

**Pembina River  
Watershed  
Water Quality Report**

**January 2009**

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**State of the Watershed Report**  
**050A and 050B Pembina River Watershed - Water Quality Component**

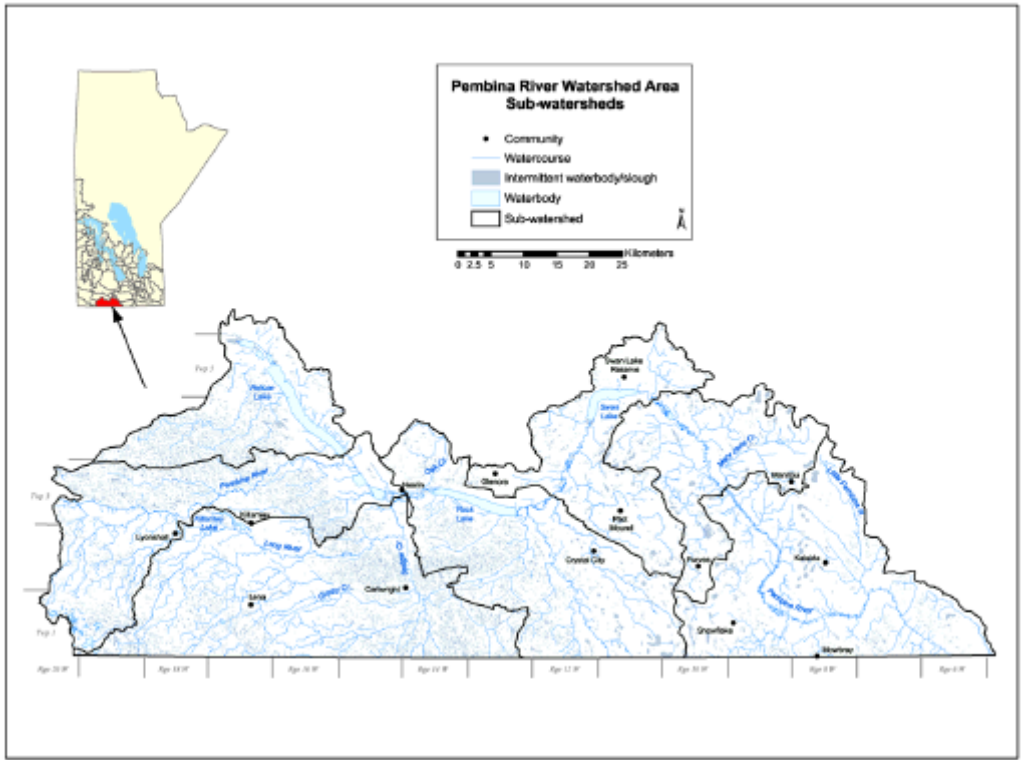
Surface water quality data have been collected by the Water Quality Management Section, Manitoba Water Stewardship, to address various issues within the Pembina River Watershed (050A and 050B). Surface water quality data are collected primarily to assess ambient water quality through short-term, intensive studies and activities. Results of water chemistry collected from the Pembina River watershed represent data that were generated from short-term, issue-driven studies. While water quality samples have been collected fairly consistently from some sites, other data collections in the watershed are not as continuous or consistent in either date range or chemistry. Table 1 highlights stations in the watershed containing water chemistry data that is discussed below.

**Table 1. Water quality monitoring stations within the Pembina River Watershed.**

Station Number	Location	Period of Record	Sampling Frequency	Agency
MB05OAS003	KILLARNEY LAKE AT WESTERN AREA	1992, 2000, 2002	Monthly in open water season	Province
MB05OAS011	KILLARNEY LAKE AT WEST BASIN	1992, 2000, 2002	Monthly in open water season	Province
MB05OAS015	KILLARNEY LAKE AT CULVERT AT ROAD, WEST END OF LAKE	1992, 2002	Monthly	Province
MB05OAS017	SOUTH END OF PELICAN LAKE NEAR DIVERSION INLET	1996	Weekly – open water season	Province
MB05OAS035	PELICAN LAKE AT NORTH END OF LAKE NEAR NINETTE	1973, 1974, 1975, 1976, 1977, 1993, 1995	Open water season	Province
MB05OAS044	PELICAN LAKE AT 14.5 KM SOUTH OF NINETTE	1973, 1974, 1975, 1976, 1977, 1993, 1995	Open water season	Province
MB05OAS045	PELICAN LAKE AT SOUTH END OF LAKE	1973, 1974, 1975, 1976, 1977, 1993, 1995	Open water season	Province

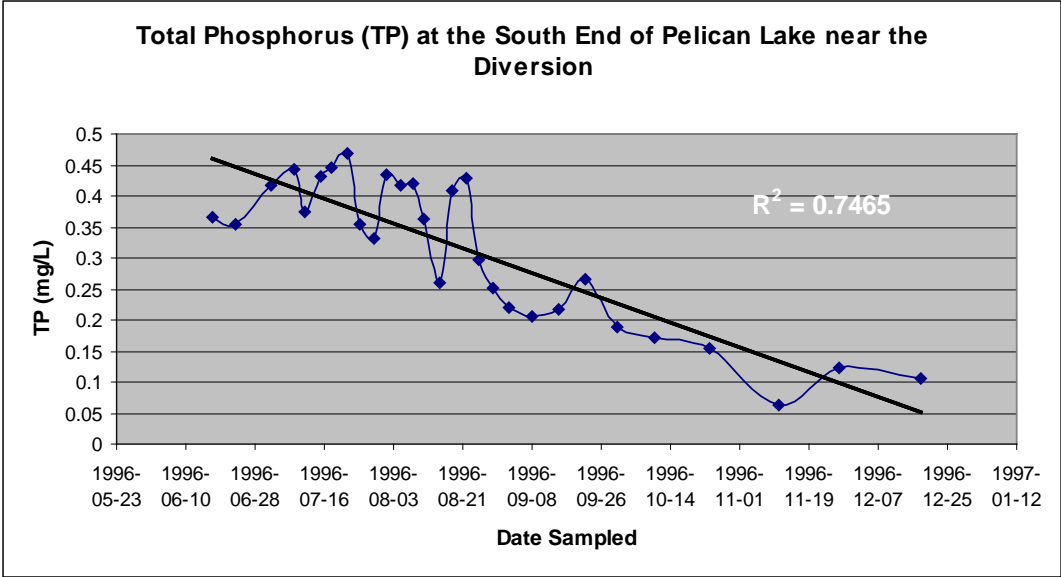
**Long-Term Trends - Surface Water Quality**

Water quality monitoring on the Pembina River dates back to the early 1970s. No sample site in this watershed has a continuous long-term data set since the monitoring was driven by short term studies. However there are clumps of time periods where continuous monitoring has taken place. Water samples taken at these sites were analyzed for a wide range of water chemistry variables including phosphorus, nitrogen, pesticides, metals, nutrients, general chemistry, and bacteria.

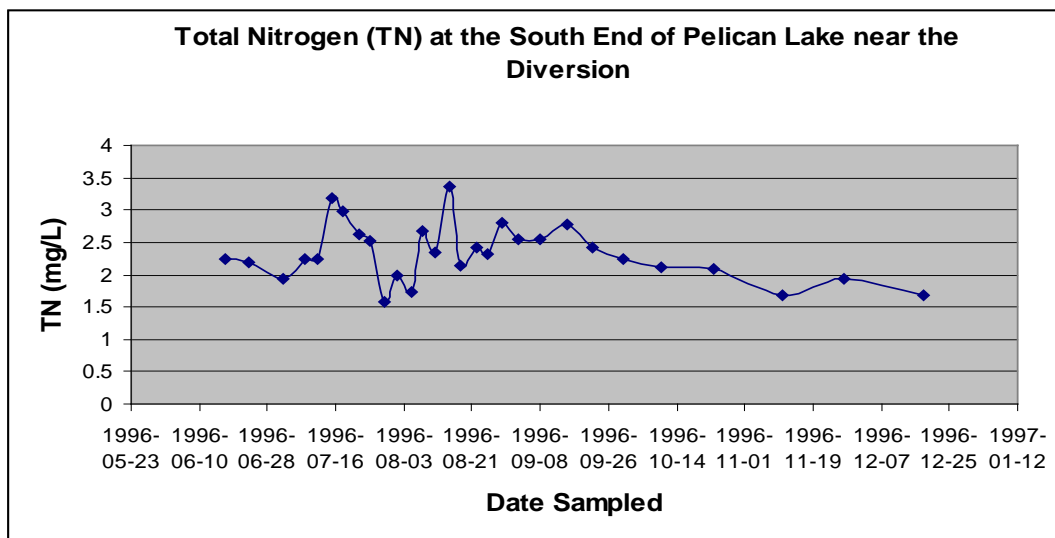


**Figure 1: Pembina River Watershed**

In 1996, Pelican Lake experienced very high levels of phosphorus. When sampling began in May in the open water season, total phosphorus levels were very high. The acceptable level of total phosphorus (TP) in a lake is 0.025 mg/L, but the samples taken were measuring levels of total phosphorus (TP) as high as 0.47 mg/L. As a result of these high levels regular monitoring was continued until the end of the year. By October of 1996 the total phosphorus levels were approaching acceptable levels.

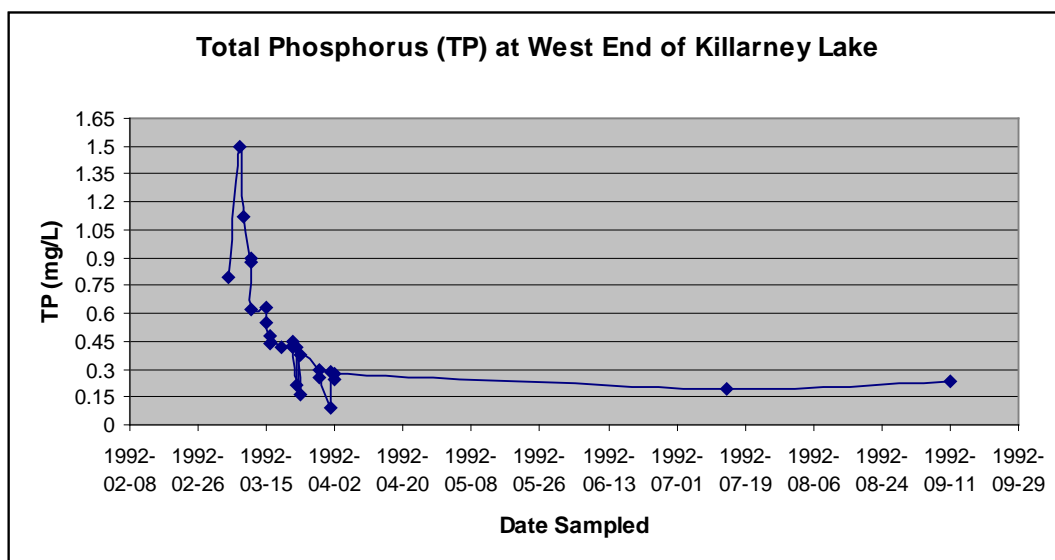


**Figure 2: Total Phosphorus Levels in Pelican Lake in 1996.**



**Figure 3: Total Nitrogen Levels in Pelican Lake in 1996.**

In 1992 the west end of Killarney Lake was continuously monitored due to high levels of total phosphorus (TP). It was in February and March of 1992 that the high levels were first detected. The lake was sampled regularly until the level of total phosphorus was back to normal in April.



**Figure 4: Total Phosphorus (TP) levels at the west end of Killarney Lake.**

**Water Quality Index:**

Water quality at long-term water quality monitoring stations can be assessed with the Canadian Council of Ministers of the Environment (CCME) Water Quality Index. The 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. Twenty-five variables are included in the Water Quality Index (Table 1) and are compared with water quality objectives and guidelines contained in the Manitoba Water Quality Standards, Objectives, and Guidelines (Williamson 2002 and Table 1).

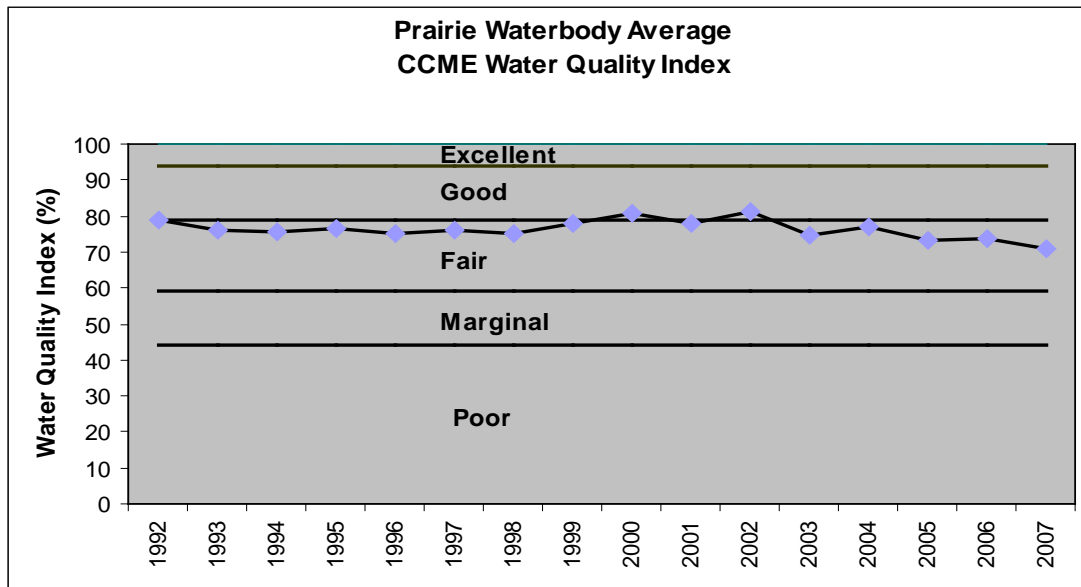
**Table 2. Water quality variables and objectives or guidelines (Williamson 2000, Williamson 1988) used to calculate Water Quality Index (CCME 2000).**

Variables	Units	Objective Value	Objective Use
Fecal Coliform MF	Bacteria/100mL	200	Recreation
Ph	Ph Units	6.5-9.0	Aquatic Life Greenhouse
Specific Conductivity	uS/cm	1000	Irrigation
Total Suspended Solids	mg/L	25 (mid range)	Aquatic Life
Dissolved Oxygen	mg/L	5 (mid range)	Aquatic Life
Total or Extractable Cadmium*	mg/L	Calculation based on Hardness (7Q10)	Aquatic Life
Total or Extractable Copper*	mg/L	Calculation based on Hardness (7Q10)	Aquatic Life Drinking Water, Health
Total Arsenic	mg/L	0.025	
Total or Extractable Lead*	mg/L	Calculation based on Hardness (7Q10)	Aquatic Life
Dissolved Aluminium	mg/L	0.1 for pH >6.5	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 Drinking Water, Aesthetic
Total or Extractable Manganese	mg/L	0.05	Drinking Water, Aesthetic
Total or Extractable Iron	mg/L	0.3	Aquatic Life
Total Ammonia as N	mg/L	Calculation based pH	Drinking Water, Health
Soluble or Dissolved Nitrate-Nitrite	mg/L	10	Nuisance Plant Growth
Total Phosphorus	mg/L	0.05 in Rivers or 0.025 in Lakes	Irrigation
Dicamba	ug/L	0.006 where detectable	Irrigation
Bromoxynil	ug/L	0.33	Irrigation
Simazine	ug/L	0.5	Irrigation
2,4 D	ug/L	4	Aquatic Life
Lindane	ug/L	0.01	Aquatic Life
Atrazine	ug/L	1.8	Aquatic Life
MCPA	ug/L	0.025 where detectable	Irrigation
Trifluralin	ug/L	0.2	Aquatic Life

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

While a long term monitoring site does not exist on the Pembina River, the Water Quality Index has been calculated for the Prairie Ecozone, in which the Pembina River is a part of. So although no long term data is available for the Pembina River we can see from Figure 5 below that the overall water quality if the Prairie Ecozone is relatively good.



**Figure 5. Water Quality Index calculated from 1992 to 2007 for the Prairie Ecozone.**

The Water Quality Index from 1993 to 2007 was overall quite good. However the province and the public have to continue to monitor and manage such issues as water quality, exceedences of *E. coli*, conductivity, suspended solids, manganese, total phosphorus, and pesticides. Management of these issues is truly one of upstream contributions. Government continues to support and develop numerous initiatives to reduce nutrient contributions within the Lake Winnipeg drainage basin. For a detailed discussion concerning Government's actions and initiatives on reducing nutrient contributions to Lake Winnipeg, please visit:

[http://www.gov.mb.ca/waterstewardship/water\\_quality/lake\\_winnipeg/index.html](http://www.gov.mb.ca/waterstewardship/water_quality/lake_winnipeg/index.html) .

### Nutrients

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 per cent to Lake Winnipeg and nitrogen loading has increased by about 13 per cent (Jones and Armstrong 2001, Bourne *et al.* 2002). A similar phenomenon has also occurred in many other Manitoba streams, rivers, and lakes.

Manitobans 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 Pembina River.

Nutrient reduction targets under the Lake Winnipeg Action Plan are interim targets that reflect the need to take immediate action to reduce nutrient loads to Lake Winnipeg. Manitoba Water Stewardship is working to develop long-term, ecologically-relevant objectives for nutrients in Lake Winnipeg and its contributing basins such as the Pembina River watershed. Long-term, ecologically-relevant objectives will also replace narrative guidelines that are currently applied across Manitoba. However, reducing nutrients across Manitoba, the Pembina River watershed, and the Lake Winnipeg watershed is a challenge that will require the participation and co-operation of all Manitobans and will involve:

- Implementing expensive controls on nutrients in municipal and industrial wastewater treatment facilities.
- Developing scientifically-based measures to control the application of inorganic fertilizers, animal manure, and municipal sludge to agricultural lands.
- Reducing nutrient contributions from individual cottagers and homeowners.
- Working with our upstream neighbours.

Individual Manitobans can help by taking the following steps:

- Maintain a natural, riparian buffer along waterways such as the Pembina River, Badger Creek and their tributaries. Natural vegetation slows erosion and helps reduce the amount of nitrogen and phosphorus entering lakes, rivers and streams.
- 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.
- Don't use fertilizer close to waterways. Heavy rains or over-watering your lawn can wash nutrients off the land and into the water.
- Use phosphate-free soaps and detergents. Phosphates have been prohibited from laundry detergents but many common household cleaners including dishwasher detergent, soaps, and other cleaning supplies still contain large amounts of phosphorus. Look for phosphate-free products when you are shopping.
- Ensure that your septic system is operating properly and is serviced on a regular basis. It's important that your septic system is pumped out regularly and that your disposal field is checked on a regular basis to ensure that it is not leaking or showing signs of saturation.

### **Water Quality Monitoring at Pelican Lakes' North and South Beaches**

A considerable amount of water quality monitoring has taken place at Pelican Lakes' North and South Beaches. These beaches are monitored for densities of *Escherichia coli* (*E. coli*) as part of Manitoba Water Stewardship's Clean Beaches Program. The monitoring frequency is monthly in open water season. Manitoba has adopted Health Canada's *Guidelines for Canadian Recreational Water Quality* of 200 *E. coli* per 100 mL for the protection of public health.

Generally, recreational water quality is excellent at both beaches with geometric means well below the recreational guideline. Occasionally, densities are above the recreational guideline but return within acceptable levels within 24 hours. On Pelican Lake, weather and lake level information appear to be good predictors of *E. coli* levels. Bacteria counts tend to increase when strong winds cause water levels to temporarily increase and large waves wash bacteria out of beach sand. When calmer weather returns, *E. coli* bacteria levels typically fall quickly

to below guideline levels. Table 3; show the *E. Coli* data from both of Pelican Lakes' beaches over the past five years.

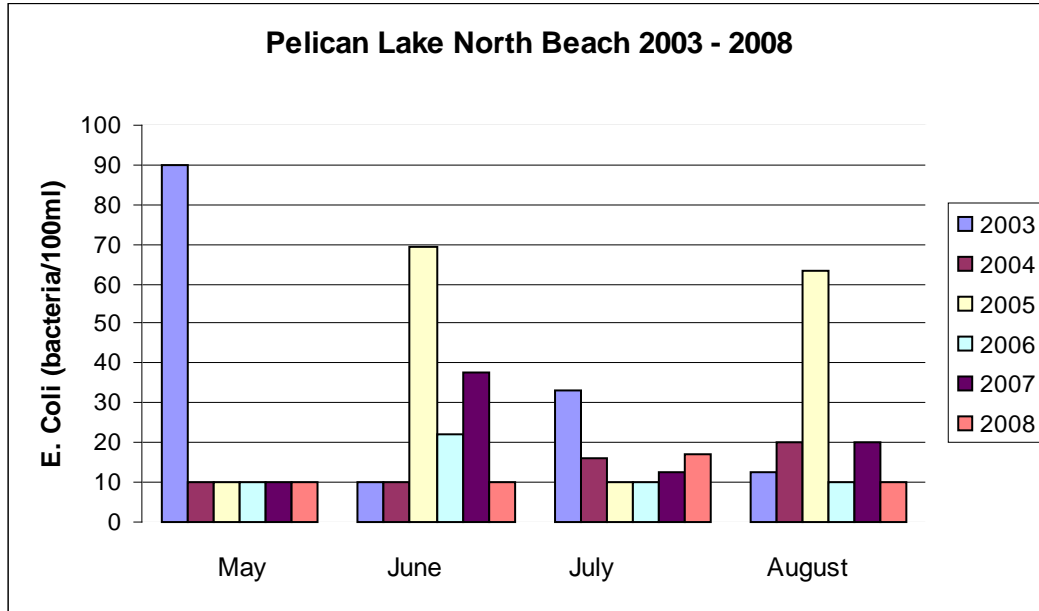


Figure 6. Pelican Lakes' North Beach *E. Coli* results from 2003 – 2008.

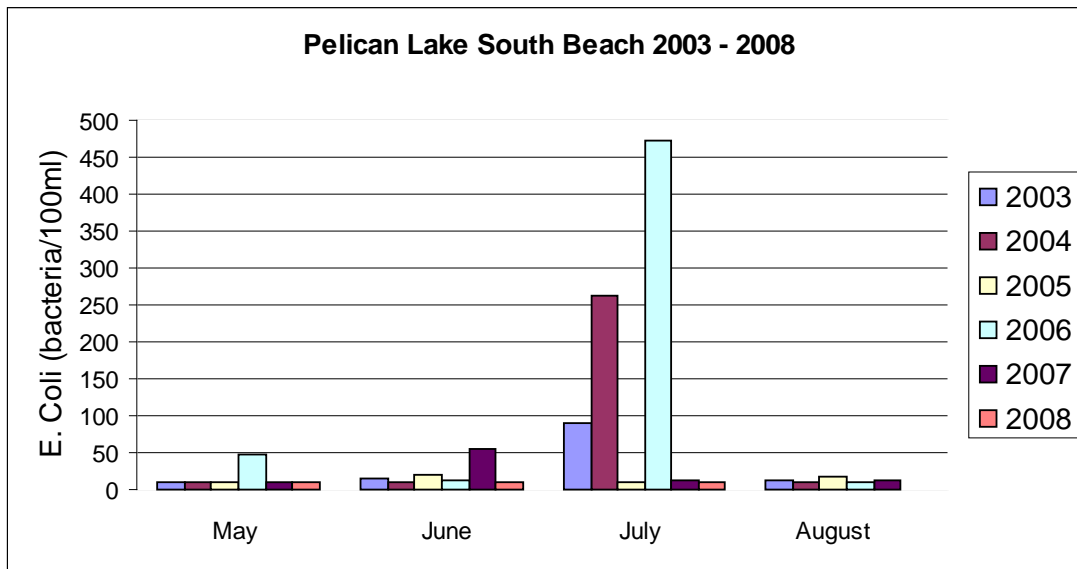


Figure 7. Pelican Lakes' South Beach *E. Coli* results from 2003 – 2008.

### Nutrient Management Regulation

Manitoba is proposing a Nutrient Management Regulation under *The Water Protection Act*. The purpose of the proposed regulation is to protect water quality by encouraging responsible nutrient planning, regulating the application of materials containing nutrients and restricting the development of certain types of facilities in environmentally sensitive areas. When nitrogen and phosphorus are applied to land surfaces in greater amounts than can be used by growing plants, excess nutrients can leach into ground water or run-off into surface water with heavy rainfall, floods, and melting snow.



Manitoba’s landscape has been separated into five zones. Zones N1, N2, and N3 consist of land that ranges in agricultural productivity while Zone N4 is generally unproductive land that represents a significant risk of nutrient loss to surface and groundwater. Zone N4 land consists of Canada Land Inventory soil classification 6 or 7 or unimproved organics. Zone N5 consists of urban and rural residential areas.

The proposed regulation also describes a Nutrient Buffer Zone with widths outlined below:

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

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

Under the proposed regulation, no nitrogen or phosphorus can be applied within Zone N4 or the Nutrient Buffer Zone.

More information on the proposed *Nutrient Management Regulation* is available at <http://www.gov.mb.ca/waterstewardship/wqmz/index.html>.

## **Drainage**

Although it is recognized that drainage in Manitoba is necessary to support sustainable agriculture, it is also recognized that drainage works can impact water quality and fish habitat. Types of drainage include the placement of new culverts or larger culverts to move more water, the construction of a new drainage channels to drain low lying areas, the draining of potholes or sloughs to increase land availability for cultivation and the installation of tile drainage. Artificial drainage can sometimes result in increased nutrient (nitrogen and phosphorus), sediment and pesticide load to receiving drains, creeks and rivers. All types of drainage should be constructed so that there is no net increase in nutrients (nitrogen and phosphorus) to waterways. To ensure that drainage maintenance, construction, and reconstruction occurs in an environmentally friendly manner, the following best available technologies, and best management practices aimed at reducing impacts to water quality and fish habitat are recommended.

The following recommendations are being made to all drainage works proposals during the approval process under *The Water Rights Act*:

- There must be no net increase in nutrients (nitrogen and phosphorus) to waterways as a result of drainage activities. Placement of culverts, artificial drainage and construction and operation of tile drains can sometimes result in increased nutrient (nitrogen and phosphorus), sediment and pesticide loads to receiving drains, creeks and rivers.
- Synthetic fertilizer, animal manure, and municipal wastewater sludge must not be applied within drains.

## **Culverts**

- Removal of vegetation and soil should be kept to a minimum during the construction and the placement of culverts.

- Erosion control methodologies should be used on both sides of culverts according to the Manitoba Stream Crossing Guidelines for the Protection of Fish and Fish Habitat.
- A strip of vegetation 1 to 3 metres wide should be maintained along drainage channels as a buffer. This will reduce erosion of channels and aid in nutrient removal.
- The proponent should revegetate exposed areas along drainage channels.

### **Surface Drainage**

- Surface drainage should be constructed as shallow depressions and removal of vegetation and soil should be minimized during construction.
- Based on Canada Land Inventory Soil Capability Classification for Agriculture (1965), Class 6 and 7 soils should not be drained.
- There should be no net loss of semi-permanent or permanent sloughs, wetlands, potholes or other similar bodies of water in the sub-watershed within which drainage is occurring.
- Erosion control methodologies outlined in Manitoba Stream Crossing Guidelines for the Protection of Fish and Fish Habitat should be used where the surface drain intersects with another water body.
- A strip of vegetation 1 to 3 metres wide should be maintained along surface drainage channels as buffers. These will reduce erosion of channels and aid in nutrient removal.
- The proponent should revegetate exposed areas along banks of surface drainage channels.

### **Tile Drainage**

- Discharge from tile drainage should enter a holding pond or wetland prior to discharging into a drain, creek or river.

Manitoba Water Stewardship is working towards the development of an environmentally friendly drainage manual that will provide additional guidance regarding best management practices for drainage in Manitoba.

### **Summary**

1. The Water Quality Index indicates that water quality is “good” in the Prairie Eco-zone in which the Pembina River is situated.
2. While most water quality variables were well below the water quality standard, objectives, and guidelines, total phosphorus occasionally exceeded objectives.
3. Recreational water quality at Pelican Lakes’ North and South Beaches is excellent.

### **Contact Information**

For more information, please contact:

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

## References:

Armstrong, N. 2002. Assiniboine River Water Quality Study: Nitrogen and Phosphorus Dynamics May 2001 to May 2002. Water Quality Management Section, Manitoba Conservation, Winnipeg, MB. Manitoba Conservation Report No. 2002-10. 36pp.

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