Alberta Agriculture and Food

OLDMAN WATERSHED COUNCIL
water management – water health

COUNTY OF LETHBRIDGE No. 26

Irrigation Branch

Beneficial Management Practice Evaluation in the Battersea Drain and Lower Little Bow River Watersheds

What are BMPs and why was the study conducted?

Beneficial Management Practices (BMPs) are practices designed to minimize agricultural impacts on the environment. The BMPs for water quality usually focus on protecting waterbodies from excessive nutrient, bacteria, and pesticide contamination. Possible BMPs include: vegetative buffer zones along waterways; off-stream watering for livestock and limited access to waterbodies; and catchment basins or berms to prevent surface runoff from entering waterbodies. From 2001 to 2003, several BMP projects were established in the Battersea Drain and Lower Little Bow River watersheds. The impact of these BMPs on water quality was investigated to determine their effectiveness and limitations. This fact sheet provides an evaluation of the efficacy of five individual BMPs.

What was done?

From 1999 to 2006, Alberta Agriculture and Food, in partnership with the Oldman Watershed Council (formerly the Oldman River Basin Water Quality Initiative) monitored water quality and flows in two agricultural watersheds, the Battersea Drain and Lower Little Bow River. The flows in the two watersheds are controlled, in part, by irrigation demand. The existing network of water quality monitoring sites was used to evaluate the BMPs established in the watersheds (Figure 1). Water samples were collected weekly or every two weeks during the irrigation season (May to October) and monthly during the winter. Additional samples were collected during major rainfall or snowmelt events. Water samples were analyzed for nutrients and bacteria. Flows were monitored continuously throughout the irrigation season. Data were used to evaluate the effect of a given BMP on concentrations and loads of nutrients and bacteria in the water.

The parameters investigated were **total nitrogen (TN)**, **total phosphorus (TP)** and **fecal coliform bacteria (FC)**. Statistics were used to analyse these parameters before and after BMP implementation (non-parametric Wilcoxon two sample test) as well as upstream and downstream of the BMP (paired t-test). Statistics were performed using annual data sets, seasonal data sets, and by separating precipitation events.

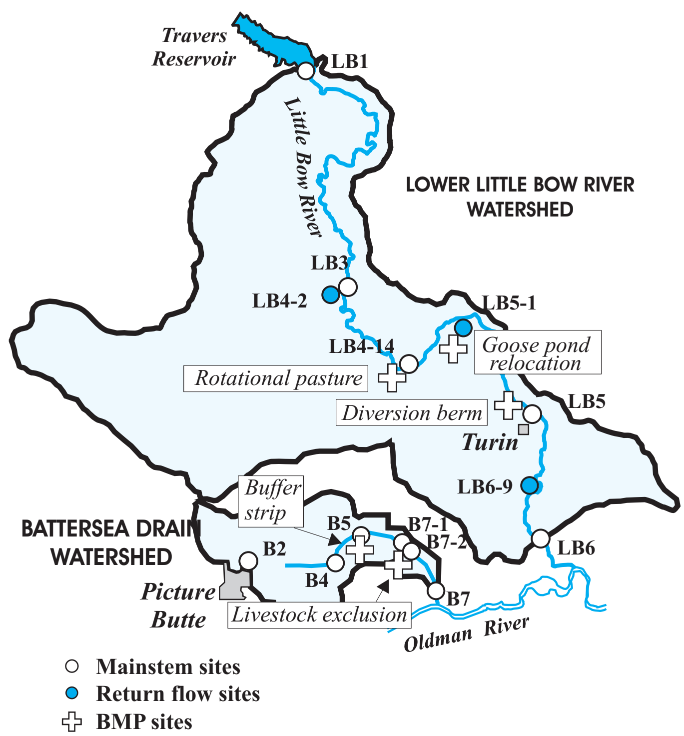

Figure 1. Water quality monitoring and BMP sites in the Lower Little Bow and Battersea watersheds.

Concentrations are the amount of material per unit volume in water (expressed as mg/L for nutrients or counts/100 mL for bacteria). Loads are the total amount of material passing by a specific location during a specified time interval (e.g. kg/day or counts/day). Loads are calculated based on stream flow (cubic metres/second) multiplied by concentration (mg/L).

What did we find?

Buffer Strip BMP

Buffer strips are areas of permanent vegetation bordering waterways. These areas receive diffuse runoff from non-point sources such as surrounding cropland. Buffer strips protect water quality by slowing runoff flow, thus removing sediment, nutrients, bacteria, and pesticides. Buffer strips 30 metres wide were planted at runoff locations on a quarter section that is bisected by the Battersea Drain (Figure 2).

Data analysis **before** and **after** BMP establishment indicated a reduction in FC loads downstream of the buffer. Since the concentrations of FC remained constant during this time, but flows were reduced post-BMP, this decrease in load is mostly attributed to the reduction in flow. Post-BMP concentrations of TN and TP increased but with the reduced flows, loads remained unchanged.

Data analysis **upstream** and **downstream** of the BMP indicated increases or no change in concentrations and loads of nutrients and bacteria. This may be attributed to other irrigation canals contributing water of unknown quality between the upstream and downstream sites.

Overall, no reductions in TN, TP, and FC concentrations or loads could be related to buffer strip establishment. The irrigated land surrounding the buffer strips had very high soil nutrient levels that likely exceeded the buffer's capacity of absorption. Concentrations and loads occassionally increased during periods when no precipitation occurred. Therefore, irrigation runoff may have transported contaminants into the drain. In nutrient rich areas such as the Battersea Drain basin, nutrient management or irrigation application BMPs may need to be used in conjunction with buffer strips to maintain or improve water quality.

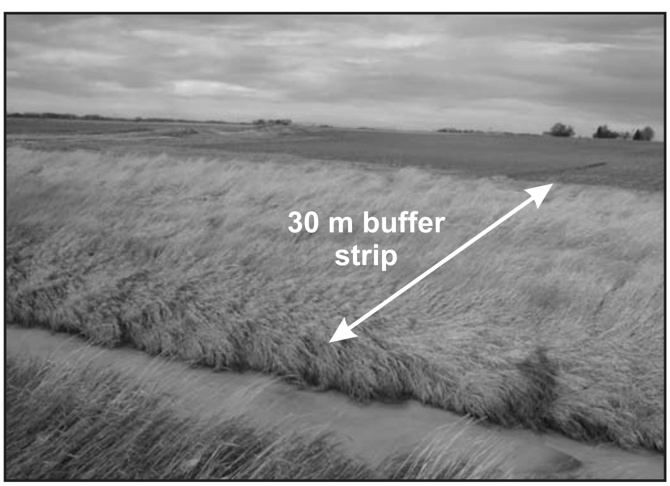

Figure 2. Buffer strip BMP along an irrigated field in the Battersea Drain watershed.

Livestock Exclusion BMP

Livestock with unrestricted access to waterways can contaminate water with manure and erode banks. Restricting livestock access eliminates the deposition of animal wastes in the water, minimizes shoreline and bottom disturbance, and protects vegetation along waterways. Approximately 20 cow/calf pairs were excluded from 800 metres of the Battersea Drain with an electric fence. A solar pump and trough provided off-stream water for the cattle (Figure 3).

Analyses comparing TN and TP **before** and **after** BMP establishment indicated no reduction in concentrations or loads. The FC data were not available for the pre-BMP period. Statistical analyses of paired water quality data **upstream** and **downstream** of the BMP did not indicate any differences in TN, TP, and FC concentrations or loads. Livestock exclusion BMPs may be considered effective if water quality is improved or maintained within the waterway corridor where the livestock are present; however, it is not possible to conclusively attribute the observed uniform water quality to this livestock exclusion BMP because paired upstream and downstream data were not available to confirm the initial impact of the cattle on water quality before they were excluded from this section of the drain.

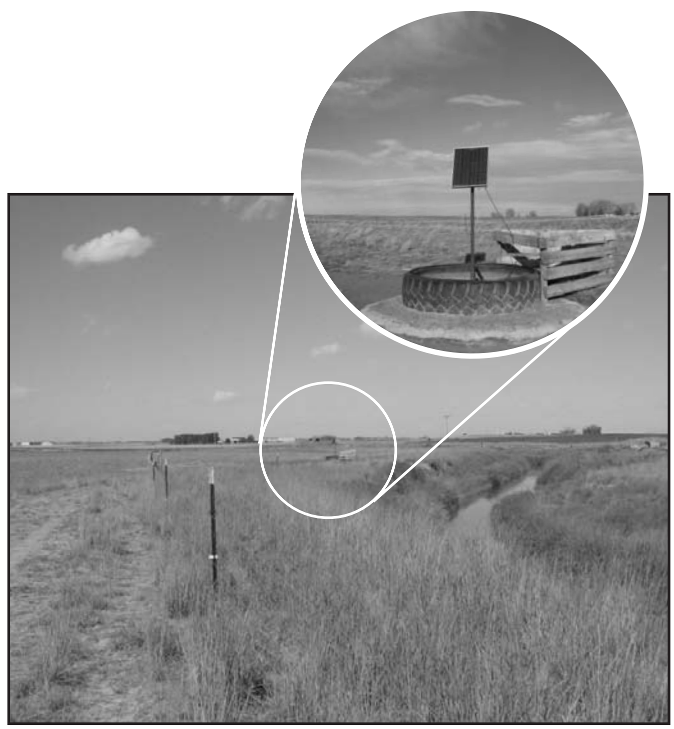

Figure 3. Livestock exclusion BMP along the Battersea Drain with electric fencing protecting the riparian zone as well as a solar pump and trough providing water.

Rotational Pasture BMP

Pasture management practices that include the use of rotational grazing systems are beneficial for water and soil quality. Systems that include the riparian area as a separate pasture are beneficial because livestock access to these areas is controlled to limit the impact on the riparian plant communities. Approximately 800 metres of riparian area along of the Lower Little Bow River was fenced on both sides and a river crossing was constructed to limit cattle access to the river but still permit cattle access to the pasture on the other side. A solar pump and trough provided off-stream water for about 100 cow/calf pairs and gates provided an opportunity to use the three pastures (north side, south side, and riparian area) in a rotational grazing system (Figure 4).

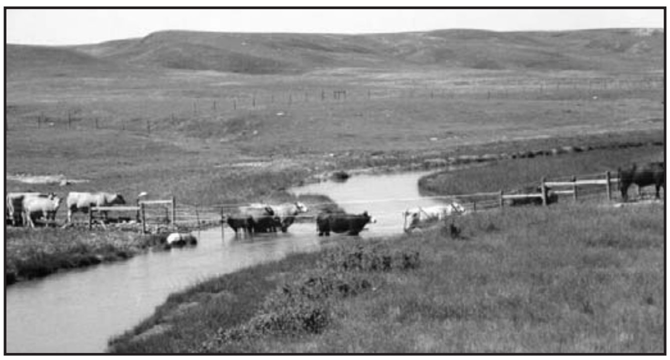

Figure 4. Rotational pasture BMP limiting livestock access along the Lower Little Bow River.

Data analysis **before** and **after** BMP establishment indicated a highly significant reduction in the FC load in the spring (Figure 5). Overall, TN and TP concentrations and loads increased after BMP establishment, which can be attributed to higher run-off and flow during the very wet summers of 2002 and 2005. No upstream and downstream analyses were conducted for this BMP, as there was no suitable upstream site.

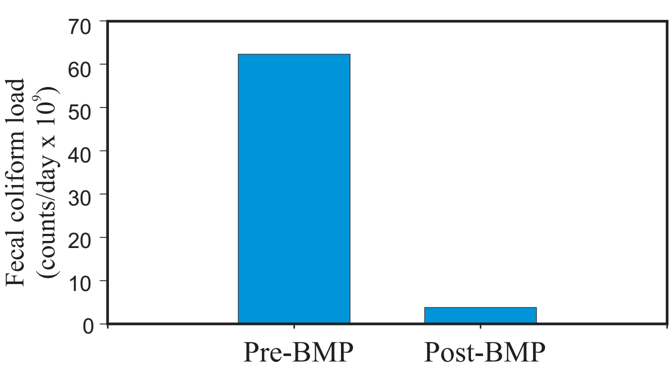

Figure 5. Median fecal coliform load in the spring before (1999-2001) and after (2002-2006) rotational pasture BMP implementation.

Goose Pond Relocation BMP

Livestock access to waterways may have a negative impact on water quality as deposition of animal wastes increases nutrients and bacteria in the water. A pond used in a goose production operation was relocated from its original location on an irrigation return flow drain which discharge into the Lower Little Bow River. A new pond was located away from all watercourses and lined to prevent seepage (Figure 6).

Figure 6. Goose pond relocation BMP located away from the irrigation return flow drain.

Data analyses **before** and **after** BMP establishment indicated highly significant reductions in FC concentrations and loads after relocation (Figure 7).

While no reduction was observed in TN loads, a small reduction was observed for TP load. Upstream and downstream analysis was not done for this BMP as there were no suitable upstream sites available on this return flow drain.

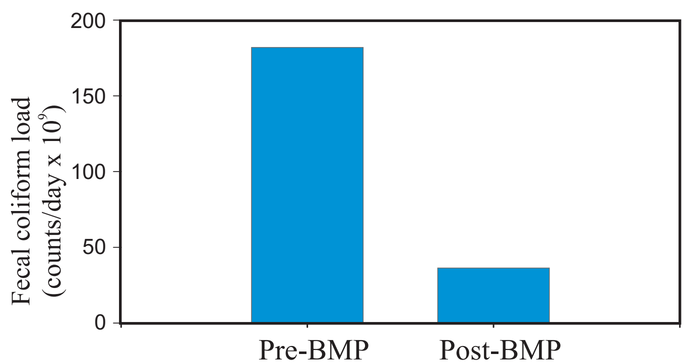

Figure 7. Median fecal coliform load before (1999-2001) and after (2001-2006) goose pond relocation BMP implementation.

Diversion Berm BMP

A diversion berm is a ridge of compacted earth material built to divert flows away from or around certain locations. A diversion berm was constructed to intercept snowmelt runoff and divert it around a cattle wintering and calving site adjacent to the Lower Little Bow River. The snowmelt runoff was redirected to a pasture, thus preventing the flushing of nutrients and bacteria from the wintering site into the river (Figure 8).

Data analyses **before** and **after** BMP establishment indicated a reduction in FC concentrations after construction of the berm (Figure 9). This trend was most noticeable in the spring when snowmelt occured. The FC loads pre- and post-BMP remained constant, in spite of the high flows in 2005 post-BMP, indicating a positive effect of the BMP. Concentrations and loads of TN and TP increased post-BMP. These increases were the strongest in the irrigation season (May-Oct.) and can be explained by major precipitation and runoff events for this time period in the post-BMP years. Analyses of data **upstream** and **downstream** of the BMP indicated no changes in TN, TP, or FC concentrations.

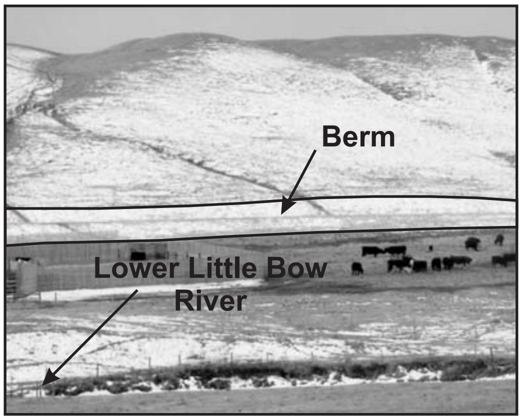

Figure 8. Diversion berm BMP diverts surface runoff away from a wintering site along the Lower Little Bow River.

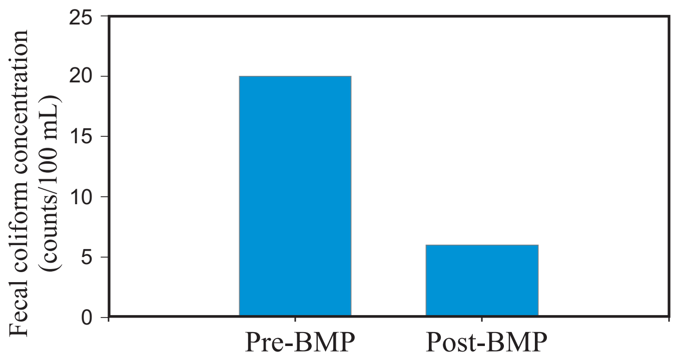

Figure 9. Median fecal coliform concentration in spring before (1999-2002) and after (2003-2006) diversion berm BMP implementation.

What did we learn?

The BMPs that target point sources of contamination are the most effective. Water quality improvements in FC loads and concentration were measured for BMPs that limited or excluded livestock access to waterways. Nutrient reductions were more difficult to quantify, suggesting that either BMPs may not be effective at reducing nutrients or more likely, that BMPs need to be applied on the landscape more extensively or monitored for a longer period of time to detect nutrient changes.

Our ability to detect changes as a result of BMPs may be overshadowed by weather events and by the artificially controlled flows for irrigation needs that have major influences on water quality. In addition, relatively large flow volumes, such as those of the Lower Little Bow River, may impact the probability of measuring changes caused by an individual BMP. Many years of data may be required to allow for analyses representative of water quality. Seasonal data and precipitation frequency considerations are also very important to BMP assessment, as certain BMPs may only be effective in specific seasons or during runoff events. Evaluation of BMPs requires that upstream and downstream water quality monitoring sites are located as close to the BMP location as possible to ensure that other influences on water quality are minimized.

Alberta Agriculture and Food continues to encourage landowners to adopt BMPs to minimize agricultural impacts on water quality. Further research is needed to evaluate long-term effectiveness of specific BMPs. However, in general, BMPs will help maintain sustainable aquatic ecosystems and promote environmental stewardship within agricultural watersheds.

This 2007 fact sheet on Beneficial Management Practice Evaluation in the Battersea Drain and Lower Little Bow River Watersheds is one of a series of information bulletins on agriculture and resource management produced by the Irrigation Branch, Alberta Agriculture and Food.

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OWC Oldman Watershed Council — water management – water health

For more information on beneficial management practices and water quality, contact Janelle Villeneuve at (403) 381-5894 or Jollin Charest at (403) 381-5195.

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