

Prepared for:

**Boyne-Morris Watershed
Integrated Watershed
Management Plan**

Water Quality Report

Prepared by:

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Boyne-Morris Watershed – Water Quality Report

Water Quality Investigations and Routine Monitoring:

This report provides an overview of the studies and routine monitoring which have been undertaken by Manitoba Sustainable Development's Water Quality Management Section within the Boyne-Morris watershed.

There are two long term water quality monitoring station within the Boyne-Morris watershed. The Boyne River at Carman has been sampled on a quarterly basis since 1973 to present. The Morris River at Morris has been intermittently sampled quarterly from 1988 to 1995 and 2012 to 2013. In 2014, this long term monitoring station was moved to its current location the Morris River northwest of Rosenort. These long term stations have been sampled for general chemistry, nutrients, metals, bacteria, and pesticides. The main beach of the Stephenfield Reservoir has also routinely been sampled during summer months for *E. coli* from 1997 to present. There are a number of historic stations in the Boyne-Morris watershed not part of the long term water quality monitoring program which are outside the scope of this report.

The Boyne-Morris watershed is characterized primarily by agricultural crop land, industry, urban and rural centres. All these land uses have the potential to negatively impact water quality, if not managed appropriately. Cropland can present water quality concerns in terms of fertilizer and pesticide runoff entering surface water. Industrial operations present water quality concerns in terms of wastewater effluent and industrial runoff. Large centers and rural municipalities present water quality concerns in terms of wastewater treatment and effluent.

The tributaries of most concern in the Boyne-Morris watershed are the Boyne and Morris Rivers as well as the Stephenfield Reservoir. The area surrounding these tributaries is primarily agricultural production yielding a high potential for nutrient and bacteria loading. In addition, the Boyne River and Stephenfield Reservoir have been listed as a vulnerable water body in the *Nutrient Management Regulation* under the *Water Protection Act*. Please refer to the section on 'Water Quality Management Zones' for more detailed information with this regard.

Water Quality Index:

The Canadian Council of Ministers of the Environment (CCME) Water Quality Index is used to summarize large amounts of water quality data into simple terms (e.g., good) for reporting in a consistent manner (CCME, 2001). Environment Canada calculates the Water Quality Index using eleven variables (Table 1) and are compared with the Canadian water quality objectives and guidelines.

The Water Quality Index combines three different aspects of water quality: the 'scope,' which is the percentage of water quality variables with observations exceeding guidelines; the 'frequency,' which is the percentage of total observations exceeding guidelines; and the 'amplitude,' which is the amount by which observations exceed the guidelines. The basic premise of the Water Quality Index is that water quality is excellent when all guidelines or objectives set to protect water uses are met virtually all the time. When guidelines or objectives are not met, water quality becomes progressively poorer. Thus, the Index logically and mathematically incorporates information on water quality based on comparisons to guidelines or objectives to protect important water uses. The Water Quality Index ranges from 0 to 100 and is used to rank water quality in categories ranging from poor to excellent.

- Excellent (95-100) - Water quality never or very rarely exceeds guidelines
- Good (80-94) - Water quality rarely exceeds water quality guidelines
- Fair (60-79) - Water quality sometimes exceeds guidelines and possibly by a large margin
- Marginal (45-59) - Water quality often exceeds guidelines and/or by a considerable margin
- Poor (0-44) - Water quality usually exceeds guidelines and/or by a large margin

Table 1: Water quality variables and objectives or guidelines used to calculate Water Quality Index (CCME 2001).

Variables	Units	Objective Value	Objective Use
pH	pH Units	6.5-9.0	Aquatic Life
Dissolved Oxygen	mg/L	6.5 (lower range)	Aquatic Life
Total or Extractable Copper*	mg/L	Calculation based on Hardness (7Q10)	Aquatic Life
Total Arsenic	mg/L	5.0	Aquatic Life
Total or Extractable Lead*	mg/L	Calculation based on Hardness (7Q10)	Aquatic Life
Total or Extractable Nickel*	mg/L	Calculation based on Hardness (7Q10)	Aquatic Life
Total or Extractable Zinc*	mg/L	Calculation based on Hardness (7Q10)	Aquatic Life
Total Ammonia as N	mg/L	Calculation based pH	Aquatic Life
Total Nitrogen	mg/L	1	Aquatic Life
Total Phosphorus	mg/L	0.05	Nuisance Plant Growth
Dissolved Chloride	mg/L	150	Aquatic Life

The Water Quality Index for the Boyne-Morris fell within the category of 'Fair', with some years in the category of 'Good' and some years in the category of 'Marginal' (figure 1). This indicates water quality sometimes exceeds water quality guidelines and possibly by a large margin. Total phosphorus is typically responsible for driving down the Water Quality Index (to be discussed in greater detail below). While some water bodies contain naturally elevated concentrations of

nutrients due to watershed characteristics, many human alterations impact nutrient loading to the Boyne-Morris watershed.

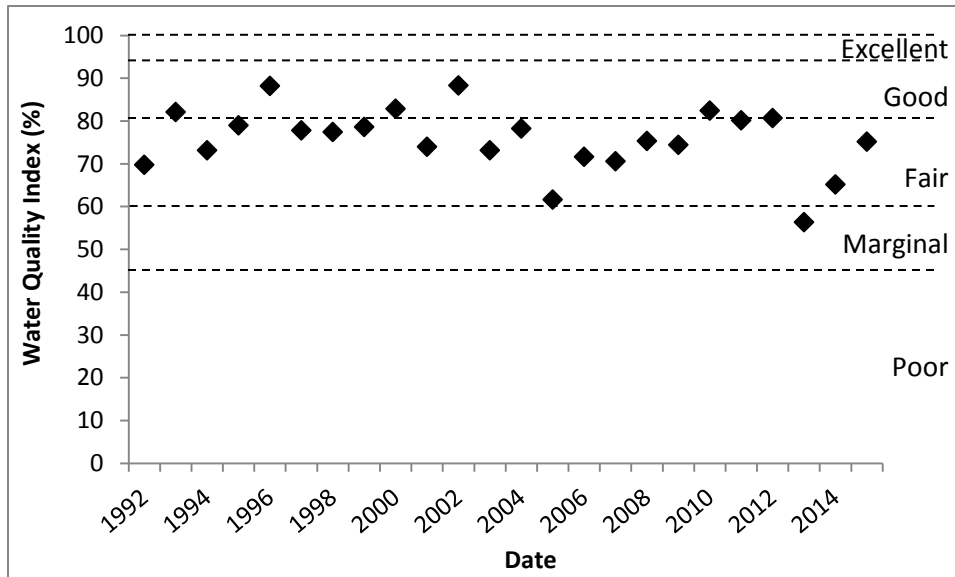


Figure 1: Water Quality Index calculated from 1992 to 2015 for the Boyne River at Carman.

Total Phosphorus

Typically, annual mean total phosphorus concentrations for the Boyne and Morris Rivers (figure 2) were above the Manitoba Water Quality Guideline for rivers of 0.05 mg/L (Water Science and Management Branch 2011). The Boyne and Morris Rivers showed an increase in annual mean total phosphorus concentrations as well as an increase in seasonal variability of total phosphorus concentrations. This may be in part due to water level fluctuations. As part of the Lake Winnipeg Action Plan, Manitoba is implementing several strategies to better manage plant nutrients. Part of this Action Plan includes the development of more appropriate site-specific or regional-specific water quality objectives or guidelines for nutrients. In the meantime, the narrative guidelines will be retained for nutrients such as nitrogen and phosphorus until more site specific objectives are developed. It is generally recognized, however, that narrative guidelines for phosphorus likely do not apply to many streams in the Canadian prairie region since other factors such as turbidity, stream velocity, nitrogen, and other conditions most often limit algal growth. As well, relatively high levels of phosphorus in excess of the narrative guidelines may arise naturally from the rich prairie soils. It should be noted that most streams and rivers in southern Manitoba exceed this guideline, in some cases due to the natural soil characteristics in the watershed and/ or due to inputs from human activities and land-use practices.

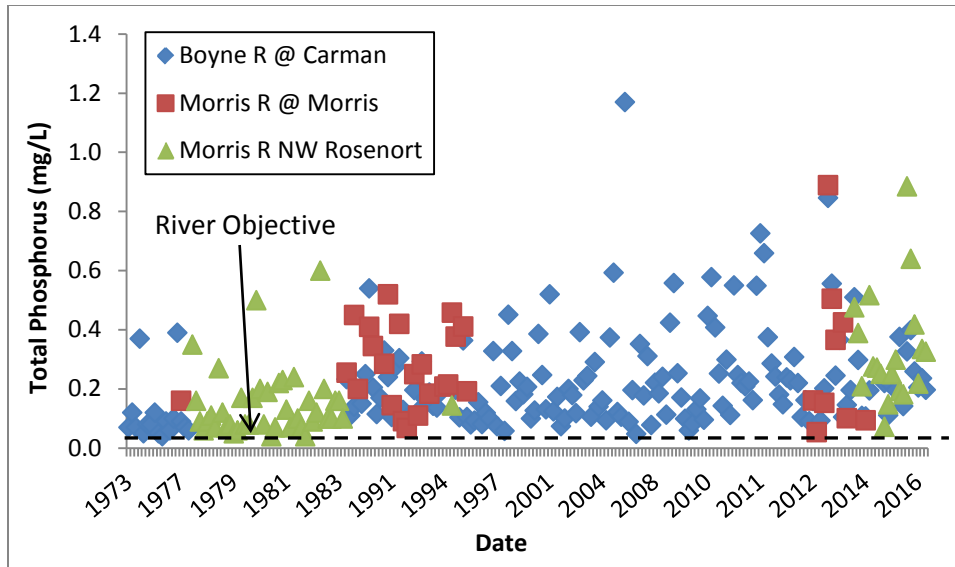


Figure 2: Annual mean total phosphorus (mg/L) concentrations from the Boyne and Morris Rivers between 1973 and 2016.

Total Nitrogen

Currently there is no guideline for total nitrogen for the protection of aquatic life in Manitoba. However, other jurisdictions have adopted a chronic total nitrogen guideline of 1.0 mg/L (Alberta Environment 1999). The narrative objective for total nitrogen states nitrogen should be limited to the extent necessary to prevent nuisance growth and reproduction of aquatic rooted, attached and floating plants, fungi, or bacteria, or to otherwise render the water unsuitable for other beneficial uses (Water Science and Management Branch 2011). Nitrogen and phosphorus are two essential nutrients which stimulate algal growth across Manitoba. Total nitrogen concentrations for the Boyne and Morris Rivers (figure 3) were typically above the narrative guideline of 1.0 mg/L. The Boyne and Morris Rivers showed an increase in annual mean total nitrogen concentrations as well as an increase in seasonal variability of total nitrogen concentrations. This may be in part due to water level fluctuations. Water quality samples collected in the spring and summer have elevated total nitrogen concentrations as compared to the remainder of the year. This indicates best management practices might be most effective if focused during the spring and summer.

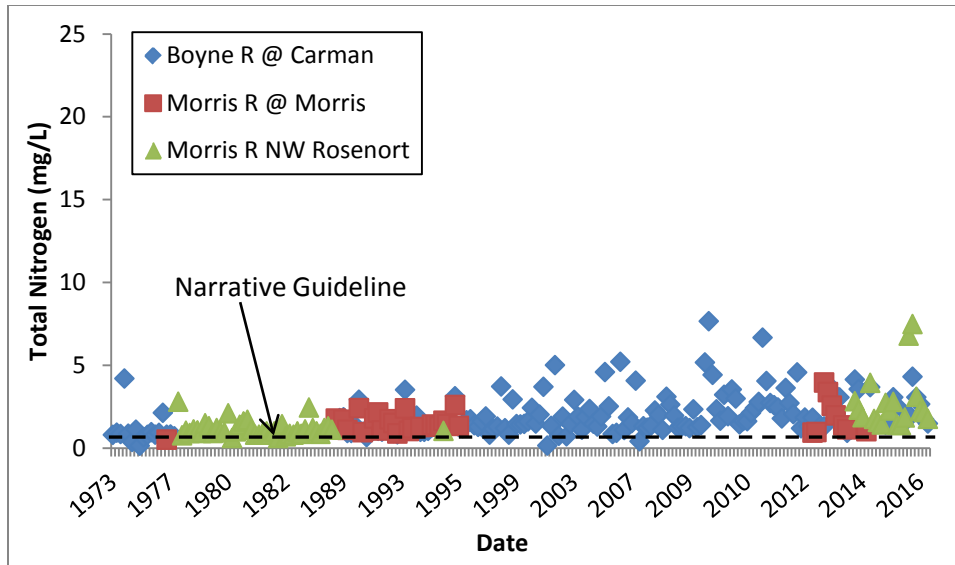


Figure 3: Annual mean total nitrogen (mg/L) concentrations from the Boyne and Morris Rivers between 1973 and 2016.

Dissolved Oxygen

Maintenance of adequate dissolved oxygen levels is essential to the health of aquatic life inhabiting rivers and streams. The monitoring conducted in the Boyne and Morris Rivers demonstrate dissolved oxygen levels have remained relatively constant since 1973 (figure 4). Dissolved oxygen levels were generally above the 5.0 mg/ L Manitoba objective (Water Science and Management Branch 2011) in the Boyne and Morris Rivers. The instances where dissolved oxygen concentrations were below the objective, indicating there is not adequate dissolved oxygen for healthy aquatic life, correlated to samples collected during the winter and occasionally later summer months. Low oxygen levels under ice conditions are not uncommon in small prairie rivers, as the decomposition of plant material consumes oxygen from the water. As well, low oxygen levels are not uncommon after a summer of intense algal blooms consuming oxygen from the water column. Overall, during the spring and summer months there is typically adequate dissolved oxygen in this watershed to support healthy aquatic life, however, during winter months there may be periods of limited oxygen available for healthy aquatic life.

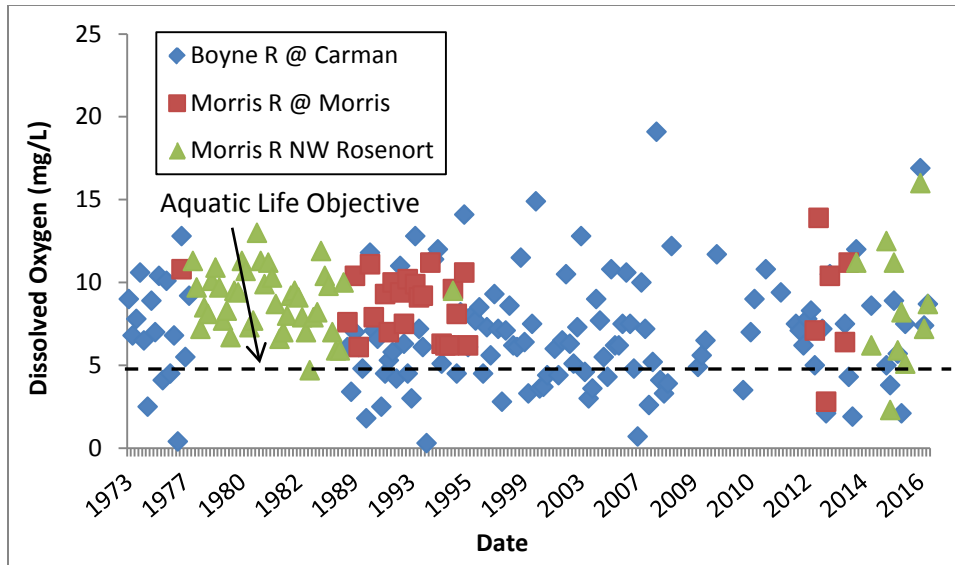


Figure 4: Annual mean dissolved oxygen (mg/L) concentrations from the Boyne and Morris Rivers between 1973 and 2016.

Escherichia coli (E. coli)

Escherichia coli (E. coli) is one type of fecal coliform, which is a bacteria commonly found all warm-blooded animals including humans, livestock, wildlife, and birds. *E. coli* itself does not generally cause illness, but when present in large numbers the risk of becoming ill from other organisms is elevated. The most common illnesses contracted by bathers are infections of the eyes, ears, nose, and throat as well as stomach upsets. Typical symptoms include mild fever, vomiting, diarrhea and stomach cramps. Extensive studies were undertaken by Manitoba Water Stewardship in 2003 to determine the source of occasionally high *E. coli* counts and the mechanism of transfer to Lake Winnipeg beaches. Studies have shown large numbers of *E. coli* present in the wet sand of beaches. During periods of high winds, when water levels are rising in the south basin, these bacteria can be washed out of the sand and into the swimming area of the lake. Research shows less than 10% of *E. coli* found at Lake Winnipeg beaches is from human sources, with the remaining percentage from birds and animals.

E. coli was always below both the irrigation objective of 1000 *E. coli* / 100 mL for the Boyne and Morris Rivers (figure 5) and the Stephenfield Reservoir (figure 6). *E. coli* was typically below the recreation objective of 200 *E. coli* / 100 mL (Water Science and Management Branch 2011) for all sites, with the exception of two samples from Stephenfield Reservoir, one sample from the Boyne River, and one sample from the Morris River at Morris. The Morris River northwest of Rosenort had three samples which exceeded the recreation objective from the late summer to fall period. This indicates best management practices might be most effective if cattle did not have direct

access to water courses in order to minimize bacterial contamination and nutrient loading to this watershed.

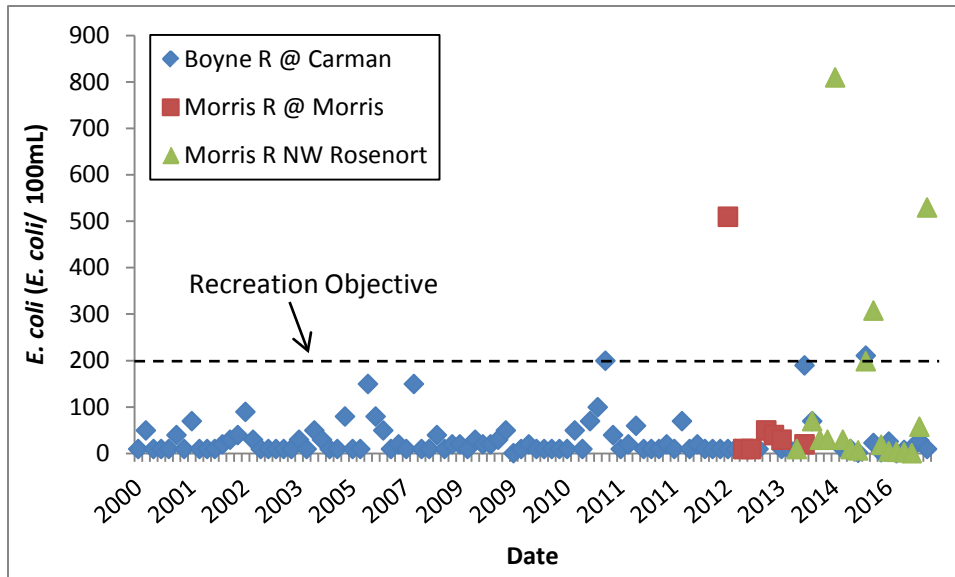


Figure 5: Annual mean *E. coli* densities (*E. coli* / 100 mL) from the Boyne and Morris Rivers between 2000 and 2016.

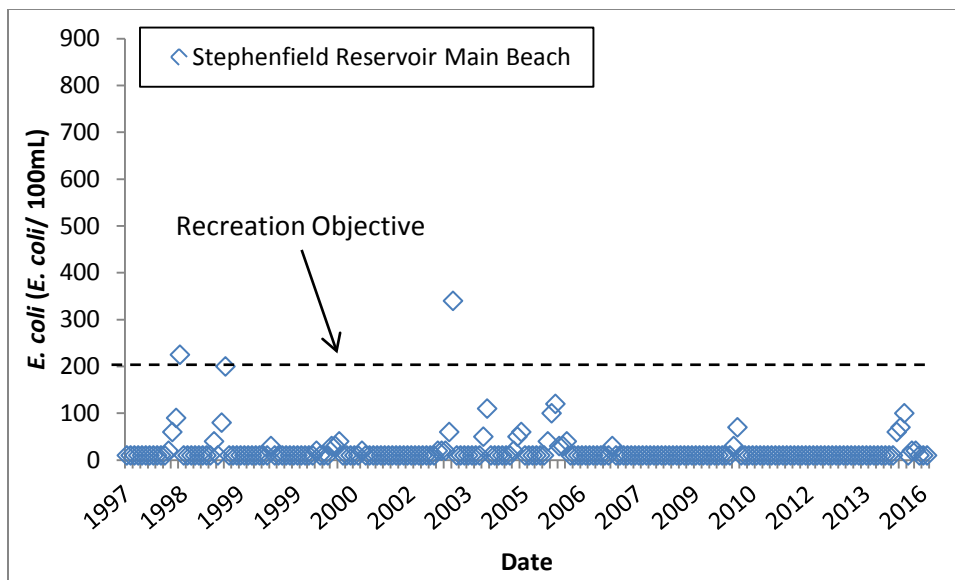


Figure 6: Annual mean *E. coli* densities (*E. coli* / 100 mL) from the Stephenfield Reservoir between 1997 and 2005.

Drinking Water Variables

Drinking water variables of greatest concern are typically nitrates (objective value = 10 mg/L), arsenic (objective value = 0.010 mg/L), barium (objective value = 1 mg/L), boron (objective value = 5 mg/L), fluoride (objective value = 1.5 mg/L), uranium (objective value = 0.020 mg/L) and total dissolved solids (objective value = <500 mg/L) (Water Science and Management Branch 2011). It should be noted that the above stated drinking water objectives and guidelines only apply to

treated, potable water. The data presented in this report however, are ambient natural untreated water quality samples, presented only for comparative purposes. At no time should raw untreated surface water be consumed for drinking water purposes, due to potential health concerns.

Drinking water variables for the Boyne and Morris Rivers were always below the objectives, with the exception of uranium on one occasion in 2012 from the Morris River at Morris. As well, total dissolved solids exceeded the drinking water objective on a number of occasions.

Total dissolved solids are a secondary drinking water objective, meaning they are primarily an aesthetic concern, rather than an immediate health concern. Total dissolved solids are related to 'hard' water which can cause problems and increased costs to drinking water and hot water systems. In addition, high concentrations of total dissolved solids can be an indication of elevated concentrations of potentially harmful ions such as nitrates, arsenic, aluminum, lead, copper, etc. which can be detrimental to health if ingested. Overall, the trend in annual mean total dissolved solids has remained relatively constant from 1973 to present in both the Boyne and Morris Rivers with a marginal increase in concentration over time (figure 7). Notably the winter, and to a lesser degree mid to late summer periods, tended to show elevated concentrations of total dissolved solids. Therefore, best management practices should focus on reducing total dissolved solid loading during the fall/ winter and summer periods for the Roseau River.

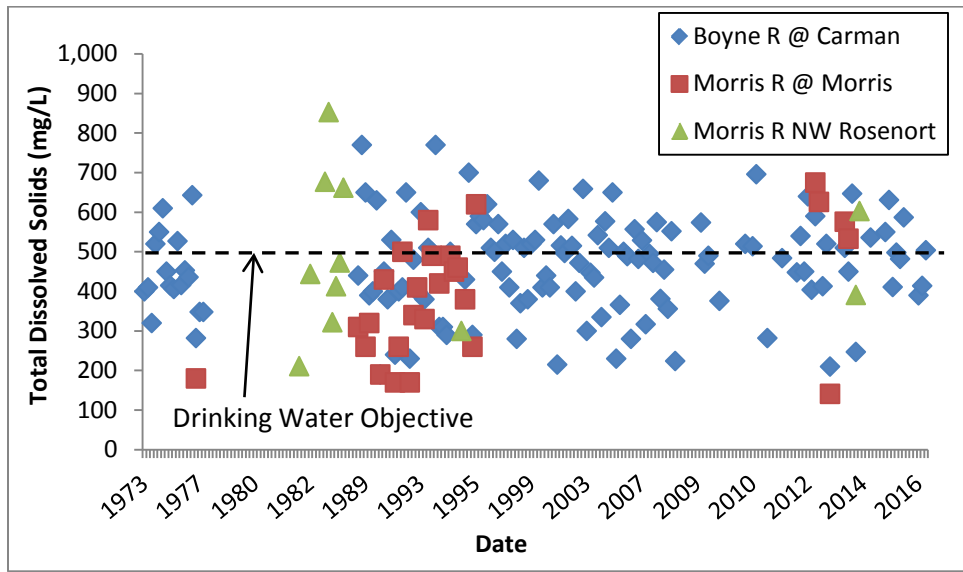


Figure 7: Annual mean total dissolved solids (mg/L) from the Boyne and Morris Rivers between 1973 and 2016.

Pesticide concentrations for the Boyne and Morris Rivers were below the level of detection, or very close to that limit, and samples rarely exceeded water quality objectives. This is with the exception of chlorothalonil (2010 and 2014 Boyne River at Carman), dinoseb (2014 Boyne River at Carman), and Lindane (1991 Morris River at Morris). Two Neonicotinoid samples were

collected from the Boyne River in July and August of 2014. Clothianidin was detected on both occasions, while imidacloprid was not detected on both occasions.

Discussion

Nutrient enrichment or eutrophication is one of the most important water quality issues in Manitoba. Excessive levels of phosphorus and nitrogen fuel the production of algae and aquatic plants. Extensive algal blooms can cause changes to aquatic life habitat, reduce essential levels of oxygen, clog fisher's commercial nets, interfere with drinking water treatment facilities, and cause taste and odour problems in drinking water. In addition, some forms of blue-green algae can produce highly potent toxins.

Studies have shown that since the early 1970s, phosphorus loading has increased by about 10% to Lake Winnipeg and nitrogen loading has increased by about 13%. A similar phenomenon has also occurred in many other Manitoba streams, rivers, and lakes.

Manitobans, including those in the Boyne-Morris watershed, contribute about 47% of the phosphorus and 44% of the nitrogen to Lake Winnipeg (Bourne *et al.* 2002, updated in 2006). About 15% of the phosphorus and 6% of the nitrogen entering Lake Winnipeg is contributed by agricultural activities within Manitoba. In contrast, about 9% of the phosphorus and 6% of the nitrogen entering Lake Winnipeg from Manitoba is contributed by wastewater treatment facilities such as lagoons and sewage treatments plants.

As part of Lake Winnipeg Action Plan, the Province of Manitoba is committed to reducing nutrient loading to Lake Winnipeg to those levels that existed prior to the 1970s. The Lake Winnipeg Action Plan recognizes that nutrients are contributed by most activities occurring within the drainage basin and that reductions will need to occur across all sectors. Reductions in nutrient loads across the Lake Winnipeg watershed will benefit not only Lake Winnipeg but also improve water quality in the many rivers and streams that are part of the watershed, including the Boyne-Morris watershed. The Lake Winnipeg Stewardship Board's 2006 report "Reducing Nutrient Loading to Lake Winnipeg and its watershed: Our Collective Responsibility and Commitment to Action" (LWSB 2006) provides 135 recommendations on actions needed to reduce nutrient loading to the Lake Winnipeg watershed. However, reducing nutrients loading to the Lake Winnipeg watershed, including the Boyne-Morris watershed, is a challenge that will require the participation and co-operation of all levels of government and all watershed residents. Ensuring good water quality in the Boyne-Morris watershed and downstream is a collective responsibility among all living in the watershed.

Water Quality Management Zones

In June 2005 *The Water Protection Act* received royal ascension. This Act is intended to enable regulations to be developed for strengthening adherence to water quality standards, for protecting water, aquatic ecosystems or drinking water sources, and to provide a framework for integrated watershed management planning. The first regulation under *The Water Protection Act* — the *Nutrient Management Regulation* (see: www.gov.mb.ca/waterstewardship/wqmz/index.html) — defines five Water Quality Management Zones for Nutrients to protect water from excess nutrients that may arise from the over-application of fertilizer, manure, and municipal waste sludge on land beyond the amounts reasonably required for crops and other plants during the growing season.

As of January 1, 2009, substances containing nitrogen or phosphorus cannot be applied to areas within the Nutrient Buffer Zone or land within Nutrient Management Zone N4 (Canada Land Inventory Soil Capability Classification for Agriculture Class 6 and 7, and unimproved organic soils). The width of the Nutrient Buffer Zone varies depending upon the nature of the body of water and is generally consistent with those contained in the Livestock Manure and Mortalities Management Regulation (42/98).

The *Nutrient Management Regulation* (MR 62/2008) prohibits the construction, modification, or expansion of manure storage facilities, confined livestock areas, sewage treatment facilities, and wastewater lagoons on land in the Nutrient Management Zone N4 or land in the Nutrient Buffer Zone. Further, the construction, installation, or replacement of an on-site wastewater management system (other than a composting toilet system or holding tank) within Nutrient Management Zone N4 or land in the Nutrient Buffer Zone is prohibited (Part 4: Section 14(1): f).

It is recommended that measures are taken to prevent the watering of livestock in any watercourses to prevent bank erosion, siltation, and to protect water quality by preventing nutrients from entering surface water.

No development should occur within the 99 foot Crown Reserve from the edge of any surface water within the rural municipalities. Permanent vegetation should be encouraged on lands within the 99 foot crown reserve to prevent erosion, siltation, and reduce the amount of nutrients entering surface water.

The Nutrient Management Regulation under *The Water Protection Act*, prohibits the application of a fertilizer containing more than 1% phosphorus by weight, expressed as P₂O₅, to turf within Nutrient Management Zone N5 (built-up area such as towns, subdivisions, cottage developments,

etc.) except during the year in which the turf is first established and the following year. In residential and commercial applications, a phosphorus containing fertilizer may be used if soil test phosphorus (using the Olsen-P test method) is less than 18 ppm.

The Nutrient Management Regulation (MR 62/2008) under *The Water Protection Act*, requires Nutrient Buffer Zones (set-back distances from the water's edge) be applied to all rivers, streams, creeks, wetlands, ditches, and groundwater features located across Manitoba including within urban and rural residential areas and within agricultural regions (Table A1 in Appendix 1).

Conclusions and Recommendations:

1. The Water Quality Index for the Boyne-Morris is typically of 'Fair' quality. This indicates water quality sometimes exceeds water quality guidelines and possibly by a large margin.
2. Total phosphorus and nitrogen data indicate an increase in annual mean total phosphorus concentrations as well as an increase in seasonal variability of total phosphorus and nitrogen concentrations. Dissolved oxygen levels have remained relatively constant. However, samples collected during the winter and occasionally later summer months tend to not have adequate dissolved oxygen to support healthy aquatic life. Therefore, management decisions should focus on nutrient reductions to the Boyne and Morris Rivers, as well as other surface water sources, to ensure the overall reduction of phosphorus and nitrogen to the Boyne-Morris watershed and ensure adequate oxygen for to support healthy aquatic life.
3. *E. coli* densities were typically below both the recreation and irrigation objectives for the Boyne and Morris Rivers, however tended to exceed the recreation objective on the Morris River northwest of Rosenort. Best management practices should ensure cattle are excluded from having direct access to water bodies. This will continue to minimize bacterial contamination and nutrient loading to surface waters in the Boyne-Morris watershed.
4. Total dissolved solid concentrations tend to be elevated during the winter and to a less degree mid to late summer. Therefore, future programming should target best management practices at reducing soil erosion, stream bank erosion, and reducing spring runoff via retention ponds and incorporation of wetlands on the landscape in the Boyne-Morris watershed.

5. Pesticide concentrations were typically below the level of detection and samples rarely exceeded water quality objectives, however, there were a few exceptions. Pesticide application in the watershed should follow label directions and adhere to appropriate setback distances to limit runoff to waterways.

6. Many steps can be taken to protect the Boyne-Morris watershed and its downstream environment. These include:
 - Maintain a natural, riparian buffer along waterways. Natural vegetation slows erosion and helps reduce the amount of nitrogen and phosphorus entering lakes, rivers and streams.
 - Where feasible, “naturalize” drainage systems to reduce streambed and stream bank erosion, and allowing opportunities for nutrients to be assimilated and settled out of the stream.
 - Value and maintain wetlands. Similar to riparian buffers along waterways, wetlands slow erosion and help reduce nutrient inputs to lakes, rivers, and streams. Wetlands also provide flood protection by trapping and slowly releasing excess water while providing valuable habitat for animals and plants.
 - Reduce or eliminate the use of phosphorus-based fertilizers on lawns, gardens, and at the cottage.
 - Choose low phosphorus or phosphorus-free cleaning products.
 - Prevent soil from eroding off urban and rural properties and reaching storm drains or municipal ditches.
 - Ensure that septic systems are operating properly and are serviced on a regular basis. It’s important that septic systems are pumped out regularly and that disposal fields are checked on a regular basis to ensure that they are not leaking or showing signs of saturation.
 - Evaluate options for potential reduction of nutrients from municipal wastewater treatment systems. Consider options such as effluent irrigation, trickle discharge, constructed wetland treatment, or chemical treatment to reduce nutrient load to the watershed.
 - Review the recommendations in the Lake Winnipeg Stewardship Board 2006 report “Reducing Nutrient Loading to Lake Winnipeg and its Watershed: Our Collective Responsibility and Commitment to Action” with the intent of implementing those that are relevant to the Boyne-Morris watershed.

Contact Information

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And visit the Department's web site: <http://www.gov.mb.ca/waterstewardship>

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Appendix 1:

Table A1: The Nutrient Buffer Zone widths as outlined in the Nutrient Management Regulation (MR 62/2008) under *The Water Protection Act*.

Water Body	A ⁽¹⁾	B ⁽¹⁾
o a lake or reservoir designated as vulnerable	30 m	35 m
o a lake or reservoir (not including a constructed stormwater retention pond) not designated as vulnerable	15 m	20 m
o a river, creek or stream designated as vulnerable		
o a river, creek or stream not designated as vulnerable	3 m	8 m
o an order 3, 4, 5, or 6 drain or higher		
o a major wetland, bog, swamp or marsh		
o a constructed stormwater retention pond		

⁽¹⁾ Use column A if the applicable area is covered in permanent vegetation. Otherwise, use column B.

A healthy riparian zone is critical to river ecosystem health providing shade, organic inputs, filtering of nutrients and habitat creation (falling trees). Preserving space along rivers gives the river freedom to naturally meander across the landscape and buffers the community from flooding impacts. Reference to the Nutrient Buffer Zone and its significance can be coupled with **Section 3.1.8 – Environmental Policies** which identifies the goals of enhancing surface water and riverbank stability, and the importance of respecting setbacks.