Manitoba

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May 6, 2005

Re: Recommendations for Regulating Phosphorus from Livestock Operations in Manitoba

Amendments to the *Livestock Manure and Mortalities Management Regulation* in 2004 included the requirement for the Minister of Conservation to review the effectiveness of regulating manure application to land on the basis of nitrate nitrogen in the soil after reviewing any recommendations of the Phosphorus Expert Committee. The concern was that long term regulation of manure application on the basis of nitrate nitrogen could result in over-application of manure phosphorus and a build-up of soil phosphorus. This has implications for the eutrophication of waterways and waterbodies, especially Lake Winnipeg.

The Manitoba Phosphorus Expert Committee was established in September, 2002 and tasked with developing recommendations for regulating manure application on the basis of phosphorus. The Committee reviewed current scientific literature, consulted with Canadian and international experts, hosted a workshop with internationally recognized speakers, and sought advice from neighbouring jurisdictions. The Committee carefully considered all the information, debated at length and ultimately reached a consensus on recommendations they consider appropriate for the Minister of Conservation to consider.

The Minister has instructed that public consultation be undertaken. A copy of the Committee's consensus on recommendations is attached because you or your organization may be affected by regulatory change that could result from these recommendations. I will contact you later in May regarding a meeting to discuss any comments you may wish to offer. Alternately, should you wish to submit written comments, please mail them to me at:

Manitoba Conservation
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Yours truly,

Al Beck, Chair
Manitoba Phosphorus Expert Committee

Attachment

Recommendations for Regulating Phosphorus from Livestock Operations in Manitoba

Manitoba Phosphorus Expert Committee

May 6, 2005

1. BACKGROUND

Amendments to the *Livestock Manure and Mortalities Management Regulation* in 2004 included the requirement for the Minister to review, by no later than March 31, 2006, "the effectiveness of regulating manure application to land on the basis of nitrate nitrogen in the soil after reviewing any recommendations of the Phosphorus Expert Committee".

The primary concern surrounding phosphorus is the eutrophication of waterways and waterbodies, especially Lake Winnipeg. Although there are multiple sources of phosphorus – including urban, industrial, agricultural and natural – Section 18 of the MR 42/98 indicates that the Minister of Conservation is particularly interested in the land application of manure. Currently, manure is most often applied to meet the nitrogen requirements of the crop. This often results in over-application of manure phosphorus and a build-up of soil phosphorus.

It is generally agreed by members of the Manitoba Phosphorus Expert Committee that soil test phosphorus levels should not be allowed to increase to infinite levels. The literature indicates that as soil test phosphorus increases to very high levels, losses of soluble phosphorus and particulate phosphorus, due to runoff and erosion, respectively, can also increase. One of the most important mechanisms by which phosphorus enters Lake Winnipeg in Manitoba is thought to be as soluble phosphorus via snowmelt and spring runoff. Unfortunately, however, this mode of phosphorus loss under our soil, landscape and climatic conditions is not well characterized.

2. PROPOSED REGULATIONS

The objective of any strategy for nutrient management, whether through education, incentives or regulations, should be to encourage the implementation of environmentally beneficial management practices. Therefore, the focus of Manitoba's regulation should be to restrict the risk of phosphorus loss to surface water by reducing excessive phosphorus loading onto land and minimizing the mobilization and delivery of phosphorus to water via transport processes.

The Manitoba Phosphorus Expert Committee has discussed the dynamics of phosphorus movement from agricultural soils and various (agricultural) phosphorus regulatory approaches with experts from England, North Carolina, Manitoba, Ontario, Alberta, Minnesota and Quebec. From those discussions and reviews of the literature, the following proposal for regulating soil test phosphorus thresholds was developed for implementation, beginning in April 2006.

3. (A) PHOSPHORUS REGULATORY THRESHOLDS

Incremental soil test phosphorus regulatory thresholds are proposed for managing the enrichment of soil with phosphorus and, in some situations, severely restricting any further application of this nutrient. These thresholds are meant to be observed on all agricultural lands that receive livestock manure (Table 1). In summary, four ranges of soil test phosphorus thresholds are

proposed and imply an increasing degree of restriction for land application of livestock manure based upon the soil's phosphorus content. In addition to the soil test phosphorus thresholds, the current restrictions for nitrogen loading also apply to all lands that receive manure as per section 12 of the *Livestock Manure and Mortalities Management Regulation.*

Table 1. Proposed soil phosphorus (P) thresholds for regulating livestock manure application on cropland in Manitoba.

Soil Test P Threshold *(Olsen P or equivalent)*[1]	Intent of Threshold	Manure P Application[2]
Less than 60 ppm	No restriction on P application	Apply on the basis of crop nitrate nitrogen (N) requirements. Soil N concentrations are subject to section 12 of LMMMReg[3]
Between 60 and 119 ppm	Control soil P accumulation rate	Apply P[4] up to 2 times the crop removal[5] rate
Between 120 and 179 ppm	Prevent further increases in soil P concentrations	Apply P up to 1 times the crop removal rate[5]
180 ppm or greater	Depletion at a rate controlled by crop removal	No manure application without written consent of the Director

1 Soil test P threshold pertains to the concentration of extractable phosphorus in soil samples taken in the 0 to 150 mm upper soil layer, using the Olsen sodium bicarbonate extraction procedure or another equivalent method recognized by Manitoba Conservation and prorated accordingly for its efficiency of extraction.

2 Manure P applications must never exceed allowable manure N applications per section 12 of the *Livestock Manure and Mortalities Management Regulation*.

3 LMMMReg: The *Livestock Manure and Mortalities Management Regulation*.

4 In the case of livestock manure, P applications are planned on the basis of total P concentrations in the manure, expressed in P_2O_5 equivalent. The application recommendation of 2 times crop removal of P will control soil test P build-up while a 1 times application rate would prevent further increases in soil test P concentrations over time.

5 Crop removal rates are published and updated regularly in the document Nutrients Removed in Harvested Portion of Crop (PPI-PPIC, 2005) or the Soil Fertility Guide (MAFRI, 2001), and are expressed in P_2O_5 equivalent. A multi-year removal rate of P_2O_5 (up to 5 years) could be applied in one year followed by no manure for the following years.

These ranges of soil test phosphorus thresholds recognize agronomic needs for phosphorus as a major crop nutrient, the increasing environmental risk associated with soil test phosphorus thresholds beyond those judged optimal for crop production, and the complicated management issues associated with soil and manure phosphorus. The mere fact that phosphorus is a nutrient universally present in soils whether in farmland, forest or other natural setting, means that zero-discharge of this element into surface watercourses will never be achieved. The particular situation associated with agricultural use of soils for crop production is the enrichment of soil test phosphorus concentrations to levels well beyond agronomic requirements. The excess enrichment will likely pose an unacceptable risk to the environment. The Manitoba Phosphorus Expert Committtee opted for managing the environmental risk associated with elevated soil phosphorus concentrations arising from livestock manure applications through incrementally restrictive requirements for use of phosphorus at different ranges of soil test phosphorus.

The intent of the thresholds is to require an appropriate management response by the producer. In other words, enforcement action would be based on management response rather than soil test phosphorus concentrations *per se*. No phosphorus based management restrictions are proposed for land where the soil test phosphorus concentration is less than 60 ppm. However, if soil test phosphorus concentrations exceed 60 ppm, producers will be required to control the phosphorus accumulation rate in soil to avoid reaching 120 ppm. This can be achieved by following the

methods prescribed in Table 1 or other methods that are acceptable to the director. If soil test phosphorus concentrations exceed 120 ppm, the manure phosphorus additions must be managed to avoid any further increases. However, if soil test phosphorus concentrations exceed 180 ppm, which are judged as excessive, manure phosphorus additions to the soil must be discontinued so that soil test concentrations can be drawn down through crop removal.

Rationale

The above management threshold approach takes into consideration the regulatory approaches from neighbouring jurisdictions, particularly Ontario and Minnesota. It also takes into consideration, as much as possible at this time, our understanding of phosphorus behaviour in Manitoba.

- Manure is a valuable source of nutrients for crop production but its characteristics pose challenges for management. These challenges include variable concentrations of phosphorus in manure and variable distribution of nutrients in the field. Additionally, soil testing for phosphorus is a useful tool for nutrient management, but it is not precise. As a result, soil test phosphorus concentrations vary tremendously with time, space and environmental conditions, even when no additional phosphorus is applied. Therefore, regulating solely on the basis of an absolute soil test phosphorus limit is likely to result in a significant number of mistakenly identified situations of apparently "excess phosphorus" and successful appeals. The thresholds focus on appropriate management responses to the best soil test information that is available and employ reasonably broad ranges in soil test phosphorus to trigger those responses (e.g., below 60 ppm, 60-119 ppm, etc.).

- Outside of sensitive areas, Minnesota uses 120 ppm phosphorus to trigger changes in management from nitrogen-based to phosphorus-based. However, our approach recommends slowing down the rate of phosphorus accumulation in soil when soil test phosphorus levels exceed 60 ppm, a level at which crop responses to additional phosphorus are highly unlikely. Although this is more stringent than what is required in Minnesota, the change in practice is graduated through the use of increasingly restrictive manure application rates.

- Above 180 ppm phosphorus, additional manure applications would be prohibited unless the operation receives written approval from the Director. This is more restrictive than both Ontario and Minnesota but may be necessary to provide that, over the long-term, soil phosphorus levels do not reach those experienced in very intensive livestock areas such as near Lethbridge, Alberta.

- Ontario bases agronomic phosphorus (P_2O_5) application rates on a 40% P_2O_5 availability and environmental P_2O_5 application rates on an 80% P_2O_5 availability; we are proposing to use 50% and 100%, respectively. The 50% and 100% availability is expressed as 2 times and 1 times crop removal in Table 1. Current agronomic recommendations for P-based manure application rates in Manitoba are based on 50% P_2O_5 availability, relative to commercial phosphorus fertilizer. Using 50% and 100% is very slightly more

restrictive as manure application rates will be slightly lower, but this is consistent with Manitoba's current agronomic recommendations.

- Both jurisdictions, and most others, use crop removal of P_2O_5 as the basis for their phosphorus-based manure application rate calculations, not total crop requirements. We are proposing to do the same.

- Both jurisdictions allow a single application of P_2O_5 at a rate that meets loading restrictions for 5 to 6 years of crop production, followed by little or no P_2O_5 applications in the following years. Based on current limitations of manure application equipment and economic application rates, we are proposing to allow multi-year applications up to 5 years of crop removal. This will encourage rotation of fields for manure application and the long-term sustainability of the operation.

3. <u>(B) SPECIAL MANAGEMENT AREAS</u>

There are areas that require special consideration when implementing management strategies to mitigate the risk of phosphorus loss. Special Management Areas (SMAs) have certain properties of location, soil, climate and landscape (topography) that cause them to be likely sources of phosphorus loss to surface water. The attributes of SMAs provide only limited opportunity for natural attenuation of phosphorus movement before it is transported to surface water. In light of this elevated risk, adoption of beneficial management practices (BMPs) to influence the processes involved in phosphorus transfer to surface water is more critical than in the rest of the landscape. BMPs that inhibit phosphorus mobilization and delivery, in particular, will be important in SMAs.

SMAs in Manitoba have been identified as those areas that are:

- subject to regular inundation, or
- immediately adjacent to surface water, whether that be
  - lakes, or
  - rivers, creeks and large unbermed drains, or
  - other watercourses and roadside ditches.

The intent of requiring certain BMPs for SMAs is to enhance the separation between phosphorus, both dissolved and particulate, and water that ultimately connects to a surface water body. This separation can be temporal (*e.g.*, timing of application relative to spring snowmelt) or spatial (*e.g.*, proximity to surface water).

Table 2 lists recommended regulations for reducing phosphorus loading from manure application in SMAs.

Table 2. Proposed livestock manure management practices for Special Management Areas (SMAs).

SMA Type	Winter Application / Buffers	Manure Application Setbacks	
		Injection / low level application with incorporation	High level broadcast application / low level application with no incorporation
Red River Valley[1] or Flood plains of other rivers[2]	Immediate prohibition on all winter application; Incorporation within 48 h or injection of fall applied manure on tilled soils[3]		
Lakes	Permanently vegetated buffer strip of 15 m; no manure application	15 m setback	30 m setback
Rivers, creeks and large unbermed drains(3rd order or higher)[4]	Permanently vegetated buffer strip of 3 m; no manure application	3 m setback	10 m setback
Other watercourses and roadside ditches	Permanently vegetated buffer strip of 1 m; no manure application	1 m setback	1 m setback

[1] That portion of the Red River Valley regularly inundated during spring snowmelt that includes land subject to overland flooding outside the Red River's 1 in 100 year floodplain.
[2] Low lying lands and incised river valleys subject to frequent inundation from overflowing watercourses.
[3] Incorporation or injection of manure is not required on perennial forage or no till systems.
[4] Drain order may be determined by reference to drainage maps which may be obtained from Water Stewardship or by on-line reference to Agri-Maps on the Manitoba Agriculture, Food and Rural Initiatives website.

Regularly inundated lands (Red River Valley and Floodplains)

Lands that are subject to regular inundation, whether by overflow from a water body or precipitation and impeded drainage, require special management because of the prolonged contact between water and the soil surface (and particularly exposed manure). Under these conditions, manure could be directly transferred to surface water, especially if the manure has been deposited on frozen ground or on top of the snow. There is also a potential for transfer of dissolved phosphorus, and to a lesser degree particulate phosphorus, to overlying floodwaters.

Proximity to surface water is not the criterion for designating regularly inundated lands as SMAs – rather, it is the high risk of connectivity between these lands and surface water via surface drainage, whether natural or artificial. Therefore, practices that reduce the exposure of applied manure at the soil surface prior to inundation should reduce the risk of phosphorus transfer to floodwaters and, ultimately, to downstream drains and surface water bodies. One such practice is the elimination of winter applications of manure. Large livestock operations are already prohibited from spreading manure during the winter. Extending the prohibition to all sizes of operations located on regularly inundated lands should significantly reduce the direct transfer of manure to surface waters from frozen and snow-covered soils. Another practice that should reduce the risk of phosphorus transfer to floodwaters is subsurface placement of manure by

injection or incorporation following broadcast application. Injection or incorporation of manure is most critical in the fall on regularly inundated lands so that there is minimal or no exposure at the soil surface prior to spring snowmelt. The adoption of this practice is limited by the cropping system (*i.e.,* limited feasibility for perennial forage or reduced-till systems). Special consideration should be given to low or zero disturbance systems that receive manure where full injection or incorporation is not feasible. In these situations, the risk posed by surface application of manure may be partially offset by reduced risk of erosion and runoff, compared to cultivated annual cropland.

Lands immediately adjacent to surface water or watercourses

Lands immediately adjacent to surface water or watercourses are at an elevated risk of contributing phosphorus simply due to their physical proximity. Maintaining narrow strips of perennial vegetation on the edges of tilled fields reduces the direct deposition of manure phosphorus into surface water and watercourses. Direct deposition could also occur via the actual entry of tillage equipment or the movement of soil due to tillage as the equipment passes very near to the waterway. Wider buffer strips along more significant waterbodies help to filter sediment from runoff before it enters the waterbody. No manure phosphorus should be applied to the permanently vegetated buffer strips. Harvesting of the perennial vegetation in the buffer strip serves as a means to remove accumulated phosphorus in plant tissue and potentially provides a source of livestock feed.

Rationale

The preceding recommendations take into consideration the scientific literature and regulatory approaches from neighbouring jurisdictions, particularly Ontario and Minnesota. They also take into consideration, as much as possible at this time, our understanding of local hydrology, agricultural practices, the landscape and phosphorus transport in Manitoba.

- Recommended buffer setback widths are generally within the ranges of those shown in the literature to provide phosphorus reductions. Buffer setbacks are generally found to be more effective at reducing particulate phosphorus although some studies have also found reductions for soluble phosphorus. Most buffer setbacks examined in literature ranged from 5 to 30 metres.

- The narrowest buffer setback width (1 metre) is recommended for the least significant watercourses such as roadside ditches and lower order (*i.e.*, 1st or 2nd order) drains. These are usually intermittent and contain water only occasionally such as during spring runoff or heavy precipitation events where transport of nutrients would usually occur. The intent is to reduce the opportunity for direct phosphorus addition to surface waterbodies through manure application or tillage while providing some minimal sediment trapping at the edge of the field.

- Larger buffer setback widths provide greater separation for manure application from more significant surface water features such as permanent rivers or lakes. They also provide an enhanced filtering and nutrient adsorption of manure residues moving off field during runoff events. Vegetated buffer strips reduce nutrients and other contaminants by decreasing velocity of runoff that induces particulate deposition. The buffer strips also

increase infiltration that subsequently reduces runoff volume, and they lower concentrations in buffer strip soils where manure is not applied, thereby allowing increased adsorption of nutrients.

- More significant water features such as rivers or creeks require larger setbacks than intermittent ditches or small watercourses because the presence of water is continual and they are more likely to transport significant amounts of nutrients. These waterbodies also have a greater susceptibility to the effects of nutrient overloading.

- The largest setback distances have been recommended for lakes because eutrophication occurs at lower phosphorus levels in lakes than in flowing water. Also, lakes allow settling of sediments and thereby retain more of the phosphorus loading received from the surrounding landscape and from watercourses draining into them.

- The manure application method has also been considered in the recommendations. Injection requires a narrower setback width than broadcast spreading without incorporation due to the lower risk of transport with surface runoff.

4. POINT SOURCES

Agricultural point sources or "end of pipe" sources include confined livestock areas, manure storage structures or field storage sites, grazing livestock access to watercourses for drinking water, and seasonal feeding areas. The *Livestock Manure and Mortalities Management Regulation* already requires a 100 metre setback from watercourses for any manure storage structures or field storage sites, as well as confined livestock areas. In addition, livestock in confined areas are prohibited from having direct access to surface watercourses.

While direct access to watercourses by grazing livestock is not specifically prohibited by the *Livestock Manure and Mortalities Management Regulation*, direct discharge of manure in surface water is prohibited. The *Protection of Water Sources Regulation* is used to protect surface water sources of community drinking water.

5. IMPLICATIONS FOR SUSTAINABLE LAND USE PLANNING

The long-term sustainability of livestock production relies on the availability of adequate, suitable land for manure application. Many soils in Manitoba benefit agronomically from some build-up in soil test phosphorus without posing a risk to environmental quality. However, agronomic response to phosphorus above initial starter levels is not expected when soil test phosphorus exceeds 60 ppm. It is important to note that soils do not have an infinite capacity to retain phosphorus. For this reason, planning for new or expanding livestock operations should ensure the availability of a cropped land-base that will allow application of manure phosphorus at no more than one times crop removal of P_2O_5. This would provide the greatest flexibility and would ensure that livestock producers have enough land to apply manure into the foreseeable future.

6. RESEARCH AND REVIEW TO DEVELOP A MORE SITE-SPECIFIC APPROACH

The above recommendations are only a first step towards improved environmental sustainability and are focused primarily on reducing excessive phosphorus loading onto agricultural land from manure. They consider only the land application of manure and do not address other potential sources of phosphorus contamination; nor do these recommendations address transport factors other than for direct, incidental contamination of water from surface-applied manure. For example, these recommendations do not address phosphorus losses from highly erosive soils and steeply sloping lands as further site specific research is needed in this regard. The above recommendations are based on best scientific information and judgment, but little scientific data for Manitoba. Therefore, it is further recommended that:

- The Minister of Conservation should review the effectiveness of the new phosphorus-based regulation no later than five years after its coming into force; and

- The department should work with other organizations to develop science-based, environmentally and economically sound beneficial management practices for reducing phosphorus losses to surface waters under Manitoba's soil, landscape and climatic conditions.

7. CAUTIONARY NOTES

An immediate prohibition on winter spreading will have severe financial impact on many existing small poultry and livestock operations that currently lack the capacity to store manure over winter. Financial assistance may be required in order for these operations to comply.

Other livestock operations may find it difficult to find enough appropriate land in close proximity for applying their manure on the basis of phosphorus removal by the crop. Some areas with intensive livestock production may already have soil phosphorus levels that are approaching or already exceed threshold values. The intensity of development in some of these areas may be such that sufficient additional spread lands may not be available to producers within economically viable distances for transport of manure. Financial support for options such as relocation or installation of treatment systems may need to be considered in order for these operations to comply.