



Oldman River Basin
Water Quality Initiative

AGRICULTURE, FOOD AND RURAL DEVELOPMENT

Irrigation Branch

Water Quality in the Battersea Drain: 1999 - 2002

From 1999 to 2002, the Battersea Drain watershed was monitored for nutrients, bacteria and flow to assess water quality in the basin and to evaluate the effectiveness of Beneficial Management Practices (BMPs). Our results indicate that water quality in the basin is highly dependent on climate. Water quality was better in dry years with less runoff and worse in average or wet years, with more runoff. However, even in dry years, water quality guidelines were often exceeded for phosphorus and indicator bacteria. Nitrogen was also a concern during low flow periods as contributions from nitrate-enriched groundwater increased. Water quality within the Battersea Drain was comparable to other irrigation return flows in the Oldman River basin.

Introduction

Since 1999, the Rural BMP Team of the Oldman River Basin Water Quality Initiative (ORBWQI) has been monitoring water quality and flow in two agricultural sub-basins: the Battersea Drain and the Lower Little Bow River. The goal of the monitoring was to assess water quality and to evaluate the effectiveness of BMP projects implemented in the basin. This fact sheet reports the findings of the Battersea Drain monitoring program during the past four years.

Monitoring Program

The study looked at three important factors in water quality: nutrients, indicator bacteria, and flow volumes.

Nutrients: Nutrients, such as nitrogen and phosphorus, are essential for plant growth. **Phosphorus** is often the limiting nutrient in fresh waters, meaning that even small additional amounts can cause increased algae and aquatic plant growth. This can lead to eutrophication, which results in nuisance algal blooms and weed growth, taste and odour problems, and oxygen depletion, which in turn can cause fish kills. **Nitrogen** also contributes to eutrophication. In addition, nitrate (NO_3), a common form of nitrogen, can lead to health problems in humans and livestock, while another form of nitrogen, ammonia (NH_3), can be toxic to fish.

Bacteria: Certain bacteria, including fecal coliforms and *E. coli*, can be used as indicators of fecal contamination. While they are not themselves harmful, they are often related to the presence of other pathogenic or disease-causing bacteria, such as *Salmonella* or *E. coli* O157:H7.

Flow volume: Flow volume has a major influence on water quality. Large flows can reduce nutrient concentrations through dilution or may be an indication of surface runoff entering the stream. Flow volumes and concentrations are used to calculate the **load**, the total amount of a substance in a stream, which can then be used to assess the impact on receiving water bodies. Streams with large flow volumes often have greater loads and a large impact on receiving water bodies than streams with small flow volumes.

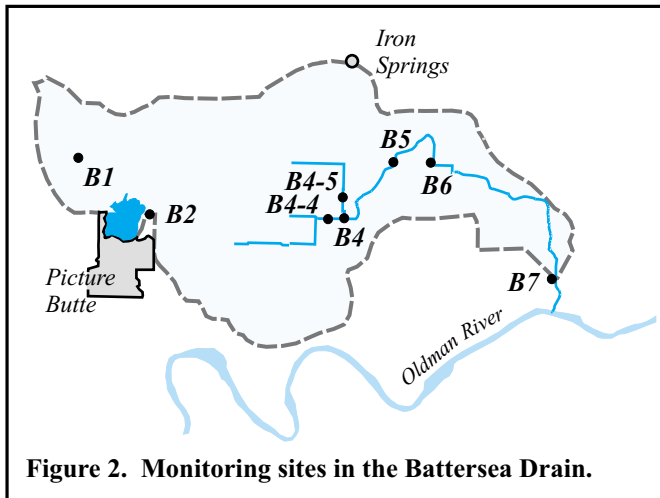
Water quality index values are calculated based on the number of variables that exceed guidelines, how often they exceed the guidelines, and by how much they exceed the guidelines.



Figure 1. Flow measurement in the Battersea Drain.

Study sites

Two supply water sites (B1, B2) and six sites along the return flow stream were monitored within the Battersea Drain from 1999 to 2002 (Figure 2). Water samples were collected weekly or biweekly in summer and monthly in winter. Additional samples were collected during rainfall and snowmelt events. Flows were monitored continuously throughout the irrigation season (May to October).

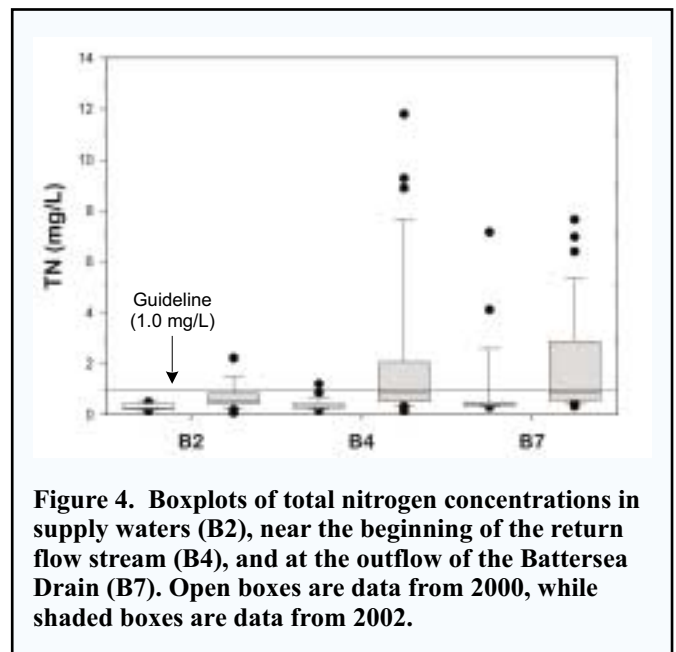
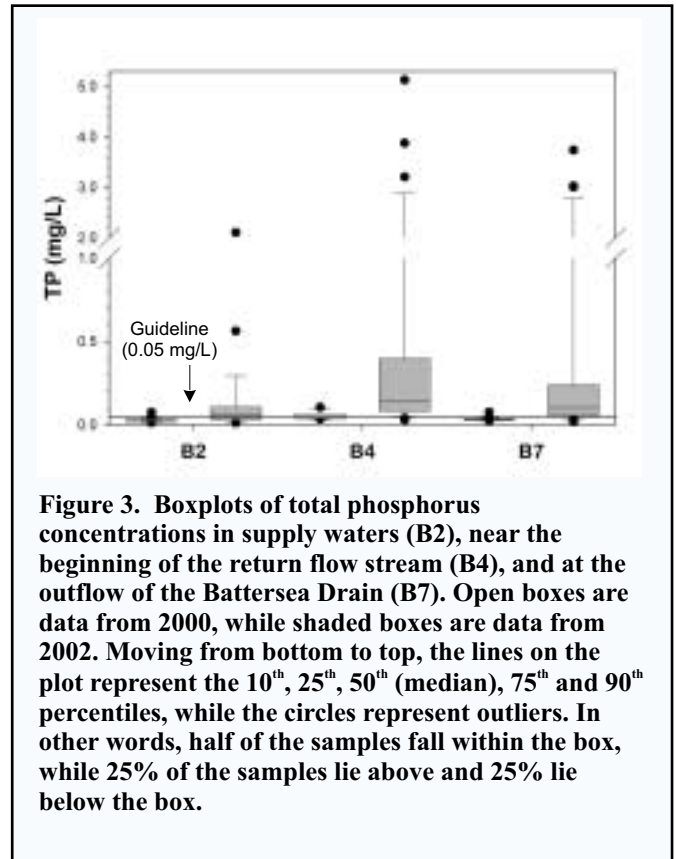


Results

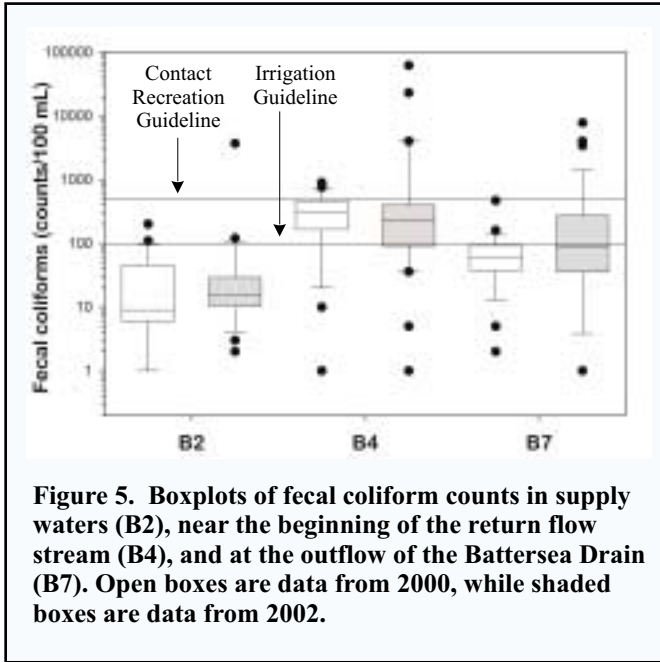
Phosphorus was often higher than the surface water quality guideline of 0.05 mg/L. In 2000, 10% of supply water samples exceeded the guideline, while slightly more than 50% of supply water samples exceeded this level in 2002 (Figure 3). Within the Battersea Drain, phosphorus concentrations increased, with 35% of samples exceeding the guideline in 2000 and up to 88% of samples exceeding the guideline in 2002 (Figure 3). Maximum phosphorus concentrations were observed following significant precipitation events in 1999 and 2002.

Nitrogen was also high following precipitation events; however, the highest concentrations occurred in the lower reaches of the drain during the winter months, when irrigation supply waters were shut down (Figure 4). Winter flows in the Battersea Drain were caused by groundwater inputs, which had high nitrogen concentrations.

In the supply waters, only 3% of the samples exceeded the fecal coliform guideline for contact recreation (400 counts/100 mL), while 10% of



samples exceeded the irrigation guideline of 100 counts per 100 mL (Figure 5). Within the irrigation return flow stream, the majority of samples met the contact recreation guideline, but between 63 and 71% of the samples did not meet the irrigation guideline for fecal coliform bacteria.



What have we learned?

Water quality in southern Alberta is highly dependent on climate and corresponding flow volumes. In 1999, the highest concentrations of phosphorus, nitrogen, and bacteria were observed after a rainfall event in early June. These high concentrations reduced the water quality index ratings in 1999 (Table 1.). Drought conditions in 2000 and 2001 resulted in higher water quality index scores due to reduced surface runoff contributions from surrounding lands. Conversely,

water quality index scores throughout the basin were much lower in 2002 than in previous years as both snowmelt runoff and a record rainfall event in June adversely impacted water quality.

Nitrogen was also a concern in the lower reaches of the Battersea Drain. Groundwater contributions, which were high in nitrate, resulted in very high concentrations following the shutdown of the irrigation supply waters. These elevated nitrate concentrations persisted throughout the winter and early spring of each year.

How does the Battersea Drain compare with other watersheds in the Oldman River Basin?

Based on basin-wide surveys conducted from 1999 to 2000, the Battersea Drain had comparable water quality index scores to other irrigation return flow streams in the Oldman River Basin. The flow volume of the Battersea Drain is small relative to the flow in the Oldman River; nevertheless, water quality in the Battersea Drain is still important to the health of both the Oldman River and the Drain itself. The Battersea Drain is only one of several irrigation return flow streams, tributaries, and wastewater treatment plants that flow into the Oldman River and their cumulative impact may adversely affect water quality.

Table 1. Water quality index ratings for the Battersea Drain sampling sites. There are five categories: Excellent, Good, Fair, Borderline, and Poor.

Site	Water Quality Index Category			
	1999	2000	2001	2002
B1	Fair	Good	Excellent	Fair
B2	Good	Excellent	Good	Poor
B4-4	–	Fair	Fair	Poor
B4-5	–	Good	Good	Poor
B4	Poor	Fair	Good	Poor
B5	Borderline	Fair	Borderline	Poor
B6	Poor	Fair	Borderline	Poor
B7	Borderline	Fair	Fair	Poor

BMPs in the Battersea Drain

In conjunction with the monitoring program, the Rural BMP Team has established a research project in the Battersea Drain to evaluate the effectiveness of a grass buffer strip on nutrient concentrations in surface runoff and groundwater from an irrigated field. The monitoring data will help determine whether the buffer strip is a viable option for protecting water quality in southern Alberta. Another research project is looking at the impact of various manure incorporation methods on surface and ground water quality. In addition, the Rural BMP Team, in collaboration with watershed groups, has established several riparian and grazing management demonstration projects throughout the Oldman River Basin.

What can you do to protect water quality?

Some practical BMPs for protecting water quality that you can incorporate into your operation include:

- Apply manure at rates that match crop requirements
- Apply manure at least 30 m (100 ft) from waterways
- Incorporate manure as soon as possible following application or inject the manure into the soil
- Provide off-stream watering for cattle and limit access of cattle to the drain
- Leave a buffer zone adjacent to the drain.

To see how to reduce the environmental risks of your operation, complete a confidential Environmental Farm Plan or consult the commodity-specific BMP manuals.



Flow has a major impact on water quality. The Battersea Drain at a) normal flows and b) following a major runoff event, in 2002.

This fact sheet, “Water Quality in the Battersea Drain: 1999 - 2002” is one of a series of information bulletins on agriculture and resource management produced by the Irrigation Branch, Alberta Agriculture, Food and Rural Development. To see how the Battersea compares with other watersheds in Alberta, refer to the annual AESA Stream Survey Watershed Report Card for the Battersea Drain.



For more information on water quality in the Battersea Drain, contact Joanne Little at (403) 381-5195.

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