Milk River
Transboundary State of the Watershed Report

2nd Edition
Messages from the Watershed Council Chairs

Milk River Watershed Council Canada

Our family has been living and ranching within the Milk River Watershed since 1885. Sustainability is a very important part of how we work with the land. To gain a better knowledge of our watershed not only defines our roots as a community but better defines where we are heading in the future. This report reflects the successes and challenges facing all three political jurisdictions in our watershed.

This report serves as a guidepost; a reflection of the research, monitoring and stewardship required to manage the common resources for future generations. The majority of Alberta’s endangered species occur in the Milk River Watershed due to the stewardship of our forefathers and will continue with our help in the future.

We want this report be read, referenced and used as a resource for watershed residents and the scientific community. The future is ours to give to our kids, let’s make it a good one.

John A. Ross
Chairman, Milk River Watershed Council Canada

Milk River Watershed Alliance

Around 1910 Jacob Pattison, my grandfather, arrived at Vandalia, Montana to work with the dam on the Milk River. I now live a couple miles downstream from that project. Many times I have wondered about the work, dreams, and visions many have had for the future of this great state.

As the Chairman of the Milk River Watershed Alliance, I welcome you to the beauty, splendor, and majesty of our home. Our team calls the Milk River “the life line of the hi-line”, as it sustains many communities as it meanders through Montana. Cooperation between Canada and the United States is essential to maintaining flows above those that would naturally be found in the Milk River. Our vision is that the Milk River watershed will help each country flourish and grow.

I am confident that Canada and the United States will continue to see the value and necessity of the Milk River not only for the present but also for the future.

Thank you for believing,

Jeff Pattison
Chairman
USA Milk River Watershed Alliance
# Table of Contents

## 1.0 Introduction .............................................1

## 2.0 The Milk River Watershed ..........................7

2.1 Bedrock Geology ........................................11
2.2 Surficial Geology ......................................16
2.3 Ecoregions ..............................................19
2.4 Climate ...................................................19
2.5 Soils .....................................................27
2.6 Land Cover .............................................31
2.7 Land Ownership and Administration ..................37
2.8 First Nations ..........................................43

## 3.0 Socio-Economic Condition ............................47

3.1 Population ..............................................47

## 4.0 Surface Water Quantity and Allocation ...............51

4.1 History of Water Management ........................51
4.2 Surface Water Supply ................................57
4.3 Surface Water Allocation and Use ..................69

## 5.0 Surface Water Quality ................................75

## 6.0 Groundwater ...........................................89

6.1 Groundwater Supply and Use ........................89
6.2 Groundwater Quality ..................................96

## 7.0 Riparian Areas and Wetlands ........................101

## 8.0 Biodiversity ...........................................117

8.1 Fish ...................................................117
8.2 Wildlife ..............................................131
8.3 Vegetation ............................................151
8.3.1 Rare and Unique Native Vegetation ..........151
8.3.2 Invasive Species ..................................155

## 9.0 Land Use and Development ..........................167

9.1 Access ...............................................167
9.2 Parks, Protected and Managed Areas ............171
9.3 Tourism and Recreation ..............................176
9.4 Commercial and Industrial Activity ..............185
9.4.1 Agriculture .......................................185
9.4.2 Rangeland .......................................195
9.4.3 Oil and Gas Activity .............................201

## 10.0 Watershed Stewardship ..............................207

## 11.0 Summary and Recommendations ..................219

## 12.0 Bibliography .........................................227

12.1 Literature Cited .....................................227
12.2 Personal Communications ........................233
12.3 Map Information .....................................234
12.4 Photo Credits .......................................237

## Maps

Map 2.1 Milk River Watershed ...............................9
Map 2.2 Canada Bedrock Geology/Montana Geology ..13
Map 2.3 Surficial Geology ................................17
Map 2.4 Ecological Regions ..............................21
Map 2.5 Precipitation ...................................23
Map 2.6 Soils .............................................29
Map 2.7 Land Cover ......................................33
Map 2.8 Satellite Image ..................................35
Map 2.9 Land Ownership ................................39
Map 2.10 Land Administration ..........................41
Map 2.11 First Nations and Indian Reservations ....45
Map 3.1 Population Density ..............................49
Map 4.1 Active Hydrometric Stations .................59
Map 5.1 Water Quality Monitoring Sites ..........77
Map 6.1 Groundwater Wells ............................91
Map 7.1 Riparian Areas ................................103
Map 8.1 Fisheries .......................................119
Map 8.2 Native Vegetation ..............................153
Map 9.1 Access ..........................................169
Map 9.2 Parks and Protected Areas .................173
Map 9.3 Crops ............................................187
Map 9.4 Crop Water Deficit ...........................191
Map 9.5 Irrigated Areas ................................193
Map 9.6 Oil and Gas Activity ........................203
### Tables

| Table 1.1 | Summary of indicators used to report on the state of the Milk River watershed | 5 |
| Table 2.1 | Bedrock geology name correlations | 11 |
| Table 2.2 | Summary of climate characteristics in the ecoregions represented in the Milk River watershed | 20 |
| Table 2.3 | Site locations, tree species and the period of record used in the tree ring analysis | 26 |
| Table 2.4 | Blackfoot translations of Milk River watershed place names | 43 |
| Table 4.1 | Total water allocations in the Milk River watershed, Alberta, including allocations on the mainstem Milk River and its tributaries as of 2012 | 69 |
| Table 4.2 | Total water allocations on the mainstem Milk River, Alberta as of 2012 | 69 |
| Table 4.3 | Total water allocations for Lodge, Middle and Battle creek basins, Alberta | 71 |
| Table 4.4 | Blackfoot translations of Milk River watershed place names | 71 |
| Table 5.1 | Nutrient criteria applicable to all Northwestern Glaciated Plains streams in Montana | 72 |
| Table 5.2 | Summary of nutrient exceedances for the Milk River in Montana, 2004-2012 | 81 |
| Table 5.3 | Summary of select metals data at Highway 880 Bridge, Alberta, 2005-2012 | 84 |
| Table 5.4 | Summary of quantity and type of metals exceedances in the Milk River in Montana, 2004-2012 | 84 |
| Table 5.5 | Median (range) water quality results for select parameters in Red Creek at the Upper, Middle and Lower sites, 2011 and 2012, Alberta | 88 |
| Table 6.1 | Appropriated (licensed) groundwater wells in the Milk River watershed, Montana | 95 |
| Table 6.2 | Summary of select parameters measured in the comparative groundwater study, Alberta, 2007 and 2011 | 97 |
| Table 6.3 | Summary of well depths and water quality in select aquifers in Montana, 1990-2012 | 99 |
| Table 7.1 | Summary of riparian health indicators and their significance to riparian function | 102 |
| Table 7.2 | Summary of total river kilometres assessed in the Milk River watershed since 1997, Alberta | 105 |
| Table 7.3 | Status of lotic riparian health indicators for tributaries in three main reaches (1997-2011), Milk River, Alberta | 106 |
| Table 7.4 | Status of lotic riparian health indicators at the four Milk River mainstem reaches (1997-2011), Milk River, Alberta | 106 |
| Table 7.5 | Indicators and relative importance of criteria used to rank ecological and conservation significance of wetland and riparian sites in the Milk River watershed, Montana | 110 |
| Table 7.6 | Summary of rank descriptions assigned to riparian areas in the Milk River watershed, Montana | 111 |
| Table 7.7 | Condition ranks for select riparian areas along the Milk River mainstem and tributaries in Montana | 112 |
| Table 8.1 | Fish species collected in selected tributaries of the Milk River, Alberta | 125 |
| Table 8.2 | Summary of fish occurring in streams and rivers in the Saskatchewan portion of the Milk River watershed | 126 |
| Table 8.3 | Fish species at risk in the Milk River watershed, Alberta and Montana | 127 |
| Table 8.4 | Status of wildlife indicator species | 133 |
| Table 8.5 | Project summaries and control work to date (2009-2012) and the estimated acreage of invasive weeds by Districts in Montana | 159 |
| Table 9.1 | Summary of road type and length in the Milk River watershed | 168 |
| Table 9.2 | Unique features of select natural areas, ecological preserves and heritage rangelands within the Milk River watershed, Alberta | 171 |
| Table 9.3 | The number of angler days at various locations in the watershed | 184 |
| Table 9.4 | Summary of oil and gas well statistics | 201 |
| Table 10.1 | Summary of Alberta Environmental Farm Plan participation | 208 |
| Table 10.2 | Number of participants in the Farm Water Program and dollars allocated within the Milk River watershed, Alberta | 208 |
| Table 11.1 | Status of wildlife indicators in the Milk River watershed | 222 |
| Table 11.2 | Status of land use indicators in the Milk River watershed | 224 |
| Table 11.3 | Status of population and watershed stewardship indicators in the Milk River watershed | 225 |
### List of Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AARD</td>
<td>Alberta Agriculture and Rural Development</td>
</tr>
<tr>
<td>AB</td>
<td>Alberta</td>
</tr>
<tr>
<td>AESB</td>
<td>Agri-Environment Services Branch</td>
</tr>
<tr>
<td>AESRD</td>
<td>Alberta Environment and Sustainable Resource Development</td>
</tr>
<tr>
<td>ATPR</td>
<td>Alberta Tourism, Parks and Recreation</td>
</tr>
<tr>
<td>AWA</td>
<td>Alberta Wilderness Association</td>
</tr>
<tr>
<td>BBS</td>
<td>Breeding Bird Survey</td>
</tr>
<tr>
<td>BLM</td>
<td>Bureau of Land Management</td>
</tr>
<tr>
<td>BMPs</td>
<td>Best (Beneficial) Management Practices</td>
</tr>
<tr>
<td>CDWQG</td>
<td>Canadian Drinking Water Quality Guidelines</td>
</tr>
<tr>
<td>DNRC</td>
<td>Montana Department of Natural Resources Conservation</td>
</tr>
<tr>
<td>DUC</td>
<td>Ducks Unlimited Canada</td>
</tr>
<tr>
<td>DUI</td>
<td>Ducks Unlimited Inc.</td>
</tr>
<tr>
<td>EFP</td>
<td>Environmental Farm Plan</td>
</tr>
<tr>
<td>ERCB</td>
<td>Energy Resources Conservation Board</td>
</tr>
<tr>
<td>FWP</td>
<td>Montana Fish, Wildlife and Parks</td>
</tr>
<tr>
<td>FWS</td>
<td>United State Fish and Wildlife Service</td>
</tr>
<tr>
<td>GSC</td>
<td>Geological Survey of Canada</td>
</tr>
<tr>
<td>INRS</td>
<td>Institut National de la Recherche Scientifique</td>
</tr>
<tr>
<td>MAC</td>
<td>Maximum Allowable (Acceptable) Concentration</td>
</tr>
<tr>
<td>MDEQ</td>
<td>Montana Department of Environmental Quality</td>
</tr>
<tr>
<td>MRWA</td>
<td>Milk River Watershed Alliance</td>
</tr>
<tr>
<td>MRWCC</td>
<td>Milk River Watershed Council Canada</td>
</tr>
<tr>
<td>MSCA</td>
<td>Montana Salinity Control Association</td>
</tr>
<tr>
<td>MT</td>
<td>Montana</td>
</tr>
<tr>
<td>MULTISAR</td>
<td>Multiple Species at Risk</td>
</tr>
<tr>
<td>NCC</td>
<td>Nature Conservancy of Canada</td>
</tr>
<tr>
<td>NGO</td>
<td>Non Government Organization</td>
</tr>
<tr>
<td>NRCS</td>
<td>Natural Resources Conservation Service</td>
</tr>
<tr>
<td>OBO</td>
<td>Operation Burrowing Owl</td>
</tr>
<tr>
<td>OGC</td>
<td>Operation Grassland Community</td>
</tr>
<tr>
<td>PCAP</td>
<td>Prairie Conservation Action Plan</td>
</tr>
<tr>
<td>PESL</td>
<td>Palliser Environmental Services Ltd.</td>
</tr>
<tr>
<td>PFRA</td>
<td>Prairie Farm Rehabilitation Administration</td>
</tr>
<tr>
<td>PMU</td>
<td>Pronghorn Management Unit</td>
</tr>
<tr>
<td>RAN</td>
<td>Saskatchewan Representative Areas Network</td>
</tr>
<tr>
<td>SK</td>
<td>Saskatchewan</td>
</tr>
<tr>
<td>SOW</td>
<td>State of the Watershed</td>
</tr>
<tr>
<td>SWA</td>
<td>Saskatchewan Watershed Authority</td>
</tr>
<tr>
<td>TDS</td>
<td>Total Dissolved Solids</td>
</tr>
<tr>
<td>TNC</td>
<td>The Nature Conservancy</td>
</tr>
<tr>
<td>USBR</td>
<td>United States Bureau of Reclamation</td>
</tr>
<tr>
<td>USDA</td>
<td>United States Department of Agriculture</td>
</tr>
<tr>
<td>USGS</td>
<td>United States Geological Survey</td>
</tr>
<tr>
<td>WHIP</td>
<td>Wildlife Habitat Incentive Program</td>
</tr>
<tr>
<td>WHPA</td>
<td>Wildlife Habitat Protection Act</td>
</tr>
<tr>
<td>WMU</td>
<td>Wildlife Management Unit</td>
</tr>
<tr>
<td>WOS PP</td>
<td>Writing-on-Stone Provincial Park</td>
</tr>
<tr>
<td>WSA</td>
<td>Water Security Agency</td>
</tr>
</tbody>
</table>

#### Useful Conversions

<table>
<thead>
<tr>
<th>Multiply</th>
<th>by</th>
<th>To obtain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td></td>
<td></td>
</tr>
<tr>
<td>cm</td>
<td>0.394</td>
<td>inches</td>
</tr>
<tr>
<td>m</td>
<td>3.2808</td>
<td>ft</td>
</tr>
<tr>
<td>km</td>
<td>0.6214</td>
<td>miles</td>
</tr>
<tr>
<td>Area</td>
<td></td>
<td></td>
</tr>
<tr>
<td>acres</td>
<td>0.004046856</td>
<td>km²</td>
</tr>
<tr>
<td>hectares</td>
<td>2.471</td>
<td>acres</td>
</tr>
<tr>
<td>hectares</td>
<td>0.01</td>
<td>km²</td>
</tr>
<tr>
<td>inch²</td>
<td>6.452</td>
<td>cm²</td>
</tr>
<tr>
<td>km²</td>
<td>247.1</td>
<td>acres</td>
</tr>
<tr>
<td>km²</td>
<td>100.0</td>
<td>ha</td>
</tr>
<tr>
<td>Volume</td>
<td></td>
<td></td>
</tr>
<tr>
<td>acre-ft</td>
<td>1234.0</td>
<td>m³</td>
</tr>
<tr>
<td>acre-ft</td>
<td>1.234</td>
<td>dam³</td>
</tr>
<tr>
<td>dam³</td>
<td>0.810713182</td>
<td>acre-ft</td>
</tr>
<tr>
<td>m³</td>
<td>0.000810713</td>
<td>acre-ft</td>
</tr>
<tr>
<td>m³</td>
<td>0.001</td>
<td>m³</td>
</tr>
<tr>
<td>m³</td>
<td>35.32</td>
<td>ft³</td>
</tr>
<tr>
<td>Yield</td>
<td></td>
<td></td>
</tr>
<tr>
<td>kg/ha</td>
<td>0.892</td>
<td>lb/acre</td>
</tr>
<tr>
<td>lb/acre</td>
<td>1.12</td>
<td>kg/ha</td>
</tr>
<tr>
<td>Discharge</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ft³/s</td>
<td>0.028</td>
<td>m³/s</td>
</tr>
<tr>
<td>m³/d</td>
<td>0.152756420</td>
<td>gpm</td>
</tr>
<tr>
<td>m³/s</td>
<td>35.32</td>
<td>ft³/s</td>
</tr>
</tbody>
</table>
1.0 Introduction

The Milk River Transboundary State of the Watershed Report is a significant achievement in the move toward resource management that is uninhibited by political boundaries. Resource managers in the provinces of Alberta, Saskatchewan and in the State of Montana have joined together with the Milk River Watershed Council Canada to report on the State of the Milk River watershed. Although resource management decisions may continue to start and end at interprovincial and international boundaries, this document signifies a turning point for the Milk River watershed where managers understand the importance of sharing information with neighbouring jurisdictions for the better management of common resources. A significant achievement is unified maps that represent the entire watershed. Where streams once ended at the border crossing, we now have unified maps illustrating the Milk River’s hydrography, geology and biology. A better picture of the state of the Milk River watershed can be made when considering the full extent of the basin.

In 2008, the Milk River Watershed Council Canada completed the first Milk River State of the Watershed Report which was confined to the Alberta portion of the watershed. The Milk River Transboundary State of the Watershed Report builds on its predecessor by expanding to include Alberta, Saskatchewan and Montana. Also in this new edition, indicator data that was presented in the 2008 report was updated to represent present day status. Data generally spans the timeframe from 2008 to 2012 and varies depending on availability for specific indicators.

This report documents general conditions and trends in the Milk River watershed. It should be used by landowners, resource managers and stakeholder groups as a support tool for natural resource planning. Where possible, historical data is used in the report to provide context for the present status of watershed indicators. The report covers a broad range of topics, with a focus on:

- Watershed Characteristics
- Socio-Economic Condition
- Surface Water Quantity and Allocation
- Surface Water Quality
- Groundwater
- Riparian Areas and Wetlands
- Biodiversity (Fish, Wildlife, Plants and Invasive Species)
- Land Use (Access, Parks, Protected and Managed Areas, Tourism and Recreation, Agriculture, and Oil and Gas)
- Watershed Stewardship

Within each of these topic areas, indicators are used to report on the condition of watershed resources through time. The indicators provide a summary measure of the overall state and function of the Milk River watershed and were chosen, in part, based on available data and existing research.
Significance
Many people would agree that the Milk River watershed is a unique and significant part of Alberta, Saskatchewan and Montana.

Location
- The Milk River watershed is the only watershed in Canada that drains to the Gulf of Mexico.
- There are 480 km (298 mi) of shared international border between Canada and the United States.

Historic and Cultural Significance
- Cretaceous period dinosaur bones (Ceratopsians [horned, frilled dinosaurs] and Tyrasorians) are found in the Milk River valley. A new species was recently found in 2008, *Acrotholus audeti*, named after a local rancher.
- Important traditional and contemporary region for First Nations. A common hunting and harvesting area, important for the seasonal round. Vision quests, trade and commerce have all taken place and continue in some instances. The watershed is homeland for the Blackfeet in Montana, the Cree in Saskatchewan and Montana, and is part of the traditional lands for the Blackfoot, Blood and North Peigan in Alberta.
- Writing-on-Stone Provincial Park is included on the Tentative List for World Heritage Site designation and is considered a place of spiritual significance. With the awe inspiring pictographs and petroglyphs, “Áísínai’pi” continues to give spiritual direction to the Blackfoot People.
- The Northwest Mounted Police established posts at Writing-on-Stone and Pendant d’Oreille, Alberta, in 1887.
- The Milk River watershed was travelled and accounts were recorded by the Lewis and Clark Expedition and the Palliser Expedition.
- The flags of the Hudson’s Bay Company, Canadian Red Ensign and six governments (France, Spanish Empire, French Republic, United States, British Empire and Canada) have flown in the watershed in Alberta, coining the term “Under Eight Flags”.
- One of the last western frontiers settled by whiskey and fur traders, and many civil war veterans remained in Montana.
- Many determined European settlers homesteaded here, and many of their families continue to make a living in the watershed today.

Diverse and Unique Landscapes and Unobstructed Viewscapes
- Large tracts of un-fragmented native rangeland are found throughout the watershed. This grassland was once important bison range but now forms the foundation for livestock grazing, one of the main economic pillars in the watershed.
- Sandstone outcrops - differential erosion of sandstone layers of varying hardness results in unique rock pillars, called hoodoos.
- Mountainous areas critical to replenishing surface water and groundwater supplies include the unglaciated Cypress Hills (AB and SK) formed of sedimentary rocks and conglomerates, and the volcanic Sweetgrass Hills (AB and MT), Bears Paw Mountains (MT) and Little Rocky Mountains (MT). These hills rise high above the prairie landscape modifying local climate and adding to the natural beauty of the region.

Special Fish, Wildlife and Vegetation Resulting in High Biodiversity
- Assemblage of fish range from trophy-size Sauger to pre-historic looking species-at-risk, including the Rocky Mountain Sculpin and Stonecat.
- Diverse habitat (e.g., grasslands, hoodoos, cliffs, badlands, hills and mountains, cottonwoods and sagebrush) supports from 230 to 280 species depending on the season. Of these, about 200 species of birds, seven species each of reptiles and amphibians, and 50 species of mammals can be found in the watershed, along with numerous other unaccounted insects and plants.
- The watershed supports about 80% of Alberta’s species-at-risk and is the most important landscape for prairie species-at-risk in Canada. Many of these species are at the northern limit of their North American distribution in the Milk River watershed.
- Unique vegetation including prairie grasses, Western Blue Flag (*Iris missouriensis*) and Soapweed (*Yucca glauca*) are found in the watershed.
Updating the previous Milk River watershed report is a challenge as new approaches for data collection and reporting are constantly being developed. State of the Watershed reporting is an evolving science and it was not until October 2012 that a guide was developed for Alberta to assist with developing a common approach to reporting indicators. Although every effort has been made to be consistent with reporting, some inconsistencies are unavoidable.

In addition, the Milk River watershed boundary has been updated in the last five years to reflect work done with regard to the Montana-Alberta Water Management Initiative. Thus, the data source for the Milk River watershed boundary in 2008 is different than the one currently being used. The 2013 basin boundary is slightly larger compared to the previous area and the revised boundary now includes, in part, the Village of Warner (Figure 1.1).

Finally, the criterion that was used to compare some indicators in 2008 has changed or is currently being revised. In 2008, the Alberta Water Quality Index was used as the main reporting index, rating water quality from poor to excellent.

Figure 1.1. Comparison of the Milk River watershed boundary in Alberta used in the 2008 Milk River State of the Watershed Report and the current 2013 watershed boundary.
Transboundary Reporting Challenges

This Milk River Transboundary State of the Watershed Report marks the first instance where Alberta, Saskatchewan and Montana are collaborating to report on the state of the Milk River watershed. As with any first attempt, there were challenges to overcome throughout the process.

Identifying key partners in each part of the watershed.
Key partners were identified at the start of the project. As the project progressed, there were areas within the report that were not well represented. Navigating various agencies and organizations can be difficult from out-of-province or out-of-state.

Locating and accessing data and data availability for state of the watershed reporting.
The availability of information for each watershed component varied according to the priorities that have been placed on monitoring and management of resources within Alberta, Saskatchewan and Montana. In some instances, there was equivalent data and information available for a given watershed component in the three different parts of the watershed, and for others, little data was available. For example, Alberta, Saskatchewan and Montana have placed similar effort on water supply, allocation and use, and data was readily available and generally similar in the type and quality of information. However, for rangeland health, only a limited amount of data was available in Saskatchewan and no data could be located for Montana. In addition, not all data sets were accessible depending on the way the data was collected and stored. A previous State of the Watershed Report was completed by the Province of Saskatchewan (Saskatchewan Water Authority 2010), however the data reported for the Milk River watershed was limited in many aspects.

Multiple levels of government, in some cases, have management responsibilities for the same natural resources. There were inconsistencies among agencies in methodologies used for data collection, data storage and reporting. An example of this is found in Section 7.0 that reports on riparian areas.

Harmonizing data sets.
Unit of measurement differs between Canada, based on the metric system and the imperial measurements made in the United States. Area, volume and distance calculations were given in both metric and imperial units where practical, but in some cases readers will need to refer to the conversion chart on page vii.

On occasion, mapping was a challenge between Canadian and United States data sets. In addition to the type and scale of data available for individual topics, the nomenclature used for various features differed for the same feature. Bedrock and surficial geology is one example of how Canada and the United States have developed knowledge about similar resources using different descriptions. Where possible, the names of similar features were correlated to integrate the information as best as possible with reasonable effort.

To address variations in the methods and purpose of data collection, each chapter highlights the differences in order that the reader may interpret the results appropriately.

Importance of Transboundary Reporting

This transboundary report recognizes that the flow of surface water and groundwater, migration of fish and wildlife and dispersal of plants, among other watershed components are not contained within political boundaries and cross-border collaboration and management should be considered.

Collaborative State of the Watershed Reporting may lead to common reporting for similar ecological regions in terms of methodologies and standards that can improve the chance of meeting environmental targets and objectives. At the very least, it will improve the collective knowledge of the state of resources and their management across the watershed and improve the interpretation of local observations.
Indicators are used throughout the State of the Watershed Report to comment on the current condition or status of social and environmental elements that contribute to health and function of the watershed. For some indicators it is possible to comment on condition using values that range from Poor to Excellent. For other indicators (e.g., population, biodiversity), a trend can be seen and the indicator values are reported as increasing, stable or decreasing. Unless otherwise noted, by individual province or state, the designated status applies to the entire watershed. Table 1.1 summarizes the indicators used in this report.

Note that not all of the watershed components had adequate data available for each indicator to determine status with confidence. In some cases, this data may exist but was not available for this report, in other instances the data has not been collected. The lack of information resulted in an “Unknown” status designation.

Table 1.1. Summary of indicators used to report on the state of the Milk River watershed.

<table>
<thead>
<tr>
<th>Watershed Component</th>
<th>Indicator</th>
<th>Measure</th>
<th>Watershed Linkages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface Water</td>
<td>Water Supply</td>
<td>Annual streamflow measurements</td>
<td>Streamflows should reflect a normal range of condition and support channel processes (erosion/building), aquatic life, the riparian environment and communities.</td>
</tr>
<tr>
<td></td>
<td>Allocation and Use</td>
<td>Water licenses and registrations; industrial water use reports</td>
<td>Water supplies support aquatic life, communities and economic activity.</td>
</tr>
<tr>
<td>Aquatic Ecosystem</td>
<td>Water Quality</td>
<td>Nutrients, sediment, metals, pathogens</td>
<td>Deviation of quality from natural condition suggests a degraded environment. Surface water quality should support designated or beneficial uses.</td>
</tr>
<tr>
<td>Groundwater</td>
<td>Water Supply</td>
<td>Number of wells and licenses, water level and yield</td>
<td>Indicates land use pressure on the groundwater resource. Deviation of water level or yields can indicate exploitation of the resource.</td>
</tr>
<tr>
<td></td>
<td>Water Quality</td>
<td>Nutrients, metals, pathogens</td>
<td>Groundwater is the main water supply for many rural people throughout the watershed.</td>
</tr>
<tr>
<td>Riparian Ecosystem</td>
<td>Wetlands (Lentic)</td>
<td>Condition</td>
<td>Density, Riparian Health Assessment (scores)</td>
</tr>
<tr>
<td></td>
<td>Riparian Areas (Lotic)</td>
<td>Condition</td>
<td>Riparian Health Assessment (Scores)</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Watershed Component</th>
<th>Indicator</th>
<th>Measure</th>
<th>Watershed Linkages</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Upland Ecosystem</strong></td>
<td><strong>Land Cover</strong></td>
<td><strong>Native Vegetation</strong></td>
<td>Native vegetation is an indicator of overall watershed condition. The greater the percent cover of native vegetation the greater the likelihood that the watershed is in a functioning condition. Native vegetation supports soil, water and biodiversity.</td>
</tr>
<tr>
<td></td>
<td><strong>Access</strong></td>
<td><strong>Road density</strong></td>
<td>Linear developments result in landscape and habitat fragmentation.</td>
</tr>
<tr>
<td></td>
<td><strong>Parks, Protected and Managed Areas</strong></td>
<td><strong>Percent of watershed protected</strong></td>
<td>Results in the conservation of historical and natural features, and wildlife refuges. Important for human health and well-being.</td>
</tr>
<tr>
<td></td>
<td><strong>Tourism and Recreation Activity</strong></td>
<td><strong>Number of visitors to serviced areas</strong></td>
<td>Indicates the pressure placed on natural resources in the watershed by people recreating, including hunting and fishing.</td>
</tr>
<tr>
<td></td>
<td><strong>Agricultural Activity</strong></td>
<td><strong>Crop footprint</strong></td>
<td>An indication of land conversion from native vegetation to annual crops.</td>
</tr>
<tr>
<td></td>
<td><strong>Agricultural Activity</strong></td>
<td><strong>Farm size</strong></td>
<td>Indicates economic well-being within the community.</td>
</tr>
<tr>
<td></td>
<td><strong>Agricultural Activity</strong></td>
<td><strong>Number of farm operators</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Rangeland condition</strong></td>
<td><strong>Rangeland condition</strong></td>
<td>An indication of permanent cover in the watershed. Healthy rangeland supports water supply, water quality, soil quality and biodiversity.</td>
</tr>
<tr>
<td></td>
<td><strong>Oil and Gas Activity</strong></td>
<td><strong>Number of oil and gas wells</strong></td>
<td>Indicates the level of disturbance on the landscape, including habitat fragmentation due to associated linear developments.</td>
</tr>
<tr>
<td><strong>Biodiversity</strong></td>
<td><strong>Fish</strong></td>
<td><strong>Species composition</strong></td>
<td>An aquatic ecosystem that supports a diverse group of fish species is more resilient to ecological adversity or changes to environmental condition.</td>
</tr>
<tr>
<td></td>
<td><strong>Wildlife</strong></td>
<td><strong>Population</strong></td>
<td>An upland ecosystem that supports a diverse group of wildlife species is more resilient to ecological adversity or changes to environmental condition.</td>
</tr>
<tr>
<td></td>
<td><strong>Vegetation</strong></td>
<td><strong>Invasive, Disturbance and Rare Plants</strong></td>
<td>An upland ecosystem that supports a diverse group of plant species is more resilient to ecological adversity or changes to environmental condition.</td>
</tr>
<tr>
<td><strong>Community</strong></td>
<td><strong>People</strong></td>
<td><strong>Population</strong></td>
<td>People influence many of the natural processes and functions within watersheds. Watersheds should also be livable places that can sustain people through time.</td>
</tr>
<tr>
<td></td>
<td><strong>Stewardship</strong></td>
<td><strong>Stewardship</strong></td>
<td>Stewardship programs are available that help residents, landowners and leaseholders maintain and improve watershed conditions.</td>
</tr>
</tbody>
</table>
The Milk River watershed spans an area of 59,857 km² (5,985,653 ha; 14,790,813 acres) in Alberta, Saskatchewan and Montana. The Milk River and its tributaries intricately connect the two provinces and the state as they share similar experience with climate, water quantity, water quality and other aspects of the ecosystem. The topographic limits for the watershed are the Rocky Mountains on the Blackfeet Reservation in the west, Montana, the Milk River Ridge that extends from the Rocky Mountains northeastward in Alberta, to the Cypress Hills, (Alberta and Saskatchewan) and Wood Mountains in the north (Saskatchewan). The Sweetgrass Hills, Bears Paw and Little Rocky Mountains form the limit in the south (Montana) (Map 2.1).

Elevations vary considerably in the watershed from west to east and reflect topographical features. The highest peak is found in the west at Glacier National Park in the Rocky Mountains (2,663 m or 8,737 ft) and the lowest elevation is located at the confluence of the Milk and Missouri rivers (619 m or 2,031 ft) (Map 2.1). At the point where the Milk River flows across the Canada-United States border, the elevation is 819 m (2,687 ft), the lowest elevation in southern Alberta. Other high points in the watershed include the Sweetgrass Hills that reach an elevation of 2,100 m (6,890 ft) in Montana and the Cypress Hills (elevation 1,467 m (4,813 ft) in Alberta).
The mainstem Milk River rises in the grasslands of Montana and flows northward into Alberta before flowing eastward a distance of about 288 km (179 mi) parallel to the Canada-United States border. The river then flows south and returns to Montana where it flows through Fresno Reservoir and continues to flow south-east a distance of 710 km (441 mi) before joining the Missouri River.

Important tributaries include the North Fork of the Milk River, that is often mistaken for the mainstem Milk River as it generally contains higher flows that are sustained by the St. Mary River Diversion in Montana. From the Canada-United States border, the North Fork flows a distance of 96 km (60 mi) before meeting the mainstem of the Milk River west of Del Bonita, Alberta. In Saskatchewan, substantial flows are delivered to the Milk River via three major tributaries: Lodge Creek, Battle Creek and the Frenchman River, that originate in the Cypress Hills. Lodge Creek and Battle Creek flow south across the Saskatchewan-Montana border and continue to flow south into the Milk River near Chinoook, while the Frenchman River joins the Milk River further downstream near Hinsdale, Montana.

Noteworthy lakes and reservoirs in the watershed include Shanks Lake (AB), Verdigris Lake (AB), Green Lake (AB), Cypress Lake (SK), Taits Lake (SK), Newton Lake (SK), Fresno Reservoir (MT), Nelson Reservoir (MT) and Lake Bowdoin (MT). In some areas, high densities of semi-permanent and seasonal wetlands are present, locally referred to as prairie potholes (see Section 7.0).

“The water of this river possesses a peculiar whiteness, being about the colour of a cup of tea with the admixture of a tablespoon of milk. From the colour of its water, we called it the Milk River.”

Meriweather Lewis and William Clark
May 8, 1805

The confluence of the Milk River and the Missouri River in Montana
Map 2.1 Milk River Watershed

The Bears Paw Mountains, Montana
2.1 Bedrock Geology

The Milk River area is characterized by a series of eroded upland plateaux draining into the present day river basin. The plateaux are remnants of pre-glacial fluvial terraces and range in elevation from 1,200 m to 1,400 m (3,937 ft to 4,593 ft). Two of the most significant plateaux in Alberta are the Del Bonita Plateaux and the Milk River Ridge. The Del Bonita Plateaux consists of an unglaciated and a glaciated portion. The unglaciated area is level to gently inclined, about three townships in size and occurs at an elevation of about 1,300 m (4,265 ft) (Adams et al. 2003). The Milk River Ridge, rises about 300 m (984 ft) above the adjacent plains on the north boundary of the watershed, and serves as a divide between the Milk River watershed and the South Saskatchewan River basin. Similar age plateaux are located on the south side of the Milk River in Montana. Three major igneous plugs in northern Montana form the Sweetgrass Hills which rise to an elevation of almost 2,100 m (6,890 ft).

Erosion and uplift have resulted in a variable bedrock profile that is exposed along the length of the Milk River. The main structural element in this area is the Sweetgrass Arch, which is a broad, north plunging anticline. The uplift associated with this arch results in the oldest formation in this area, the Milk River Formation (Eagle Formation in Montana), being exposed along the river on the east side of the Town of Milk River. The younger formations of bedrock typically radiate outwards from this area on all sides. The uplift and tectonic events in this area have resulted in structural deformation of the bedrock formations along the Milk River by folding, faulting and jointing.

The various upper bedrock formations in the Milk River watershed are Upper Cretaceous in age (Meyboom 1960). Many of the formations in the watershed are common to Alberta, Saskatchewan and Montana (Map 2.2). While the formation may be the same, the nomenclature used to describe the geology in Canada and the United States is sometimes different. Table 2.1 provides name correlations for the formations that are common to Canada and the United States.

Table 2.1. Bedrock geology name correlations.

<table>
<thead>
<tr>
<th>Canada</th>
<th>United States</th>
</tr>
</thead>
<tbody>
<tr>
<td>Battle Formation</td>
<td>Lower Hell Creek Formation</td>
</tr>
<tr>
<td>Bearpaw Formation</td>
<td>Bearpaw Formation</td>
</tr>
<tr>
<td>Belly River Formation</td>
<td>Judith River Formation</td>
</tr>
<tr>
<td>Blood Reserve Formation</td>
<td>Fox Hills Formation and Lower Hell Creek Formation</td>
</tr>
<tr>
<td>Cypress Reserve Formation</td>
<td>No known correlation</td>
</tr>
<tr>
<td>Del Bonita Gravels</td>
<td>No known correlation</td>
</tr>
<tr>
<td>East End Formation</td>
<td>Lower Fox Hills Formation</td>
</tr>
<tr>
<td>Foremost Formation</td>
<td>Lower Judith Formation</td>
</tr>
<tr>
<td>Frenchman Formation</td>
<td>Upper Hell Creek Formation</td>
</tr>
<tr>
<td>Lea Park Formation</td>
<td>Claggett Formation and Eagle Formation</td>
</tr>
<tr>
<td>Milk River Formation</td>
<td>Eagle Formation and Virgelle Sandstone</td>
</tr>
<tr>
<td>Oldman Formation</td>
<td>Upper Judith River Formation</td>
</tr>
<tr>
<td>Pakowki Formation</td>
<td>Claggett Formation</td>
</tr>
<tr>
<td>Ravenscrag Formation</td>
<td>Fort Union Formation</td>
</tr>
<tr>
<td>St. Mary River Formation</td>
<td>St. Mary River Formation, including Fox Hills Formation and Lower Hell Creek Formation</td>
</tr>
<tr>
<td>Sweetgrass Hills Intrusives</td>
<td>Broken down by petrology classification (syenite, syenite porphyry, trachyte porphyry, diorite porphyry, monzonite porphyry, lamprophyre)</td>
</tr>
<tr>
<td>Willow Creek Formation</td>
<td>Willow Creek Formation</td>
</tr>
<tr>
<td>Wood Mountain Formation</td>
<td>No known correlation</td>
</tr>
</tbody>
</table>
Battle Formation
The Battle River Formation is found in the eastern half of the watershed in Saskatchewan and outcrops in river cuts and in the Cypress Hills. The formation has a mauve-grey weathering, dark brownish grey to purplish black, bentonitic, silty shale with a porous, weathered crust (Binda and Watters 1997). The formation is up to 12 m (39 ft) thick but usually less because the upper contact has been eroded. Erosion has removed parts of the Frenchman River valley in Saskatchewan.

Bearpaw Formation
This unit consists of up to 200 m (656 ft) of dark grey, marine clay shale with clayey sandstone beds, ironstone concretions and bentonite layers. In Alberta, it is located in the highlands, adjacent to the plains to the west of the watershed and along the east in the Cypress Hills. The Bearpaw is the dominant formation in the watershed in Saskatchewan.

Belly River Formation
The Belly River Formation is located in the southwestern and central portion of the watershed in Saskatchewan and is a complex inter-tonguing wedge of non-marine and marine sediments. The lithology of the formation is composed of fine grained sandstone with coarse grained beds and minor bentonite, coal, green shale and concretionary beds (Canadian Geoscience Knowledge Network, online).

Cypress Hills Formation
In Alberta and Saskatchewan, tertiary deposits (the first period of the Cenozoic Era) are covered by glacial drift (gravel, sand, or clay transported and deposited by a glacier), except the Cypress Hills Formation which was not affected by glacial activity. The Cypress Hills Formation is topped by a thick conglomerate of Oligocene age and consists of pebble and cobble conglomerate with some sandstone lenses. Most of the pebbles consist of chert and quartzite, with a matrix of calcareous sandstone (Meyboom 1960, Borneuf 1976).

Del Bonita Gravels
Extensive preglacial deposits of gravel are located in upland areas in the Del Bonita area in the western portion of the watershed in Alberta, covering an area of approximately 50 km² (12,355 acres). The material varies in thickness from 3 to 5 m (10 to 16 ft) and generally has less than 3 m (10 ft) of overburden. These gravels are not being widely used at present but may become an important source of granular material in the future (Shetson 1980).

Eastend Formation
This formation overlies the Bearpaw shale and is confined to the foot of the main escarpment of the Cypress Hills (Borneuf 1976) in Alberta and Saskatchewan. The Eastend Formation is composed of lithic sandstone with volcanic grains, concretionary layers and green-grey shale beds. In Alberta it contains lignite beds (Canadian Geoscience Knowledge Network, online).

Foremost Formation (Member of the Judith River Formation)
This formation is located in the central portion of the watershed in Alberta and is a series of fresh and brackish water deposits consisting of up to 150 m (492 ft) of pale grey feldspathic sandstone, grey and green siltstone and dark grey, carbonaceous shale. Coal and oyster beds are present in this formation as well as thin beds of bentonite. The Foremost Formation is exposed along the North Fork of the Milk River, and also in the eastern Milk River canyon (Robertson and Hendry 1982).
Frenchman Formation
The Frenchman Formation in the Cypress Hills of Saskatchewan consists of olive-green to brown cross bedded sandstone with interbedded claystone bands and occasional layers of intraformational clay clast conglomerate (Canadian Geoscience Knowledge Network, online).

Milk River Formation
This formation is located in the central portion of the watershed in Alberta and is characterized by fine-grained, massive sandstone units that reach a maximum thickness of 60 m (197 ft). The sandstone units are overlain by sandy and bentonitic shales and sandstones that grade upwards into the Pakowki Formation. The Milk River sandstones outcrop along Red Creek, the southern section of Verdigris Lake and the valleys of the Milk River and its tributaries, for a length of approximately 50 km (31 mi) including Writing-on-Stone Provincial Park. The Milk River Formation is a major groundwater aquifer for surrounding areas.

Oldman Formation (Member of the Judith River Formation)
This formation found in Alberta, is located near the western edge and the southeastern portion of the watershed and is comprised of 60 m to 185 m (197 ft to 607 ft) of pale grey, thick bedded, medium to coarse-grained feldspathic sandstone, grey, clayey siltstone and dark grey and brown carbonaceous shale. The Oldman Formation is exposed along upstream sections of the Milk River and North Milk River.

Pakowki Formation
This formation is found in the central portions of the watershed in Alberta, comprising up to 275 m (902 ft) of grey marine shale with thin interbeds of silty shale and bentonite. The shales are exposed near the mouth of Pakowki Coulee. In the eastern extent of the watershed, the formation outcrops in the Milk River canyon.

Ravenscrag Formation
This unit is confined to a narrow rim around the highest parts of the Cypress Hills in Alberta and Saskatchewan (Borneuf 1976) and along the entire northern edge of the watershed in Saskatchewan. The formation consists of sandstones and shales of the Paleocene age (Meyboom 1960).

St. Mary River Formation
The non-marine St. Mary Formation consists of pale grey and green, fine to medium grained calcareous sandstone and green and grey siltstone. The St. Mary Formation is located on the western edge of the watershed in Alberta.

Sweetgrass Hills Intrusives
This formation occurs as five very small deposits in the central portion of the watershed in Alberta that were formed by plutonic (i.e., deep igneous) activity associated with primary tectogenesis. These intrusions together with more deeply seated intrusions, disturbed the regional dip in the area and created a radiating pattern of nose and dome-like structures extending from Montana into Alberta (Meyboom 1960).

Wood Mountain Formation
The Wood Mountain Formation is found in isolated pockets along the northern portion of the watershed in Saskatchewan and is composed predominantly of unconsolidated gravels and sand which are an erosional remnant of a much more expansive sheet of gravel and sand. The formation has a maximum thickness of 31 m (102 ft) (Leckie et al. 2004).
2.2 Surficial Geology

Much of the Milk River watershed topography was influenced by the Laurentide glaciation and post-glacial activity (Map 2.3). Most areas adjacent to the Milk River valley were covered and infilled by thick sequences of glacial till with surficial zones and inter-till layers of water sorted clay, silt, sand and gravel. Mostly, these deposits are expressed as hummocky and undulating moraines. The result was the formation of new river valleys due to changes in the drainage pattern. Although postglacial drainage patterns coincide partly with preglacial drainage, there are several areas where the preglacial and postglacial river channels deviate. Deposition in the present day river valleys typically consists of coarse-grained gravels in the upstream sections of the Milk River with fine-grained sands in the lower reaches downstream of the Town of Milk River, Alberta. Floodplain deposits are commonly fine-grained silts and clays (Klohn Crippen Consultants Ltd. 2003).

Stagnation of receding glaciers also resulted in the formation of several meltwater channels such as Lonely Valley, Verdigris Coulee and MacDonald Creek/Black Creek Coulee. These valleys were eroded to a lower elevation than the existing river system valleys and have been infilled with alluvial and lacustrine sediments including silts, sands and clays with minor inclusions of gravel. The existing channels in these valleys generally carry very little flow today.

The upland area near Del Bonita, Alberta was unglaciated and is covered by mixed deposits overlying preglacial gravels. The dominant surficial material is medium-textured loess up to 2 m (7 ft) thick, underlain by Tertiary-aged quartzitic gravels (Brierley et al. 1991). Loess is wind-blown silt-dominated material deposited during deglaciation of areas to the north. Gravels and cobbles occur within the upper loess due to freeze-thaw processes over the last 18,000 years since the glacial maximum. Glaciofluvial sands and gravels also cover the upland area surrounding the Milk River near the confluence with the North Milk River.

The combination of low rainfall, limited vegetation growth and presence of erodible valley deposits has resulted in the formation of extensive areas of badlands which contribute large quantities of silt and sand sized sediments to the Milk River in Alberta (Borneuf 1976).
Map 2.3 Surficial Geology

Undulating topography along Cypress Creek, Saskatchewan

Note: Montana Geology is shown on Map 2.2

Legend

ALBERTA
1. Bedrock
2. Bedrock & Glacial, undivided
3. Cryoturbated Eolian (loess) & Fluvial
4. Eolian
5. Fluvial
6. Glacial
7. Glacial & Fluvial, undivided
8. Ice-contact Lacustrine & Fluvial, undivided
9. Ice-contacted Fluvial
10. Lacustrine
11. Stream & Slopewash Eroded

SASKATCHEWAN
12. Alluvial
13. Alluvial floodplain
14. Glaciofluvial eroded
15. Glaciolacustrine plain
16. Lacustrine
17. Morainal
18. Morainal eroded by glacial melt streams
19. Morainal hummocky
20. Morainal plain
21. Morainal ridged
22. Morainal undulating
23. Morainal veneer
24. Rock
The Milk River winding through alluvial deposits southeast of Glasgow, Montana

Rolling grasslands in Saskatchewan
2.3 Ecoregions

Ecoregions are areas of land that have been grouped within a boundary due to similarities in type and in the quantity and quality of environmental resources (Commission for Environmental Cooperation (CEC) 2009). Ecoregions have been defined for North America by assessing geology, physiography, vegetation, climate, soils, land use, wildlife and hydrology that affect or reflect differences in ecosystem quality and integrity (Map 2.4).

As a transboundary watershed, an understanding of ecoregions in the Milk River watershed can be used to develop a spatial framework for research, assessment, management and monitoring of ecosystems and ecosystem components (CEC 2009). Ecoregions also provide a spatial context for national and regional state-of-the-environment reporting, environmental resource inventories and assessments, setting regional resource-management goals, determining carrying capacity, as well as developing biological criteria and water quality standards (CEC 2009).

Five Level III ecoregions are represented in the Milk River watershed; these are the Canadian Rockies, Middle Rockies, Cypress Uplands, Northwestern Glaciated Plains and the Northwestern Great Plains (CEC 2009) (Map 2.4). The Northwestern Glaciated Plains covers the majority of Alberta and Saskatchewan, except in the northern part that is characterized by the Cypress Uplands. The watershed in Montana is predominantly Northwestern Glaciated Plains, except for some peripheral areas at the western edge (Canadian Rockies Ecoregion), at the southern watershed boundary (Middle Rockies Ecoregion) and at the eastern edge (Northwestern Great Plains) (Map 2.4). In addition to the North American Ecoregion designations, natural sub-regions (Alberta) and natural eco-districts (Saskatchewan) are further delineated in Canada (Map 2.4).

The climate, soils, and vegetation that characterize the ecoregions, natural sub-regions and/or ecodistricts are each discussed in the following sections.

2.4 Climate

Generally, the Milk River watershed experiences short warm summers and cold winters that experience occasional to frequent mild periods, known as Chinooks. The Milk River watershed is prone to drought that can occur frequently across the region. Historical records show that prolonged periods of below-average precipitation (drought) were greater in severity and duration prior to European settlement. In Alberta, the driest reconstructed 12-month period occurred from August 1793 to July 1794 (Dormaar 2003).

Late spring to early summer brings high winds and short, heavy rains (Graspointer 1980). Prevailing westerly winds are most evident during the period from October to December. The average annual wind speed is 20.4 km/h and maximum gusts of 170 km/h have been recorded in Alberta. Soil erosion by wind is a very real concern in this watershed (Kjeærsgaard et al. 1986).

Precipitation

Most precipitation occurs during the growing season (May through September), accounting for more than 50% of the annual total. There is a high yearly variability and uneven distribution of rainfall within the watershed (Kjeærsgaard et al. 1986) (Map 2.5). Climate is modified, locally, by the Milk River Upland, the Sweetgrass Hills and Cypress Hills in Alberta, and by the Bears Paw Mountains in Montana (Klohn Crippen Consultants Ltd. 2003).

The highest average snowfall occurs in January, however, the greatest single snowstorm event often occurs in March or April (Klohn Crippen Consultants Ltd. 2003). Snow contributes about 30% to the total annual precipitation in the watershed in Alberta. Table 2.2 summarizes the climate characteristics of the five ecoregions within the Milk River watershed.
Table 2.2. Summary of climate characteristics in the ecoregions represented in the Milk River watershed (Wiken 2011).

<table>
<thead>
<tr>
<th>Ecoregion</th>
<th>Climate Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Middle Rockies</td>
<td>A severe, mid-latitude, humid continental climate with more subarctic climate at high elevations. Generally, it is marked by warm to cool summers and severe winters. The mean annual temperature varies greatly by elevation from approximately -5°C to 8°C. The frost-free period ranges from 25 to 140 days. The mean annual precipitation is 621 mm, ranging from 300 mm to over 2,500 mm.</td>
</tr>
<tr>
<td>Canadian Rockies</td>
<td>A severe, mid-latitude, humid continental climate with more subarctic climates at high elevations. The mean annual temperature for the region varies from north to south. A typical value for the mean annual temperature for major valley systems is about 2.5°C. Mean summer temperature is 12°C and the winter mean is -7.5°C. The mean annual precipitation ranges from 500 mm to more than 2,500 mm, increasing with elevation. Climatic conditions in the major valleys are marked by warm, dry summers and mild, snowy winters. Subalpine summers are cool, showery, and prone to early frosts.</td>
</tr>
<tr>
<td>Cypress Uplands</td>
<td>Cooler and moister than that of the surrounding Northwestern Glaciated Plains ecoregion. The mean annual temperature is approximately 3°C with a mean summer temperature of 15°C and a mean winter temperature of -9°C. The mean annual precipitation ranges from 325 mm to 450 mm.</td>
</tr>
<tr>
<td>Northwestern Glaciated Plains</td>
<td>Mostly a dry, mid-latitude steppe climate. It is marked by warm to hot summers and cold winters. The mean annual temperatures range from 2.5°C in the north to 7°C in the south. The mean summer temperature is 16°C and the mean winter temperature is -10.5°C. The frost-free period ranges from 95 days to 170 days. The mean annual precipitation ranges from 250 to 350 mm in drier areas and from 350 mm to 550 mm in moist areas.</td>
</tr>
<tr>
<td>Northwestern Great Plains</td>
<td>A dry mid-latitude steppe climate marked by hot summers and cold winters with a mean annual temperature of about 5°C in some northern areas rising to 8.5°C in the south. The frost-free period ranges from 90 days to 155 days. The mean annual precipitation is 393 mm, ranging from 250 mm to 510 mm.</td>
</tr>
</tbody>
</table>
Map 2.4 Ecological Regions

Legend

NORTH AMERICA - ECOLOGICAL REGIONS
- 6.2.10 MIDDLE ROCKIES
- 6.2.4 CANADIAN ROCKIES
- 6.2.6 CYPRESS UPLANDS
- 9.3.1 NORTHWESTERN GLACIATED PLAINS
- 9.3.3 NORTHWESTERN GREAT PLAINS

ALBERTA - NATURAL SUBREGIONS
- DRY MIXEDGRASS
- FOOTHILLS FESCUE
- MIXEDGRASS
- MONTANE

SASKATCHEWAN - ECODISTRICTS
- CLIMAX PLAIN
- CYPRESS HILLS
- OLD MAN ON HIS BACK PLATEAU
- SWIFT CURRENT PLATEAU
- WILD HORSE PLAIN
- WOOD MOUNTAIN PLATEAU
- WOOD RIVER PLAIN
Map 2.5 Precipitation
The Variability of the Climate of the Milk River Watershed During the Past 500 Years

Contributed by Dr. D. Sauchyn

The description of the climate of the Milk River watershed in Table 2.2 is based on weather data from the past several decades, however climate tends to change such that the ‘normal’ climate is only a snapshot of current conditions. Temperatures have been increasing in recent decades so today the watershed is warmer than in the past. Similarly, precipitation varies between years and decades. With cycles and extremes in precipitation, the natural streamflow in the Milk River rises and falls from year to year and decade to decade. We cannot be certain that the full range of climate variability and river flows was recorded by weather and water gauges. However, there is a source of proxy climate information that can extend the weather and water records by hundreds of years. The inter-annual climate variability is recorded in old trees (Axelson et al., 2009; Sauchyn et al., 2011). Besides light, soil and carbon dioxide, which are abundant in southern Alberta, the trees need heat and water for growth. There usually is plenty of heat in summer and thus soil moisture is the limiting growth factor. Annual growth is recorded in the tree rings, which are narrow in dry years and wider in wet years (Figure 2.2). Trees from fourteen sites within or adjacent to the Milk River watershed boundary were used in the tree ring analysis of climate (Table 2.3).

Figure 2.2. Top: These two cores are from a living Douglas fir at the Boyce Ranch in the Bears Paw Mountains, MT. You can see the ring width variability in wet and dry years. Bottom: This wood is from the inner part of an old, dead tree collected at the Cut Bank Creek site in the upper end of the Milk River watershed, MT. By cross-dating this sample with wood from younger trees, it was determined that the pith (the dark circle in the middle representing the first year of the life of the tree) is from the year 1342.
There is a strong correlation between the amount of water in the Milk River and the annual growth of Douglas fir (*Pseudotsuga menziesii*), limber pine (*Pinus flexilis*), ponderosa pine (*Pinus ponderosa*), lodgepole pine (*Pinus contorta*), whitebark pine (*Pinus albicaulis*) and white spruce (*Picea glauca*) that grow in the upper part of the watershed and in the Cypress Hills, Sweet Grass Hills and Bears Paw Mountains. This statistical relationship was used to reconstruct the flow of the Milk River at the Eastern Crossing of the International Boundary back to 1572. In Figure 2.3, these annual flows are plotted as departures from the average flow for the entire 435-year record. Positive departures are blue and negative departures are red. The moisture recorded in the tree rings shows the dry years of the 1920s and 30s and the last 10 years. One of the wettest episodes in the entire record is during the first two decades of the 20th century, the homesteading period, when Alberta’s population increased by about 500%. In comparison, some of the driest single years in the tree-ring record are in recent decades. The most severe droughts are those that last for a decade or more; these severe droughts were captured by the tree rings in the mid to late 1600s, late 1700s and most recently during the 1840s through 1860s, when the southern prairies were declared “forever comparatively useless” by John Palliser.

Records of past climate such as those demonstrated by the tree ring analysis put our recent experience with weather in a longer historical context. Because drought of long duration occurred in the past, it will reoccur in the future, but in a time of global warming.

<table>
<thead>
<tr>
<th>Site Name</th>
<th>Location</th>
<th>Species Name</th>
<th>Elevation (m)</th>
<th>Period of Record</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beaver Creek Rd (Bears Paw Mountains)</td>
<td>MT</td>
<td><em>Pinus ponderosa</em></td>
<td>1325</td>
<td>1714-2010</td>
</tr>
<tr>
<td>Boyce Ranch (Bears Paw Mountains)</td>
<td>MT</td>
<td><em>Pinus ponderosa</em></td>
<td>1395</td>
<td>1572-2010</td>
</tr>
<tr>
<td>Boundary</td>
<td>AB</td>
<td><em>Pseudotsuga menziesii</em></td>
<td>1484</td>
<td>1580-2010</td>
</tr>
<tr>
<td>Bowery Peak (Bears Paw Mountains)</td>
<td>MT</td>
<td><em>Pseudotsuga menziesii</em></td>
<td>1297</td>
<td>1759-2005</td>
</tr>
<tr>
<td>Beazer</td>
<td>AB</td>
<td><em>Pinus flexilis</em></td>
<td>1468</td>
<td>1467-2007</td>
</tr>
<tr>
<td>Crandell Mountain</td>
<td>AB</td>
<td><em>Pseudotsuga menziesii</em></td>
<td>1284</td>
<td>1450-2005</td>
</tr>
<tr>
<td>Cut Bank River</td>
<td>MT</td>
<td><em>Pseudotsuga menziesii</em></td>
<td>1673</td>
<td>1312-2006</td>
</tr>
<tr>
<td>Chief Mountain</td>
<td>MT</td>
<td><em>Pseudotsuga menziesii</em></td>
<td>1490</td>
<td>1673-2005</td>
</tr>
<tr>
<td>Cypress Hills</td>
<td>AB/SK</td>
<td><em>Pinus contorta</em></td>
<td>1000</td>
<td>1756-2001</td>
</tr>
<tr>
<td>Cypress Hills</td>
<td>AB/SK</td>
<td><em>Picea glauca</em></td>
<td>1000</td>
<td>1762-1997</td>
</tr>
<tr>
<td>East Butte (Sweetgrass Hills)</td>
<td>MT</td>
<td><em>Picea glauca</em></td>
<td>2110</td>
<td>1859-2010</td>
</tr>
<tr>
<td>West Butte Summit (Sweetgrass Hills)</td>
<td>MT</td>
<td><em>Pinus albicaulis</em></td>
<td>1800</td>
<td>1560-2010</td>
</tr>
<tr>
<td>West Butte (Sweetgrass Hills)</td>
<td>MT</td>
<td><em>Pinus contorta</em></td>
<td>1700</td>
<td>1653-2010</td>
</tr>
</tbody>
</table>

Figure 2.3. Annual flows plotted as departures from the average flow for the 435 year record. Positive departures are blue and negative departures are red.
2.5 Soils

Soils are the foundation of the watershed, providing minerals for plants, absorbing rainwater and releasing it at a later date to prevent floods and droughts, and also providing habitat for soil organisms. Soils in the Milk River watershed reflect differences in parent materials and changes in climate that can be seen in the surface colours of soils (Map 2.6). These colours range from black through dark brown to brown.

Chernozemic soils (A) (Mollisols in Montana) are the predominant soils in the watershed in Alberta, Saskatchewan and Montana. These soils, which are common in the prairie regions of Canada and US, have dark surface horizons that have high organic matter content from roots of grasses. In Canada, these soils are also called Black soils, Dark Brown soils, or Brown soils, depending on their appearance based on organic matter contents. Undulating and hummocky terrain and slopes between two and nine percent predominate in these areas. They occur in an area that experiences water deficits in most growing seasons. The deficits limit agricultural production to small grains, oilseeds, pulses and forage crops. Nonetheless, these soils are very productive due to their high organic matter content.

Gleysolic soils (B) (Aqu Entisols or Aqu Inceptisols in Montana) result from prolonged water saturation of the soil profile. They are typically found in the poorly drained depressions associated with hummocky terrain. Saturation conditions result from the concentration of surface water runoff into depressions and/or from a rising groundwater table. The water-saturated conditions reduce decomposition of organic matter, which can accumulate over centuries and form peat. If groundwater discharge occurs in these areas, localized salinization may be evident. In the watershed, these soils are found in small patches west of the Town of Milk River, Alberta.

Luvisolic soils (C) (Alfisols in Montana), also called Gray soils in Canada, are dominant in forested landscapes and are usually loamy or clayey in texture. On the Canadian side of the watershed, they are found in the northern region at the Cypress Hills on either side of the Alberta-Saskatchewan border. In Montana, they occur in a swath starting north of Sun Prairie and Content, and extending northwest to the western part of the Montana-Saskatchewan border. They tend to have lower organic matter content, and therefore are less productive than Chernozemic soils. Their low soil organic matter and high silt content sometimes result in crusts that inhibits seedling emergence and water infiltration.

Regosolic soils (D) (Entisols in Montana) are poorly developed soils in the early stages of soil formation. These soils are primarily found on eroded knolls, where minimal infiltration of precipitation retards soil development, and in floodplain areas, where frequent flooding disrupts profile development either by deposition of sediment or removal of material. Regosolic soils are found in the floodplain of the Milk River and other rivers and creeks in the watershed.
Solonetzic soils (E) (Natric Mollisols or Natric Alfisols in Montana) occur where soils develop on saline (salt-rich) materials. The sodium could originate from the parent material (e.g., shales that formed in marine [salty] environments) or it could increase through deposition of salts from groundwater in the soil profile. In Alberta, these soils occur west of the Town of Milk River, north and east of Aden and south of the Cypress Hills to the international border. In Saskatchewan, solonetzic soils are predominant in the south-west corner of the province and in patches along the Frenchman River. Alfisols in Montana extend from the international border east of Wild Horse south-east to Sun Prairie. Salinity limits the productivity of these soils.

Vertisolic soils (F) (Vertisols in Montana) are found throughout the prairies on parent material that is high in clay. The heavy clay expands when the soil is wet, and shrinks when the soil dries, causing cracking at the soil surface that poses problems for agricultural and engineering use. On the Canadian side of the watershed, these soils are found in a small area around Vidor, Saskatchewan. In Montana, they occur along a creek that extends from Sun Prairie north-east through Content to Saco. There is also an area in Montana at the site where the three borders (Montana-Alberta-Saskatchewan) meet. If artificially drained, these soils are some of the most productive for agricultural crops.
Map 2.6 Soils

Soil Name Correlations

<table>
<thead>
<tr>
<th>Canada</th>
<th>USA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chernozemic</td>
<td>Mollisols</td>
</tr>
<tr>
<td>Gleysolic</td>
<td>Aqu-suborders, e.g., Aquents (Aqu Entisols) or Aquepts (Aqu Inceptisols)</td>
</tr>
<tr>
<td>Luvisolic</td>
<td>Alfisols</td>
</tr>
<tr>
<td>Regosolic</td>
<td>Entisols</td>
</tr>
<tr>
<td>Solonetzic</td>
<td>Natric Mollisols or Natric Alfisols</td>
</tr>
<tr>
<td>Vertisolic</td>
<td>Vertisols</td>
</tr>
</tbody>
</table>

Legend

<table>
<thead>
<tr>
<th>Canada Soil Order</th>
<th>United States of America Dominant Soil Order</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chernozemic</td>
<td>Alfisols</td>
</tr>
<tr>
<td>Gleysolic</td>
<td>Entisols</td>
</tr>
<tr>
<td>Luvisolic</td>
<td>Inceptisols</td>
</tr>
<tr>
<td>Regosolic</td>
<td>Mollisols</td>
</tr>
<tr>
<td>Solonetzic</td>
<td>Vertisols</td>
</tr>
<tr>
<td>Vertisolic</td>
<td>Rock Outcrop</td>
</tr>
</tbody>
</table>
2.6 Land Cover

Changes in land cover through time are one of the most important indicators of the health and function of the Milk River watershed. Land cover influences the quality and quantity of surface water, indicates the availability of habitat for fish, wildlife and plants, and provides more indirect insight into other watershed elements such as air quality.

The Milk River watershed, unlike other areas in Canada and the United States, remains predominantly a rural landscape with just one percent of the watershed considered developed (i.e. urban area) (Map 2.7 and Map 2.8). Cropland covers 30% of the entire watershed, with the largest percentage of cropland cover in Montana (33%) and the smallest percentage covering Alberta’s part of the watershed (17%). Thirty-one percent of the watershed in Saskatchewan has been converted to cropland. Most of the cultivated land found in Montana is located west of Havre, along the Milk River valley, and on the eastern edge of the watershed. In Alberta and Saskatchewan, cropland is located centrally in each region. Alberta maintains a higher percent land cover in tame grass (6%) compared to Saskatchewan (2%) or Montana (1%).

Fifty-one percent of the total watershed area remains as native grassland, with the highest percent of native grassland cover located in Alberta (65%) and the smallest percentage found in Montana (44%) (Map 2.7). In 2008, native grassland cover in Alberta was reported as 71% of the watershed area. It is likely that better mapping (e.g., Grassland Vegetation Inventory [GVI] data and an updated watershed boundary which takes in more cropland near the Village of Warner) is accountable for reduction in percent grassland cover rather than land conversion.

Within the Northwestern Glaciated Plains, spear grass (Stipa comata), blue grama grass (Bouteloua gracilis), and wheat grass (Agropyron spp.) were once the dominant native grasses that covered much of the landscape (Wiken 2011). The Mixedgrass Natural Subregion in Alberta is dominated by western porcupine grass (Stipa curtiseta), western wheatgrass (Pascopyrum smithii), northern wheat grass (Agropyron dasystachyum or Elymus lanceolatus) and green needle grass (Stipa viridula). The Dry Mixedgrass Natural Subregion is characterized by western porcupine grass, western wheat grass, northern wheat grass and blue grama. Short and mid-grass prairies co-exist due to variability in precipitation; shorter, drought-resistant grasses such as blue grama increase in percent cover during times of drought. Mid-grasses, principally the rhizomatous thick-spike wheatgrass, bearded wheatgrass (Elymus trachycaulus) and western wheatgrass and the bunch-forming prairie junegrass (Koeleria macrantha), needle-and-thread (Hesperostipa comate) and porcupine grass increase under more favorable moisture conditions (Cooper et al. 2001).

On the driest sites, prickly pear (Opuntia polyacantha) is found. Local saline areas support alkali grass (Puccinellia), wild barley (Hordeum spp.), black greasewood (Sarcobatus vermiculatus), red sampire (Salicornia rubra), and sea blite (Suaeda spp.). At higher elevations (i.e., the Foothills Fescue Natural Subregion), foothills rough fescue (Festuca hallii) is the dominant grass. The alpine vegetation is characterized by low-growing heather (Calluna vulgaris) with sedges (Carex spp.) and mountain avens (Dryas octopetala) occurring on warmer sites.

Shrubland is extensive throughout Montana, particularly in the south-east, covering about 12% of the watershed. In Alberta, shrubland covers five percent of the watershed, and only one percent of the watershed in Saskatchewan. Shrub communities in the Cypress Uplands include red-osier dogwood (Cornus stolonifera), bunchberry (Cornus canadensis), pincherry (Prunus pensylvanica) and northern gooseberry (Ribes oxyacanthoides).

Shrub communities vary across the Northwestern Glaciated Plains, reflecting the varied moisture conditions and micro-climates found across the region. Shrub communities in the mixedgrass prairie include shrubby cinquefoil (Potentilla fruticosa). In stream and river valleys (riparian environments) willow (Salix spp.)
communities are common throughout the watershed, as well as red-osier dogwood, western snowberry (Symphoricarpos occidentalis), Wood’s rose (Rosa woodsii) and wild current (Ribes spp.) communities in Montana. Shrub steppe is rare in the watershed in Montana, however, there are several small stands of Wyoming big sagebrush (Artemisia tridentate ssp. Wyomingensis) in uplands west of the Bitter Creek Badlands (Cooper et al. 2001). These stands represent the northern extent of Wyoming big sagebrush in North America. Silver sagebrush (Artemisia cana) generally occurs in drier parts of riparian areas throughout the watershed.

Forest cover in the Canadian part of the watershed is mainly found in the Cypress Uplands (Montane) Ecoregion. About one percent of the watershed in each of Alberta and Saskatchewan is forest. In Montana, forest covers about two percent of the watershed in the Canadian Rockies and Middle Rockies Ecoregions. Forest species found in the higher elevation ecoregions include Douglas fir (Pseudotsuga menziesii), lodgepole pine (Pinus contorta), trembling aspen (Populus tremuloides), alpine fir (also known as subalpine fir, Abies lasiocarpa) and Engelmann spruce (Picea engelmannii). In the Bears Paw Mountains, Montana, mixed deciduous and coniferous forests are dominated by ponderosa pine (Pinus ponderosa), Douglas fir and trembling aspen. In the Cypress Uplands, lodgepole pine, white spruce (Picea glauca), white birch (Betula papyfera), balsam poplar (Populus balsamifera) and aspen forest communities dominate (ATPR 2011). In the Northwestern Glaciated Plains Ecoregion, Rocky Mountain juniper (Juniperus scopulorum) occurs as small isolated stands on northern slopes of draws and coulees in Rock Creek Canyon (Cooper et al. 2001). Ponderosa pine also grows in the Northwestern Great Plains. Scrubby aspen, cottonwood, and box elder (Acer negundo) occur to a limited extent on shaded slopes of valleys and river terraces.

Four percent of the Milk River watershed is covered by water and wetlands. The wettest area is found in Montana, having five percent water/wetland cover, followed by Alberta (3%) and Saskatchewan (2%). Some of the water in Montana is owing to the large Milk River Project that has created reservoirs and lakes where none had existed historically (see Section 9.0 for a detailed description of the Milk River Project).

Barren, non-vegetated lands are present throughout the watershed and they are better known as “the badlands”. Two percent of the watershed in Saskatchewan and Montana portion of the Milk River Watershed and three percent of the watershed in Alberta is non-vegetated. Badlands are restricted mainly to areas of semi-arid to arid climate in which relatively weak bedrock is horizontally layered and the vegetation cover is extremely sparse or completely absent (Beaty 1975). In Alberta, badlands or bedrock outcrops apply to all inclined to steeply sloping landscapes with greater than ten percent bedrock exposures of soft rock or hard rock less than 1 m (3.3 ft) deep (AGRASID 3.0). In Montana, badlands are considered highly eroded landforms having less than ten percent vegetated cover (Vance and Luna 2010). Vegetation communities in the Bitter Creek Badlands, Montana are restricted to longleaf sagewort (Artemisia longifolia) and creeping juniper (Juniperus horizontalis), which acts as a soil stabilizer (Cooper et al. 2001).
Map 2.7 Land Cover

Alberta
- Tame Grass: 6%
- Shrubland: 6%
- Non-vegetated: 3%
- Grassland: 55%

Saskatchewan
- Tame Grass: 2%
- Shrubland: 1%
- Non-vegetated: 1%
- Grassland: 62%

Montana
- Tame Grass: 1%
- Shrubland: 1%
- Non-vegetated: 2%
- Grassland: 44%
Map 2.8 Satellite Image
2.7 Land Ownership and Administration

Land in the Milk River watershed is owned by the Federal and Provincial or State governments, First Nations/Indian Tribes, local municipalities and private landowners (Map 2.9). In Alberta, the Federal government owns about 1,123 ha (2,776 acres) of land at Onefour, where they operate the Onefour Research Station. Nearly the entire eastern half of the watershed in Alberta, and a large tract of land in the west, is owned by the provincial government and maintained as Public Land. Public Lands make up 60% of the watershed in Alberta and the remaining 40% is privately owned (i.e., deeded).

While the majority of lands in the watershed in Alberta, are Public Lands, the Federal and Provincial government own a smaller percent area of the watershed in Saskatchewan (Map 2.9). About 16% (226,460 ha or 559,592 acres) of the watershed in Saskatchewan is Federal land and includes lands managed by Agriculture and Agri-Food Canada, historically referred to as the Prairie Farm Rehabilitation Administration (PFRA), and Grasslands National Park (Map 2.9). Provincial land ownership in Saskatchewan (18% of the watershed area) is found in large tracts at Cypress Hills, adjacent to the Alberta-Saskatchewan border, and scattered across the central and eastern part of the watershed. The majority of Federal and Public Lands in Alberta and Saskatchewan are managed under grazing leases held with local ranchers. In 2012, the Federal Government announced the transition of the PFRA pastures to the Saskatchewan Government. When transitioned, the lands will be managed in a similar way as other leased Crown grazing land. Pasture patron groups will have the opportunity to own or lease each pasture and each pasture will remain as a complete block (B. Kirychuk, pers. comm.). In 2012, 65% of the land in the watershed in Saskatchewan was owned privately.

There is no First Nations land in the Milk River watershed in Alberta, although much of the area is considered traditional land. In Saskatchewan, the Nekaneet First Nation occupies 7,034 ha (17,381 acres) of land in the northwestern part of the watershed. There is very little to no municipal land in the watershed in Alberta or Saskatchewan.

About 23% of the Milk River watershed in Montana is owned by the Federal government (Map 2.9). This area is managed largely by the United States Bureau of Land Management (BLM), the Bureau of Reclamation (USBR) and the Department of Defence. The Department of Defence manages a strip of land about 15 to 20 m (49 to 66 ft) wide along the Canada-United States border. Small blocks of Montana state-owned lands are also found throughout the

The Alberta-Montana border fence
watershed; These are mainly State (school) Trust Lands and lands managed by Montana Fish, Wildlife and Parks (FWP). According to Montana State law, the Department of Natural Resources and Conservation (DNRC) must manage State School Trust Lands in a way that produces revenue to help support state public schools. Generally, state land includes, but is not limited to, sections 16 and 36 of each township (Shultz and Butler 2003). Tribal lands cover about 14% of the watershed. These lands include the Blackfeet, Rocky Boy’s, Fort Belknap and Fort Peck Indian Reservations. Tribal Lands are distributed across the watershed, including the western headwaters of the mainstem Milk River and at the North Milk River, the south-central part of the watershed and the eastern part of the watershed, north and east of Nashua.

Administration

In Alberta, the Milk River watershed is represented by the urban municipalities of the Village of Warner, Town of Milk River and Village of Coutts, as well as by four rural municipalities (Map 2.10). From west to east, the rural municipalities in the Alberta watershed are Cardston County, County of Warner, County of Forty Mile and Cypress County. The County of Warner and Cypress County manage the largest rural area in the watershed (32% and 40% of the watershed area, respectively) and Cardston County and County of Forty Mile each manage about 12% and 16% of the watershed area, respectively.

There are numerous small hamlets, six larger urban municipalities (i.e., the Town of Eastend, and the Villages of Consul, Frontier, Climax, Bracken and Val Marie) and fifteen rural municipalities represented in the watershed in Saskatchewan. Rural municipalities tend to be smaller than those found in either Alberta or Montana. The largest rural municipalities are Reno in the west, that covers 25% of the watershed adjacent to the Alberta-Saskatchewan border and Val Marie that encompasses 22% of the watershed further east (Map 2.10).

Similar to the watershed in Saskatchewan, there are numerous small hamlets, villages, towns and cities in the watershed in Montana. The major urban centres are Havre, Malta, Glasgow and Nashua. There are eight rural municipalities represented which include the majority of Hill, Blaine, Phillips and Valley counties, and a small portion of Glacier, Toole, Liberty and Choteau counties.
Map 2.10 Land Administration
2.8 First Nations

The Milk River watershed is rich in its pre-contact cultural expression on the land by various Indigenous Peoples. Just as each rancher has roots in their land, First Nations or Native Americans have indigenous knowledge that has been handed down generation to generation that link their way of life to the watershed.

Collectively known as the Blackfoot Confederacy, “Siksikaitsitapi,” and, “Niitsipoyiwa” (those that speak the real language), the Blood Tribe, Piikani and Siksika are now situated on reserves in Southern Alberta, with relationships to the Blackfeet in Montana. They traditionally occupied the area from the Yellowstone River to the North Saskatchewan River, east of the Continental divide to the Sand Hills in Saskatchewan. The Milk River watershed played a central role in the way of life of the Blackfoot.

Members of the Blackfoot Nation used the area now known as Writing-On-Stone (Áísínai’pi). Evidence of their presence is seen in the form of petroglyphs and pictographs dating back within the last 500 years. Groups which may have contributed to the work include Shoshone, Kutenai and Atsina.

Known Medicine Wheels and Sacred Sites (such as Writing-On-Stone) are shown on Map 2.11. It should be noted that the term “Medicine Wheel” has become a generally used description and does not necessarily cover the diversity of the origin and purpose of each landmark or rock formation. In a similar fashion, “Sacred Site” is used here as a general reference to represent icons that are connected to areas of significance.

**Place Names**

The Blackfoot translation for Milk River is Ki-nuh-si-suht/Kiina’kssissa’ahta, or “Little River”. This was derived from an early geological map by George W. Dawson who wrote:

“The names in these lists were received from Mr. J.C. Nelson, who, in association with Mr. A.P. Patrick, was during several years engaged in surveys in the Northwest. The phonetic values of the letters are not stated and I have not ventured by transliteration to make the orthography conform to any phonetic system. It appears, nevertheless, desirable to place the original Indian names of places on record as far as possible” (Dawson 1895).

Place names often indicate unique spatial connections, such as the area of land between the Sweetgrass Hills (Katoyiisiksî) and the Cypress Hills (Aiyihkimmikoï), which is considered the heartland of the region known as the traditional territory of the Blackfoot/Blackfeet people or “Kitawahsinnoonni” (Table 2.4). To the east, the Cypress Hills marks the western edge of the Assiniboine and Plains Cree territories (Rees 1995).

<table>
<thead>
<tr>
<th>Name</th>
<th>Blackfoot source: Dawson, 1895</th>
<th>Blackfoot source: Mistaken Chief, pers. comm. 2013</th>
<th>Comment/ literal translation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk River</td>
<td>Kiina’kssissa’ahta</td>
<td>-</td>
<td>Little River</td>
</tr>
<tr>
<td>Cypress Hills</td>
<td>Ai-ya-ki’ mikoi</td>
<td>Aiyihkimmikoï</td>
<td>-</td>
</tr>
<tr>
<td>Ghost Pound</td>
<td>Sta-a-piskan</td>
<td>Sta’a-piskaan</td>
<td>Ghost pound</td>
</tr>
<tr>
<td>Writing-on-Stone</td>
<td>Áísínai’pi</td>
<td>-</td>
<td>It has been written</td>
</tr>
<tr>
<td>Sweetgrass Hills</td>
<td>-</td>
<td>Katoyiisiksî</td>
<td>The Sweetpine (Hills)</td>
</tr>
</tbody>
</table>
Seasonal Rounds

For the Blackfoot, the Milk River watershed comprised a significant portion of what many early writers referred to as the “seasonal rounds”, the practice of seasonal movement in order to intercept resources as they became available for use.

Uhlenbeck (1912) documented the seasonal round of the South Peigans, highlighting patterns intrinsic to Blackfoot lifestyles (in Dormaar and Barsh 2000).

Far down on the Maria’s river (literally: Bear Creek), there they stayed till late in spring...They waited for the bulls, that they had shed their hair... We shall move up (away from the river). Then they moved up. It was in the Battle-coulee that they camped. In the morning the chiefs went around saying: come on, we shall move. When the buffaloes were far, we overtook them in the Cypress Hills; when they were not far, we overtook them in the Small Sweetgrass hills...Following skinning, when the slices of meat are dry, then we shall move. We shall move down over on Milk river (literally: Little Creek). Close by (that river) are the better buffalo...We shall make a circle (to chase the buffalo). We shall camp on Bad-water (a lake). They camped...After the meat and skins were dry, the chief said: Come on, we shall move to the Manyberries (a local name). We shall camp there. The berries were found to be ripe...When they moved again, the chief said: We shall move. We shall camp at Buffalo-head (a local name), we shall camp there, and there we shall chase elk. And there they camped...When the hides were all good, then (the chiefs) said: We shall move to the mountains (the Cypress Hills). We shall cut the lodge poles. Then they started to move. Then they separated (by bands). Then they would move this way. They camped over there at Long-lakes (a local name). There are many berries, (especially cherries). They camped there...Then the chief would say: We shall move (alongside Milk river) to Woman’s point (a local name). We shall camp along the river to hunt buffalo and antelopes...Then the chief said: We shall cut our lodge-poles from Cut-bank river...By that time it was late in the fall...When it snowed (first) in the fall, then they would hurry, that they moved down (near the lower country). There (down) on the river, there they would be camped about. There they waited, where the buffalo would come the nearest. To that place they would move. They would carefully look, where they (themselves) would be during the winter. Then they camped in different places all along the river. In the beginning of the winter they were all happy.

The Winter Count

Winter counts are recollections of events in chronological order that took place during the winter when many of the Blackfoot camped together. Specific individuals would highlight the most significant event of the year and record it. Each year’s event was also retold. Winter counts provide valuable historical records. The Blackfoot counts provide information such as the extent of hunting grounds, location of camp sites, the movement of traders into the area and the identification of chiefs (Dempsey 1965).

The location of two winter counts are known in the Milk River watershed (Map 2.11). The winter count for 1876 was recorded as “Itakainiskoy”(Iitakai Iiniskoi), meaning “when there were plenty of buffalo”. The traditions among the Blackfoot culture, including every aspect of their way of life, are in relation to the buffalo or “Iiniiwa”. Whether it is a society or an individual bundle ceremony, in every-day life (food, clothing, and shelter) the buffalo was core to the culture.
Medicine Wheels
Medicine wheels are important to the culture and heritage of the Blackfoot. The wheels represent different origins and some are associated with an important bundle known as the Beaver Bundle or “Kssistaaki’ Omipistaan”. It is the oldest of the ceremonies among the Blackfoot people and has become revitalized through repatriation and the efforts of individuals, tribes, governments and institutions working together to continue this tradition.

Sacred Sites
The locations identified on Map 2.11 are general locations to indicate the recordings from secondary source data. In the case of Canada, Dawson (1895) preserved place names but did not necessarily map them. For the USA, a source generally used is James Willard Shultz and a map was produced by Red Crow Community College, Alberta based on his information. The sites are associated again in different ways and for mapping purposes are included to give an example of the features on the landscape and a sense of associations to culture, conservation and stewardship.
3.1 Population

Trends in human population are often cited as an indicator of watershed health as they describe the social “quality of life” aspect of watersheds. In many watersheds in North America, urbanization is occurring rapidly, resulting in land use changes from a rural landscape to more centralized urban centres. The Milk River watershed remains rural and the total population is relatively small. According to Figure 3.1, the population is decreasing in all three jurisdictions.

In 2008, the total population in the watershed was estimated at 47,098 people compared to the 44,773 people at the end of 2012.

Population is:

Assessment

In Alberta, the total population in the watershed is 2,534, showing a -9.1% population decline since 2008. Population for the two main urban centres, the Town of Milk River and the Village of Coutts, were reported in the 2008 State of the Watershed Report. With the updated watershed boundary used in the present report, part of the Village of Warner is in the Milk River watershed; consequently, the previous urban population was adjusted to 1,534. Since 2008, the urban population has decreased to 1,480 in 2012. The Town of Milk River experienced population growth from about 1943 to 1999 when the population peaked at 929 (Figure 3.2). Since then, the Town has seen a slow but steady decline in population to its current population of 811 in 2012. The Village of Coutts has also experienced a steady decline in population since about 1961 (population: 505) to the current population of 277. The Village of Warner has had a stable population since about 2002 to the present population of 392 (Figure 3.2).

The rural population in Alberta has also declined from 1,252 people reported in 2008 to 1,054 people in 2012. This represents a loss of about 15.8% of the rural population within the watershed in 5 years. The largest population declines were observed in Cypress County and the County of Forty Mile. While part of the loss of rural population may be attributed to census errors (J. Storch, Cypress County, pers. comm.), the decline is part of an overall trend that may be described by the following reasons:

1. An aging community that is selling their land to larger agricultural operations and moving to towns and cities.
2. The small-scale farming community is selling their land to large-scale farmers for economic reasons and moving to towns and cities in search of jobs (County of Warner).

3. Young producers who prefer to live in towns/cities but still own their land but either rent it out or commute between the farm and town/city.

4. The lack of work opportunities for younger people (County of Warner).

5. Error in GIS compilation and census inaccuracies (Cypress County).

Other local services that attract people to the watershed are also declining, and include the closure of the public school in Coutts in 2010 and the lack of medical care in the Town of Milk River. While the hospital struggles to remain open, the 23 care beds historically available has been reduced to just two emergency beds for up to 48-hour care. It has been difficult to attract and keep doctors in the Town of Milk River.

In Saskatchewan, the population density is low (i.e., 0.5 or less people/km²) (Map 3.1), with the majority of the population considered rural (about 71%). In 2011, there was an estimated 6,647 people in the watershed in Saskatchewan; this area experienced a -6.9% population decline in the past 5 years. While all of the rural municipalities and most of the urban communities showed population declines, small growths were seen in the

---

**Population Data Collection**

In Alberta and Saskatchewan, the federal census is conducted every five years and was completed in 2006 and 2011. In addition, Alberta Municipal Affairs posts annual municipal census data on their website (AMA 2013).

The Montana Department of Commerce, Census & Economic Information Center used GIS to calculate the 2010 Montana population within the Milk River watershed boundary. Note that census data is collected every 10 years in the United States, with a census held in 2000 and 2010. The Department was unable to report Montana population based on GIS calculations for year 2000 for comparison. However, the growth rate for municipalities from 2000 to 2010 was applied to the 2010 watershed numbers to obtain a 2000 population estimate.

The majority of the population in the Milk River watershed is found in Montana (35,592), situated in communities along the Milk River corridor and in the four First Nations communities (Map 3.1). Here, population densities are >25 people/km². By far, Havre is the largest centre in the watershed with a population of 9,310 people (2010). However, the population in Havre has decreased by 3.2% in 10 years. The rural municipalities of Glacier, Toole and Liberty counties experienced small growths in population while the other rural municipalities experienced small losses. There are large tracts of uninhabited land in Montana.

First Nations communities have generally increased in population, particularly on the Blackfeet and Rocky Boy’s Indian Reservations, and in the communities of Hays and Lodgepole. A minor increase in population was observed in the community of Fort Belknap (31 people from 2000 to 2010). There seems to be a large decrease in population at Box Elder (from 794 in 2000 to 87 people in 2010). It is unclear why the population decreased significantly (-89%) in a ten year period (United States Census Bureau online).
4.0 Surface Water Quantity and Allocation

4.1 History of Water Management

1882

Canadian Northwest Irrigation Company was granted most of the land south of Lethbridge. Land was sold to farmers with the guarantee of irrigation to raise crops in times of low rainfall. Settlers begin to divert water from the St. Mary River to irrigate lands, with water reaching Lethbridge in 1900. At the same time, several projects were designed in the U.S. to provide more water for the Milk River valley downstream of Havre, Montana.

1894

Government of Canada passed the North West Irrigation Act. The Act claimed all water for the Crown and initiated a licencing system for all persons wanting to use water, except for domestic use by riparian landowners.

1903

Montana begins construction of a diversion to direct part of the spring and summer flow of the St. Mary River into the Milk River. Government of Canada responded by constructing a canal that could divert an amount of water equivalent to the St. Mary River diversion toward Ridge Reservoir.

1938

Fresno Dam Constructed in Hill County west of Havre.

1991

Letter of Intent signed (revised in 2001) that allows the U.S. to utilize more than its share of the St. Mary River by allowing a deficit up to 4,900 dam$^3$ (4,000 acre-ft) during March through May each year, and refunded through surpluses or Canadian deficits on the Milk River later in the season. This allows Montana to utilize its full diversion canal capacity early in the season and Alberta irrigators to access summer water when their respective shares of the natural flow may be inadequate.

2003

The Governor of Montana requests that the IJC review the IJC 1921 Order which apportions flows generated by the St. Mary River and Milk Rivers, and if not being apportioned equally, determine how the flows could be better apportioned.
The IJC held a series of public meetings within the St. Mary and Milk River basins and in December 2004 established the St. Mary/Milk Rivers Administrative Measures Task Force.

Task Force Report submitted to the IJC. No resolution found but several suggestions for further investigation were provided.

During the irrigation season, Canada is entitled to one-quarter of the flow in the Milk River up to 666 cfs and three-quarters of the flow in the St. Mary River. Flows above 666 cfs during the irrigation season are apportioned evenly on both rivers.

Alberta and Montana formed a “Joint Initiative Team” to make recommendations to the two governments on options to increase the ability of each jurisdiction to better access the shared waters of the St. Mary and Milk rivers.
**Water Allocation in Alberta**
The water allocation system in Alberta and Saskatchewan is based on “Prior Allocation”. The system began in 1894 when the Government of Canada passed the *North West Irrigation Act*. The Act claimed all water for the Crown and initiated a licencing system for all persons wanting to use water, except for domestic use by riparian landowners. With the *Natural Resources Transfer Act* of 1931 the Government of Canada transferred the responsibility for the management of natural resources, including water, to the western Provinces.

Soon after, the *Water Resources Act* was passed by Alberta and carried much of the same principles as its predecessor. The *Water Resources Act* was replaced in 1999 with the *Water Act* which continues to enable the management of water use in Alberta. The *Water Act* carried forward, to present day, the system of “prior allocation” and most notably added the provision for transfers and licensing instream flows. The water allocation system applies to groundwater as well as to surface water. Under Alberta’s *Water Act*, the consumptive use of water is provided for through household statutory rights, licenses, traditional agricultural uses and registrations.

In addition to the regulation of the “prior allocation” system the *Water Act* also provides additional tools for water management. Water assignments and water allocation transfer allow users to manage risk of water shortage. Water assignments are available to licensees where a licensee with a senior priority may assign their allocation to a licensee with a junior right. Assignments are intended as a short term tool for management of a shortage situation where the junior licensees may be without water for the season.

Water allocation transfers allow new water users in a basin to seek out and acquire an existing allocation. The tool is intended to encourage the best use of the available water supply and to allow users to reduce the risk of shortage by acquiring an allocation with a more senior priority.

---

**Prior Allocation**
The allocation priority is a number on a license that represents the application date for the allocation and is based on the principle of “First in time, first in right”. This priority number is used during a water shortage to determine who is allowed to take the water first.

**Household Statutory Right**
Under the *Water Act*, the Household Statutory Right provides for the use of up to 1,250 m$^3$ (1 acre-ft) of water for human consumption, sanitation, the watering of lawns, gardens, trees and some animals. This water use must be associated with a household or dwelling place and the water must be sourced on or under the land where it is used. There is no document issued for household users who have priority over all other users in the basin.

**Licenses**
Water allocations are recorded in a license document that includes information such as the source and location of the diversion, maximum annual volume of water that may be diverted, maximum diversion rate, purpose, and priority number based on the date of application for the license. Other conditions may be included to further define the diversion (e.g., timing of use).

**Traditional Agricultural Registration** When the *Water Act* was first proclaimed (1999), traditional agricultural users were encouraged to register their livestock use and establish a priority within the prior allocation system. The Traditional Agricultural Registration is for water use within a farm unit of up to 6,250 m$^3$ (5 acre-ft) for the purpose of raising animals or applying pesticides to crops. The water must be sourced on or under the land where it is used. A document provides record of the registration including the location of the water source and a priority number (first date of use). Registrations differ from licenses in that they cannot be transferred to another location. The registration is treated the same as a license as it determines who is entitled to receive the water first in a water shortage.
For water allocation transfers to take place in a specific river basin, the transfer process must first be approved in a Water Management Plan or by the Lieutenant Governor in Council. In the Milk River watershed there is presently no approved Water Management Plan that authorizes the use of water license transfers in the watershed. However, transfers can still be considered if approved by the Lieutenant Governor in Council.

**Water Allocation in Saskatchewan**

Similar to Alberta, Saskatchewan instituted the *Water Rights Act* in the late 1930s that maintained a priority-based system. The legislation identified riparian rights and included a priority by type of use. Similar to Alberta, obtaining a water right was only possible through application to the Crown. A water right holder could transfer the right to a new owner if the land to which the right was assigned was sold, or within reason transfer the right to another location in the basin. The individual could not retain the right without making beneficial use of the water nor could the right be retained for sale independent of the property.

From 1931 to 1984, more than 30 different provincial agencies were involved with water issues. In 1984, the Saskatchewan Water Corporation (Sask Water) was created which combined most of the agencies into one organization and was governed by *The Water Corporation Act*. The *Water Corporation Act* removed the priority of use by number and type and former water master powers were eliminated through the repeal of *The Water Resources Management Act*. Allocations of water became protected solely by availability and riparian rights were limited to the use of water from an adjacent stream only if water was present in the stream; the ability to demand that flow be maintained was removed. Approvals became appurtenant to the land irrespective of change in ownership of the land. But as with *The Water Rights Act*, the water remained vested with the province and the holder of the approval could not sell the allocation independent of the land. Water users were entitled to use their allocated volumes, but in instances of shortages water users were encouraged to share the water.

In 2002, *The Water Corporation Act*, was in part replaced with *The Saskatchewan Watershed Authority Act* (revised in 2005), and was administered by the Saskatchewan Watershed Authority (Authority). The changes included the transfer of water right and allocation activities to the Authority and included the increased emphasis on source water protection and conservation related activities. In 2012, the Authority was replaced by the Water Security Agency (WSA). The WSA is currently administering *The Saskatchewan Watershed Authority Act*. Saskatchewan also released a 25-Year Water Security Plan, which sets out a vision, principals and goals for how Saskatchewan will address water issues now and into the future.
The Montana Water Rights System

Montana’s water rights laws are principled on the prior appropriation doctrine, also known as “First in time, first in right”. These laws are detailed in Montana Code Annotated (MCA), Title 85 Water Use. The prior appropriations doctrine evolved during the early mining days in the western United States in response to the region’s scarcity of water. The prior appropriation doctrine works on a simple priority rule relating to a priority date when the water was first diverted and put to beneficial use. In Montana, there are five essential elements of the prior appropriation doctrine:

**Intent**
Prior to July 1, 1973, intent was recognized by a posting on the land, filing at the county courthouse and/or simply putting water to beneficial use. After ratification of the Montana Water Use Act in 1973, intent became recognized by submitting a permit application to the Montana DNRC.

**Diversion**
Except for in-stream beneficial uses, water can be diverted for utilization on riparian or non-riparian lands, and even in other watersheds. The diversion redirects water from its source to the area of use.

**Beneficial Use**
To complete an appropriation, beneficial use must occur. Usage is so critical, that an unused water right may be deemed abandoned. Common beneficial uses include, but are not limited to domestic/municipal, agricultural, industrial, recreation, and fish/wildlife.

**Priority Access**
Once put to beneficial use, the water right receives a priority date. The priority date is generally the date of established intent. Priority dates determine seniority of users on a water source (e.g., the earlier the priority date, the more senior the user). Subsequent priority date users are junior appropriators. Water users exercise their rights in descending order of priority.

**Definite Quantity**
The quantity of a right depends on water availability, quantity of water needed for the beneficial use, historic beneficial use, and diversion capacity. Diversions cannot exceed the established quantity and must occur in priority order.

Montana Water Rights and the 1973 Montana Water Use Act

The Montana Water Use Act (WUA), effective July 1, 1973, significantly changed Montana water rights administration by: requiring a statewide adjudication process in state courts of all water rights existing prior to July 1, 1973, establishing a permit system for obtaining water rights for new or additional water developments, establishing an authorization system for changing water rights, establishing a centralized water rights records system, and provided a system for reserved water for future consumptive uses and to maintain minimum instream flows for water quality and fish and wildlife.

The WUA was amended in 1979 to establish the Montana Water Court to administer the adjudication process. Today, the WUA is administered by the Department of Natural Resource Conservation (DNRC), the Montana Water Court and the Environmental Quality Council. The DNRC administers the permit system for water appropriated after July 1, 1973, maintains the central records system, and provides assistance to the Water Court. The Water Court has jurisdiction over adjudication of all water rights existing prior to July 1, 1973. The Environmental Quality Council provides policy oversight to the administration of state water rights.

The Adjudication Process

The 1973 WUA required all claim holders to file their water right claims with the DNRC, which was necessary to begin the adjudication process. State waters were divided into eighty-five adjudication basins as a means to manage this massive undertaking.

The DNRC examines each claim to determine if it is complete, accurate and reasonable, and attempts to resolve any discrepancies with the claimant. If a discrepancy cannot be resolved, an issue remark is placed on the claim. After all claims have been examined in a given adjudication basin, DNRC issues a Summary Report to the Water Court.

The Water Court issues a temporary or preliminary decree which is based on the statements of claim, the DNRC Summary Report, and reserved water rights compacts if applicable. Issuance of a temporary or preliminary decree depends on whether any unquantified reserved water rights exist in the basin. If reserved water rights are involved, the Water Court issues a preliminary decree, if not, a temporary decree is issued. A public
notice of the decree is issued for every preliminary decree to all parties who may be affected. The notice provides information about deadlines for objections.

Persons who disagree to the decree have 180 days to file an objection. Hearings are held to re-evaluate all disputes. A final decree is issued by a Water Judge after resolution of all objections and issue remarks. Each water right in a decree states a flow rate, priority date, beneficial use, time and place of use, source of water, and place and means of diversion. Irrigation rights also include an acreage.

To obtain a new water right, a permit to appropriate water must be obtained from the DNRC in accordance with the WUA. Anyone who transfers ownership of land with a water right is required to file a “Water Rights Ownership Update” form with the DNRC. Water rights may also be severed from the land and sold or retained independently from the land. Any change in the ownership or place of use of a water right requires the water-right holder to submit a change application to the DNRC. This provides other water right holders an opportunity to object to the change if they believe it will cause adverse effect to their water use.

Water reservations may also be granted for future beneficial uses, or to maintain minimum streamflows or quality of water. Water reservations are only granted to political subdivisions, the State of Montana or its agencies, or to the United States or any of its agencies. Water reservations maintain the priority date even though the water may not be put to beneficial use for decades.

**Water Rights Dispute Resolution, Management and Enforcement**

It is illegal to waste water, use water without authorization, prevent water from reaching a prior appropriator or otherwise violate water use laws in Montana. Anyone breaking water use laws is guilty of a misdemeanor and subject to civil penalties of up to $1,000 per violation. Each day of a violation is a separate violation. A senior water right holder also may bring a civil action and seek damages from a junior water right holder who interferes with the senior’s use of water.

If a water user feels that their water right is being adversely affected by the actions of another water user, it is the senior’s obligation by law to make “call” on the water to junior water users who must cease or diminish their diversion and pass the requested amount of water to the downstream senior making the call. Disputes typically arise when a senior water rights holder is not receiving water. The DNRC urges the parties to settle the matter privately. If the parties cannot settle, numerous District Court actions exist depending on individual circumstances and the basin’s adjudication status.

The DNRC supervises water use to ensure compliance with permits and laws. Among its powers, the DNRC may require appropriators to install and maintain water measurement/control devices to meter water use; require appropriators to record and report measurements; and inspect diversions and water use locations. Enforcement issues of water rights fall under the jurisdiction of the District Courts.
4.2 Surface Water Supply

The mainstem Milk River (also referred to as the South Fork Milk River) originates in the foothills of western Montana, U.S.A and flows north-east into Alberta, Canada, at the “Western Crossing”. The North Fork Milk River also rises in the foothills of Montana, but prior to entering Alberta, its flow is supplemented by U.S. St. Mary River diversion water during the irrigation season. Once in Canada, the North Milk River flows east and continues in an easterly course for about 96 km (60 mi) before joining the mainstem Milk River, about 19 km (12 mi) west of the Town of Milk River. Downstream of the confluence of the mainstem Milk River and the North Fork, the river continues east flowing parallel about 10-16 km (6-10 mi) north of the Canada-U.S. border, for a distance of about 248 km (154 mi). The Milk River then flows south east and back across the International Boundary and into Montana at the “Eastern Crossing”.

At the Eastern Crossing, the Milk River drains an area of about 6,737 km² (2,601 mi²) with a median natural flow from 1912 to 2008 of about 145,000 dam³ (117,500 acre-ft) and a median recorded flow for the same period of about 314,000 dam³ (254,500 acre-ft). The difference between the natural and recorded flow is due to imported flow from the U.S. St. Mary Canal.

St. Mary River - A Part of the Milk River Watershed Hydrology

Beyond the International Boundary at the Eastern Crossing, the Milk River flows south and east about 790 km (490 mi) to its confluence with the Missouri River, near Nashua, Montana.

There are numerous tributaries that enter the Milk River. The larger northern tributaries include Lodge Creek and Battle Creek, which originate in Alberta and are known as the “Eastern Tributaries”, and the Frenchman River and Rock Creek, which originate in Saskatchewan. Peoples Creek and Beaver Creek flow north into the Milk River, originating in the relatively higher elevations of the Bears Paw and Little Rocky mountains in Montana. A segment of the Milk River forms the northern boundary of the Fort Belknap Indian Reservation.
Fresno Dam, which is located about 80 km (50 mi) downstream of the Eastern Crossing, is the largest on-stream storage reservoir in the watershed. Major irrigation diversions from the Milk River begin just below Havre and there are a number of irrigation diversion dams and pumping stations along the river that supply water to about 56,737 ha (140,200 acres). One of these diversions, the Dodson South Canal near Malta, supplies water to Nelson Reservoir, an off-stream storage reservoir, and to the Bowdoin National Wildlife Refuge.

The drainage area of the Milk River at its mouth is about 59,860 km\(^2\) (23,110 mi\(^2\)) and its median annual flow volume near the mouth from 1940 - 2011 is about 467,00 dam\(^3\) (379,000 acre-ft).
At the end of 2011, a total of 57 stream flow gauges were active in the Milk River basin (see Map 4.1). Of the 57 active stream flow gauges, 42 are operated by Water Survey of Canada (WSC), 34 are located in Saskatchewan and 8 are in Alberta. The remaining 15 active flow gauges are operated by United States Geological Survey (USGS) in Montana.

Although many stations are used to calculate international and interprovincial apportionment, Map 4.1 highlights the locations where international and interprovincial apportionment are administered.
The Milk River provides water for various purposes such as municipal, domestic, agricultural and recreational activity; however, irrigation is the main water use across the watershed. Since the Milk River is considered an arid basin (meaning that evaporation exceeds precipitation), various storages and diversions are operated in the watershed mainly in Saskatchewan and Montana to meet irrigation demand. Such infrastructure is not available in the Alberta portion of the Milk River; however the St. Mary River Diversion augments Milk River natural flows during the irrigation season, typically from the beginning of March to the end of October (Refer to Figure 4.1). The natural flow of the Milk River (Alberta) in winter months is low and may approach zero in the lower reaches in times of drought. Flow depths across the channel width can be less than 0.1 m, limiting the movement of larger fish and increasing the potential for isolated pools that are disconnected from the main channel (Golder Associates 2010; AMEC Earth and Environmental 2011).

The operation of the St. Mary Canal and Fresno Reservoir downstream of the Eastern Crossing regulates flow in the mainstem Milk River. The regulated flow patterns can be observed in gauges at the Eastern Crossing and at Havre where the hydrograph follows the pattern of operations during the irrigation season. Incremental increases in drainage area and tributary inflow produce a more natural hydrograph in the lower part of the Milk River basin recorded at the Nashua gauge near the mouth of the Milk River (see Figure 4.2).
The Milk River watershed can experience extreme dry and wet years; however, the variability of flow is most evident farthest downstream of diversions or dams, such as at Nashua. By comparing Figures 4.3 and 4.4 it can be observed that the 25th, 50th and 75th percentiles for river flows at Havre follow a similar pattern due to regulation that maintains flow at a fairly constant release rate. In contrast, at the mouth the 75th percentile is very different from either the 25th percentile or 50th percentile (the median) as river flows fluctuate in relationship to snowmelt and precipitation.

**Natural Versus Recorded Flow**
Natural flow is the quantity of water moving past a point on a natural river where flow is not affected by human activity (e.g., stream diversion, storage). Recorded flow is the “actual data” collected at a streamflow gauging station. Where no regulation occurs upstream and water diversion is low, recorded flow is similar to natural flow. In regulated rivers, like the Milk River, flows recorded by gauges may be significantly different than natural flows. Natural flow in the Milk River is calculated by eliminating the effects of the U.S. St. Mary River diversion and consumptive use from recorded flows.

**Percentile**
Percentiles are values that divide a set of observations into 100 equal parts. The percentile rank is the proportion of values in a distribution that a specific value is greater than or equal to. The 25th percentile represents low flows since 75 percent of flows are greater than this value. Middle flows are the 50th percentile and high flows are represented by the 75th percentile.
Although typically thought of as a water-short basin, the Milk River watershed can also experience wet periods such as experienced in 2010 and 2011. These two wet years generated high flows within Alberta and Saskatchewan and major flooding in Montana. During these two years, water diversions from the St. Mary River were significantly different compared to average diversions (Figure 4.5). Diversions from the St. Mary River were significantly decreased in 2010 and were absent in the first half of the irrigation season in 2011 in an effort to reduce flooding downstream of Havre and in the greater Missouri River basin.

![Figure 4.5. St. Mary River Diversion Canal flows in 2010 and 2011, compared to the 5-year and 30-year average.](source: http://waterbaila.aagis.gov/nrri/news/current/waterflow)

The Milk River above the Fresno Reservoir, Spring 2011
For the period from 1972 to 2011, the 2011 year also marked the highest natural and recorded flow volumes observed for the Frenchman River at the International Boundary (Figure 4.6). The difference between the recorded and natural flow is due to irrigation depletions and reservoir storage. Observations at the Frenchman River are representative of other northern tributaries.

Figure 4.6. Comparison of natural and recorded annual volumes for the Frenchman River at the International Boundary (1972-2011).
**Flood of 2011**

The 2011 flood stands out as the most significant hydrological event to take place since the 2008 Milk River State of the Watershed Report. The 2011 flood was essentially two distinct precipitation events that overlapped, resulting in prolonged flooding and record volumetric runoff, surpassing the previous flood of record in 1952. Figure 4.7 shows annual runoff volumes and peak flows for the period of record. Note that the 1952 flood still holds the peak record discharge rate, whereas the 2011 flood year holds the volumetric record.

Most of the runoff originated in the lower portion of the basin. This can be observed in Figure 4.8, which compares USGS Gauging Stations along the mainstem starting at the upstream Milk River North Fork downstream to Nashua. Note that the St. Mary Diversion did not operate until after the floodwaters had subsided.

The 2011 Flood was a combination of record prairie snowpack with totals of over 250 cm (100 in) recorded in many parts of Valley County and over 150 cm (60 in) in Phillips County. Record rains followed closely with saturated ground and swollen rivers. This differs from the 1952 flood, which was primarily a prairie snowpack event that was exacerbated by other conditions such as saturated and frozen ground that could not absorb any of the snowmelt, even though the snowfall in 1952 was less than half of the 2011 event. The 1952 flood caused the failure of the Frenchman Dam, directly contributing to the record peak flow recorded at the Nashua gauge. Once the snow melted in 1952, the region went into a much drier pattern (Figure 4.9).
Figure 4.9. Snow-melt caused flows that led to the failure of the Frenchman Dam in 1952.

Though flooding in the upper half of the Milk River watershed was minimal, prolonged high runoff resulted in geomorphic changes in the river channel due to the sandy and erosive nature of soil along the river banks (Figure 4.10).

In the lower portion of the basin, below the mouth of Frenchman River, the channel is much more incised and less susceptible to erosion; however, the flooding was far more severe, spreading out across the floodplain and causing significant property damage.

Figure 4.10. An example of Milk River channel migration that resulted from the 2011 flooding near Chinook, Montana. The blue represents the 2009 channel location superimposed on top of a 2011 aerial photograph taken after the flood.
Milk River Project Reservoir Facilities

Milk River flows are heavily influenced by the Milk River Project facilities in Montana. Three major facilities totaling 293,544 dam$^3$ (237,976 acre-ft) of storage capacity make up the Milk River Project (Figure 4.11). Sherburne Dam on Swiftcurrent Creek, a tributary to the St. Mary River, captures mountain runoff and winter flows. This gives the United States a greater ability to manage and utilize its share of the St. Mary River. Fresno Dam, located on the Milk River below the Eastern Crossing, is vital to managing and regulating flows in the middle portion of the basin year around. Nelson Reservoir, an off-stream reservoir located in the lower Milk River basin near Malta, Montana, provides stability for irrigation in this lower reach. Each reservoir plays a vital role in water management.

Over time, declining storage capacity in Fresno Reservoir due to sedimentation has affected operations of all the Milk River Project facilities. Figure 4.12 shows the lost capacity in Fresno Reservoir since it was constructed in 1938. As a federally authorized flood control facility, the ability to capture prairie snowmelt, runoff and St. Mary River water can be diminished by this loss of storage capacity. Declining storage capacity reduces water management flexibility and limits other quantifiable benefits.

A study was undertaken to better understand sedimentation and erosion in the Milk River in Alberta (AMEC 2008). Eroded and transported streambank and streambed material increase suspended sediment (i.e., sand and silt) in the Milk River. Suspended sediment concentrations during the May/June high water period are now about two to three times the natural (pre-diversion) levels.

The Water Survey of Canada estimated the mean annual sediment transport in the Milk River gravel-bed and sand-bed reaches to be 111,000 tonnes and 642,000 tonnes, respectively (Spitzer 1988). The latter equates to an average of about 350 acre-ft of storage by volume, annually. The greatest contribution of the suspended sediment load arises between the Town of Milk River and the Eastern Crossing (Alberta-Montana border).

Note: To convert from tonnes to acre-ft of reservoir storage, multiply by 0.000541. It is important to note that the above conversion is for reservoir storage and is for the submerged density. The conversion would be different on dry land. The above conversion should be considered approximate. It assumes that the material is mostly sand, which has a submerged density of 1,500 kg/m$^3$ (93 lbs/ft$^3$).
Remote Water Metering Pilot and Demonstration Projects

Under Alberta’s Water for Life Strategy, AESRD in partnership with AARD and private irrigators established a pilot project on the mainstem Milk River to investigate a cost-effective system to collect reliable water use data from private irrigation projects. The project involved the installation and testing of water meters and telemetry devices to transmit water use information from 33 field sites. Of the meters and telemetry devices evaluated, propeller meters and cell phone communication proved the most reliable and accurate. However, for sites not within cell phone range, satellite transmission was an accurate alternative, but not as reliable. The project will continue to test newer, improved and possibly more cost-effective technologies for real-time water use reporting.

The Alberta Irrigation Water Use Tracking System (AIWUTS) is a website that was developed to support the pilot project and test an online water use reporting system. It allows project participants and the public to view real-time water use information in the Milk River watershed. Monitoring agencies can quantify, when and at what rate water is diverted from the Milk River, while project participants can access personal water use information that is protected by password. AIWUTS functions in combination with other agricultural tools, such as the Irrigation Management Climate Information Network (IMCIN), to provide users with management tools to better utilize water for crop irrigation.

In 2010 the Montana DNRC partnered with the U.S. Bureau of Reclamation (USBR) to implement a water measurement demonstration project similar to the undertaking in Alberta. Metering and telemetry technologies were installed at irrigation pump sites along the Milk River to demonstrate that real-time water measurement, data collection and water management is feasible at remote locations throughout the basin.

Eight sites within the watershed were selected to participate in the project; five sites near Chinoak and three near Hinsdale. At each pump site, in-line prop meters fitted with transmitters were installed. The transmitters convert analog data into a digital signal that can be logged on site, conveyed daily by satellite, and uploaded to a password protected website. The web interface allows users to view, analyze and export time-series data, and to set user-defined alerts via text messaging, emails or phone. The project results are currently being assessed to determine if remote metering is a viable water management tool for use in the Milk River watershed and elsewhere.
4.3 Surface Water Allocation and Use

**Alberta**

There is a total volume of 31,944.5 dam$^3$ (25,898 acre-ft) of water allocated in the Milk River watershed, including all licenses and registrations (Table 4.1). Of the total water allocated, 47% is from the Milk River mainstem (Table 4.2) and 53% is from tributary sources.

Water use in the basin is for many purposes. The largest use is for agricultural activity, specifically irrigation by private irrigators, that uses a combined total of 93.5% of the allocated volume of water. About half of the agricultural allocations are from tributary sources. Water set aside for habitat (e.g., Ducks Unlimited Canada reservoir projects) is the second largest use, followed by municipal use by the Town of Milk River and the Village of Coutts which divert water directly from the mainstem Milk River.

The Milk River watershed has been under moratoria regarding the issuance of new irrigation licenses as well as stockwater licenses over 24.7 dam$^3$ (20 acre-ft) since 1986 (based on the use of 70% of the median Canadian share of water). However, municipal, rural community water supply, and small agricultural stockwatering applications are considered based on a review of water availability.

Since the 2008 Milk River SOW Report, AESRD has finished processing Traditional Agricultural Use Registrations on Public Lands and six license applications for agricultural stockwatering purposes within the watershed. The number of registrations increased from 595 to 1,801, increasing the percent of total quantity allocated to registrations from 0.8% in 2007 to 1.7% in 2013. The agricultural stockwatering applications were part of a license application backlog (from 2002 to 2007) that averaged 2.7 dam$^3$ (2.2 acre-ft) in volume per allocation.

In contrast, there has been a small decrease of three irrigation licenses in the watershed since 2008. With the reduction in irrigation licenses and the increase in registrations and stockwatering licenses there has been a net increase of 258.6 dam$^3$ (210 acre-ft) water allocated in the Milk River, from 31,685.8 dam$^3$ (25,688 acre-ft) in 2008 to 31,944.5 dam$^3$ (25,898 acre-ft) in 2012. Note that one irrigation license was not documented in the 2008 Milk River SOW Report water allocation calculation which results in a difference of 87.8 dam$^3$ (71 acre-ft).

<table>
<thead>
<tr>
<th>Total By Purpose</th>
<th>Quantity (dam$^3$)</th>
<th>Quantity (acre-ft)</th>
<th>No. of Allocations</th>
<th>% of Total Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural</td>
<td>4,628.5</td>
<td>3,752</td>
<td>453</td>
<td>14.50%</td>
</tr>
<tr>
<td>Commercial</td>
<td>114.7</td>
<td>93</td>
<td>2</td>
<td>0.40%</td>
</tr>
<tr>
<td>Habitat</td>
<td>988.0</td>
<td>801</td>
<td>7</td>
<td>3.10%</td>
</tr>
<tr>
<td>Irrigation</td>
<td>24,680.7</td>
<td>20,009</td>
<td>126</td>
<td>77.30%</td>
</tr>
<tr>
<td>Municipality</td>
<td>717.9</td>
<td>582</td>
<td>2</td>
<td>2.20%</td>
</tr>
<tr>
<td>Water Co-op</td>
<td>246.5</td>
<td>200</td>
<td>7</td>
<td>0.80%</td>
</tr>
<tr>
<td>Recreation</td>
<td>33.3</td>
<td>27</td>
<td>1</td>
<td>0.10%</td>
</tr>
<tr>
<td>Registration</td>
<td>534.9</td>
<td>434</td>
<td>1,801</td>
<td>1.70%</td>
</tr>
<tr>
<td>Total</td>
<td>31,944.5</td>
<td>25,898</td>
<td>2,399</td>
<td>100.00%</td>
</tr>
</tbody>
</table>

Table 4.1. Total water allocations in the Milk River watershed, Alberta, including allocations on the mainstem Milk River and its tributaries as of 2012.

<table>
<thead>
<tr>
<th>Total By Purpose</th>
<th>Quantity (dam$^3$)</th>
<th>Quantity (acre-ft)</th>
<th>No. of Allocations</th>
<th>% of Total Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural</td>
<td>80.9</td>
<td>66</td>
<td>2</td>
<td>0.50%</td>
</tr>
<tr>
<td>Commercial</td>
<td>114.7</td>
<td>93</td>
<td>2</td>
<td>0.80%</td>
</tr>
<tr>
<td>Irrigation</td>
<td>13,748.3</td>
<td>11,146</td>
<td>66</td>
<td>91.60%</td>
</tr>
<tr>
<td>Municipality</td>
<td>717.9</td>
<td>582</td>
<td>2</td>
<td>4.80%</td>
</tr>
<tr>
<td>Water Co-op</td>
<td>239.6</td>
<td>194</td>
<td>4</td>
<td>1.60%</td>
</tr>
<tr>
<td>Registration</td>
<td>102.9</td>
<td>83</td>
<td>405</td>
<td>0.70%</td>
</tr>
<tr>
<td>Total</td>
<td>15,004.3</td>
<td>12,164</td>
<td>481</td>
<td>100.00%</td>
</tr>
</tbody>
</table>

Table 4.2. Total water allocations on the mainstem Milk River, Alberta, as of 2012.
**Water Use**

Depending on license conditions, most water use generally must be reported on an annual basis. For the mainstem Milk River (including the North Fork and South Fork), actual water use has been gathered by remote meters and by direct contact with the users on a monthly basis. The information is used for apportionment purposes. Actual water use in any one year is highly variable and depends on moisture conditions. Figure 4.13 compares license allocations on the mainstem Milk River including the South and North Forks, to actual water use in the watershed.

Figure 4.14 shows the distribution of water use by reach along the mainstem Milk River (including the North Fork and South Fork). The majority of the consumptive use takes place downstream of the confluence of the North and South Fork of the Milk River with almost two-thirds of the consumptive use downstream of the Town of Milk River.

Most irrigation development in the Milk River watershed, Alberta, occurred in the 1970s. An unreliable supply of late season water and the moratorium on the issuance of new water licenses stopped development by 1986. The administrative innovation of the modified letter of intent has been effective at providing reasonably secure summer water supplies for the approximately 1,214 ha (3,000 acres) of active mainstem Milk River irrigation. Water storage would increase the volume of water available to meet existing licenses on the mainstem of the Milk River and improve the security of water supplies. Storage could also provide additional water to potentially increase the area of irrigated land in the watershed in Alberta to about 10,522 ha (26,000 acres) (W. Herrera, pers. comm.), thereby using more of Canada’s share of the natural flow of the Milk River.

![Graph showing water use and allocations](image-url)
Lodge, Middle and Battle Creek Basins

The allocations in the Lodge, Middle and Battle creek basins were capped in 1983 based on a 50% Canadian share of water. Alberta and Saskatchewan may each divert and use 25% of the Canadian share, with the remainder of the natural flow passed into Montana to achieve the U.S. 50% share. There is a total volume of 8,991.3 dam$^3$ (7,289 acre-ft) allocated in these Alberta basins including all licenses and registrations (Table 4.3).

Since the 2008 Milk River SOW Report, AESRD has finished processing the Traditional Agricultural Use Registrations on Public Lands and one license application for agricultural stockwatering purposes within the Lodge, Middle and Battle creek basins. The number of registrations increased from 184 to 818, increasing the percent total quantity of registrations allocated from 0.7% in 2007 to 2.3% in 2012 (Table 4.3). The agricultural stockwatering applications were part of a license application backlog (from 2002) for agricultural stockwatering and household purposes.

Water in these basins is used for many purposes. The largest use is for agriculture, provincial storage projects and irrigation making up a combined total of 85.6% of the allocated volume. There are no Irrigation Districts that source their water from this basin. The irrigation use is by private irrigators only. Most of the agricultural allocations come from tributary sources.

The Lodge, Middle and Battle creek basins have been under moratoria regarding the issuance of new irrigation licenses as well as stockwater over 24.7 dam$^3$ (20 acre-ft) since 1983. However, applications for municipal, rural community water supply and small agricultural stockwatering are considered based on a review of water availability.

**Water Use**

For Lodge, Middle and Battle creeks, depending on the license conditions, most water use must be reported annually. Actual water use has been gathered by monthly program of direct contact with the users. The information is used for apportionment purposes. Actual water use in any one year is highly variable and depends on moisture conditions. Figure 4.15 summarizes water use at Middle Creek and Lodge Creek from 1995 to 2011. Generally, water use is low (less than or equal to 400 dam$^3$ (324 acre-ft) in the last 5 years reported) in Lodge and Middle creeks, although slightly greater in Lodge Creek. There was zero water use at Battle Creek during the 1995-2011 period.

### Table 4.3. Total water allocations for Lodge, Middle and Battle creek basins, Alberta.

<table>
<thead>
<tr>
<th>Purpose</th>
<th>Quantity (dam$^3$)</th>
<th>Quantity (acre-ft)</th>
<th>No. of Allocations</th>
<th>% of Total Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural</td>
<td>1,114.9</td>
<td>904</td>
<td>90</td>
<td>12.40%</td>
</tr>
<tr>
<td>Irrigation</td>
<td>4,768.6</td>
<td>3,866</td>
<td>26</td>
<td>53.00%</td>
</tr>
<tr>
<td>Other</td>
<td>9.9</td>
<td>8</td>
<td>1</td>
<td>0.10%</td>
</tr>
<tr>
<td>Registration</td>
<td>202.9</td>
<td>164</td>
<td>818</td>
<td>2.30%</td>
</tr>
<tr>
<td>Water Coop</td>
<td>986.8</td>
<td>800</td>
<td>1</td>
<td>11.00%</td>
</tr>
<tr>
<td>Water Management</td>
<td>1,609.7</td>
<td>1,305</td>
<td>4</td>
<td>17.90%</td>
</tr>
<tr>
<td>Wetlands</td>
<td>298.5</td>
<td>242</td>
<td>2</td>
<td>3.30%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>8,991.3</strong></td>
<td><strong>7,289</strong></td>
<td><strong>942</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

![Figure 4.15. Summary of water use at Middle and Lodge creeks, Alberta, 1995-2011.](image-url)
**Saskatchewan**

Water use in Saskatchewan can be highly variable from year to year. Inconsistent water use results from the natural annual variation in stream flows and weather conditions. The main tributaries of the Milk River (i.e., Frenchman River, Battle Creek and Lodge Creek) provide water for many different types of irrigation projects; these range from large irrigation districts that include thousands of acres of border-dyke flood irrigation to small back-flood projects of only a few acres. Water use is calculated using hydrometric station information from irrigation canals or minor use reporting directly from the irrigator.

At the Frenchman River, approximately 3,642 ha (9,000 acres) of land are irrigated (Table 4.4). Total water use ranged from 12,490 dam$^3$ (10,126 acre-ft) in 2009 to 20,180 dam$^3$ (16,360 acre-ft) in 2011. At Battle Creek, about 2,145 ha (5,300 acres) are irrigated. Total water use ranged from 2,220 dam$^3$ (1,799 acre-ft) in 2009 to 6,150 dam$^3$ (4,986 acre-ft) in 2010. There was no water use reported for Consul and Vidora Irrigation Projects in 2009 because no water was available that year.

Table 4.4. Summary of estimated water use in the Frenchman River and, Battle and Lodge creek watersheds, Saskatchewan, 2009-2011.

<table>
<thead>
<tr>
<th>Watershed</th>
<th>Approx. Size of Project</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ha (acres)</td>
<td>dam$^3$ (acre-ft)</td>
<td>dam$^3$ (acre-ft)</td>
<td>dam$^3$ (acre-ft)</td>
</tr>
<tr>
<td><strong>Frenchman River</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eastend Irrigation Project</td>
<td>1,052 (2,600)</td>
<td>5,230 (4,240)</td>
<td>4,450 (3,608)</td>
<td>2,060 (1,670)</td>
</tr>
<tr>
<td>West Val Marie Irrigation Project</td>
<td>971 (2,400)</td>
<td>4,670 (3,786)</td>
<td>4,790 (3,883)</td>
<td>4,530 (3,673)</td>
</tr>
<tr>
<td>Val Marie Irrigation Project</td>
<td>1,619 (4,000)</td>
<td>7,480 (6,064)</td>
<td>6,930 (5,618)</td>
<td>3,460 (2,805)</td>
</tr>
<tr>
<td>Minor Use (Irrigation and Domestic estimate)</td>
<td>-</td>
<td>2,800 (2,270)</td>
<td>2,530 (2,051)</td>
<td>2,440 (1,978)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>20,180 (16,360)</td>
<td>18,700 (15,160)</td>
<td>12,490 (10,126)</td>
</tr>
<tr>
<td><strong>Battle Creek</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consul Irrigation Project</td>
<td>1,174 (2,900)</td>
<td>0</td>
<td>2,250 (1,824)</td>
<td>950 (770)</td>
</tr>
<tr>
<td>Vidora Irrigation Project</td>
<td>971 (2,400)</td>
<td>0</td>
<td>2,080 (1,686)</td>
<td>770 (624)</td>
</tr>
<tr>
<td>Minor Use (Irrigation and Domestic estimate)</td>
<td>-</td>
<td>2,220 (1,800)</td>
<td>1,820 (1,476)</td>
<td>2,090 (1,694)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>2,220 (1,800)</td>
<td>6,150 (4,986)</td>
<td>3,810 (3,089)</td>
</tr>
<tr>
<td><strong>Lodge Creek</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lodge Creek Irrigation Project</td>
<td>405 (1,000)</td>
<td>1,560 (1,265)</td>
<td>1,510 (1,224)</td>
<td>560 (454)</td>
</tr>
<tr>
<td>Minor Use (Irrigation)</td>
<td>-</td>
<td>220 (178)</td>
<td>220 (178)</td>
<td>90 (73)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>-</td>
<td>1,780 (1,443)</td>
<td>1,730 (1,403)</td>
<td>650 (527)</td>
</tr>
</tbody>
</table>
Montana
In Montana, surface water allocation and use distinctly differs in the upper reaches of the Milk River (the headwaters) compared to the lower reaches downstream of the Eastern Crossing. The difference is largely due to the influence of the Milk River Project facilities that transfer water from the St. Mary River for use in the lower reach.

Upper Headwater Reach
The Upper Headwater Reach is comprised of the North Fork Milk River, which crosses the International Boundary near Whiskey Gap, and the Milk River (South Fork) which crosses the International Boundary near Del Bonita (the Western Crossing). The long-term median discharge for the period March through October at the Western Crossing is about 54,027 dam$^3$ (43,800 acre-ft), about double the discharge generated at the North Fork Milk River. Approximately 70% of the discharge occurs in the April through June period.

Irrigation water use in the headwater regions is primarily limited to spring runoff in April, May and early June. A total of about 1,214 ha (3,000 acres) could be irrigated with some modest improvements to infrastructure; however, only about 567 ha (1,400 acres) are being irrigated on the Milk River (South Fork) on a somewhat regular basis. No lands have been irrigated on the North Fork in the past 10 years (DNRC 2012). The study conducted by DNRC showed irrigation diversions totaled an estimated 802 dam$^3$ (650 acre-ft) in 2008 and 876 dam$^3$ (710 acre-ft) in 2009. For those years, March through October runoff totaled 57,974 dam$^3$ (47,000 acre-ft) and 33,551 dam$^3$ (27,200 acre-ft), respectively. There are no municipal or industrial uses in this region, and no data could be found that estimates stock use.
Lower Reach
Downstream of the Eastern Crossing, water is predominately used for irrigation. Water transferred from the St. Mary River provides an additional median annual volume of 220,238 dam$^3$ (178,550 acre-ft) to the Milk River generating a combined median water supply of about 323,666 dam$^3$ (262,400 acre-ft) as measured at the Eastern Crossing. The water supply for the gauged tributaries of the Milk River downstream of Fresno Reservoir is approximately 145,884 dam$^3$ (118,270 acre-ft), although this can vary considerably from year to year. The total median annual water supply available below the Eastern Crossing is about 468,723 dam$^3$ (380,000 acre-ft).

Of the total median water supply in the Milk River available for direct diversion during the irrigation season, St. Mary River water accounts for 59%, Milk River flow above Fresno Reservoir accounts for 28%, and Milk River tributary flows make up the remaining 13%. The St. Mary River transfers can account for 75% of available Milk River flows in dry years.

About 16,187 ha (40,000 acres) of land is irrigated from tributary streams, although not all this land is irrigated regularly or consistently, and approximately 56,737 ha (140,200 acres) are irrigated from the Milk River. The USBR owns all of the Milk River Project facilities and has service contracts with water users to irrigate about 44,637 ha (110,300 acres) of the total acres irrigated on the Milk River mainstem. Municipalities also have USBR water service contracts in the amount of 5,674 dam$^3$ (4,600 acre-ft) annually. However, the actual municipal water use is about 3,207 dam$^3$ (2,600 acre-ft), annually. Other water uses include fish and wildlife, recreation and water quality. Bowdoin National Wildlife Refuge has a contract for 4,317 dam$^3$ (3,500 acre-ft) annually for Milk River water. A minimum winter release of 0.71 m$^3$/s (25 ft$^3$/s) is provided under contract from Fresno Reservoir to provide mixing flows for treated wastewater and suitable water for municipal diversions. There are reservoir storage targets and recommendations for fishery and recreation use, but these are not mandated.
Surface water quality is an important indicator of watershed condition. It is often an accurate reflection of adjacent land use and management. Parameters that are used for measuring water quality include physical (e.g., dissolved oxygen, water temperature and total suspended solids), chemical (e.g., nutrients, metals, pesticides) and biological (e.g., bacteria) constituents. In the Milk River watershed, various agencies and organizations in Alberta, Saskatchewan and Montana have evaluated water quality using different approaches to meet similar goals.

Water quality regulation, assessment and results are discussed for Alberta and Montana. Although there may be some water quality data available for creeks and rivers in the watershed in Saskatchewan, it was not readily available for inclusion in this report.

Water Quality Regulation

There are multiple agencies/organizations participating in water quality data collection and reporting; some of these agencies have regulatory authority. Water quality data is used to support resource management decisions between countries (Canada and the United States), between provinces (Alberta and Saskatchewan) and locally, within provinces, states and municipalities.

Alberta Environment and Sustainable Resource Development (AESRD) is the primary provincial agency responsible for implementing the Environmental Protection and Enhancement Act that regulates water quality. The Prairie Provinces Water Board monitors interprovincial streams, however they currently are not monitoring any of the streams that flow from Alberta into Saskatchewan within the Milk River watershed. Environment Canada is responsible for monitoring international water bodies. In order to report on the state of the Milk River watershed and make watershed management recommendations, the Milk River Watershed Council Canada (MRWCC) monitors water quality at a number of mainstem and tributary sites.

The Montana Department of Environmental Quality (MDEQ) is the state agency primarily responsible for implementing the Montana Water Quality Act, a law which reflects the federal Clean Water Act for waters under state jurisdiction. MDEQ is required by the Clean Water Act to monitor state waters to assess their water quality and to identify surface waterbodies (or segments of surface water bodies) that are threatened or impaired. These threatened or impaired waters are added to the 303(d) list and submitted to the Environmental Protection Agency (EPA) every two years (Clean Water Act 2002) as part of Montana’s Water Quality Integrated Report (MDEQ 2012a). MDEQ considers all existing and readily available data in the assessment, including data from federal, state and local agencies, private entities, or individuals with an interest in water quality protection (Montana Code Annotated 75-5-702) (EQC 2012).

Beneficial Water Use Classification

In Montana, waterbodies are classified according to the present and future beneficial uses they should be capable of supporting (Montana Code Annotated 75-5-301). Beneficial uses are valuable characteristics of a stream or river resource that, directly or indirectly, contribute to human welfare (Suplee et al. 2008). Waters in the Milk River watershed in Montana have been assigned a B-3 use classification, meaning they are to be maintained suitable for drinking, culinary, and food processing purposes, after conventional treatment; bathing, swimming, and recreation; growth and propagation of non-salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply (ARM 17.30.625) (State of Montana 2010).

In Alberta, there is no provincial standard water quality classification system to support beneficial use designation. However, the MRWCC recognizes designated uses for the Milk River that are similar to uses classified in Montana; designated uses include drinking water (after conventional treatment), irrigation, stock water, commercial/industrial, contact recreation and the protection of aquatic life.
Water Quality Standards and Assessment

Water quality standards are adopted to establish maximum allowable changes in surface water quality and a basis for limiting the discharge of pollutants which affect beneficial uses of surface waters (ARM 17.30.603) (State of Montana 2010; MDEQ WQPB 2011). In Montana, water quality criteria are required by law to protect the most sensitive use from harm (Suplee et al. 2008). Generally, if a waterbody supports the beneficial uses that are most sensitive to harm, including drinking water, culinary and food processing, recreation, and aquatic life, MDEQ assumes it will also support those less sensitive uses such as agricultural and industrial uses. However, additional salinity and toxicity information may be required to determine suitability for agricultural use (MDEQ WQPB 2011).

To determine if standards have been met, MDEQ assesses particular pollutant groups (e.g., nutrients, metals) by considering specific and representative parameters in the assessment. Minimum standards for data quality, sample size and statistical analysis must be met in order to complete the assessment and to support the decision framework (MDEQ WQPB 2011).

MDEQ has divided the Milk River, from the Canada/U.S. border at the Eastern Crossing to the river’s confluence with the Missouri River, into six individual assessment units (i.e., segments) (Map 5.1). All six segments are located within the Northwestern Glaciated Plains Level III Omernik ecoregion (Woods et al. 2002). Nutrient criteria have been developed for the Northwestern Glaciated Plains (Table 5.1).

In Alberta, water quality has historically been compared to the Surface Water Quality Guidelines for Use in Alberta (AENV 1999) to determine if water quality supports designated uses. The Federal Canadian Council of Ministers for the Environment (CCME) guidelines are also consulted when provincial guidelines are absent. However, the Surface Water Quality Guidelines for Use in Alberta are being reviewed and new provincial guidelines are being developed based on more recent science-based knowledge. There is also a move to developing site-specific water quality objectives (WQO’s) for some of the rivers in Alberta. Concurrently, WQOs are being developed locally by the MRWCC as part of the Milk River Integrated Watershed Management Plan. Rather than compare data to outdated guidelines and criteria, only data comparisons through time and among river locations for nutrients in Alberta are presented. The Alberta reach of the Milk River was divided into four segments (Map 5.1).

### Table 5.1. Nutrient criteria applicable to all Northwestern Glaciated Plains streams in Montana.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Criteria (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Phosphorus</td>
<td>0.11</td>
</tr>
<tr>
<td>Total Nitrogen</td>
<td>1.4</td>
</tr>
<tr>
<td>Nitrate+Nitrite Nitrogen</td>
<td>0.02</td>
</tr>
</tbody>
</table>

Metals Standards

Numeric metals standards for aquatic life and human health in Montana are outlined in the Circular MDEQ-7 (MDEQ 2012b). Aquatic life standards are for acute and chronic exposure. Metals concentration in the water column is used to assess whether metals meet the standards. One-third of samples are collected during high flow conditions (i.e., spring runoff periods when streams are reaching maximum flow and expected pollutant loads are likely mobilized), and the remaining samples are collected during baseflow conditions. Generally, when greater than 10% of the samples exceed the acute or chronic criteria, or if any one sample exceeds twice the acute standard, the assessment unit is considered impaired for that metal with respect to aquatic life. If just one sample exceeds the human health standards, the assessment unit is considered impaired for that metal with respect to drinking water (Drygas 2012).

Sediment metals data are valuable in determining potential sources of metals in the watershed (Drygas 2012).
Map 5.1 Water Quality Monitoring Sites
Pathogens Criteria
MDEQ considers *Escherichia coli* (*E. coli*) the primary indicator of suitability of a waterbody for recreational use. The general provision in the Administrative Rules of Montana (ARM) states: “Standards for *Escherichia coli* bacteria are based on a minimum of five samples obtained during separate 24-hour periods during any consecutive 30-day period analyzed by the most probable number or equivalent membrane filter methods” (ARM 17.30.620(2)) (State of Montana 2010).

The water quality standard applicable to the Milk River varies seasonally and states: “from April 1 through October 31, the geometric mean number of *E. coli* may not exceed 126 colony forming units per 100 milliliters and 10% of the total samples may not exceed 252 colony forming units per 100 milliliters during any 30-day period,” and “from November 1 through March 31, the geometric mean number of *E. coli* may not exceed 630 colony forming units per 100 milliliters and 10% of the samples may not exceed 1,260 colony forming units per 100 milliliters during any 30-day period” (ARM 17.30.625(2)) (State of Montana 2010).

Status of Water Quality
Map 5.1 shows the location of historical and current water quality monitoring sites on the mainstem Milk River and some of the major tributaries. In Alberta, there are eight monitoring sites on the Milk River mainstem. The Milk River at the Western Crossing and the Eastern Crossing of the International Boundary are monitored monthly by Environment Canada. The site at Highway 880 Bridge, Alberta, is monitored monthly by AESRD. The remaining five mainstem sites are monitored by the MRWCC, from April to October (10 samples), as part of a water monitoring program initiated in 2006. In addition, the MRWCC has monitored select tributaries to support local watershed stewardship group activity. The data for select parameters (total phosphorus (TP), total nitrogen (TN), metals, fecal coliform bacteria and total suspended solids (TSS)) for the years 2007 to 2012 at select sites is reported here.

In Montana, monitoring was conducted between 2004 and 2012 during the designated index period (i.e., growing season from June 16th to September 30th) for nutrient assessment. This monitoring was conducted by the MDEQ as part of their fixed station monitoring program, United States EPA and by the Milk River Watershed Alliance. Samples were analyzed for TP, TN, nitrite+nitrate (NO$_2^-+3$), metals, pathogens and total suspended solids, among others, and compared to applicable criteria.

**Nutrients**

**Total Phosphorus**
Phosphorus is an essential nutrient required for plant growth. Sources of phosphorus include animal manures, commercial inorganic fertilizers, sewage treatment plants, phosphate-containing detergents, urban runoff, atmospheric deposition and natural levels found in soils and bottom sediments. Phosphorus adsorbs to soil and suspended material in the water column (particulate phosphorus) and is readily transported with sediment downstream. Total phosphorus measures the nutrient in all forms, whether particulate or dissolved, organic or inorganic.

Excessive nutrients in the water can cause eutrophic conditions resulting in increased growth of algae and aquatic macrophytes. Increased plant abundance can change the chemistry of the water, affect oxygen concentrations (through photosynthesis, respiration and decay of organic matter), affect aesthetics and affect the physical movement of water.

Total phosphorus concentrations varied by year in the Milk River, Alberta, from 2007 to 2012 (Figure 5.1). Even though 2010 was a wet year and a higher median total phosphorus concentration would be expected to coincide with the higher range of concentrations observed that year, the St. Mary River Diversion did not operate at full capacity in order to reduce further flooding downstream in Montana. Thus, the lower flows in the Alberta reach resulted in a lower median value for the year. Total phosphorus concentrations tend to correlate with streamflow volumes and the transport of suspended sediment.
Milk River streambanks often consist of unconsolidated material (e.g., silt and sand) and are susceptible to erosion, contributing phosphorus to the water column. Elevated streamflows occur naturally during periods of high rainfall or runoff, and also during the diversion of water from the St. Mary River into the Milk River. The higher flow during diversion likely increases resuspension of bottom sediments where phosphorus may have been buried in the long-term. Figure 5.2 compares total phosphorus concentrations during the diversion period with those observed during the natural flow period.

Figure 5.2. Comparison of total phosphorus concentrations during the diversion period and natural flow period, 2006-2011, Milk River.

Overall, total phosphorus concentrations tend to increase in the downstream direction (Figure 5.3). The increase in phosphorus concentration in the water column corresponds to the stream bed material within Reach 3 (the gravel-bed reach represented by the site “Upstream Milk River”) and Reach 4 (the sand-bed reach represented by “HWY 880”, the “Pinhorn” and “Eastern Crossing” sites), with the gravel-bed reach generally having lower phosphorus concentrations compared to the sand-bed reach (Figure 5.3). In 2009, a synoptic survey of phosphorus concentrations in the Milk River bottom sediments was conducted in Alberta to help identify sources of phosphorus to the water column. The study showed that phosphorus in the sediment also increased in the downstream direction and may be an ongoing source of phosphorus to the water column via resuspension (MRWCC Unpublished). Furthermore, the sand-bed reach also receives runoff from tributaries that flow through an area known as the badlands. The badlands tend to be void of vegetation and subject to soil erosion that can contribute sediment (and phosphorus) to the Milk River.

In 2010, the MDEQ completed a survey of water quality in the mainstem of the Milk River in Montana in the month of July and August. This data was combined with the data collected in Alberta in the same year and months to show water quality trends from the headwaters at the North Fork of the Milk River downstream to Nashua, Montana (Figure 5.4). Total phosphorus concentrations were similar in July and August in Alberta, but were much higher in Montana in July compared to August. In July, total phosphorus concentrations likely increased in response to precipitation and runoff events, with sedimentation and water quality improvements occurring where reservoirs are present on the river. Total phosphorus concentrations decreased downstream of Fresno Dam, due to the settling of solids from the water column in the reservoir (sedimentation).

Interpreting Boxplots
All boxplots were developed using NCSS 2007 Software Program™ (Kaysville, UT) statistical software. The figure below provides an interpretation of the boxplots. A longer box represents a more variable data set.
The 2004-2012 nutrient dataset for the mainstem Milk River in Montana contains a total of 45 total phosphorus samples. Thirty-three percent of the samples exceeded the total phosphorus criteria of 0.11 mg/L (Table 5.2). Both samples collected downstream of the Eastern Crossing (Canada border to Fresno Reservoir) exceeded criteria, while 47% of samples collected at the most downstream reach (Beaver Creek to mouth) exceeded criteria. Additional monitoring is needed to complete the nutrient assessment for total phosphorus in Montana.

While high phosphorus concentration is a concern due to its role in eutrophication of freshwater systems, it is not a major concern in the Milk River in Alberta. The excessive growth of algae and aquatic plants, typical of eutrophic waterbodies, has not been

![Graph showing comparison of total phosphorus concentrations at mainstem sites in 2010 from the North Fork Milk River (a), Alberta, to the confluence with the Missouri River downstream of Nashua (r), Montana.](image)

Figure 5.4. Comparison of total phosphorus concentrations at mainstem sites in 2010 from the North Fork Milk River (a), Alberta, to the confluence with the Missouri River downstream of Nashua (r), Montana.

Table 5.2. Summary of nutrient exceedances for the Milk River in Montana, 2004-2012.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Canadian border to mouth (Missouri River)</th>
<th>Canada border to Fresno Reservoir</th>
<th>Fresno Dam to Thirtymile Creek</th>
<th>Thirtymile Creek to Dobson Creek</th>
<th>Dobson Creek to Whitewater Creek</th>
<th>Whitewater Creek to Beaver Creek</th>
<th>Beaver Creek to mouth (Missouri River)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TN</td>
<td># samples: 42</td>
<td># exceedances: 1</td>
<td>% exceedance: 2%</td>
<td># samples: 2</td>
<td># exceedances: 0</td>
<td>% exceedance: 0%</td>
<td># samples: 12</td>
</tr>
<tr>
<td>TP</td>
<td># samples: 45</td>
<td># exceedances: 15</td>
<td>% exceedance: 33%</td>
<td># samples: 2</td>
<td># exceedances: 2</td>
<td>% exceedance: 100%</td>
<td># samples: 12</td>
</tr>
<tr>
<td>NO₂+NO₃</td>
<td># samples: 44</td>
<td># exceedances: 17</td>
<td>% exceedance: 39%</td>
<td># samples: 2</td>
<td># exceedances: 0</td>
<td>% exceedance: 0%</td>
<td># samples: 12</td>
</tr>
</tbody>
</table>
observed. The low abundance of algae and aquatic phosphorus concentrations suggests that other elements that support plant growth may be missing. It is likely that sunlight (required for photosynthesis) is unable to penetrate through the water column due to the “milky” colour of the Milk River. In addition, higher than natural flows and unconsolidated streambank material may prevent establishment of macrophytes as bottom sediments may be scoured and redeposited annually. However, the transport of phosphorus may be a concern to downstream water users (e.g., Fresno Reservoir) where phosphorus may settle from the water column and accumulate in bottom sediments.

**Total Nitrogen**

Total Nitrogen is the calculated sum of laboratory analysis for nitrate-nitrogen, nitrite-nitrogen and Total Kjeldahl Nitrogen. Total Kjeldahl Nitrogen includes both ammonia-nitrogen and organically bound nitrogen. Nitrate is the most soluble and mobile form of nitrogen that can easily enter surface water via runoff or percolate deep into the ground and contaminate groundwater. Transport of large amounts of nitrate to surface waters is a concern because it is rapidly taken up by aquatic plants and can lead to eutrophication. Sources of organic nitrogen include the decomposition of aquatic life and sewage effluent, and sources of inorganic nitrogen include sewage effluent, fertilizers and erosion.

Total nitrogen concentrations in the Milk River, Alberta, were similar in 2007, 2008, 2009 and 2012. Total nitrogen concentrations increased substantially in 2010 and 2011 with the highest concentrations observed in 2011 (Figure 5.5). Similar to other parameters, the increased concentrations of total nitrogen are likely attributed to increased runoff volumes from the surrounding watershed in these wet years. In 2011, there was no dilution effect from the St. Mary River Canal for most of the open water period.

![Figure 5.5. Comparison of total nitrogen concentrations in the Milk River watershed, Alberta, from 2007 to 2012.](image)

Total nitrogen in the Milk River in Alberta tends to increase during the natural flow period compared to the diversion period (Figure 5.6). In 2010 and 2011, the St. Mary River Canal did not operate at full capacity due to flooding downstream of the Eastern Crossing in Montana. Thus, the higher total nitrogen concentration observed in 2010 and 2011 is likely due to the increased precipitation and runoff that year and lower St. Mary River Canal water, that in average years serves to dilute nitrogen concentrations.

![Figure 5.6. Comparison of total nitrogen concentrations during the diversion period and natural flow period, 2007 to 2012, Milk River, Alberta.](image)

Generally, median total nitrogen concentrations remain constant throughout the Milk River in Alberta. Unlike phosphorus, there is no increasing trend in total nitrogen concentration as water flows downstream (Figure 5.7).

![Figure 5.7. Total nitrogen concentrations from upstream (a) to downstream (f) locations in the Milk River, AB, for the period April through October, 2007 to 2012.](image)
In 2010, the MDEQ completed a survey of water quality in the mainstem of the Milk River in Montana in the month of July and August. This data was combined with the data collected in Alberta in the same year and months to show water quality trends from the headwaters at the North Fork of the Milk River downstream to Nashua, Montana (Figure 5.8). Total nitrogen concentrations were higher in July compared to August at all sites. In Alberta (sites a-g), concentrations were generally below 0.7 mg/L in July and below 0.3 mg/L in August. In Montana (sites h-r) concentrations tended to range between 0.8 mg/L and 1.0 mg/L in July and between 0.6 mg/L and 0.8 mg/L in August (Figure 5.8).

The 2004-2012 nutrient dataset for the mainstem Milk River in Montana contained a total of 42 total nitrogen samples with one exceedance of water quality criteria (1.4 mg/L) (2% exceedance rate) and 44 nitrate+nitrite samples with 17 exceedances (39% exceedance rate) (Table 5.2). In Montana’s 2012 Water Quality Integrated Report (MDEQ 2012a), the segment (Whitewater Creek to Beaver Creek) is listed as impaired by nitrates (Map 5.1). Additional monitoring is needed to complete the nutrient assessment in Montana.

![Figure 5.8. Comparison of total nitrogen concentrations at mainstem sites in 2010 from the North Fork Milk River (a), Alberta, to the confluence with the Missouri River downstream of Nashua (r), Montana.](image-url)
Metals

In Alberta, metals data is collected at three sites, at the Western Crossing of the International Boundary (Environment Canada, monthly since 2011), at Highway 880 Bridge (AESRD, four times per year) and at the Eastern Crossing of the International Boundary (Environment Canada, monthly since 2011). Although a suite of metals are analysed, only those that were shown to exceed metals standards in Montana are discussed for comparison (i.e., total recoverable aluminum, total recoverable copper and dissolved fractions of iron and lead).

Iron and lead concentrations at the Milk River at Highway 880 Bridge site, Alberta met USEPA guidelines for the period 2005 to 2012 (Table 5.3). Six percent of samples analysed for copper exceeded the chronic guideline. Aluminum exceeded the USEPA chronic guidelines in 97% of samples, while 53% of samples exceeded the acute guideline of 750 µg/L. Aluminum occurs naturally in soil, water, and air. High levels in the environment can be caused by the mining and processing of aluminum ores or the production of aluminum metal, alloys, and compounds; however, none of these activities occur in the Milk River watershed.

Metals monitoring was conducted in Montana by the MDEQ as part of their fixed station monitoring program, United States EPA and by the Milk River Watershed Alliance between 2004 and 2012. Samples were analyzed for MDEQ’s basic suite of metals which includes total recoverable fractions of arsenic, cadmium, chromium, copper, iron, lead, selenium, silver, zinc as well as dissolved aluminum. Several other metals parameters which are not part of MDEQ’s basic metals suite were also analyzed. An impairment decision cannot be completed until additional monitoring is undertaken to determine high flow water chemistry, and, ideally, metals concentration in sediments.

However, comparing Milk River metals data to numeric metals standards, the number of sample exceedances was determined (Table 5.4). Aluminum, copper, iron and lead are the only metals that exceeded the aquatic life standards from 2004 through 2012. No samples exceeded either the acute chronic life standards or the human health standards. Map 5.1 indicates the water quality impairments that are currently associated with each segment in Montana’s 2012 Water Quality Integrated Report (MDEQ 2012a). Each segment is listed as impaired by at least one metals parameter, particularly mercury, iron, lead and copper.

Table 5.3. Summary of select metals data at Highway 880 Bridge, Alberta, 2005-2012 (32 samples).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Guideline Chronic (Acute)</th>
<th>Sample Exceedance %</th>
<th>Median µg/L</th>
<th>Range µg/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum (TR)</td>
<td>87 (750)a</td>
<td>97 (53)</td>
<td>827</td>
<td>61 - 10,500</td>
</tr>
<tr>
<td>Copper (TR)</td>
<td>7 (43)b</td>
<td>6 (0)</td>
<td>2.17</td>
<td>0.87 - 7.88</td>
</tr>
<tr>
<td>Iron (D)c</td>
<td>1000a</td>
<td>0</td>
<td>3.45</td>
<td>1 - 111</td>
</tr>
<tr>
<td>Lead (D)</td>
<td>0.65 (0.65)a</td>
<td>0</td>
<td>0.02</td>
<td>0.001 - 0.100</td>
</tr>
</tbody>
</table>

*USEPA Guidelines; aASWQG - assuming TR = acid extractable copper; cTR is the total recoverable fraction; D is the dissolved fraction.

Table 5.4. Summary of quantity and type of metals exceedances in the Milk River in Montana, 2004-2012.

<table>
<thead>
<tr>
<th>Waterbody Name (Assessment Unit ID)</th>
<th>Number of Samples</th>
<th>Number and Type of Exceedances (sample size)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entire River, Canadian border to mouth (Missouri River) (all segments)</td>
<td>44</td>
<td>1 chronic aluminum</td>
</tr>
<tr>
<td></td>
<td>45</td>
<td>2 chronic copper</td>
</tr>
<tr>
<td></td>
<td>45</td>
<td>38 chronic iron</td>
</tr>
<tr>
<td>Canada border to Fresno Reservoir (MT40F003_010)</td>
<td>2</td>
<td>2 chronic copper</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>2 chronic iron</td>
</tr>
<tr>
<td>Fresno Dam to Thirtymile Creek (MT40J001_011)</td>
<td>12</td>
<td>1 chronic aluminum</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>8 chronic iron</td>
</tr>
<tr>
<td>Thirtymile Creek to Dodson Creek (MT40J001_012)</td>
<td>3</td>
<td>3 chronic iron</td>
</tr>
<tr>
<td>Dodson Creek to Whitewater Creek (MT40J001_013)</td>
<td>6</td>
<td>4 chronic iron</td>
</tr>
<tr>
<td>Whitewater Creek to Beaver Creek (MT40J001_020)</td>
<td>5</td>
<td>4 chronic iron</td>
</tr>
<tr>
<td>Beaver Creek to mouth (Missouri River) (MT400001_010)</td>
<td>17</td>
<td>17 chronic iron</td>
</tr>
</tbody>
</table>
Pathogens

In the Milk River, Alberta, fecal coliform bacteria are high and often exceed the ASWQG for irrigation (100 CFU/100 mL) and occasionally the ASWQG for contact recreation (200 CFU/100 mL), particularly during the summer months. These exceedances have led to the posting of Public Notices at Writing-on-Stone Provincial Park (Riemersma 2011). Fecal coliform bacteria counts remained fairly consistent throughout the 2007 to 2012 monitoring period with counts slightly higher in 2010 (Figure 5.9).

Fecal coliform bacteria counts are generally highest during periods of heavy precipitation and increased surface runoff and/or periods of lower flow and high water temperatures. Figure 5.10 shows increased fecal coliform bacteria counts during the diversion period, compared to the natural flow period. This is likely due to the time of year that is generally more wet and more conducive to proliferation of bacteria (warmer temperatures) compared to the natural flow period.

Median fecal coliform counts tend to increase from upstream to downstream in the Milk River, Alberta, although they tend increase slightly from upstream of the Town of Milk River to the Highway 880 Bridge (Figure 5.11). UV radiation from sunlight is one way that fecal coliform bacteria is removed from the water column. There is likely little removal of bacteria by die-off through UV radiation due to the milky colour of the water. Sedimentation is another way bacteria are removed from the water column, but as discussed, sediments remain high in the Milk River during the diversion period. Currently, the sources of the fecal coliform bacteria are unknown but may include livestock, wildlife and waterfowl, pets and human sources. Currently, a Fecal Coliform Source Tracking Project is underway to help identify sources (see Highlight Box on page 86).

A very limited E. coli dataset exists for the Milk River in Montana. Three total E. coli samples were collected by MDEQ on the Milk River from 2004 through 2012 as part of their statewide fixed station monitoring program. Additional monitoring is needed for each assessment unit before the status of E. coli can be determined. In Montana’s 2012 Water Quality Integrated Report (MDEQ 2012a), one segment (Beaver Creek to Mouth) is listed as impaired by the pathogen Escherichia coli (Map 5.1).
Milk River Fecal Coliform Source Tracking Project

Agricultural activity associated with livestock production is often cited as the main source of fecal contamination to surface water in rural areas. However, potential sources of fecal contamination which may contain pathogens that affect human health are diverse, and include wildlife, waterfowl, humans, pets, and livestock. Recently, media attention has highlighted public concerns regarding fecal contamination in the Milk River, Alberta which has resulted in the posting of public health notices at Writing-on-Stone Provincial Park four times in the last eight years including 2012. While fecal coliform bacteria, which are used as an indicator of fecal contamination, occasionally exceed provincial water quality guidelines, the source of this contamination has not been determined.

Molecular-based microbial source tracking (MST) methods have been developed for identifying the source of fecal contamination in waterways. In Alberta, DNA markers associated with ruminants have been identified in Meadow Creek and Trout Creek and the Upper Elbow River watershed. Unfortunately these studies did not determine the relative contribution of fecal contamination from different ruminant sources (i.e., deer versus cattle), thus the impact of agricultural activity on water quality relative to other sources cannot be determined.

The objective of the present study is to identify the sources of fecal contamination in the Milk River and determine relative contributions of fecal contamination from agricultural and non-agricultural sources using MST and traditional environmental measurements during a three-year period.

The first year of study was completed in 2012. Preliminary results suggest that there are multiple sources of fecal coliform bacteria in the Milk River, including cattle and a substantial wildlife component (particularly Cliff Swallows and Canada Geese); humans are, however, not a significant contributor. Initial results suggest that wildlife and cattle may be contributing an equal share to the coliform counts in the Milk River, Alberta. In addition, up to half of the fecal coliform bacteria may arise from environmental sources, although additional research is required to confirm this. Environmental E. coli refer to those that can be attributed to growth in the environment rather than originating directly from a host source. One way this may occur, is when E. coli is introduced into surface water through fecal contamination, and upon finding suitable conditions, they multiply in the environment.

Total Suspended Solids

Total suspended solids are relatively high in the Milk River compared to other major rivers in Alberta and Montana. Suspended solids originate from streambank erosion and surface runoff from the erodible badlands during rainfall events. AMEC (2008) documented streambank erosion rates that ranged from about 0.8 m up to 2.5 m annually at some locations in the Alberta reach. The streambanks consist of unconsolidated material, mainly sand, that is highly erosive. The St. Mary River Canal increases flow rates and river volumes above natural levels during the March through September period in Alberta. This saturates the streambanks for longer periods of time. As water recedes in the fall, sloughing of the streambanks occurs. It is not uncommon to hear the streambank falling into the Milk River. Figure 5.12 compares total suspended solids concentrations in the Milk River, Alberta for the monitoring period 2007 to 2012. The range of suspended solids concentration was highest in 2010 which was a high rainfall year. The lower median concentration in 2010 is likely due to the decrease in flow volumes from the St. Mary River Canal for the majority of the irrigation season.
Total suspended solids are higher during the diversion period compared to the natural flow period (Figure 5.13). In 2011, the St. Mary/Milk River Diversion was not operational due to unusually high precipitation and flooding on the lower Missouri and Mississippi rivers. It is likely that much of the suspended sediments were contributed by the badlands in the lower reaches in this year. The lower reach, named the “sand-bed” reach is represented by Highway 880, the Pinhorn and the Eastern Crossing sites. Total suspended solids concentrations were highest at these three sites, particularly at the Pinhorn (Figure 5.13 and Figure 5.14). A number of tributaries that flow through the badlands feed into the Milk River in this reach. Approximately five percent of the Milk River watershed is considered non-vegetated (i.e., the badlands) with much of this area concentrated toward the eastern end of the watershed (Map 2.7).

High total suspended solids are a nuisance for irrigation farmers as it clogs pumps and irrigation nozzles and wears out parts prematurely. Total suspended solids are also a concern for downstream water users, particularly at Fresno Reservoir, Montana, where fine-grained sediments settle and reduce the storage capacity of the reservoir. The U.S Bureau of Reclamation (2012) reported that as of May 1999, Fresno Reservoir had lost an estimated 44,652 dam$^3$ (36,200 acre-ft) (about 28% loss) of storage capacity since 1939 as a result of sedimentation. The estimated average annual rate of reservoir capacity lost to sediment accumulation is 750.7 dam$^3$ (608.6 acre-ft) (Ferrari 2000). Similar rates of sedimentation are expected to occur in to the future (also refer to Section 4.2, Figure 4.12).
Access to current water quality information is essential to the success of active watershed stewardship groups. Baseline water quality data helps to explain natural variability in water quality and identify when water quality may be degraded by anthropogenic activity. Water quality information also connects people to the watershed and helps to measure the impact made by stewards who seek to improve watershed health.

In the Milk River watershed, a few tributaries are monitored to support watershed stewardship group activity. Red Creek flows into the Milk River downstream of the Town of Milk River, Alberta. The MRWCC has been collecting water quality data at the mouth of Red Creek since 2006 and at the Upper and Middle sites since 2011. The results of the 2011 and 2012 April through October water monitoring period are presented in Table 5.5.

Unlike the mainstem Milk River where water quality is influenced by the augmentation of natural flows with water from the St. Mary River, Red Creek and other tributaries tend to be ephemeral, flowing in spring and drying up in the summer unless enough precipitation falls to generate flow. At Red Creek, streamflows ended in June (2007, 2009) and July (2008), while 2010, 2011 and 2012 were relatively wet and flows were continuous. In many tributaries in the watershed, including Red Creek, groundwater is an important contributor to streamflow. As discussed in Section 6.0, groundwater in the watershed tends to be high in salts and this is reflected in the high concentrations at Red Creek.

Specific conductivity is the measure of minerals (e.g., sodium, chloride, magnesium, potassium) dissolved in the water (total dissolved solids), or the salinity. Sources include soil and mineral weathering, surface runoff from saline soils, groundwater discharge, municipal and industrial effluents, agricultural runoff and aerosol fallout. Excessive salts applied to soils through irrigation may interfere with the extraction of water by plants. At high concentrations, salts may have a laxative effect in humans and livestock. The irrigation guideline for conductivity is 1000 μS/cm (Alberta Agriculture 1983); however, for more sensitive crops (e.g., strawberries, carrots) a guideline limit of 700 μS/cm is recommended (CCREM 1987). Typically, the specific conductivity at Red Creek, was similar at all three sites and was about 2.5 times the recommended irrigation guideline for less sensitive crops (Table 5.5).

Nutrients are generally high at Red Creek. Median total phosphorus concentrations tend to be highest at the Upper and Middle sites (0.063 mg/L and 0.101 mg/L, respectively) and lowest at the Mouth (0.037 mg/L) (Table 5.5). Total nitrogen concentrations were similar at the Upper and Middle sites (1.2 mg/L) and highest at the Mouth (1.5 mg/L) (Table 5.5). Note that these median values would have exceeded the historic Alberta Surface Water Quality Guideline of 0.05 mg/L total phosphorus and 1.0 mg/L total nitrogen (AENV 1999).

Median total suspended solids concentrations were generally low at all three sites, ranging from 8 mg/L at the Mouth to 12 mg/L at the Upper site (Table 5.5). For comparison, the median total suspended solids concentrations in the mainstem Milk River at Highway 880 Bridge, Alberta, for the period 2007 to 2012 was about 125 mg/L.

Median fecal coliform bacteria counts were highest at the Mouth (140 cfu/100 mL) and lowest at the Middle site (39 cfu/100 mL). Maximum counts, however, were highest at the Upper site (11,800 cfu/100 mL) and also high at the Middle site (3,800 cfu/100 mL) (Table 5.5). The Fecal Coliform Source Tracking Study is currently underway for the mainstem Milk River which should also help to identify sources of bacteria in tributaries (see Highlight Box). Sources likely include wildlife, waterfowl, livestock and environmental bacteria.

Table 5.5. Median (range) water quality results for select parameters in Red Creek at the Upper, Middle and Lower sites, 2011 and 2012, Alberta.

<table>
<thead>
<tr>
<th>Site</th>
<th>Specific Conductivity</th>
<th>Total Phosphorus</th>
<th>Total Nitrogen</th>
<th>Total Suspended Solids</th>
<th>Fecal Coliform Bacteria</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>µS/cm</td>
<td>mg/L</td>
<td>mg/L</td>
<td>mg/L</td>
<td>cfu/100 mL</td>
</tr>
<tr>
<td>Upper</td>
<td>2510 (1,570-2,880)</td>
<td>0.063 (0.003-0.604)</td>
<td>1.2 (0.8-3.9)</td>
<td>10 (2-40)</td>
<td>39 (0-11,800)</td>
</tr>
<tr>
<td>Middle</td>
<td>2545 (1,830-3,020)</td>
<td>0.101 (0.009-0.566)</td>
<td>1.2 (0.9-3.4)</td>
<td>12 (2-77)</td>
<td>23 (1-3,800)</td>
</tr>
<tr>
<td>Mouth</td>
<td>2570 (1,870-2,990)</td>
<td>0.037 (0.003-0.486)</td>
<td>1.5 (0.8-2.8)</td>
<td>8 (4-117)</td>
<td>140 (4-800)</td>
</tr>
</tbody>
</table>
6.0 Groundwater

6.1 Groundwater Supply and Use

The Milk River watershed contains a number of significant groundwater aquifer resources (Map 6.1). Unlike surface water that defines a watershed boundary, groundwater may cross one or more watershed boundaries below ground.

Overview of Hydrogeology

Regionally, the Milk River watershed is characterized by groundwater in the surficial Quaternary alluvium and glacial deposits, Quaternary pre-glacial alluvial deposits (typically unconsolidated sand and gravel), and the underlying bedrock composed of upper Cretaceous rocks. In the western portion of the Milk River watershed, significant aquifers include the Quaternary alluvium and Higher Terrace Deposits, Two Medicine Formation, and the Milk River Formation (also known in Montana as the Eagle Sandstone Formation including the Virgelle Sandstone Member). In the eastward direction, these units taper out as the Quaternary alluvium, glacial drift, Tertiary Flaxville Gravels, and the Cretaceous Judith River Formation become more important aquifers (Map 6.1).

Groundwater in these aquifers is primarily recharged by infiltration of precipitation through permeable rock outcroppings at higher elevations along the Rocky Mountain front and topographically high areas such as the Sweet Grass Hills, Bears Paw Mountains, and Little Rocky Mountains. Recharge also occurs in the basins where water is focused into channels or reservoirs and infiltrates through permeable streambed sediments or rock outcroppings.

The Sweetgrass Hills are unique regarding aquifer recharge and groundwater flow. Recharge originating in the hill closest to the border (West Butte) generates groundwater flow essentially to the north. Recharge originating on the other two hills (Middle/Gold Butte and East Butte) generate groundwater flow to the north and northeast (Tuck 1993), but also to the south and southeast into Montana (A. Rivera, pers. comm.). In other parts of the watershed, groundwater follows pre-glacial valleys that typically drain eastward. Groundwater can re-emerge at the surface through seepage zones and springs observed along valley slopes at the contacts of different geologic units (Klohn Crippen Consultants Ltd. 2003). Similarly, groundwater flow patterns in pre- and post-glacial deposits trend in the same manner as the existing drainage basins and can discharge in adjacent streams and rivers.

Water levels within these hydrogeologic units across the watershed are typically less than 75 m below the land surface. Artesian conditions that can produce flowing wells exist where groundwater pressures are greater than the local pressures at the land surface. Artesian wells in the Milk River watershed are typically completed in confined or semi-confined aquifers that are overlain with less-permeable materials and recharged at higher elevations.

Alberta

The transboundary Milk River Sandstone Aquifer is also an important water resource in the Milk River watershed in Alberta and Montana (see Highlight Box on page 100). The formation outcrops at ground surface in a number of places, including at Writing-on-Stone Provincial Park (AB) and in Montana. The formation is much deeper elsewhere in the watershed, in excess of 200 m near the east to about 550 m below the Milk River Ridge in the west. Well yields from the Milk River Sandstone Aquifer vary from 6.6 to 32.7 m³/d south of the river to a high of 163.7 m³/d on the north side of the river (Borneuf 1976).

The Whisky Valley Aquifer is a regional sand and gravel aquifer that extends approximately 30 km along the river in the vicinity of the Town of Milk River. The Whisky Valley aquifer is a “surficial deposit” that is generally less than 50 m below ground (Stantec Consulting Ltd. 2002; Hydrogeological Consultants Ltd. 2004). Wells completed in this aquifer generally have yields ranging from 45
Groundwater withdrawals have resulted in water level declines in parts of the Milk River watershed. Almost all of the early wells developed in the Milk River Aquifer in Alberta in the 1900s flowed when completed. By the 1960s, long-term withdrawals of groundwater lowered the piezometric surface and reversed gradients in the areas of heaviest use (Hendry et al. 1991). Water level declines exceeding 30 m (98 ft) were noted between 1937 and 1959 due to water usage by the Village of Foremost (Printz 2004). Efforts were made by the Milk River Aquifer Reclamation and Conservation Program to decommission unused and sometimes flowing wells. By cementing 22 flowing wells, the program assisted to conserve about 59.7 dam³ (48 acre-ft) of water per year based on observations at surface (Printz 2004).

m³/d to more than 654.6 m³/d. Generally, the Whisky Valley Aquifer produces higher yields than the Milk River Aquifer because of its coarser sand/gravel material composition. Water moving through the Milk River Aquifer can recharge the Whisky Valley Aquifer in some places (Stantec Consulting Ltd., 2002).

In the western part of the watershed, well depths are generally less than 50 m deep. The apparent yields for individual water wells completed through the Bearpaw Aquifer and the Oldman Formation range mainly from 10 to 100 m³/d, with more than 80% of the values being greater than 10 m³/d (Hydrogeologic Consultants Ltd. 2003). In the central part of the watershed, well depths range from 1 to 342 m with the majority of wells having depths less than 100 m. Well depths completed in surficial deposits are generally less than 20 m deep, but can range up to 61 m deep. Well yields range from 10 to 100 m³/d depending on localized sand and gravel deposits. Local yields in the Milk River Aquifer can range from 229 to 818 m³/d in this area (Stantec Consulting Ltd. 2002). Further east, estimated water yields from the principal aquifers in the Milk River, Foremost and Oldman formations and surficial units (located mainly along creeks) were determined by desktop study (Aqua Terre Solutions Inc. 2002). About 80% of the wells were completed in bedrock at relatively shallow depths and typically yielded 30 m³/d to 60 m³/d. Higher well yields were generally from wells completed in the Milk River Aquifer.

Previous studies have shown that water levels in the Milk River Aquifer are lower than those in the glacial deposits, creating the potential for significant recharge conditions via leakage through overlying shale units (Toth and Corbet 1986; Stantec 2002). The potential for discharge conditions also exists in local areas, one south of the Town of Milk River which roughly coincides with the Whisky Valley, and another southwest of Writing-on-Stone Provincial Park (Stantec 2002). In the area of the Whisky Valley, there is some indication of discharge conditions in the Pakowki and Foremost formations, which suggests that discharge from the Milk River Aquifer could recharge the basal Whisky Valley Aquifer. The Milk River Aquifer has low hydraulic conductivity and very low groundwater velocities (about 0.15 to 1.5 m/yr) (Meyboom 1960). Considering an average transmissivity (the rate which groundwater flows horizontally through an aquifer) of 1.5 m²/day, a thickness of 45 m, an average hydraulic gradient of 0.016 m/m and a porosity of 0.1, the inferred groundwater velocity would be on the order of 2 m/yr (Stantec 2002).
Map 6.1 Groundwater Wells
In Saskatchewan, plentiful groundwater supplies are considered to have played an important role in the province’s socio-economic development, even more so than surface water supplies, which are relatively scarce (Rutherford 2004).

Drift (also known as inter-till or glacial aquifers) and bedrock aquifers generally have sufficient water yields and good quality suitable for domestic use. Bedrock aquifers form from sediments that were laid down before glaciation, while drift aquifers are comprised of material of glacial origin, primarily of Quaternary age, overlying bedrock aquifers (Pomeroy et al. 2005).

In southern Saskatchewan, drift aquifers bounded by till layers are common. These aquifers range from large regional aquifers to very small local aquifers. Surface and near-surface aquifers, that recharge during periods of snowmelt and spring rainfall (in wet years), occur in outwash and alluvial and aeolian sands deposited in the glacial and immediate post-glacial periods (Pomeroy et al. 2005). While water levels in deep bedrock aquifers respond slowly to dry or wet years, consecutive drought years can cause immediate declines in water levels in surface aquifers (Pomeroy et al. 2005).

As noted on Map 6.1, several surficial and drift aquifers occur within the watershed in Saskatchewan, namely surficial aquifers (adjacent to larger creeks and rivers), the Empress Group (a series of smaller, drift aquifers that occur in a horizontal direction from Consul to Val Marie) and the Saskatoon Group (two larger aquifers generally extending from Ravenscrag and Eastend to south of Canuck to the international border). Though these deposits are identified on the map, the full extent of some of the aquifers is not known due to a lack of groundwater data. Several studies completed in the watershed provide some description and lithology for the aquifers (Millard 1990; Maathius and Thorleifson 2000; Maathius and Simpson 2002; Whitaker 1982).

The Empress Group of aquifers include deposits of silt, sand and gravel generally found within buried valleys cut into the bedrock. Generally, wells in the Empress Group are completed to 30 to 60 m depth and result in water yields that range considerably depending on the areal extent of thickness and hydraulic conductivity of the aquifer. It is anticipated that the yields would be quite low (Maathius and Simpson 2007).

Bedrock silts, sands and gravels are the most important aquifers in this area for domestic and municipal water supply. Bedrock aquifers include the Judith River Formation sands in south-west and south-central Saskatchewan, and sands and gravels of the Bearpaw, Eastend and Ravenscrag formations in the south-west (Pomeroy et al. 2005) (Map 6.1). The Eastend to Ravenscrag Formation was delineated by Christiansen (1983) into a unit that is a combination of the Late Cretaceous Eastend, Whitemud, Battle and Frenchmen formations and the Tertiary Ravenscrag Formation. The formation consists mostly of inter-bedded sand, silt and clays and coal. Generally, water well depth ranges considerably and well yields range from 159 m$^3$/d to 579 m$^3$/d (Maathius and Simpson 2007).

The Ribstone Creek Aquifer underlies the Judith River Formation within the watershed. The aquifer consists of non-calcareous, very fine to fine-grained sand, with a clayey matrix and non-calcareous clays and silts. The aquifer can reach a thickness of 20 m along the Alberta-Saskatchewan border (Whitaker 1982).

The Judith River Formation consists of non-marine and marine, multi-coloured sands silts and clays. The aquifer underlies the Milk River watershed in Saskatchewan, occurs in Alberta and extends southwards into Montana.

The Bearpaw Formation contains several sand members, including the Ard kenneth, Demaine, Matador, Outlook, Oxarat, Belanger, Thelma and Cruikshank members. These generally consist of marine sands within the Bearpaw Formation. Generally speaking, where these sand members occur with some thickness, they may act as potential aquifer zones.

**Threats to Groundwater Supply**

- Groundwater as a source of water for crop irrigation in parts of the watershed.
- Groundwater as a source of water for the oil and gas industry in the recovery of oil in parts of the watershed.
- Reduction in groundwater due to land cover changes that alter the permeability of surfaces (e.g., soil compaction, pavement).
- Groundwater may be affected by climate change or natural cycles such as drought.
Groundwater Allocation and Use

In comparison to surface water, there are few large users relying on groundwater for supply. Generally, the aquifers in the Milk River watershed are unlikely to be able to provide the large quantities (i.e., daily pumping rates) required by municipal and commercial users.

In 2008, there were 2,087 groundwater well records reported for the Milk River watershed, Alberta. In five years, the number of well records increased to 2,436 wells (2012). The number of wells include all “holes in the ground” including test holes, dry wells and shot holes. The 14% increase in wells can be attributed, in part, to the increase in watershed size due to changes in the original boundary. However, the greatest increase is likely due to recent oil and gas activity in the watershed and the increased seismic activity that can result in a large number of “shot” holes even in one quarter section (J. Gutsell, pers. comm.).

A recent study investigated the status of 261 groundwater wells in the Milk River Aquifer, Alberta, as part of the Milk River Transboundary Aquifer Project (MiRTAP) (see Highlight Box on page 100) (MRWCC 2011). Only a small number of the wells were actually active (6%). Twenty-five percent of the wells were abandoned, decommissioned or the location was unknown to the well owner. About 61% of the wells were related to oil and gas activity (e.g., test holes and shot holes and chemistry reports), while the remaining eight percent of wells had previously been verified in another study (MRWCC 2011).

Saskatchewan maintains the lowest number of groundwater wells in the watershed (1,525 wells) and the majority of groundwater wells are found in Montana (10,097). In Montana, 43% of the wells were drilled for domestic purposes and 24% of the wells were drilled for the purpose of stockwatering (Figure 6.1).

Overall, groundwater well density is about 0.24 wells/km² (0.62 wells/mi²). The highest density of wells occurs in Alberta (0.36 wells/km² or 0.94 wells/mi²) and the lowest density occurs in Saskatchewan (0.11 wells/km² or 0.29 wells/mi²). Montana has a well density of 0.26 wells/km² (0.68 wells/mi) with the highest density concentrated in the alluvial aquifer that extends from just west of Havre to Glasgow and in the Milk River Aquifer at Rocky Boy.

There are 39 licensed groundwater wells and 293 groundwater registrations in the Alberta portion of the watershed that have a combined water allocation of 969.9 dam³ (Figure 6.2). Most of the licensed volume (59%) is for municipal use for rural water co-ops that source their water from the Whisky Valley Aquifer. Sixteen percent of the license volume is allocated to agricultural activity, namely stockwater (126.9 dam³ or 103 acre-ft) and feedlots (14.4 dam³ or 12 acre-ft). Groundwater registrations for Traditional Agricultural Use (e.g., stockwatering and application of pesticides), make up 21% of the licensed groundwater volume in the
watershed. Commercial groundwater licenses, including those for bottling, campgrounds and a golf course, make up five percent of issued licenses. Only one groundwater license is issued related to oil and gas activity, and it provides water to offices at a plant site (Figure 6.2). Since 2008, the licensed groundwater volume in the Alberta watershed has increased by 38.1 dam$^3$ (31 acre-ft). Although there is a slight increase in actual groundwater use in the watershed, much of the increase is attributed to improvements in groundwater data management and not actual changes in use (B. Hills, pers. comm.). There are currently no allocations of groundwater licensed for irrigation in the watershed.

Although there are numerous groundwater wells in the watershed in Saskatchewan, only 56 of these require licenses (Figure 6.3) (WSA unpublished). The remaining wells are designated for domestic use and water volumes are considered a statutory right for use up to 1.0 dam$^3$ (0.811 acre-ft) per year. Twenty-four of the licensed groundwater wells are for domestic use, representing three percent of the total allocated volume, and twenty are for municipal use (e.g., urban distribution, recreation and tank loads), representing 32% of the total allocated volume. Municipal groundwater licenses include supply water for the Town of Eastend and the Villages of Climax, Consul and Frontier and water supplies for Cypress Hills Provincial Park and Grasslands National Park. The municipal well-type “tank load” allows rural users to fill truck or trailer-mounted tanks with water that can be transferred to a cistern for household use, rather than distributed through a pipeline system. This is common in Saskatchewan where sparse rural population makes pipeline construction relatively expensive per user. There are also 11 industrial licenses allocated that total 632.9 dam$^3$ (513 acre-ft) (54% of the total allocated volume) for the purpose of oil recovery (Figure 6.3). Most of the licensed wells are developed in the surficial aquifers that include the Empress Group and Saskatoon Group, and the Judith River Formation. The total allocated volume is 1158.8 dam$^3$ (940 acre-ft) as of 2012.

In Montana, 7,024 (70% of the total wells) are appropriated or “licensed”. Of these wells, 36% are appropriated for domestic use and 49% of the wells are appropriated for stockwater (Table 6.1). About six percent of the wells are for the use “multiple domestic” (i.e., household use including drinking water, lawn and garden). Groundwater is also used to irrigate about 14,994 ha (37,052 acres) of land. Appropriations for the purpose of irrigation make up nearly 3.5% of the wells.
6.2 Groundwater Quality

Safe drinking water is essential to human health. Groundwater quality can vary considerably across the watershed, even though most of the wells are developed within the same aquifer. Local and areal variations in recharge, depth of completion, relation to groundwater flow path, and variations in the chemical compositions of glacial and bedrock deposits, can all contribute to the chemical composition of groundwater.

**Groundwater Quality is:**

- increasing
- stable
- stressed
- unknown

*(where 1% to 50% of wells exceed at least one human-influenced Maximum Allowable Concentration)*

### Comparative Groundwater Quality Study 2007/2011 (Alberta)

In 2007, the Milk River Watershed Council Canada commissioned a study to investigate groundwater quality in 40 private wells across the watershed in Alberta. Ten water wells were selected and sampled within each of the counties of Cardston, Warner, Forty Mile and Cypress. Samples were analysed for nutrients, salts, metals and bacteria. Results of this study were presented in the Milk River State of the Watershed Report (2008). The information formed a valuable snapshot of groundwater quality in the basin and acts as a benchmark for future comparative studies.

In late 2011, a second set of 34 samples was obtained from many of the same groundwater wells as sampled in 2007. For comparison, results for the two years of study are reported as percent exceedance of applicable Canadian Drinking Water Quality Guidelines (CDWQG). In addition, the results for select parameters are presented as median (50th percentile) and range values (Table 6.2). Generally the combination of these constituents determines the suitability of a groundwater supply for human and livestock consumption.

Total dissolved solids (TDS) is a measure of calcium, magnesium, sodium, potassium, carbonate, bicarbonate, chloride, sulphate and nitrate in water. TDS above 500 mg/L results in excessive scaling in water pipes, water heaters, boilers and appliances. TDS can be naturally occurring or it can be an indicator of point or non-point source pollution. In the study, TDS ranged from 270 mg/L to 3,400 mg/L and was highest in the eastern part of the watershed. In 2007, 88% of samples exceeded appropriate guidelines compared to 79% of samples collected in 2011. These results are comparable to the literature which has stated that the Milk River Aquifer is generally high in sodium, fluoride and bicarbonate. Untreated, the concentration of total dissolved solids (TDS) typically exceeds the CDWQG.

Sodium is a naturally occurring ion that originates from the erosion and weathering of salt deposits and contact with igneous rock or seawater intrusion. Sources of sodium also include point and non-point sources such as sewage and industrial effluents, and sodium-based water softeners. About 60% of the samples collected in the groundwater study exceeded the CDWQG of 200 mg/L. Sodium concentrations ranged from 12 mg/L to 1,800 mg/L with both the highest and lowest concentrations measured in eastern part of the watershed (Cypress County) (Table 6.2). Sodium can impart taste to water and can impact human health when ingested in excess.

Chloride (Cl) is a naturally occurring element that may also be present due to dissolved salt deposits, highway salt, industrial effluents, oil well operations, sewage and irrigation drainage. About five percent of samples collected from water wells in 2007 and 2011 exceeded the CDWQG of 250 mg/L. The highest concentration of chlorides was measured in eastern part of the watershed (1,130 mg/L and 1,200 mg/L in 2007 and 2011, respectively) (Table 6.2). Chloride imparts taste to drinking water and can corrode distribution systems.
Table 6.2. Summary of select parameters measured in the comparative groundwater study, Alberta, 2007 and 2011. Median and (range) concentrations are presented. All concentrations are reported as mg/L unless otherwise noted (MRWCC unpublished). Note that many, but not all, of the same wells sampled in 2007 were re-sampled in 2011.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>CDWQG</th>
<th>Cardston County</th>
<th>County of Warner</th>
<th>County of Forty Mile</th>
<th>Cypress County</th>
<th>% Exceedance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Dissolved Solids a</td>
<td>500</td>
<td>934</td>
<td>1100</td>
<td>910</td>
<td>770</td>
<td>1140</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(505-1690)</td>
<td>(360-1700)</td>
<td>(442-2430)</td>
<td>(350-1800)</td>
<td>(813-2440)</td>
</tr>
<tr>
<td>Sodium b</td>
<td>200</td>
<td>206</td>
<td>160</td>
<td>237</td>
<td>290</td>
<td>425</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(57-630)</td>
<td>(16-620)</td>
<td>(66-795)</td>
<td>(58-630)</td>
<td>(354-947)</td>
</tr>
<tr>
<td>Chloride a</td>
<td>250</td>
<td>28.9</td>
<td>55</td>
<td>15.5</td>
<td>15</td>
<td>20.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(2.7-96.4)</td>
<td>(13.0-110.0)</td>
<td>(2.8-61.7)</td>
<td>(3.7-230)</td>
<td>(4.3-187)</td>
</tr>
<tr>
<td>Manganese a</td>
<td>0.05</td>
<td>0.006</td>
<td>0.0063</td>
<td>0.033</td>
<td>0.002</td>
<td>0.004</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.002-0.598)</td>
<td>(0.002-0.266)</td>
<td>(0.002-0.270)</td>
<td>(0.002-0.4)</td>
<td>(0.002-1.05)</td>
</tr>
<tr>
<td>Dissolved Nitrate</td>
<td>45</td>
<td>1</td>
<td>14</td>
<td>0.008</td>
<td>0.0065</td>
<td>0.0015</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.003-19.9)</td>
<td>(0.0065-78)</td>
<td>(0.002-0.892)</td>
<td>(0.0015-39)</td>
<td>(0.0015-0.15)</td>
</tr>
<tr>
<td>Dissolved Lead</td>
<td>0.01</td>
<td>0.0001</td>
<td>0.00022</td>
<td>0.0001</td>
<td>0.0001</td>
<td>0.0001</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.0001-0.0003)</td>
<td>(0.0001-0.0014)</td>
<td>(0.0001-0.0007)</td>
<td>(0.0001-0.0005)</td>
<td>(0.0001-0.0015)</td>
</tr>
<tr>
<td>Cadmium a (µg/L)</td>
<td>5</td>
<td>0.01</td>
<td>0.011</td>
<td>0.008</td>
<td>0.0025</td>
<td>0.005</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.005-0.13)</td>
<td>(0.0025-0.11)</td>
<td>(0.005-1.14)</td>
<td>(-0.0025)</td>
<td>(0.005-0.21)</td>
</tr>
</tbody>
</table>

aThe CDWQG are aesthetic objectives and not health related
bCadmium is reported as µg/L. Divide by 1,000 to convert µg/L to mg/L.

groundwater Vulnerability

Surface and drift aquifers are most susceptible to groundwater contamination from human or animal surface wastes, oil and gas production wells, and transportation and dumping of hazardous materials. Bedrock aquifers are less at risk to surface contamination unless they are near the surface or overlain by a highly permeable unit (Pomeroy et al. 2005). Additionally, contamination of typically deep aquifers is a threat where they are exposed in their recharge zones at higher elevations or where coulees cut deep through the overlying aquifers (Golder Associates Ltd. 2004).
Manganese (Mn) is a naturally occurring element that is made available through erosion and weathering of rocks and minerals. It is a household nuisance as it degrades taste and can stain laundry and plumbing fixtures. Water from 35% of wells sampled in 2007 and 21% of wells in 2011 exceeded the CDWQG of 0.05 mg/L for manganese (Table 6.2).

Dissolved nitrate (NO$_3^-$) can be naturally occurring or be found in surface runoff from fertilized lawns or fields, manure and domestic sewage. Nitrate may be produced from excess ammonia or from microbial activity in distribution systems. In excess, dissolved nitrate can pose a serious health risk, particularly to infants less than three months of age, as it is the cause of methaemoglobinemia (blue baby syndrome). It is also classified as a possible carcinogen. The Maximum Allowable Concentration (MAC) for dissolved nitrate in drinking water is 45 mg/L. Nine percent or three wells sampled in the watershed exceeded the CDWQG in 2011, compared to zero wells in 2007; all wells were located in Cardston County (Table 6.2). The source of the nitrate is unknown at this time.

Twenty-nine elements were analyzed as part of the standard metals quality analysis, including lead and cadmium. Metals in domestic drinking water supplies can cause aesthetic issues and some metals have human health implications. Iron may impart a taste to the water and cause staining of plumbing fixtures and laundry.

One water sample exceeded the lead CDWQG of 0.01 mg/L in 2007 and no sample exceeded the guideline in 2011. Sources of lead in drinking water include leaching from plumbing (e.g., pipes, solder, brass fittings and lead service lines). Lead can affect intellectual development and behaviour in infants and young children (under 6 years). It can also cause anaemia, affect the central nervous system and is classified as a probable human carcinogen. No water from wells sampled in 2007 and 2011 exceeded the CDWQG MAC (5 µg/L) for cadmium.

The presence of *Escherichia coli* (*E. coli*) indicates recent fecal contamination and the potential presence of microorganisms capable of causing gastrointestinal illnesses. It is used as an indicator of the microbiological safety of drinking water; if detected, enteric pathogens may also be present. The CDWQG MAC is zero mpn/100 mL, where mpn is defined as most probable number. Bacteria was only analysed in samples collected in the 2011 monitoring year. One sample exceeded the guideline in Cardston County, having a value of 27 mpn/100 mL. Water in this same well also measured high in dissolved nitrate.

**Saskatchewan**

In the watershed in Saskatchewan, groundwater quality is highest in the surface aquifers where TDS concentrations are generally less than 1,000 mg/L. Inter-till aquifers have high calcium, magnesium and sulphate concentrations (TDS ranges from 1,500 to 2,500 mg/L) and the water is considered “hard”. Water in bedrock aquifers is high in sodium (ion concentration ranges from 1,000 to 2,500 mg/L) and the water is considered “soft” (Pomeroy et al. 2005). The major buried valley aquifers have a mixture of bedrock and till water with high calcium, sulphate, magnesium and sodium concentrations (TDS concentration ranges from 1,500 to 3,000 mg/L). Saskatchewan groundwater normally has high concentrations of iron, which can cause taste problems (Pomeroy et al. 2005).

Specific water quality data for Ribstone Creek aquifer is limited, however studies have documented TDS concentrations that ranged from 3,000 mg/L to 15,000 mg/L (Maathuis and Simpson 2007). The total dissolved solids concentration in the Judith River Formation ranges from 894 mg/L to 7,630 mg/L with a mean value of 2,329 mg/L (Whitaker 1982).

In Saskatchewan, trends in groundwater quality were assessed by examining the change in the percentage of wells that exceed at least one human-influenced Maximum Acceptable Concentration (according to the Canadian Drinking Water Quality Guidelines) between two time periods (1999 to 2003 and 2004 to 2008) (SWA 2010).

In the Cypress Hills North Slope watershed, 158 wells (1999-2003) and 135 wells (2004-2008) were sampled through the Rural Water Quality Advisory Program. Fewer wells were sampled in the Milk River watershed, with 57 wells sampled during the period 1999 to 2003 and 15 wells sampled from 2004 to 2008. Using Saskatchewan criteria, both watersheds were considered stressed (where 1% to 50% of wells exceed at least one human-influenced MAC) in both time periods. Note that human-influenced Maximum Acceptable Concentrations include nitrate (NO$_3^-$), total coliform bacteria, and *E. coli* bacteria.
The Cypress Hills North Slope watershed had at least one human-influenced MAC exceedance in 53% of the wells sampled during the 2004 to 2008 period, compared to 47% of wells sampled during the previous period (SWA 2010).

Montana

In Montana, there are 443 well records that have groundwater quality test results on file (GWIC 2013). This data was sorted according to aquifer/formation and summary statistics were applied to select parameters for all wells sampled since 1990. Well depths were most shallow in the Drift Aquifers (13 m or 43 ft), Alluvium Aquifers (20 m or 66 ft) and in the Flaxville Formation (23 m or 66 ft), and deepest in the Eagle Formation (102 m or 333 ft) andVirgelle Formation (91 m or 300 ft). Note that the Eagle and Virgelle Formations (together) are equivalent to the Milk River Formation in Alberta.

In terms of groundwater quality, total dissolved solids ranged from 0 mg/L to 11,582 mg/L in the Drift Aquifer (Table 6.3). The very high maximum TDS concentration found in the drift aquifer well was likely influenced by a saline seep. The Flaxville Formation generally had the best water quality with the median TDS concentration below the Environmental Protection Agency (EPA) Guidelines of 500 mg/L (347 mg/L). The Judith River Formation had the highest concentration of TDS (median concentration: 2,260 mg/L), sodium (median concentration: 865 mg/L) and chloride (median concentration: 53 mg/L). Median nitrate-nitrogen concentrations were generally low (<7 mg/L); however, some very high maximum concentrations were measured in the Drift Aquifer (130 mg/L), Judith River Formation (182 mg/L), Eagle Formation (188 mg/L) and Two Medicine Formation (600 mg/L).

Table 6.3. Summary of well depths and water quality in select aquifers in Montana, 1990-2012.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Alluvium</th>
<th>Drift</th>
<th>Judith River</th>
<th>Flaxville</th>
<th>Eagle</th>
<th>Virgelle</th>
<th>Two Medicine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth (ft)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>58</td>
<td>56</td>
<td>30</td>
<td>24</td>
<td>7</td>
<td>16</td>
<td>35</td>
</tr>
<tr>
<td>Median (Range)</td>
<td>66 (9-200)</td>
<td>43 (5-135)</td>
<td>214 (80-540)</td>
<td>75 (54-145)</td>
<td>333 (27-600)</td>
<td>300 (118-850)</td>
<td>120 (30-223)</td>
</tr>
<tr>
<td>Total Dissolved Solids (mg/L)</td>
<td>58</td>
<td>30</td>
<td>21</td>
<td>7</td>
<td>16</td>
<td>39</td>
<td>34</td>
</tr>
<tr>
<td>Median (Range)</td>
<td>1470 (204-3552)</td>
<td>1068 (0-11582)</td>
<td>2260 (0-7222)</td>
<td>347 (260-524)</td>
<td>959 (115-5754)</td>
<td>1027 (528-7489)</td>
<td>1354 (511-8569)</td>
</tr>
<tr>
<td>NO₃-N (mg/L)</td>
<td>58</td>
<td>29</td>
<td>19</td>
<td>15</td>
<td>0</td>
<td>39</td>
<td>34</td>
</tr>
<tr>
<td>Median (Range)</td>
<td>0 (0-13)</td>
<td>1 (0-130)</td>
<td>1 (0-182)</td>
<td>7 (1-10)</td>
<td>0 (0-188)</td>
<td>0 (0-83)</td>
<td>0 (0-600)</td>
</tr>
<tr>
<td>Na (mg/L)</td>
<td>58</td>
<td>29</td>
<td>19</td>
<td>7</td>
<td>16</td>
<td>39</td>
<td>34</td>
</tr>
<tr>
<td>Median (Range)</td>
<td>315 (3-1040)</td>
<td>72 (14-2800)</td>
<td>865 (18-2670)</td>
<td>82 (25-101)</td>
<td>219 (17-1036)</td>
<td>336 (37-1910)</td>
<td>304 (66-2100)</td>
</tr>
<tr>
<td>Cl (mg/L)</td>
<td>58</td>
<td>29</td>
<td>19</td>
<td>7</td>
<td>15</td>
<td>39</td>
<td>34</td>
</tr>
<tr>
<td>Median (Range)</td>
<td>25 (0-785)</td>
<td>17 (2-511)</td>
<td>53 (2-4135)</td>
<td>5 (3-18)</td>
<td>6 (1-43)</td>
<td>13 (2-59)</td>
<td>16 (5-160)</td>
</tr>
</tbody>
</table>
The Milk River Transboundary Aquifer Project (MiRTAP) was launched by the Geological Survey of Canada (GSC) in 2009, in partnership with local stakeholders that include the Milk River Watershed Council Canada, provincial, municipal and state government representatives and landowners.

The Milk River Aquifer straddles southern Alberta (Canada) and northern Montana (United States), in a semi-arid region considered water short (Figure 6.4). Since the 1960s, the aquifer plays an important role in the water supply for urban and rural residents. However, there is no agreement between the two countries for the sharing of this resource.

Several studies have shown that the aquifer has depleted in Alberta due to heavy use in some areas. In 1989, the Province placed a moratorium on applications for the diversion of surface water from the Milk River for irrigation, industrial and commercial uses, which could increase groundwater use as a consequence.

Unfortunately, previous studies of the Milk River Aquifer have been limited by the Canada-USA border; most studies have focused on Alberta conditions only. Thus, the Milk River Aquifer has never been studied in its entirety and its current state is unknown. Since two countries share this groundwater resource, it is crucial to assess the aquifer within its natural boundaries.

MiRTAP meets the need for an international assessment of the Milk River Aquifer.

MiRTAP aims to better understand the dynamics of the Milk River Aquifer in order to make recommendations for sustainable management and good governance by the two international jurisdictions, Canada and the USA. This action is recommended in the United Nations General Assembly Resolution 63/124 on the Law of Transboundary Aquifers. A sound cooperation between the two countries (at different levels of jurisdiction) is essential to make MiRTAP successful.

The GSC is gathering data (e.g., geological, hydrogeological, chemical, and groundwater use) from Alberta and Montana to construct a unified three-dimensional conceptual model of the aquifer. It will form the basis of a numerical model of the aquifer, which will be used as a scientific tool to simulate several water use scenarios.

Fieldwork was recently undertaken to collect groundwater samples and measure water levels. Isotopic analysis of the samples will allow determination of groundwater flow-paths as well as the recharge and discharge areas of the aquifer.
Riparian areas and wetlands are integral components of the Milk River watershed as they occupy the transition zone between upland and water. Riparian areas, including those associated with flowing water (lotic systems) and non-flowing water (wetlands or lentic systems) are valuable to maintain water balance in a semi-arid region. Riparian areas occupy a relatively small area of land compared to other landcover types, but they provide habitat for many of the species present in the watershed.

Functioning riparian areas reduce streambank erosion and sediment transport, maintain water quality, store water to minimize the impacts of drought and floods, and provide forage and shelter for wildlife and domestic livestock. When maintained, functioning riparian areas mitigate impacts from human activity and preserve and/or increase biodiversity in the region. An assessment of riparian condition provides an indication of the overall function of the watershed.

**Riparian Health Assessment**

In Alberta, the majority of riparian health data is collected by the Alberta Riparian Habitat Management Society (also known as Cows and Fish). Cows and Fish use riparian health inventory and riparian health assessment methods to report on riparian function for lakes, sloughs and wetlands, streams, and small and large rivers. A variety of indicators related to ecological status, plant community structure and site stability are used in the inventories and assessments, including vegetative cover, disturbance and invasive plants, tree and shrub establishment, tree and shrub regeneration and utilization, and human disturbance. These parameters are intended to indirectly evaluate the ability of a site to perform ecological functions. These riparian health inventory and riparian health assessment methods were first developed by Hanson et al. (2000), in Montana, and adopted by Cows and Fish for use in Alberta. More recently Saskatchewan has also adopted these methods (Saskatchewan PCAP Greencover Committee 2008a and 2008b).

The riparian health inventory is a comprehensive riparian health survey that examines vegetation, soil parameters and hydrology through 79 parameters related to health indicators, many of which require detailed measurements (ARHMS 2012). The riparian health assessment is a more rapid assessment and it is typically used by landowners, non-profit organizations and others to evaluate riparian condition. The riparian health assessment evaluates nine questions for lakes and wetlands and 11 questions for streams and small rivers (see accompanying DVD ‘Riparian Areas and Wetlands’ for detailed methods) (ARHMS 2012).

Riparian health inventories and assessments assign scores to each indicator that contributes to system function. The 11 main health indicators, which appear in many of the figures that follow, are described in Table 7.1. The riparian health scores are interpreted in the following way:

<table>
<thead>
<tr>
<th>Health Category</th>
<th>Score Ranges</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Healthy</td>
<td>80-100%</td>
<td>Little or no impairment to riparian function</td>
</tr>
<tr>
<td>Healthy, with Problems</td>
<td>60-79%</td>
<td>Some impairment to riparian functions due to human or natural causes</td>
</tr>
<tr>
<td>Unhealthy</td>
<td>&lt;60%</td>
<td>Impairment to many riparian functions due to human or natural causes</td>
</tr>
</tbody>
</table>
Table 7.1. Summary of riparian health indicators and their significance to riparian function.

<table>
<thead>
<tr>
<th><strong>Riparian Health Indicators</strong></th>
<th><strong>Significance</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetative Cover of Floodplain and Streambanks</td>
<td>Native plants provide deep binding root mass to maintain streambanks, slow the flow of overland runoff to facilitate water quality improvements, provide summer and winter forage for wildlife and livestock.</td>
</tr>
<tr>
<td>Preferred Tree and Shrub Establishment and Regeneration</td>
<td>The root systems of woody species stabilize streambanks, while their spreading canopies provide protection to soil, water, wildlife and livestock.</td>
</tr>
<tr>
<td>Standing Decadent and Dead Woody Material</td>
<td>The amount of decadent and dead woody material may indicate a change in water flow due to human or natural causes, dewatering of a reach can change vegetation from riparian to upland species, flooding of a reach or persistent high water table can kill or eliminate some species, chronic overuse of browse, physical damage such as rubbing and trampling and climatic impacts.</td>
</tr>
<tr>
<td>Utilization of Preferred Trees and Shrubs</td>
<td>The root systems of woody species provide streambank stability. Removal of this material reduces stability, causes loss of preferred woody species and leads to invasion of disturbance and weed species.</td>
</tr>
<tr>
<td>Occurrence of Invasive Plant Species</td>
<td>Invasive plants do not provide deep-binding root mass for bank protection and they provide minimal structural and habitat diversity when present in high densities. Weeds impact wildlife and livestock by replacing the vegetation they utilize for shelter and food.</td>
</tr>
<tr>
<td>Disturbance-Increaser Undesirable Herbaceous Species</td>
<td>Disturbance plants generally do not have deep binding root mass to protect streambanks and they provide minimal structural and habitat diversity when present in high densities. These plants are not as palatable to wildlife and livestock.</td>
</tr>
<tr>
<td>Streambank Root Mass Protection</td>
<td>Root mass provided by native vegetation acts similar to rebar and holds streambanks together, preventing erosion and limiting lateral cutting.</td>
</tr>
<tr>
<td>Human-Caused Bare Ground</td>
<td>Bare ground is void of plants, plant litter, woody material or large rocks and is more susceptible to erosion processes. Human-caused bare ground may be caused by livestock, recreationists and vehicle traffic. It provides an opportunity for disturbance or weed species.</td>
</tr>
<tr>
<td>Streambanks Structurally Altered by Human Activity</td>
<td>Structural alterations of the streambanks (e.g., mechanically broken down by livestock activity or vehicle traffic) increase the potential for erosion while inhibiting the establishment of riparian vegetation.</td>
</tr>
<tr>
<td>Human Physical Alteration to the Rest of the Site</td>
<td>Stable streambanks maintain channel configuration and bank shape. Altered streambanks may increase erosion and mobilize channel and bank materials, water quality can deteriorate and instability can increase downstream.</td>
</tr>
<tr>
<td>Stream Channel Incision (Vertical Stability)</td>
<td>Incision can increase stream energy by reducing sinuosity, water retention and storage and increase erosion.</td>
</tr>
</tbody>
</table>
Early descriptions of the watershed note that from the confluence of the North Milk River and mainstem Milk River, the river valley was treeless and slopes comparatively gentle. Below Pendant d’Oreille (downstream of Writing-on-Stone Provincial Park) downstream to the Lost River, the banks are very high and steep and the area adjacent to the river is composed principally of badlands. The valley is narrow, wooded and deeply cut by freshet channels from the clay and sandstone formation above. The bed of the river along this stretch is quicksand and shifts greatly at high stages (Jones and Burley 1920). From the mouth of Lost River to Havre, the river banks and bed resemble the upstream reach, however the banks are lower and less steep. The valley is wider, but the land is poor, the vegetation is scant and forests are lacking. Below Havre, the hills are lower, the slopes are gentle and the valley contains “first class” agricultural land. From Havre to the mouth of the river, there is a considerable growth of trees, such as large poplars and willows (Jones and Burley 1920).
Lotic Riparian Areas

Alberta

Riparian health data for the Milk River watershed in Alberta was acquired through Cows and Fish who compiled the data according to major river reach (Reaches 1 to 4) and the Eastern tributaries (Reach 5) (Figure 7.1). A total of 220 riparian sites were inventoried or assessed within the Milk River watershed by Cows and Fish from 1997 to 2011. Eighty-six of the 220 sites were on tributaries, and of these, 58 (67%) of the sites were on Reach 5 - the Eastern Tributaries. About 130 km of riparian lands were assessed in the past 15 years along the mainstem Milk River and 218 km assessed along tributaries (Table 7.2). Of the 55 mainstem sites originally assessed at Reach 4 in 1998 and 1999, 25 sites (46%) were re-visited, 15 sites in 2008 and 10 sites in 2011. Four sites on the same tributary and one lentic site have been re-assessed in Reach 5 in 2001 and 2003.

At tributary sites, the state of riparian indicators are described in Table 7.3. Unhealthy ratings for invasive and disturbance plants are common among all reaches. Invasive plants do not provide deep-binding root mass for streambank protection and they provide minimal structural and habitat diversity when present in high densities. Weeds impact wildlife and livestock by replacing the vegetation they utilize for shelter and food.

Unhealthy ratings for preferred tree/shrub utilization (Reach 1, 4 and 5) and preferred tree/shrub regeneration (Reach 1, 3 and 4) is common among tributaries. If improved conditions exist for these two parameters, root mass protection can be expected to improve

(Reaches 3, 4 and 5). Preferred tree/shrub utilization occurs from wildlife and also domestic livestock. Trees and shrubs are vulnerable to increased browse when forage material, such as grasses and forbs, is reduced due to drought conditions, overgrazing by livestock and wildlife, or when the forage becomes less palatable in the fall and trees and shrubs are preferred. Heavy browse can deplete root reserves, inhibit establishment and regeneration, cause the loss of preferred woody species, lead to replacement by less desirable wood species and lead to invasion by disturbance or weed species.

Table 7.2. Summary of total river kilometres assessed in the Milk River watershed since 1997, Alberta.

<table>
<thead>
<tr>
<th>Milk River Reach</th>
<th>Mainstem</th>
<th>Tributaries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reach 1</td>
<td>11.5</td>
<td>12</td>
</tr>
<tr>
<td>Reach 2</td>
<td>15.3</td>
<td>38</td>
</tr>
<tr>
<td>Reach 3</td>
<td>46.2</td>
<td>44</td>
</tr>
<tr>
<td>Reach 4</td>
<td>56.6</td>
<td>40</td>
</tr>
<tr>
<td>Reach 5</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Wetlands</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>129.6</strong></td>
<td><strong>-</strong></td>
</tr>
</tbody>
</table>
For riparian sites that were assessed on the mainstem Milk River, the state of riparian indicators is described in Table 7.4. All mainstem sites were impacted by the St. Mary/Milk River Diversion that increases flows above natural from about March through September each year. Thus, all sites received an Unhealthy rating (except Reach 2 - South Fork Milk River) for the indicator “removal or addition of water from/to the river system”. The diversion has been operational since 1917 and will continue to operate to meet the terms outlined in the Boundary Waters Treaty 1909 and the IJC Order of 1921. Emphasis was placed on the equal sharing of water in these early documents and flows that may be required for environmental function was not considered. Altering the timing and duration of augmented flows to the Milk River may reduce the occurrence of frequent scouring of riverbanks by high flows and ice, and allow point bars to form and thus improve conditions for tree and shrub regeneration.

Current flow management generates a flow regime with very little within-year seasonal variability. Managing flow recession and providing seasonal flow variability within this range of flows will likely result in improved riparian conditions on the Milk River in Alberta (Golder Associates 2010).

An Unhealthy rating for invasive and disturbance plants was common to all reaches of the mainstem Milk River.

Unhealthy ratings were also assigned to the indicators root mass protection and preferred tree/shrub utilization for all reaches. Improved rootmass protection may be achieved by reducing utilization of preferred trees and shrubs and improving the regeneration of trees, including cottonwoods, poplars, other

Table 7.3. Status of lotic riparian health indicators for tributaries in three main reaches (1997 to 2011), Milk River, Alberta. Note that no tributaries were assessed in Reach 2.

<table>
<thead>
<tr>
<th>Riparian Health Indicator</th>
<th>Tributaries</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Reach 1</td>
</tr>
<tr>
<td>Channel incisement</td>
<td></td>
</tr>
<tr>
<td>Human-caused alterations to the site</td>
<td></td>
</tr>
<tr>
<td>Human-caused alterations to banks</td>
<td></td>
</tr>
<tr>
<td>Human-caused bare ground</td>
<td></td>
</tr>
<tr>
<td>Root mass protection</td>
<td></td>
</tr>
<tr>
<td>Disturbance plants</td>
<td></td>
</tr>
<tr>
<td>Invasive plants</td>
<td></td>
</tr>
<tr>
<td>Woody vegetation removal other than browse</td>
<td></td>
</tr>
<tr>
<td>Preferred tree/shrub utilization</td>
<td></td>
</tr>
<tr>
<td>Dead and decadent woody material</td>
<td></td>
</tr>
<tr>
<td>Preferred tree/shrub regeneration</td>
<td></td>
</tr>
<tr>
<td>Vegetative cover</td>
<td></td>
</tr>
</tbody>
</table>

Table 7.4. Status of lotic riparian health indicators at the four Milk River mainstem reaches (1997 to 2011), Milk River, Alberta. NC is not collected and NA is not applicable.

<table>
<thead>
<tr>
<th>Riparian Health Indicator</th>
<th>Mainstem</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Reach 1</td>
</tr>
<tr>
<td>Floodplain accessibility</td>
<td></td>
</tr>
<tr>
<td>Human-caused alterations to the site</td>
<td></td>
</tr>
<tr>
<td>Human-caused alterations to banks</td>
<td></td>
</tr>
<tr>
<td>Control of flood peak and timing by upstream dam(s)</td>
<td></td>
</tr>
<tr>
<td>Removal or addition of water from/to the river system</td>
<td></td>
</tr>
<tr>
<td>Human-caused bare ground</td>
<td></td>
</tr>
<tr>
<td>Root mass protection</td>
<td></td>
</tr>
<tr>
<td>Disturbance plants</td>
<td></td>
</tr>
<tr>
<td>Invasive plants</td>
<td></td>
</tr>
<tr>
<td>Total canopy cover of woody species</td>
<td></td>
</tr>
<tr>
<td>Woody vegetation removal other than browse</td>
<td></td>
</tr>
<tr>
<td>Preferred tree/shrub utilization</td>
<td></td>
</tr>
<tr>
<td>Dead and decadent woody material</td>
<td></td>
</tr>
<tr>
<td>Preferred shrub regeneration</td>
<td></td>
</tr>
<tr>
<td>Regeneration of other native tree species</td>
<td>NA</td>
</tr>
<tr>
<td>Cottonwood and poplar regeneration</td>
<td></td>
</tr>
</tbody>
</table>

Healthy (little or no impairment to riparian function) | Healthy, with problems (some impairment to riparian functions) | Unhealthy (impairment to many riparian functions)
native trees and shrubs (particularly at Reach 3 and Reach 4). Root mass protection provides stability to riverbanks and reduces erosion that may be caused by irregular flow patterns.

**Reach 4: Re-visits**

At Reach 4, 25 sites that were assessed in 1998 and 1999 were re-assessed in 2008 and 2011. For the first assessments (1998 and 1999), the average score was 56, rating riparian areas in this reach Unhealthy. In the re-assessment, the average score was slightly improved (62) rating riparian areas at the lower end of the Healthy with Problems category (Figure 7.2). There was a marked improvement in the indicator “preferred tree and shrub regeneration” that improved from an Unhealthy rating to a Healthy rating in the re-assessment (Figure 7.3). The scores for indicators “total canopy cover of woody species” and “human-caused alterations to banks” also improved in the re-assessment. Scores were lower in the re-assessment for indicators associated with invasive and disturbance plants (Figure 7.3).

![Cottonwood seeds](image-url)
Reach 5: Re-visits

At Reach 5, four tributary sites that were assessed in 2001 were re-assessed in 2003. For the first assessments (2001), the average score was 51, rating riparian areas in this reach Unhealthy. In the re-assessment, the average score was slightly improved (64) rating riparian areas in the lower end of the Healthy with Problems category. Similar to Reach 4 findings, there was a marked improvement in the indicator “preferred tree and shrub regeneration” that improved from an Unhealthy rating to a Healthy rating in the re-assessment (Figure 7.4). The scores were also higher in the re-assessment for indicators associated with invasive and disturbance plants (Figure 7.4).

![Cottonwood seedling](image1)

![Willow sapling and sedges](image2)

Figure 7.4. Comparison of riparian health indicators at Reach 5 - Eastern Tributaries, reported by Cows and Fish, 2001 (top bar) and 2003 re-visits (bottom bar) (N=4), Alberta. Green indicates Healthy, yellow indicates Healthy with Problems and red indicates Unhealthy ratings. NC is not collected.
Saskatchewan

Trends in riparian health in Saskatchewan cannot be assessed on a site-by-site basis since very few riparian areas in the watershed have been sampled more than once and the site selection process is typically project-related. Differences in the average riparian health by watershed were assessed between two time periods. The average health of riparian areas that were sampled between 1999 and 2003 was compared to the average health of riparian areas that were sampled between 2004 and 2008 (SWA 2010).

For the Milk River watershed, ten assessments were completed between 1999 and 2003. The average scores show that riparian areas are stressed (average score of 60% to 79%). From 2004 to 2008, only five assessments were completed and this was not enough to generate an average score.

Saskatchewan also uses the percent of riparian buffer as an indicator of health. The percent of permanent cover within a 40 m (131 ft) buffer of a waterway or waterbody rated healthy (75% to 100%) in the Milk River watershed (SWA 2010).
Montana

Multiple agencies and organizations have assessed riparian and wetland health in Montana using the methods developed by Hanson et al. (2000). However, there is no central location or organization storing this data; thus, the data is challenging to locate and access. Other agencies and organizations have collected and reported on riparian condition in the Milk River watershed using different methods than those described by Hanson et al. (2000).

In one study, wetlands and riparian areas were surveyed during the summers of 2001 and 2002 using Community Viability Ranking Criteria developed by The Nature Conservancy and the Natural Heritage Network (NatureServe 2002). Factors that were considered in the viability ranking were condition, landscape context, diversity, rarity and size (Table 7.5). Each factor that was assessed was assigned an overall condition rank, based on riparian health indicators, that ranged from A to D, with A being excellent and D being poor (Table 7.6).

About 73 sites were assessed in the Milk River watershed, Montana during the summers of 2001 and 2002 (Jones 2003).

Table 7.5. Indicators and relative importance of criteria used to rank ecological and conservation significance of wetland and riparian sites in the Milk River watershed, Montana.

<table>
<thead>
<tr>
<th>Factor (% of Overall Rank)</th>
<th>Riparian Health Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Condition (25%)</td>
<td>Alteration of hydrologic, geomorphic, or biogeochemical processes.</td>
</tr>
<tr>
<td></td>
<td>Presence of intact, representative native plant communities with characteristic structure and composition.</td>
</tr>
<tr>
<td></td>
<td>Presence of exotic species or cultural vegetation.</td>
</tr>
<tr>
<td>Landscape Context (25%)</td>
<td>Extent of land uses in the surrounding uplands that disrupt hydrologic and habitat connectivity among the site, uplands, and adjacent wetlands.</td>
</tr>
<tr>
<td>Diversity (20%)</td>
<td>Number of plant communities, number of structural vegetation types, number of hydrologic classes.</td>
</tr>
<tr>
<td>Rarity (20%)</td>
<td>Number and condition of rare plants, animals, or plant communities present at the site.</td>
</tr>
<tr>
<td>Size (10%)</td>
<td>Size of site.</td>
</tr>
</tbody>
</table>
Table 7.6. Summary of rank descriptions assigned to riparian areas in the Milk River watershed, Montana (Jones 2003).

<table>
<thead>
<tr>
<th>Rank</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Sites have the greatest ecological and conservation significance that is in good to excellent condition. These sites have high quality native plant communities, with few to no exotic species present. There are minimal anthropogenic influences at these sites or in their surrounding uplands, therefore, wetland functions are largely intact and most likely fall within the range of natural variation.</td>
</tr>
<tr>
<td>B</td>
<td>Sites support diverse, high quality plant communities, but they have a greater degree of anthropogenic disturbance either on- or off-site compared to A-Rank sites. These disturbances are localized and/or minimal and are restorable. May support a number of state rare plant or animal species. Most of the wetland plant communities at these sites are in excellent condition, but a few have moderate impacts. Improvement in resource management, such as changing grazing management plans or reducing trapping pressure on beaver, would improve the overall suite of wetland functions at these sites.</td>
</tr>
<tr>
<td>C</td>
<td>Sites have been degraded by systematic hydrologic or geomorphic modifications or by disruptive land uses in the wetland or its surrounding uplands. These sites may still support high quality native plant communities, but exotic species are often widespread. Alternatively, these sites may be homogenous wetlands in good condition dominated by structurally simple, common communities, such as broadleaf cattail (<em>Typha latifolia</em>) monocultures. Although these wetlands are often degraded, they perform some hydrologic function.</td>
</tr>
<tr>
<td>D</td>
<td>Sites have been significantly affected by hydrologic or geomorphic alterations and often provide poor function or habitat values. Vegetation at these sites is often degraded with little to no regeneration and exotic weeds may be widespread. The uplands may have been converted from native vegetation to agricultural or residential land uses, or the site may have become hydrologically isolated or been subject to excessive sedimentation, erosion and nutrient loading.</td>
</tr>
<tr>
<td>0</td>
<td>Sites with no rare elements.</td>
</tr>
</tbody>
</table>

The results of the 2001 and 2002 Community Viability Rank Assessment showed that the factors condition, landscape context and rarity generally ranked poorly (C or D) at mainstem Milk River sites (Table 7.7) (Jones 2003). The factors size and diversity ranked better at these sites (generally A and B). Overall, riparian areas ranked poor (C) at all mainstem sites except at the Milk River near Little Cottonwood Creek that received a D-Rank overall. At Milk River tributary sites, riparian ranks were somewhat better, with mainly A-Ranks for diversity, B- and C-Ranks for condition, landscape context and size and C- and D-Ranks for rarity (Table 7.7). Overall, riparian areas ranked Fair (B and C) at tributary sites except Little Cottonwood Creek and Red Rock Coulee that each received a D-rank.

Riparian areas in the Milk River watershed in Montana have been greatly affected by hydrological alterations and land use changes (Jones 2003). The Fresno Dam has substantially altered the downstream hydrology. The Milk River becomes increasingly incised below Fresno Dam, and in many segments it does not appear to be able to access its historic floodplain. Little cottonwood regeneration was observed at any of the sample locations. In addition, riparian forests along the Milk River have been reduced and fragmented by conversion of significant portions of the floodplain to irrigated agriculture and pasture. Although this area is still critically important to the regional biological diversity, these changes have greatly reduced the quantity and quality of riparian habitats, especially cottonwood communities.
The Fresno Dam is noted as the most important factor determining the long-term persistence of cottonwood stands along the lower Milk River. The dam has altered channel forming processes and studies have shown a decrease in channel meander by 1.3 m/year and an overall reduction in channel width of 16.8 m. These changes are primarily due to an average reduction of 60% of peak flows from dam operations.

Despite their small size and ephemeral nature, many of the small Milk River tributaries contain some Plains Cottonwood. However, successful cottonwood recruitment is largely absent due to diversion of flows for irrigation, presence of small dams that regulate flood events and livestock grazing (Jones 2003). Cottonwood recruitment is also threatened by invasion of Russian Olive (*Elaeagnus angustifolia*) along the Milk River, as it has been widely planted for windbreaks within the watershed and does not require periodic flooding for reproduction; it is slowly replacing cottonwood communities within the watershed (Jones 2003).

Table 7.7. Condition ranks for select riparian areas along the Milk River mainstem and tributaries in Montana (Jones 2003).

<table>
<thead>
<tr>
<th>Assessment Area</th>
<th>Ranking Indicator Criteria</th>
<th>Condition</th>
<th>Landscape Context</th>
<th>Diversity</th>
<th>Rarity</th>
<th>Size</th>
<th>Overall Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk River Mainstem</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rookery Wildlife Management Area</td>
<td></td>
<td>C</td>
<td>C/D</td>
<td>A</td>
<td>C</td>
<td>A</td>
<td>C</td>
</tr>
<tr>
<td>Vandalia Dam</td>
<td></td>
<td>C</td>
<td>C/D</td>
<td>A</td>
<td>C</td>
<td>A</td>
<td>C</td>
</tr>
<tr>
<td>Milk River near Rock Creek</td>
<td></td>
<td>C</td>
<td>D</td>
<td>A</td>
<td>C</td>
<td>A</td>
<td>C</td>
</tr>
<tr>
<td>Hewitt Lake National Wildlife Refuge</td>
<td></td>
<td>C</td>
<td>D</td>
<td>B</td>
<td>C</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>Dodson Wildlife Management Area</td>
<td></td>
<td>B</td>
<td>D</td>
<td>A</td>
<td>O</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>Milk River near Little Cottonwood Creek</td>
<td></td>
<td>C/D</td>
<td>D</td>
<td>B</td>
<td>O</td>
<td>A</td>
<td>D</td>
</tr>
<tr>
<td>Milk River Tributaries</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assiniboine Creek Springs</td>
<td></td>
<td>A</td>
<td>B</td>
<td>A</td>
<td>C</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>Alkali Creek</td>
<td></td>
<td>A</td>
<td>B</td>
<td>A</td>
<td>C</td>
<td>C</td>
<td>B</td>
</tr>
<tr>
<td>Beaver Creek</td>
<td></td>
<td>B</td>
<td>B</td>
<td>A</td>
<td>D</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>DHS Creek</td>
<td></td>
<td>C</td>
<td>B</td>
<td>A</td>
<td>C</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>Little Cottonwood Creek</td>
<td></td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>O</td>
<td>B</td>
<td>D</td>
</tr>
<tr>
<td>Red Rock Coulee</td>
<td></td>
<td>C/D</td>
<td>D</td>
<td>A</td>
<td>O</td>
<td>C</td>
<td>D</td>
</tr>
</tbody>
</table>

The Fresno Dam is noted as the most important factor determining the long-term persistence of cottonwood stands along the lower Milk River. The dam has altered channel forming processes and studies have shown a decrease in channel meander by 1.3 m/year and an overall reduction in channel width of 16.8 m. These changes are primarily due to an average reduction of 60% of peak flows from dam operations.

Despite their small size and ephemeral nature, many of the small Milk River tributaries contain some Plains Cottonwood. However, successful cottonwood recruitment is largely absent due to diversion of flows for irrigation, presence of savoy creek, Montana
**Wetlands (Lentic Riparian Areas)**

**Alberta**

In southern Alberta, about 64% of wetlands have been lost since settlement. Alberta loses approximately 0.3 - 0.5% of wetlands each year due to drought, population growth, industrial development, land use changes, management practices and policies (AESRD 2012). There is currently no recent study that has documented the remaining wetland area in the Milk River watershed in Alberta, however, Figure 7.5 shows that the percentage of area within the Milk River watershed ranges from one to four percent in the central and western part of the watershed and from four to eight in the eastern part of the watershed. There is an isolated area north and east of the Milk River mainstem where wetlands cover 8 to 13% of the area (Figure 7.5).

In Alberta, 12 wetland health assessments were completed in the Milk River watershed during the period 1998 to 2008 (generally two assessments per year in 2002, 2003, 2006 and 2008). Five of the sites were assessed in Reach 4 and seven sites were assessed in Reach 5. The results showed that 25% of sites were rated as Healthy, 42% of sites were rated as Healthy with Problems and 33% were rated as Unhealthy (Cows and Fish unpublished).

Indicators that rated Healthy were vegetative cover, preferred tree and shrub regeneration, woody vegetation removal other than browse and artificial water level change (Figure 7.6). Two indicators “human-caused alterations to vegetation” and “human-caused bare ground” were rated Healthy with Problems. The indicator “vegetative cover” rated Healthy, but the indicators “invasive plants” and “disturbance plants” that contribute to vegetative cover rated Unhealthy. In addition, indicators related to human disturbance also rated Unhealthy; these were “human-caused alterations to site” and “severity of human-caused alterations”.

![Figure 7.5. Areal extent of wetlands in the agricultural area of Alberta (Agriculture and Agri-Food Canada, Ducks Unlimited and Alberta Agriculture, Food and Rural Development.](image)

![Figure 7.6. Summary of riparian health indicators for wetlands in Reach 4 and Reach 5 reported by Cows and Fish, 1998 to 2008 (N=12), Alberta. Green indicates Healthy, yellow indicates Healthy with Problems and red indicates Unhealthy ratings.](image)
**Saskatchewan**

Although wetlands are numerous in the province of Saskatchewan, the size of most wetlands is small. Over 80% of the wetlands cover less than one hectare and less than one quarter of one percent of wetlands are greater than 50 ha in size (Huel 2000). It has been estimated that 40% of wetlands have been lost and half of those remaining are threatened. Loss of wetlands is largely due to drainage and degradation (Huel 2000). No data could be found that documented the present status of wetlands specifically in the Milk River watershed in Saskatchewan.

**Montana**

It has been estimated that over 25% of wetlands have been lost to anthropogenic alterations in Montana (Jones 2003). In 2011, multiple wetlands were assessed across the Milk River watershed in Montana using the three-tiered assessment method (McIntyre et al. 2011). Level 1, 2 and 3 assessments were conducted to identify potential anthropogenic stressors in the Milk, Marias and St. Mary’s watersheds. A Level 1 landscape analysis was used to characterize potential landscape level disturbances (e.g., landcover/land use, hydrology and roads) at three spatial scales (100, 300 and 1,000 m) around the perimeter of the wetland. A Level 2 rapid wetland assessment was completed at 123 sites that involved field measurements of ecological attributes that reflect the structure and function of the wetland. Indicators were assigned a rating that was then summarized into an overall score for five attributes: 1) landscape context, 2) relative patch size, 3) biotic, 4) physiochemical, and 5) hydrology. The ratings of these five attributes were combined to produce an overall EIA condition score. Level 3 field assessments were undertaken and used to calculate site-specific indices of biological integrity at 44 of the 123 sites evaluated in the Level 2 assessment.

The Level 1 landscape analysis showed that the area near Wildhorse/Simpson had the highest wetland density (14 - 21 per acre) and in the central part of the watershed north of Savoy and Malta to the international border (McIntyre et al. 2011) (Figure 7.7 B). In the Lower Milk River reaches, the percentage of altered wetlands exceeded the percentage of natural, unaltered wetlands (Figure 7.7 C). Eighty-one percent of wetlands in the project area were located on private land and were characterized as freshwater emergent wetlands with a temporarily or seasonally flooded water regime (Figure 7.7 D). Only a small percentage of wetlands were located on state or federal lands. See accompanying DVD for more study details.

Figure 7.7. Map series showing the results of the Level 1 landscape analysis in the Milk River watershed, Montana.
Level 2 rapid wetland assessments were conducted during the summer of 2009. Most sites were located within the Milk River watershed. Wetlands were grouped into four categories: relatively unaltered (score 90 - 100), slightly altered (score 80 - 89), moderately altered (score 70 - 79), and severely altered (score < 70). Overall condition scores ranged from 50 to 100. Twenty five percent of wetlands fell into the severely altered category (Figure 7.8). The highest number of sites fell into the 70 - 79 condition category (moderately altered) and only 16% of sites were scored 90 - 100 (slightly altered) (Figure 7.8).

![Pie chart showing the percentage of wetlands scored in each condition category](chart)

Figure 7.8. Percentage of wetlands that fall into each condition category, Montana (adapted from McIntyre et al. 2011).

Level 3 vegetation data was collected at 44 sites and then extrapolated to wetland condition for each site in the study area. Since the majority of the wetlands were depressional wetlands that undergo cyclic fluctuations in water levels, metrics were calculated and compared separately for wetlands classified as temporary, seasonal, or semi-permanent. However, there was very little variability found between the wetlands with different water regimes. Minor increases in species richness (or the number of species present) were observed with increasing water duration. Most of the wetlands assessed were dominated by species that can tolerate and are characteristic of moderate disturbance. A high-valued riparian community was only observed at a couple of sites. The dominant human disturbances affecting wetland condition were roads, conversion of temporary and seasonal wetlands to dryland farming and ponds for watering livestock, and soil and vegetation disturbance associated with heavy livestock grazing (McIntyre et al. 2011).

Results for the rapid assessments indicate that among depressional wetlands, Great Plains Prairie Potholes and Great Plains Saline Depressions are in better condition than either Great Plains Open or Closed Depressions. Higher condition scores for Great Plains Prairie Potholes and Western Great Plains Saline Depressions can be attributed to fewer impacts from livestock grazing. Prairie potholes occur in wetland complexes so that the effects of livestock are more evenly distributed on the landscape and saline depressions are often dominated by vegetation that is unpalatable.
The effects of human induced disturbance to wetlands may compound with natural disturbances including drought (McIntyre et al. 2011). Drought may affect wetland condition more than local or landscape level human disturbance. Despite hydrological and landuse modification, there are still large areas of high density wetlands remaining in Montana where native grassland persists, and continued sustainable management is critical for their conservation (Jones 2003).

### Status of Riparian Areas (Lotic)

**Riparian Condition is:**

![Diagram showing riparian condition](image)

Few riparian monitoring programs revisit the same site more than once, and occasionally different methods are used in the assessment. This makes assessment of riparian condition difficult since there is no data available for comparison. Effort should be made to revisit riparian sites about five years after the first assessment takes place.

### Status of Wetlands (Lentic)

**Area of Land Covered by Wetlands is:**

![Diagram showing area of land covered by wetlands](image)

Although it is known that 25% of wetlands in Montana and 64% of wetlands in Southern Alberta have been lost, the loss of wetlands in the Milk River watershed is not well understood. It is likely that the wetland area is decreasing due to drainage, cultivation or infill; however, there is no data to support this status designation. Effort should be made to document historical condition, present condition and monitor wetland trends periodically to identify whether wetland density is increasing, stable or decreasing.

**Wetland Condition is:**

![Diagram showing wetland condition](image)

Similar to above, there are few wetland monitoring programs that revisit the same site more than once, and different methods of assessment may be used in different studies. This makes assessment of wetland condition difficult since there is no data available for comparison.
8.0 Biodiversity

8.1 Fish

Fish are important indicators of the ecological integrity of aquatic systems. Species composition or species richness (the number of species present) and abundance, barriers to fish passage, the number of introduced species and the species considered “at risk” or “of concern” all provide an indication of whether a river is providing quality habitat (e.g., sufficient stream flows and good water quality) to support a diverse and healthy fish community. Fish studies have varied in frequency and effort in the Milk River watershed; the following provides an overview of the status of fish in the watershed.

**Fish Species Composition is:**

Willock (1969) completed the first synoptic survey of fish in the Milk and North Milk rivers (Alberta), plus most of the creeks in the Alberta portion of the Missouri drainage. Although a number of studies have been conducted since then, they have been for specific purposes and not synoptic in nature. In Alberta, studies completed in the 1970s and 1980s were undertaken in relation to water storage project proposals, focusing primarily on potential dam sites. Studies conducted in Montana during the same timeframe focused primarily on species presence/absence and relative abundance.

Studies completed since 2000 in Alberta and Montana have primarily been to assess the status of species at risk. The most current and complete data set is found in the lower Milk River from Vandalia Dam (Montana) to the confluence with the Missouri River. In either jurisdiction there have not been any collections comparable to Willock’s, and as such, it is difficult to compare the various studies to determine how the fishery has changed since the 1960s.

Capture methodology differed between Willock’s collections and most of the later studies. Willock’s sampling was done primarily with a beach seine, although set lines were used at some locations. An electrofisher was tried with little success in the Milk and North Milk rivers, and traps and gill-nets were used but river current and debris rendered them impractical for most of the field season. Most of the more recent studies have employed backpack or boat electrofishers and seine as the key gear. Downstream of Writing-on-Stone Provincial Park the substrate is much finer, and seine nets have been most successful.

Another variable that has changed since the 1960s has been fish species stocked in Fresno Reservoir, Montana. This reservoir is the farthest upstream impoundment on the Milk River. There is approximately 75 km (47 mi) of lotic (flowing) habitat between this reservoir and the Eastern Crossing, upstream, with no physical barriers to the movement of fish from Fresno Reservoir into Alberta.

Sauger are found in the mainstem Milk River in Alberta.
Species Composition

Species composition is one indicator used to describe changes in the fishery through time. Willock (1969) reported that he captured 20 fish species in the Milk River and tributaries in Alberta. These included five species of sport fish and 15 non-sport fish species. More recent studies conducted since 2000 have reported the capture of 22 species (Map 8.1).

Two species, the Cutthroat Trout (Oncorhyncus clarki) and Finescale Dace (Phoxinus neogaeus), were collected by Willock (1969) but have not been captured recently. Both of these species were represented by one individual so it is not surprising that they have not been observed recently. The Cutthroat Trout most likely originated from the St. Mary River and was diverted by the St. Mary Canal into the North Milk River. Four fish species have been captured recently that were not collected by Willock (1969). These are the Trout-perch (Percopsis omiscomaycus), Yellow Perch (Perca flavescens), Lake Whitefish (Coregonus clupeaformis) and Walleye (Sander vitreus). Both Lake Whitefish and Walleye were represented by single individuals, while only a few Yellow Perch were collected. Trout-perch are becoming more common in collections near the Town of Milk River. Trout-perch are typically found in deposition areas (low velocity areas having silt or sand bottoms) and use boulders to hide under during the day. Lake Whitefish and Trout-perch likely reached the Milk River drainage by downstream movement, via the St. Mary Diversion Canal. Mogen and Kaeding (2001) reported that Trout-perch are native to the St. Mary River and that Lake Whitefish were stocked into waters within the drainage and have become self-sustaining.

Milk River (South Fork) and North Milk River, Alberta

In the South Fork Milk and North Milk rivers, the four most common species collected by Willock (1969) were White Sucker (Catostomus commersoni) (27%), Longnose Sucker (Catostomus catostomus) (21%), Longnose Dace (Rhinichthys cataractae) (19%), and Flathead Chub (Hybopsis gracilis) (9%). In total, 18 fish species were captured.

RL&L undertook collections for species at risk in the Milk and North Milk rivers in 2000 and 2001. They captured a total of 14 species, and the four most common species were Flathead Chub (74%), Longnose Dace (14%), White Sucker (3%) and Longnose Sucker (3%).

Species collected by Willock (1969), but not by RL&L (2002), included Mountain Whitefish (Prosopium williamsoni), Cutthroat Trout, Northern Pike (Esox lucius), Northern Redbelly Dace (Phoxinus eos), Fathead Minnow (Pimephales promelas) and Iowa Darter (Etheostoma exile). Brassy Minnow (Hybognathus hankinsoni) and Trout-perch were captured by RL&L, but not by Willock.

White Suckers and Longnose Suckers were most abundant in Willock’s study, while the more recent study observed that Flathead Chub was the most abundant. The difference may be explained by capture methods, timing of sampling and site locations. Willock (1969) primarily used seining, while RL&L used both backpack electrofishing and seining. Backpack electrofishing is most suitable for sampling cobble/boulder habitats, common in the North Milk River, and riffle habitat around the Town of Milk River. Generally, the North Milk River provides better habitat for Suckers than for Flathead Chub.

The top four species collected in the late 1960s and early 2000s has not changed, only the percentage of each species. This suggests that during the three decades between the studies, there was no substantial change in the most abundant species composition.
Writing-on-Stone Provincial Park to Eastern Crossing, Alberta

Clayton and Ash (1980) divided the mainstem Milk River, Alberta, into six reaches, based on stream gradient and substrate size. The lower reach, which extends from upstream of Writing-on-Stone Provincial Park and to the Eastern International Border Crossing has been sampled most frequently due to concerns with species at risk. The gradient in the lower reach was approximately 0.65 m/km, much lower compared to upstream reaches, and the substrate was dominated by fines (i.e., silt and sand) compared to the upper reaches that contained a higher percentage of gravel, cobbles and boulders. Due to the unique conditions of the lower reach, it was dominated by different species compared to those collected farther upstream.

Willock (1969) documented the earliest fish collections in the lower reach. Downstream of Police Creek, located near the western edge of Writing-on-Stone Provincial Park, the four most common species were Flathead Chub (38%), Lake Chub (*Couesius plumbeus*) (37%), Longnose Sucker (10%) and Longnose Dace (4%) (Sikina and Clayton 2006). The principal collection method was seining, similar to Willock’s study. The 2005 survey resulted in the capture of 17 species, compared to 12 species captured by Willock in the same reach. Species captured downstream of Police Creek in 2005 that were not observed in the late 1960s included Trout-perch, Burbot (*Lota lota*), Rocky Mountain Sculpin (*Cottus spp.*), Brassy Minnow and Brook Stickleback (*Culaea inconstans*). There were not more than four individuals of the aforementioned five species captured, so these species are relatively rare downstream of Police Creek.

Fisheries and Oceans Canada (DFO) conducted surveys in July 2005, and May, August and October of 2006. These surveys were completed at the reach extending from the Highway 880 Bridge (near Aden and about 40 river kilometres downstream of Police Creek) to the Eastern International Border Crossing. The primary collection method was boat electrofishing, and the secondary method was seining. In the July survey, the four most common species collected were Flathead Chub (38%), Western Silvery Minnow (*Hybognathus argyritis*) (19%), Longnose Sucker (15%), and White Sucker (3%). In the May study, the four most common species collected were Western Silvery Minnow (52%), Flathead Chub (42%), Sauger (*Sander canadensis*) (2%), and White Sucker (2%). There were 10 fish species observed in July 2005 and 9 species observed in May 2006.

Over the last four decades, Flathead Chub have remained the most numerous species downstream of Police Creek. The latest surveys conducted by DFO suggest that Western Silvery Minnow numbers are increasing, since this species is contributing a larger percentage to the total catch. However, a substantial amount of survey effort by DFO was in the farthest downstream part of the river, a section that had relatively little sampling effort conducted earlier (Willock 1969, RL&L 2002, and Sikina and Clayton 2006). In addition, the primary sampling method by DFO was boat electrofishing, in comparison to the other studies, which relied mainly on seining. Boat electrofishing may be the preferred method for capturing Western Silvery Minnow in the Milk River. Differences in the relative ranking (i.e., percent abundance) for other species between years probably reflects the physical habitat present at the time of sampling.
Eastern Crossing to the Confluence with the Missouri River

In Montana, very little fisheries data has been collected since the 1990s; most current studies focus on the lower Milk River (i.e., Vandalia Dam to its confluence with the Missouri River). There are a few exceptions. Studies have tried to collect Sauger genetic samples near the Eastern Crossing since 2010. Although there has been no success to date, crews did observe Stonecat (*Noturus flavus*), Flathead Chub, Northern Pike and Burbot during this sampling effort. Currently, Montana Fish, Wildlife and Parks (FWP) is working to establish a standardized sampling protocol to track long-term trends on the Milk River from the Eastern Crossing to Vandalia Dam.

The fish assemblage of the Milk River downstream of Vandalia Dam is highly interconnected to the Missouri River and contains high native and non-native species richness. The abundance of native and non-native fish can vary greatly on a seasonal or yearly basis depending on the river’s discharge and the number of fish migrating upstream from the Missouri River. Five Montana Species of Special Concern inhabit the lower Milk River during certain flow regimes and seasons. Paddlefish (*Polyodon spathula*), Sauger, Blue Sucker (*Cycleptus elongates*), Sicklefin Chub (*Macrhybopsis meeki*) and Sturgeon Chub (*Macrhybopsis gelida*) have all been captured in the lower Milk River in recent years (Fuller and Braaten 2013). Game fish that occur in this section include Channel Catfish (*Ictalurus punctatus*), Sauger, Walleye, Shovelnose Sturgeon (*Scaphirhynchus platyrynchus*), Northern Pike, Burbot, Lake Whitefish, Smallmouth Bass (*Micropterus dolomieu*) and Paddlefish. Non-game fish include, but are likely not limited to, Pallid Sturgeon (*Scaphirhynchus albus*), Bigmouth Buffalo (*Ictiobus cyprinellus*), Smallmouth Buffalo (*Ictiobus bubalus*), River Carpsucker (*Carpioide scarpio*), Blue Sucker, White Sucker, Longnose Sucker, Shorthead Redhorse (*Moxostoma macrolepidotum*), Freshwater Drum (*Aplodinotus grunniens*), Goldeye (*Hiodon alosoides*), Stonecat, Black Bullhead (*Ameiurus melas*), Flathead Chub, Sicklefin Chub, Sturgeon Chub, Sand Shiner (*Notropis stramineus*), Emerald Shiner (*Notropis atherinoides*), Spottail Shiner (*Notropis hudsonius*), Fathead Minnow, Brassy Minnow, Western Silvery Minnow, Plains Minnow (*Hybognathus plactitus*) and Common Carp (*Cyprinus carpio*).

The lower Milk River (i.e., Vandalia Dam to its confluence with the Missouri River) serves as a spawning ground for several large-bodied Missouri River fishes. FWP have used radio telemetry and larval sampling techniques in this reach since 2001. Data have shown that when the discharge in the Milk River increases in the spring or early summer, several species migrate into the Milk River from the Missouri River and spawn (Fuller and Braaten 2013). Telemetry data indicate that Paddlefish move into the Milk River from the Missouri River when flows approach 28 m$^3$/s (1,000 ft$^3$/s) and remain in the river as long as flows do not subside (Fuller and Braaten 2013). In addition, larval Paddlefish have been collected in the Milk River drift in years that spring flows exceed 28 m$^3$/s (Fuller and Braaten 2013). The total days that larval Paddlefish were found in the Milk River drift was positively correlated with the longevity of flows exceeding 28 m$^3$/s (Fuller and Braaten 2013), where the longer the duration of flow occurs the longer larval Paddlefish are present.
Similar to Paddlefish, Blue Suckers migrate into the Milk River during the late spring/early summer when discharge approaches $28 \text{ m}^3/\text{s}$ ($1,000 \text{ ft}^3/\text{s}$) (Fuller and Braaten 2013). These fish migrate into the Milk River and presumably spawn. When flows fall below $28 \text{ m}^3/\text{s}$, Blue Suckers migrate back into the Missouri River, where approximately half of them remain. The other half move downstream to begin their migration upstream to the Yellowstone River. Although Blue Suckers consistently migrate into the Milk River during the spring when adequate flows are present, few larvae or young-of-the-year have been sampled in either the Milk or Missouri rivers. In addition, standardized trammel netting and otter trawling of the Missouri River has captured very few smaller and presumably younger age classes of Blue Suckers over the past several years of sampling. At this time, Blue Sucker production and recruitment is poorly understood in the Missouri/Milk river system.

Additionally, Sauger use the lower Milk River during their spring spawning period. The relative abundance of Sauger increases during April through early June as Sauger migrate into the Milk River from the Missouri River (Haddix 2012). The Sauger that use the lower Milk River for spawning are of relatively pure genetic makeup, with little to no hybridization with Walleye occurring (FWP data). While both Sauger and Walleye inhabit the lower Milk River, spring electrofishing data indicate that Sauger are more than twice as abundant as the non-native Walleye. However, spill events at Fort Peck Dam greatly increase the abundance of adult Walleye in the Missouri River adjacent to the Milk River and may increase Walleye abundance within the Milk River during the spring spawning period.

Channel Catfish are prevalent year round within the lower Milk River. While Channel Catfish are abundant, their population is made up of smaller individuals when compared to other high quality Channel Catfish waters within Montana. This may be due to limited food as a result of high densities or low forage production in drought years, which occurs routinely in the lower Milk River due to irrigation withdrawals. Currently, Montana FWP is conducting a Channel Catfish age and growth study to better understand the age structure and individual growth rates of the lower Milk River population compared to the Missouri and Yellowstone river populations.
Reservoir Fisheries on the Milk River

**Fresno Reservoir** Located 19 km (12 mi) northwest of Havre, Fresno Reservoir is a mainstem reservoir built in 1939 on the Milk River to function as an irrigation storage facility. The reservoir encompasses 2,330 hectares (5,757 acres) with a mean depth of 8 m (27 ft) and a maximum depth of 15 m (48 ft). Fresno Reservoir was initially managed as a Rainbow Trout (*Oncorhynchus mykiss*) fishery in the 1940s and 1950s; however, an illegal introduction of Northern Pike in the 1940s resulted in a severe decline in the Rainbow Trout fishery. As a result, Fresno Reservoir was developed into a warm-water fishery supporting Walleye, Northern Pike, Yellow Perch, Black Crappie (*Pomoxis nigromaculatus*), Lake Whitefish, Emerald Shiner and Spottail Shiner. Fresno Reservoir ranked second in the region (Fort Peck Reservoir ranked first) for angler pressure in 2009-10 with 19,362 (+/- 2,392) angler days (McFarland 2010). Fresno Reservoir continues to build its reputation as one of the premiere Walleye reservoirs in Montana.

The fishery in Fresno Reservoir has fluctuated throughout the years largely due to fluctuations in water levels. On average, water levels in Fresno Reservoir fluctuate 6.4 m/yr (21.1 ft/yr) with an annual water retention rate of 4 days. The timing of this fluctuation greatly impacts the reproduction and survival of forage and sport fish. The fishery in Fresno Reservoir was severely impacted in 2001 and 2002 when severe drought reduced the reservoir to eight percent and four percent of storage capacity, respectively. Forage fish populations were drastically reduced and abundance and condition of key sport fish was poor. In 2004, water levels increased and flooded shoreline vegetation, allowing the successful spawning and recruitment of forage fishes. From 2005 to 2012, water levels have remained high during spring spawning and early summer rearing periods allowing sport and forage fish populations to rebound to unprecedented levels. The continued recovery of the fishery is dependent on maintaining water levels that will allow the successful spawning, recruitment, and overwintering of forage and sport fishes.

**Nelson Reservoir** Located 31 km (19 mi) east of Malta, Nelson Reservoir is an off-stream reservoir constructed in 1915 for irrigation storage. At full storage capacity, Nelson Reservoir covers approximately 1,748 hectares (4,320 acres), has a mean depth of 4.3 m (14.2 ft) and a maximum depth of 15.2 m (50 ft). Nelson Reservoir is a relatively stable reservoir, which is not affected by drought when compared to other regional reservoirs, with an average annual fluctuation of 2.6 m (8.4 ft) and average water retention time of 24 days.

Nelson Reservoir was established as a fishery in the 1930s and 1940s with the introduction of Largemouth Bass (*Micropterus salmoides*), Black Crappie, Black Bullhead and Rainbow Trout. Commercial fishing for Common Carp, Smallmouth Buffalo and Goldeye was conducted in the 1920s, 1930s and in the mid-1960s. Nelson Reservoir has approximately 26 fish species and is managed primarily as a Walleye fishery. Walleye reproduce naturally in Nelson Reservoir; however, Walleye fingerlings have been stocked annually since 2003 in order to boost an already good population. In 2009-2010 Nelson received an estimated 17,680 plus or minus 3,354 angler days and remains a top destination for anglers seeking Walleye, Yellow Perch and Northern Pike.
**Tributaries**

**Alberta**

The mainstem Milk River has a number of tributaries which support fish populations. Some of the tributaries enter the Milk River mainstem outside of Alberta. Table 8.1 provides a listing of fish species collected in select tributaries, including the fish species that the tributaries are known to support. Kennedy Creek joins the Milk River a few hundred metres (about 1000 ft) south of the International Boundary, and the species listed below occur in the Alberta portion of the creek.

Table 8.1. Fish species collected in selected tributaries of the Milk River, Alberta.

<table>
<thead>
<tr>
<th>Tributary</th>
<th>Fish Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shanks Creek</td>
<td>White Sucker, Fathead Minnow, Lake Chub</td>
</tr>
<tr>
<td>Lonely Valley Creek</td>
<td>Northern Pike, White Sucker, Fathead Minnow</td>
</tr>
<tr>
<td>Red Creek</td>
<td>Yellow Perch, White Sucker, Longnose Sucker, Brassy Minnow, Brook Stickleback, Fathead Minnow, Iowa Darter, Lake Chub, Northern Redbelly Dace</td>
</tr>
<tr>
<td>Van Cleeve Creek</td>
<td>White Sucker, Brook Stickleback, Fathead Minnow, Lake Chub, Longnose Dace</td>
</tr>
<tr>
<td>Police Creek</td>
<td>White Sucker, Fathead Minnow, Lake Chub</td>
</tr>
<tr>
<td>Breed Creek</td>
<td>White Sucker, Longnose Sucker, Brook Stickleback, Iowa Darter, Lake Chub, Longnose Dace</td>
</tr>
<tr>
<td>Bear Creek</td>
<td>Lake Chub</td>
</tr>
<tr>
<td>Kennedy Creek</td>
<td>White Sucker, Brassy Minnow, Fathead Minnow, Iowa Darter, Lake Chub</td>
</tr>
</tbody>
</table>

Red Creek is the largest tributary in terms of discharge, and it supports the most diverse fish assemblage. Brassy Minnow, an uncommon species in Alberta, inhabits Red Creek and some of the other tributaries. Brassy Minnow have a sporadic distribution pattern in Alberta, since they occur in south-eastern Alberta, in the House and Athabasca rivers near Fort McMurray, and in Musreau Lake near Grande Prairie. Brassy Minnow are often found in conjunction with fathead minnow, and the juveniles of the two species are difficult to distinguish. It has been proposed that the provincial government complete a status report on the species, given its distribution and relative rarity in waters it does inhabit. This small minnow grows to about 8 cm (3.2 in) in total length and feeds on algae.

The occurrence of Yellow Perch in Red Creek is puzzling. They are often plentiful in lentic (standing) waters such as lakes and ponds, and do occur in slow-moving lotic (flowing) waters, such as the margins of larger rivers. They are, however, much less common in creeks. In the latter instance they are usually found in the confluence area with mainstem rivers, but in Red Creek they were collected some distance upstream of the Milk River. Nelson and Paetz (1992) did not report Yellow Perch as occurring in the Milk River drainage.

There have been very few systematic collections of fish from Milk River tributaries, Alberta. As such it is difficult to determine if the species composition has changed over time. All of the species in these creeks are native fish to Alberta, although as mentioned above, the origin of Yellow Perch in Red Creek is unclear.

**Saskatchewan**

The mainstem Milk River does not flow through Saskatchewan, rather there are four main tributaries in Saskatchewan that contribute flow to the Milk River in Montana. These tributaries are Middle Creek, Lodge Creek, Battle Creek and the Frenchman River. Fisheries data for these tributaries are presented on Map 8.1 and in Table 8.2 along with fish data for some of the smaller watercourses associated with the main tributaries.

![Longnose Dace](image)
Atton and Merkowsky (1983) documented the historical occurrence of fish in the Milk River watershed, Saskatchewan, in the “Atlas of Saskatchewan Fish”. A more recent survey was completed in June 1993 to document the occurrence of rare and threatened fish species (McCulloch et al. 1993). In this study, twenty-seven sites were sampled. Twenty of the 26 expected species were collected, 17 of which were native species (McCulloch et al. 1993). The White Sucker, Fathead Minnow, Brook Stickleback, Longnose Dace and Northern Redbelly Dace represented 88% of the total number of fish sampled. At the Frenchman River, one Burbot was collected, in the same region as reported in an earlier study (1978), as well as a single Stonecat that is considered a successfully invading species in Saskatchewan. The Stonecat was first recorded in the Frenchman River in 1970 and has since expanded its range upstream in this river (McCulloch et al. 1993). In addition, new locations for the Finescale Dace and Mountain Sucker were identified. The Mountain Sucker was found in higher elevation reaches of Battle Creek and Frenchman River tributaries.

Saskatchewan also has a stocking program for Brown Trout, Brook Trout and Rainbow Trout. Brown Trout were stocked in Battle, Belanger, Conglomerate and Fairwell creeks in 2008, 2010 and 2012. In 1981, Brown Trout were stocked in the Frenchman River but the population did not establish. Brook Trout and Rainbow Trout were stocked in the previously mentioned creeks in 2007 and 2012, except for Brook Trout in Battle Creek, which was only stocked in 2012.

Table 8.2. Summary of fish occurring in streams and rivers in the Saskatchewan portion of the Milk River watershed.

<table>
<thead>
<tr>
<th>Watercourse</th>
<th>Fish Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Battle Creek</td>
<td>Brown Trout, Brook Trout, Rainbow Trout, White Sucker, Mountain Sucker, Lake Chub, Fathead Minnow, Pearl Dace (<em>Margariscus margarita</em>), Northern Redbelly Dace, Finescale Dace, Brassy Minnow, Longnose Dace, Brook Stickleback, Iowa Darter</td>
</tr>
<tr>
<td>Belanger Creek</td>
<td>Brown Trout, Brook Trout, Rainbow Trout, Mountain Sucker, Shorthead Redhorse, Fathead Minnow, Longnose Dace</td>
</tr>
<tr>
<td>Boiler Creek</td>
<td>Brook Trout, Northern Redbelly Dace, Longnose Dace, Brook Stickleback</td>
</tr>
<tr>
<td>Calf Creek</td>
<td>Brook Trout, White Sucker, Mountain Sucker, Pearl Dace, Northern Redbelly Dace, Finescale Dace, Fathead Minnow, Longnose Dace, Brook Stickleback, Iowa Darter</td>
</tr>
<tr>
<td>Caton Creek</td>
<td>Brown Trout, White Sucker, Mountain Sucker, Shorthead Redhorse, Fathead Minnow, Pearl Dace, Longnose Dace, Brook Stickleback, Iowa Darter</td>
</tr>
<tr>
<td>Concrete Coulee</td>
<td>Brown Trout, Longnose Dace</td>
</tr>
<tr>
<td>Conglomerate Creek</td>
<td>Brown Trout, White Sucker, Mountain Sucker, Stonecat, Pearl Dace, Northern Redbelly Dace, Finescale Dace, Fathead Minnow, Brook Stickleback, Longnose Dace</td>
</tr>
<tr>
<td>Davis Creek</td>
<td>Brook Stickleback</td>
</tr>
<tr>
<td>Fairwell Creek</td>
<td>Brown Trout, Brook Trout, Rainbow Trout, White Sucker, Northern Redbelly Dace, Pearl Dace, Longnose Dace, Brook Stickleback, Iowa Darter</td>
</tr>
<tr>
<td>Frenchman River</td>
<td>Northern Pike, Walleye, Yellow Perch, Burbot, White Sucker, Shorthead Redhorse, Common Carp, Stonecat, Lake Chub, Fathead Minnow, Pearl Dace, Northern Redbelly Dace, Longnose Dace, Brassy Minnow, Channel Catfish, Brook Stickleback, Iowa Darter</td>
</tr>
<tr>
<td>Lodge Creek</td>
<td>Northern Pike, White Sucker, Lake Chub, Fathead Minnow, Pearl Dace, Northern Redbelly Dace, Longnose Dace, Brassy Minnow, Brook Stickleback, Iowa Darter</td>
</tr>
<tr>
<td>Lonepine Creek</td>
<td>Brook Trout, White Sucker, Mountain Sucker, Lake Chub, Fathead Minnow, Pearl Dace, Northern Redbelly Dace, Finescale Dace, Longnose Dace, Brassy Minnow, Brook Stickleback, Iowa Darter</td>
</tr>
<tr>
<td>Middle Creek</td>
<td>White Sucker, Lake Chub, Fathead Minnow, Northern Redbelly Dace, Longnose Dace, Brook Stickleback, Iowa Darter</td>
</tr>
<tr>
<td>Sucker Creek</td>
<td>Brook Trout, Brown Trout, Shorthead Redhorse</td>
</tr>
</tbody>
</table>
Fisheries Threats

Changes to fish populations typically manifest themselves through temporary or permanent alterations to fish habitat. Fish species with narrow habitat requirements (i.e., habitat specialists) are generally affected before fish species with broad habitat requirements (i.e., generalists). Table 8.3 summarizes the federal and state/province fish species that have received a species at risk designation and lists the known threats to each species. In Alberta, three fish species were listed as Threatened, and two species were considered Sensitive. In Montana, 10 fish species are considered a Species of Concern, with Pallid Sturgeon also designated as Endangered by the U.S. Endangered Species Act. No fish species in the Saskatchewan portion of the Milk River drainage have been designated as species at risk.

Table 8.3. Fish species at risk in the Milk River watershed, Alberta and Montana.

<table>
<thead>
<tr>
<th>Species</th>
<th>Designation</th>
<th>Threats and Limiting Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Alberta</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rocky Mountain Sculpin</td>
<td>Threatened (Alberta Wildlife Act and SARA)</td>
<td>The greatest threat to the Rocky Mountain Sculpin is habitat alteration or loss due to the reduction of flowing water. This may be caused by impoundment of water in reservoirs, diversions and water removal for irrigation. In addition, low water flow results from the frequent and extreme droughts that southern Alberta experiences during the summer. Other undesirable changes to Sculpin habitat include elevated water temperature, increased siltation of substrate and loss of riffle habitat.</td>
</tr>
<tr>
<td>Stonecat</td>
<td>Threatened (Alberta Wildlife Act)</td>
<td>Extremely rare within the province. Loss of overwintering habitat during drought years and unscheduled canal maintenance during flow augmentation period are threats.</td>
</tr>
<tr>
<td>Western Silvery Minnow</td>
<td>Threatened (Alberta Wildlife Act and SARA)</td>
<td>At risk due to extremely limited range in Alberta. Threats include drought, surface water extraction during non-augmented periods, dam construction, canal maintenance (during augmentation period), predatory fish species introduction and changes in flow regime due to canal upgrades or abandonment.</td>
</tr>
<tr>
<td>Northern Redbelly Dace</td>
<td>Sensitive</td>
<td>Clustered distribution trends in population and abundance unknown. Local populations could be affected by habitat changes brought about by human activity.</td>
</tr>
<tr>
<td>Sauger</td>
<td>Sensitive</td>
<td>Few occurrences sauger are found in slow moving rivers and may be vulnerable to habitat degradation in these systems. Little is known about this species.</td>
</tr>
<tr>
<td>Montana Species of Concern</td>
<td>Montana Species of Concern</td>
<td></td>
</tr>
<tr>
<td>---------------------------</td>
<td>---------------------------</td>
<td></td>
</tr>
<tr>
<td>Blue Sucker</td>
<td>Potentially at risk because of limited and/or declining numbers, range and/or habitat, even though it may be abundant in some areas. The Blue Sucker is considered an indicator species for ecosystem health because of its habitat-specific requirements. Current monitoring information indicates the populations are in stable condition. Research being conducted on locating spawning and rearing areas. Habitat protection includes protecting or promoting the natural spring-time hydrograph. Establishment of more natural seasonal flow conditions are presently being discussed and initiated for three storage reservoirs in Montana.</td>
<td></td>
</tr>
<tr>
<td>Iowa Darter</td>
<td>As with many small native stream fishes, Northern Redbelly Dace are affected by stream channelization, reductions to discharge, changes in water quality and temperature and introductions of non-native predatory fishes.</td>
<td></td>
</tr>
<tr>
<td>Northern Redbelly Dace</td>
<td>Same as Iowa Darter.</td>
<td></td>
</tr>
<tr>
<td>Paddlefish</td>
<td>Slow to mature (9 years for males and 16 for females) and spawn every 2 to 3 years (slow-maturing and low productivity). Current research and monitoring are designed to prevent over-harvest and insure a sustainable wild fishery. Changes in the age structure of the population are monitored to insure that young fish are added and older fish retained. The aging of the population, along with decline in fishing success rates and higher harvest of tagged (adult) paddlefish resulted in the reduction of the Paddlefish limit from two/person/year to one/person/year in both Montana and North Dakota, and the proposed reduction to a 1,000 fish annual harvest cap/state. The aim is to stabilize the population at 30,000 fish and avoid over-harvest of this unique, slowly-maturing species.</td>
<td></td>
</tr>
<tr>
<td>Pallid Sturgeon</td>
<td>Pallid Sturgeon are long-lived and are thought to spawn at several year intervals. Females may not reach sexual maturity until they are 15 to 20 years old. Because of unique biological characteristics, including obligatory lengthy migrations and larval drift distances, high habitat specificity and late sexual maturity, Pallid Sturgeon is a species vulnerable to extirpation. One of the most detrimental changes in the Pallid Sturgeon environment was the damming of the Missouri River and several other important tributaries.</td>
<td></td>
</tr>
<tr>
<td>Pearl Dace</td>
<td>At the southern end of its range in northern Montana and not abundant when they are collected in small streams and ponds they are known to inhabit. Threats include loss of habitat from stock ponds, dams, diversions disrupting hydrologic regimes in pools and introduced Northern Pike invasions.</td>
<td></td>
</tr>
<tr>
<td>Sauger</td>
<td>At risk because of very limited and/or potentially declining population numbers, range and/or habitat, making it vulnerable to extirpation in the state.</td>
<td></td>
</tr>
<tr>
<td>Sicklefin Chub</td>
<td>Threats include habitat and flow alterations from dams, diversions, irrigation operations and riparian development. Decreased flows and excessive siltation of gravel threaten life history requirements. Reservoirs created behind dams inundate riverine habitats, which is unsuitable habitat for Sicklefin Chubs. Dams create unsuitable habitat for chubs downstream by reducing turbidities and/or altering temperature and flow regimes.</td>
<td></td>
</tr>
<tr>
<td>Sturgeon Chub</td>
<td>Same as Sicklefin Chub.</td>
<td></td>
</tr>
<tr>
<td>Trout-perch</td>
<td>Limited distribution; the entire known range of Trout-perch in Montana is within Glacier National Park and the Blackfeet Indian Reservation.</td>
<td></td>
</tr>
</tbody>
</table>

Generally, the threats to fish can be summarized as:

- Drought/low flow
- Altered flow regimes from reservoir activities
- Water diversion (irrigation and non-irrigation)
- Barriers to upstream movement
- Loss of fish habitat (channelization, bank erosion, degraded riparian areas, increased siltation)
- Poor water quality including increased temperatures and low oxygen
- Introduction of non-native predatory fish

Of these threats, the construction and operation of dams has probably had the greatest impact on the fish populations of the Milk River, especially in Montana. In the Alberta portion of the Milk River, drought and low water levels likely have the greatest impact on fish populations.

**Fish Barriers**

Instream barriers such as dams, weirs, culverts and other road or railway crossing infrastructure can compromise the survival of fish including the ability to spawn, forage, and escape from predators (Gosset et al. 2006). Among other impacts, high flows resulting from storm events or water management actions can wash fish downstream of a barrier where they have limited ability to return to appropriate habitat. In Montana, fish passage issues exist in the middle Milk River from Fresno Dam to Vandalia Dam. In this reach there are seven diversion dams/weirs that completely restrict upstream fish migrations during normal flows. Although these structures make it impossible for the upstream movement of fish they have become very popular fishing areas during certain times of the year when fish congregate below them, increasing their susceptibility to angling mortality. In Alberta it is illegal to fish within 25 yards downstream of a dam; however, in Montana this activity is permitted.

The modification of downstream river flow characteristics (regime) by an impoundment can have a variety of negative effects on fish species: loss of stimuli for migration, loss of migration routes and spawning grounds, decreased survival of eggs and juveniles, diminished food production. Dams can modify thermal and chemical characteristics of river water: the quality of dam-releases is determined by the limnology of the impoundment, with surface-release reservoirs acting as nutrient traps and heat exporters and bottom-release reservoirs exporting nutrient and cold-waters. This can affect fish species and populations downstream.

The construction of dams creates reservoirs that favour generalist fish species (i.e., those species that do well in lakes or rivers) over species that require riverine habitat to complete their lifecycle. Reservoirs are sometimes stocked with sport and forage fish that may not be native to the watershed, which can be detrimental to native fish upstream of the reservoir. Fish present in Fresno Reservoir that have yet to be collected in the Milk River in Alberta include Rainbow Trout, Black Crappie, Emerald Shiner and Spottail Shiner. Predatory species in Fresno Reservoir that can move upstream into Alberta, include Walleye, Sauger, Northern Pike, Yellow Perch, Burbot, Rainbow Trout and Black Crappie. All of these species, with the exception of Rainbow Trout and Black Crappie are found in the Alberta portion of the Milk River. Walleye likely moved upstream from Fresno Reservoir into the Milk River in Alberta. Although Yellow Perch were also stocked into Fresno Reservoir, the original source of Yellow Perch in the Alberta portion of the drainage (i.e., Red Creek) remains uncertain.

Although dams are generally viewed as detrimental with regards to fisheries and upstream movement (i.e., Pallid Sturgeon) they can be beneficial in some instances. The Fresno Dam is likely preventing the introduced Common Carp in Montana from migrating upstream into Alberta as there are no migration barriers upstream of Fresno Reservoir in Montana.
Drought and Low Water Levels

The Milk River has been severely impacted by changes in its seasonal flow regimes in Alberta. Since 1917, Montana has diverted water from the St. Mary River in northwestern Montana via the St. Mary Canal into the North Milk River. This water flows eastward through southern Alberta before entering northeastern Montana, where it is used for irrigation and by municipalities. These augmented flows occur in the Alberta portion of the Milk River from late March or early April through early September or mid-October. During the rest of the year natural flows prevail within the Milk River. Under natural conditions average monthly summer flows in Alberta ranged from 1 to 2 m³/s (35.3 ft³/s to 70.6 ft³/s) in the North Milk River to between 2 and 10 m³/s (70.6 ft³/s and 353.2 ft³/s) at the Milk River’s eastern crossing of the international border. Since the diversion, flows in the Milk River at the Town of Milk River have ranged from 10 to 20 m³/s (353.2 ft³/s to 706.3 ft³/s) (from May to September and averaged 15 m³/s (529.7 ft³/s) between June and August. When the diversion of water from the St. Mary River is terminated in early September to mid-October, the river reverts to natural flow conditions for the remainder of the winter season. Under severe drought conditions, such as those of 2001-2002, there may be little or no surface flow and the lower Milk River can be reduced to a series of isolated pools until spring, although subsurface flows may continue (Milk River Fish Species Recovery Team 2008).

At the Town of Milk River, the average flow rate over the period 1912 to 2005 was less than 2 m³/s in November and February and less than 1 m³/s in December and January (WSC 2006; Milk River Fish Species at Risk Recovery Team 2008). Drought conditions in combination with water regulation, premature or temporary canal closure for emergency maintenance work during the augmentation period and water extraction (irrigation and non-irrigation) can significantly reduce the amount of summer and overwintering habitat available to fish populations. Natural drought conditions alone may seriously stress fish populations, but in combination with other anthropogenic stresses could significantly compound the severity of drought effects. The effects of drought and low water levels are likely to affect fish species with specific habitat requirements and/or low population numbers such as Rocky Mountain Sculpin, Stonecat and Western Silvery Minnow (ASRD 2004a; ASRD 2004b; Milk River Fish Species at Risk Recovery Team 2008).
8.2 Wildlife

The Milk River watershed is home to a unique group of wildlife species that can be found throughout the basin. The large variety of species or “species richness” is largely related to the watershed’s geographic location, on the southern-most edge of Alberta and Saskatchewan and the northern-most edge of Montana, as well as to the abundance of unfragmented habitat features, including hoodoos, cliffs, coulees, badlands, river valley habitats (including cottonwood forests), sagebrush and large tracts of native prairie. The low human population and the compatible agricultural land use, namely rangeland, has conserved much of the habitat for wildlife in Alberta and Saskatchewan.

Several wildlife species such as the short-horned lizard, Mountain Plover, Greater Sage Grouse and swift fox (all endangered species in Canada) are at the northern limit of their North American distribution within the Milk River watershed, particularly in Alberta and Saskatchewan. Ecologically, maintaining these peripheral populations of species is highly important since they are being displaced by population and land use activity in the core of their continental ranges.

The Milk River watershed is significant for wildlife at the international, national, provincial and state level. Provincially, the area supports about 80% of Alberta’s species at risk, and supports the provincial populations of mule deer and pronghorn. Nationally, the Milk River watershed is the most important landscape in Canada for prairie species at risk. Internationally, the watershed is a source area for the re-colonization of swift fox into northern Montana, provides key habitat for international species such as the Greater Sage Grouse and pronghorn, and is an essential part of the range of many migratory bird species which reside elsewhere at other times of the year. The number of different wildlife species that occur within the Milk River watershed ranges from 230-280 depending on the time of season. Seven species of amphibians, 50 species of mammals, and about 200 species of birds use the Milk River watershed. A complete list of species can be found on the accompanying DVD.

Wildlife is a valuable resource in the Milk River watershed. Many hunters enjoy the abundance of upland game birds and trophy quality big game that are found in the area. The financial benefit of wildlife to communities is seen with the influx of hunters to the watershed; however, the natural processes that are sustained through rural stewardship provide a social reward of quality of life, in addition to economic gains.
**Wildlife Indicators**

Wildlife indicators chosen for the State of the Watershed report are the same as those presented in the previous edition (MRWCC 2008), with the exception of the Northern Pintail which is not reported on in the current edition. The species were selected based on the current availability of baseline data, the potential for future monitoring, the species is a focal species for a particular habitat, the watershed provides unique habitat for this species, and an increase/decrease in population can be directly linked to the overall health of the watershed.

Resident species such as the Greater Sage Grouse, Sharp-tailed Grouse, northern leopard frog, Great Plains toad, plains spadefoot, prairie rattlesnake and pronghorn were chosen as they rely on a healthy watershed throughout the year. Migratory species, that rely on unique habitat found in the watershed during the spring and summer months were also selected, including Burrowing Owls, grassland birds and Ferruginous Hawks.

Several rankings systems exist throughout the various jurisdictions of the Milk River watershed to assign a conservation status to species. Each is designed to meet the differing intents and objectives of the leading organization or agency. In addition, species may receive a certain legal designation or listing under the law to address their management and/or protection. These status ranks and designations for the wildlife species selected as indicators in the Milk River watershed are summarized in Table 8.4. It should be noted that NatureServe uses the same ranking system for all provinces and states, and is the only conservation status rank that can be compared between the three state and provinces that the watershed encompasses.

A comparison of population numbers in the watershed and those for the rest of the provinces and State, can provide a better understanding of the integrity of migratory species. A decrease in population within the provinces or State, but a subsequent increase or maintenance of the species in the Milk River watershed can indicate good habitat conditions within the watershed. On the other hand, the maintenance of species outside of the watershed coupled with a decrease within the watershed should be concerning and action may need to be taken to improve habitat conditions within the watershed.
Table 8.4. Status of wildlife indicator species.

<table>
<thead>
<tr>
<th>Species</th>
<th>Gen Status of AB Wild Species 2010¹</th>
<th>Gen Status of SK Wild Species 2010¹</th>
<th>Gen Status of Wild Species in Canada 2010²</th>
<th>MT Fish, Wildlife &amp; Parks Conservation Tier³</th>
<th>AB Wildlife Act⁴</th>
<th>SK Wildlife Act, 1998⁵⁴⁵</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greater Sage Grouse</td>
<td>At Risk</td>
<td>May Be At Risk</td>
<td>At Risk</td>
<td>1</td>
<td>Endangered</td>
<td>Endangered</td>
</tr>
<tr>
<td>Sharp-tailed Grouse</td>
<td>Sensitive</td>
<td>Secure</td>
<td>Secure</td>
<td>3</td>
<td>Upland Game Bird</td>
<td>Upland Game Bird</td>
</tr>
<tr>
<td>Northern Leopard Frog</td>
<td>At Risk</td>
<td>At Risk</td>
<td>Secure</td>
<td>1</td>
<td>Threatened</td>
<td>-</td>
</tr>
<tr>
<td>Great Plains Toad</td>
<td>May Be At Risk</td>
<td>At Risk</td>
<td>Sensitive</td>
<td>2</td>
<td>Non-Game Animal</td>
<td>-</td>
</tr>
<tr>
<td>Plains Spadefoot</td>
<td>May Be At Risk</td>
<td>Sensitive</td>
<td>Secure</td>
<td>2</td>
<td>Non-Game Animal</td>
<td>-</td>
</tr>
<tr>
<td>Prairie Rattlesnake</td>
<td>May Be At Risk</td>
<td>Sensitive</td>
<td>Sensitive</td>
<td>2</td>
<td>Non-Game Animal</td>
<td>-</td>
</tr>
<tr>
<td>Pronghorn</td>
<td>Sensitive</td>
<td>Secure</td>
<td>Secure</td>
<td>3</td>
<td>Big Game</td>
<td>Big Game</td>
</tr>
<tr>
<td>Burrowing Owl</td>
<td>At Risk</td>
<td>At Risk</td>
<td>At Risk</td>
<td>1</td>
<td>Endangered</td>
<td>Endangered</td>
</tr>
<tr>
<td>Ferruginous Hawk</td>
<td>At Risk</td>
<td>At Risk</td>
<td>At Risk</td>
<td>2</td>
<td>Endangered</td>
<td>-</td>
</tr>
<tr>
<td>Loggerhead Shrike</td>
<td>Sensitive</td>
<td>Sensitive</td>
<td>At Risk</td>
<td>2</td>
<td>Non-Game Animal</td>
<td>-</td>
</tr>
<tr>
<td>Richardson's Ground Squirrel</td>
<td>Secure</td>
<td>Secure</td>
<td>Secure</td>
<td>3</td>
<td>Non-Game Animal</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Greater Sage Grouse</td>
<td>Candidate</td>
<td>Endangered</td>
<td>Endangered (Schedule 1)</td>
<td>AB (S1) MT (S2) SK (S1)</td>
<td>CAN(N2) USA (N3N4)</td>
<td>G3</td>
</tr>
<tr>
<td>Sharp-tailed Grouse</td>
<td>-</td>
<td>Not Assessed</td>
<td>AB (S3S4) MT (S1,S4) SK (S5)</td>
<td>CAN (N5) USA (N4)</td>
<td>G5</td>
<td></td>
</tr>
<tr>
<td>Northern Leopard Frog</td>
<td>Not listed</td>
<td>Special Concern</td>
<td>Special Concern (Schedule 1)</td>
<td>AB (S2) MT (S1,S4) SK (S3)</td>
<td>CAN (N5) USA (N5)</td>
<td>G5</td>
</tr>
<tr>
<td>Great Plains Toad</td>
<td>-</td>
<td>Special Concern</td>
<td>Special Concern (Schedule 1)</td>
<td>AB (S2) MT (S2) SK (S3)</td>
<td>CAN (N3) USA (N5)</td>
<td>G5</td>
</tr>
<tr>
<td>Plains Spadefoot</td>
<td>-</td>
<td>Not at Risk</td>
<td>AB (S3) MT (S3) SK (S3)</td>
<td>CAN (N3N4) USA (N5)</td>
<td>G5</td>
<td></td>
</tr>
<tr>
<td>Prairie Rattlesnake</td>
<td>-</td>
<td>Not Assessed</td>
<td>AB (S2S3) MT (S4) SK (S3)</td>
<td>CAN (N3) USA (N5)</td>
<td>G5</td>
<td></td>
</tr>
<tr>
<td>Pronghorn</td>
<td>-</td>
<td>Not Assessed</td>
<td>AB (S3S4) MT (S5) SK (S3)</td>
<td>CAN (N4) USA (N5)</td>
<td>G5</td>
<td></td>
</tr>
<tr>
<td>Burrowing Owl</td>
<td>Not listed (Western sub-species)</td>
<td>Endangered</td>
<td>Endangered (Schedule 1)</td>
<td>AB (S2) MT (S3B) SK (S2B)</td>
<td>CAN (N2B) USA (N4B, N4N)</td>
<td>G4</td>
</tr>
<tr>
<td>Ferruginous Hawk</td>
<td>Not listed</td>
<td>Threatened</td>
<td>Threatened (Schedule 1)</td>
<td>AB (S2S3) MT (S3B) SK (S4B,S4M)</td>
<td>CAN (N4B) USA (N4B,N4N)</td>
<td>G4</td>
</tr>
<tr>
<td>Loggerhead Shrike</td>
<td>Not listed</td>
<td>Threatened</td>
<td>Threatened (Schedule 1)</td>
<td>AB (S3) MT (S3B) SK (S3B)</td>
<td>CAN (N3N4B) USA (N4)</td>
<td>G4</td>
</tr>
<tr>
<td>Richardson's Ground Squirrel</td>
<td>-</td>
<td>Not Assessed</td>
<td>AB (S5) MT (S5) SK (S5)</td>
<td>CAN (N5) USA (N5)</td>
<td>G5</td>
<td></td>
</tr>
</tbody>
</table>

⁷Species at Risk Public Registry: http://www.sararegistry.gc.ca/default_e.cfm
⁸NatureServe Explorer: http://www.natureserve.org/explorer
The conservation status of a species or ecosystem is designated by a number from 1 to 5, preceded by a letter reflecting the appropriate geographic scale of the assessment (G = Global), N = National, and S = Subnational). The numbers have the following meaning: 1 = critically imperiled; 2 = imperiled; 3 = vulnerable; 4 = apparently secure; 5 = secure.
Ferruginous Hawk

<table>
<thead>
<tr>
<th>Residence</th>
<th>Seasonal/migratory.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indicator</td>
<td>As a wide-ranging top predator specific to short grass prairie habitat, a negative trend in the number of breeding pairs of Ferruginous Hawks may be indicative of a change in the “health” of the short grassland ecosystem in the watershed.</td>
</tr>
</tbody>
</table>

Assessment: Based on trend data collected during provincial surveys conducted in the Milk River watershed by the provincial government and during the past two surveys by the MULTISAR program, it appears that the number of breeding pairs of Ferruginous Hawks has decreased in the watershed in Alberta since 1987 (Figure 8.1). This is consistent with the 5-year block surveys conducted by the provincial government throughout the range of the species. In this study, a substantial decrease in the number of nesting pairs from 1987 to 2010 is observed (Figure 8.2). Between 2005 and 2010 there has been a non-significant increase in the number of breeding pairs in the Milk River watershed.

![Figure 8.1. Number of nests and adult Ferruginous Hawks observed on trend blocks in the Milk River watershed, Alberta, 1982 to 2010.](image)

![Figure 8.2. Estimated Ferruginous Hawk population within Alberta based on provincial trend surveys.](image)

Population is:
**On the Ground Actions:** Nest poles have been installed throughout the basin to help increase the Ferruginous Hawk populations. The most recent hawk poles have been installed in collaboration with local landowners at five sites of which four were active in 2012 and produced a total of 12 young.

**Data Required:** 1) Impact of climate change on ground squirrel populations and on Ferruginous Hawk nesting success; 2) Monitoring of nest success.

One nesting pair of Ferruginous Hawks can eat 500 ground squirrels in a single breeding season.
Loggerhead Shrike

<table>
<thead>
<tr>
<th>Residence</th>
<th>Seasonal/migratory.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indicator</td>
<td>As a shrub-dependant species, a change in loggerhead shrike densities may indicate an environmental problem with shrubland habitat in the Milk River watershed.</td>
</tr>
</tbody>
</table>

**Assessment:** Loggerhead Shrikes are surveyed in the watershed in Alberta as part of the provincial survey at two transects (i.e., 72E2 and 72E4) (Figures 8.4 and 8.5). The transect 72E2 has been surveyed since 1998 and shows an increasing trend in the number of adults observed. This transect generally covers the area east of the Town of Milk River to Deer Creek Bridge, Alberta. The transect 72E4 has been surveyed since 2003. A slight decline in observations of Loggerhead Shrike was found at this transect that generally covers the Milk River area from about Deer Creek Bridge to Aden, and the Eastern Tributaries south of the Cypress Hills.

**On the Ground Actions:** Habitat enhancements for Loggerhead Shrike include upland watering sites and riparian protection to encourage shrub growth.

**Population is:**

*Increasing*  
*Stable*  
*Decreasing*  
*Unknown*

**Data Required:** Additional monitoring of Loggerhead Shrike populations along the Milk River in the watershed should be undertaken, particularly in thorny buffaloberry communities in the riparian zone.

Loggerhead Shrikes are also known as the “butcher bird” as they often hang their prey (e.g., small mammals, insects) on barbed wire or thorns. If a grasshopper is observed impaled on a fence line, chances are that a Loggerhead Shrike is nearby.

**Figure 8.4:** Number of adult Loggerhead Shrike at Transect 72E2, 1998-2012, Alberta.

**Figure 8.5:** Number of adult Loggerhead Shrike at Transect 72E4, 2003-2008, Alberta.

*Thorny buffaloberry*
Grassland Breeding Birds

<table>
<thead>
<tr>
<th>Residence</th>
<th>Seasonal/migratory/residents.</th>
</tr>
</thead>
</table>

Long-term negative trends in grassland bird density and diversity as derived from the North American Breeding Bird Survey (BBS) or other grassland bird surveys may be indicative of a decrease in the “health” of the grassland ecosystem in the Milk River Basin.

This Grassland Habitat group of the North American Breeding Bird Survey in Canada is characterized by “obligate” grassland species as established by the National Wildlife Research Centre of the Canadian Wildlife Service. In the Milk River watershed, the species include: Baird’s Sparrow, Bobolink, Chestnut-collared Longspur, Ferruginous Hawk, Grasshopper Sparrow, Horned Lark, Lark Bunting, Le Conte’s Sparrow, Long-billed Curlew, McCown’s Longspur, Northern Harrier, Ring-necked Pheasant, Savannah Sparrow, Sharp-tailed Grouse, Short-eared Owl, Sprague’s Pipit, Upland Sandpiper, Vesper Sparrow, Western Meadowlark.

**Assessment:** Long-term data from the BBS Milk River routes indicate a decrease in density (Figure 8.6) and a small decrease in diversity (Figure 8.7) of birds from the BBS Grassland Habitat group between 1970 and 2011 in Alberta. The same BBS Grassland Habitat group during the period 1980-2011 has a stable density and slight increase in diversity in Montana. Recognition is given to the hundreds of skilled volunteers who have contributed to the long-term BBS data set throughout the years.

**On the Ground Actions:** In Alberta, the ranching community collaborates with conservation groups to develop Habitat Conservation Strategies to investigate ways to increase benefits to both wildlife habitat and cattle operations. Detailed wildlife surveys completed as part of a Habitat Conservation Strategy continues to provide important data on grassland bird populations within the watershed. Enhancements such as offsite watering systems, native grass restoration, and tree protection are a few of the projects implemented by landowners and leaseholders.

**Figure 8.6.** Number of individual grassland birds observed on the Milk River BBS routes from 1970-2011. Note that the Alberta route was not surveyed in 1972, 1977 and 1996.

**Figure 8.7.** Number of grassland bird species observed on the Milk River BBS Routes, 1970-2011. Note that the Alberta route was not surveyed in 1972, 1977 and 1996.
Burrowing Owl

<table>
<thead>
<tr>
<th>Residence</th>
<th>Seasonal/migratory.</th>
</tr>
</thead>
</table>

**Indicator**

A decrease in the productivity at sites where Burrowing Owls occur may indicate an environmental concern with the integrity of the native grassland ecosystem in the Milk River watershed. However, the number of nesting owls is more likely due to factors outside the watershed and productivity the previous year. Burrowing Owls migrate to southern Texas and Mexico for the winter. The owls use agricultural fields, as well as more open grassland country, orchards, and even thorny shrub woodlands. They often hide in burrows, culverts, or open pipes in the daytime, but sometimes sit under grass clumps and use artificial tubular roosts when they are available. Over-winter mortality was estimated at 17-30%. Survival in winter cannot explain why only 6% of juvenile owls return to Canadian study areas (Holroyd & Trefry, Environment Canada).

**Assessment:** There are currently no accurate large-scale surveys for the Burrowing Owl in the Milk River watershed. In addition, Breeding Bird Survey (BBS) data are unreliable to detect trends for this rare species (C. Downes pers. comm.). However, local surveys and annual reports from producers can provide relative indices of population change.

In 2012, AESRD initiated a road-side survey to monitor the Burrowing Owl population throughout the Alberta portion of the range and in highly suitable habitat. Although five road-transects fell within the Milk River watershed, no owls were detected there. Of the 15 transects surveyed in the greater study area, only one pair of owls was detected.

The Canadian Wildlife Service has been conducting surveys at the Onefour Agricultural Research Sub-Station (Alberta) within the watershed since 2002 (Figure 8.8). These data indicate a negative trend in the number of Burrowing Owl sites detected over the 13-year period, with none detected in 2012.

Operation Grassland Community (OGC Alberta) and Operation Burrowing Owl (OBO Saskatchewan) have conducted an annual census with their program members since 1989 and 1987, respectively, throughout the Alberta and Saskatchewan Burrowing Owl range. In the Milk River watershed, a negative trend is clear on the Saskatchewan side of the watershed over the 25 year span, while only a few owl pairs were observed sporadically from year to year and reported from six or fewer properties in Alberta (Figure 8.9). For the entire range of the species in Alberta and Saskatchewan, an important negative trend in the number of Burrowing Owl pairs reported by OGC and OBO members is also evident over the 22-25 year period (Figure 8.10a and 8.10b). Similar declines have been recorded in the Regina Plain (R. Poulin unpublished) and Grassland National Park (Holroyd and Trefry unpublished) in Saskatchewan.

![Figure 8.8](https://example.com/figure8.8.png) **Figure 8.8.** Number of Burrowing Owl sites at Onefour Research Station since 2002, Alberta. (Unpublished data from Geoff Holroyd and Helen Trefry, Canadian Wildlife Service; pink line = trend).

![Figure 8.9](https://example.com/figure8.9.png) **Figure 8.9.** Index of Burrowing Owl population in the Milk River watershed. Data from Operation Grassland Community (AB) and Operation Burrowing Owl (SK). *OGC data available from 1989. Pink line=trend for OBO (SK) data only.
Overall, it appears that the long-term trend in the Milk River watershed Burrowing Owl population is still downward, reflecting the situation in the entire Canadian extent of the range of this species and pointing at problems that are not unique to the Milk River watershed or that may be outside of the northern extent of this species’ range. This species may be on its way to extirpation in Canada (G. Holroyd, pers. comm.).

**Known Stressors:** Conservation concerns include: Elimination of burrowing mammals that provide critical habitat, habitat loss and fragmentation due to agricultural and urban development, petroleum exploration and development, residual effects of pesticide use, and nest site disturbance.

**On the Ground Action:** Burrowing Owls live in relatively flat open grasslands or arid regions devoid of trees or dense shrubs. They nest in areas of short (< 10 cm) and sparse vegetation, where they also feed predominantly on insects and small mammals. They hunt for small mammals within 1-2 km of their nest burrow, adjacent to tall (> 30 cm) and dense vegetation such as ditches and low lying wetland areas. They are completely dependent on burrowing mammals such as badgers, ground squirrels, foxes, and coyotes to create the burrows in which they nest and roost (ASRD and ACA 2005, COSEWIC 2006).

Land owners and leaseholders are maintaining Burrowing Owl habitat by applying the following BMPs. 1) Maintain native prairie habitat and prevent its fragmentation, 2) Encourage patchy grazing intensity on breeding range (greater grazing intensity in proximity (< 100 m) of nest burrows from July to April, 3) Use moderate to low grazing intensity within 2 km (1.2 mi) of nest burrows, 4) No ground-squirrel and badger control, especially in nesting areas on native prairie, 5) Avoid using pesticides within 800 m (0.5 mi) of nesting areas, 6) Avoid the planting of trees or shrubs on native range or within 1.6 km (1 mi) of nesting areas (RCS 2004, Anonymous 2007b).

**Data Required:** 1) Survival rates of Burrowing Owls at various stages of life cycle, 2) Extent and impact of between-year dispersal by juveniles and adults, 3) Effect of various grazing practices on prey species populations, 4) Effect of environmental contaminants on survival and reproduction, 5) Migratory route and winter range of “Milk River Basin” owls, 6) Upper development threshold.

![Burrowing Owls](image1)

Figure 8.10. Index of Burrowing Owl population throughout the range of the Burrowing Owl in Alberta (a) and Saskatchewan (b). Data from Operation Grassland Community (AB) and Operation Burrowing Owl (SK); pink line = trend).
**Sharp-tailed Grouse**

<table>
<thead>
<tr>
<th>Residence</th>
<th>Year-round.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indicator</td>
<td>Upland shrubby habitat.</td>
</tr>
</tbody>
</table>

**Assessment:** In Alberta, the Sharp-tailed Grouse population appears to be decreasing since 1996. In 1996, the average number of grouse per lek was about 22 birds (Figure 8.11). This number decreased to about 7 grouse per lek in 2001 and 2002. Although numbers have increased somewhat from this low point, the number observed in the Milk River Ridge Area and in the Writing-on-Stone Provincial Park Area (WOS PP) has been fluctuating to the current population of about 17 Sharp-tailed Grouse per lek in the Milk River Ridge Area in 2012 and seven grouse at WOS PP in 2011.

In Montana, the Sharp-tailed Grouse population is considered stable. The average number of male grouse per lek in the last 14 years shows an increasing trend from 10 male grouse per lek in 1999 to about 18 male grouse per lek in 2007. In recent years, the average number of Sharp-tailed Grouse observed has decreased somewhat to the current 15 male grouse per lek (Figure 8.12).

**Known Stressors:** Cultivation of native prairie, loss of native prairie habitat, and heavy livestock grazing for long periods in both the uplands and riparian areas. Disturbance near nesting areas and leks during breeding and nesting season can also impact populations. Agricultural conversion of Conservation Reserve Program (CRP) grassland habitats in Montana. Possible stressors include heavily impacted habitat where cover has been reduced and predation can have a greater impact on the population.

**On the Ground Actions:** Sharp-tailed Grouse are omnivorous and eat fruits, buds, green leaves, and insects. They require native prairie containing shrubby patches in which to nest, raise their brood, and to over-winter. Sharp-tailed Grouse typically nest within 1.1 km of their lek. Leks are dancing grounds located on knolls or flat open areas that allow for good visibility. Sharp-tailed Grouse habitat is found throughout the Milk River watershed with highest concentrations on the Milk River Ridge and around Writing-on-Stone Provincial Park.
Landowners and leaseholders can help to maintain Sharp-tailed Grouse by incorporating the following BMPs into their management strategies. 1) Maintain native prairie uplands, 2) Zero tillage of croplands and retain stubble fields within 1 km of woody draws, 3) Limit disturbance from March-June around nesting areas and leks, 4) Defer grazing in key Sharp-tailed Grouse habitat until mid-June, 5) Protect riparian areas, 6) Strategically place salt blocks away from leks between March and June.

**Data Required:** 1) Validation of the Resource Selection Function model to predict lek locations, 2) Evaluation of the beneficial management practices used by MULTISAR for Sharp-tailed Grouse.

![Figure 8.11. Average number of Sharp-tailed Grouse per lek from 1996 to 2012 in the Milk River Ridge and Writing-on-Stone Provincial Park regions. Data provided by AESRD.](image1)

Figure 8.11. Average number of Sharp-tailed Grouse per lek from 1996 to 2012 in the Milk River Ridge and Writing-on-Stone Provincial Park regions. Data provided by AESRD.

![Figure 8.12. Number of male Sharp-tailed Grouse per lek from 1999 to 2011 in Hill County, Montana. Data provided by Montana FWP.](image2)

Figure 8.12. Number of male Sharp-tailed Grouse per lek from 1999 to 2011 in Hill County, Montana. Data provided by Montana FWP.
Greater Sage Grouse

<table>
<thead>
<tr>
<th>Residence</th>
<th>Year-round in the southeast portion of the Milk River watershed.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indicator</td>
<td>Health of sagebrush communities. Decrease in natural drainage may result in a decrease in silver sage brush habitat and subsequently Greater Sage Grouse populations (McNeil and Sawyer 2001, 2003).</td>
</tr>
</tbody>
</table>

**Assessment:** Greater Sage Grouse populations have declined in Alberta to a point in which the province is now supplementing the population with a total of 40 birds (2011 and 2012) captured in Montana in partnership with Montana Fish and Wildlife and released in Alberta. The Government of Canada has also identified critical habitat for Greater Sage Grouse in Alberta and Saskatchewan.

**Known Stressors:** Habitat alterations resulting in loss and fragmentation of sagebrush habitat and water impediments that reduce overflows which are needed for silver sagebrush habitat can negatively affect Greater Sage Grouse (McNeil and Sawyer 2001). Greater Sage Grouse are also affected by fragmentation of habitat by industrial activity. The recent appearance of West Nile Virus, which is a known stressor, could impact populations further if it becomes more prevalent. Increases in traffic and auditory disturbances during the breeding and nesting season have also been shown to negatively impact the grouse populations (Adams et al. 2004; Alberta Sage Grouse Recovery Action Group 2005). Sagebrush manipulation and grazing practices that negatively impact sagebrush habitat quality may also negatively impact Greater Sage Grouse populations, along with increases in invasive plant species. Possible stressors include predators (Alberta Sage Grouse Recovery Action Group 2005).

**On the Ground Actions:** Greater Sage Grouse habitat is limited to silver sagebrush and the immediate surrounding area. In Montana, the core of Greater Sage Grouse habitat is Wyoming big sagebrush, silver sagebrush and surrounding areas. Leks have sparser vegetation adjacent to larger areas of sagebrush habitat. Most dense silver sagebrush habitat in Alberta occurs along drainages (winter habitat). Nesting habitat consists of less dense sagebrush on uplands. Greater Sage Grouse nest under sagebrush and feed on sagebrush leaves, forbs and insects within the sagebrush community. Greater Sage Grouse broods feed in taller vegetation, with lower shrub density, where food is more plentiful (Adams et al. 2004; Alberta Sage Grouse Recovery Action Group 2005).

A number of steps are being taken to increase and maintain Greater Sage Grouse populations. 1) Alberta is supplementing the population with birds from Montana, 2) Landholders and NGOs have restored
marginal croplands back to native grass on 526 ha (1,300 acres) within the Greater Sage Grouse range in Alberta, 3) Over 1,500 silver sagebrush plugs have been planted, and 4) Reflectors have been placed on the top wire of fence lines by several organizations and landholders to increase visibility of the fence line to Greater Sage Grouse.

Landowners and leaseholders are improving habitat for the Greater Sage Grouse by incorporating the following BMPs into their management strategies. 1) Avoid placing salt or minerals within 0.8 km (0.5 mi) of leks, 2) Protect, maintain, and encourage regeneration of silver sagebrush habitat, 3) Defer grazing near leks until late spring, 4) Construct new livestock facilities away from leks, 5) Avoid supplemental feeding of livestock in key Greater Sage Grouse wintering habitat, 6) Maintain high range health in Greater Sage Grouse habitat (Adams et al. 2004; Alberta Sage Grouse Recovery Action Group 2005).

In Montana key activity includes: 1) 74,058 ha (183,000 acres) of sagebrush habitat has been conserved through long-term (30-year) leases, 2) Implementation and evaluation of rest-rotation grazing systems, 3) Protection of important Greater Sage Grouse habitats through perpetual conservation easements and acquisitions, 4) Development of recommended energy development stipulations to minimize impacts to Greater Sage Grouse populations, 5) Identification of core habitat areas of high importance for Greater Sage Grouse, 6) Structural modifications of fences (markers) and water tanks (escape ramps) to decrease Greater Sage Grouse mortality.
## Northern Leopard Frog

<table>
<thead>
<tr>
<th>Residence</th>
<th>Year-round.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indicator</td>
<td>Riparian. A reduction in the population or loss of a once active site could indicate a significant change in the watershed and should be investigated as they can be affected by both water quality and quantity.</td>
</tr>
</tbody>
</table>

### Assessment:
There was a sharp decline in northern leopard frog populations by 1979 resulting in the extirpation of the species in most of central and western Alberta and in greatly reduced numbers in southern Alberta. Surveys conducted in 1991 identified leopard frogs as locally abundant in the Cypress Hills and parts of the Milk River watershed. However, a subsequent provincial survey in 2000-2001 found that out of 269 historical and recent sites, northern leopard frogs where found at only 54 (Kendell 2002). In 2001 there were only four geographical areas with major populations of 10 or more adult frogs, two of these were in the Cypress Hills and the Milk River watershed (Alberta Sustainable Resource Development 2003). Surveys conducted in 2005 at 33 previously known sites in the watershed revealed that 10 (30%) were still occupied by adults and only 5 of those had young of the year. Three of the occupied sites had adult counts in the upward of 27-65 individuals, and young of the year in the 80-641 range. This shows the importance of the Milk River watershed in providing habitat for northern leopard frogs. However, several previously occupied sites no longer had northern leopard frogs (Kendell et al. 2007).

### Population is:

- Increasing
- Stable
- Decreasing
- Unknown

### Known Stressors:
Drought conditions affect egg and tadpole development and survivorship, and may contribute to over-winter mortality. Severe droughts may cause outright loss of habitat. Cattle impacts to wetland littoral zones and riparian areas was one of the most common threats to breeding habitat identified in a 2005 provincial survey (Kendell et al. 2007). Other stressors include disease and introduction of pesticides and other biocides to water (ASRD 2003). Other possible stressors include the introduction of exotic game fish, which can prey on all age classes of frogs and transmit diseases; climate change, which can lead to extreme weather events (i.e. flooding); prevalence of organisms that can cause disease in amphibians; and an increase in ultra-violet radiation that can be harmful to eggs (ASRD 2003).

### On the Ground Actions:
Northern leopard frogs depend on permanent ponds (e.g., marshes, springs, rivers, or creeks) with deep water and high dissolved oxygen content for over-wintering and on shallow, standing water (e.g., ponds, marshes, ditches, dugouts, oxbows or occasionally quiet backwaters and low velocity streams) for breeding. Upland habitat near water bodies provides important foraging areas as well as dispersal routes.

Landowners and leaseholders are improving habitat for the northern leopard frog by incorporating the following BMPs into their management strategies.
1. Providing alternative cattle watering sites away from water bodies that support northern leopard frog populations to improve water quality, shoreline vegetation and reduce the possibility of egg masses being trampled in the spring.
2. Placing salt blocks away from water to reduce impacts to the riparian zone and summer foraging habitat.
3. Avoiding the drainage of wetlands and restoring where possible.
4. Avoiding winter grazing near northern leopard frog ponds as excess feces and urine can create low oxygen conditions that lead to winter kills.
5. Avoiding application of pesticides to wetlands or to adjacent lands.
6. Avoiding water diversion and drawdowns during the spring, fall and winter in those waters that support over-wintering frogs (Rangeland Conservation Service 2004).
### Plains Spadefoot and Great Plains Toad

#### Residence
- Ephemeral wetlands. A decrease in the number of sites containing toads may indicate a reduction in the number of wetlands or increase in water contamination (e.g., pesticides, herbicides), which would negatively impact the overall health of the watershed.

#### Indicator
- Year-round.

#### Assessment:
Great Plains toads are found in the southeast corner of the Milk River watershed, in Alberta, in isolated patches in Saskatchewan and in much of Montana. The Plains spadefoot toad can be found throughout most of the central and eastern parts of the Alberta watershed, but are less abundant toward the west and onto the Milk River Ridge. There is limited information on the extent of the Plains spadefoot and Great Plains toad population as they are elusive and can remain underground for years at a time. As of 2008, six general Great Plains toad populations had been identified in Alberta; one of those exists in the Milk River watershed in the Onefour area (ASRD and ACA 2009). This latter population may extend west to the Pakowki Lake area (unpublished data from AESRD). A survey in 2002 after a heavy precipitation event in the Milk River watershed found 253 breeding ponds containing Plains spadefoot where previous records had only 50 ponds. Similarly the number of known Great Plains toad ponds increased from 10 to 19 ponds. However, this may be a result of more intensive surveys. Ongoing surveys are needed to grasp a better understanding of population size (Quinlan et al. 2003).

### Population is:

<table>
<thead>
<tr>
<th>Increasing</th>
<th>Stable</th>
<th>Decreasing</th>
<th>Unknown</th>
</tr>
</thead>
</table>

#### Known Stressors:
Draining and cultivation of ephemeral wetlands during dry years removes important breeding habitat. Road kills are also a major concern during mass migration events as toads migrate between habitats following heavy rain or when young emerge from ephemeral breeding wetlands and disperse into adjacent lands. Water contamination and consumptive use of ephemeral wetland water can also impact the population (Rangeland Conservation Service 2004; Saunders et al. 2006). Other possible stressors include drought that eliminates breeding habitat and, the conversion of ephemeral ponds into permanent ponds (although toads may be found in permanent ponds), could compromise recruitment of young because aquatic invertebrate predators are able to over-winter in the pond, resulting in an increase predation of tadpoles (Rangeland Conservation Service 2004). Montana stressors include: 1) Habitat loss/Alteration, 2) Disease (Chytrid fungus), 3) Non-native predators and, 4) Chemicals (pesticides, herbicides, fertilizers).

#### On the Ground Actions:
The Great Plains and Plains spadefoot toads prefer ephemeral wetlands with clear water in native prairie with sandy soils. Toads have also been found in cultivated areas where ephemeral wetlands have been left undisturbed (James 1998; Lauzon 1999; Rangeland Conservation Service 2004). Both species burrow deeply underground and can remain there for several years to escape summer droughts and freezing winter temperatures. Heavy precipitation events are often required to stimulate the emergence of the toads and breeding activity (James 1998; Lauzon 1999; Rangeland Conservation Service 2004). Landowners and leaseholders can improve habitat for the Great Plains and Plains spadefoot toads by incorporating the following BMPs into their management strategies: 1) Avoiding cultivation or draining of ephemeral wetlands and re-establishing if possible, 2) Avoid converting ephemeral wetlands into permanent wetlands as permanent ponds may contain amphibian predators (i.e. fish and aquatic invertebrate predators), 3) Leave buffer of natural vegetation around wetlands, 4) Avoid using pesticides or herbicides around wetlands, 5) Avoid heavy cattle use around wetlands in spring and early summer, 6) Place salt blocks at least 1 km away from natural water bodies which will encourage cattle to make better use of the range, 7) Consider off-site water systems to draw cattle away from water bodies (Rangeland Conservation Service 2004; Saunders et al. 2006).

#### Data Required:
1) Identify and map current and historical ephemeral wetlands, 2) Study on the impact of road mortality of toads in Alberta, 3) Initiate a monitoring program during high and low precipitation years as there is limited information on the population of these species, 4) Evaluate the effect of water management projects on reproductive success and over wintering survival, 5) Evaluate the effect of water quality on reproductive success (Rangeland Conservation Service 2004).
### Prairie Rattlesnake

**Residence** | Year-round.
---|---
**Indicator** | Loss of hibernacula can indicate that a threshold has been crossed such as too much habitat fragmentation or habitat loss.

**Assessment:** There is a suspected decline in the prairie rattlesnake population however; more research is needed on this subject. The number of known hibernacula in the Milk River watershed in Alberta has increased from 11 in 2008 to 14 hibernacula in 2012. No data was located for prairie rattlesnakes in Saskatchewan or Montana for inclusion in this report.

**Known Stressors:** Loss of native habitat and habitat fragmentation are the key stressors for the Prairie rattlesnake. Rattlesnakes are also lost to direct mortality from persecution, intensive agriculture, roads, urbanization and pipeline construction (Watson and Russell 1997). Possible stressors include the cumulative effects of land use activities (Rangeland Conservation Service 2004).

**On the Ground Actions:** Landowners and leaseholders can help maintain prairie rattlesnakes by using fencing or salt placement to redirect cattle away from important habitat. Avoid grazing near hibernacula in spring when snakes are congregating. Avoid spring grazing near slopes when soils are moist and susceptible to slumping. A variety of grazing intensities (i.e., light, moderate and heavy grazing) can produce patchy cover on uplands. Municipalities can install signs in key areas where rattlesnakes cross roads to encourage motorists to slow down (Rangeland Conservation Service 2004).

**Data Required:** 1) Use road mortality information to identify areas of high mortality of rattlesnakes and place signs to warn motorist as well as investigate the feasibility of snake tunnels under the road, 2) Identification of hibernacula in highly suitable areas to better understand the population (Rangeland Conservation Service 2004).

During the winter, snakes gather together in dens called “hibernacula” which are critical to their survival. Destroying hibernacula is illegal and can eliminate the entire local population.
Richardson’s Ground Squirrel

<table>
<thead>
<tr>
<th>Residence</th>
<th>Year-round.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indicator</td>
<td>Vital prey source for several bird, mammal, and reptile species and a critical excavator for several secondary burrow users, changes in its populations may preclude important changes in the integrity of the prairie ecosystem in the Milk River watershed.</td>
</tr>
</tbody>
</table>

Assessment: Population densities of Richardson’s ground squirrels can fluctuate up and down by 10-fold over the span of a decade or more. In the Milk River watershed, road-side surveys have been conducted between 2003 and 2009 on up to ten 12.8 km (8 mi) transects as part of annual Ferruginous Hawk surveys (Figure 8.15). Ground squirrel populations remained fairly stable from 2003-2008 and then started to increase in 2009.

On the Ground Action: Surveys to assess ground squirrel populations were last completed in 2009 and are currently being considered for 2013.

Data Required: 1) Impact of ground squirrels on forage quality at colony sites, 2) Cattle grazing behaviour (selectivity, indifference, or avoidance) in presence of ground squirrel colonies, 3) Impact of habitat fragmentation on ground squirrel density, 4) Impact of climate change on hibernation pattern.

Population is:

![Population Chart](Figure 8.15. Density of adult Richardson's ground squirrels in the Milk River watershed, Alberta.)
**Pronghorn**

<table>
<thead>
<tr>
<th>Residence</th>
<th>Year-round and migratory.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indicator</td>
<td>Health of sagebrush communities and connectivity of native prairie habitat.</td>
</tr>
</tbody>
</table>

**Assessment:** The pronghorn population in Alberta fluctuates between 5,000 to 32,000 individuals (Mitchell 1980). In the Milk River watershed in Alberta, the pronghorn population is monitored in three Antelope Management Areas (AMA) (i.e., A, B and C). Survey blocks within A and C cover mostly native prairie habitat, while those in B encompass large areas of cultivated land. C block, in southeastern Alberta where much of the remaining sagebrush is found, is also where the greatest densities of pronghorn occur. The trend in pronghorn densities in the Alberta portion of the watershed has been negative between 2007 and 2012, largely due to harsh winters on the prairies in 2010 and 2011. (Figure 8.16). However, densities appear to be increasing following a milder winter in 2012.

A negative trend in pronghorn densities was also observed in the watershed between 2002 and 2012 in Montana (Figure 8.17), and between 2009 and 2012 in Pronghorn Management Units (PMU) 3 and 4 in Saskatchewan (Figure 8.18).

![Figure 8.16. Pronghorn Trend Survey Data for Three Antelope Management Areas in the Milk River watershed, Alberta (Unpublished data from AESRD).](image1)

![Figure 8.17. Pronghorn trend survey data for the Milk River watershed, Montana (Unpublished data from Montana Fish, Wildlife & Parks).](image2)
Figure 8.18. Pronghorn trend survey data for two Pronghorn Management Units in the Milk River watershed, Saskatchewan (Unpublished data from Saskatchewan Ministry of Environment).

**Known Stressors:** Low quality and quantity of forage (forbs, shrubs, grasses), quality of winter habitat, severe winters, droughts, access to water, habitat fragmentation, oil/gas development, road mortality, and fences (low bottom wire) (Autenrieth et al. 2006). Possible stressors include disease and predators (Autenrieth et al. 2006).

**On the Ground Action:** Pronghorn prefer flat open native prairie with abundant forbs and sagebrush/shrubs. Pronghorn can also be found in cultivated areas, but their densities and reproductive success are not known. In Saskatchewan, annual surveys indicate better and higher fawning success rates on altered/cropped lands than on native habitat. Winter habitat that contains abundant sagebrush and experiences chinooks, to reduce snow depth, is crucial for pronghorn survival (Alberta Forestry, Lands and Wildlife 1990).

Conservation groups have been active within the watershed collaborating with landholders to install double stranded smooth bottom wire 46 cm (18 in) high to allow pronghorn movement. Roughly 48 km (30 mi) of fence lines have already been enhanced throughout Alberta by Fish and Game Association volunteers with many more miles identified. A demonstration site was also developed in partnership with Alberta Conservation Association and Writing-on-Stone Provincial Park that showcases several different wildlife friendly fencing options. The demonstration site is located just off the parking lot beside the interpretive center at Writing-on-Stone Provincial Park.

Landowners and leaseholders can improve habitat for pronghorn by incorporating the following BMPs into their management strategies: 1) Grazing management that allows forb and sagebrush production, 2) Installation of watering sites throughout pastures will provide pronghorn with clean water to drink, 3) Maintaining sagebrush communities, which are relied upon during deep snow and droughts, 4) Fences should have a bottom wire > 46 cm (18 in) above the ground and preferably smooth (Autenrieth et al. 2006).

**Data Required:** 1) Long-term detailed range assessments on native grasslands studying forb and shrub abundance in relation to fluctuations in pronghorn number, 2) Population demographics for pronghorns inhabiting native prairie and those in agricultural areas, 3) Beneficial management practices for reclaiming silver sagebrush, 4) Sight ability model for pronghorn to assist with aerial surveys (Alberta Forestry, Lands and Wildlife 1990; Adams et al. 2004; Autenrieth et al. 2006).
8.3 Vegetation

8.3.1 Rare and Unique Native Vegetation

The Milk River watershed provides habitat for a wide variety of unique plant communities and rare plant species. Understanding species distribution on a transboundary watershed scale provides insight regarding not only the historic or current range of some species but also recognizes how certain species may be considered rare or at risk in one jurisdiction though widely abundant in another jurisdiction. Many of the uncommon species found in the watershed are at their northern climatic boundary and may be susceptible to environmental or climatic stresses.

Sound rangeland management practices, and habitat stewardship support for private landowners and lease holders can help ensure the persistence of rare plant communities. The following highlights some of the unique and rare species that occur within the watershed.

Conservation Status is determined by the NatureServe ranking system which helps determine which species are thriving and which are rare or declining; thus helping government agencies and stewardship organizations to target conservation efforts towards the greatest need. NatureServe rankings use a suite of factors to assess the conservation status of plant species across North America. Conservation status ranks are based on a one to five scale, ranging from critically imperiled (G1) to demonstrably secure (G5). Status is assessed and documented at three distinct geographic scales-global (G), national (N), and state/province (S).

**Prickly Milk Vetch (Astragalus kentrophyta)**

Global Ranking: G5, Alberta: S2, Saskatchewan: S1, Montana: S4

The prickly milk vetch is a perennial herb in the pea family with yellow to white and often tinged with purple flower. The needle-like leaves help it to conserve water in a hot dry environment. The plants grow in gravelly and sandy soils and have a deep binding taproot that help anchor loose soils and reach deep water. Within the Milk River watershed it is found in all three jurisdictions.

**Soapweed (Yucca glauca)**

Global Ranking: G5, Alberta: S1, Saskatchewan: Not applicable (introduced), Montana: S4-S5

Soapweed is a large perennial evergreen with a woody crown. Cream-coloured flowers bloom on a large spike that rises from a densely tufted base of spiked leaves. It favours dry open grasslands and coulees and is the northern most member of the agave family. Soapweed is a prime example of a species at the northern extent of its natural range. In Alberta, soapweed is restricted to a few areas within the Milk River watershed, but it is found extensively throughout much of Montana. The Saskatchewan population is thought to be introduced and status ranking is not applicable. The yucca moth and soapweed depend on one another for survival, as the moth pollinates the plants and in turn some of the seeds become home for moth eggs and grubs to grow.
Tufted Hymenopappus
(*Hymenopappus filifolius*)
Global Ranking: G5, Alberta: S2, Saskatchewan: S3, Montana: Status under review
Tufted hymenopappus is a perennial aster that has a yellowish flower with mainly basal leaves and forms hairy seed-like fruits tipped with a crown of tiny scales. The plant grows on dry gravelly sites with bare ground on valley slopes and the edges of coulees in badlands areas. Though rare in Alberta, the species is locally abundant in areas such as the Milk River Canyon.

Carolina Whitlowgrass
(*Draba reptans*)
Global Ranking: G5, Alberta: S1, Saskatchewan: S2, Montana: Status not reported
Whitlow grass is a small delicate annual in the mustard family. It has egg-shaped basal leaves that are covered in rough hairs and produces a white flower in elongated clusters. Whitlow grass favours naturally disturbed sand or gravel areas within native grasslands.

Hare-footed Locoweed
(*Oxytropis lagopus Nutt.*)
Global Ranking: G4, Alberta: S1, Saskatchewan: Not Found, Montana: S3
Hare-footed locoweed is a silvery looking hairy perennial in the pea family that has pink to purple or blue flowers that are sharply tipped and distinguishes them from other smaller milk vetches. This plant likes sandy and grassy knolls and sagebrush plains. In Alberta, hare-footed locoweed is found only in the Milk River watershed and is locally abundant in areas within Montana.

Small-flowered Hawk’s-beard (*Crepis intermedia* - Gray)
Global Ranking: G5, Alberta: S2, Saskatchewan: S1, Montana: S4
Small-flowered hawk’s-beard and intermediate hawk’s-beard are short yellow flowering perennial plants in the aster family. They grow on dry eroding slopes and produce a very distinct cylindrical ribbed fruit of approximately 10-20 per flower. Noted as relatively to highly rare in Saskatchewan and Alberta, they are abundant and not at risk in Montana.

Western Blue Flag (*Iris missouriensis* - Nutt.)
Global Ranking: G5, Alberta: S2, Saskatchewan: Not Found, Montana: S4
This thin perennial Iris spreads through large rhizomatous root systems. The plants like open wet meadows and riparian areas, and are adapted to grazing. Some hoof shear actually helps promote expansion of blue flag colonies. The flowers can be very large and showy and are deep purple to nearly white. There is only one known location of blue flag within the Alberta portion of the watershed, near the North Fork Milk River. Some localized populations exist in Saskatchewan near First Nation’s historic sites where it is thought to have been planted for medicinal purposes. In Montana the plant is widespread with a stable population.
Map 8.2 Native Vegetation

Prickly pear cactus
8.3.2 Invasive Species

Invasive plants are a serious ecological and environmental threat to natural resources. Invasive species displace native plant communities (including endangered species), alter wildlife habitat, reduce forage for wildlife and livestock and lower biodiversity. In some cases, noxious weeds increase soil surface runoff and sedimentation into streams (Grubb et al. 1999). Generally, invasive plants spread throughout the Milk River watershed along linear disturbances (e.g., roads, railroads), through river, stream and creek valleys and by seeds carried by wind, water, wildlife and livestock. The number, distribution and density of invasive species in the watershed provide an indication of the overall health of the landscape.

Invasive and Disturbance-caused Plants are:

- Increasing
- Stable
- Decreasing
- Unknown

Invasive plants are present in the Milk River watershed but a status designation (increasing, stable or decreasing) cannot be determined. Weed surveys are undertaken in the watershed and the species composition in select areas are identified; however, there are few comprehensive weed studies that document the distribution of weeds across the watershed (in Alberta, Saskatchewan and Montana). Few monitoring programs assess the increase or decrease in the size of weed patches in the watershed, except in very specific and isolated projects.

Weed Legislation and Management

Alberta

The Alberta Weed Control Act (Province of Alberta 2008) aims to regulate weeds and weed seeds through various control measures, such as inspection and enforcement, and provides for the recovery of expenses in cases of non-compliance. Additionally, it mandates the licensing of seed cleaning plants and mechanisms. The new Weed Control Act, proclaimed in 2010, reduced the classification of weeds from three categories (i.e., restricted weeds, noxious weeds and nuisance weeds) to two categories (i.e., prohibited noxious weeds and noxious weeds). Weed species are classified based on a number of factors, including the potential to damage agricultural crops and pastures, and native vegetation.

Prohibited Noxious Weeds, including the plant’s seeds, are plants designated according to the regulations (see DVD for listing of Alberta’s Invasive Plants (Wheatland County 2012)). This weed designation provides regulatory support for an “Early Detection, Rapid Response” stage of invasive plant management. Plants in this category are either not currently found in Alberta or are found in few locations such that eradication could be possible (Province of Alberta 2008). A landowner has the responsibility to destroy a prohibited noxious weed under the Weed Control Act.

Noxious Weeds, including the plant’s seeds, are plants designated in accordance with the regulations (see DVD for listing of Alberta’s Invasive Plants (Province of Alberta 2008). This weed designation provides regulatory support for a “Containment” stage of invasive plant management. Plants listed in this category are considered too widely-distributed to eradicate. A local authority may initiate control programs for these weeds if there is potential for significant ecological or economic impact on lands within the municipality (Province of Alberta 2008).

The Alberta Riparian Habitat Management Society actively documents the occurrence of invasive weeds while conducting riparian health inventories in the watershed. Within riparian health assessments and inventories, prohibited noxious and noxious weeds are generally called “invasive plants”. Nuisance and less desirable non-native plants that increase as a result of disturbance are mostly categorized as “disturbance-caused undesirable plants” (Cows and Fish 2001). As noted in Section 7.0, invasive plants and disturbance-caused undesirable plants generally received unhealthy scores at mainstem Milk River and tributary sites in Alberta.
Invasive plants are typically non-native species that can cause economic or environmental harm. They are generally aggressive and hard to remove once established. They include most prohibited noxious and noxious weeds.

Disturbance-caused undesirable herbaceous species includes most nuisance weeds, as well as many other plant species that respond to site disturbance. Disturbance-caused undesirable species include native and non-native species that tend to increase with site disturbance, specifically in riparian areas, and are regarded as undesirable because they do not perform optimal riparian functions (e.g., provide deep-binding root mass for bank protection). Such site disturbance is often linked to a downward trend for plant communities from the potential natural community, and reduced riparian function or “health” (Fitch and Ambrose 2003).

Escaped agronomic species are primarily grasses and legumes, including smooth brome grass (*Bromus inermis*), timothy (*Phleum pratense*), crested wheatgrass (*Agropyron pectiniform*) and sweet clover (*Melilotus spp.*), that were deliberately introduced as pasture or forage species, and are often still valued in agriculture. These plants are very competitive and can have significant impacts on biodiversity and ecosystem function (McClay et al. 2004).

**Montana**

The Montana *Local County Weed Act* (Montana Department of Agriculture 2011) governs the activity of state-wide Weed Management Districts, commonly called County Weed Control Districts. This Law gives responsibility to County Boards to develop and administer the District’s noxious weed program, establish management criteria for noxious weeds on all lands in the district, and develop and implement a noxious weed program covering all land within the district owned or administered by a federal agency. In Montana, weeds are categorized into five different priorities (i.e., 1A, 1B, 2A, 2B and 3). The system is based on the management techniques used to control the species as well as their presence and population density.

Priority 1A weeds are not present in Montana, and if detected, they must be eradicated, and education and preventative measures should be taken. The yellow-star thistle is the only species currently listed under Priority 1A.

Priority 1B weeds are found but have limited presence in Montana. Management requires eradication if possible or containment and education. This category features many aquatic invasive weeds such as flowering rush and Eurasian watermilfoil (*Myriophyllum spicatum*).

Priority 2A weeds are common in isolated areas of Montana. Management requires eradication or containment where the species is less abundant. Local weed districts prioritize management of species in this category. Species in this category include

**Saskatchewan**

In Saskatchewan, the *Weed Control Act* (Government of Saskatchewan 2010) replaced *The Noxious Weeds Act* (1984). The new legislation focuses on preventing the introduction and spread of new weeds in the province rather than eradicating well-established weeds. The new Act also establishes three categories of weeds (i.e., Prohibited, Noxious and Nuisance). This categorization allows the enforcement effort to vary with the weed’s relative importance. Weeds that are rare and are a demonstrated problem outside Saskatchewan are of higher importance than weeds that are widespread. Few people will have heard of many of the weeds in the Prohibited category, such as saltcedar (*Tamarix ramosissima*) and yellow-star thistle (*Centaurea solstitialis*). While many of the weeds in the Noxious category, such as leafy spurge (*Euphorbia esula*) and scentless chamomile (*Tripleurospermum perforatum*), or the Nuisance category (e.g., dandelion (*Taraxacum spp.*)) are more familiar. The *Weed Control Act* protects natural areas such as native rangeland, forests and aquatic habitats from the introduction of invasive plants.
orange hawkweed (*Pilosella aurantiaca*) and tall buttercup (*Ranunculus acris*), commonly found in higher moisture sites in West and West Central Montana.

Priority 2B weeds are abundant in Montana and widespread in many counties. Management requires eradication or containment where the species is less abundant. Local weed districts prioritize management of species in this category. Spotted knapweed (*Centaurea maculosa*) and Saltcedar are two Priority 2B species.

Priority 3 weeds are Regulated Plants and not listed as noxious weeds in Montana. The plant may not be intentionally spread or sold other than as a contaminant in agricultural products. The state recommends research, education and prevention to minimize the spread of the regulated plant. Cheatgrass (Downy Brome) (*Bromus tectorum*) and Russian olive (*Elaeagnus angustifolia*) are both listed in this priority and have the potential to negatively impact ecology and agricultural production in the Milk River watershed.

The Montana Noxious Weed Trust Fund (NWT) grant program was established by the 1985 Montana Legislature to provide funding for the development and implementation of weed management programs; provide for research and development of innovative weed management techniques, including biological control; and to support educational and other research projects that benefit Montana citizens. The grant program is designed to assist counties, local communities, researchers, and educators in their efforts to solve a variety of weed problems in Montana.

### Distribution and Occurrence of Invasive Plants

Like almost all riparian areas and rangelands in southern Alberta, the prevalence of invasive plants and disturbance-caused plants is a concern. Most riparian areas assessed along the Milk River have continuous occurrences of non-native introduced plants. Canada thistle (*Cirsium arvense*) and perennial sow-thistle (*Sonchus arvensis*) are the most commonly occurring invasive plants. Canada thistle was also identified as commonly occurring throughout Montana.

A survey of spotted knapweed on the North Fork Milk River, Alberta was conducted in 2010 to address knowledge gaps identified in the Milk River SOW Report 2008 (MRWCC 2008). Although there are known infestations of spotted knapweed along the St. Mary Diversion Canal to the North Fork Milk River Drop Structure #2, no occurrence of spotted knapweed were identified from the International Boundary at the North Fork through to the confluence with the mainstem Milk River (also known as the South Fork). It is thought that the stable streambanks, good vegetative cover and few disturbed areas prevent Spotted Knapweed from establishing along this reach of the Milk River. Continued monitoring is needed by local landowners and leaseholders to ensure early detection of spotted knapweed if it should migrate down the North Fork Milk River.

Weed inventories, monitoring and mapping of invasive species are ongoing in the Alberta watershed, including at Alberta Parks. At Writing-on-Stone Provincial Park (WOS PP), a two-person crew spends about 2-3 weeks per year managing creeping (Canada) thistle (*Cirsium arvense*), common burdock (*Arctium lappa*), dalmatian toadflax (*Linaria dalmatica*), dames rocket (*Hesperis matronalis*), baby’s breath (*Gypsophila spp*), dalmatian toadflax (*Linaria dalmatica*), dames rocket (*Hesperis matronalis*), baby’s breath (*Gypsophila spp*), dalmatian toadflax (*Linaria dalmatica*), dames rocket (*Hesperis matronalis*), baby’s breath (*Gypsophila spp*), dalmatian toadflax (*Linaria dalmatica*), dames rocket (*Hesperis matronalis*), baby’s breath (*Gypsophila spp*), dalmatian toadflax (*Linaria dalmatica*), dames rocket (*Hesperis matronalis*), baby’s breath (*Gypsophila spp*), dalmatian toadflax (*Linaria dalmatica*), dames rocket (*Hesperis matronalis*), baby’s breath (*Gypsophila spp*), dalmatian toadflax (*Linaria dalmatica*), dames rocket (*Hesperis matronalis*), baby’s breath (*Gypsophila spp*), dalmatian toadflax (*Linaria dalmatica*), dames rocket (*Hesperis matronalis*), baby’s breath (*Gypsophila spp*), dalmatian toadflax (*Linaria dalmatica*), dames rocket (*Hesperis matronalis*), baby’s breath (*Gypsophila spp*), dalmatian toadflax (*Linaria dalmatica*), dames rocket (*Hesperis matronalis*), baby’s breath (*Gypsophila spp*), dalmatian toadflax (*Linaria dalmatica*), dames rocket (*Hesperis matronalis*), baby’s breath (*Gypsophila spp*), dalmatian toadflax (*Linaria dalmatica*), dames rocket (*Hesperis matronalis*), baby’s breath (*Gypsophila spp*), dalmatian toadflax (*Linaria dalmatica*), dames rocket (*Hesperis matronalis*), baby’s breath (*Gypsophila spp*), dalmatian toadflax (*Linaria dalmatica*), dames rocket (*Hesperis matronalis*), baby’s breath (*Gypsophila spp*), dalmatian toadflax (*Linaria dalmatica*), dames rocket (*Hesperis matronalis*), baby’s breath (*Gypsophila spp*), dalmatian toadflax (*Linaria dalmatica*), dames rocket (*Hesperis matronalis*), baby’s breath (*Gypsophila spp*), dalmatian toadflax (*Linaria dalmatica*), dames rocket (*Hesperis matronalis*), baby’s breath (*Gypsophila spp*), dalmatian toadflax (*Linaria dalmatica*), dames rocket (*Hesperis matronalis*), baby’s breath (*Gypsophila spp*), dalmatian toadflax (*Linaria dalmatica*), dames rocket (*Hesperis matronalis*), baby’s breath (*Gypsophila spp*), dalmatian toadflax (*Linaria dalmatica*), dames rocket (*Hesperis matronalis*), baby’s breath (*Gypsophila spp*), dalmatian toadflax (*Linaria dalmatica*), dames rocket (*Hesperis matronalis*), baby’s breath (*Gypsophila spp*), dalmatian toadflax (*Linaria dalmatica*), dames rocket (*Hesperis matronalis*), baby’s breath (*Gypsophila spp*), dalmatian toadflax (*Linaria dalmatica*), dames rocket (*Hesperis matronalis*), baby’s breath (*Gypsophila spp*), dalmatian toadflax (*Linaria dalmatica*), dames rocket (*Hesperis matronalis*), baby’s breath (*Gypsophila spp*), dalmatian toadflax (*Linaria dalmatica*), dames rocket (*Hesperis matronalis*), baby’s breath (*Gypsophila spp*), dalmatian toadflax (*Linaria dalmatica*), dames rocket (*Hesperis matronalis*), baby’s breath (*Gypsophila spp*), dalmatian toadflax (*Linaria dalmatica*), dames rocket (*Hesperis matronalis*), baby’s breath (*Gypsophila spp*), dalmatian toadflax (*Linaria dalmatica*), dames rocket (*Hesperis matronalis*), baby’s breath (*Gypsophila spp*), dalmatian toadflax (*Linaria dalmatica*), dames rocket (*Hesperis matronalis*), baby’s breath (*Gypsophila spp*), dalmatian toadflax (*Linaria dalmatica*), dames rocket (*Hesperis matronalis*), baby’s breath (*Gypsophila spp*), dalmatian toadflax (*Linaria dalmatica*), dames rocket (*Hesperis matronalis*), baby’s breath (*Gypsophila spp*), dalmatian toadflax (*Linaria dalmatica*), dames rocket (*Hesperis matronalis*), baby’s breath (*Gypsophila spp*), dalmatian toadflax (*Linaria dalmatica*), dames rocket (*Hesperis matronalis*), baby’s breath (*Gypsophila spp*), dalmatian toadflax (*Linaria dalmatica*), dames rocket (*Hesperis matronalis*), baby’s breath (*Gypsophila spp*), dalmatian toadflax (*Linaria dalmatica*), dames rocket (*Hesperis matronalis*), baby’s breath (*Gypsophila spp*), dalmatian toadflax (*Linaria dalmatica*), dames rocket (*Hesperis matronalis*), baby’s breath (*Gypsophila spp*), dalmatian toadflax (*Linaria dalmatica*), dames rocket (*Hesperis matronalis*), baby’s breath (*Gypsophila spp*), dalmatian toadflax (*Linaria dalmatica*), dames rocket (*Hesperis matronalis*), baby’s breath (*Gypsophila spp*), dalmatian toadflax (*Linaria dalmatica*), dames rocket (*Hesperis matronalis*), baby’s breath (*Gypsophila spp*), dalmatian toadflax (*Linaria dalmatica*), dames rocket (*Hesperis matronalis*), baby’s breath (*Gypsophila spp*), dalmatian toadflax (*Linaria dalmatica*), dames rocket (*Hesperis matronalis*), baby’s breath (*Gypsophila spp*) and whitetop (hoary cress) (*Lepidium draba*) are a concern in Montana. Downy and Japanese brome pose a more recent threat and
Grazing is an Important Element in Invasive Plant Management

In 2012, the Milk River Management Committee, responsible for planning at the Kennedy Coulee Ecological Reserve and Milk River Natural Area, commissioned an extensive survey of invasive plants. Fifteen invasive non-native plants were discovered. Of these species, three noxious species downy brome (cheatgrass), Japanese brome and creeping (Canada) thistle, four nuisance weeds and seven escaped agronomic species were observed (see accompanying DVD for full report).

The long term rangeland monitoring at Kennedy Coulee Ecological Reserve and the Milk River Natural Area have documented the movement of invasive, non-native species during the past 20 years, when livestock grazing was prohibited in the area. The recent surveys noted that invasive encroachment is more prominent in areas where grazing has been excluded. The key recommendation of the project was that grazing should be reintroduced to the area as an important tool to suppress the invasion of aggressive agronomic weeds (Tannas 2012). Ongoing monitoring of invasive species, coinciding with existing rangeland management programs, will be essential to ensure the effectiveness of control measures (Tannas 2012).

In addition, Table 8.5 summarizes the work completed to estimate the acreage of invasive weed species and control weeds within six counties in the Milk River watershed, Montana. As part of this program, common tansy and oxeye daisy were found for the first time in Hill County, though just a few individual plants. Also, Russian olive has been added to Montana State University’s (MSU) target list in Hill County. All young seedlings are being mechanically removed, trees near waterways have been targeted for removal, and established shelter belts are being addressed as money and time allows. Methods used to control invasive weeds included biocontrols, herbicides and mechanical methods, depending on the target species. In Toole County, leafy spurge flea beetles were released on State land on West Butte (Sweet Grass Hills). Sheep grazing was also used to target noxious weeds on the West Butte.

land managers are taking action to prevent their spread. Note that the listed species do not reflect all of the control efforts, but rather highlights those of highest concern at present.

Although no formal joint initiative or Cooperative Weed Management Area exists within the Milk River watershed, weed managers across municipal districts and counties commonly work together to share best available information regarding occurrences and control measures. Multiple jurisdictions have discussed the potential for international monitoring initiatives along the Milk River and it is anticipated that through organizations like the MRWA in Montana and the MRWCC in Alberta, this will likely be achievable.

In 2009, the Milk River Watershed Alliance (MRWA) teamed up with the Bureau of Land Management (BLM), the Weed Districts and Conservation Districts of Hill, Blaine, Phillips and Valley Counties to embark on a 10 year BLM-funded Cooperative Weed Management Area Grant. The purpose of this grant is to inventory and control Montana listed noxious weeds on each side of the Milk River for a width of 61 m (200 ft). The area included in the project starts at Fresno Reservoir in Hill County and ends downstream at the confluence of the Milk and Missouri rivers in Valley County. Weeds will be controlled on private and publicly owned lands.
### Table 8.5. Project summaries and control work to date (2009-2012) and the estimated acreage of invasive weeds by Districts in Montana.

| County and Land Management Agency | Estimated Infested Acres | Total Weed Control Expenditures | Canada Thistle | Cheategass (Downy Brome) | Dalmation Toadflax | Diffuse Knapsweed | Field Bindweed | Hoary Alyssum | Houndstongue | Leafy Spurge | Meadow Hawkweed | Orange Hawkweed | Perennial Pepperweed | Russian Knapweed | Russian Olive | Spotted Knapweed | Sulfur Cinquefoil | Whitetop | Yellow Toadflax | Other |
|----------------------------------|--------------------------|---------------------------------|---------------|-------------------------|---------------------|-------------------|-----------------|--------------|--------------|-------------|----------------|-------------------|---------------------|-----------------|----------------|-----------------|----------------|----------------|-------|
| Blaine                           |                          |                                 |               |                         |                     |                   |                 |              |              |              |                  |                  |                    |                 |              |           |                 |             |             |
| DNRC                             | 2,900                    | 300                             |               |                         | X                   | X                 | X               | X            | X            | X            | X                 | X                 | X                   | X                | X            | X                | X              | X             |
| FWP                              | 0                        | 0                               | -              | -                       | -                   | -                 | -               | -            | -            | -            | -                 | -                 | -                   | -                | -            | -                | -              | -             |
| Transportation                   | 366                      | 48,928                          | X              | X                       | X                   | X                 | X               | X            | X            | X            | X                 | X                 | X                   | X                | X            | X                | X              | X             |
| Glacier                          |                          |                                 |               |                         |                     |                   |                 |              |              |              |                  |                  |                    |                 |              |                 |                |               |
| DNRC                             | 125                      | 150                             | X              |                         |                     |                   |                 |              | X            | X            | X                 | X                 | X                   | X                | X            | X                | X              | X             |
| Transportation                   | 710                      | 8,735                           | X              |                         | X                   | X                 | X               | X            | X            | X            | X                 | X                 | X                   | X                | X            | X                | X              | X             |
| Hill                             |                          |                                 |               |                         |                     |                   |                 |              |              |              |                  |                  |                    |                 |              |                 |                |               |
| DNRC                             | 2,100                    | 2,000                           | X              |                         | X                   | X                 | X               | X            | X            | X            | X                 | X                 | X                   | X                | X            | X                | X              | X             |
| FWP                              | 30                       | 7,548                           | X              |                         |                     |                   | X               | X            | X            | X            | X                 | X                 | X                   | X                | X            | X                | X              | X             |
| Transportation                   | 288                      | 31,656                          | X              |                         | X                   | X                 | X               | X            | X            | X            | X                 | X                 | X                   | X                | X            | X                | X              | X             |
| MSU                              | 150                      | 1,000                           | X              |                         | X                   | X                 | X               | X            | X            | X            | X                 | X                 | X                   | X                | X            | X                | X              | X             |
| Phillips                         |                          |                                 |               |                         |                     |                   |                 |              |              |              |                  |                  |                    |                 |              |                 |                |               |
| DNRC                             | 3,805                    | 2,000                           | X              |                         |                     |                   |                 |              | X            | X            | X                 | X                 | X                   | X                | X            | X                | X              | X             |
| FWP                              | 41                       | 1,867                           | X              |                         |                     |                   | X               | X            | X            | X            | X                 | X                 | X                   | X                | X            | X                | X              | X             |
| Transportation                   | 157                      | 26,046                          | X              |                         | X                   | X                 | X               | X            | X            | X            | X                 | X                 | X                   | X                | X            | X                | X              | X             |
| MSU                              | 20                       | 775                             |     |                         |                     |                   |                 |              |              |              |                  |                  |                    |                 |              |                 |                |               |
| Toole                            |                          |                                 |               |                         |                     |                   |                 |              | X            | X            | X                 | X                 | X                   | X                | X            | X                | X              | X             |
| DNRC                             | 1,946                    | 1,000                           | X              |                         | X                   | X                 | X               | X            | X            | X            | X                 | X                 | X                   | X                | X            | X                | X              | X             |
| FWP                              | 2,640                    | 26,664                          | X              |                         | X                   | X                 | X               | X            | X            | X            | X                 | X                 | X                   | X                | X            | X                | X              | X             |
| Transportation                   | 898                      | 51,030                          | X              |                         | X                   | X                 | X               | X            | X            | X            | X                 | X                 | X                   | X                | X            | X                | X              | X             |
| Valley                           |                          |                                 |               |                         |                     |                   |                 |              | X            | X            | X                 | X                 | X                   | X                | X            | X                | X              | X             |
| DNRC                             | 4,367                    | 2,000                           | X              |                         | X                   | X                 | X               | X            | X            | X            | X                 | X                 | X                   | X                | X            | X                | X              | X             |
| FWP                              | 41                       | 1,867                           | X              |                         | X                   | X                 | X               | X            | X            | X            | X                 | X                 | X                   | X                | X            | X                | X              | X             |
| Transportation                   | 284                      | 46,418                          | X              |                         | X                   | X                 | X               | X            | X            | X            | X                 | X                 | X                   | X                | X            | X                | X              | X             |
Leafy Spurge (Euphorbia esula)

There are only a few areas infested with leafy spurge within the Alberta portion of the watershed, primarily east of the Town of Milk River. It is commonly found across the watershed in Montana.

Leafy spurge is an aggressive, persistent, deep-rooted perennial that reproduces vegetatively, spreading from rhizomatous roots, and by the production of seeds that are often dispersed by birds, wildlife, humans, and along watercourses. Leafy spurge displaces native vegetation, resulting in a monoculture that reduces biodiversity and threatens both abundant and sensitive species. The economic impact of leafy spurge can be staggering with annual production losses of over $100 million documented in the northwestern United States (Leistritz et al. 2004).

Spotted Knapweed (Centaurea maculosa)

In Alberta, spotted knapweed commonly occurs along the South Fork Milk River, through to the Town of Milk River. It is common along the St. Mary Canal to the North Fork Milk River and occurs sporadically throughout the watershed in disturbed areas. In Saskatchewan, spotted knapweed is actively controlled along the TransCanada Highway and there are sporadic occurrences along the Frenchman River. In Montana, spotted knapweed has been found state-wide in nearly all counties. It is established in Glacier Park, Montana and along the St. Mary River diversion infrastructure, though it is significantly reduced along the St. Mary River. Spotted Knapweed is established along the mainstem Milk River near the Western Crossing and further east, south of the Eastern Crossing to the confluence of the Missouri River.

Spotted knapweed is primarily a biennial plant that produces a rosette the first year and a flowering bolt the second. It can also be a short-lived perennial, blooming for a few years before dying. Spotted knapweed has degraded large tracts of rangeland in the northwestern U.S. and parts of southern BC. While livestock and wildlife will graze spotted knapweed early in its growth form, it becomes unpalatable and can out-compete a native range community with its allelopathic properties. Knapweed invades disturbed ground along watercourses, and can be trans-located in contaminated hay or by plant skeletons caught in vehicles or rail cars.
Dalmation Toadflax (*Linaria dalmatica*)

<table>
<thead>
<tr>
<th></th>
<th>Alberta</th>
<th>Saskatchewan</th>
<th>Montana</th>
</tr>
</thead>
<tbody>
<tr>
<td>Status</td>
<td>Noxious</td>
<td>Prohibited</td>
<td>Priority 2B</td>
</tr>
</tbody>
</table>

In Alberta, dalmation toadflax is sporadically occurring in the Del Bonita gravels, and along the North and South Fork Milk River. Localized pockets of dalmation toadflax are found through to the Highway 880 Bridge and within Writing-on-Stone Provincial Park. Dalmatian toadflax prefers warmer sites particularly along open south-facing coulees and along exposed gravel bars and can be found throughout the watershed, in Saskatchewan and Montana.

Dalmation toadflax is a perennial plant that reproduces by seed and by creeping rhizomes. First year plants develop a rosette of leaves and a deep tap root system (about 1.2 m (4 ft) deep) with lateral rhizomes extending up to 3.7 m (12 ft). Flowers are yellow and very showy, similar to ornamental snapdragons.

Saltcedar - Tamarisk (*Tamarix spp.*)

<table>
<thead>
<tr>
<th></th>
<th>Alberta</th>
<th>Saskatchewan</th>
<th>Montana</th>
</tr>
</thead>
<tbody>
<tr>
<td>Status</td>
<td>Prohibited Noxious</td>
<td>Prohibited</td>
<td>Priority 2B</td>
</tr>
</tbody>
</table>

Saltcedar is not currently found in the wild in the Milk River watershed, however it was confirmed to be sold at a Walmart Garden Centre in Southern Alberta in 2010. It has since been removed from known horticultural sales. In Montana, a single plant was found and eradicated in Hill County, near Fresno Reservoir. Saskatchewan also had an occurrence of saltcedar, but not within the Milk River watershed.

Saltcedar was introduced into Canada and the U.S. from Asia in the 1800s and is now considered an invasive species. Active invasion in the U.S. occurred between 1935 and 1955, and by 2001, saltcedar had reached the eastern Canadian border. Saltcedar is a deciduous shrub/small tree that grows most successfully along riparian areas. Its roots extend deep into the soil to access groundwater. Where groundwater is not present, saltcedar sends out lateral roots to access other sources of water. Saltcedar has a great reproductive ability and, when mature, can produce 600,000 seeds annually that are easily dispersed by wind and water. Severed stems and shoots can root in moist soil. These trees can consume as much as 757 L of water per day. Scale-like leaves remove salt from the atmosphere which is then released into the soil. The increased salinity in the soil makes it unsuitable for many native plants and shrubs.

Russian Olive (*Elaeagnus angustifolia*)

<table>
<thead>
<tr>
<th></th>
<th>Alberta</th>
<th>Saskatchewan</th>
<th>Montana</th>
</tr>
</thead>
<tbody>
<tr>
<td>Status</td>
<td>Noxious</td>
<td>Not Designated</td>
<td>Priority 3</td>
</tr>
</tbody>
</table>

In Alberta, Russian olive has invaded native riparian communities from the Town of Milk River to below Writing-on-Stone Provincial Park. In north-central Montana, Russian olive is replacing cottonwoods below dams and other water impoundments.

Russian olive is a Eurasian tree that was imported in the 1930s to stabilize soil. It is fast growing and favoured as a windbreak tree. It thrives in poor soils because it is capable of fixing nitrogen from the atmosphere. It will grow in dry soils but does best in sandy riparian areas. Admired for its silvery foliage, Russian olive produces large amounts of leaf litter. Russian olive can out-compete the cottonwood community in the Milk River watershed as it does not require a disturbance event (e.g., flood) to reproduce. It has the ability to simplify the riparian community and decrease the diversity of habitat available for wildlife.
Crested Wheat Grass (*Agropyron pectiniforme*)

Alberta | Not Listed  
Saskatchewan | Not Listed  
Montana | Not Listed

In Alberta, although no longer used as a reclamation species, crested wheat grass is invading native plant communities throughout the watershed from adjacent tame pastures and from disposition rights of way. Crested wheat grass is not listed or controlled in Montana and Saskatchewan.

Crested wheat grass is an introduced agronomic species which was historically seeded and used in complementary and deferred grazing systems as well as for reclamation on disturbed sites. Its qualities include excellent establishment, even on poor soils, early spring growth, high nutrient quality in the spring and hay production. Despite these attributes, research indicates serious negative consequences to sites containing crested wheat grass. It releases less carbon into the soil, produces less litter, reduces soil organic matter content of the site, decreases biodiversity, and aggressively uses available soil moisture. An increase in bare ground on crested wheat grass dominated sites can lead to accelerated soil erosion. Crested wheat grass is very competitive, produces an abundance of seed and subsequently invades into adjacent native prairie. This invasion creates significant grazing management issues due to selective and preferential grazing of native species over crested wheat grass. New seeding of crested wheat grass should be discouraged and research is required to determine the level of infestation and its impact on the watershed.

Scentless Chamomile (*Tripleurospermum perforatum*)

In Alberta, scentless chamomile is known to occur north and east of Del Bonita. It is not currently reported along the Milk River though it has been found along seasonal waterways connected to the Milk River. Continued monitoring and vigilance is necessary for effective control.

Scentless chamomile is native to Europe and was introduced into Canada and the U.S. as an ornamental in gardens and by contaminated crop seed. Scentless chamomile reproduces by seed only and can behave as an annual, biennial, or occasionally a perennial. Plants are usually very bushy and have a fibrous root system. It continually blooms and forms seed which germinate throughout the growing season. Fall seedlings overwinter and are usually first to flower in spring. A single, robust plant can occupy 1 m² and produce up to one million seeds. Scentless chamomile may be mistaken for oxeye daisy, having similar flowers but different leaves, or for stinking mayweed (*Anthemis cotula*) or pineapple weed (*Matricaria matricaioides*), although the foliage of these latter two plants has an odour. Scentless chamomile is well adapted to heavy clay soils and tolerates both periodic flooding and dry sites. It is a poor competitor but establishes quickly on disturbed sites. The seeds float and are widely dispersed on water.
In the Milk River watershed, Alberta, rangeland stewardship organizations have noted a substantial increase in downy and Japanese brome while conducting range health assessments. Assessments completed in 2004 and 2005 observed that Japanese brome was present in 13 of 102 plots (13%) surveyed. In 2011, these same sites were re-assessed and Japanese brome was present in 44 of the 102 plots (43%) surveyed. These sites were considered well managed without significant variation in range management practices, and no additional bare ground disturbance occurred within the assessment area (Unpublished data).

For nearly 100 years, downy brome and Japanese brome have had a widespread but low level of presence in the watershed, primarily on disturbed sites (e.g., fence lines and road ditches). Traditionally seen on rangeland in thin break range sites and coulee slopes, the bromes have been observed on some healthy upland sites. Further effort is needed to map the presence and distribution of downy and Japanese brome in the Milk River watershed, and to identify potential risk factors and control methods in range situations. Annual brome populations appear to be closely associated with wet and dry cycles, however research should be undertaken to address questions regarding its continued persistence. Rangeland management should strive to limit disturbance areas and bare ground.

Downy and Japanese brome have unique features that make them easy to identify. At the seedling stage they are hairy and found in very dense clumps. At maturity, both species have large, open, drooping panicles that have 1.3 cm (0.5 in) awns. These are a purple colour in downy brome while the awns are shorter, and brownish in colour in the slightly taller Japanese brome. These plants are palatable prior to ripening, but when mature, the brittle awns have been known to cause eye and mouth problems for livestock.

The bromes are primarily winter annuals but may be biennial. Control efforts should be focused on reducing its prolific seed production. On pastureland, options include mowing or early selective grazing to prevent seed set. Herbicide treatment is effective in cropland, particularly in wheat, winter wheat and wheatgrass; however, no chemical controls are registered for control of brome in rangelands.

Downy and Japanese bromes are difficult to control once established on rangeland and preventive measures are more effective than control efforts. On native range, vulnerable pre-disposed sites are areas that have very coarse or fine soil texture, solenetzic blow-outs and bunch grass communities (needle and thread or spear grass [Stipa spp.]), especially after extended droughts. Range management practices that minimize or eliminate disturbance sites (e.g., over-grazed areas, feeding areas or fresh soil exposures) help maintain a healthy plant community that is able to withstand the persistent threat of brome infestation.

At this time Alberta’s public rangeland contains multiple sites totalling a few hundred acres where the annual bromes are one of two dominant species (with Stipa spp.) occupying 20% of the canopy cover. There are no known monoculture infestations in the watershed where downy brome dominates undisturbed, public native range.
**Biological Control**

Biocontrol of invasive weeds is the deliberate use of a weed’s “natural enemies” to suppress its population density and distribution. Biocontrols include insects, bacteria, or fungi. These “control agents” feed on or cause disease in the weed, thereby limiting its growth, reproduction and spread. Biocontrol agents are selective to target weed species, effective in inaccessible areas, have insignificant environmental impact, and are often less expensive through time. The most significant limitation is that most agents lack the immediacy of chemical control as populations require time to establish.

**Leafy Spurge** - Brown and Black Flea Beetles (Aphthona nigrascutis, and Aphthona lacertosa) have been extensively released in Montana for over 25 years. In Alberta, beetles were first transplanted from Montana stock in the mid 1990s and since then have been locally adapted and reared for releases across southern Alberta. Flea beetles can reduce leafy spurge to less than 10% under ideal conditions. Larvae bore in the smaller roots and feed externally on the larger ones to weaken and kill their host.

**Dalmation Toadflax** - Stem-mining Weevil (Mecinus janthinus) was first evaluated as a potential dalmation toadflax biocontrol agent at Montana State University in the late 1990s. In Alberta, field testing in the Milk River watershed occurred in 2007 near Del Bonita. The weevils are not well-suited to over-winter in the watershed due to winter temperature fluctuations brought by Chinook winds. Beetles overwintering in the upper stocks often suffer high mortality. Further research is required and locally adapted weevils may be present in the future.

**Houndstongue** - The weevil (Mogulones cruciger) was first released in 2005 in Southern Alberta after extensive work in British Columbia. Houndstongue can be difficult to control with conventional treatments as it is spread extensively in underbrush by rubbing action of the bur covered seeds. Cruciger weevils are able to locate remote patches of houndstongue and have effectively eliminated entire infestations within a 1 km (0.62 mi) radius of release sites after 4 years (Van Hezewijk et al. 2010). By law, weevils cannot be released in Montana, although a number of Alberta release sites are near the international border and populations are likely migrating into the state.

**Spotted Knapweed** - Unlike leafy spurge, dalmation toadflax and houndstongue, there are many different biocontrol agents that will feed on spotted knapweed. Larinus minutus is a weevil that feeds on the seed-head of spotted knapweed and is the most common and viable agent. A single larva will destroy all seeds in a head, while adults feed on the foliage and stems to reduce the plant size, amount of heads matured, and length of flowering season.

Complete elimination of invasive and disturbance-caused plants is not realistic; however, with a combination of sound land management practices and weed control measures, the prevalence of these plants could be reduced.

Weed control is primarily the responsibility of the landowner or lease holder within the majority of the Milk River watershed; with control coordination originating with the local Municipal District or County.

Recent increases in industrial disturbance are an emerging issue in the western end of the Alberta portion of the watershed.
Aquatic Invasive Species: Can they Impact the Milk River Watershed?

For years, we have heard of the impact of zebra mussels on the Great Lakes and stories of flying Asian carp in the Mississippi River in the United States; but never have we been concerned about these aquatic invasive species (AIS) in the Milk River. However, at a recent Aquatic Invasive Species Risk Analysis Workshop at Waterton Lakes National Park, the threat of invasives in the watershed was brought forward.

Individual states in the U.S. have taken a lead on AIS prevention, management, and monitoring. Caryn Miske, Flathead Basin Commission, Kalispell, Montana clearly outlined the severe and significant ecological and economic damages done by AIS. For example, management of Quagga Mussel alone cost an estimated $900 million a year in infrastructure damage. Quagga attach to any hard surfaces including irrigation intakes and pipes and, within a few short months, completely coat the surfaces. The arrival of these mussels poses ecological ramifications including negatively impacting aquatic biodiversity, water quality, and reducing food sources for native mussels, fish, and invertebrates. Once established, these mussels can clog water intake and delivery pipes, foul dam intake gates and pipes, and adhere to boats, pilings, and most hard and some soft substrates. Mussels will impact water delivery systems, fire protection, irrigation systems, and require costly removal and maintenance (Western Regional Panel on Aquatic Nuisance Species 2010).

Miske (2012) noted that decontamination of boats, ballasts, and semi-aquatic equipment is critical to controlling Quagga and Zebra mussels. Once established, eradication of mussels can only be completed by sterilizing a water body of all living organisms.

Many western states, including Montana, have passed legislation on AIS (e.g., Aquatic Invasive Species Act (State of Montana 2009)). The states of Idaho and Montana each have mussel detection stations and programs that are funded by boat user fees. Two types of high risk boats leaving Lake Mead and lakes in Utah are targeted in the programs. These boats are 1) those that have been moored in marinas for extended periods of time and may have adult mussels attached, and 2) those boats that are launched for weekend recreation; these may include cigar and wakeboard boats that have internal ballasts or live wells (A. Ferriter, pers. comm.). Internal ballasts may contain water with floating “villager mussels” as small as tadpoles that can live for up to 30 days before being deposited into another lake.

Although no quagga mussels have been found in Montana waterbodies, they are present in Utah. With the number of boaters travelling between Montana and Utah there is a real risk of invasion of mussels into Montana. The boat inspection stations in Montana have successfully prevented many infected boats from launching. Legislation also exists under an inter-state agreement that allows for the impoundment of contaminated watercraft bound for another state. There is also risk to Alberta waterways since no legislation or AIS prevention program is in place. Many boaters interviewed in surveys conducted at Utah’s mussel-infected lakes, identified Alberta as a future destination.

Another aquatic invasive, Eurasian Water Milfoil, has taken hold in Montana, at Beaver Lake, in Flathead County. Extensive control work has been undertaken and the plant is nearly eradicated. A recent infestation was also found at Fork Peck Reservoir, and eradication work was also initiated in August 2012.

It is clear that the Alberta and Federal governments should work to ensure that risk of contamination by AIS is minimized. Border and Customs staff need enabling legislation to search, inspect and quarantine potentially infested boats. AESRD, municipalities and local community groups should work together, with assistance from Montana agencies and organizations, to develop an early detection and rapid response plan. This plan would address monitoring that is currently absent in Alberta, and the necessary actions to take if and when AIS are detected.
9.1 Access

Road networks are an essential part of the human landscape, creating social connection and allowing for the transport of goods and services. The type and length of access roads in the watershed provides an indication of fragmentation and disruption on the landscape. Roads create a high area of edge per unit area and cause either the temporary or permanent loss of habitat (Forman and Alexander 1998). All linear corridors can increase predation rates by providing travel routes that increase search range and efficiency for predators (Trombulak and Frissel 2000). Roads also provide better access to hunters and anglers thereby increasing harvest effort and success. Increased road and trail density has also been related to increased sediment transport and peak flows in streams, and correlated with declines in trout populations (Salmo Consulting Inc. and DES 2003). Roads also facilitate the spread of invasive and disturbance-caused plants (Trombulak and Frissel 2000). Finally, access roads are associated with other developments such as power and transmission lines, wind turbines, drilling and pipelines, as well as compression stations and other noise point sources.

In the Milk River watershed, there is a total of 20,598 km (12,799 mi) of local roads, two-lane highways and divided highways on the landscape (Map 9.1). Local roads include paved roads that are not designated highways, one and two lane gravel roads, unimproved roads (e.g., roads that are not regularly maintained, dirt roads which are generally passable only in fair weather and “well site” roads). In Alberta, there are an additional 1,837 km (1,141 mi) of truck trails that provide access to more remote areas in the watershed (Table 9.1). Truck trails are generally not maintained, are 4-wheel drive access only, may have frequent recreational traffic (e.g., hunters) and are sometimes abandoned roads. Truck trails are often used to access Public Lands. These trails are likely present in Saskatchewan and Montana but this data was not readily available. The overall road density in the watershed is 0.34 km/km² (0.55 mi/mi²). The highest road density is found in Saskatchewan (0.45 km/km²) (0.72 mi/mi²), followed by Alberta (0.36 km/km²) (0.58 mi/mi²) and then Montana (0.30 km/km²) (0.48 mi/mi²). When the truck trail distance is included in the Alberta calculation, road density increases substantially to 0.63 km/km² (1.01 mi/mi²). It is likely that the road density is higher (closer to 0.60 km/km² (0.97 mi/mi²)) for the entire watershed when these are considered.
Studies have suggested road density thresholds to maintain a number of different fish and wildlife species in watersheds. Although none of these studies have been undertaken in the Milk River watershed, road densities of greater than 0.6 km/km² have been shown to affect habitat use by elk (Salmo Consulting Inc. and DES 2003). In addition to road location and density, traffic volume also has negative consequences for many wildlife species, especially as traffic levels increase (Charry and Jones 2010). Increases in traffic volume alter species composition, impede animal movement, causes direct mortality and fragments habitat. Recommendations to maintain quality habitat include limiting new traffic on low use roads in rural and remote areas (Charry and Jones 2010). In the Milk River watershed, Alberta, future plans for the re-alignment and upgrade of Highway 41 will increase the highway’s traffic capacity and allow for a 24-hr north-south transportation corridor from the United States to Fort McMurray. This could result in increased wildlife disturbance during construction and elevate traffic volume in the long-term in the Milk River Sage Creek Area (AWA 2011).

Table 9.1. Summary of road type and length in kilometres (miles) in the Milk River watershed. Historical access data for Saskatchewan and Montana was not assessed for this report.

<table>
<thead>
<tr>
<th>Road Type</th>
<th>Alberta 2008</th>
<th>Alberta 2012</th>
<th>Saskatchewan 2012</th>
<th>Montana 2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Truck Trails</td>
<td>1,825 (1,134)</td>
<td>1,837 (1,141)</td>
<td>Not Available</td>
<td>Not Available</td>
</tr>
<tr>
<td>Local Roads</td>
<td>1,764 (1,096)</td>
<td>2,018 (1,254)</td>
<td>5,863 (3,643)</td>
<td>10,190 (6,332)</td>
</tr>
<tr>
<td>2-Lane Highway</td>
<td>261 (162)</td>
<td>378 (235)</td>
<td>538 (334)</td>
<td>1,578 (981)</td>
</tr>
<tr>
<td>Divided Highway</td>
<td>19 (12)</td>
<td>30 (19)</td>
<td>0 (0)</td>
<td>3 (2)</td>
</tr>
<tr>
<td>Total</td>
<td>3,869 (2,404)</td>
<td>4,263 (2,648)</td>
<td>6,401 (3,977)</td>
<td>11,771 (7,315)</td>
</tr>
</tbody>
</table>
9.2 Parks, Protected and Managed Areas

The percentage of the watershed maintained in parks and protected areas can be used as an indicator of landscape condition, as well as social quality of life. Parks and protected areas play a large role in conserving historical and natural features, and provide refuge for wildlife. Recent research confirms that parks and natural areas are important for human health as well. Spending time in nature, whether it be parks or in wild spaces, can reduce stress, boost immunity, enhance productivity and promote healing (Maller et al. 2008).

**Parks and Protected Areas are:**

- **Increasing**
- **Stable**
- **Decreasing**
- **Unknown**

Currently, seven percent of the total Milk River watershed is maintained as parks or protected area (Map 9.2). Saskatchewan maintains the largest area in parks and protected area, designating 248,928 ha (615,507 acres) or 17% of the watershed area. Alberta protects 12% of the watershed within its boundary encompassing an area of 81,089 ha (109,225 acres); this has increased from eight percent in 2008 (MRWCC 2008). Parks and protected areas make up about five percent of the Milk River watershed in Montana or about 86,415 ha (496,530 acres) (Map 9.2).

In Alberta, parks and protected areas have increased in the last five years, namely due to the acquisition of land by Writing-on-Stone Provincial Park (WOS PP). The park purchased about 1,000 ha (2,471 acres) in 2011 from an adjacent landowner. In addition, private and non-profit organizations like the Nature Conservancy of Canada (NCC) have increased land ownership in the watershed. The NCC increased land ownership from 1,620 ha (4,003 acres) in 2008 to 3,720 ha (9,192 acres) in 2012.

In Alberta, parks and protected areas are classified according to landscape management objectives. Provincial Parks (i.e., Cypress Hills and Writing-on-Stone) were established to preserve natural heritage and support outdoor recreation, heritage tourism and heritage appreciation (ATPR 2011). Designated Natural Areas, on the other hand, are parks designated to preserve and protect sites of local or unique ecological significance while providing opportunities for low-impact nature-based recreation. Ecological Reserves preserve and protect natural heritage in an undisturbed state for scientific research or education. Generally, Natural Areas and Ecological Reserves are small, accessed on foot and have minimal to no services. Heritage Rangelands were established to preserve and protect natural features that represent Alberta’s prairies; grazing is used to maintain grassland ecology. Unique features are summarized in Table 9.2.

Table 9.2. Unique features of select natural areas, ecological reserves and heritage rangelands within the Milk River watershed, Alberta.

<table>
<thead>
<tr>
<th>Site</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ross Lake Natural Area</td>
<td>Unglaciated area of foothills fescue grassland containing rare plants and insects.</td>
</tr>
<tr>
<td>Milk River Natural Area</td>
<td>Gently rolling grassland dissected by deeply-cut stream valleys, coulees and rugged badlands, permanent streams, springs and oxbow lakes. Contains many geological features including one of five known igneous rock dykes on the Canadian Prairie.</td>
</tr>
<tr>
<td>Kennedy Coulee Ecological Reserve</td>
<td>The only Ecological Reserve in the watershed. Established to maintain a rich plant and wildlife community found there.</td>
</tr>
<tr>
<td>Onefour Heritage Rangeland</td>
<td>Characterized by extensive grasslands, ephemeral wetlands, minor badlands and riparian shrublands. Contains two of the five igneous rock dykes known on the Canadian Prairie. Contains rare wildlife species.</td>
</tr>
<tr>
<td>Twin River Heritage Rangeland</td>
<td>Features dense nesting bird of prey populations including Ferruginous Hawks. A variety of rare grassland plants are also found here such as Carolina whitlow grass.</td>
</tr>
</tbody>
</table>
All of the parks and protected areas designated in Saskatchewan are part of the Saskatchewan Representative Areas Network (RAN), launched in 1997 to conserve representative and unique examples of the provinces varied and diverse landscapes (Saskatchewan Environment 2006). Representative sites protect native biological diversity and act as benchmarks when evaluating ecological health. Protected areas also provide valuable recreation, cultural and/or heritage opportunities. RAN gathers enduring features (i.e., specific rock, soil and landform types that are stable through time) that likely support characteristic plant and animal communities and influence the development and characteristics of aquatic systems in the watershed (Saskatchewan Environment 2006).

In Saskatchewan, Grasslands National Park is the largest park, well-known for preserving one of Canada’s remaining contiguous tracts of native prairie grassland. This federal park is managed by Parks Canada and is open year around. Currently the park encompasses an area of about 50,227 ha (124,114 acres) but the proposed park area covers an area nearly double that (92,074 ha or 227,520 acres).

In addition, large tracts of land have been designated as Wildlife Habitat Protection areas, Wildlife Refuges or Migratory Bird Sanctuaries (Map 9.2). The Wildlife Habitat Protection Act (WHPA) protects 1,375,931.4 ha (3.4 million acres) of uplands and wetlands in the agricultural region of Saskatchewan. The Act was passed in response to the loss of 75% of the province’s natural areas in the agricultural region due to cultivation and other developments (Government of Saskatchewan, no date). The Act prevents the government from selling designated Crown land, and lessees require permission before any clearing, breaking or draining. The philosophy of the Act is to conserve wildlife habitat while enabling compatible, traditional uses to co-exist (Map 9.2).

The Migratory Bird Sanctuary at Val Marie Reservoir is one of 15 sanctuaries maintained by Environment Canada in Saskatchewan. It was established in 1948 to protect migratory birds. Although access is not restricted, hunting, as well as disturbing migratory birds, their eggs, nests or habitat is prohibited.

Parks and protected areas are also increasing in Montana with the recent purchase and designation of the Lost River Wildlife Management Area (Montana FWP) located at the Milk River just south of the Alberta-Montana border.

A small part of Glacier National Park, Montana, forms the headwater of the Milk River at the most western extent of the watershed. Established in 1910, this park was set aside to preserve more than a 400,000 ha (1 million acres) of forests, alpine meadows, lakes, rugged peaks and glacial-carved valleys in the Rocky Mountains.
Map 9.2 Parks and Protected Areas
"Wilderness is a resource which can shrink but not grow... the creation of new wilderness in the full sense of the word is impossible."

Aldo Leopold
Similar to Saskatchewan, many parks and protected areas in Montana are designed to preserve wildlife and wildlife habitat through wildlife refuges, wildlife management area, wilderness study areas and Areas of Critical Environmental Concern. National Wildlife Refuges form a network of lands and waters for the conservation, management, and where appropriate, restoration of fish, wildlife and plant resources and their habitats. At the state level, the primary goal of Wildlife Management Areas is to maintain vital wildlife habitat for the protection of species and the enjoyment of the public.

Wilderness Study Areas in Montana are protected from development and often have special qualities such as ecological, geological, educational, historical, scientific and scenic values. To be designated as a Wilderness Study Area, the area must be roadless and at least 2,023 ha (5,000 acres) or of a manageable size, appear to be unaltered from natural processes, and provide outstanding opportunities for solitude or primitive and unconfined types of recreation.

Areas of Critical Environmental Concern are also designated in Montana to protect important riparian corridors, threatened and endangered species habitats, cultural and archeological resources and unique scenic landscapes that are in need of special management attention. There are three Areas of Critical Environmental Concern in the Milk River watershed, Montana, which are Bitter Creek, Mountain Plover and Prairie Dog Towns (Map 9.2).

Although not a typical protected area, the Bureau of Reclamation’s Milk River Project supports a diversity of fish and fish habitat in the watershed. Beaver Creek County Park, in Hill County, is also unique and is known as the largest county park in the United States. Private organizations also provide protection of natural landscapes in the Montana watershed, including The Nature Conservancy’s Matador Ranch Preserve (see Watershed Stewardship section) and the American Prairie Reserve (Map 9.2).

Across the watershed in Alberta, Saskatchewan and Montana, there are many private landowners who participate in conservation easement programs. These are relatively small areas where management is aimed at preserving specific landscape features beneficial to wildlife or rare species. Restrictions may be placed on the land to limit the type of development that may occur there or to manage the timing and duration of certain activities to preserve seasonal habitat (e.g., grazing restrictions to maintain migratory bird habitat). In Montana, conservation easements have been placed on about 13,846 ha (34,215 acres) of land in the Milk River watershed (S. Hemmer, pers. comm.).
9.3 Tourism and Recreation

Tourism and recreation opportunities are abundant throughout the Milk River watershed and many people enjoy camping, hiking, bird-watching, wildlife viewing, photography, hunting and fishing activities in this unique landscape. Visitors can explore a variety of landscapes that include the wide-open prairie with its native grasslands, badlands, coulees and hoodoos, as well as rolling and mountainous terrain in the Cypress Hills, Sweetgrass Hills, Bears Paw Mountains and Little Rocky Mountains. The Milk River is also a popular route for avid canoeists, rafters or tubers, with river access points providing day or multi-day trips with extraordinary scenery. People of all ages can enjoy recreating under large, open skies year-round in some of the watersheds serviced and un-serviced parks and protected areas (Map 9.2).

Tourism and recreation activity is often dictated by weather conditions (that influence flows in the Milk River and recreation opportunity), and provincial or state economy as people tend to travel less when economic conditions are poor. The number of visitors recreating in the watershed can be an indicator of the stresses that might be placed on natural resources, as well as an indicator of human health and that of the local economy.

Tourism and Recreation Activity is:

Numerous recreation opportunities are provided within national, provincial, state, municipal and private parks, as well as in designated natural areas, ecological reserves and wildlife management areas (Map 9.2). Recreational access to lands under grazing lease (on Public Lands) is only permitted with permission from the leaseholder. The following describes recreation activity (i.e., camping, river sports, hunting and fishing) at select recreation sites in Alberta, Saskatchewan and Montana and comments on site use where possible.

**Alberta and Saskatchewan**

**Grasslands National Park (SK)**

From 2002 through 2006, an estimated 6,000 to 7,000 people have visited Grasslands National Park each year. An accurate estimate of visitors is difficult to obtain because the Visitor Reception Centre is located outside of the park in Val Marie and there are many possible entry points into the park, all of which are unattended. Some areas of the park are accessible by vehicle and are suitable for day-use, while other areas are remote and un-serviced and must be explored in solitude on foot or by horse.

**Writing-on-Stone Provincial Park (Áísínai’pi National Historic Site) (AB)**

Writing-on-Stone Provincial Park protects a large tract of native prairie badlands and riparian habitat in the watershed in Alberta. The park contains significant archaeological features that include rock art paintings and carvings as well as historical resources from the North West Mounted Police when it served as a border outpost. Áísínai’pi is a sacred landscape that has special spiritual significance for First Nations people who hunted and traveled the Great Plains for generations. This park is a designated National Historic site. Facilities include an Interpretive Centre and programs, meeting facilities, camp site and day use areas.

In the 1970s and 1980s, the number of campers visiting the park annually was between 10,000 and 15,000 people. In the 1990s the number increased to over 20,000 campers per year. Since 2000, the number of campers staying at WOS PP ranges consistently between 15,000 and 20,000 per year, with an overall increasing trend in numbers (Figure 9.1). Park attendance is influenced by the provincial economy, seasonal weather variations, fluctuating tourism trends in Alberta/Canada, and local/park issues (e.g., fire, river advisories). The increased number of campers in 2009 was likely due to the introduction of the Reserve.AlbertaParks.ca online reservation system. In 2009 campers could...
reserve sites online, which saw an increase in mid-week usage. The decline in visitors since 2009 may be due to the economic downturn and increased frequency of public health notices posted at the beach in mid-summer (see Section 5.0).

Periodically, the Milk River flood water submerges a portion of WOS PP. In recent memory, flooding has occurred in 1986, 1996, 2006 and 2010. Flooding at the park results in an immediate period of campsite closure, depending on the scale of the flood, followed by a period of facility repair to restore camping opportunities and rehabilitate the site. The scale of the impact depends on the severity of the flood (A. Domes, pers. comm.).


Cypress Hills Interprovincial Park (AB, SK)
The Cypress Hills are a unique landform on the Canadian prairies, reaching elevations of 600 m (1,969 ft) above the surrounding grasslands in Alberta and Saskatchewan (ATPR 2011). The mountain-like environment contrasts with the surrounding prairies providing unique natural and cultural values. The park contains a wide variety of flora and fauna, some of which are rare, unique or endangered species (ATPR 2011). Although Alberta and Saskatchewan share the Cypress Hills Interprovincial Park, each jurisdiction is responsible for managing and operating its own provincial park (ATPR 2011).

Cypress Hills Interprovincial Park-Alberta offers many recreational opportunities, including several campgrounds, lake recreation (e.g., swimming, fishing and boating), hiking trails and watchable wildlife. A year-round Visitor Centre is located in the community of Elkwater.

Cypress Hills was the fifth most visited park for camping in Alberta between April 1, 2005 and March 2006, with a total of about 68,690 campers. It was the ninth most visited park for day use (ATPR 2011).

In Saskatchewan, the estimated 5-year average number of total visits between April and September (2003-2007) was 213,757 visitors, showing an increase of 28.3% in visitors from 2003 to 2007 (Ministry of Tourism, Parks, Culture and Sport 2009).

Del Bonita Campground (AB)
Del Bonita Campground is one of the only public access and camping areas on the Milk River west of the Town of Milk River, Alberta. Although, average annual attendance and use of the campground is not recorded, the
estimated number of campers and canoeists is between 40 and 60 groups per year. The site is also a frequent stop for travelers to and from Montana using the Del Bonita Port of Entry; this can easily add another 200 or more campers per year. Since 2008, the use of the campground has been steady to possibly increasing (L. Morton, pers. comm.).

**Gold Springs Park (AB)**

Gold Springs Park is a private campground that offers many recreational opportunities that include camping, a fish pond, paddle boats and access to the Milk River during the regular season (May 1st to September 30th). It is located on Highway 4 between the Town of Milk River and the Village of Coutts. The Park maintains 102 campsites, 60 of which are reserved for campers and 42 sites that are rented by the season. Recent improvements to the park include aerators in the fish pond to keep the water open year round for fishing and upgraded playground equipment. Plans are made for 2013 to improve the beach area (Gold Spring Park Society Board of Directors, pers. comm.)

At the end of the regular season in 2007, an estimated 7,100 people camped at Gold Springs Park. Since 2007, the number of campers at Gold Springs Park has increased incrementally to about 11,400 people in 2012 and the number of annual day use visitors has increased from about 400 (2008) to 1,200 (2012).

**Other (AB)**

An additional camping opportunity is provided at the Eight Flags Campground (Town of Milk River). The number of campers at the Under Eight Flags Campground was estimated to be 713 in 2012. Weir Bridge is a popular access point used by canoeists, rafters and tubers throughout the summer. The best estimate of use is about 1,400 people from May through September (K. Brown, pers. comm.). River users also often camp at Poverty Rock, a primitive campsite within the new land of Writing-on-Stone Provincial Park.

**Montana**

In Montana, outdoor recreation lands and facilities are owned and managed by several federal and state natural resource agencies. The federal agencies are: National Park Service, Blackfeet Indian Reservation, Bureau of Land Management, U.S. Fish & Wildlife Service and Bureau of Reclamation (USBR). State agencies are: Montana DNRC and Montana Fish Wildlife & Parks (FWP).

When comparing the Milk River watershed to other regions within the State, the amount of outdoor recreation sites for camping, picnicking, hiking and fishing is noticeably fewer along the Milk River. Human populations are lower in northern Montana, hence demand for such types of recreation is lower.

On the upper reaches of the South Fork of the Milk River, Glacier National Park provides backcountry hiking and camping. Before the river enters into Alberta, there are a few sites on the Blackfeet Indian Reservation that provide river access to the South Fork Milk River.

After the Milk River leaves Alberta and re-enters Montana, it meanders through four counties, flowing through mostly privately owned land; commonly farm and ranch properties. Some of these private landowners allow access to the Milk River when the public asks for permission, or through a partnership between the landowner and Montana FWP. Once a person gains legal access to the river for water-based recreation activities, this person can move within the river corridor below the ordinary high water mark; no permission is required from the landowner of the property in which the river flows through.
At Fresno Reservoir, there are designated recreation sites along the shoreline that are managed by the USBR and the local chapter of Walleyes Unlimited. Downstream of the Reservoir, there are three designated Fishing Access Sites and several Wildlife Management Areas that are managed by Montana FWP (Map 9.2). Some of these sites are ‘day-use only’ and others provide opportunity for camping.

In 2012, the three Fishing Access Sites along the Milk River received an estimated 10,310 visitors. It is estimated that 95% of the users of these sites were Montana residents, and the vast majority of these visitors used these sites to access the river to fish. Over the last 10 years, the amount of visitation at the Fishing Access Sites on the Milk River has slightly increased. This increase is partially due to the development of an access fishing platform for people with disabilities at one site, and some major parking, bathroom and trail improvements at another site.

**Beaver Creek Park (MT)**

Beaver Creek Park is a 4,047 ha (10,000 acre) recreation area bordering the north slopes of the Bears Paw Mountains. It is one of the largest county parks in the United States and contains interesting geological formations, including glacial deposits, volcanic strata and dikes, and metamorphic and sedimentary rocks containing fossils. The landscape includes rolling grasslands, pine woods, aspen and cottonwood groves, rocky cliffs and cold rushing streams. Within the park, there are two lakes stocked with rainbow trout and brook trout that are open to fishing year-round. There are many developed camp and picnic grounds, as well as a youth camp at Camp Kiwanis. In 2012, the total number of day use, annual use and reserved site permits sold was 1,572. Of these permits sold, 65% were sold within Hill County (the location of the park) and nine percent were sold to Canadians. Permit and reserve site sales increased in 2012, compared to the 1,229 reported in 2011, likely due to a normal flow year. Many campgrounds were closed or had limited visitation due to flooding in 2010 and 2011 (C. Edgar, pers. comm.).
River Sport

Many people canoe or float the Milk River during the summer season. It is difficult to obtain an accurate estimate, but it has been suggested that up to 10,000 canoeists, kayakers and rafters enjoy the Milk River, Alberta, annually (Great Canadian Rivers 2007).

Milk River Raft Tours is one outfitter that tracks the number of days on the river and those canoeing, rafting or tubing through their services. The number of days on the river has ranged from 19 days in 2010 to 120 days on the river in 2012 during the last five years. The low number of days on the river in 2011 reflects the flow regime. The St. Mary River water diversion was not turned on in April due to high water levels that caused severe flooding in the lower Milk and Missouri Rivers. A period of high water made navigation unsafe.

Figure 9.2. Summary of canoeists, rafters and tubers on the Milk River, Alberta (Source: K. Brown, Milk River Raft Tours).
Hunting and Fishing

Alberta

Hunting and fishing are popular recreational sports enjoyed by Albertans. There are many opportunities within the Milk River watershed to participate in big game, bird game, non-season hunting and fishing activities. These long-term, sustainable activities provide recreational opportunities within the Milk River watershed, contribute to the local and provincial economy and can provide useful wildlife management tools in a changing landscape.

Seasonal big game species hunted in the watershed are pronghorn, mule deer, white-tailed deer, elk and cougar. There are various timing restrictions (i.e., seasons) when big game may be hunted and these vary by species. For example, timing restrictions are in place for archers or those who hunt with rifles and for trophy or non-trophy animals. There are as many as 5 seasons for elk in Wildlife Management Units (WMUs) 102, 104, 108 and 118, while WMU 106 does not have an elk season. Although white-tailed deer (rifle), mule deer (archery) and white-tailed deer (archery) require a general tag, all other species categories require special license draw tags that can be obtained by entering the draw before the season begins. If drawn, a special license is issued; if not drawn, the individual is placed in a draw priority. The draw system allows Alberta Fish and Wildlife to manage wildlife populations by increasing or decreasing the number of licenses issued within WMUs.

Of the big game species hunted, the mule deer tag is the most sought after in the watershed, with pronghorn a close second. More recently (i.e., the last two decades), the hunting opportunities for elk have increased significantly as the population has spread throughout the watershed. There are often record-book specimens of these three species taken in the watershed and this attracts hunters from all over Alberta, Canada, USA and Europe.

Big game outfitters also require special licenses referred to as “outfitter allocation tags” that are available for rifle and archery trophy pronghorn, mule deer and white-tailed deer. These tags are owned by outfitters who provide the tag and guide service to non-resident hunters for a fee that may range from $4,000 up to $8,000 for combination (two species) hunts. With dozens of outfitter allocations within the Milk River watershed, there is significant economic benefit to the province and to a lesser extent the local economy (e.g., local guides, restaurants, bed and breakfasts).

Game birds are managed within the same regions and WMUs as big game. Rather than using WMU draws and limited licenses, AESRD relies on daily possession limits to control the harvest of game birds. The hunting season is divided into the two categories migratory waterfowl and upland game birds. Migratory waterfowl that can be hunted in the watershed are Snow Goose, Ross’s Goose, White-fronted Goose, Canada Goose, all species of duck (Mallard, Northern Pintail, American Wigeon, and Gadwall the most common), American Coot and Common Snipe. Swans of any kind cannot be hunted. Upland game bird species are male Ring-necked Pheasant, Sharp-tailed Grouse, and Gray

Recreational Access

For all hunting or fishing activity, permission to access property must be taken into consideration. Whether hunting trophy mule deer, sharp-tailed grouse, gophers, or accessing the Milk River for Sauger fishing, landowner or leaseholder permission is required. It is the responsibility of hunters and fishermen to contact the landholder. Very specific guidelines and regulations are found in the Alberta Fishing and Hunting Regulations regarding access and trespass. To prevent conflict between sportsmen and landholders, always obtain access permission.
(Hungarian) Partridge. The Greater Sage Grouse which inhabit the eastern portion of the watershed are a protected species and cannot be hunted in Alberta. It is imperative to properly identify game birds when hunting in Greater Sage Grouse habitat to prevent the accidental shooting of this endangered species.

**Montana**

Hunting in Montana remains one of the most popular outdoor recreational activities. Approximately 33% of Montana’s population participates in hunting, which is almost four times greater than the national average (Cordell 2004). Hunting in Montana is regulated by Montana FWP. The majority of the Milk River watershed is contained within FWP Administrative Region 6. Region 6 is further divided into smaller management units called hunting districts. There are 16 deer/elk hunting districts and 6 pronghorn hunting districts in this Region. The primary hunting opportunities available are for mule deer, white-tailed deer, pronghorn, elk, upland game birds, waterfowl and cougars. Recreational opportunities are also provided for trapping of a variety of furbearers and predators including bobcat, beaver, muskrat, mink and coyote.

**Seasons**

There are a variety of hunting seasons in this Region that vary by species hunted and weapon type. Archery-only seasons occur prior to the general big game hunting seasons. The general deer and elk archery and rifle seasons each last roughly 5 weeks. Upland bird hunting, deer hunting and most waterfowl hunting by Montana residents is allowed in almost all Region 6 hunting districts with the purchase of a general license(s). Pronghorn and elk hunting in this Region are more restrictive and a draw is held to award special licenses or permits in most hunting districts.

**Non-Season Hunting**

Non-seasonal hunting activity takes place to control impacts of predators such as coyote, raccoon and skunk or perceived pests such as Richardson’s ground squirrels, rabbits, European Starlings and Black-billed Magpies, particularly on agricultural lands. Many farmers and ranchers invite or permit local hunters to help control problem wildlife that threaten livestock, particularly gophers and coyotes, providing significant hunting opportunities to local hunters. The hides of any fur-bearing species may be sold which some hunters use as a supplementary income. A complete list of species that can be hunted without a license and without a season can be found in the Alberta or Montana hunting regulations.
**Hunting Trends**

In Montana, hunter participation has continued to remain strong despite a decreasing national trend. Region 6 hunter numbers have been mostly stable in recent years. However, severe winter weather in 2010-2011 resulted in a considerable decrease in pronghorn and mule deer populations. The number of hunting licenses available for these species was subsequently reduced in Montana. In addition, a large percentage of the white-tailed deer populations along the Milk River experienced an epizootic hemorrhagic disease outbreak in 2011. White-tailed deer licenses were also reduced in response to this event. The decreases in both game numbers and available licenses resulted in a drop in hunter numbers in 2011 (Figure 9.3).

![Hunting Trends Graph](image)

Figure 9.3. Trends in Montana Hunter Participation in the Milk River watershed, 2004 to 2011. Hunter numbers reported from annual hunter harvest phone surveys conducted by Montana, Fish, Wildlife and Parks. Milk River watershed trends were estimated by measuring hunter numbers for corresponding counties and hunting districts.
Fishing

Fishing in the Milk River watershed, Alberta, is not as popular as game hunting, and most of the people fishing are from the local area. The only major fish-bearing water body is the Milk River, although there are a few other small publicly stocked ponds (i.e., Gold Springs Park, Heninger Dam and Michelle Reservoir) that allow year round fishing for Rainbow Trout. There are also privately stocked ponds and dugouts that are used by landowners and their family and friends.

The species that are fished in the Milk River are Northern Pike, Walleye, Mountain Whitefish, Burbot and Sauger. The Milk River has a reputation for producing some of the largest Sauger in the province. The Alberta provincial record for the largest Sauger was caught in the Milk River.

Fishing Trends

Table 9.3 shows the number of Montana angler days at Fresno and Nelson Reservoirs and for the Upper, Middle and Lower Milk River reaches. Angler pressure has increased significantly at the reservoirs, particularly at Nelson Reservoir where the number of angler days more than doubled in two years. Angler days at the Milk River mainstem was considerably less in 2007 compared to 2005 or 2009.

Angler pressure is influenced by water conditions and the response of local fish populations to these better conditions. From 2000-2002, the Milk River watershed in Montana experienced a prolonged drought that greatly reduced the fisheries resource in Fresno and Nelson reservoirs. Fishing pressure shifted away from the reservoirs to area ponds less impacted by drought and to the Milk River mainstem where fish were supplementing the river fishery after passing through the major dams. Since 2006, water conditions have improved and created excellent spawning habitat for forage fish (e.g., Yellow Perch, Black Crappie). Montana FWP implemented a major Walleye stocking strategy that has been very successful. Fresno and Nelson reservoirs boasted the two highest Walleye densities in the state of Montana (based on relative abundance (Walleye/net)). Word quickly spread and angling pressure focused on the two reservoirs in 2007. By 2009, fish densities were high in Fresno and Nelson reservoirs and many fish went over the spillway or through the outlet structures which acted as an adult fish stocking program for the Milk River for species such as Walleye and Northern Pike. Furthermore, improved water conditions created good spawning conditions in many tributaries, allowing anglers more opportunity to fish and have success in the reservoirs and in the mainstem Milk River.

Table 9.3. The number of angler days (i.e., people fishing) at various locations in the watershed (Source: Montana statewide angling pressure surveys, FWP 2005, 2007, 2009).

<table>
<thead>
<tr>
<th>Year</th>
<th>Fresno</th>
<th>Nelson</th>
<th>Upper Milk</th>
<th>Middle Milk</th>
<th>Lower Milk</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>8,124</td>
<td>9,917</td>
<td>1,157</td>
<td>3,748</td>
<td>4,280</td>
</tr>
<tr>
<td>2007</td>
<td>14,584</td>
<td>9,543</td>
<td>262</td>
<td>1,348</td>
<td>2,033</td>
</tr>
<tr>
<td>2009</td>
<td>19,819</td>
<td>20,371</td>
<td>917</td>
<td>3,439</td>
<td>3,279</td>
</tr>
</tbody>
</table>
9.4 Commercial and Industrial Activity

9.4.1 Agriculture

The agricultural footprint is an indicator of land use change in the watershed, and agricultural activity is an economic indicator for the social welfare of people living in the area. In the Milk River watershed, agriculture is the predominant land use type. Cropland, including a mix of cereals, oilseed/pulse, specialty crops, forage, tame pasture and fallow land, makes up 33% of the total watershed area (1,990,126 ha or 4,917,708 acres) (Map 9.3). Alberta has the lowest percent watershed area covered by cropland (24%), and Saskatchewan and Montana have a similar percent watershed area in cropland (33% and 35%, respectively). In Alberta, grain farms are generally found in the central west part of the watershed while ranching predominates in the east (Klohn Crippen Consultants Ltd. 2003). The Census of Agriculture, completed every five years, reports on agricultural trends within municipalities (Statistics Canada online). For the municipalities represented in the watershed in Alberta, the number of farms in the region decreased by about 9% from 2006 to 2011. Based on this average decrease, it is likely that the number of farms in the watershed has decreased from 400 (MRWCC 2008) to about 360. At the same time, the number of farm operators decreased by about the same percentage. The average farm size increased in all rural municipalities by about 67 ha (166 acres), with farm sizes currently ranging between 635 ha (1,569 acres) to 1250 ha (3,089 acres). Farm size in the eastern municipalities is nearly three times the average Alberta farm size of 473 ha (1,168 acres). Between 2005 and 2010, total farm receipts increased by 15.3% and 27.0% in the western part of the Alberta watershed (Cardston County and County of Warner, respectively) and decreased by nine percent in the eastern part of the watershed.

It is difficult to report on crop trends as the acreage of oilseeds, cereals, specialty crops and forage changes from year-to-year. Varied rotations are critical practices for nutrient cycling, ending pest and disease cycles, and maintaining soil quality. The types of crops seeded also reflect annual market conditions.

The most recent crop data available for Alberta only differentiates between “mixed/unknown/fallow” cropland and tame pasture; it does not differentiate between crop type. About 129,402 ha (319,759 acres) are seeded to crops and the remaining 26% of the cropped area is seeded to tame pasture. Crop types vary across the watershed, although cereals (i.e., wheat and barley) represent most of the total crop production. Wheat predominates in the central and eastern parts of the watershed and barley is grown more often in the west. Oilseeds and pulse crops, that include mustard, canola and peas, make up only a small portion of the crop production. Forage crops and tame pastures are found throughout the watershed to support the livestock industry.

In Saskatchewan, about 438,538 ha (1,083,650 acres) are seeded to crops and about five percent of this area is maintained in tame pasture. Crop information for rural municipalities and dating back to 1938 is available for Saskatchewan (Sask Ag 2013). The data reported here reflects crops grown within the rural...
municipalities of Reno, Frontier, White Valley, Lone Tree and Val Marie. The five crop types spring wheat, oats, barley, fall rye and flax have been grown in the Milk River watershed in Saskatchewan since the thirties. The crop yields have increased through time (Figure 9.4). The number of crops grown in the watershed has increased consistently since 1938, reflecting improved agricultural production technology through better equipment, better crop varieties (including genetically modified ones), better access to information and market demands (Figure 9.5).

Canola was first grown in the watershed in 1969. In the following year (1970), durum wheat was grown. Tame hay crops were grown mainly through the 1980s and 1990s but was likely replaced by higher value crops such as mustard in 1992, and by sunflowers, lentils, peas and canary seeds in 1993. Sunflower and flax crops are less prominent in recent years, however acres seeded to chick peas are increasing.
Map 9.3 Crops
In Montana, approximately 1,326,543 ha (3,277,960 acres) of land are seeded to crop (Map 9.3). Although the crop type is better defined on Map 9.3, 57% of the cropped area is still described as “Mixed/Unknown/Fallow”. Generally, cereals make up the largest crop type seeded in the watershed (32%), followed by forage crops (6.8%) and tame pasture (2.2%). Oilseed and pulse crops make up 1.9% of agricultural production and specialty crops make up only 0.1% of production (Figure 9.6).

The most recent trends for agricultural activity in Montana are reported in the 2002 and 2007 U.S. Agriculture Census (United States Census Bureau online) (note 2012 census results have not been released at time of reporting). Opposite to the increasing trend in farm size in Alberta, the average farm size in the watershed in Montana, tends to be decreasing. Across all counties, average farm size decreased by an average of 84 ha (208 acres), with the largest decrease observed in Glacier County (-310 ha or -766 acres) from 2002 to 2007. In the other two western counties (Toole and Liberty) and in the eastern Phillips and Valley counties, farm size remained relatively unchanged (about -20 ha or -50 acres). In the central part of the watershed, farm size decreased by about 95 ha (235 acres).

Dryland farms make up a significant portion of agricultural land in the watershed. In Montana, dryland crops are seeded on about 961,165 ha (2,375,091 acres) (ECONorthwest 2008). Generally, precipitation across the watershed is below the amount required for optimum growth and production, limiting the type and variety of crops that can be grown.

The Montana-Alberta Joint Initiative Team (2009) estimated crop water deficits for alfalfa in the Milk River watershed to identify the amount of irrigation water needed to produce an optimal crop, and estimate current irrigation water shortages (Map 9.4). The crop water deficit is the amount of additional water required to meet the requirements of a crop for optimum growth and production. The crop water deficit is equal to the evapotranspiration (ET) of a crop minus the effective precipitation available to the crop over the growing season. Alfalfa was chosen as the reference crop for crop water deficit analysis due to the availability of water use data, and because alfalfa has the highest seasonal water demand of any commonly grown hay crop in the watershed.

Montana Conservation Reserve Program (CRP)

At its height in the early 2000s, Montana had more than 1.3 million hectares (3.2 million acres) enrolled in the Conservation Reserve Program (CRP) designed to convert cropland to perennial forage. Since then, as the USDA government contracts expire, the majority of the reserve acres are being rotated back to cropland. This is the function of higher grain prices and lower CRP rental rates per acre with re-enrollment. All but a few CRP acres are dryland cropland with the majority returning to cereal grain production.

Generally, landowners who chose to re-enroll in the program are removing larger parcels and selecting only the most sensitive acres to reserve. However, larger parcels of land (about 32 ha or 80 acres) are needed to provide meaningful environmental benefits, including wildlife habitat (Knutson 2013). The CRP land has added benefit in that it provides security to livestock producers in times of drought. In 2012, in Montana, 44,515 ha (110,000 acres) were grazed and 58,679 ha (145,000 acres) were hayed in response to the drought.

In Alberta, the 30 year average crop water deficit was estimated using meteorological data collected at Cardston and at Manyberries (located just north of the Milk River watershed). Average crop water deficit was 337 mm (13.3 in) at Cardston and ranged from 32 mm (1.3 in) to 566 mm (22.3 in) (Map 9.4). At Manyberries, the average crop water deficit was 492.7 mm (19.4 in) ranging from 224 mm (8.8 in) to 693 mm (27.3 in) (Montana-Alberta Joint Initiative 2009).
In Saskatchewan, crop water deficits generally range from 500 to 550 mm (between 20 in and 22 in) (Map 9.4).

Crop water deficits ranged from 295 mm (11.6 in) at the East Glacier weather station to 604 mm (23.8 in) at the Glasgow weather station in Montana (Map 9.4).

Due to annual deficits in crop water demand, irrigation has become an important part of crop production in the watershed. In Alberta, there are 66 water licenses issued to 33 license holders, allowing for withdrawals from the North Milk and Milk rivers for irrigation purposes. Irrigation takes place on about 3,320 ha (8,200 acres) of land. The majority of irrigation occurs in the area from upstream of the Town of Milk River to about Deer Creek Bridge (Map 9.5). Crops that are grown under irrigation include cereals, hay and, more recently, hybrid canola seed.

In Saskatchewan, approximately 6,192 ha (15,300 acres) of land are irrigated. Most of the irrigation occurs through the Eastend, West Val Marie and Val Marie irrigation projects. A minor amount of irrigation occurs at Battle Creek through the Consul and Vidora irrigation projects and at Lodge Creek when water is available. Similar to Montana, there are a number of private irrigators in the Milk River watershed in Saskatchewan. The size of irrigated acres range from thousands of acres of border-dyke flood irrigation to small back-flood projects of only a few acres (see Section 4.3 for water use information).

Irrigation improves the reliability of winter feed supplies, such as alfalfa, other forages and cereals (SAFRR 2003).

Irrigation in Montana is mainly serviced by the Bureau of Reclamation’s Milk River Project (the Project) that provides water for about 49,000 ha (121,000 acres) of land or about half of the irrigated land in the watershed (93,232 ha or 230,381 acres). Prior to the development of the Project early in the 20th century, the limited irrigation that occurred in the watershed frequently resulted in a complete de-watering of the river. With the project and its associated imports of water, the Milk River is likely the only major river system in Montana (and Alberta) whose total flows exceed natural levels as a result of irrigation development (ECONorthwest 2008). The principal crops produced on the farms in the Project area are alfalfa and native hay (forage), with a smaller percentage of fields seeded to oats, wheat and barley (USBR 2012). The number of irrigated acres has remained constant since 1944 due, in part, to limited water supplies (ECONorthwest 2008). In addition to irrigation serviced by the Milk River Project, there are also numerous private irrigators that access water from smaller tributaries in the basin (Figure 9.7).

Fallowing practices have been used since the early days of cultivation in southern Alberta. Chem-fallow is generally used in the drier, eastern parts of the Milk River watershed, where soil moisture levels do not support continuous cropping. Chem-fallow conserves soil moisture, and is a tool used to control weeds and disease within crop rotations.

**Agriculture Supports Milk River Economy**

Agriculture is one of the economic pillars in the Milk River watershed in Alberta, Saskatchewan and Montana. Irrigated agriculture, in particular, allows for crop intensification and diversification, and reliability of feed production that supports the livestock industry. Crop production is highly unstable and can be relatively unproductive without irrigation in areas of the watershed where crop water deficits are high (SAFRR 2003). Increased yield and reduced risk benefit producers and their communities.

The Bureau of Reclamation (USBR) estimated that the value of irrigated land in Montana was $280 per acre higher than non-irrigated land: $610 vs. $330 per acre. Irrigation produces a benefit as it reduces farmer’s losses, but it does not necessarily yield crops worth more than it costs to produce them. Farming can continue, even at a net economic loss, if farm families are willing to accept a loss so they can enjoy the related lifestyle (ECONorthwest 2008).

The Milk River Project, Montana, provides other economic benefits to the watershed, as it provides water to about 18,000 people who would likely incur higher costs to secure alternative sources of water (ECONorthwest 2008). The project directly or indirectly provides water for wetlands, improves the quality of water in the Milk River, and generates recreational opportunities associated with reservoirs (e.g., angling, wildlife watching). Similar benefits of irrigation are realized in Alberta and Saskatchewan.
Map 9.5 Irrigated Areas

Figure 9.7. Irrigation management systems in the Milk and Marias watersheds, Montana (ECONorthwest 2008).
9.4.2 Rangeland

Upland health is critical for maintaining the integrity of watersheds as a whole. “Upland” refers to areas of higher ground that occur upslope from adjacent water bodies. In the Milk River watershed, uplands are often grazed by livestock. The condition of these rangelands is assessed from time to time by rangeland agrologists. The term “range health” refers to the ability of rangelands to perform key ecological functions which sustain grasslands (Adams et al. 2009).

Healthy range areas also provide forage for livestock and wildlife. Healthy rangelands are more resilient in times of drought and thus are able to provide forage resources and wildlife habitat during these dry periods.

Generally, livestock grazing occurs on most of the native grassland found on Public and Private Lands throughout the watershed, as well as on tame pasture (Map 9.3). Native rangeland makes up about 65% of the watershed in Alberta, 62% in Saskatchewan and 44% in Montana.

Some recent events have occurred in the watershed that may change the future composition of rangeland in Saskatchewan and Montana. In Saskatchewan, an announcement was made in 2012 that the Prairie Farm Rehabilitation Administration (PFRA) community pastures will be sold. It is unclear how this may influence rangeland in the future. When divested, the community pastures on native range have a conservation easement on the land that prevents tillage or draining. However, this only applies to native range and tame pastures can be converted to cropland (K. LaForge, pers. comm.).

In Montana, the expiration of many lands that were enrolled in the Conservation Reserve Program (CRP) means that areas that were maintained in native grassland or tame pasture may be converted to cropland (see Highlight Box on page 189).

Area Maintained as Rangeland is:
Range Health Assessment

Once background knowledge has been obtained for the local soils and vegetation, range health is rated for an ecological site type in relation to its reference plant community and assigning a score for five factors that address selected indicators of range health. These include:

I. Integrity and Ecological Status
Each ecological site produces a characteristic type and amount of vegetation called a reference plant community. Is the plant community native or modified to non-native species? Has grazing management maintained the plant community or have there been shifts in species to less desirable or weedy species?

II. Plant Community Structure
Are the expected plant layers present or are there any missing or significantly reduced plant layers, revealing a possible reduction in plant vigor?

III. Hydrologic Function and Nutrient Cycling
Are the expected amounts of organic residue present to safeguard hydrologic processes and nutrient cycling? When functioning properly, a watershed captures, stores and beneficially releases the moisture associated with normal precipitation events. Live plant material and litter (either standing, freshly fallen or slightly decomposed on the soil surface) is important for infiltration (slowing runoff and creating a path into the soil), reducing soil erosion from wind and water, reducing evaporative losses and reducing raindrop impact. Litter also acts as a physical barrier to heat and water flow at the soil surface. Litter conserves moisture by reducing evaporation and effectively retaining scarce moisture.

IV. Site Stability
Is site stability being maintained or is the ecological site subject to accelerated erosion?

V. Noxious Weeds
Are designated noxious weeds present on the site?

When a site is rated, the combined score of all five indicators is expressed as a health score, which then falls into one of three categories: healthy, healthy with problems or unhealthy. While AESRD manages for an overall “healthy” score on most public rangelands, the presence of lower health scores on the landscape at select locations is sometimes desirable. Rangelands evolved under the impact of large herbivores (i.e., bison) whose movement and feeding behaviours significantly affected grasslands. Areas that were heavily grazed and scarred by bison hooves created desirable conditions for some species for a period of time. Thus, some prairie birds have specific habitat requirements that coincide with lower range health classes - which in effect mimic habitat created by bison in the past. Grazing leaseholders may be requested to manage for a particular level of rangeland health that addresses range resource issues and/or particular wildlife objectives - in some cases providing habitat requirements for one or more species at risk (e.g. providing patch grazed habitat adjacent to the nesting sites of Burrowing Owls so that owls can benefit from the improved visibility afforded by heavy grazing).

Range health assessment date is presented for Alberta and Saskatchewan. No data was located indicating range health in Montana.
In 2008, 62% percent of 1,400 grassland sites assessed on Public Lands in the watershed in Alberta were considered healthy, while 33% rated healthy with problems and 5% rated unhealthy (MRWCC 2008). For this SOW report, range health assessment data was averaged for the periods “pre-2008” and “2008-2012” and included data for tame pasture, native grasslands and forest sites. The general status of range health remained much the same for the period 2008-2012, rating 63% healthy, 29% healthy with problems and 8% unhealthy (Figure 9.8) (AESRD unpublished). The selected health assessment sites require ongoing monitoring and reassessment to establish trends and to identify when range health scores decline below acceptable levels.

Trends in rangeland health were also assessed in Saskatchewan by examining differences in average rangeland health between the two time periods “1999 to 2003” and “2004 to 2008” (Saskatchewan Watershed Authority (SWA) 2010). Nineteen range health assessments were completed in the first assessment (1999 and 2003) and 110 assessments were completed in the last study (2004 and 2008). The rangeland health assessment scores for watersheds with fewer than 10 assessments were not averaged across the watershed. No assessments were made in the watershed between 1999 and 2003, while 18 were completed between 2004 and 2008. Results showed that average range scores fall within the “stressed” category for 50% to 75% of sites.

Values and Benefits of Healthy Range (Adams et al. 2009)

For Livestock Producers
- Renewable and reliable source of forage production.
- Reduced animal feed costs.
- Stability of forage production during drought.
- When properly managed, provides greater flexibility and opportunities for extending the grazing season (i.e., fall or winter grazing may be possible).
- Lower maintenance costs for weed control.
- Reduced concern for the establishment of noxious weeds.
- Does not require the input of inorganic fertilizers and other soil amendments or additives.

For The Public
- Maintains landscape aesthetics.
- Improves watershed protection.
- Improves water quality.
- Prevents soil erosion.
- Provides large soil carbon sinks.
- Improves biodiversity (through the provision of fish and wildlife habitat).
- Provides opportunities for passive and consumptive recreation such as hunting and tourism.
Alberta Rangeland Reference Areas

An important environmental monitoring tool for rangelands in Alberta is the Rangeland Reference Areas network (RRA). AESRD maintains 180 rangeland reference sites in the province; six of these are located in the Milk River watershed. RRA sites are fenced off to exclude livestock grazing. RRAs provide data that identifies how the overall range landscape is likely to perform in relation to climatic variability and general stewardship practices. Reference site data reveals the year-to-year variation in grass yields and the residual amount of litter that is present under moderate levels of grazing. If forage yields or litter reserves show a sharp decline at one or more reference sites, it alerts resource managers that special drought management practices may be needed to safeguard rangeland health and minimize the negative impacts of drought.

Data collected at the Onefour rangeland reference area site showed a decline in grass yields and litter reserves during the severe droughts of the early 1980s and in 2000 and 2001 (Figure 9.9). A rapid recovery of grass yields and litter reserves was observed in subsequent years (Figure 9.9). Very similar patterns of drought and recovery are also evident at the Aden and Milk River Ridge reference area sites (Figures 9.10 and 9.11). Above average forage production occurred at the three select RRAs in the last three years (2010-2012), which coincided with above average moisture conditions (AESRD unpublished).
Milk River Alberta Fire

What started as a combine fire during the threshing season near Del Bonita, Alberta on September 7, 2012, quickly became one of the largest and most intense grassland fires during 100 years along the western reach of the Milk River. (This grassland fire followed an earlier fire on the Milk River Ridge that occurred on November 28, 2011 - which was started from a discarded cigarette butt - and burned 3,238 ha or 8,000 acres). The 2012 fire was thought to have been extinguished on the same day, however strong winds up to 80 km/h (50 miles/hr) blew embers from a cultivated stubble field eastward onto native grasslands in the western block of the Twin River Provincial Grazing Reserve (TRPGR). The TWPGGR, located in the mixed-grass subregion of southern Alberta’s Grassland region, is the oldest community pasture in the province (established in 1934) and is over 13,355 ha (33,000 acres) in size.

Fire-fighting crews from all over southern Alberta, as well as fire department staff from Sunburst and Cut Bank, Montana, worked diligently to contain the fire which was predominantly located on Public Land. An estimated 225 km (140 mi) of fire guards were cut using various kinds of equipment, including municipal road graders and double disks. Fire intensity was higher than anything previously observed by Alberta Public Lands staff for a grassland fire (K. France, pers. comm.). Initial assessments confirmed that in some areas 100% of the organic material had been burned and the remaining mineral soil was virtually sterilized due to severe alteration of the physical and chemical properties of the upper soil horizons. The fire burned a total of 6,750 ha (about 16,680 acres); of this area nearly 95% was native grasslands.

Aerial view of the grass fire in the Milk River watershed, west of the Town of Milk River, Alberta.

Aerial view of the Milk River grass fire in Alberta, west of the Town of Milk River. View is to the south at the eastern extent of the burn site. The Canadian Milk River Canal (locally known as the ‘Spite Ditch’) is in the foreground and the Milk River meanders through the centre of the photo.
Approximately 15 grazing dispositions located on provincial Public Lands were affected by the fire, impacting over 40 area livestock producers. Additionally, two farmsteads were directly impacted with damage or losses to infrastructure, stockpiled forage, and winter grazing pastures.

When soil exposure exceeds 10 - 15 % after burning, accelerated erosion has been observed on all grassland types, especially the higher elevation grasslands (Adams 1995). Grassland recovery from fire can be highly variable depending on the fire intensity, severity, season, fuel and soil moisture conditions, and available moisture for subsequent plant recovery (Wright & Bailey 1982).

The MRWCC, in cooperation with AESRD, the University of Alberta and the University of Waterloo are undertaking a project to monitor watershed recovery. A series of monitoring sites within the burn area have been established to investigate the effects of variable burn intensities and the impact of potential contaminants from runoff and wind erosion events. Dr. Uldis Silins of the University of Alberta indicated that to the best of his knowledge researchers have not documented the runoff quality from a grassland fire of this intensity.

The project is investigating the characteristics of runoff from burned areas and the impact of heavy metals, released phosphorus, and organic carbon on water quality and the aquatic ecosystem. Dr. Silins indicated that runoff high in dissolved organic carbon can complicate conventional municipal water treatment processes that use chlorination as a disinfectant; there is a potential that by-products are formed during the process that can pose a risk to human health. The impact of the 2012 fire on water quality and watershed recovery will be reported in the next Milk River State of the Watershed Report.
The oil and gas industry in Alberta contributes significantly to the Alberta economy. By the end of 2000, more than 260,000 oil and gas wells had been drilled in the province (Sinton 2001). This activity has accelerated so that there are currently about 400,000 wells that have been drilled in Alberta. In recent years, there has also been increased activity in the oil and gas sector in the Milk River watershed.

There are a total of 2,856 wells associated with oil and gas activity in Alberta, 2,496 in Saskatchewan and 9,856 wells in Montana within the Milk River watershed (Map 9.6). The number of wells in the Alberta part of the watershed has increased by 363 in the last five years. Abandoned wells make up a large percent of the total number of wells present in Alberta and Saskatchewan. Wells are abandoned when they are at the end of their life and have no other potential to produce.

The average depth of wells within the watershed is 935 m (3,068 ft) though many newer, tight oil wells have completion depths in excess of 1,500 m (4,921 ft) (ERCB unpublished).

In Alberta, there are approximately 230 oil and gas companies/owners operating in the watershed, though many are not currently active. The largest operators in the watershed include Spur Resources Ltd. (229 wells), 919472 Alberta Ltd. (182 wells), Canadian Natural Resources Ltd. (CNRL) (157 wells), Crescent Point Energy Corp. (125 wells), Murphy Oil Company Ltd. (80 wells), ConocoPhillips Canada Operations Ltd. (73 wells), Deethree Exploration Ltd. (68 wells), Devon Canada Corp. (47 wells), Suncor Energy Inc. (46 wells) and Husky Oil Operations Limited (41 wells). It is unknown at this time how many of these companies may be operating in Saskatchewan or how many companies/owners are present in the watershed in Montana.

A well density of up to four wells per section for each production zone is typically allowed on any given landscape. Each of these well sites will have associated linear developments which generally include access structures and pipelines. Applications by industry for reduced spacing can result in higher well site densities for specific high production landscapes. The number of oil and gas wells and the number of pipelines and access roads associated with oil and gas activity can be an indicator of fragmentation and disturbance on the landscape as well as a social indicator for economic welfare of people living in that area.

Table 9.4. Summary of oil and gas well statistics.

<table>
<thead>
<tr>
<th>Type of Well</th>
<th>Alberta 2007¹</th>
<th>Alberta 2012</th>
<th>Saskatchewan 2012</th>
<th>Montana 2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active Oil Wells</td>
<td>121</td>
<td>162</td>
<td>506</td>
<td>998</td>
</tr>
<tr>
<td>Active Gas Wells</td>
<td>409</td>
<td>476</td>
<td>760</td>
<td>5,126</td>
</tr>
<tr>
<td>Water Wells²</td>
<td>-</td>
<td>18</td>
<td>109</td>
<td>114</td>
</tr>
<tr>
<td>Miscellaneous Well</td>
<td>-</td>
<td>336</td>
<td>212</td>
<td>3,223</td>
</tr>
<tr>
<td>Abandoned Well</td>
<td>1,624</td>
<td>1,864</td>
<td>909</td>
<td>125</td>
</tr>
<tr>
<td></td>
<td>2,493</td>
<td>2,856</td>
<td>2,496</td>
<td>9,586</td>
</tr>
</tbody>
</table>

¹MRWCC (2008); ²Associated with Oil and Gas Activity.

Oil and Gas Activity is:

- increasing
- stable
- decreasing
- unknown

In Alberta, Saskatchewan, and Montana.
**Horizontal Multi-Stage Fractured Wells**

Since 2007, 14 Horizontal Multi-Stage Fractured (HMSF) wells have been completed in the watershed in Alberta as of December 31, 2012 (ERCB 2013). Horizontal multi-stage fracking is a relatively new industry practice where multiple fractures are created along the horizontal section of the wellbore in a series of consecutive operations. Generally fluid pressure is used in each segment of the horizontal wellbore that is isolated and fractured individually. Frack fluid is pumped from the surface at a predetermined and constantly monitored rate to the “toe,” the farthest isolated segment in the horizontal section. When the fracture is created, proppant-laden fluid is pumped into the fracture to keep it open. Once complete, the process is repeated for each segment in the wellbore, working back towards the “heel.”

After all segments have been fractured, hydraulic pressure is removed from the formation and the fracking equipment leaves the location. The wellbore pressure is then reduced to allow the frack fluid to be recovered at surface, known as flowback; often only a portion of the frack fluid and proppant is recovered with the remainder staying in the formation.

Use of HMSF technology has many advantages for the oil and gas industry and area residents. Potential benefits include enhanced recovery of the resource, and the ability to access tight oil from areas such as the Bakken Formation in the Milk River watershed in Alberta. In addition, the overall time that drilling and servicing equipment spend in a given area can be reduced as companies are able to more effectively develop hydrocarbon reservoirs through fewer wells. This process also causes area residents and communities concern. Water used in HMSF is often sourced from treated or municipal sources to ensure quality. In addition, the integrity of casings and formations are a concern when subjected to fracturing pressure; the process is thought by some to pose risk to groundwater resources.

**Future Developments**

The Upper Cretaceous Milk River Formation in southeastern Alberta is a prolific producer of natural gas from relatively shallow depths (Fishman and Hall 2004). The Milk River watershed, which overlies the Upper and Lower Cretaceous geological formations, may become an important region for natural gas development in the future. The Upper and Lower Cretaceous period accounts for about 73% of Alberta’s remaining established reserves of marketable gas (ERCB 2012). The geologic strata containing the largest remaining reserves are the Lower Cretaceous Mannville (37% of the reserve), the Upper Cretaceous Belly River, Milk River, and Medicine Hat (18% of the reserve) and the Mississippian Rundle (7% of the reserve). Together, these strata contain 62% of Alberta’s remaining established marketable gas reserves. Understanding the dynamics between natural gas development and the Milk River Aquifer will be important to preserving the groundwater resource (see Highlight Box). Currently, there are two main gas plants with approximately 40 wells producing about 75,103 m$^3$/d from the shallow zones in the watershed (e.g., Second White Specks/Medicine Hat/Milk River formations) and deeper zones (e.g., Sunburst Formation) (D. Lloyd, pers. comm.). Three main distribution lines direct the natural gas into the United States.

A new oil and gas resource that is currently being developed within the watershed is the Bakken Formation in Alberta. The development involves a shale oil formation (Banff/Exshaw) similar in many ways to the Bakken Formation in south east Saskatchewan and North Dakota. The new technology and drilling approach used to develop the Bakken Formation in Alberta may lead to a significant upswing in energy development in the Milk River watershed in the future as a result of this new oil development (an increase in drilling activity is already underway). In Alberta, landowners are concerned about energy drilling and resource development activity along the edge of the Sunburst pool that is within 3.2 km (2 mi) of the Milk River. This formation becomes deeper as you move northward. Although oil and gas
Map 9.6 Oil and Gas Activity
Oil and Gas Activity and Groundwater Protection in Alberta

In Alberta, the oil and gas regulating authority has requirements to ensure protection of groundwater. All oil and gas wells must be constructed with steel casing that is cemented to the wellbore (and regularly pressure tested to confirm integrity). Wells typically have three different sets of steel casing cemented into the wellbore to prevent communication between hydrocarbon zones and potable groundwater. The casing must extend down to a defined depth called the base of groundwater protection.

Other Requirements and Information

- No surface wells to be located within 100 m (328 ft) of a water body unless diking or secondary containment is in place.
- No oil based fluids or other chemical fluids are to be used when drilling the surface hole for a well.
- All pipelines must be continuously monitored to ensure integrity.
- Industry must abide to release reporting requirements.
- Industry must submit fracture fluid composition to www.fracfocus.ca.
- Typically multi-stage fracturing operations take place at a depth of greater than 2,000 m (6,562 ft) below the surface, far below aquifers.

wells that are now being contemplated in the watershed are still well below the Whisky Valley Aquifer, an important water source for humans and livestock.

Flaring and venting are two negative environmental consequences of oil and gas production, and the public is concerned about the potential environmental effects, wildlife habitat and fragmentation, possible health risks and climate change. Improved practices such as incineration can prevent the release of harmful gasses to the atmosphere by returning bi-products to the subsurface. There are six pipelines that cross the Milk River in Alberta and an estimated five pipelines that cross tributaries to the Milk River (Map 9.6). The age and integrity of these pipelines should be monitored to prevent accidental spills in the watershed.
How May the Milk River Aquifer be Affected by the Oil and Gas Industry?

Presence of Gas Fields
The Milk River Aquifer is an important water source for many people in the watershed. The Milk River Transboundary Aquifer Project (MiRTAP) is working to better understand this resource in Alberta and Montana (See Section 6.0).

Within the Milk River Transboundary Aquifer Project (MiRTAP) (See Section 6.0), there are two gas fields that overlap the study area. These are:

- The Medicine Hat gas field located in Alberta and parts of Saskatchewan overlaps the northeastern part of MiRTAP; and
- The Bears Paw Mountains gas field, located in Montana, overlaps the southeastern part of MiRTAP (Figure 9.12).

Natural gas extraction could potentially impact the groundwater resource due to changes in gas/water pressure.

Mechanisms and Potential Effects
On the northern and eastern parts of the aquifer, the Milk River Formation (which is a combination of the Deadhorse Coulee, Virgelle and Telegraph Creek Members) undergoes a facies change to its sandy shale equivalent, the Alderson Member. The Alderson Member is a gas bearing formation. Figure 9.13 shows the facies change as interpreted in the current conceptual model.

In Montana, two smaller gas fields are located around the City of Havre on both sides of the Bears Paw Mountains, known as the Tiger Ridge gas fields (Figure 9.13). In that area, the gas is contained within the Eagle Formation, composed of biogenic gas (mostly methane gas), which is heavily exploited. A recent study (Anna 2011) evaluated the effect of groundwater flow on the accumulation of biogenic gas around the Bears Paw Mountains. Supported by a numerical model, the study showed that biogenic gas, contained in low-permeability reservoirs, is kept in place by piezometric head (i.e., water pressure) of the aquifer, which is higher than the gas pressure. Another study estimated that, in Alberta, it was very unlikely that groundwater use - from the Virgelle or Upper Alderson aquifers could affect the production of gas (O’Connell 2010).

However, there are currently no studies performed to evaluate the effect of gas exploitation on groundwater flow within the Milk River transboundary aquifer. The MiRTAP project will evaluate the potential effects with the use of a two-phase flow model (gas-water), using the conditions and dynamics of the Medicine Hat gas field, or of the Tiger Ridge gas field. This specific study will determine how current and future gas exploitation may affect the Milk River Aquifer, including groundwater flows and natural fluxes at the regional and transboundary scale.
Watershed Stewardship 10.0

Landowners, leaseholders and rural and urban residents have common ties regarding the stewardship of lands and natural resources throughout the Milk River watershed. As the dominant land use in the watershed, agriculture has been forged with the fundamental understanding of the natural limitations imposed by this semi-arid landscape, including climatic extremes, drought, flood, violent storms and the threat of fire. Agricultural producers naturally try to balance conservation practices so that forage production from native rangeland is compatible with sustaining some of North America’s most diverse plant and animal communities, including rare species and many species at risk.

Although the Milk River watershed is one of the smallest major watersheds in the provinces of Alberta and Saskatchewan, its unique landscape and connectivity to the Missouri Basin make it an area of interest for a number of organizations operating within its boundaries. Landowners, leaseholders and residents participate in programs developed by provincial or state agencies and non-profit organizations committed to maintaining and improving environmental sustainability. The following details various organizations and programs underway that have measurable impact regarding community awareness and involvement in watershed stewardship.
Alberta Farm Water Program

The Farm Water Program is a five-year provincial initiative, launched in 2009, to provide technical assistance and financial incentives to producers who develop farm-scale Long-Term Water Management Plans. The program provides funding to producers to implement actions that will improve their access to secure water supplies. Water concerns expressed by agricultural producers include: 1) legal access to water and their ability to expand operations in the future in light of limited water availability (maintain access to water), 2) the reliability of existing water sources and the ability to secure quality water in sufficient supply (many producers are now considering local water co-ops as a water supply option when this was not considered a viable option 10 to 15 years ago), and 3) surface water and groundwater quality. Producers are working to improve water management in their operations, including water quality as it relates to “food safety”.

Improved access to local extension programs and tools like the Environmental Farm Plan has created a subtle shift in thinking toward proactive management. Recently, within the past 5-years, producers are concerned with oil and gas development near water sources. Participation in the Farm Water Program has been substantial, with the greatest participation observed in 2012. Since 2009, 41 agricultural producers have taken steps to improve their access to quality water, receiving $148,778 to implement actions within their Water Management Plans (Table 10.2).

Table 10.1. Summary of Alberta Environmental Farm Plan participation. Note that NA indicates that data was not available.

<table>
<thead>
<tr>
<th>Year</th>
<th>Cardston County</th>
<th>County of Warner</th>
<th>County of Forty Mile</th>
<th>Cypress County</th>
</tr>
</thead>
<tbody>
<tr>
<td># Plans Completed</td>
<td>Acres</td>
<td># Plans Completed</td>
<td>Acres</td>
<td># Plans Completed</td>
</tr>
<tr>
<td>2004 - Feb 2008</td>
<td>13 24,000</td>
<td>27 109,160</td>
<td>30 94,000</td>
<td>Note</td>
</tr>
<tr>
<td>Feb 2008 - Jan 2009</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>2009 - 2010</td>
<td>0 0</td>
<td>1 3,680</td>
<td>0 0</td>
<td>3 9,540</td>
</tr>
<tr>
<td>2010 - 2011</td>
<td>2 22,000</td>
<td>1 20,000</td>
<td>4 5,360</td>
<td>1 9,200</td>
</tr>
<tr>
<td>2011 - Nov 2012</td>
<td>5 12,360</td>
<td>4 49,920</td>
<td>10 37,447</td>
<td>8 30,880</td>
</tr>
<tr>
<td>Total Since Feb 2008</td>
<td>7 34,360</td>
<td>6 73,600</td>
<td>14 42,807</td>
<td>12 46,340</td>
</tr>
</tbody>
</table>

a - From the 2008 SOW Report; b - County of Forty Mile and Cypress County results were combined in the 2008 SOW Report; c - The area covered by 2 EFPs are not included in this number, thus the number of acres managed under EFPs is slightly larger.

Table 10.2. Number of participants in the Farm Water Program and dollars allocated within the Milk River watershed, Alberta (Source: J. Harrington, AARD).

<table>
<thead>
<tr>
<th>Municipality</th>
<th>2009 - 2010</th>
<th>2010 - 2011</th>
<th>2011 - 2012</th>
<th>2012 - 2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>#</td>
<td>#</td>
<td>#</td>
<td>#</td>
<td>#</td>
</tr>
<tr>
<td>#</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>Cardston County</td>
<td>2 8,665</td>
<td>2 3,175</td>
<td>5 18,049</td>
<td>1 4,187</td>
</tr>
<tr>
<td>County of Warner</td>
<td>0 0</td>
<td>2 7,000</td>
<td>0 0</td>
<td>2 2,966</td>
</tr>
<tr>
<td>County of Forty Mile</td>
<td>2 9,040</td>
<td>2 2,933</td>
<td>2 7,761</td>
<td>3 9,035</td>
</tr>
<tr>
<td>Cypress County</td>
<td>6 25,654</td>
<td>2 9,930</td>
<td>2 10,493</td>
<td>8 29,890</td>
</tr>
<tr>
<td>Total</td>
<td>10 43,359</td>
<td>8 23,038</td>
<td>9 36,303</td>
<td>14 46,078</td>
</tr>
</tbody>
</table>
Alberta Growing Forward Stewardship Plans and Projects
This is a provincial initiative where Stewardship Plans are designed to help agricultural producers document their current management practices and plan for operational improvements that will reduce their environmental impact. When the plan is complete, producers can apply for grant funding to three separate Stewardship Plan programs (i.e., Manure Management, Integrated Crop Management and Grazing & Winter Feeding Management) to help them implement actions identified in their work plan. Figures 10.1 to 10.3 show the total number of projects funded in each of the three program categories.

Figure 10.1. Summary of participation in the Growing Forward - Stewardship Plans Manure Management Category.

Figure 10.2. Summary of participation in the Growing Forward - Stewardship Plans Integrated Crop Management Category.

Figure 10.3. Summary of participation in the Growing Forward - Stewardship Plans Grazing and Winter Feeding Management Category.
Alberta Riparian Habitat Management Society (Cows and Fish)

As resource managers, Cows and Fish couples local knowledge of riparian areas with riparian health monitoring to build ecological literacy. Cows and Fish have worked closely with landowners in the Milk River watershed since 1998, beginning with conversations and detailed riparian health assessments in the counties of Forty Mile and Warner. Cows and Fish staff recognized early the cumulative knowledge and respect that local landowners have for water, the Milk River and the lush ribbon of green bordering the river. The riparian health data collected and assessed by Cows and Fish is one tool available to individual landowners and the community that can assist to make practical and sustainable land-use decisions.

In 2008, Cows and Fish reported the completion of more than 100 riparian health assessments, with 28 individual landowners along 106 km of the Milk River. Each landowner received a riparian health assessment report and many community meetings were held to share the combined results for the watershed. As of 2011, Cows and Fish have completed 220 riparian health assessments in the watershed (an increase of about 120 assessments in the past 5 years) representing a total of 129.6 km along the mainstem Milk River and an additional 217.8 km along tributaries to the Milk River. Refer to Section 7.0 for a detailed description of riparian health.

Municipal Farm-Based Extension Program (formerly Alberta Environmentally Sustainable Agriculture (AESAA))

The Municipal Farm-Based Extension Program is managed by Agricultural Service Boards (ASBs) within rural municipalities and encourages the on-farm adoption of cost-effective and practical BMPs to minimize environmental impacts of agricultural operations. Each of the four municipalities (i.e., Cardston County, County of Warner, County of Forty Mile and Cypress County) employ a Rural Extension Staff and/or Assistant Agricultural Fieldman to work with local producers and communities to provide technical assistance and coordinate education opportunities (e.g., workshops, field tours) that promote environmental stewardship.

While similarities exist among the four municipalities, particularly in their efforts to address invasive weeds and promote soil and water conservation, unique attributes of each municipality require individual programming. For example, the County of Forty Mile has been proactive in groundwater management and has pioneered a number of studies to better understand the Milk River Aquifer. In an effort to preserve the groundwater resource, the County of Forty Mile assisted to decommission abandoned wells.

Priorities for the County of Warner include salinity management, crop protection, and biodiversity for increased crop production and provision of wildlife habitat. The County also supports local, community-driven stewardship initiatives such as the Milk River Ranchers Group and is assisting with the formation of a community group at Red Creek, a tributary to the mainstem Milk River. In the counties of Warner and Cardston, there has been a renewed interest in oil and gas exploration and extraction. These municipalities have been actively providing information to producers in order that they understand the benefits and liabilities of oil and gas activities on private lands.

Large carnivores are increasingly a management concern in Cardston County. In areas where grizzly bears were only a rare occurrence in the past, producers now must change management strategies to reduce attractants (i.e., predator-proof storage). Resident grizzly bears are now common on the western extent of the Milk River Ridge, from west of Kimball through the McIntyre and Deseret Ranches. The County has responded with a deadstock pick-up program and developed the first community deadstock composting facility in Alberta. Cardston County is also supporting wildlife management and inventory work to define social carrying capacities for community residents.

All rural municipalities are actively partnered with the MRWCC to monitor water quality across the Milk River watershed. Cypress County supports water monitoring activity for the Eastern Tributaries (i.e., Lodge, Middle, and Battle creeks), while the County of Warner and Cardston County monitor select sites on the mainstem Milk River. Refer to Section 5.0 for a summary of water monitoring results.
Southern Alberta Youth Range Days
Since 2008, rural municipalities have supported the Annual Southern Alberta Youth Range Days, an interactive event for youth, families, and leaders interested in learning about a variety of range, watershed, wildlife and other natural resource management topics within the Milk River watershed. Youth from all backgrounds including farm and ranch, acreage and town attend and will form the next generation of watershed stewards. The Range Days camps are rotated among the four partner municipalities each year.

Youth Range Days is entering its 6th season in 2013 with Cypress County hosting the 2013 event. Over 110 youth have participated in the Range Days camps from across southern Alberta and northern Montana, with many attending multiple years. A number of youth have proceeded to post-secondary schooling in environmental sciences and agriculture inspired by activities, teachings and mentorship provided by the Range Days organizers. Past participants have also represented Alberta at the Society of Range Management High School Youth Competition in the United States, often finishing in the top ten.

Milk River Watershed Council Canada
The Milk River Watershed Council Canada (MRWCC) is a registered, non-profit charity and Watershed Planning and Advisory Council established under Alberta’s Water for Life Strategy. The MRWCC’s vision is a watershed where community well-being is supported by a vibrant economy and sustained by a healthy environment that will endure as our legacy for future generations. The MRWCC is responsible for reporting on the state of the Milk River watershed and for developing an integrated Milk River watershed management plan. In addition, the Council is involved in a variety of research projects and stewardship initiatives that promote knowledge and understanding of watershed processes among its members. Individual and organizational memberships with the MRWCC have increased steadily since formation, from 85 members (2005), 103 members (2007) to 160 members in 2012.

MULTISAR Program
The MULTISAR conservation program is a cooperative and voluntary initiative between landholders, Alberta Conservation Association (ACA) and Alberta Environment and Sustainable Resource Development (AESRD). MULTISAR strives to promote wildlife values in landholders by providing information and tools to assist recovery efforts for species at risk and the conservation of native prairie habitat. The program’s vision is “that multiple species of wildlife including species at risk are effectively conserved at the landscape level, through a process that integrates range and landuse management with fish and wildlife management principles and in a manner that contributes to the sustainability of the rural economy”.

In 2008, MULTISAR reported that they were working collaboratively with landowners on approximately 505.9 km² of land in the Milk River watershed. In 2012, this number increased to 775.5 km² (191,630.3 acres) of land represented by twenty-nine landholders in the watershed. Twelve of the landholders have partnered to develop Habitat Conservation Strategies for their land totalling an area of 643.5 km² (159,012.3 acres) and 17 landholders have Species at Risk Conservation Plans that cover an area of 132 km² (32,618 acres).

The Milk River Ranchers Group
The Milk River Ranchers is currently the only producer-driven watershed stewardship group actively working within the Milk River watershed in Alberta. The group has worked to promote sustainable riparian management and overall healthy watersheds. The stewardship group was formed in 2003 when a group of concerned ranchers met with the extension specialist from the County of Warner. Soon after forming, the Milk River Ranchers were successful in accessing funding for stewardship projects and began a series of demonstration projects throughout the watershed. Since 2008, the group worked with the local municipalities to provide signage on river egress locations, and information regarding invasive species management on common areas in the watershed such as community grazing reserve access locations. The group is currently soliciting funding to continue efforts and review past project successes and challenges in 2013.
Caring for Our Watersheds

Caring for Our Watersheds (CFOW) is an educational program sponsored by Agrium that weaves together the combined strengths of industry, environmental organizations and communities to engage students in preserving and improving their watersheds. It acknowledges that healthy communities need healthy watersheds. This program empowers students to imagine, develop, and create solutions in their local watersheds.

CFOW asks students (Grades 7 to 12) to submit a proposal that answers the question, “What can you do to improve your watershed?” Students research their local watershed, identify an environmental concern and come up with a realistic solution. Students can win cash rewards for themselves and their school. Agrium also provides funding to help implement student ideas.

Since 2010, the MRWCC has supported the delivery of the CFOW program in the Milk River watershed. Eight Grade 8 students from Erle Rivers High School in the Town of Milk River were successful in earning top rankings in the contest. The students were awarded money for themselves, for their school and dollars for implementation.

The winning proposals were:

- A solar powered remote livestock watering system that manages livestock access to the Milk River, reducing the potential for streambank erosion, water quality degradation and loss of riparian vegetation.
- The placement of fences around young cottonwood seedlings to protect them from damage by wildlife, livestock and people; this will improve riparian health along the banks of the Milk River.
- A water conservation initiative that promoted the use of rain barrels to Town of Milk River residents.
- A water conservation initiative that promoted the use of low-flow showerheads to Town of Milk River residents.
- A sign project that directed people to stay on pathways in riparian areas to reduce impacts of foot traffic on riparian vegetation.
- A bioengineering project to control erosion and improve Milk River streambank stability.

The six ideas were successfully implemented with the help of MRWCC. The MRWCC strives to engage students in preserving and improving the condition of the Milk River watershed.
Montana

Conservation Districts
Montana’s Conservation Districts (CDs) use locally-led and largely non-regulatory approaches to address general natural resource issues. CDs have a long history of conserving Montana’s resources by pairing local needs with technical and financial resources.

Montana’s CDs are political subdivisions of the state and are governed by a Board of five supervisors elected by local voters in a general election. In addition, a municipality that has chosen to be incorporated into a district may appoint up to two urban supervisors to represent urban interests on the Board. There are portions of seven CDs active within the Milk River watershed; these are Glacier, Toole, Liberty, Hill, Blaine, and portions of Phillips and Chouteau districts.

Conservation District programs include conservation education like the Montana Natural Resources Youth Camp, the Montana Youth Range Camp and the Montana Range Days. Conservation Districts sponsor many projects related to riparian and range management which include stream restoration projects, demonstrations and tours of innovative riparian management techniques and projects and programs that provide voluntary incentives for rangeland improvement.

In addition to conservation education, CDs are the local contact for the control of nonpoint source (NPS) pollution. Districts implement projects which demonstrate NPS pollution control practices, preferring voluntary and incentive-based approaches over regulatory approaches. CDs also work with state and federal regulatory agencies to identify problem areas and prioritize treatment. Conservation districts also work closely with the USDA’s NRCS to provide local administration of federal conservation programs, including the Conservation Reserve Program, the Wetlands Reserve Program, the Wildlife Habitat Incentives Program, and the Environmental Quality Incentives Program.

Similar to rural municipalities in Alberta, Conservation Districts demonstrate and rent out a wide array of equipment to land users, including tree planters, fabric layers, weed sprayers, weed badgers, conservation tillage...
drills, grass seeders, and tree chippers, all with the goal of promoting conservation practices.

**Conservation Livestock Operations (CALO) Funding**

In November 2012, the Soil and Water Conservation Districts of Montana, Inc. (SWCDMI) developed a program that offers $50,000 for the implementation of Best Management Practices associated with small animal feeding operation (AFO) less than 300 cow/calf pairs. To receive funds, BMPs must result in improved water quality from AFO operations in approved focus watersheds. BMP funding is limited to $3,000 - 5,000 per BMP. Eligible BMPs include the relocation or redesign of confinement fences, drinking water development associated with relocated or redesigned confinement areas, diversion of overland flows above confinement areas, plantings associated with buffers and filter strips below confinement areas, rain gutters and management of rain/snow waters from confinement roofs and approved stream crossings.

**Milk River Watershed Alliance**

The Milk River Watershed Alliance (MRWA) is a locally led organization working together to preserve, protect and enhance natural resources within the Milk River watershed while maintaining the quality of life. Members of the MRWA represent all aspects of life in the watershed, including representatives from Conservation Districts, County Weed Districts, DNRC, Montana FWP, NRCS and the BLM. Members of the MRWA are also farmers, ranchers, business owners, irrigation ditch supervisors, fisherman and municipality users.

Milk River Watershed Alliance activities are currently confined to the Milk River basin within the counties of Hill, Blaine, Phillips and Valley, Montana, but this does not preclude the MRWA from extending its boundaries in the future to include other Milk River watershed counties in Montana or in Alberta and Saskatchewan. Throughout the year the members of the MRWA take part in various tours and projects that are related to the Milk River watershed.

There are approximately 50 members in the MRWA. These members work on projects and educate people in the watershed on many issues. One of the main issues the MRWA addresses is the importance of the St. Mary’s Irrigation Project. Without a functioning St. Mary’s system, life on the Milk River as we know it would cease to exist. The website for the Milk River Watershed Alliance is http://milkriverwatershedalliance.com.

**Montana Salinity Control Association**

The Montana Salinity Control Association (MSCA) is a satellite organization of the Conservation Districts and is based in Conrad, MT. The MSCA provides technical assistance in the reclamation and control of saline seeps in agricultural areas. Although the program spans the entire State of Montana, within the Milk River watershed the emphasis has been in the vicinity of Sage Creek. Sage Creek is an intermittent stream that has reaches with slight to severe saline ground water discharge into the stream. While the saline conditions are primarily confined to the local dryland watershed, saline-affected surface run-off does reach the confluence periodically during high-flow periods.

The Liberty and Hill county conservation districts, MSCA, USDA and the Sage Creek Watershed Alliance (landowner group) work together to bring in technical and financial assistance to landowners on a voluntary basis. Saline ground and surface water investigations within Sage Creek have been funded by a combination of locally-derived funds, and state and federal agency grants.

**Montana State University Extension Service**

The Montana State University (MSU) Extension Service is a statewide educational outreach network that applies research-based university resources to practical needs identified by Montana residents in their communities. There are Extension offices in every county in Montana that answer questions and provide resources to residents in that county. The Extension Service is part of a nationwide network that was formed by land grant universities to meet the needs of people off of the university campus.
Wildlife Habitat Incentive Program
The Wildlife Habitat Incentive Program (WHIP) is a voluntary program for private landowners to develop and improve high quality habitat that supports wildlife populations of National, State, Tribal, and local significance. Through WHIP, the USDA’s Natural Resources Conservation Service (NRCS) provides technical and financial assistance. WHIP agreements range from one year after project completion to not more than ten years. Since 2007, WHIP has assisted in the Montana Youth for Wildlife which is a special initiative designed to expose Montana’s youth to natural resource concerns for fish, wildlife and habitat needs.

In 2012, the Working Lands for Wildlife Partnership was established between NRCS and the U.S. Fish and Wildlife Service (FWS) to use agency technical expertise and $33 million in financial assistance from WHIP to combat the decline of seven wildlife species. In the Milk River watershed the priority species are the Lesser Prairie Chicken and the Greater Sage Grouse.

Through Working Lands for Wildlife, landowners can voluntarily participate in incentive-based efforts to restore populations of declining wildlife species. The program provides farmers, ranchers, and forest managers with regulatory certainty that conservation investments made today will help sustain their operations in the long-term.

Transboundary Conservation Organizations

Nature Conservancy of Canada
Since the mid-1990s, the Nature Conservancy of Canada (NCC) has worked with landowners, farmers, ranchers and partner agencies and organizations in the Milk River watershed to conserve Canada’s diversity of native plants and animals, including Species at Risk. Conservation is achieved by stewarding ecologically significant natural areas that are secured through land purchases, donations, and Conservation Agreements in Alberta and Saskatchewan, and also Crown Land leases in Saskatchewan.

In 2008, NCC - Alberta reported working with landowners in the watershed to steward approximately 1,620 ha (4,003 acres), both owned and with conservation easements. In 2012, the amount of land that is owned and/or managed under Conservation Easement Agreements by the NCC has increased to a total of 3,720 ha (9,129 acres) in Alberta. Of this land area, 1,860 ha (4,596 acres) is owned by NCC, 950 ha (2,348 acres) is managed lease land and 910 ha (2,249 acres) are managed within Conservation Easement Agreements. There are seven landowners from the Milk River watershed, Alberta, partnering with NCC.

In 2012, NCC - Saskatchewan is responsible for stewarding 17,230 ha (42,576 acres) of conservation lands. Of this land area, 990 ha (2,466 acres) are owned by NCC, 4,280 ha (10,576 acres) are leased by NCC, and 11,960 ha (29,554 acres) are managed within Conservation Agreements. There are 29 landowners within the Milk River watershed in Saskatchewan currently participating with NCC.
The Nature Conservancy
The Nature Conservancy in Montana (TNC) has established a community-based conservation program, based at its Matador Ranch south of Malta, Montana. The Matador Ranch encompasses 24,281 ha (60,000 acres) of mixed-grass prairie, sagebrush steppe, and riparian habitat. The property is the site of one of the most successful grassbanks in the U.S., in which forage is leased to area ranchers for a discount in exchange for conservation practices targeted at maintaining or improving habitat for species of conservation concern and rangeland health on their ranches. In 2013 there are 13 ranches participating in the grassbank, which encompass roughly 91,054 ha (225,000 acres). Additionally, voluntary stewardship practices and research projects are being implemented on ranches not enrolled in the grassbank. The Conservancy has established Conservation Easements on nearly 8,094 ha (20,000 acres) of privately-owned land within the watershed.
Ducks Unlimited Canada

Ducks Unlimited Canada (DUC) conserves, restores and manages wetlands and associated habitats for North America’s waterfowl within Canada. These habitats have multiple benefits for other wildlife and humans. DUC works with landowners and other organizations by providing financial assistance, technical expertise and stewardship advice regarding wetland management. DUC has held project agreements with landowners and managers in the Canadian part of the Milk River watershed that total an area of 13,357 ha (33,005 acres) in Alberta and 203 ha (501 acres) in Saskatchewan. DUC currently offers four programs and/or initiatives in the watershed (Figure 10.4).

Conservation agreements are legal agreements that assist landowners in protecting their land. Landowners retain ownership of the land, while at the same time committing to conserve the natural integrity of the site by limiting the amount and type of development, however, haying and grazing is permitted. In Alberta, DUC had 14 agreements in place totaling an area of 6,813 ha (16,836 acres). Nine of these agreements expired between January 1, 2009 and December 31, 2012, while 1,507 ha (3,724 acres) of the remaining 6,552 ha (16,191 acres) have a perpetual agreement in place. In Saskatchewan, three perpetual conservation agreements are in place covering an area 186 ha (460 acres).

The Winter Wheat Program is an effective alternative to spring-seeded crops that often provides higher yields, allows for more efficient use of crop inputs and helps distribute work load. Ducks that choose to nest in winter wheat are 24 times more productive than those choosing to nest in spring-sown cereals. For 2011 and 2012, DUC had a total of 1,167.5 ha (2,885 acres) of winter cereals seeded within the Milk River watershed to improve survivorship of nesting waterfowl.

DUC’s Forage Program promotes the use of perennial forages that contribute to the daily weight gain of cattle and also provide safe and attractive habitat for upland nesting waterfowl and other birds. Agricultural areas that include forages also help to protect wetlands found in the landscape. DUC has converted 4,893 ha (12,091 acres) of annual cropland within the watershed to perennial forages through this program. The project agreements expire in 2020 and 2021.
DUC’s wetland restoration program focuses on restoring naturally occurring water levels of drained and altered wetlands. Restoration projects are combined with other DUC programs such as conservation agreements and forage conversion to maximize the benefits in the landscape. DUC has completed two restoration projects in association with producers within the Milk River watershed that cover an area of 483 ha (1,193 acres).

**Ducks Unlimited, Inc.**

Ducks Unlimited Canada’s U.S. counterpart, Ducks Unlimited, Inc. (DUI) primarily uses conservation agreements to protect waterfowl and waterfowl habitat in Montana (Figure 10.5). Conservation agreements cover a total of 21,601 ha (53,377 acres) in Montana, including 7,114 ha (17,578 acres) in Hill, Blaine, Phillips and Valley Counties in the Milk River watershed. Technical assistance has been provided for the management of an additional 23,033 ha (56,916 acres), 4158 ha (10,274 acres) of which are also in Hill, Blaine, Phillips and Valley Counties. The largest number of habitat acres occur to the eastern side of the watershed in Blaine and Phillips counties.

Primary waterfowl species that benefit from DUI’s efforts within the State of Montana are Mallard, Northern Pintail, Canada Goose, Blue-Winged Teal, Green-Winged Teal, Cinnamon Teal, Lesser Snow Goose, Gadwall and American Wigeon.

![Cinnamon Teal](image)

**Figure 10.5. Summary of acreage managed in programs or by conservation agreements by Ducks Unlimited Canada (AB and SK) and Ducks Unlimited, Inc. (MT) as of 2012.**
11.0 Summary and Recommendations

The Milk River watershed is abundant in its natural beauty that spans from the Canadian Rockies in the west to the Northwestern Glaciated Plains in the east. The watershed is characterized by unique topography including the Cypress Hills in Alberta and Saskatchewan, and the Sweetgrass Hills, Bears Paw and Little Rocky Mountains in Montana. The watershed conserves open space, large tracts of native grassland, rich species diversity and rare plants. This semi-arid region experiences water shortages that contribute to the overall low population. Water supplies that are variable and unpredictable, in part, limit economic opportunities and growth in the watershed, resulting in a slow, but continuous decline in population in all three jurisdictions. Land use activities are mainly agricultural in nature, with farming and ranching supporting much of the local economy. There is a strong oil and gas industry and exploration and development is increasing as new oil and gas fields are identified.

This transboundary report has compiled data from numerous sources throughout the watershed with assistance from a multi-disciplinary team. Indicators of watershed condition include water supply, water quality, groundwater supply and quality, riparian areas and wetlands, biodiversity (fish, wildlife, plants and invasive species) and land use. In some cases, comprehensive data sets were available that supported status designations for watershed indicators. In other cases, data was sparse, unavailable or non-existent and has led to an unknown status designations for some indicators.

Aquatic Ecosystem

Surface Water Quantity and Allocation

Surface water supplies can be unreliable in the Milk River watershed in Alberta, Saskatchewan and Montana due to natural and unpredictable variations in precipitation and aging water supply infrastructure. The natural supply of water varies greatly from year to year with annual evapotranspiration often exceeding the annual precipitation. On the mainstem Milk River, very low flows to no natural flow can generally occur during the summer months of July and August; this is the time period when water demand by the irrigation sector, the largest water user in the watershed, is the highest. The St. Mary Canal diversion was constructed to allow Montana to access their entitlement to St. Mary River water. The St. Mary Canal diversion also benefits Alberta residents and irrigators by providing improved recreational opportunities, and by improving access to the limited natural flow of the Milk River and additional water from accumulated U.S. deficits of St. Mary River water under the Letter of Intent (LOI, refer to pg. 51). The
diverted water supply, although thought to be a more reliable supply of water, is dependent on downstream conditions like annual precipitation and crop demand, erosion problems and delivery system repairs. For example, in 2011, no U.S. St. Mary Canal diversions occurred in the first half of the irrigation season due to flooding conditions downstream of Fresno Reservoir.

The past five years were relatively wet and there were no major failures of infrastructure that prevented delivery of water to users. However, water supplies in the watershed continue to be a concern for local water users during times of drought. Therefore, fostering collaborative relationships among U.S.A. (Montana) and Canada (Alberta and Saskatchewan) is important to make the best use of the limited supplies of water.

**Surface Water Quality**
Surface water quality is considered stable in the Alberta reaches of the Milk River, and is strongly influenced by the U.S. St. Mary Canal diversion. This water management practice is beyond the influence of local stewardship activity. While fecal coliform counts have been high in the Alberta reaches, current research is investigating the sources of the fecal coliform bacteria. Preliminary results are suggesting that on average, about 20% of bacteria originate from livestock, while the other 80% originate from wildlife (e.g., geese, Cliff Swallows, deer) and environmental bacteria. In Montana, limited water quality data has been collected and these data deficiencies have prevented the assessment of Milk River water. Three impairment listings have been made for individual reaches for copper, iron, lead, nitrates and mercury. Water quality monitoring should continue to be a priority in the watershed, as well as establishing specific water quality objectives and criteria for the entire Milk River watershed.

**Groundwater Supply and Use**
Groundwater aquifers are important resources that cross watershed boundaries below surface. In the Milk River watershed, the transboundary Milk River Aquifer that crosses the Canada-United States border, is an important water supply for communities and rural residents. Historically, declines in groundwater levels have caused concern in some parts of the watershed. The groundwater well density in the watershed is 0.24 wells/km² (0.62 wells/mi²), with the highest density of wells occurring in Alberta. The number of wells in the watershed in Alberta is increasing, and is likely increasing in Saskatchewan and Montana as well, although the data to support this status is not currently available. In Alberta the largest licensed volume is allocated to municipal use, followed by agricultural use. Montana’s groundwater appropriations are mainly for domestic use and stockwater use, however there are 240 wells appropriated for irrigation purposes. Groundwater monitoring programs should be developed that periodically document and report on groundwater levels in the watershed.

**Groundwater Quality**
Groundwater quality in the Milk River watershed aquifers tends to be high in Total Dissolved Solids, particularly in the deeper aquifers. Limited data is available to report on groundwater quality in the Milk River watershed, however, in Alberta, a survey of wells across the watershed provides some indication of quality. Generally, 80% of samples analysed for TDS, and 60% of samples analysed for sodium, exceeded the Canadian Drinking Water Quality Guidelines. In 2011, 9% of samples exceeded the CDWQG for dissolved nitrate. In Saskatchewan, groundwater quality was considered stressed, where 1% to 50% of wells exceed at least one human-influenced Maximum Acceptable Concentration. With increased oil and gas activity occurring in the Milk River watershed,
baseline groundwater quality information should be collected and re-assessed every two to five years. The groundwater quality assessment should include the analysis of hydrocarbons. This data would serve as a benchmark on which to compare future condition.

**Riparian Ecosystem**

**Riparian Areas and Wetlands**

Riparian areas and wetlands make up a small part of the land cover type in the watershed, but they have an essential role in maintaining overall watershed condition. Assessment of riparian condition was completed in the watershed in Alberta, Saskatchewan and Montana. However, some of the data is not readily available, as it is collected by multiple agencies and organizations. Furthermore, different methods have often been applied to rate the status of riparian areas and wetlands, and these studies are not easily comparable. In Alberta, many indicators of riparian condition in the watershed rated Healthy with Problems. Disturbance plants and invasive plants commonly received Unhealthy scores at tributary and mainstem sites. In Montana, the dominant human disturbance affecting wetland condition were roads, conversion of temporary and seasonal wetlands to dryland farming and ponds for watering livestock, and soil and vegetation disturbance associated with heavy livestock grazing. In future, riparian area and wetland condition at select sites should be re-assessed every three to five years to detect improvements through time. Methods used in the assessment should be consistent in order that data sets can be easily compared.

**Biodiversity**

**Fish**

Fish are important indicators of the ecological integrity of aquatic ecosystems. Some of the main sport fish that live in the Milk River include Northern Pike, Sauger and Walleye. Fish species composition is considered stable in the mainstem Milk River in Alberta as it generally has not changed since 1969. Fish species composition is also considered stable in Saskatchewan and Montana. In Alberta, the Rocky Mountain Sculpin, the Stonecat and the Western Silvery Minnow are all designated Species-at-Risk. In Montana, Species of Special Concern include Paddlefish, Sauger, Blue Sucker, Sicklefin Chub and Sturgeon Chub among others. Drought and low flow, altered flow regimes from reservoir activities, water diversion, barriers to upstream movement, loss of habitat, poor water quality and the introduction of non-native predatory fish are all considered threats to fish in the watershed. Measures should be taken to identify critical overwintering habitat (winter Milk River flow can be zero in Alberta) and implement stewardship projects to ensure the protection of critical areas for aquatic life. More information is necessary to understand fish population dynamics, particularly species at risk, and the importance of tributaries to fish in the Milk River.

**Wildlife**

The presence of a variety of wildlife species indicate that supporting habitat (e.g. grassland, riparian) is available in good condition. The status of 11 select wildlife species was assessed by documenting trends in population numbers mainly for Alberta and Montana (Table 11.1). Saskatchewan data was not readily available for many species. The species selected represent a variety of habitat types and their presence or absence relate, in part, to landscape condition. Ferruginous Hawks are increasing in Montana and decreasing in Alberta. Consistent and periodic monitoring across the entire watershed is essential to confidently determine the status of many species in the watershed. Improved management actions should be undertaken when population declines are noted. Research should be undertaken to identify and establish road density thresholds for select wildlife and to identify critical wildlife habitat that should remain roadless.
measures/procedures are required to address the emerging threat of aquatic invasive species such as Quagga mussel. Municipalities should increase collaboration across political boundaries to document the distribution and occurrence of invasive species in the watershed and develop co-operative programs for monitoring and management of weeds and other aquatic invasive species.

### Native Plants

Native vegetation covers a large area of the watershed and contributes to high biodiversity. There are a number of unique plants in the watershed that include the prickly milk vetch, soapweed, tufted hymenopappus, small-flowered hawk’s beard and western blue flag. Some of these species are abundant in Montana but are relatively rare in Alberta and Saskatchewan.

### Invasive Species

Invasive species are problematic in watersheds as they displace native plant communities, alter wildlife habitat, reduce forage for wildlife and livestock and lower biodiversity. Some invasive species such as spotted knapweed and scentless chamomile will alter plant communities with allelopathic properties that inhibit growth of native desirable plants, destabilize soil properties and reduce rootmass protection of riverbanks. Currently, the distribution and occurrence of invasive plants is not well documented. Consistent and regular monitoring and mapping of invasive species is necessary across all jurisdictional boundaries. Cooperative weed management strategies, control, and inventory work should be standardized to provide accurate and accountable management to private land owners and leaseholders across the watershed. Further research should also be undertaken to understand the relationship of climate and native plant communities resistance to invasive and persistent disturbance weed species.

<table>
<thead>
<tr>
<th>Watershed Component</th>
<th>Indicator</th>
<th>Alberta</th>
<th>Saskatchewan</th>
<th>Montana</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population of a variety of seasonal, migratory and resident species</td>
<td>Ferruginous Hawk</td>
<td>Decreasing</td>
<td>Unknown</td>
<td>Increasing</td>
</tr>
<tr>
<td></td>
<td>Loggerhead Shrike</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Unknown</td>
</tr>
<tr>
<td></td>
<td>Grassland Breeding Bird Density</td>
<td>Decreasing</td>
<td>Unknown</td>
<td>Stable</td>
</tr>
<tr>
<td></td>
<td>Grassland Breeding Bird Diversity</td>
<td>Decreasing</td>
<td>Unknown</td>
<td>Increasing</td>
</tr>
<tr>
<td></td>
<td>Burrowing Owl</td>
<td>Decreasing</td>
<td>Decreasing</td>
<td>Unknown</td>
</tr>
<tr>
<td></td>
<td>Sharp-tailed Grouse</td>
<td>Decreasing</td>
<td>Unknown</td>
<td>Stable</td>
</tr>
<tr>
<td></td>
<td>Greater Sage Grouse</td>
<td>Decreasing</td>
<td>Unknown</td>
<td>Stable</td>
</tr>
<tr>
<td></td>
<td>Northern Leopard Frog</td>
<td>Decreasing</td>
<td>Unknown</td>
<td>Unknown</td>
</tr>
<tr>
<td></td>
<td>Plains Spadefoot and Great Plains Toad</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Unknown</td>
</tr>
<tr>
<td></td>
<td>Prairie Rattlesnake</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Unknown</td>
</tr>
<tr>
<td></td>
<td>Richardson’s Ground Squirrel</td>
<td>Increasing</td>
<td>Unknown</td>
<td>Unknown</td>
</tr>
<tr>
<td></td>
<td>Pronghorn</td>
<td>Decreasing</td>
<td>Decreasing</td>
<td>Decreasing</td>
</tr>
</tbody>
</table>

Table 11.1. Status of wildlife indicators in the Milk River watershed.
**Land Use**

**Access**
Although roads are an essential part of the human landscape, they can disrupt and fragment the watershed and cause the temporary or permanent loss of habitat. The increased density of roads in watersheds has been correlated to a reduction in the presence of sensitive wildlife species. Roads can also facilitate the spread of invasive and disturbance-caused plants. In the watershed in Alberta, road density is increasing (Table 11.2). It is likely that road density is also increasing in Saskatchewan and Montana, however historical data was not available to determine this trend. The highest road density was found in Saskatchewan, however when truck trails were applied to the Alberta calculation, Alberta had the highest road density. Upgrading local gravel roads to paved highways or twinned highways improves access to remote areas in the watershed and increases risks to fish, wildlife, plants and their habitat. Efforts should be made to maintain roadless areas in the watershed, particularly in areas that have been identified as critical wildlife habitat.

**Parks, Protected and Managed Areas**
The percentage of the watershed maintained as parks and protected areas is an indicator of landscape condition, as well as social quality of life. The area maintained as park or protected are in Alberta and Montana is increasing, and the status is unknown for Saskatchewan (Table 11.2). Recent land purchases by the Alberta government have increased the area of Writing-on-Stone Provincial Park in 2011 and private organizations like the Nature Conservancy of Canada are increasing their land ownership in the basin. Montana Fish, Wildlife and Parks also recently purchased land for the Lost River Wildlife Management Area. Parks and protected areas are critical to preserving local or unique ecological areas, natural heritage and natural biological diversity.

**Tourism and Recreation**
The number of people recreating in the watershed is an indicator of stresses that might be placed on natural resources in the watershed, and it also indicates human health and economic condition. Tourism and recreation activity in the Milk River watershed is considered stable in that the number of visitors to parks is relatively constant, fluctuating or declining in response to weather conditions and the provincial and state economy. Greater effort should be made to track tourism and recreation activity in the watershed, particularly river use, at some of the more remote and significant places.

**Agriculture**
Agriculture is the predominant land use in the Milk River watershed. Cropland covers about 1,990,126 ha (4,917,708 acres) of land in the Milk River watershed (or 33% of the entire watershed). In Alberta, the crop footprint has remained stable, while in Montana it is increasing as land is taken out of the Conservation Reserve Program and seeded to higher value crops. Farm size tends to be increasing in the watershed in Alberta as
smaller operations are amalgamated into larger farms; at the same time the number of farm operators is decreasing. In contrast, farm size in the watershed in Montana is decreasing and the status is unknown in Saskatchewan. Native rangeland makes up about 65% of the watershed in Alberta, 62% in Saskatchewan and 44% in Montana.

**Oil and Gas**
The oil and gas industry is important to the local economy in the Milk River watershed. However, infrastructure associated with the industry can increase linear disturbance and fragment wildlife habitat, particularly for reptiles and amphibians. In the Milk River watershed in Alberta, the number of oil and gas wells has increased from 2,493 wells (MRWCC 2008) to 2,856 wells in 2012 (Table 11.2). There are about 230 oil and gas companies operating in the watershed in Alberta. There are about 2,496 and 9,586 oil and gas wells in the watershed in Saskatchewan and Montana, respectively. Information related to the oil and gas industry is limited. Efforts should be made to better understand the oil and gas activity in the watershed and to communicate local concerns regarding oil and gas exploration and development.

<table>
<thead>
<tr>
<th>Watershed Component</th>
<th>Indicator</th>
<th>Alberta</th>
<th>Saskatchewan</th>
<th>Montana</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access</td>
<td>Road density</td>
<td>Increasing</td>
<td>Unknown</td>
<td>Unknown</td>
</tr>
<tr>
<td>Parks, Protected and Managed Areas</td>
<td>Percentage of watershed in parks and protected areas</td>
<td>Increasing</td>
<td>Unknown</td>
<td>Increasing</td>
</tr>
<tr>
<td>Tourism and Recreation Activity</td>
<td>Number of visitors to serviced areas</td>
<td>Stable</td>
<td>Stable</td>
<td>Stable</td>
</tr>
<tr>
<td></td>
<td>Number of anglers and hunters in the watershed</td>
<td>Stable</td>
<td>Unknown</td>
<td>Stable</td>
</tr>
<tr>
<td>Agricultural Activity</td>
<td>Crop footprint</td>
<td>Stable</td>
<td>Unknown</td>
<td>Increasing</td>
</tr>
<tr>
<td></td>
<td>Farm size</td>
<td>Increasing</td>
<td>Unknown</td>
<td>Decreasing</td>
</tr>
<tr>
<td></td>
<td>Number of farm operators</td>
<td>Decreasing</td>
<td>Unknown</td>
<td>Unknown</td>
</tr>
<tr>
<td></td>
<td>Area maintained as rangeland</td>
<td>Stable</td>
<td>Unknown</td>
<td>Decreasing</td>
</tr>
<tr>
<td></td>
<td>Rangeland condition</td>
<td>Stable</td>
<td>Stressed</td>
<td>Unknown</td>
</tr>
<tr>
<td>Oil and Gas Activity</td>
<td>Number of oil and gas wells</td>
<td>Increasing</td>
<td>Unknown</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

Table 11.2. Status of land use indicators in the Milk River watershed.
Community

Table 11.3. Status of population and watershed stewardship indicators in the Milk River watershed.

<table>
<thead>
<tr>
<th>Watershed Component</th>
<th>Indicator</th>
<th>Alberta</th>
<th>Saskatchewan</th>
<th>Montana</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>Number of people</td>
<td>Decreasing</td>
<td>Decreasing</td>
<td>Decreasing</td>
</tr>
<tr>
<td>Stewardship</td>
<td>Participation in programs</td>
<td>Increasing</td>
<td>Unknown</td>
<td>Increasing</td>
</tr>
</tbody>
</table>

Population
Trends in human population describe the social “quality of life” aspect of watersheds. Population declines in watersheds suggest that one or more elements that contribute to quality of life may be lacking in the region, making it less desirable. Population density is generally low in the Milk River watershed (e.g., <0.5 people/km²) with larger densities (>25 people/km²) in urban centres. In addition, population is declining across the watershed in Alberta, Saskatchewan and Montana (Table 11.3). Aging communities, poor employment opportunities, loss of local services (e.g., schools, hospitals), amalgamation of farms and a preference for larger centres by younger people all contribute to the loss of population in the watershed. Strategies should be developed to attract people to the watershed, including securing water supplies, keeping necessary services in the local area, and identifying new employment opportunities to support the local economy.

Watershed Stewardship
Many residents, landowners, agricultural producers and industry in the Milk River watershed collaborate with organizations or participate in programs that maintain and improve watershed condition. There has been a strong participation rate in all programs offered across the watershed. Organizations should continue working in partnership with land stewards to maintain water quality, riparian condition and biodiversity in the watershed.
Looking Ahead

The MRWCC and the MRWA have worked together to create the first Milk River Transboundary State of the Watershed Report. The two groups have learned a great deal about working together across provincial and international borders and significant results were achieved. The report has unified maps to show the extent of resources and their management; it has also increased shared knowledge about common resources among watershed residents, agencies and governments. Cross-border cooperation should continue and the partnership between the two groups should be strengthened.

The State of the Watershed Report is a milestone toward effective, collaborative watershed management; however, additional important work is left unfinished, namely 1) the systematic monitoring of environmental problems and their remediation, and 2) actions that generate small but incremental changes that leave the Milk River watershed a better place for future generations. The following next steps should be considered in order to build on the State of the Watershed Report success:

- Core funding from provincial, state and federal agencies, that will support a designated watershed coordinator within each jurisdiction, should be sought and acquired as a critical component of future transboundary collaboration.

- A central Team of technical collaborators from Alberta, Saskatchewan and Montana, brought together by the MRWCC and the MRWA, should be established to discuss indicators, data accessibility, and research and monitoring needs for future transboundary State of the Watershed evaluation and reporting.

- Surface water, groundwater, riparian areas/wetlands and biodiversity are valuable resources that contribute to watershed condition and to the economy. In recognition, an on-going, knowledgeable Committee should be assembled to provide a forum to discuss collaborative integrated watershed management, transparent of political boundaries. The Committee could identify and recommend management strategies that result in more effective utilization of communal watershed resources.
12.1 Literature Cited

Adams, B. W. 1995. Fire and grazing to manage willow forest on foothills range. Range Notes 15.


Hydrogeologic Consultants Ltd. 2003. Cardston County: Part of the South Saskatchewan and Missouri River Basins. Tp 001 to 007, R 19 to 29, W4M Regional Groundwater Assessment. Cardston County and Prairie Farm Rehabilitation Administration.


Montana Department of Commerce, Census & Economic Information Center. Online: http://www.census.gov.


12.2 Personal Communications


Ferriter, A. Aquatic Invasive Species Coordinator, Idaho State Department of Agriculture. September 9, 2012.


LaForge, K. Manager, Range and Forage Division, Agriculture and Agri-Food Canada. Email. April 24, 2013.


Mangold, Dr. J. Assistant Professor, Land Resources and Environmental Sciences: Montana State University. Bozeman, Montana. April 19, 2012.


12.3 Map Information

Acknowledgement of Sources, Waivers and Disclaimers

For Saskatchewan data:
The incorporation of data sourced from Her Majesty The Queen In Right of Saskatchewan, within this product shall not be construed as constituting an endorsement by Her Majesty The Queen In Right of Saskatchewan of such product. Reproduced with the permission of Her Majesty The Queen In Right of Saskatchewan.

Her Majesty The Queen In Right of Saskatchewan as represented by The Minister for Environment makes no representation or warranties of any kind with respect to the accuracy, usefulness, novelty, validity, scope, completeness or currency of the Data and expressly disclaims any implied warranty of merchantability or fitness for any particular purpose.

For Alberta data:
The Minister and the Crown provides this information without warranty or representation as to any matter including but not limited to whether the data/information is correct, accurate or free from error, defect, danger, or hazard and whether it is otherwise useful or suitable for any use the user may make of it. © 2013 Government of Alberta.

Milk River Basin Boundary:
Milk River Basin boundary provided by U.S. Geological Survey (USGS), National Hydrography Dataset/U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) Watershed Boundary Dataset.

All Maps Produced by:

Map Data Sources/Credits:

Map 2.1
Alberta data: Base Data provided by Spatial Data Warehouse Ltd. Montana data: Road network provided by Montana Dept. of Transportation/Planning/Data & Statistics Bureau/RIM. Municipalities provided by Montana Base Map Service Center, Department of Administration, Information Technology Services Division. Hydrography provided by USGS National Hydrography Dataset/USDA NRCS Watershed Boundary Dataset, Saskatchewan data: Roads (National Road Network) and Hydrography © Department of Natural Resources Canada. All rights reserved. Urban Places provided by Saskatchewan Research Council.

Elevation provided by USGS National Elevation Dataset. Hillshade provided by Alberta Environment and Sustainable Resource Development.

Map 2.2 Canada Bedrock Geology/Montana Geology
Alberta data: Base Data provided by Spatial Data Warehouse Ltd. Bedrock Geology provided by Alberta Energy and Utilities Board, Alberta Geological Survey. Montana data: Road network provided by Montana Dept. of Transportation/Planning/Data & Statistics Bureau/RIM. Municipalities provided by Montana Base Map Service Center, Department of Administration, Information Technology Services Division. Hydrography provided by USGS National Hydrography Dataset/USDA NRCS Watershed Boundary Dataset. Geology provided by U.S. Geological Survey, from General Surficial Geology of Montana compiled 1955.

Saskatchewan data: Roads (National Road Network) and Hydrography © Department of Natural Resources Canada. All rights reserved. Urban Places provided by Saskatchewan Research Council. Bedrock Geology from the Geological Atlas of Saskatchewan, Saskatchewan Geological Survey, Saskatchewan Ministry of Energy and Resources.

Map 2.3 Surficial Geology
Alberta data: Base Data provided by Spatial Data Warehouse Ltd. Surficial Geology from data created by Alberta Energy and Utilities Board, Alberta Geological Survey (AGS), Irina Shetsen, from data from AGS Map 207, ‘Quaternary Geology, Southern Alberta’ compiled by I. Shetsen., published by AGS.

Saskatchewan data: Roads (National Road Network) and Hydrography © Department of Natural Resources Canada. All rights reserved. Urban Places provided by Saskatchewan Research Council. Surficial Geology obtained from the Surficial Geology of the Cypress Lake and Wood Mountain map areas provided by the Geological Survey of Canada © Department of Natural Resources Canada. All rights reserved.

Map 2.4 Ecological Regions
Alberta data: Base Data provided by Spatial Data Warehouse Ltd. Natural Subregions provided by Alberta Environment and Sustainable Resource Development, derived from the report, Natural Regions and Subregions of Alberta, compiled by Downing and Pettapiece, Edmonton for the Alberta Natural Region Committee, Government of Alberta, 2006.

Montana data: Road network provided by Montana Dept. of Transportation/Planning/Data & Statistics Bureau/RIM. Municipalities provided by Montana Base Map Service Center, Department of Administration, Information Technology Services Division. Hydrography provided by USGS National Hydrography Dataset/USDA NRCS Watershed Boundary Dataset.

Saskatchewan data: Roads (National Road Network) and Hydrography © Department of Natural Resources Canada. All rights reserved. Urban Places provided by Saskatchewan Research Council.

Map 2.5 Precipitation
Alberta data: Base Data provided by Spatial Data Warehouse Ltd. Weather Stations provided by Alberta Agriculture and Rural Development, and Alberta Environment and Sustainable Resource Development.

Montana data: Road network provided by Montana Dept. of Transportation/Planning/Data & Statistics Bureau/RIM. Municipalities provided by Montana Base Map Service Center, Department of Administration, Information Technology Services Division. Hydrography provided by USGS National Hydrography Dataset/USDA NRCS Watershed Boundary Dataset. Weather Stations provided by Meso West, Meteorology Department, University of Utah.

Saskatchewan data: Roads (National Road Network) and Hydrography © Department of Natural Resources Canada. All rights reserved. Urban Places provided by Saskatchewan Research Council. Weather Stations provided by Environment Canada.

Precipitation data created and provided by Montana Department of Natural Resources & Conservation (DNRC), from data provided by DNRC, the U.S. Geological Survey (USGS), Environment Canada, Alberta Agriculture and Rural Development, and Alberta Environment and Sustainable Resource Development.

Map 2.6 Soils
Alberta data: Base Data provided by Spatial Data Warehouse Ltd. Soils obtained from the Agricultural Region of Alberta Soil Inventory Database (AGRASID 3.0), Alberta Soil Information Centre, Alberta Agriculture and Rural Development, and Agriculture and Agri-Food Canada.

Montana data: Road network provided by Montana Dept. of Transportation/Planning/Data & Statistics Bureau/RIM. Municipalities provided by Montana Base Map Service Center, Department of Administration, Information Technology Services Division. Hydrography provided by USGS National Hydrography Dataset/USDA NRCS Watershed Boundary Dataset. Soils provided by U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS).

Saskatchewan data: Roads (National Road Network) and Hydrography © Department of Natural Resources Canada. All rights reserved. Urban Places provided by Saskatchewan Research Council. Soils provided by the National Soil Database (NSDB), Canadian Soil Information Service, Agriculture and Agri-Food Canada.
Saskatchewan data: Roads (National Road Network) and Hydrography © Department of Natural Resources Canada. All rights reserved. Urban Places provided by Saskatchewan Research Council. Map Areas provided from the alluvial floodplain category of Surficial Geology of the Cypress Lake and Wood Mountain map areas provided by the Geological Survey of Canada © Department of Natural Resources Canada. All rights reserved.

Map 8.1. Fisheries
Alberta data: Base Data provided by Spatial Data Warehouse Ltd. Montana data: Road network provided by Montana Dept. of Transportation/Planning/Data & Statistics Bureau/RIM. Municipalities provided by Montana Base Map Service Center, Department of Administration, Information Technology Services Division. Hydrography provided by USGS National Hydrography Dataset/USDA NRCS Watershed Boundary Dataset. Saskatchewan data: Roads (National Road Network) and Hydrography © Department of Natural Resources Canada. All rights reserved. Urban Places provided by Saskatchewan Research Council. Parks and protected areas provided by Saskatchewan Ministry of Environment, sourced: Her Majesty The Queen in Right of Saskatchewan, Land Ownership, First Nations Reserves provided by Information Services Corporation of Saskatchewan.

Map 9.2 Parks and Protected Areas
Alberta data: Base Data provided by Spatial Data Warehouse Ltd. Montana data: Road network provided by Montana Dept. of Transportation/Planning/Data & Statistics Bureau/RIM. Municipalities provided by Montana Base Map Service Center, Department of Administration, Information Technology Services Division. Hydrography provided by USGS National Hydrography Dataset/USDA NRCS Watershed Boundary Dataset. Managed Areas (Land Ownership) provided by Montana Natural Heritage Program.

Saskatchewan data: Roads (National Road Network) and Hydrography © Department of Natural Resources Canada. All rights reserved. Urban Places provided by Saskatchewan Research Council. Parks and protected areas provided by Saskatchewan Ministry of Environment, sourced: Her Majesty The Queen in Right of Saskatchewan, Land Ownership, First Nations Reserves provided by Information Services Corporation of Saskatchewan.

Map 9.3 Crops
Alberta data: Base Data provided by Spatial Data Warehouse Ltd. Crop data summarized from the Grassland Vegetation Inventory (GVI), Alberta Environment and Sustainable Resource Development.

Montana data: Road network provided by Montana Dept. of Transportation/Planning/Data & Statistics Bureau/RIM. Municipalities provided by Montana Base Map Service Center, Department of Administration, Information Technology Services Division. Hydrography provided by USGS National Hydrography Dataset/USDA NRCS Watershed Boundary Dataset. Crop data depicted is from two sources: 1. 2012 Montana Cropland Data Layer provided by United States Department of Agriculture (USDA), National Agricultural Statistics Service (NASS), Research and Development Division (RDD), Geospatial Information Branch (GIB), Spatial Analysis Research Section (SARS), 2. Landcover 2010 provided by the Montana Natural Heritage Program.

Saskatchewan data: Roads (National Road Network) and Hydrography © Department of Natural Resources Canada. All rights reserved. Urban Places provided by Saskatchewan Research Council. Crop data (Vegetation Cover) produced by: the Government of Saskatchewan, Prairie Farm Rehabilitation Administration (PFRA), and Ducks Unlimited Canada, with credits to the Saskatchawan Research Council (SRC).

Map 9.4 Crop Water Deficit
Alberta data: Base Data provided by Spatial Data Warehouse Ltd.

Montana data: Road network provided by Montana Dept. of Transportation/Planning/Data & Statistics Bureau/RIM. Municipalities provided by Montana Base Map Service Center, Department of Administration, Information Technology Services Division. Hydrography provided by USGS National Hydrography Dataset/USDA NRCS Watershed Boundary Dataset. Crop Water Deficit data created/provided by Montana Department of Natural Resources & Conservation (DNRC), from data provided by DNRC, the U.S. Geological Survey (USGS), Environment Canada, Alberta Agriculture and Rural Development, and Alberta Environment and Sustainable Resource Development.

Alberta data: Base Data provided by Spatial Data Warehouse Ltd. Irrigated Areas summarized from the Grassland Vegetation Inventory (GVI), Alberta Environment and Sustainable Resource Development.

Montana data: Road network provided by Montana Dept. of Transportation/Planning/Data & Statistics Bureau/RIM. Municipalities provided by Montana Base Map Service Center, Department of Administration, Information Technology Services Division. Hydrography provided by USGS National Hydrography Dataset/USDA NRCS Watershed Boundary Dataset. Irrigated Areas provided by Montana Department of Natural Resources & Conservation (DNRC), from data provided by DNRC and the U.S. Geological Survey (USGS).

Saskatchewan data: Roads (National Road Network) and Hydrography © Department of Natural Resources Canada. All rights reserved. Urban Places provided by Saskatchewan Research Council. Pipelines and Wellsite data provided by IHS Energy(Canada) Ltd. and reformatted by Informatics Branch, Corporate Services Division, Alberta Environment and Sustainable Resource Development. Hydrography provided by USGS National Hydrography Dataset/USDA NRCS Watershed Boundary Dataset. Managed Areas (Land Ownership) provided by Montana Natural Heritage Program.

Alberta data: Base Data provided by Spatial Data Warehouse Ltd. Pipelines and Wellsite data provided by IHS Energy(Canada) Ltd. and reformatted by Informatics Branch, Corporate Services Division, Alberta Environment and Sustainable Resource Development.

Alberta data: Base Data provided by Spatial Data Warehouse Ltd. Nature Conservancy of Canada land provided by The Nature Conservancy of Canada, Saskatchewan Region.

Saskatchewan data: Roads (National Road Network) and Hydrography © Department of Natural Resources Canada. All rights reserved. Urban Places provided by Saskatchewan Research Council. Fishes provided by Terry Clayton, Alberta Environment and Sustainable Resource Development, Cody Nagel and Tyler Hadidix, Montana Fish, Wildlife and Parks, and Doug Watkinson, Fishes and Oceans Canada.

Map 8.2 Native Vegetation
Alberta data: Base Data provided by Spatial Data Warehouse Ltd. Native Vegetation data summarized from the Grassland Vegetation Inventory (GVI), Alberta Environment and Sustainable Resource Development.

Montana data: Road network provided by Montana Dept. of Transportation / Planning / Data & Statistics Bureau / RIM. Municipalities provided by Montana Base Map Service Center, Department of Administration, Information Technology Services Division. Hydrography provided by USGS National Hydrography Dataset / USDA NRCS Watershed Boundary Dataset. Native Vegetation from Landcover 2010 provided by the Montana Natural Heritage Program.

Saskatchewan data: Roads (National Road Network) and Hydrography © Department of Natural Resources Canada. All rights reserved. Urban Places provided by Saskatchewan Research Council. Native Vegetation (Vegetation Cover) produced by: the Government of Saskatchewan, Prairie Farm Rehabilitation Administration (PFRA), and Ducks Unlimited Canada, with credits to the Saskatchewan Research Council (SRC).

Map 9.5 Irrigated Areas
Alberta data: Base Data provided by Spatial Data Warehouse Ltd. Irrigated Areas summarized from the Grassland Vegetation Inventory (GVI), Alberta Environment and Sustainable Resource Development.

Montana data: Road network provided by Montana Dept. of Transportation/Planning/Data & Statistics Bureau/RIM. Municipalities provided by Montana Base Map Service Center, Department of Administration, Information Technology Services Division. Hydrography provided by USGS National Hydrography Dataset/USDA NRCS Watershed Boundary Dataset. Irrigated Areas provided by Montana Department of Natural Resources & Conservation (DNRC), from data provided by DNRC and the U.S. Geological Survey (USGS).

Saskatchewan data: Roads (National Road Network) and Hydrography © Department of Natural Resources Canada. All rights reserved. Urban Places provided by Saskatchewan Research Council.

Map 9.6 Oil and Gas Industry
Alberta data: Base Data provided by Spatial Data Warehouse Ltd. Pipelines and Wellsite data provided by IHS Energy (Canada) Ltd. and reformatted by Informatics Branch, Corporate Services Division, Alberta Environment and Sustainable Resource Development.

Montana data: Road network provided by Montana Dept. of Transportation/Planning/Data & Statistics Bureau/RIM. Municipalities provided by Montana Base Map Service Center, Department of Administration, Information Technology Services Division. Hydrography provided by USGS National Hydrography Dataset/USDA NRCS Watershed Boundary Dataset. Managed Areas (Land Ownership) provided by Montana Natural Heritage Program. Wellsites provided by Montana Board of Oil and Gas.

Saskatchewan data: Roads (National Road Network) and Hydrography © Department of Natural Resources Canada. All rights reserved. Urban Places provided by Saskatchewan Research Council. Land Ownership provided by Saskatchewan Ministry of Environment, sourced: Her Majesty The Queen in Right of Saskatchewan, Land Ownership. First Nations Reserves provided by Information Services Corporation of Saskatchewan. Wellsites extracted from Saskatchewan Geological Atlas (Saskatchewan Ministry of Energy and Resources). Pipelines provided by CanVec base data © Department of Natural Resources Canada, Earth Sciences Sector, Mapping Services Branch. All rights reserved.
Where the fence lines and borders of Alberta, Saskatchewan and Montana meet in the heart of the Milk River watershed.