5.0 Data Gaps

5.1 Land Use Indicators

5.1.1 Wetland Loss

Wetlands serve many functions in the natural landscape including water storage, flood attenuation, wildlife habitat, groundwater recharge and general water quality improvements (e.g., nutrient uptake, degradation of pesticides, sediment retention). Additionally, wetlands provide a cost effective and sustainable alternative to engineered treatment options. The loss of wetlands to development and/or agriculture can be deleterious to surface and groundwater quantity and quality as well as wetland facultative or obligate species.

Comprehensive wetland inventories have not been completed for any of the 15 subwatersheds. To date, very limited data are available on wetland distribution, classes, coverage and loss in the watershed. This represents a significant data gap, and the development of comprehensive wetland inventories should be included in future watershed studies.

5.1.2 Riparian Health

Riparian health inventories are conducted primarily by Cows and Fish (Alberta Riparian Habitat Management Society), as they are the only recognized agency providing technical riparian health inventories and assessments in Alberta; however, other agencies are using the riparian health assessment (survey) methods developed by Cows and Fish. Currently, there are limited data on the riparian health of many riparian areas throughout Alberta. In addition, the limited number of sites along a given waterbody generally does not permit an overall conclusion of riparian health for that waterbody.

Riparian health assessments have been done in six subwatersheds (Panther River, James River, Little Red Deer River, Blindman River, Kneehills Creek and Rosebud River) and have not been conducted anywhere in the remaining nine subwatersheds. These assessments are generally limited to one or a few specific locations on one or two waterbodies. Consequently, this presents a significant data gap that needs to be addressed in future watershed studies, particularly since riparian health is positively correlated with water quality and organismal biodiversity.

5.1.3 Livestock Manure Production

Areas of higher livestock density and their associated higher manure production, if not properly managed, can have greater impacts on downstream water quality within a subwatershed. Streams that drain land with high intensity livestock operations have higher nutrient concentrations, dissolved nutrients, mass loads, fecal bacteria and exports of total dissolved phosphorus than streams with medium or low intensity livestock operations and manure production.

Livestock, manure production and agricultural intensity data are based on 2001 Agriculture Census data and are accurate to 200-400 m. Cattle density data are based on cattle density and no other livestock

species. These are data from the 2006 Agriculture Census and accurate to 200-400 m. Manure production data are based on all livestock species. Feedlot locations are based on data from the Alberta Natural Resources Conservation Board. These data originate from 2007 and are accurate to 400 m. These four datasets are complete for all subwatersheds, i.e., there are no data gaps.

5.1.4 Urban, Rural, Agricultural and Recreational Developments

Urban sprawl, rural and recreational development is the expansion of urban areas, rural subdivisions and recreational areas into surrounding landscape. This expansion can have many negative effects on the environment, including the loss of wetlands, riparian areas, intermittent streams and wildlife habitat, as well as increased surface runoff into neighboring creeks, rivers and lakes.

Locations of urban centres and population data originated from the Atlas of Canada (Government of Canada, 2006) and Statistics Canada (Government of Canada 2006 census), respectively. These datasets are complete for all subwatersheds, i.e., there are no data gaps. The data on recreational facilities in each of the subwatersheds is managed at the provincial level and originated from Alberta Tourism, Parks and Recreation. Visitation statistics for these facilities are not always complete and have been published only until 2003. The lack of more recent data represents a data gap and may be of concern in light of the increasing population base in Alberta and a likely increase in the use of recreational facilities across the province.

5.1.5 Linear Developments

Linear developments include seismic lines, pipelines, roads, railways and utility right of ways. These developments have been shown to negatively impact water quality and fish and wildlife populations, e.g., wildlife corridors can be interrupted by roads, and watersheds can have their drainage patterns permanently altered by increases in impervious or compacted surfaces. Linear developments also include infrastructures crossing waterbodies, e.g., pipelines and bridges.

Linear development data originate from Alberta Environment and are accurate to 3 m. Waterbody crossing maps and maps of pipelines crossing waterbodies were generated from 2001 Canvec 1:50,000 hydrology data and linear development data from Alberta Environment. All three datasets are complete for all subwatersheds, i.e., there are no data gaps.

5.1.6 Oil and Gas Activities

Oil and gas activity is very common throughout the province of Alberta. A number of environmental impacts are associated with oil and gas development, including loss of wetlands, habitat fragmentation, increased water use and surface water and groundwater contamination.

Well location and density data, active and abandoned, originated from Albert Environment. These data are accurate to 400 m and were generated in 2008. This dataset is complete for all subwatersheds, i.e., there are no data gaps.

5.2 Water Quality Indicators

5.2.1 Nutrients

Nitrogen and phosphorus are essential nutrients for most aquatic plants, whereby excess nutrients can lead to eutrophication, i.e., an excessive amount of aquatic plant and phytoplankton growth. Concomitant with increased plant and phytoplankton growth, oxygen levels may significantly decrease in the water column, which may negatively impact aquatic organisms, including fish. In addition, excessive phytoplankton growth, particularly of cyanobacteria, can lead to the release of toxins into the water column, which may be harmful to aquatic organisms, waterfowl, livestock and humans.

Water quality is monitored primarily by Alberta Environment, Canada-Alberta Environmentally Sustainable Agriculture Agreement (CAESAA) and the Prairie Provinces Water Board (PPWB). Monitoring efforts were generally more intensive in the 1970s-1990s, i.e., water samples were collected at more locations and more frequently at each location. To obtain a more 'holistic' snap-shot of the watershed, it is recommended that stakeholders interested in water quality collaborate and develop more comprehensive monitoring programs. This may serve to increase monitoring efficiencies, in terms of cost and time, while alleviating sample duplications. The lack or limited extent of recent water quality data for many waterbodies in the 15 subwatersheds is a significant data gap.

5.2.2 Bacteria

Coliforms are a broad class of bacteria found in human and animal wastes. Total coliforms include *Escherichia coli*, fecal bacteria and other coliforms that occur naturally in warm blooded animals. *E. coli* is one of three bacteria commonly used to measure the direct contamination of water by human or other mammal wastes. Ingestion of or exposure to fecal bacteria can have negative health impacts. Sources of this type of bacteria include agricultural and municipal runoff, wildlife, faulty septic systems and septic fields.

Microbiological data have been collected in 11 of the 15 subwatersheds (only lacking in Panther River, Raven River, Waskasoo creek and Michichi Creek). Those data that exist originate from generally limited sampling in a small number of waterbodies within their respective subwatersheds, e.g., 1-3 creeks, streams or lakes. Future water quality monitoring programs should include and/or expand microbiological monitoring efforts to fill this data gap.

5.2.3 Parasites

Waters that are polluted may contain several different disease-causing organisms, commonly called parasites, including *Cryptosporidium* and *Giardia* spp. The ingestion of these parasites can cause gastrointestinal conditions known as cryptosporidiosis and giardiasis.

Despite the widespread occurrence of parasites in terrestrial and aquatic habitats and their potentially harmful impacts on human and animal health, there are virtually no data on their presence and frequency in any of the subwatersheds (only the Medicine River subwatershed has limited parasite

data). Future water quality monitoring programs need to include parasite analyses to fill this data gap, especially since Alberta's population has been increasing and more people may be exposed to these organisms.

5.2.4 Pesticides

Pesticides are a group of chemicals, including herbicides, insecticides, rodenticides and fungicides, used for many purposes, including pest control and aesthetics in urban areas, golf courses and in forestry and agricultural production. Pesticides are a common contaminant of streams and dugouts in the high intensity agricultural areas of Alberta.

Pesticide data have been collected to a limited degree in seven subwatersheds (Little Red Deer River, Medicine River, Blindman River, Buffalo Lake, Threehills Creek, Michichi creek and Rosebud River), and there are no data from the remaining eight subwatersheds (principally the three most western and three most eastern subwatersheds). Those data that exist originate from generally limited sampling in a small number of waterbodies within their respective subwatersheds (generally only 1-3 creeks, streams or lakes). Future water quality monitoring programs should include and/or expand pesticide monitoring efforts to fill existing data gaps. Moreover, few pesticides have water quality guidelines, and federal and provincial agencies should endeavor to establish those guidelines and refine detection methods in the near future.

5.2.5 Point Source Inputs

Point source inputs include effluents from waste water treatment plants, municipal stormwater outfalls and industry. The types of pollutants primarily include nutrients, solids, pharmaceuticals, metals, salts, hydrocarbons, all of which can have detrimental impacts on the receiving waterbody.

The National Pollution Release Inventory (NPRI) monitors the release of pollutants into the environment at the national level and maintains a current and publically-accessible data base. Under the authority of the *Canadian Environmental Protection Act* (1999), owners or operators of facilities that manufacture, process or otherwise use one or more of the NPRI-listed substances and meet reporting thresholds and other requirements are required to report their pollutant releases, disposals and transfers for recycling annually to the NPRI. This dataset is complete for all subwatersheds, i.e., there are no data gaps, and current as of 2007.

5.3 Water Quantity Indicators

5.3.1 Volume

Water volume is the amount of water flowing past one point over a given time, or in the case of lakes, the total amount of water present in the lake at a given time. This amount varies seasonally and annually with shifts in weather patterns or water diversion endeavors for human, industrial, commercial or agricultural activities.

Waterbody maps were generated using 2001 Canvec 1:50,000 hydrology data. This dataset is complete for all subwatersheds, i.e., there are no data gaps. Water discharge data originated from Alberta Environment and provide historic, average and current year data. Water discharge data are limited by the number of active water discharge monitoring stations in each subwatershed, which varies from 1-5. Occasionally, there are several water monitoring stations along the same water course, while some water courses lack water discharge monitoring stations, which represents a data gap.

5.3.2 Minimum Flows to Maintain Ecological Integrity

Minimum flows to maintain ecological integrity are the lowest flows or volumes (lakes) required to sustain native aquatic species and natural ecosystem functions. Minimum flows must be determined before allocation of water can safely take place to preserve the ecological functionality of aquatic ecosystems.

Minimum flow requirements could not be determined for most water courses in the Red Deer River watershed, which represents a significant data gap. Alberta Environment manages these data but has not computed minimum flow needs for the maintenance of ecological integrity for any tributary of the Red Deer River. These data have been generated only for the Red Deer River mainstem.

5.3.3 Contributing Areas to the Watershed

Contributing areas to the watershed are areas from which runoff flows into the lakes, creeks and rivers of the watershed. These data are used to determine an estimated volume of water contributed to the river on an annual basis.

These data originate from Agriculture and Agri-Food Canada. The data are accurate to 200-400 m and current to 2007. This dataset is complete for all subwatersheds, i.e., there are no data gaps.

5.3.4 Allocations

Surface and groundwater water withdrawal permits for the watershed are quantified by user sector along with information on licenses, consumption and return flows. These data along with water flow data can be used to identify areas of potential future constraints on surface water availability, which may have implications for future development.

Data on surface and groundwater diversion licenses and quantities are provided by Alberta Environment and are current as of 2008. Accompanying locations of license holders have been plotted using the data from Alberta Environment. Location data for license holders are based on the centre of the ¼ section of land where the license is held. It is possible that > 1 license is held in the same ¼ section. The surface and groundwater license datasets are complete for all subwatersheds, i.e., there are no data gaps; however, there are gaps in the data that report on the amount of water allocations actually used by a user and on return flow. These data are generally not provided to Alberta Environment.

5.3.5 Groundwater Recharge/Discharge

Areas where groundwater reserves are recharged or discharges to the surface indicate areas where the groundwater table is close to the surface and the soils are generally more permeable. These areas are at greater risk of becoming negatively impacted from development or agricultural and/or industrial activities.

Groundwater maps have been generated for most counties in Alberta by several consulting companies, including HCL, Stantec, AMEC and WorleyParsons Komex between 1998 and 2008. The accuracy of these data is dependent on the methods used to generate them, i.e., there are no standard protocols to determine the extent of groundwater recharge or discharge areas. Most reports indicate that more detailed studies are required to assess more accurately the extent of groundwater discharge and recharge areas in a given region. While there are no data gaps in these data at the county scale, more detailed studies are lacking and represent data gaps, particular in ecologically sensitive areas.

5.4 Biological Indicators

5.4.1 Wildlife Biodiversity

Changes to the presence and/or abundance of wildlife species can indicate changes in environmental conditions, e.g., a loss of biodiversity can cause an ecosystem to become less stable and more vulnerable to environmental change. A change in diversity may also affect nutrient cycling and/or energy flow through the ecosystem.

The Alberta Biodiversity Monitoring Institute was established in 1997 to monitor the changing state of Alberta's species, habitats, and ecosystems to support natural resource decision-making by providing relevant, timely, and credible scientific knowledge on the state of provincial biodiversity. In spring 2007, the Alberta Biodiversity Monitoring Program became operational. To date, limited sampling locations have been assessed, none of them in the Red Deer River watershed. Given the presence of numerous endangered and threatened species and species of special concern in the Red Deer River watershed, particularly in its eastern regions, it is imperative that biodiversity assessments be completed in future watershed studies. The lack of any biodiversity data represents a major data gap for this watershed.

5.4.2 Fish

Inventories of selected fish populations may show increases or declines through introductions or changes in environmental conditions. Invasive species, if present, will indicate areas of concern requiring future monitoring. Monitoring of fish populations is primarily carried out by Alberta Sustainable Resource Development and the Department of Fisheries and Oceans.

While nine of the 15 subwatersheds have fish population data (James River, Raven River, Little Red Deer River, Medicine River, Blindman River, Buffalo Lake, Threehills Creek, Berry Creek and Matzhiwin Creek), those data generally originated from a limited number of waterbodies (generally only 1-2 streams or lakes). The remaining six subwatersheds, four of which are located in a primarily crop production

oriented region in the Red Deer River watershed (Waskasoo Creek, Kneehills Creek, Michichi Creek and Rosebud River), lack fish population data. Future watershed monitoring programs should include and/or expand fish population monitoring efforts to fill this data gap.

5.4.3 Land Cover

The land cover inventory data originates from Agriculture and Agri-Food Canada's Prairie Farm Rehabilitation Association. These data are accurate to 30 m and current as of 2000. The dataset was created from 1:50,000 LANDSAT imagery. Generally, data gaps range from about 1-6% in the subwatersheds; however, they are substantially larger in the Raven River, Kneehills Creek and Blindman River subwatersheds (14.60, 8.40 and 7.81%, respectively).

5.4.4 Species at Risk

The *Species at Risk Act* (*SARA*) provides legal protection of wildlife species and conservation of biological diversity. The Act aims to prevent Canadian indigenous species, subspecies and distinct populations from becoming extirpated or extinct, to provide for the recovery of endangered or threatened species and encourage the management of other species to prevent them from becoming at risk. Individual species are monitored by provincial government departments, e.g., Alberta Sustainable Resource Development, and/or federal government departments, e.g., the Department of Fisheries and Oceans.

Numerous species protected under the *Species at Risk Act* occur throughout the Red Deer River watershed. There is an increasing gradient of these species from west-east, i.e., from the headwaters of the Red Deer River towards its confluence with the South Saskatchewan River. While this is currently not a data gap, future monitoring of the currently identified endangered and threatened species and species of special concern is required to protect them from extinction or extirpation or a change in their status.

