Annual reports can be viewed online on the website of the Ministry of Environment and Food. Fertilizer plans do not appear to be available for public viewing.
Best management practices	<ul style="list-style-type: none"> Per the requirements of the 1991 Nitrates Directive, Member States must develop a code of good agricultural practices, which farmers may apply on a voluntary basis. Annex II of the Nitrates Directive list the minimum requirements of a Member State's code, such as the identification of periods when land application of fertilizer is inappropriate, land application near watercourses, and the capacity and construction requirements of manure storage vessels.
Compliance, Monitoring and Enforcement	
How are permitting requirements enforced	<ul style="list-style-type: none"> The Danish Agricultural Agency ensures compliance with the harmony rules through reviews of submitted fertilizer accounts and/or inspections. All submitted fertilizer accounts undergo an automated review according to a predefined set of risk criteria. Municipalities have the authority to supervise a livestock operation's compliance with the conditions of a permit, and to notify the Ministry of Environment and Food of any violations. Violations of legislation or the conditions of an approval are punishable by fines, and may escalate to imprisonment of up to 2 years for significant offences that were committed intentionally and/or through gross negligence.

Oversight of Animal Feeding Operations for Manure Management Outside the Great Lakes Basin
Review Matrix Table A-2.7: Denmark

Inspections	<ul style="list-style-type: none"> • The Danish Agricultural Agency conducts inspections of larger farms registered in the Fertilizers Accounting System. Approximately 1.9% of agricultural holdings undergo on-site inspections each year. The inspections cover crop rotation planning, plant cover and catch crops, integrated fertilizer accounting and planning, and provisions for the land application of manure. On-site inspections may also involve the collection of soil or manure samples for laboratory testing. Operations are randomly selected for inspection based on various risk criteria, and may or may be announced in advance. • Municipalities are responsible for environmental inspections of smaller farms that are not required to be registered in the Fertilizers Accounting System. All livestock farms with more than 3 livestock units must be inspected regularly (every 3-6 years). The frequency of inspection is selected based on the size of the farm and by a systematic appraisal of the environmental risks. • Farms with a slurry tank with a capacity greater than 100 m³ must have their tank inspected at least once every 10 years by an authorized inspector. The frequency of inspection is increased to every 5 years if the tank is located within 100 m of a water body.
Complaints	<ul style="list-style-type: none"> • Nuisance-related complaints are directed to the municipality in which the nuisance took place. No further information was identified on the protocol following the submission of a complaint.
Input from Public Stakeholders and Indigenous Communities	
Notification of a proposed new animal feeding operation	<ul style="list-style-type: none"> • When a new livestock operation is proposed, the applicable municipality notifies the public and other affected authorities of the proposal and of the applicable public consultation process. • After the review of a livestock operation's environmental impact assessment, the Danish Environmental Protection Agency announces their decision on the agency's website. • The decision can be appealed by directly affected parties or any other interested member of the public.
Indigenous communities	<ul style="list-style-type: none"> • Not applicable; Denmark's only recognized Indigenous group, the Inuit, are located in Greenland, which is outside the scope of this assessment.
Role of Indigenous people in regulatory and enforcement oversight, and how regulatory agencies coordinate with Indigenous people	<ul style="list-style-type: none"> • Not applicable; Denmark's only recognized Indigenous group, the Inuit, are located in Greenland, which is outside the scope of this assessment.
Public access to records	<ul style="list-style-type: none"> • Fertilizer accounts are published online after the submitted information is processed, and remains online for a period of 5 years. Manure transfer agreements are not published.
Funding	
Funding and/or incentives for manure management	<ul style="list-style-type: none"> • The Danish Agricultural Agency administers the Rural Development Program (2014-2020), which itself is derived from the EU's Common Agricultural Policy. The program, with funding provided by both the EU and the Danish government, includes financial support to farmers to operate in an environmentally sustainable manner, such as by adopting new technology, updating equipment, adjusting crop rotation, etc.

Oversight of Animal Feeding Operations for Manure Management Outside the Great Lakes Basin
Review Matrix Table A-2.7: Denmark

Other	
Are there non-government nutrient management programs that include manure application elements (organized voluntary efforts, best practices guidelines, farm assistance programs, etc.)	<ul style="list-style-type: none"> The Baltic Manure Project involved a collaboration of researchers, developers and industry, whose goals included the improvement of manure handling, processing and spreading, development in renewable energy and the reduction of environmental load from agriculture into the Baltic Sea. Danish participants in the project included Aarhus University and the University of Southern Denmark. The project ran from 2010 - 2013.
Nutrient release reduction targets related to manure being developed by individual and collective state/provincial water quality management agencies	<ul style="list-style-type: none"> A Food and Agricultural Package was agreed to by the Danish government on December 2015, which would see the creation of a new environmental regulation for agriculture by August 2019. The new regulation would establish farm-specific restrictions on nitrogen leaching, based on nitrogen targets of the various coastal water bodies in Denmark. Each farm will be appointed a leaching permit to the environment, which will set the maximum nitrogen leaching from the root zone in kg N per hectare. Farmers will be able to choose from a selection of leaching-reduction techniques (e.g. catch crops, buffer strips, reduced N application) in order to comply with the leaching permit. Compensation will be provided for the costs involved in complying with the reduced leaching permit.
Are there permit requirements that indirectly impact manure produce, storage, management and application	<ul style="list-style-type: none"> The Danish Water Supply Act ensures that the use and protection of groundwater occurs under a coordinated approach, and establishes drinking water quality standards for the protection of human health. Approx. one-third of groundwater withdrawals in the country are for agricultural purposes. Approval is required to install a new groundwater well, and taxes and restrictions are imposed on the removal of groundwater.

APPENDIX B

Oversight of Animal Feeding Operations for Manure Management – Evaluation Matrices



Oversight of Animal Feeding Operations for Manure Management – Evaluation Matrices
Table B-1: Jurisdictions Within the Great Lakes Basin

	Ontario (Canada)	US Federal	New York	Pennsylvania	Ohio	Indiana	Illinois	Michigan	Wisconsin	Minnesota
Regulators, legislation										
<i>Rating:</i>	3	3	3	3	3	3	3	3	3	3
<i>Comment:</i>	Both provincial and municipal regulators have comprehensive involvement in oversight, permits, approvals and/or enforcement and there is some coordination between the different regulatory agencies. However, federal regulators are not significantly involved.	Federal EPA sets the ground rules of the NPDES permits for CAFOs. States must follow these initial regulations but the delegated agency may add more to the regulations as they see fit.	Both Federal and State levels are involved in oversight, permits, approvals, and/or enforcement and there is some coordination between the different regulatory agencies. Federal EPA sets forth original regulations and State levels add more regulation depending on their personal state's needs.	Both Federal and State levels are involved in oversight, permits, approvals, and/or enforcement and there is some coordination between the different regulatory agencies. Federal EPA sets forth original regulations and State levels add more regulation depending on their personal state's needs.	Both Federal and State levels are involved in oversight, permits, approvals, and/or enforcement and there is some coordination between the different regulatory agencies. Federal EPA sets forth original regulations and State levels add more regulation depending on their personal state's needs.	Both Federal and State levels are involved in oversight, permits, approvals, and/or enforcement and there is some coordination between the different regulatory agencies. Federal EPA sets forth original regulations and State levels add more regulation depending on their personal state's needs.	Both Federal and State levels are involved in oversight, permits, approvals, and/or enforcement and there is some coordination between the different regulatory agencies. Federal EPA sets forth original regulations and State levels add more regulation depending on their personal state's needs.	Both Federal and State levels are involved in oversight, permits, approvals, and/or enforcement and there is some coordination between the different regulatory agencies. Federal EPA sets forth original regulations and State levels add more regulation depending on their personal state's needs.	Both Federal and State levels are involved in oversight, permits, approvals, and/or enforcement and there is some coordination between the different regulatory agencies. Federal EPA sets forth original regulations and State levels add more regulation depending on their personal state's needs.	Both Federal and State levels are involved in oversight, permits, approvals, and/or enforcement and there is some coordination between the different regulatory agencies. Federal EPA sets forth original regulations and State levels add more regulation depending on their personal state's needs.
Definitions, quantifications, etc. for permitting purposes										
<i>Rating:</i>	3	3	3	3	3	3	3	3	3	3
<i>Comment:</i>	There are very detailed comprehensive permit requirements that include consideration of animal weights, type of livestock and age to support manure requirements, scale of farm with respect to animal/livestock units, estimation of manure volumes and nutrient content. In addition to storages, it addresses transfer systems and contaminated runoff/washwater control. P Index, while a BMP, is not directly included in the permitting process.	Federal EPA sets forth regulations defining animal thresholds - the definition follows defensible data that includes consideration of animal turnover, weights, type of livestock and age to support manure requirements.	US EPA sets forth the definition for animal thresholds - which follows defensible data that includes consideration of animal turnover, weight, type of livestock and age to support manure requirements.	Pennsylvania State University Extension defines an Animal Equivalent Unit (AEU) as “1,000 pounds of live weight of any animal on an annual basis.”	US EPA sets forth the definition for animal thresholds - which follows defensible data that includes consideration of animal turnover, weight, type of livestock and age to support manure requirements.	US EPA sets forth the definition for animal thresholds - which follows defensible data that includes consideration of animal turnover, weight, type of livestock and age to support manure requirements.	The Illinois Department of Agriculture sets calculation standards for animal number thresholds. <ul style="list-style-type: none">• Mature dairy cow (1.4)• Dairy heifers and calves (0.6)• Feeder cows (1.0)• Swine over 55 lb (0.4)• Swine under 55 lb (0.03)• Laying hens/broilers – liquid manure system (0.03)• Ducks (0.02)	Michigan DEQ sets a threshold of animal for groundwater permits as follows: <ul style="list-style-type: none">• Slaughter/feeder cattle (including heifers and veal) – 5,000 animals• Mature dairy cattle – 3,500 animals• Hogs over 55 lb – 12,500 animals• Laying hens or broilers – 150,000 animals• Turkeys – 275,000 animals	The Wisconsin Department of Natural Resources sets thresholds for calculating animal/nutrient unit as: <ul style="list-style-type: none">• Heifers over 800 lb (1.4)• Heifers under 800 lb (1.1)• Bulls (1.4)• Steer or cows – 400 lb to market (1.0)• Veal calves (0.5)• Horse (2.0)• Sows (0.4)• Boars (0.5)	The Minnesota Department of Agriculture sets the threshold for animal unit calculation as follows: <ul style="list-style-type: none">• Slaughter steer or stock cow (1.0)• Mature dairy cows (1.4)• Swine weighing over 300 lb (0.4)• Swine between 55-300 lb (0.3)• Sheep and lambs (0.1)• Laying hen/broiler – liquid manure system (0.033)• Chicken over 5 lb – dry manure system (0.005)
Regulatory requirements										
<i>Rating:</i>	3	3	2	2	3	3	3	3	3	3
<i>Comment:</i>	The province has a comprehensive regulatory approach for farmstead requirements (manure and other wastes) and field application requirements. However, a gap exists if manure is transferred off the designated farm unit since a nutrient management plan is only required for a regulated farm unit. Also, application rules are only related to phosphorus, with no direct rules for nitrogen application.	EPA sets solid guidelines for CAFOs around issues such as manure storage, monitoring and inspection, however a lot of regulation is to be site specific and up to delegated state agencies to regulate/better define based on their specific state.	NYSDEC has broadly based or flexible regulatory requirements around the issues of siting livestock, manure storage, inspection and monitoring. NYSDEC does not specify acreage requirements, nor does it define manure testing protocols or transfer of manure. Stricter regulations have been created from the US EPA based regulations for BMP/MMP/NMP and for manure storage.	PA DEP has broadly based or flexible regulatory requirements around the issues of siting livestock, manure storage, inspection and monitoring. PA DEP elaborates on some of the EPA's requirements, however for soil/manure testing, PA DEP does not add any more requirements and overall, mainly just follows the EPA's regulations and requirements.	OEPA has requirements around the issues of siting livestock, manure storage, inspection and monitoring. OEPA broadens the land application requirements of manure but does not elaborate on manure storage, acreage needed or protocols for manure testing.	Prescribed regulatory requirements around the issues of siting livestock operations, manure storage, monitoring, and inspection - IDEM elaborates on all categories of regulations set forth by the federal EPA with some discretionary interpretation in respect to regulatory requirements.	Prescribed regulatory requirements around the issues of siting livestock operations, manure storage, monitoring, and inspection – IEPA more heavily enforces storage requirements as well as requirements for land application and provides resources for proper NMPs/BMPs. There is some discretionary interpretation with respects to the regulatory requirements.	Prescribed regulatory requirements around the issues of siting livestock operations, manure storage, monitoring, and inspection - MDEQ incorporates stricter regulations with concerns to manure transfer, NMPs, and manure testing. There is some discretionary interpretations in respect to the regulatory requirements, specifically acreage needed for manure land applications.	WI DNR has regulatory requirements around the issues of siting livestock, manure storage, inspection and monitoring. WI DNR does not elaborate on BMPs, protocols for manure sampling or acreage requirements, nor does the DNR add onto the EPA's land application restrictions and soil testing.	Prescribed regulatory requirements around the issues of siting livestock operations, manure storage, monitoring, and inspection - MPCA incorporates stricter regulations set forth by the US EPA, such as manure and soil testing/sampling protocols. There is some discretionary interpretations in respects to the regulatory requirements, specifically BMPs and the transfer of manure.
Compliance, Monitoring and Enforcement										
<i>Rating:</i>	4	1	3	3	3	2	3	3	3	2
<i>Comment:</i>	Enforcement is completed by an indirect government agency; i.e., not by an agricultural ministry that may be seen as having conflicting goals. Enforcement is completed both on a spill/complaint basis and through random inspections.	The Federal EPA leaves enforcement, inspection and handling of complaints to the delegated agencies for each state. The US EPA rarely get involved with these matters.	In addition to enforcement after spills, there is some enforcement related to building permits and construction standards, as well as routine inspections, state required certifications, and specific analysis of sites/operations Discharge Monitoring Reports.	In addition to enforcement after spills, there is some enforcement related to building permits and construction standards, as well annual inspections and PA registered PE certification needed for structural integrity	In addition to enforcement after spills, there is some enforcement related to building permits and construction standards, as well unannounced inspections (random, routine, or because of a tip or complaint). OEPA also may issues notices of violation, and can conduct criminal investigations.	Enforcement is conducted by the IDEM and inspections are conducted randomly after a complaint has been filed or a spill has taken place. Otherwise there is a 24hr notice before all inspections. There is no information pertaining to types of violations given out for CAFOs.	Enforcement takes place after spills as well as routine inspections - inspections to be random. IEPA distributes noncompliance advisory, violation notices, and requests for injunctive relief, IEPA also handles complaints.	Inspections are conducted 3 times every 5 years, per MDEQ. Nuisance farm complaints are handled by MDARD. 24hr Pollution Emergency Alert System (PEAS).	WI DNR requires compliance calendars stating in-house inspections. The Runoff Management Act rules (NR 151) include performance standards and prohibitions. WI DNR tip hotline for reporting concerns	No specifications are made as to the frequency of inspections, however there are multiple categories of violations (Stips, APO, SEP, and citations) that can be given to operations that are violating state and federal CAFO regulations.

Oversight of Animal Feeding Operations for Manure Management – Evaluation Matrices
Table B-1: Jurisdictions Within the Great Lakes Basin

	Ontario (Canada)	US Federal	New York	Pennsylvania	Ohio	Indiana	Illinois	Michigan	Wisconsin	Minnesota
Input from Public Stakeholders and Indigenous Communities										
Rating:	2	1	1	1	3	3	3	3	2	3
Comment:	There is only limited public access to approvals. There is no requirement for public notification if the livestock facility meets the municipal zoning criteria.	The Federal EPA delegates the handling of public records to the authorized agency for CAFO management. EPA does not get involved with public access or records, nor does it have any regulatory requirements for indigenous communities/ people.	No access to public records besides for a map of large/medium CAFOs. Also no regulations involving indigenous people/communities and no input from stakeholders.	PA bulletin for public to view permits, no other formalized public participation, no regulations for indigenous communities. NOI to be completed for new construction but not specified if public has access to NOI. No input from stakeholders.	There are limited requirements around consultation related to siting of proposed new or expanding animal feeding operations. DLEP require PTI to be submitted for public notice. Database with access to all permitted CAFO, no regulations for indigenous communities/people.	There are limited requirements around consultation related to siting of proposed new or expanding AFOs – public has access to all CFO/CAFO permits. There is no regulations for indigenous communities/people. Public/people neighboring potential CFO are given notice and 33 days to comment on proposed new or expanding operations.	There are limited requirements around consultation related to siting proposed new or expanding AFOs. The public has access to CAFOs covered under general permit, however, there are no regulations for indigenous people/ communities. NOITC: five step process for public which lasts about 90 days.	Public records and information relating to CAFOs are available on MiWaters, MDEQ's online database. The public may also request a public hearing, in which they may offer oral verbal or submit written comments and provide supporting documentations regarding the specific CAFO.	Records are made available to the public through Open Record Requests via the WI DNR webpage. WI DNR releases copies of records for the fee.	The County Feedlot Program is a cooperative arrangement between MPCA and county government to administer Minnesota's feedlot rule. MPCA also has all of its public notices available online (both current and archived) – all documents are available in PDFs.
Funding										
Rating:	3	3	3	3	3	2	1	1	3	2
Comment:	Currently, there is limited access to funding for ongoing operations. Significant funding was available in the past when regulations were initiated to help cover the costs for existing operations to meet new regulatory requirements.	Limited funding is available through programs such as AgSTAR and GLRI as well as EQUIP.	Funding is available to operations through incentive programs - up to \$385,000 per proposal for engineering and constructional expenses to improve/protect drinking water.	Some funding is available through the REAP, which is an incentive program for operations to better implement BMPs. Funding is given in the form of state tax credits, up to \$150,000 per operation.	Some funding is available through the OEPA, with two incentive programs – WPCLF and WSRLA. The programs offer assistance with planning, design and construction of programs to improve Ohio's water resources.	Limited state funding is available through one agency – LARE. LARE provides grants to projects that reduce non-point sediment and nutrient pollution of surface waters of the state.	No state specific funding information was found - funding available through federal incentive programs, specifically EQUIP.	No state specific funding information was found - funding available through federal incentive programs.	Funding is available through the state of Wisconsin – the state provides approximately \$20 million annually for farm conservation in the form of cost share grants. The cost share grants include grants for practices needed to comply with state farm conservation standards.	Limited funding is available through one state program – AgBMP. AgBMP is a part of the Minnesota Dept. of Agriculture Finance and Budget Division, and works with counties, SWCDs, and local water planners to identify current/future financial needs for agricultural operations.
Other										
Rating:	3	1	3	3	3	2	3	3	3	2
Comment:	There are ongoing strong Environmental Farm Plan (EFP) programs. Completion of an EFP is often a prerequisite for obtaining funding of other programs. There is strong participation by livestock groups in such programs.	No related NGO programs or extension work that may impact AFOs - Federal EPA delegates implementation of nongovernment organizations to the respected agency in charge of handling/ management CAFOs.	Limited NGO programs or extension work that may impact AFOs - Cornell University Extension & Watershed Agricultural Council Guidance.	Penn. State Extension provides information, both to the public and CAFO operators, on topics such as high nutrient reduction goals developed by the DCNR and DEP, as well as restrictions on discharge into surface waters of the state.	The Ohio State University (OSU) Extension offers information to both the public as well as farm operators. OSU offers the Ohio Composting and Manure Management (OCAMM) program which provides resources and guides for manure management, application, processing, etc.	Limited to no NGO programs or extension work - Purdue extension offers minimal water quality criteria, no numeric criteria, no specific permit requirements.	The University of Illinois (UI) Extension offers information to the public as well as to farm operations. The UI Manure Share is also offered for assistance in the exchange of manure between farmers who do not have enough acreage to properly spread manure and gardeners/landscapers who are searching for organic materials. AGDAILY is an app available to anyone for calculating manure application rates.	Michigan State University Extension offers information to the public and farm operators, explain laws and regulations pertaining to manure spreading as well as what classifies as a CAFO. MAEAP is a voluntary program designed to reduce farmer's legal and environmental risks. Sea Grant Nutrient Runoff Tool is an online tool that farmers can use to reduce the amount of nutrients in runoff from their farms.	Extension work is offered through the University of Wisconsin (UW) Extension which is a three-way partnership with the USDA and Bayfield County that provides generalized information on CAFOs and recommendations for following regulatory requirements for permits.	Limited extension work is offered through the University of Minnesota Extension. The extension provides recommendations on soil testing, information on runoff, storage, and generalized CAFO requirements/limitations.

Oversight of Animal Feeding Operations for Manure Management – Evaluation Matrices
Table B-2: Jurisdictions Outside the Great Lakes Basin

	Saskatchewan	Alberta	Maryland	Iowa	North Carolina	Netherlands	Denmark
Regulators, legislation							
Rating:	3	3	3	3	3	2	3
Comment:	Provincial/municipal requirements are coordinated, but generally little federal involvement. The Minister of Agriculture may solicit the input of other federal, provincial and municipal regulators when reviewing applications for intensive livestock operations.	Federal regulators do not have significant involvement, but provincial/municipal requirements are comprehensive.	Federal and state permits are required for animal feeding operations, however the state enforces and regulates animal feed operations. There is coordination between both parties.	Federal and state permits are required for animal feeding operations, however the state enforces and regulates animal feed operations. There is coordination between both parties.	Federal and state permits are required for animal feeding operations, however the state enforces and regulates animal feed operations. There is coordination between both parties.	Regulation of manure production, use, storage and disposal occurs predominantly at the federal level. Complaints may be directed to municipal and/or provincial authorities.	Regulation of manure production, use, storage and disposal occurs largely at the federal level. Municipalities may impose terms and conditions on the approval of animal feeding operations.
Definitions, quantifications, etc. for permitting purposes							
Rating:	2	3	2	3	3	3	3
Comment:	The Agricultural Operations Act does not prescribe specific approaches for estimating manure production, nutrient content, etc. However, the livestock operation must use accepted standard values or specific management practices, which will be reviewed and approved/rejected by the Minister.	Very detailed regulatory requirements in the Agricultural Operation Practices Act and its regulations.	There are some standards and definitions available through the Maryland Department of the Environment. There are scale of farm and livestock unit values, but no nutrient content or manure volume definitions.	Specific standards and definitions are available in the Iowa Administrative Code regarding nutrient content, manure production for various livestock types, and scale of farm.	Specific definitions and standards have been developed by universities and approved by the state to implement into animal feeding operation estimation of manure volumes and nutrient content.	Definitions and quantifiable standards are provided in the tables of the Dutch Manure Policy.	Standards and guidelines applicable to manure management are updated as needed and published by the Danish Agricultural Agency on an annual basis.
Regulatory requirements							
Rating:	2	3	3	2	3	4	3
Comment:	Regulatory requirements for intensive livestock operations generally appear to be flexible, in that the Agricultural Operations Act does not prescribe specific requirements for the application of manure, acreage, etc. However, such details must be outlined in a waste management plan and waste storage plan that must be submitted to the Minister for review and approval.	Regulatory requirements around siting, storage, land application, etc. are very prescriptive. No requirements surrounding manure testing were identified.	Regulatory requirements around siting, storage, land application, and manure testing were identified. Volumes of manure for land application are site specific and standards are not available.	Regulatory requirements around siting, storage, land application, etc. are site specific and standards are flexible. No requirements surrounding manure testing were identified.	Regulatory requirements for intensive livestock operations are strict and have specific requirements for the application of manure, acreage, testing, etc. All details must be outlined in a waste management plan and waste storage plan that must be submitted with the MDE Animal Feeding Operations permit.	Federal caps limit the total numbers of pigs and chickens that can be commercially owned in the country. Limits are placed on the amount of nitrogen that can be applied per hectare of land, and the transport and disposal of manure is strictly regulated.	Regulatory requirements on the siting of animal feeding operations and the application of manure are prescriptive. The application limits of manure and fertilizer (in kg of nitrogen and phosphorus per hectare) are calculated based on the numbers and types of livestock, climate conditions, crop and soil type, etc. Requirements to test soil and manure appear to be limited to farms with special approvals (derogation and/or higher phosphorus application limits) and as part of some on-site inspections.
Compliance, Monitoring and Enforcement							
Rating:	3	3	3	3	3	3	2
Comment:	Clear enforcement guidelines and procedures. Enforcement may occur prior to an incident occurring (e.g. an inspector is of the opinion that a release of manure may occur, an emergency order may be issued).	Clear enforcement guidelines and procedures. Enforcement may occur prior to an incident occurring (e.g. an inspector is of the opinion that a release of manure may occur, an emergency order may be issued).	Clear enforcement guidelines and procedures. Enforcement may occur prior to an incident occurring (e.g. an inspector is of the opinion that a release of manure may occur, an emergency order may be issued).	Clear enforcement guidelines and procedures. Enforcement may occur prior to an incident occurring (e.g. an inspector is of the opinion that a release of manure may occur, an emergency order may be issued).	Clear enforcement guidelines and procedures. Enforcement may occur prior to an incident occurring as annual inspections of all facilities takes place annually. (e.g. an inspector is of the opinion that a release of manure may occur, an emergency order may be issued).	Clear enforcement guidelines and procedures. Enforcement may occur prior to an incident occurring (e.g. an inspector is of the opinion that a release of manure may occur, an emergency order may be issued). elatively little information was identified regarding the procedure and response protocol for nuisance complaints against a feeding operation.	The majority of agricultural operations are required to submit annual reports detailing their operations and manure production and use. Operations are randomly selected for inspection based on various risk criteria. Relatively little information was identified regarding the procedure and response protocol for nuisance complaints against a feeding operation.
Input from Public Stakeholders and Indigenous Communities							
Rating:	1	4	3	1	1	1	3
Comment:	No distinct process was identified for notifying or consulting public stakeholders or Indigenous communities.	There is a prescribed consultation process, and affected parties may comment on applications for new or expanded feeding operations. Notices and complete applications are made publicly available on the Natural Resources Conservation Board's website.	A public consultation process exists for AFOs applying for permit coverage. Members of the public can review and comment on an applicant's Notice of Intent and nutrient management plan. However, permitting records do not appear to publicly accessible after the end of public consultation period.	No distinct process was identified for notifying or consulting public stakeholders or Indigenous communities. There are copies of all animal feeding operations available online for public knowledge.	No distinct process was identified for notifying or consulting public stakeholders or Indigenous communities.	No distinct process was identified for notifying or consulting public stakeholders. The Netherlands do not have an indigenous people that is distinct from, and historically colonized by, the Dutch.	A public notification and consultation process exists for proposed new livestock operations. Decisions made by the Danish Environmental Protection Agency on a proposal may be appealed. Select documentation on livestock operations are made publicly available. No Indigenous consultation process was identified; Denmark's only recognized Indigenous group, the Inuit, are located in Greenland.

Oversight of Animal Feeding Operations for Manure Management – Evaluation Matrices
Table B-2: Jurisdictions Outside the Great Lakes Basin

	Saskatchewan	Alberta	Maryland	Iowa	North Carolina	Netherlands	Denmark
Funding							
Rating:	3	3	3	2	2	3	2
Comment:	The province offers rebates to livestock operations for the purchase of specialized equipment or for modifying existing equipment for improved manure application. Funding is also available to operators to develop infrastructure that will minimize environmental risk related to manure use and storage.	Funding available to assist CFOs in reducing the risk of agricultural contaminants entering the surface and groundwater resources. Due to the large number of applications received, the Growing Forward 2 program for the period 2013 -2018 had to stop accepting new applciations as of February 2017.	Government funding is available for Cost-Share Programs covering up to 87.5% of the costs for implementing BMPs on site. NGOs also support BMP implementing initiatives, manure transport programs, and nutrient loss reduction programs.	Low interest loans are available for implementing best management practices through the Iowa Agricultural Development Authority.	Government funding is available for cost-sharing programs that cover up to 75% of the cost for implementing best management practices.	Financial incentives are offered to livestock operations that meet the targets for reducing the size of their livestock and/or voluntarily leave the dairy farming business.	Funding is available that indirectly affects manure management. The Danish Agricultural Agency offers financial support to farmers to operate in an environmentally sustainable manner.
Other							
Rating:	2	3	3	3	3	3	2
Comment:	A producer-run, not-for-profit organization assists agricultural operations in developing voluntary Environmental Farm Plans. Intensive livestock operations must consider whether any permits, approvals and/or licences are required for the use of surface or groundwater.	A producer-run, not-for-profit organization assists agricultural operations in developing voluntary Environmental Farm Plans. CFOs that also require a water licence have the option of coupling their applications in order to harmonize the review process.	The Tributary Strategy assists agricultural operations bu identifying nutrient load reductions based upon a variety of Best Management practices (BMPs). Applicants have the option of coupling their application for a permits for MDE Animal Feeding Operations (MAFO) with a General Discharge Permits (GD Permits under COMAR 26.08.04.09). CFOs that also require a water licence have the option of coupling their applications in order to harmonize the review process.	The Iowa Manure Management Action Group (IMMAG), a part of Iowa State University outreach program, provides information about submitting reports, buying and selling manure, permits and regulations, as well as news topics and updates. They also send a volunteer to go onsite and help develop a Manure Mangement Plan.	The Agricultural Water Resources Assistance Program (AgWRAP) is a not-for-profit assists agricultural operations in developing their Certified Animal Waste Management Plans.	Voluntary initiatives exist for improving the safe environmental use of manure. Federal initiatives are targeting the reduction of nitrate concentrations in groundwater and an overall reduction in phosphate production.	A collaborative project among researchers, developers and industry from various Baltic countries examined and provided recommendations to improve the manure nutrient handling process. It is uncertain if or how the recommendations were implemented since the conclusion of the project in 2013.

Appendix B – Workshop Report

Oversight of Animal Feeding Operations for Manure Management In the Great Lakes Basin

Workshop Report

**GREAT LAKES WATER QUALITY BOARD
LEGACY ISSUES WORK GROUP**

November 13-14, 2018

Windsor, Ontario



Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin Workshop Summary Report

Acknowledgements

This report is the product of a binational workshop that involved experts from Canada and the United States, discussing the oversight of animal feeding operations for manure management in the Great Lakes basin. The International Joint Commission's Great Lakes Water Quality Board expresses its sincere appreciation to the experts from multiple government, non-governmental organizations, animal farming organizations and academia who participated in the workshop. Their efforts have provided advice and insights for the consideration of the Water Quality Board in providing advice to the Commission who may, in-turn provide advice to the governments of Canada and the United States.

This report was prepared by Jim Faught (Lura Consulting, Toronto, Ontario), in consultation with the Legacy Issues Work Group of the Great Lakes Water Quality Board. Participation in the workshop does not constitute endorsement or support of the report or its recommendations by participants or their respective organizations.

**Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin
Workshop Summary Report**

Contents

Acknowledgements	1
Executive Summary	3
Introduction	5
Detailed Report on Workshop	6
<i>Welcome/Opening</i>	6
<i>Setting the Context</i>	7
<i>LIWG Report and Recommendations</i>	7
<i>Manure Management in Ontario</i>	7
Discussion – Report Findings and Recommendations - Did the work group get the report content right?	8
<i>Feedback on the Report Overall</i>	8
<i>Items That Could be Added to the Report</i>	10
<i>Items That Could Be Made Clearer In the Report</i>	11
Discussion – Recommendation #1	12
<i>Feedback on Recommendation #1</i>	13
Discussion - Recommendation #2	17
<i>Feedback on Recommendation #2</i>	18
Discussion - Recommendation #3	24
<i>Feedback on Recommendation #3</i>	24
Discussion – Recommendation #4	26
<i>Feedback on Recommendation #4</i>	26
Final Feedback on the Report and Recommendations	27
Next Steps	28
Appendix A: Workshop Agenda	30
Appendix B: Workshop Participants	32

**Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin
Workshop Summary Report**

Executive Summary

On November 13-14, 2018 the International Joint Commission's (IJC) Water Quality Board (WQB) Legacy Issues Work Group (LIWG) convened a binational workshop on the oversight of animal feeding operations for manure management in the Great Lakes basin. The purpose of the workshop was to gain feedback on the LIWG's draft report and the four recommendations contained therein, on the adequacy of management/regulatory programs to deal with manure derived from animal feeding operations for the protection of the waters of the Great Lakes and to identify opportunities for strengthening manure management practices to reduce nutrient runoff. The outcomes of the workshop will be used to inform the development of advice and recommendations that the WQB will present to the IJC for their consideration in forwarding to the governments of Canada and the United States.

The facilitated workshop brought together a diverse group of experts from manure management interests from both countries. Input was received from participants through a series of small group discussions, followed by plenary sessions. Given the diversity of stakeholders present at the workshop, it is recognized that not all participants agree with or endorse all information, conclusions or recommendations developed through the workshop, but that points of general agreement will provide support and assistance in the long term for the report to be used for states and provinces to consider. The following is a summary of the outcomes from the workshop derived from the discussion sessions that provide feedback on the manure report recommendations.

The first discussion by workshop participants was a general determination on the overall report content. In general, there was agreement on the report content. Next the workshop participants discussed each of the four draft work group recommendations. There was general support for Recommendation #1, conducting an in-depth assessment of each state and province's manure management framework; Recommendation #3, U.S. and Canadian funding for manure management; and Recommendation #4, assessing Netherlands and Denmark manure practices for possible applications in the U.S. and Canada. There was mixed support for Recommendation #2, manure application management. There was general support for two components under Recommendation #2 regarding registry of manure and timing of application, while there was mixed support for rules for manure application. Summarized below is the workshop participants' overall feedback on each of the four draft work group recommendations. Detailed participant input on each of the recommendations is provided in the body of the report.

Workshop Feedback on Recommendation #1

Draft Report Recommendation #1

Each Great Lakes state and Ontario should conduct an in-depth assessment of the actual implementation of each state/province's respective manure management framework to identify successes and challenges in achieving reduced nutrient runoff goals. Establish a set of guidelines and regulations to be incorporated by all states/provinces to ensure an equivalent implementation framework which includes the coordination and oversight of manure management among federal and provincial/state regulators. Such guidelines and regulations should include:

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin Workshop Summary Report

- 1.1 Developing Comprehensive Nutrient Guidelines that may include Management Plans by a qualified professional that are consistent for all nutrient sources.
- 1.2 Requiring grid testing of manure nutrient soil content and developing a template of best management practices and recommended standards for optimal nutrient application that minimize nutrient runoff. The template should provide a process for evaluating the effectiveness of the plan, and include an adaptive management component.
- 1.3 Developing a joint, central Great Lakes information center that shares new and evolving technology for manure treatment/reuse (potentially through the U.S. Great Lakes Observing System Data Portal).
- 1.4 U.S. Great Lakes states should eliminate the practice that allows animal feeding operations to subdivide adjoining operations, physically located in the same area, to bypass the requirement for a permit and thus bypass permit requirements.

In general, this recommendation was supported by participants. Feedback on each of the specific components of Recommendation #1 is as follows:

- Bullet point #1.1 - Developing comprehensive nutrient guidelines. General support by the participants.
- Bullet point #1.2 - Requiring grid testing of soil nutrient content. General support for sampling with discussion on options for what sampling works best with cost as a factor.
- Bullet point #1.3 - Developing a centralized information hub. General support by the participants. Many said this is a good idea.
- Bullet point #1.4 - Eliminate sub-dividing adjoining operations where permits are not needed when the number of animals is reduced below the permitted threshold. (A U.S. issue). The recommendation is to use the mid-size rather than the large size threshold as defined by USEPA. There was mixed support by the participants.

Workshop Feedback on Recommendation # 2

Draft Report Recommendation #2

The U.S. Great Lakes states and Ontario, if not already doing so, should create rules and policies for manure applications that include:

- 2.1 Developing a systematic approach that requires dedicated minimum acreage for the amount of land needed per animal unit for manure application that includes consideration of factors such as livestock types and soil phosphorous levels; and a requirement for manure storage needed per animal unit. The minimum acreage requirement applies to onsite and offsite manure applications. Ontario's approach, under the Nutrient Management Act, should be used as a model for this recommendation.
- 2.2 Developing a land base registry or equivalent tracking system for overseeing manure application agreements, parcel identification where manure is applied, the number of animals and the application dates and amounts.

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin Workshop Summary Report

- 2.3 Developing requirements for the permissible timing and amount of manure applications –e.g., not on frozen ground and not when there are forecasts for heavy rains, that is applicable to both onsite and offsite locations, and to animal feeding operations that are both permitted and unpermitted.
- 2.4 Developing requirements that all property owners and residents within a certain radius of a new or expanding animal feeding operation should be notified and have the opportunity to comment.

In general, there was mixed support for this recommendation. Feedback on each of the specific components of Recommendation #2 is as follows:

- Bullet point #2.1 - Developing a systematic approach for manure acreage requirements based on soil, crop, etc. There was mixed support by the participants.
- Bullet point #2.2 Developing a land base registry for manure application agreements, where manure is applied. There was general support by the participants.
- Bullet point #2.3 Developing requirements for permissible timing – i.e. frozen ground, application after heavy rains. There was general support by the participants.
- Bullet point #2.4 Developing requirements to notify property owners in a certain radius for new and expanding operations. There was much discussion on this recommendation and there was little support by the participants.

Workshop Feedback on Recommendation #3

Draft Report Recommendation #3

Provide dedicated federal Canadian and U.S., along with Great Lakes states and the province of Ontario, funding for proper manure management, re-use and treatment technologies by assisting existing animal feeding operations to make necessary changes to meet recommended standards and best management practices.

Workshop participants were in general agreement with Recommendation #3.

Workshop Feedback on Recommendation # 4

Draft Report Recommendation #4

With federal funding from Canada and the US, investigate the nation-wide manure management policies, tools, technologies, reporting and record-keeping practices of the Netherlands and Denmark and opportunities for application in the Great Lakes Basin.

Workshop participants were in general agreement with Recommendation #4.

Introduction

The International Joint Commission is a binational organization that prevents and resolves disputes over boundary waters of the United States and Canada, including the Great Lakes, and is served in an

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin Workshop Summary Report

advisory capacity by the Great Lakes Water Quality Board. The WQB includes a Legacy Issues Work Group that has identified a priority topic related to the oversight of animal feeding operations and their management of manure in the Great Lakes basin.

Manure from animal feeding operations can contribute pollutants to the lakes, particularly nutrients, depending on the amounts that are land-applied and used as a source of fertilizer in crop production. All Great Lakes are experiencing significant water quality issues related to nutrients, caused in part by runoff of excess nutrients originating primarily from agricultural land use (fertilizers and manure), and exacerbated during snowmelt, winter rainfall and extreme storm events. Nutrients can contribute to the eutrophication of waters, resulting in algal blooms. The increase in harmful algal blooms continues to be a challenge for the Great Lakes, and is particularly pronounced in the Western Lake Erie Basin.

The overall goal of the LIWG's project is to provide advice to the IJC, and ultimately governments, on the adequacy of management/regulatory programs to deal with manure derived from animal feeding operations for the protection of the waters of the Great Lakes and to identify opportunities for strengthening manure management practices to reduce nutrient runoff. The IJC Water Quality Board work group developed a draft report in August of 2018, which includes four recommendations, based on a consultant's report that identified and evaluated how existing regulations, rules, policies and practices in the Great Lakes basin are applied to the use, management, storage and disposal of manure from animal feeding operations.

On November 13-14, 2018 the LIWG convened a binational workshop that brought together approximately 25 experts from a range of sectors including government (state/provincial), agricultural organizations, non-governmental organizations and academia. A group of IJC staff was also present to assist with notetaking and to provide workshop support. The workshop agenda and list of participants are provided in Appendix A and Appendix B, respectively.

The knowledge of workshop participants provided feedback on the overall draft work group report content and each of the four recommendations. The participants' feedback on the report and recommendations will be used to inform the development of advice and recommendations that the WQB will present to the IJC for their consideration in forwarding to the governments of Canada and the United States. Furthermore, participation in the workshop does not constitute endorsement or support of the work group's report or its recommendations by participants or their respective organizations.

The following workshop summary provides an overview of the presentations, discussion highlights, and feedback on the draft work group report and recommendations, based on notes taken by IJC staff. The next steps in completing the work group's report include, review of the workshop report by participants; refinement of the work group draft report based on workshop outcomes; and review and approval by the full Water Quality Board membership.

Detailed Report on Workshop

Welcome/Opening

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin Workshop Summary Report

David Burden, Director of the IJC's Great Lakes Regional Office, provided an overview of the IJC and its role under the Great Lakes Water Quality Agreement (GLWQA). David closed by highlighting the importance of sharing perspectives through these binational contributions, to ensure the best strategies and recommendations are developed. It was also noted that participation in the workshop does not constitute endorsement or support of the report or its recommendations by participants or their respective organizations, however feedback from the binational participants at this workshop was vital for finalizing the work group's report and recommendations.

Setting the Context

LIWG Report and Recommendations

Sandy Bihn, LIWG member, Lake Erie Waterkeeper, provided context for the workshop related to the work group's draft report and recommendations with the following points:

- Overview of the U.S. and Canadian governments' commitments on addressing nutrients under the GLWQA and Annex 4 (Nutrients)
- Examples of work undertaken by the IJC on nutrients: 2014 Lake Erie Ecosystem Project Report (LEEP) and 2017 Triennial Assessment of Progress Report (TAP)
- Overview of the LIWG project tasks and timelines to date:
 - Consultant report and subsequent expert review (Spring 2018)
 - Development of draft work group report (Fall 2018)
 - Hosting of the experts' workshop (November 2018)
- Geographic jurisdiction of work group project:
 - Great Lakes basin: Eight states and province of Ontario
 - Jurisdictions outside the basin: Iowa, Maryland, and North Carolina; Alberta and Saskatchewan
 - International: Netherlands and Denmark
 - The goals of the project: Provide advice and recommendations to the Commission, and ultimately governments, to assist decision makers in providing a regulatory and policy framework to manage manure from animal feeding operations
 - Identify opportunities to reduce harmful algae through strengthening manure management practices to reduce nutrient runoff

Manure Management in Ontario

Mark Wales, LIWG member, Ontario Federation of Agriculture, provided context for the workshop regarding the history of manure management in Ontario with the following points:

- Nutrient management plans (NMP) started in the late '90s as a result of municipal by-laws, which created a patchwork of laws
- The Walkerton crisis (2000), which happened around the same time as nutrient management planning, resulted in the creation of the Clean Water Act as well as the Nutrient Management Act (NMA), 2002
- NMA is jointly administered by the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) and the Ontario Ministry of Environment, Conservation and Parks (OMECPP), who has investigative authority

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin Workshop Summary Report

- The NMA applies to livestock farm >300 nutrient units (NU) and farms >5 NU that are new or expanding
 - Nutrient management strategy (NMS) is developed for farms >5 NU and <300 NU, which is then submitted to OMAFRA for approval
- NMA originally, provided up to 90% grant funding to build manure storage coverage/275-day storage
- One difference between Ontario and the U.S., that helps to limit livestock farm size (for poultry, dairy and eggs) in Ontario, is the use of the quota system:
 - Quota system matches total supply of product with market demand
 - Additional quota must be purchased in order to increase or expand operations, this can be as much as \$25k-\$30k/cow
- Use of Minimum Distance Separation (MDS) to determine setback distances between livestock farms and other land uses:
 - MDS1 – distance between new development and existing livestock farm
 - MDS2 – distance between new or expanding livestock operations and residences
 - MDS1 and MDS2 distances are calculated based on a formula using livestock type, numbers, and other factors
- Challenges ahead for NMA:
 - Language for ban on winter spreading only applies to those farms that fall under the NMA
 - No dedicated funding; need a simple process to access funding

Discussion – Report Findings and Recommendations - Did the work group get the report content right?

Following the “setting the context” presentations, participants broke into three small groups to discuss feedback and impressions of the work group report using the following questions as prompts:

- Could anything be made clearer?
- Is anything substantive missing?

The following is a compilation of the comments from the small group discussions on the report overall, clarity of the report and items that are missing from the report.

Feedback on the Report Overall

Manure as a Resource

- In the report manure is portrayed/stated as being a waste product, but it really is seen to have value, not as a wasted resource, as there are benefits of adding manure to soil (increased organic content, improved soil health, nutrients)
 - Manure should be promoted as a valuable source of nutrients (as an organic, non-commercial fertilizer) not a waste that needs to be dealt with

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin Workshop Summary Report

- Manure has an economic value – farmers buy manure as a fertilizer/replacement for commercial fertilizers
 - Manure has value both in terms of helping to reduce the purchase of fertilizer and as part of helping improve soil health
- Throughout the report rather than use the term “disposal”, use “utilization”
- Inherent value of the nutrients isn’t easily seen in the report. Manure is referred to as “waste” and contrasted to commercial fertilizer; this paradigm is becoming outdated – should be a continuum
- Manure is a “waste” only if you don’t know what to do with it. Make it an asset to harness its nutrients and soil potential
- Recommend clarifying how manure is defined in each state (e.g. waste vs. organic fertilizer)
 - The key point is the proper management of the manure, regardless of whether it is defined as a waste or a resource (*point of general agreement by the participants*)
 - Emphasize manure management vs. its definition (acknowledging that the definitions can differ among states)
- Promoting the value of manure, as an economic resource, is key to managing nutrients and promoting manure management
- In Ontario:
 - When farmers do a NMP and NMS they are encouraged to think of manure as a valuable resource
 - As a result of rapidly increasing fertilizer costs for both nitrogen and phosphorus, manure has been viewed as a valuable resource not to be wasted
 - In working to achieve higher corn yields to fulfill the increasing ethanol market, in addition to the other corn uses, manure has been viewed as a very cost effective option
 - Farmers with large volumes of liquid manure (hog and dairy) were able to install bio-digesters and take the manure, along with restaurant waste, to create electricity, which is a very saleable product

Manure Lagoons

- Manure/waste lagoons not tested for all constituents in them
 - For example, even though waste is applied at the phosphorus (P) or nitrogen (N) requirements there may be increased levels of copper sulfate, which is toxic to soil health
 - Need to look at bigger picture than just nutrients, such as testing for cleaners, copper sulfate, pharmaceuticals (antibiotics, hormones), etc.

Information Hub

- It was generally agreed by participants that the idea of an information hub, as recommended in the report, is a good one and to put more emphasis on this point
- As part of this hub include the research needs, what has been done, what needs to be done, to avoid duplication of efforts

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin Workshop Summary Report

Referencing in the Report

- All numbers used in the report should be referenced/footnoted, for example:
 - State the source of the estimate that 25% of P is coming from manure
- In Table 1 (Soil P Threshold Values) references are needed:
 - Ohio column for management actions could be expanded, similar information as Illinois (i.e. multiple tiers) instead of just >150 ppm
- Include reference to the IJC's Science Advisory Board Fertilizer Application Patterns and Trends report

Soil Sampling

- Some are doing zone sampling instead of grid sampling
 - Needs to be clarification on sampling – zone sampling is possibly more effective
 - In Ontario, majority of sampling is done by a third-party
- Technology will help with the sampling methods

Application of Manure

- In Ontario, most farmers tend to apply all their own manure but there is some custom application as well
- In Ohio, there is a lot of third-party application and not all necessarily follow the rules
- In a perfect world manure would be run through an anaerobic digester
- Farmer tends to be more careful with application on their own land
- Winter spreading should never be happening regardless of farm size
- Innovation - many are building their own incorporation equipment
- In Indiana, Confined Feeding Operations (CFOs) with 300 cows/30,000 poultry/600 swine undergo a permitting process that requires identification of where manure is going and ensuring there is enough land for its application
 - Office of the Indiana State Chemist (OISC) oversees nutrient plans for all fertilizers (including manure), but each county can have different building permit requirements
- Aerial application of manure was banned in Ontario in 2003
- Ohio and Michigan still use pivot or travelling irrigation
- In Ontario, 25% of manure is directly incorporated and the rest is applied directly and is incorporated at some point using equipment such as a dragline system or dribble bar
 - Differences in U.S. and Canadian application methods result in differences in incorporation practices

Items That Could be Added to the Report

- Ontario Nutrient Management Act – this could be added as an appendix
 - In Ontario, nutrient management planning is enforceable and a certain percentage are being audited
- Opportunity to add how to improve the record keeping and accountability, using the 4Rs nutrient stewardship concept (right source, right rate, right time, right place):
 - 4R integration isn't mentioned in the report
 - Pushes farmers to go beyond the minimum regulatory requirements
 - Accountability/record keeping that keeps track of all nutrients
- No discussion of BMPs on a field-level and reference to adaptive programs

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin Workshop Summary Report

- State or regional staff should verify use of BMPs. i.e. paper regulations vs. actual in-field implementation
- Small/medium sized operations – storage issues are not addressed in the report
 - What is the cost to implement the recommendations (i.e. small farms can't deal with this). For example small farms have issues with no winter application rules
- Weather/climate change issues could be better referenced in the report
 - Climate Change complicates the whole thing
 - Really need to consider weather and climate change
- Clean Water Act for Ontario should be referenced, as the source water protection legislation isn't captured well in this report
- Should provide a 'definitions' appendix for the report
- Biosolids were also discussed, but are outside the scope of this report

Items That Could Be Made Clearer In the Report

Funding and Costs

- Cost sharing for programs – banks won't approve loans for any capital expenditures that aren't production or revenue related
- Look at jurisdictions to analyze the funding availability and eligibility rules
- Cost sharing programs must value the farmers' time and equipment costs (in-kind contributions)
- Costs - report has some sweeping generalizations

Lake Erie

- Nutrient balance/status in Lake Erie:
 - Watershed nutrient budget (P in/ P out)
 - P was in surplus. Now at a stage where, in both Ohio and Ontario (macroscale), we are at a P balance
 - Add clarity to the situation – not like Netherlands (surplus)
 - Be clear on the nutrient status to help focus on the real problem which is an imbalance at the local scale
- Ohio has special legislation for the western Lake Erie basin for restriction on manure application, but this is not consistent across the state

Soil P Threshold Values

- Need a better explanation of the agricultural and environmental soil P threshold values used in the report
 - Commercial fertilizers are a single nutrient applied at an agronomic rate; manure and biosolids have many nutrients/micronutrients, which is why environmental thresholds were created
 - Until 2000 in the U.S., only a nitrogen standard was used to manage manure application, then they developed a phosphorus standard
 - The P-Index was created because manure and biosolids have more than one nutrient

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin Workshop Summary Report

- The table on pg. 7 of the report – the agronomic soil threshold are for corn, soybeans and wheat, if other specialty crops are added into the rotation the agronomic rate can be higher (some as high as 150 ppm) – this needs to be added/clarified in the report

Field Ownership and Size of Operation

- All the fields need to be captured by the regulations. Challenge is around field ownership (rented/leased) “declared farm unit”. Expand these recommendations to:
 - “Designated receiver”
 - What are the ways to build in short to long term accountability?
 - Does land tenure affect above question?
- Size of the operation (small-medium farms) and information collection is a challenge.
 - Complaint based
 - Funding is a challenge
 - Where are these smaller farms? CAFOs are obvious
- Selling of manure to unregulated facilities (manifested site) makes state regulations difficult. Put obligation on the farm itself to provide information

General Clarification

- There were some misrepresentations about Michigan in the report, for example, enforcing agency is the Department of Environmental Quality (DEQ); permitted facilities are required for large operations; no required acres per animal
- Many of the recommendations are currently being done in Wisconsin
- Confused about definitions of size of animal feeding operations

Discussion – Recommendation #1

Draft Report Recommendation #1: Each Great Lakes state and Ontario should conduct an in-depth assessment of the actual implementation of each state/province’s respective manure management framework to identify successes and challenges in achieving reduced nutrient runoff goals. Establish a set of guidelines and regulations to be incorporated by all states/provinces to ensure an equivalent implementation framework which includes the coordination and oversight of manure management among federal and provincial/state regulators. Such guidelines and regulations should include:

- 1.1 Developing Comprehensive Nutrient Guidelines that may include Management Plans by a qualified professional that are consistent for all nutrient sources.
- 1.2 Requiring grid testing of manure nutrient soil content and developing a template of best management practices and recommended standards for optimal nutrient application that minimize nutrient runoff. The template should provide a process for evaluating the effectiveness of the plan, and include an adaptive management component.

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin Workshop Summary Report

- 1.3 Developing a joint, central Great Lakes information center that shares new and evolving technology for manure treatment/reuse (potentially through the U.S. Great Lakes Observing System Data Portal).
- 1.4 U.S. Great Lakes states should eliminate the practice that allows animal feeding operations to subdivide adjoining operations, physically located in the same area, to bypass the requirement for a permit and thus bypass permit requirements.

Participants were provided with a recap of Recommendation #1 from the work group's draft report (above). Participants then broke into three small groups to discuss their feedback on the recommendation using the following guidance questions:

- Do you feel this recommendation is on target?
- Are the content and facts for this recommendation correct?
- Are there any refinements that can be added to improve this recommendation?
- Is anything substantive missing?

In general, this recommendation had support of the participants with the consideration of the notes on each of the sub-bullets in the recommendation as noted below.

- Bullet point #1.1 - Developing comprehensive nutrient guidelines. Generally supported by the participants.
- Bullet point #1.2 - Requiring grid testing of soil nutrient content. General support for sampling with discussion between grid and zone sampling.
- Bullet point #1.3 - Developing a centralized information hub. Generally supported by the participants. Many said this is a good idea.
- Bullet point #1.4 - Eliminate sub-dividing adjoining operations where permits are not needed when the number of animals is reduced below the threshold (A U.S. issue). There was mixed support by the participants.

Each group reported in plenary their feedback on the recommendation including refinements that should be considered and anything that is missing. The following is a compilation of participant comments:

Feedback on Recommendation #1

General

- The start of the recommendation regarding a consistent framework is good
- The recommendation is sound because it mentions a nutrient management framework, which is much more than regulations
- Need to clarify whether this recommendation is for permitted or non-permitted facilities or both
- Are these recommendations applicable to all nutrient sources? Is the intent behind a consistent framework to include all nutrient sources? It's not clear

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin Workshop Summary Report

- Need to look at all sources at the farm level (biosolids, manure and fertilizer)
 - The language preceding the recommendation needs to clarify what it is talking about – is it just manure?
- Needs to be looked at in the larger context of all nutrients
- There is 4R (right source, right rate, right time, right place) certification in Ohio, but this is for commercial fertilizers not manure
 - 4R principles should be practiced/applied for nutrient management for manure
- In Ontario, the agronomic rate is the optimal nutrient level to maximize crop yields, the environmental rate is to reduce risk of runoff from fields
- The P-Index allows for the use of manure, for the benefits of the multiple nutrients and micronutrients it contains, but limits the P-runoff to prevent environmental degradation
 - P-Index considers the P-level in the soil and what you are applying; the agronomic rate looks at plant uptake
 - The P-Index is a somewhat arbitrary value as the saturation levels in soils can vary widely from one soil type to another
- The timing and placement of P (for either manure or fertilizer) is more critical than the soil testing
- Could add, “successes, challenges and gaps”
- Strive to equate the terminology across jurisdictions
 - Scale and size is much different between the 2 countries
 - How many of each type of farm size in the basin?
 - Creative way to capture that graphically?
 - Lost 50-60% of smaller dairies in the past 5 years (Ohio)
 - U.S. –with any violations you are basically a permitted farm
 - US EPA – has a sheet for how many CAFOs are permitted
- Ontario – not a lot of resources to do the enforcement
- If permitted at a lower threshold level then bigger facilities will be built
- Lack of knowledge of what is happening with the small to medium size; less of those each in all livestock commodities
- In Ontario, livestock farm expansion is tied to quota regulations – buffers the big getting bigger situation

Comments on Bullet point #1.1 (i.e. Developing comprehensive nutrient guidelines) **(Generally supported by the participants)**

- Bullet point #1.1 is good as it notes all nutrient sources
- Comprehensive NMPs are for farms that generate manure, not for farms that apply manure
- Writing a plan for what purpose?
 - Voluntary plan
 - Verification visits
 - Educational component
- In the U.S., National Pollutant Discharge Elimination System (NPDES) permits and Right to Farm statutes are an example of regulatory measures, some examples of voluntary measures:

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin Workshop Summary Report

- Michigan Agriculture Environmental Assurance Program (MAEAP)
- Michigan's Generally Accepted Agricultural and Management Practices (GAAMP)
- NRCS Practice Standard 590 (Nutrient Management) – voluntary unless identified in a facility's permit
- In Ontario, the development of NMPs and NMSs are requirements under the NMA; the Environmental Farm Plan and 4Rs are voluntary measures
- In Ontario, if a farm >5 NUs (which is approximately equivalent to 5 horses) applies for a building permit or manure storage construction they have to develop a NMS
- In Indiana, facilities that apply >10 cubic yards or >4,000 gallons of manure are to develop a fertilizer application plan taking into account all sources of fertilizer
- Ontario and Indiana have lower animal number thresholds that trigger regulation/permitting (e.g. in Indiana this limit is at 300 cows vs. the federal level of 700, in Ontario it is about 230 cows for a 300 Nutrient Unit farm)
- Wisconsin requires nutrient management guidelines for all crops specific to Wisconsin
- In the U.S., for small/medium facilities agricultural associations will go out and visit the farmer if a complaint gets to them
- Michigan also provides nutrient management guidelines for specific crops, soil conditions, etc., following the Michigan State University sampling requirements and administered through the extension system
 - Strongly agree with public education component. Should be an outreach document to understand N & P and the volume of loads
- A Manure Management Framework encompasses more than just regulations
 - Emphasis on record keeping and accountability
 - Non-regulatory actions that can be done to get the right messages out there
- In Ontario, a 300 Nutrient Unit facility requires a nutrient management plan, with compliance overseen by the Ministry of Environment, Conservation and Parks
 - How comprehensive are the Ontario Nutrient Management Plans?
 - Are the Ontario plans practical and usable?
- Reporting and plans need to be simple and adaptable to weather/yearly conditions. There is no clear template for record keeping and reporting
 - Reporting – need to make people report properly and tie into 4R stewardship education stewardship program- Right place, right amount, right time, right source
 - In the U.S. all Concentrated Animal Feeding Operations (CAFO's) must submit a report

Comments on Bullet point #1.2 (i.e. Require grid testing for soil nutrient content)

(Generally not fully supported by the participants)

- Standard template for grid testing – what would that look like?
- Best Management Practices (BMP's) aren't really tied into this
- Implementation would be up to the operator – need a list of BMPs to start though
- What if the operator doesn't need the BMP – forcing people to do things that aren't needed
- Idea behind this is educating farmers on possibilities rather than requiring specific type of soil testing
- Edge of field soil testing work is essential

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin Workshop Summary Report

- Encourage rather than require
- Decreasing the animal threshold number that triggers permitting will require greater resources for enforcement/oversight
 - Determining what these lower threshold numbers should be is not something that can be done now – this is very complex
 - Reporting/counting numbers of animals on a farm can be difficult given the turn-over/life cycle of some animals within a given year
 - Grid size/method requires definition
 - Suggest that testing be encouraged, but not to identify a specific method, there may be other methods that work, why just this one?
 - Grid testing is expensive
- Monitoring for effectiveness:
 - Not sure if monitoring is possible for everyone
 - Very expensive and standardized sampling is an issue
 - Due to expense, need representative sample locations
- Need to identify who should do what
 - For example, if this is beyond the scope of the individual, should it fall to the regulator
 - Once those are identified through the science then the individual is responsible and the state needs to oversee and re-evaluate
 - Encourage research on edge of field of field monitoring
- The intent of grid testing, is a more systematic sampling regime
 - Require systematic sampling for soil nutrient content, consistent with state/provincial guidelines
 - Use term “systematic” instead of grid testing
 - Grid testing has been considered in Michigan, but other soil sampling test methods are allowed. More info on this specific recommendation is needed.
 - Edge of field testing/monitoring is expensive and the technology is not there yet to do this on a mass-scale
 - In the U.S., the Environmental Quality Incentives Program (EQIP) can help fund edge-of-field testing

Comments on Bullet point #1.3 (i.e. Developing a centralized information hub)

(Generally supported by the participants)

- Stress public involvement, public access to these technologies and what they mean
- Look at IJC's involvement/recommendations for similar problems in other basins: NW Ontario, NE Minnesota, SE Manitoba (Rainy Lake of the Woods basin)
- Information sharing has been a challenge - parties consuming but not sharing
- Are there any opportunities to link with the 4Rs and stewardship programs?
- How do we use information from CAFOs for permit approvals?
- There is more research on impacts than land-use measures
 - Guelph and Ontario have conducted research on these topics
- Should be done the way it was done in Ontario (public transparency) – however even well-informed people aren't familiar with the scheme in Ontario

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin Workshop Summary Report

- Public should be included in the assessment process
- There needs to be a collaboration of the Great Lakes states and Ontario to develop guidelines and a unified framework for manure that considers the adequacy of the current framework
- Record keeping is of interest:
 - How are the strict record requirements affecting environmental outcomes (both positively and negatively)? What is the compliance to the record requirements?
 - What are the education/outreach campaigns to promote the record compliance in these jurisdictions?
 - What are the socio-cultural differences that contribute to the compliance of these record requirements?
 - How is record redundancy prevented? How is the value of these record requirements communicated to stakeholders?

Comments on Bullet point #1.4 (i.e. Eliminate sub-dividing of adjoining operations) **(Generally not fully supported by the participants)**

- Recommendation is very specific
 - Could provide a better overview of the problem
 - Process – first part of the recommendation is to evaluate, and it needs to be completed to get to the next parts
- What is adjoining? At the federal level, if you own all the ground between them than they're one operation
 - Sell-off 10 acres – put a barn on it and as long as they have enough acreage then it works - not used regularly but it does happen
- In Ontario, rural severance rules have been tightened up
 - No specific numbers but needs to be approved at the local level
 - Provincial planning rules applied by the local municipality
 - Quota rules that limit the total number of animals allowed in Ontario
- In the U.S. – permission to sub-divide depends on the municipality
 - Can still get severance lots
- Wisconsin state code addresses common ownership/management
- Eliminate the Limited Liability Corporation (LLC) loopholes in the U.S. and Ontario
 - There should be a single-set of rules for all farms regardless of size to reduce loopholes.
 - Make the regulations simple

Discussion - Recommendation #2

Draft Report Recommendation #2: The U.S. Great Lakes states and Ontario, if not already doing so, should create rules and policies for manure applications that include:

- 2.1 Developing a systematic approach that requires dedicated minimum acreage for the amount of land needed per animal unit for manure application that includes consideration of factors such as livestock types and soil phosphorous levels; and a requirement for manure storage needed per animal unit. The minimum acreage requirement applies to onsite and offsite manure applications.

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin Workshop Summary Report

Ontario's approach, under the Nutrient Management Act, should be used as a model for this recommendation.

- 2.2 Developing a land base registry or equivalent tracking system for overseeing manure application agreements, parcel identification where manure is applied, the number of animals and the application dates and amounts.
- 2.3 Developing requirements for the permissible timing and amount of manure applications –e.g., not on frozen ground and not when there are forecasts for heavy rains, that is applicable to both onsite and offsite locations, and to animal feeding operations that are both permitted and unpermitted.
- 2.4 Developing requirements that all property owners and residents within a certain radius of a new or expanding animal feeding operation should be notified and have the opportunity to comment.

Participants were provided with a recap of Recommendation #2 from the work group's draft report (above). Participants then broke into three small groups to discuss their feedback on the recommendation using the following guidance questions:

- Do you feel this recommendation is on target?
- Are there any refinements that can be added to improve this recommendation?
- Is anything substantive missing?

In general, there was mixed support by participants for this recommendation and its components as follows:

- Bullet point #2.1 - Developing a systematic approach for manure acreage requirements based on soil, crop, etc. There was mixed support by participants.
- Bullet point #2.2 - Developing a land base registry for manure application agreements, where manure is applied. Generally supported by the participants.
- Bullet point #2.3 - Developing requirements for permissible timing – e.g. frozen ground, application after heavy rains. Generally supported by the participants.
- Bullet point #2.4 - Developing requirements to notify property owners in a certain radius for new and expanding operations. There was much discussion on this recommendation and there was little support by the participants

Each group reported in plenary their feedback on the recommendation including refinements that should be considered and anything that is missing. The following is a compilation of participant comments:

Feedback on Recommendation #2

General

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin Workshop Summary Report

- Simple land application standards that apply to all farms in the basin. Education outreach campaigns (peer-to-peer) to facilitate behavior change.
- Seems contradictory - there are numerous small operations that don't have oversight, but moving back to municipal-based oversight would be difficult. The Ontario Nutrient Management Act includes a nutrient management framework.
- There are gaps in the recommendation:
 - Compost not addressed
 - Could add more about developing technology, innovation
- In Michigan, all farms fall under the Right to Farm Act, although participation is voluntary
 - Provides protection to farmers from nuisance complaints as long as they are following the Michigan GAAMPs
 - Any farm over 50 animals requires a siting process (e.g. proximity to neighbours, land use zoning, etc.) to be covered by the Right to Farm
- Overall the report and this recommendation are fuzzy on whether it is talking about permitted or non-permitted facilities or both
 - Suggest that the report be clearer on this; also in same thread check the report for instances where the terms "regulations" and "rules" are used and whether they are being used appropriately
- An outstanding nutrient management plan will accomplish Recommendation #2
- Delays are problematic in New York - don't want to give unpermitted CAFOs an advantage over permitted farms
- Composting / large storage (pile)
 - In the U.S., horse farms may never spread their manure and it will sit there for a long time
 - How do we deal with that? How do you deal with compost?
- Suggested model – set out clear principles and look how the legislation currently fits those
 - How does the science fit with the principles?
 - Rather than looking at the mechanisms
 - Not to reduce the amount of P getting to the lakes, but look at how to keep the P on the farm
 - Need the ability and the enforcement capabilities to enforce anything that is new

Comments on Bullet Point #2.1 (i.e. Developing a systematic approach)

(Mixed support by participants)

- Concerned that this is a very specific recommendation that could eliminate options for manure use
 - This isn't done for fertilizer
 - There are benefits but trying to develop processes so that manure is a commercial source like fertilizer
- In reference to Bullet point #2.1 background on understanding the Ontario system was provided:
 - A building permit is need for a barn to be constructed; application made through the municipal building permit process

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin Workshop Summary Report

- Prior to 2000 each municipality had different building permit standards and then the 2002 NMA standardized this
- Since 2005 every new livestock barn or expansion has to go through the NMA regulatory process
- So far, 42,000 livestock farms have a NMS and/or a NMP (i.e. they have gone through the approval/regulatory process)
 - This requires identifying items such as type of livestock, number of livestock, manure storage, adequate land base for application of manure (either on your farm unit or have an agreement with a receiving farm)
 - Efforts are made to ensure that the same farm is not receiving manure from multiple facilities
 - NMS and NMPs are subject to a review and renewal process
- The ultimate objective in Ontario is to have all farms fall under the NMA linked to the building permit process
- Public input/notification:
 - The NMS/NMP goes to OMAFRA along with the building permit application
 - If the facility can show it meets the Minimum Separation Distance (MSD) then there is no public notification
 - If facility can't meet MSD, then there is public notice and consultation is overseen by the local municipality
 - Notice is sent to non-farm facilities within a 2 km radius
 - The MSD is based on a formula that takes into account factors such as animal numbers, odour thresholds, manure storage method, etc.
 - If the land use near the farm is a residence, or community center, etc., the MSD can be as much as doubled
 - The building permit application process, development of a NMP/NMS and public consultation process (if needed) can be expensive (as much as \$10k-\$15k) and this can be for farms as small as 5 Nus (or 5 horses)
 - After the public consultation process, the municipality makes the final approval decision; there is also an appeal process in place
- NMS/NMPs are not publicly available
- A NMS is distinct from a NMP; a NMS is much higher-level (e.g. ID number of animals, minimum 240 day manure storage, amount of manure generated, show that there is an adequate land based to accept the manure); NMP requires more detail (e.g. nutrient testing of manure, nutrient testing of soil/field, crop types/rotation, etc.)
- Those facilities with a NMS/NMP are subject to audits.
 - Complaint response audits and fines can be issues through the regulatory enforcement process
- In Ohio, permits are renewed every 5 years; permits can be revoked if there are/have been issues
 - Ohio also has permits to install, but these are for larger operations, not as small as those in Ontario

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin Workshop Summary Report

- Is the minimum number permitted ok?
 - How is Ohio setting these?
 - Recommendation is complex even though it seems simple
 - Series of minimum acreage based on a few parameters
 - In Ontario – minimum acreage is set by a number of parameters and are moving towards a P index approach
 - In practice, things don't work that way and aren't that simple
 - For example, a large poultry producer in Michigan ships their manure all over the country and won't necessarily know how much acreage they'd need

Comments on Bullet point #2.2 (i.e. Developing a land base registry)

(Generally supported by participants)

- In Michigan, this information can be tracked for permitted farms, farms under MEAP, farms covered by the Right to Farm Act, or in the EQIP program
- Tricky to implement in New York - recommendation is too restrictive
- Minimum acreage per animal would be difficult to implement in Michigan. Difficult to outline and to enforce. Current plan focuses on N & P.
- Avoid having separate record-keeping, accountability records for different end-users
 - Whatever the platform used for record-keeping, ensure it meets multiple purposes
- If there is a registry it will need to have funding associated
- Why would this be done? How would the information be used from a management perspective?
- Is there a way to develop good numbers in a more efficient way rather than through record keeping?
- How good are the records being generated – true and verifiable, how do they relate to the actual issues (how the nutrients are getting off the field, etc.)
- Could a sample/census get to the same information?
- There is concern about this information being publicly available/released, as accepters of manure (who in the past have been identified) have been threatened, abused in the media and/or have had damage done to their property (same concern shared in Ontario)
- Are the offsite soils able to accommodate the manure? The obligation should be on the generator of the manure to obtain info about receiving soil's suitability
- In Ontario, to encourage the transfer of manure from a nutrient surplus farm to a nutrient deficit farm, there can't be a lot of strings attached/hoops to go through for the transfer process (needs to be easy/straight forward)
- It may be overkill to include this particular bullet point #2.2
- In Ontario, inclusion of farm sizes from 5 NU to 300 NU under regulation puts everyone on the same playing field; the information contained in a NMS/NMP is not made public
 - 20% of the 4,200 farms under the NMA regulation are at/exceed the 300 NU threshold
 - A NMS/NMP is developed and goes to OMAFRA for approval; OMAFRA extracts the needed information for the building permit official (info confidential); the record of approval from OMAFRA goes to the municipality (not confidential)
 - Ontario is looking at more alignment with the 4Rs process for recordkeeping

**Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin
Workshop Summary Report**

Comments on Bullet point #2.3 (i.e. Requirements for timing and amount of manure application)
(Generally supported by participants)

- 4Rs nutrient stewardship program addresses this recommendation and should be included
- In Ontario, under the 4Rs principles – do not apply fertilizer if local forecast calls for 50% chance of >1 inch rainfall, unless it can be incorporated
- Some states have this covered already (Ohio) and (Michigan)
- Who is not doing it? In the U.S., permitted facilities are already doing this
- In Ohio, outside of the Great Lakes basin this isn't covered
- Regulations don't always solve an issue or situation
 - Regulatory response is probably not the best approach
- On the permitted side of this issue this is covered, but for small/medium producers this may be an issue
 - For the small/medium producers this will either force them out or force them to become CAFOs
- Definition of frozen/covered land is an issue
- Work towards getting all producers in a position that they don't HAVE to spread on frozen or snow-covered ground. May need assistance (funding) to support this
 - Dedicated funding is definitely needed – historically this has been shown to be true
- Should be a normal farm practice – need to get farmers to think this way
- Develop effective programing to move industry this way
- Dependent upon the nutrient management plan
 - Suggest changing to total collection volume and total nutrients instead of animal units
- Enforcement on the large operations may be a good example for the small/medium operations
- Unsure how this recommendation would be enforced on an unpermitted CAFO
- All precipitation (including snow) should be included
 - “frozen and snow-covered ground”
- 100-year flood lines (plains) were included in the CAFO permitting process decision-making process
 - Suggest developing coping strategies for dealing with 100-year storms to encourage thinking about (and recognition of) extreme weather events
- Michigan currently has manure application standards with a 24-hour reference to weather (precipitation) events
- These recommendations should consider the highest risk practices and the practices with the most benefit (e.g., application of nutrients during heavy precipitation periods is a high-risk practice)
- Manure and commercial fertilizer represent similar risk and the recommendation should apply to both
- “Forecasts for heavy rain” should be a BMP and not a regulation
- Michigan already has a 6-month storage capacity requirement (for permitted operations) to make it through the winter/spring wet months
- States reporting on timing and amount of manure applied

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin Workshop Summary Report

- Ohio - information is there for permitted facilities but there is no database to track timing
 - Michigan – permitted facilities are being tracked
 - Indiana – being done for permitted facilities, which have lower permit thresholds than Ohio and Michigan, but may not be tracked in a database
 - 4R certification for farms – require record keeping for BMPs
- Issues with land use and some people not knowing what is happening with certain parcels of land, so this would be helpful
- Is the social expense worth the few situations where it is an actual issue?
 - Cost/benefit analysis
 - Can it be enforced?
- In Ohio, already have this for the western basin of Lake Erie (i.e. no application on frozen ground)
- In Michigan, under Right to Farm/GAAMPs (voluntary programs) there is something in place for restriction on frozen ground
- Struggle with the weather aspect of the recommendation (i.e. restrict application before heavy rains)
 - Looking at a risk curve of nutrient runoff, unincorporated manure is a greater risk than applying before a heavy rain
 - Not the biggest bang for your buck in terms of telling farmers what to do
- A greater impact on reducing nutrient runoff would be seen if efforts are made to ensure materials (fertilizer or manure) are incorporated and do not sit on the surface when a heavy rain hits (i.e. make sure material is incorporated before a heavy rain)
- More of a placement issue rather than timing issue when it comes to minimizing runoff risk

Comments on Bullet point #2.4 (i.e. Notification of public within radius of operation)

(Little support by participants)

- Don't see how this bullet point impacts water quality
- Not the appropriate place for this component of the recommendation. It is not relevant to the document and the goal of water quality protection and should be removed
- Noted that it is important with regard to setbacks from wells, or impacts on ground water aquifers
 - Further noted that siting requirements or MSDs should take this into account
 - In Ontario, groundwater is considered in the siting process
 - In Michigan, under Right to Farm siting process, proximity to groundwater and surface is taken into account as well as notification to nearby neighbours
- Don't dispute the point, but not appropriate for inclusion in this particular document that is focused on protection of water
- In Michigan, already included for all farms
 - Radius is dependent on the size of the expansion
 - Neighbours need to sign-off
- Michigan currently makes contacts at the township administration level to obtain/share information

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin Workshop Summary Report

- Ontario already has a minimum distance separation that requires public notice (neighbours)
- Contacting neighbours may be too much work, but contacting the local municipality/regulator may be easier/have higher adoption
- Appears to be a building permit issue instead of a manure management issue
- Recommendation should be more specific on what the notification is being made for

Is anything substantive missing?

- Should choose the priority issues that have the greatest effect on water quality to target recommendations with a timeline for implementation
 - Accommodate for regional differences, size of farm
- New York has a funding mechanism for farms of all sizes
- The new United States-Mexico-Canada (USMCA) trade agreement (that's yet to be ratified) will shift some livestock production from Canada (3% dairy market and some chicken market) to the US and add to the USA's manure to be managed
- The 4R program (voluntary) is most used in Ontario. In the Great Lakes states it is being developed by New York) and is recognized in Wisconsin, but additional certification is required
- Commercial fertilizer has less regulation than manure that has inherent benefits as a resource (contains organic matter). They shouldn't be treated differently. No two-tiered approach.
- IJC already has a whitepaper on fertilizer

Discussion - Recommendation #3

Recommendation #3: Provide dedicated federal Canadian and U.S., along with Great Lakes states and the province of Ontario, funding for promoting proper manure management, re-use and treatment technologies by assisting existing animal feeding operations to make necessary changes to meet recommended standards and best management practices.

Participants were provided with a recap of Recommendation #3 from the work group's draft report (above). Participants then broke into three small groups to discuss their feedback on the recommendation using the following guidance questions:

- Do you feel this recommendation is on target?
- Are there any refinements that can be added to improve this recommendation?
- Is anything substantive missing?

All were in general agreement with recommendation #3. Each group reported in plenary their feedback on the recommendation including refinements that should be considered and anything that is missing. The following is a compilation of participant comments:

Feedback on Recommendation #3

- In the U.S., funding is provided under the EQIP program
- Funding should be across the board for farms of all sizes

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin Workshop Summary Report

- Accountability in how funds are used; are they used appropriately?
 - Perhaps funding should be tied to effectiveness of BMPs implemented/production of desired results; money for research to identify effective BMPs; money for measuring effectiveness/benefits of BMPs
- Under EQIP, it encourages farms to implement more BMPs to gain more “points” to support approval of funding
- In Ontario, there is a lack of funding. If a facility is new or expanding then it is not eligible for funding; funding is there to help farms go beyond legislative requirements, not to get you to legislation
 - Existing facilities can get funding to improve/upgrade manure management equipment as long as they are not increasing their animal numbers
- In Ontario, banks don’t want to provide loans/money for something that will not generate revenue (such as improved manure storage)
- Technologies for farms are often too much for farmers to maintain/operate, both from a financial and human resources standpoint
- The report may want to note the Ontario funding gap, and the U.S. situation to provide context leading up to the recommendation
- Purposes for funding
 - Promote innovation, support early adopters
 - Subsidy
 - Market won’t reward people enough to make it economically viable
 - Needs to be an ongoing payment
 - May not be a good term – biosolids, providing a service to society
 - Biodigester – if not big enough than you need some help in terms of setting these up
 - Paying for what you get in return
 - Records, information, etc.
 - Off-setting of overall costs
 - Overall operating expenses balance
- Extend this beyond just government funding
- Green energy funding in Ontario is a possibility
- Need a fundamental shift in how materials are dealt with and funding could help with this shift
- Funding should be focused on getting people to where they need to be and this is especially important to small/medium producers
- Include funding for promoting and/or developing new technologies
 - Promotion of new technologies may be missing from this recommendation
- Regulations have improved – 4R integrates all nutrient sources which is a better approach
- Funding is complementary to other parts of the program – need to look at everything to make sure they work together
- Need funding at all aspects of the nutrient management programs
- 4R farm certification for ALL nutrients – everything balances out
- Funding objective should be sustainable nutrient management
- If regulations are expanded, there must be accompanying funding to support farms of all sizes
 - Farms of all sizes should have access to these funds.

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin Workshop Summary Report

- Cost share approach (high proportion ~90%)- even a small producer could be phased into the Nutrient Management Plan
- In New York, both permitted and non-permitted farms are eligible to funding
- To qualify for EQUIP funding (US federal), farm must have a nutrient management plan
- New York recently passed a Clean Water Infrastructure Act that provides \$50 million mostly for storage
- For Wisconsin, this would be an opportunity to provide funding for CAFOs
- The outcome of the funding should be to improve the nutrient management (use nutrients more efficiently) than simply increasing the number of storage days (process goal)
- Currently in Michigan, there is a two-tiered funding approach:
 - Large farms: can access funding from banks and Natural Resources Conservation Service (NRCS) cost sharing
 - Small farms: non-point source program (319) funding, a BMP train is required, identification of pollutant source, monitoring is done over decades (macroinvertebrate and benthic surveys)
 - Would like to have more funding especially for storage structures especially for small and medium size farms
- Suggest that funding be allocated for research for innovation (e.g., EPA challenge grant, Everglades Million Dollar challenge)
- Consider whether this funding should be allocated for education too

Discussion – Recommendation #4

Recommendation #4: With federal funding from Canada and the US, investigate the nation-wide manure management policies, tools, technologies, reporting and record-keeping practices of the Netherlands and Denmark and opportunities for application in the Great Lakes Basin.

Participants were provided with a recap of Recommendation #4 from the work group's draft report (above). Participants then broke into three small groups to discuss their feedback on the recommendation using the following guidance questions:

- Do you feel this recommendation is on target?
- Are there any refinements that can be added to improve this recommendation?
- Is anything substantive missing?

All were in general agreement with recommendation #4. Each group reported in plenary their feedback on the recommendation including refinements that should be considered and anything that is missing. The following is a compilation of participant comments:

Feedback on Recommendation #4

- This would be a good project for a master's student
- Some differences that exist between the U.S. and Netherlands:

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin Workshop Summary Report

- In the Netherlands manure is applied at ground level; no application after Sept. 1; and the use of forage crops vs. corn/silage crops (as used in U.S.)
- In Ontario, this recommendation would not be of practical value in terms of the path Ontario is currently on and is steering toward, particularly with looking toward the 4Rs practices for recordkeeping
 - Resources may be better spent looking at how to integrate the 4Rs principles/practices for manure management
- Feel the 4Rs will help achieve protections for Lake Erie/Great Lakes
- Look across country, world-wide at who is implementing a program for water protection more broadly
- The basis of MEAEP is to protect surface water and groundwater at the field level
- This research effort may result in some useful information/lessons learned
- Need to recognize that farmers have been undertaking many process/activities to improve their manure management and to build on that effort
- Should dig deeper than the consultant's report
 - More concentrated animal producers in a smaller area
- Quota issues in the Netherlands – Nutrient quota
 - Sale of their quota paid for the move to NA
 - How was the quota established?
 - Register of fertilizer accounts – parameters put in and quota calculated
- Review what the benefits of doing the research are and how it would be applied to Great Lakes situation
- Bringing all the information together in one place would be useful
- Highlight practical things that could be applied in the Great Lakes basin
- Look at the evidence/science and policies behind the principles of nutrient management in the Great Lakes before looking at other jurisdictions
- Netherlands/Denmark situation is likely not applicable to the Great Lakes due to various factors
- Some don't see the value of spending more money on something like this
- What is the water quality angle? -needs more emphasis
- Future studies should seek a better understanding of how different things are or are not working in the Great Lakes and not look at other jurisdictions
- Economic lens of cost to government, industry, society

Final Feedback on the Report and Recommendations

The final plenary session of the workshop allowed an opportunity for participants to provide any additional comment on the report and its recommendations, and any other feedback participants wanted to provide for the consideration of the work group.

Report Overall

- Would have been beneficial to read the consultant's report in advance of the workshop to better understand the context of the work group report
- Focus must be on all nutrients and not just manure; not just one nutrient producer, we must consider the whole system

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin Workshop Summary Report

- WQB should have a more comprehensive look at the nutrient issue than just agriculture
- Common paradigm is to view just the farmer as responsible for nutrient management; other players (custom applicator, nutrient consultants, brokers, policy) should be considered too
- Remember, the overarching goal is water quality in the Great Lakes. Measureable results are necessary to make this assessment and develop BMPs.
- Try to find common ground in compiling this report; consider all policy options
- Include in the report - the Canada quota system for some commodities (eggs, poultry, dairy); and in the U.S., the market system. Driven by different economics and issues.
- Consider adding a definitions section
- Try to pull the recommendations together in a coherent story
- The recommendations with bullets should be split-up, as some seem to be separate/stand-alone recommendations

Recommendation 1

- No further feedback beyond what the participants had provided previously

Recommendation 2

- Third Bullet: change “requirements” to “recommendations” – Throughout the report; reconsider word usage of “requirements, recommendations”. Is this really what is meant or is it more of a framework? Consider using “framework” to avoid interpretation.

Recommendation 3

- No further feedback beyond what the participants had provided previously

Recommendation 4

- No further feedback beyond what the participants had provided previously

Next Steps

The outcomes of this workshop will be used to inform the development of advice and recommendations that the WQB will present to the IJC for their consideration in forwarding to the governments of Canada and the United States. Participants were informed of the next steps in completing the report:

- The workshop report will be shared with participants for review and comment.
- The work group plans to have a webinar in late February to further discuss their draft report and recommendations with a larger group, as well as to potentially highlight some of the outcomes of the workshop. *(Please note after the input received from the diverse group of participants at the workshop, there will not be an invitee only webinar, but instead a webinar for the public that will follow the release of the WQB’s final report).*
- The work group will refine their report and recommendations based upon the workshop outcomes.

**Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin
Workshop Summary Report**

- The work group's report will then undergo a review and approval process by the full Water Quality Board membership.
- Upon approval by the board the report will be forwarded to the IJC for their review.
- The IJC will then decide what advice and recommendations should be forwarded to the US and Canadian governments.

**Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin
Workshop Summary Report**

Appendix A: Workshop Agenda

DAY 1: November 13, 1:00 PM – 5:00 PM

**Holiday Inn, LaSalle Room
Windsor, Ontario**

Agenda

Time	Agenda Item	Who
12:30	Registration	All
1:00	Welcome & Opening Remarks	David Burden – Director, IJC Great Lakes Regional Office
1:10	Workshop Overview & Introductions	Jim Faught - Lura Consulting
1:25	Setting the Context <i>Presentation: IJC WQB Report and Recommendations</i> <i>Presentation: Manure Management in Ontario</i> Q & A	Sandy Bihn- Legacy Issues Work Group, Lake Erie Waterkeeper Mark Wales - Legacy Issues Work Group, Ontario Federation of Agriculture
2:10	Breakout Session 1 <i>Report Findings and Recommendations</i> <i>Did the Legacy Issues Work Group get the report content right?</i> <i>Breakout groups</i> <i>Groups report back and discussion</i>	All – 3 groups All
3:10	Break	All
3:25	Breakout Session 2 – Recommendation #1 <i>Breakout groups</i> <i>Groups report back and discussion</i>	All – 3 groups
4:55	Day 1 Wrap-up	Jim Faught - Lura Consulting Antonette Arvai – IJC GLRO
5:00	Adjourn	
6:00	Presentation – Gordie Howe International Bridge	Windsor-Detroit Bridge Authority
6:30+	Social Dinner (Grill 55)	All

Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin
Workshop Summary Report

DAY 2: November 14, 8:30 AM – 3:00 PM

**Holiday Inn, LaSalle Room
Windsor, Ontario**

Agenda

Time	Agenda Item	Who
8:30	Morning Refreshments & Networking Opportunity	All
9:00	Review of Day 1; Agenda, Purpose and Objectives for Day 2	Jim Faught - Lura Consulting
9:10	Breakout Session 3 – Recommendation #2 <i>3 Breakout groups</i> <i>Groups report back and discussion</i>	All – 3 groups
10:40	Break	All
11:00	Breakout Session 4 – Recommendation #3 <i>3 Breakout groups</i> <i>Groups report back and discussion</i>	All – 3 groups
12:00	Lunch (provided)	All
1:00	Breakout Session 5 – Recommendation #4 <i>3 Breakout groups</i> <i>Groups report back and discussion</i>	All – 3 groups
2:00	Workshop Summary and Discussion	All
2:45	Next Steps and Closing Remarks	Legacy Issues Work Group Antonette Arvai
3:00	Adjourn	

**Oversight of Animal Feeding Operations for Manure Management in the Great Lakes Basin
Workshop Summary Report**

Appendix B: Workshop Participants

Participants

Larry Antosch Ohio Farm Bureau Federation	Glen Arnold Ohio State University	Chris Attema Beef Farmers of Ontario
Sandy Bihn (<i>WQB Member</i>) Lake Erie Waterkeeper	Shelby Burlew Michigan Department of Agriculture & Rural Development	Don Ciparis National Farmers Union - Ontario
Trish Dunn Office of Indiana State Chemist	Kevin Elder Private Consultant - Representative of Ohio pork, beef, dairy and poultry organizations	Katherine Fox Beef Farmers of Ontario
Lynn Henning Socially Responsible Agricultural Project	Peter Jeffery Ontario Federation of Agriculture	Joe Kelpinski Michigan Department of Agriculture & Rural Development
Stephan Larrass Ontario Pork	Sara Latessa New York State Department of Environmental Conservation	Margaret May Ontario Soil and Crop Improvement Association
Theresa McClenaghan Canadian Environmental Law Association	Megan McMahon Michigan Department of Environmental Quality	Mike Mitchell Ontario Pork
Aaron O'Rourke Wisconsin Department of Natural Resources	Nathan Scaiff Ontario Ministry of the Environment, Conservation and Parks	Len Senyshyn Ontario Ministry of Agriculture, Food and Rural Affairs
Kip Studer Ohio Department of Agriculture	Pam Taylor Environmentally Concerned Citizens of South Central Michigan	Mark Wales (<i>WQB Member</i>) Ontario Federation of Agriculture

IJC Staff Support

Paul Allen International Joint Commission Canadian Section Office	Antonette Arvai International Joint Commission Great Lakes Regional Office	David Burden (<i>Director</i>) International Joint Commission Great Lakes Regional Office
Ryan Graydon (<i>Sea Grant Fellow</i>) International Joint Commission Great Lakes Regional Office	John Wilson International Joint Commission Great Lakes Regional Office	

Facilitator

Jim Faight Lura Consulting
