SOURCE WATER QUALITY PRIMER

Red Deer River Municipal Users Group October 2016

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This report was written by Bill Shaw, FCIP, RPP of BPS Consulting Ltd for the Red Deer River Municipal Users Group.

The cover photograph is the North Raven River, a tributary of the Raven River which is a tributary of the Red Deer River. The restoration and protection of the riparian lands along this famous trout stream is one of Alberta's most successful riparian management programs. It was accomplished through the efforts of the Alberta Government (at the time Fish and Wildlife), Clearwater County and the many cooperating landowners and farmers along the stream.

EXECUTIVE SUMMARY

Maintaining source water quality in the Red Deer River system is an integral part of the Red Deer River Municipal Group's (RDRMUG) strategic goal to secure sufficient water to support sustainable communities.

Source water is any untreated water found in rivers, streams, reservoirs, lakes and aquifers used for the supply of raw water for drinking water systems and for use by industries, irrigators and other water users. (Note: for this report, the terms 'source water' and 'water' are often used interchangeably. The word 'water' includes 'source water' such that 'water quality' entails 'source water quality' and 'water supply' includes 'source water supply'.)

Water is the lifeblood of municipalities. It is vital for municipal sustainability, including economic viability, environmental integrity, social well being and cultural vibrancy. Both rural and urban municipalities have many roles in water management and source water protection.

The Red Deer River watershed has less than a 20% share of water in the South Saskatchewan River basin. Of that portion, water management in Alberta has capped the portion of Red Deer River water that can be licenced at a much smaller percentage than historically licenced for the Bow and Oldman River watersheds. This means that water, and the uses thereof, in the Red Deer River watershed must be diligently managed.

Of the total water allocated for use from the Red Deer River, allocations for municipal use are the second highest single sector at 18%. Only irrigation allocation at 21% is higher. The petroleum sector is third at 14%.

Studies prepared for the Red Deer River Watershed Alliance rated the health of sub-watersheds within the basin. The combination of rating of risk and condition indicators report only 2 of the15 subwatersheds received a rating of "A" (good) - Panther, Alkali. These are at the most upper and lower portions of the watershed. Eight received a rating of "B" (medium) - James, Raven, Little Red Deer, Waskasoo, Threehills, Rosebud, Berry, Matzshiwin, and the remaining five received a rating of "C" (poor) - Medicine, Blindman, Buffalo, Kneehills, Michini) (see Map 5). The main characteristics contributing to poor rating were linear development densities, resource exploration and extraction activities, nutrient concentrations in surface water and land conversion activities.

River water quality has been assessed. Regarding certain contaminants (metals, nutrients, bacteria and pesticides), testing at Highway 2, Nevis Bridge and Morrin Bridge indicate water quality is generally good, while further downstream at Jenner it is only fair. Dissolved oxygen levels are an issue, mostly downstream from Drumheller within the lower reaches of the river. Summer water temperatures are also another issue, especially in slower flowing and shallower portions of the middle to lower reaches of the river.

There are numerous stresses and threats to water quality within the Red Deer River watershed (see Section 7). This section also notes it is important to recognize the relation between water quality and water quantity.

Ensuring drinking water quality is more about water from the treatment plant to the tap. It has much to do with protecting source waters – the water that reaches the treatment plant! Source water protection is the first step in the multi-barrier approach to protecting drinking water. Recognizing this, the Red Deer Municipal Users Group is in the process of preparing a follow-up report to this Source Water Quality Primer. It will essentially be an action report that contains a 'toolkit' which will be comprised of a series of watershed conservation and source water protection tools.

SOURCE WATER QUALITY PRIMER

Prepared for the Red Deer River Municipal Users Group

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Notes:

This report refers to dam^3, being a measure of water volume.
1.0 decameter (dam^3) = 1000 m^3 = 0.811 acre feet.

All photographs by Bill Shaw.

1.0 INTRODUCTION

1.1 Impetus and Framework

Maintaining source water quality in the Red Deer River system is an integral part of the Red Deer River Municipal Group's (RDRMUG) strategic goal to secure sufficient water to support sustainable communities. This strategic desire lines up with that of Albertans, as expressed in the provincial *Water for Life Strategy*, and the Alberta Water Council and the Red Deer River Watershed Alliance (RDRWA).

The Alberta *Water for Life Strategy* addresses both water quality and water quantity issues, as well as environmental concerns. It recognizes that the management and use of water involves not only economic and environmental aspects, but social ones as well. The three goals of the provincial water strategy are:

1. Safe, secure drinking water supply
2. Healthy aquatic ecosystems
3. Reliable, quality water supplies for a sustainable economy.

Recently, the Albert Water Council expressed the importance of source water protection and the need for integrated action to protect source waters, or in more general terms - to protect water quality.

The Red Deer River Watershed Alliance (RDRWA) promotes a healthy watershed to ensure a legacy of ecological integrity and economic sustainability. One of its goals is to promote the use of beneficial practices as an integral part of the integrated management of land and water resources. The RDRWA is in the process of preparing an Integrated Watershed Management Plan (IWMP) for the Red Deer River basin. A primary thrust of this plan is the RDRWA's vision that the IWMP will promote water quality within the watershed to meet, or even better exceed, provincial requirements under government regulations. In terms of water quality management this implies that, at a minimum, 'use protection' will be achieved.

Municipalities represent a core group within the membership of the RDRWA. Meaningful integrated action by the member municipalities of the RDRMUG to address the protection of water quality will serve to significantly assist the preparation of an IWMP for the Red Deer River Watershed. This will be done mindful that the future quality of water is strategically important to the economic, environmental and social sustainability of municipalities throughout the Red Deer River Watershed, and the other municipalities outside the watershed that receive water from the Red Deer River for use within those communities.

1.2 Source Water Definition

Source water is any untreated water found in rivers, streams, reservoirs, lakes and aquifers used for the supply of raw water for drinking water systems and for use by industries, irrigators and other water users.

Note: for this report, the terms 'source water' and 'water' are often used interchangeably. The word 'water' includes 'source water' such that 'water quality' entails 'source water quality' and 'water supply' includes 'source water supply'.

1.3 Importance of Source Water Quality to Municipalities

Alberta's *Water for Life Strategy* states: "In Alberta, our quality of life, and life itself, depends on having a healthy and sustainable water supply for the environment, for our communities and for our economic well being."

The Alberta Urban Municipalities Association (AUMA) recognizes the vital importance of water, both quality and quantity to municipalities in its *Municipal Water Primer and Discussion Paper.* It emphasizes:

> "No water, no municipality. Water is the lifeblood of municipalities. It is essential to all five elements of municipal sustainability:

- Economic viability depends on the availability of water for local residential, commercial and industrial development as well as for large-scale energy projects that fuel the province's economy.
- Environmental integrity is dependent on healthy aquatic ecosystems. Aquatic environments provide a source of potable water, a buffer against extreme weather events, and a home for diverse species.
- Social well being relies on having a safe, secure supply of water for drinking and other basic needs.
- Cultural vibrancy is enhanced by the beauty of healthy aquatic ecosystems and the recreational opportunities they provide.
- Governance is defined and legitimized in part by the ability of municipalities to provide water services to residents safely and efficiently."

These five key elements are significant to all municipalities – both rural and urban.

1,4 Municipal Roles in Source Water Quality

Because water is vital to municipal well being, both the rural and urban municipal associations in Alberta address municipal roles in water management.

The Alberta Association of Municipal Districts and Counties (AAMDC) recognizes the roles of municipalities in water management and protecting water quality. In its Position Statement on Water, the AAMDC notes:

- "Municipalities are responsible for land-use planning and environmental decisions where water bodies or wetlands are factors.
- Municipalities play a role in managing water systems that impact residents, business and industry.
- Municipalities should have equitable opportunity to economic development benefits without being impeded by water access issues.
- Water is a limited resource in high demand by multiple stakeholders including municipalities, industry and the environmental sector. Good communication and coordination is essential to enhancing effective water management practices.
- Effective service delivery requires strong working relationships with the provincial government (e.g. Alberta Water Council), neighbouring municipalities, regional commissions, regulatory bodies and related service providers
- Effective collaboration requires specific roles. Decision makers must acknowledge and work with municipalities in their role as a primary authority regarding local water management. Similarly, municipalities must keep current and comply with the regulatory framework.
- To promote sound environmental stewardship, it is necessary to have coordinated legislation and jurisdiction surrounding the protection of water bodies and the environmentally sensitive areas adjacent to them."

The AUMA points out "One of the most important ways that we can effectively manage our water is to change the way we manage our land. Land use has many impacts on our watersheds, from encroachment of development on riparian areas and wetlands, to creation of impervious surfaces that cause stormwater issues, to environmentally damaging uses that leech contaminants into our groundwater. It is vitally important to combine land use management with watershed management to ensure that both our land and water are protected."

Without doubt, municipalities have key roles to play in protecting water quality. These key roles are:

1. drinking water and wastewater management
2. wetland, riparian land and aquatic habitat protection
3. point source and non-point source pollution management

4. land use planning
5. management of land use impacts, and
6. the promotion of land stewardship.

As such, municipalities – especially when working in concert with each other and other partners – can do much to protect source water quality within a watershed through the land use planning roles and tools provided in the Municipal Government Act (e.g. municipal land use plans, growth strategies and subdivision and development authority).

1.4 Purposes of the Source Water Quality Primer

The Water Primer Report has the following purposes:

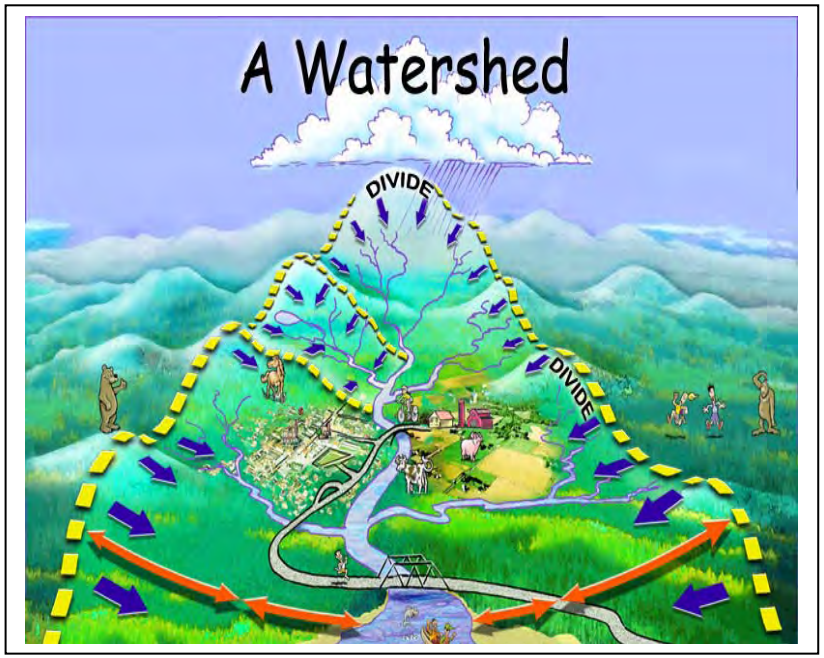
1. emphasize the importance of source water quality to all municipalities within the Red Deer River watershed and those served with water from the Red Deer River
2. provide a range of background information on water availability in the Red Deer River watershed within the context of water availability in Alberta and the South Saskatchewan River basin, including the Red Deer River
3. provide a range of information on the nature of the Red Deer River and its watershed
4. summarize current water quality within the watershed, including influences on water quality and challenges to maintaining (or improving) water quality
5. relate water quality and water quantity
6. provide an overview on basic municipal roles in addressing water quality
7. introduce a follow-up report, being a toolkit to assist municipalities to work individually and collaboratively to maintain, and improve where necessary, source water quality.

This report focuses on flowing surface water (i.e. rivers and streams).

1.5 What is a Watershed?

A watershed is an area of land that feeds all the water running under it and draining off of it into a body of water. It combines with other watersheds to form a network of rivers and streams that progressively drain into larger areas (see Figure 1). Crests of mountains, hills and undulating prairies determine the boundary of a watershed. Topography determines where and how water flows.

Figure 1 A Watershed



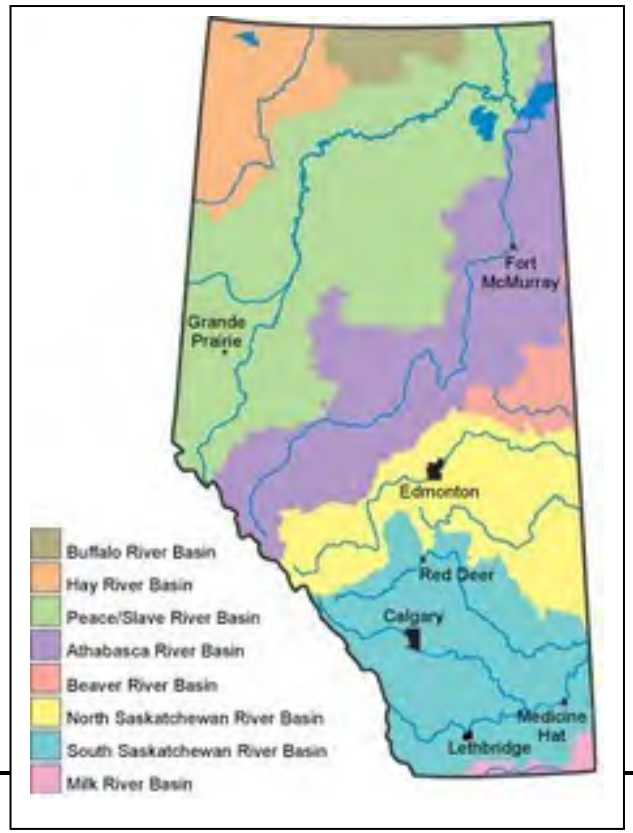
Source: Google images

2.0 WATER AVAILABILITY IN THE RED DEER RIVER WATERSHED

2.1 Alberta Context

The Red Deer River watershed is one of eight major river basins in Alberta (see Figure 2). These rivers form parts of larger river systems that flow out of the province to the south, east and north. The Athabasca, Peace, Beaver and Hay rivers flow north into the Artic Ocean as part of the Mackenzie River system while the Beaver, North Saskatchewan and South Saskatchewan flow east into Hudson Bay as part of the Nelson River system. Only one, the Milk River, eventually flows south into the Caribbean as part of the Mississippi River system.

Figure 2 River Basins in Alberta



Northern Alberta has 86% of the river flow water in Alberta, while southern Albert has only 14% (see Table 1).

Table 1 River Volumes at Outflow from Alberta

Basin	Volume (dam³)	Combined (dam³)	%
Buffalo	1,327,000	109,053,000	86
Hay	3,564,000		
Peace/Slave	81,917,000		
Athabasca	25,809,000		
Beaver	613,000	17,590,000	14
North Saskatchewan	7,555,000		
South Saskatchewan	9,262,000		
Milk	160,000		
		126,643,000	100

Source: Calculated from p.12 Alberta Facts About Water in Alberta
Note: 1.0 decameter (dam³) = 1000 m³ = 0.811 acre feet.

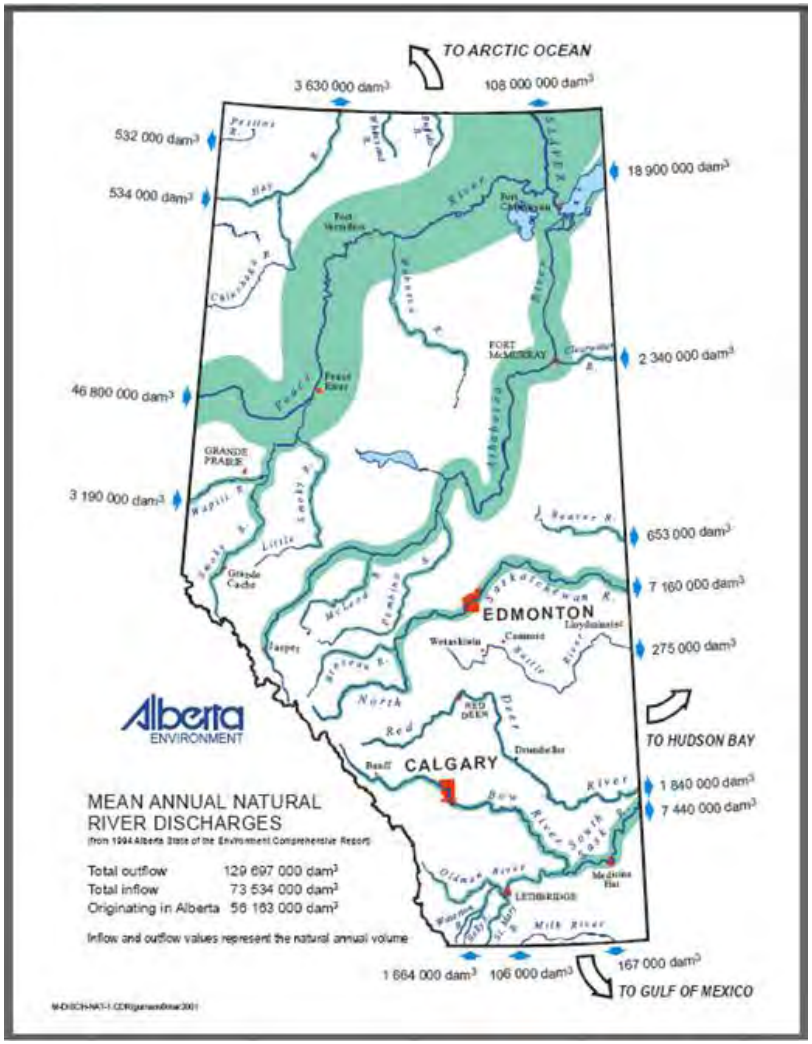
Figure 3 shows the relative sizes of Alberta's major rivers. Clearly, the Peace/Slave and Athabasca systems are demonstrably larger than Alberta's southern rivers.

2.2 South Saskatchewan River Basin Context

The Red Deer River is one of four major watersheds in the South Saskatchewan River basin, the other three being the Bow River, Oldman River and the South Saskatchewan River, which is below the confluence of the Bow and Oldman (see Map 1). The total volume of the South Saskatchewan River system in Alberta is 8,842,000 dam³ (see Table 2; note: this volume is different from Table 1 due to different sources and data years).

The Red Deer River watershed is over 80% larger than each of the Bow and Oldman watersheds (Map 1, Table 2, Figure 4**).** However, the mean flow volume of the Red Deer River is only 43.5% the flow of the Bow River and 49.8% of the Oldman River (Table 2, Figure 5).

Figure 3 River Mean Annual Discharges



Source: Alberta Environment

Map 1 South Saskatchewan River Basin

Both the size of the Red Deer River watershed, with it's widespread population centres, and the lower volume of the river in comparison the smaller southern basins which have much larger rivers, provide significant water management and future water availability challenges.

Table 2 River Volumes in the South Saskatchewan River Basin

Sub-Basin	Size Km²	%	Volume (dam³)	%
Red Deer	46,800	41.5	1,666,000	18.8
Bow	25,300	22.4	3,829,000	43.3
Oldman	27,500	24.4	3,343,000	37.8
South Sask.	13,200	11.7	4,000	00.1
	112,800	100.0	8,842,000	100.00

Source: Alberta, South Saskatchewan River Basin Water Supply Study

2.3 Water Allocations in the South Saskatchewan River Basin

Water availability (for offstream use) is further challenged by the allocation limit set on the Red Deer River in the 2005 South Saskatchewan River Basin Approved Water Management Plan. The water allocation (licence) limit for the Red Deer is 550,000 dam³, or about 33% of the mean volume of 1,666,000 dam³.

The Province considered it necessary to set the low allocation limit for the Red Deer River because: (1) water in the Bow and Oldman systems historically was over-allocated (almost 70% for each system), (2) Alberta needs to pass 50% of the South Saskatchewan River's combined flow (including the Red Deer River) to Saskatchewan, and (3) the instream conservation objectives established in 2005 (see Section 3.3). Once the limit of 550,000 dam³ is met, the Province will review how the river is performing (quality in relation to demand) and may set a higher allocation limit at 600,000 dam³.

2.4 Red Deer River Flows and Variability

Like all rivers, the flow of the Red Deer River is highly variable, from season to season and year to year (see Figure 6). Under natural conditions, about 75% of the median annual flow of the Red Deer River occurs during the summer months.

Figure 4 Basin Area

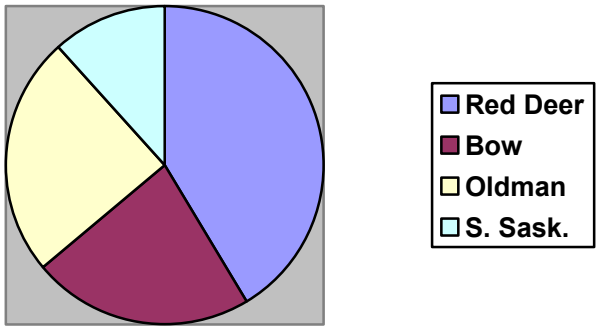


Figure 5 River Volume

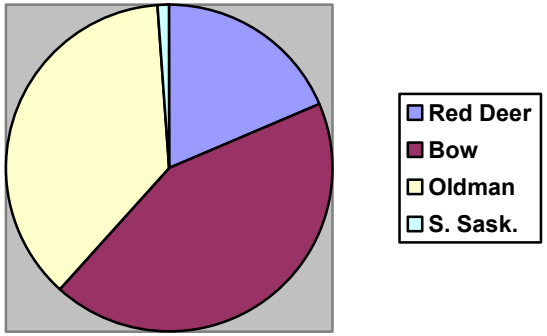
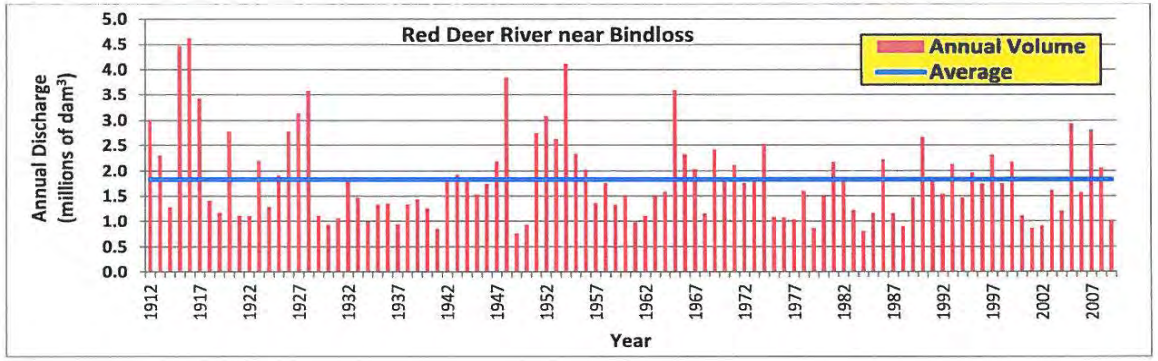


Figure 6 is a hydrograph (flow chart) for the Red Deer River for the years 1912 to 2009. It shows the highly variable annual river flows over the years. While the mean annual flow is about 1,666,000 dam³, the hydrograph shows that floods in the mid 1910s exceeded 4,500,000 dam³ while in a number of years annual flows were around 800,000 dam³.

The chart indicates prolonged droughts with consecutive years of below average flows roughly spanning years 1929 to 1942, 1956 to 1964, and 1975 to 1985. These are the years when water supply and instream flow deficits are likely to occur.

While the hydrograph shows an apparent trend of decreasing flows, care must be taken to not misinterpret this as a trend due to climate change without more detailed analyses.

Figure 6 Red Deer River Hydrograph (1912 – 2009)



3.0 WATER ALLOCATION, USE & CONSERVATION OBJECTIVES

3.1 Water Allocation and Use in Alberta

As reported in Facts About Water in Alberta, in 2009 there was 9,891,606 dam³ of water allocated for use in Alberta. Of this, 97% is from surface water sources and only 3% from groundwater.

A report by Alberta Environment in 2007 indicated of all surface water allocated in Alberta (2007 statistics shown in Table 3) 43% was allocated to irrigation and over 28% to industry, including cooling for power generation. In comparison, the allocation for municipal use was 11%.

However, the use of water is not proportionate to water allocations. By far the largest portion (and amount) of water used is by the irrigation sector at nearly 63% (Table 3) with petroleum being 8%.Of all water used, municipalities accounted for only 4%. For all of Alberta, of the total water allocated (licenced), only 55.4% was used.

When Table 1 and Table 3 are compared, the challenges of managing water in Alberta becomes clearer. While 86% of Alberta's water supply is in the north, the southern half of the province has the irrigation industry, which accounts for 43% of water allocations and 63% of water used. Southern Alberta also has 88% of the province's population.

3.2 South Saskatchewan River Basin Water Allocation and Use

A report titled South Saskatchewan River Basin in Alberta Water Supply Study by the SSRB Water Supply Study Steering Committee provides water allocation information for the basin, using 2005 data.

Of the 5,402,993 dam³ of water allocated, nearly 89% was in the Bow and Oldman sub-basins (see Table 4). The Red Deer basin had just over 6% of the water allocations.

Table 3 Surface Water Allocations and Use in Alberta (2005)

Sector	Allocation	Use	Licence Utilization
Irrigation	43%	62.8%	54.4%
Industry	28%	5.5%	57.9%
Municipal	11%	3.9%	37.5%
Petroleum	8%	7.9%	35.2%
Agriculture	2%	3.1%	64.8%
Commercial	1%	2.0%	100.0%
Other	7%	13.1%	100.0%
	100%	100.0%	55.4%

Source: Alberta Environment Current and Future Water Use in Alberta. March 2007

Table 4 Total Allocation among the four Sub-basins making up the South Saskatchewan River System.

Sub-basin	Allocation (dam³)	%
Red Deer	335,386	6.2
Bow	2,561,345	47.4
Oldman	2,231,326	41.3
South Saskatchewan	274,936	5.1
	Total Allocation	5,402,993 dam³

Source: South Saskatchewan River Basin in Alberta Water Supply Study, 2009

As expected, irrigation use dominates water allocation in the South Saskatchewan River basin (Table 5). The total irrigation allocation across the four basins was 4,095,082 dam³, or 75.8% of water allocated in the South Saskatchewan river basin. This is significantly above total municipal allocations of 778,927 dam³, which comprises only 14.4% of total water allocations. Licences attributed to 'Other', which includes water and habitat management, totaled 297,378 dam³ or 5.5% of all water allocations.

Table 5 Water Allocation by Use in the Four Sub-basins

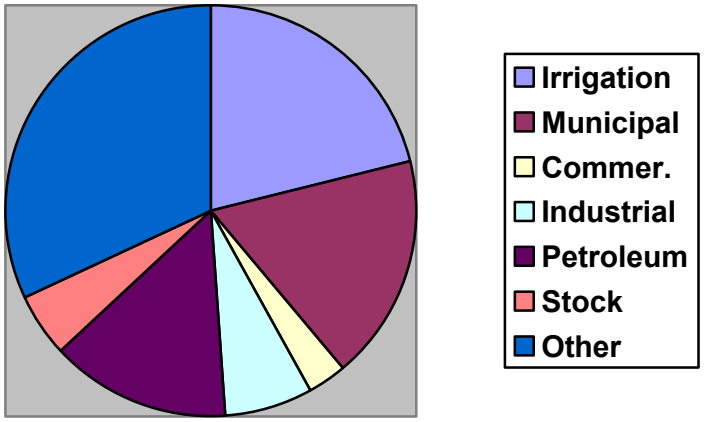
Sector	Red Deer (dam^3)	Bow (dam^3)	Oldman (dam^3)	S. Sask. (dam^3)
Irrigation	70,431 21%	1,997,849 78%	1,963,567 88%	63,235 23%
Municipal	60,369 18%	486,656 19%	66,940 3%	164,962 60%
Commercial	10,062 3%	25,613 1%	1% 22,313	1% 2,749
Industrial	23,477 7%	25,634 1%	----- 0%	16,496 6%
Petroleum	46,954 14%	----- 0%	----- 0%	2% 5,499
Stock	16,769 5%	----- 0%	22,213 1%	13,747 5%
Other	107,324 32%	25,613 1%	156,193 7%	8,248 3%
Total Allocation	335,386 100%	2,561,345 100%	2,231,326 100%	274,936 100%

Source: South Saskatchewan River Basin in Alberta Water Supply Study
Note: total irrigation allocation - 4,095,082 dam^3, or 75.8% of water allocated in the South Saskatchewan river basin.

Although perhaps a surprise to many, within the Red Deer River Basin the irrigation sector has the largest single sector total water allocation. While there is scattered irrigation along the middle portions of the river, there is considerable irrigation within the lower reaches of the river basin. Municipal allocations has the second highest single sector water licence volumes while the petroleum sector is third. The multi-sector 'others' category, which has a number of use sectors including licenses for water management and habitat purposes, accounts for 32% of all allocations.

Figure 7 graphically shows water allocations within the Red Deer River Basin.

Figure 7 Water Allocation by Use in the Red Deer River Basin



3.3 Red Deer River Water Conservation Objectives

The Province has established water conservation objectives (WCOs) for rivers. These objectives require the amount of water to remain in rivers at different times of the year to conserve the quality of the river and its aquatic environment. WCOs are flow targets under the *first-in-time, first-in-right* priority water allocation system and will apply to all new licences and existing licences with a retrofit provision.

The WCOs recommended in the South Saskatchewan River basin's management plan provide direction on how to manage flows in the highly allocated Bow, Oldman and South Saskatchewan River sub-basins and in the Red Deer River sub-basin. The objectives are subject to future review and refinement in light of improved knowledge and information about the aquatic environment and water quality.

The following WCOs for the Red Deer River were established on January 16, 2007, yet appear to be effective as of May 1, 2005.

Red Deer River Water Conservation Objectives

- for the Red Deer River between Dickson Dam and the confluence with the Blindman River:
  - for new licences issued after 1 May 2005 and for existing licences with a retrofit provision, a rate of flow that is 45% of the natural flow or 16.0 m^3/s, whichever is greater;
- for the Red Deer River downstream of the confluence with the Blindman River:
  - for licences issued after 1 May 2005 with withdrawals in November to March, a rate of flow that is 45% of the natural flow or 16.0 m^3/s, whichever is greater;
  - for licences issued after 1 May 2005 that withdraw from April to October inclusive, a rate of flow that is 45% of the natural flow or 10.0 m^3/s, whichever is greater; and,
  - for existing licences with a retrofit provision, a rate of flow that is 45% of the natural flow or 10.0 m^3/s, whichever is greater.
- For the headwater reaches (above Dickson Dam) of the Red Deer River and the tributaries of the Red Deer River, a rate of flow not to be less than the existing instream objective or the WCO downstream of the mainstem, whichever is greater at any point in time, for any applications received or licences issued after May 1, 2005.

There are also retrofit provisions such that water licences issued since February 1997 usually contain a condition that indicates that the licence may be amended to include a WCO once one has been established. For amended licences, the licensee would not be permitted to divert when the river flow is less than the WCO.

To be noted is that the water conservation objectives are a water licence (in the name of the province) and therefore are subject to FITFIR (first-in-time, first-in-right), being the priority system for managing water in Alberta. This means that any water licence approved after May 1, 2005 is junior to the water conservation objectives for the Red Deer River and its tributaries.

During times of shortage, senior water licence holders are entitled to their allocation of water before more junior water licence holders, regardless of purpose, although there are provisions in the Water Act that would allow the Minister of AEP to address issues in an emergency situations.

The Hart report notes between 2005 to 2013 during winter months the recorded flow of the Red Deer River frequently was less than the winter minimum by more than 0.5 m^3/s, as shown in Table 6.

Table 6 Red Deer River recorded flow less than the winter minimum by more than 0.5 m^3/s (percent of days)

	January	February	March	November	December
Red Deer	30%	25%	4%	4%	13%
Drumheller	22%	12%	0%	7%	19%
Bindloss	48%	40%	10%	5%	36%

Source: Hart. Compilation of Responses

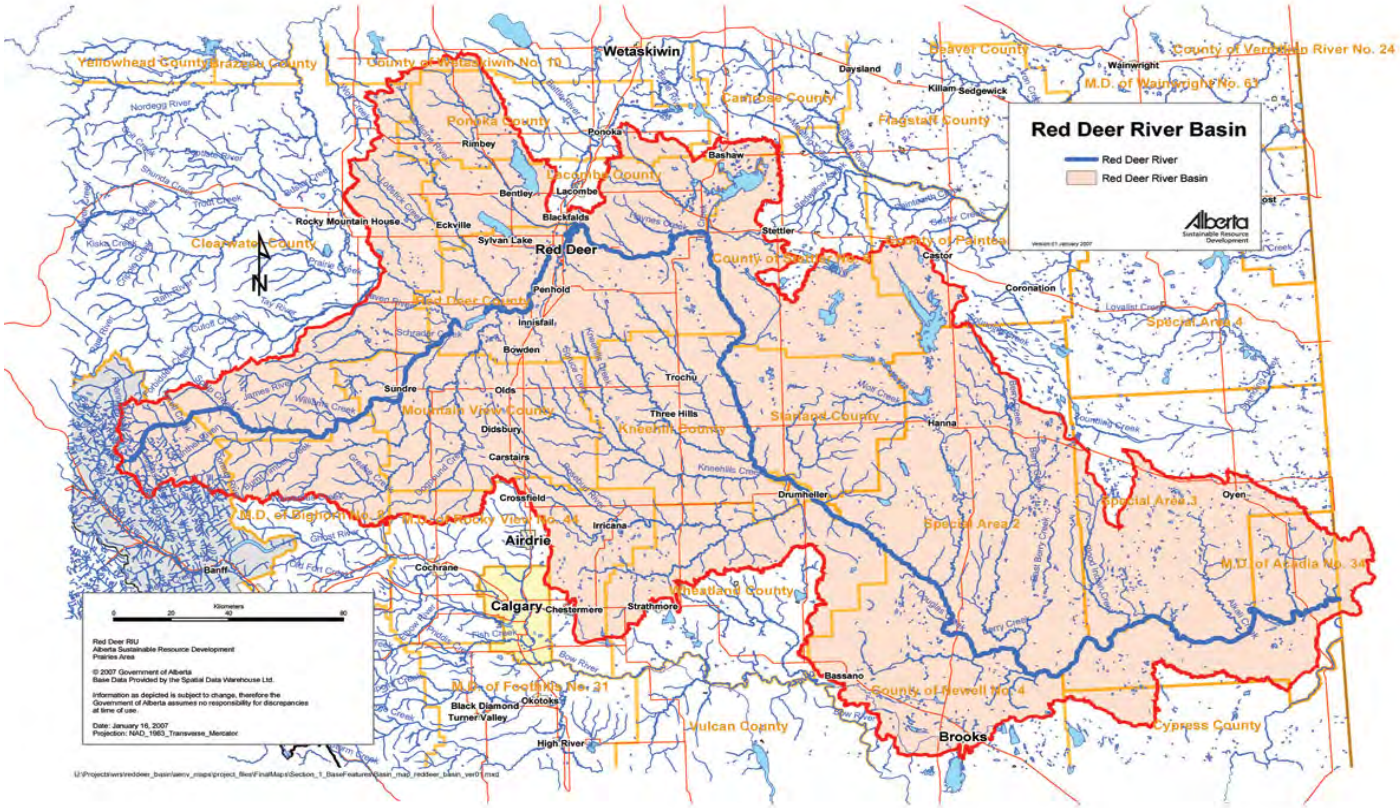
Dickson Dam

4.0 THE RED DEER RIVER WATERSHED

4.1 The Watershed

The Red Deer River watershed encompasses 46,800 km², traversing central Alberta from within Banff National Park to just east of the Saskatchewan border, where it meets the South Saskatchewan River (see Map 2). The river travels 740 km (460 miles) and descends 1,358 m (4,455 ft) in its journey from the Drummond Glacier in Banff National Park to its confluence with the South Saskatchewan River in Saskatchewan.

Map 2 Red Deer River Watershed (Basin)



On Maps 1 and 2 it can be seen that the western portion of the basin is very narrow, unlike the western portions of the Bow and Oldman River basins. Thus, the Red Deer River basin has a very small land base in the high mountains and foothills (see Map 3) where winter snows and summer rains contribute greatly to annual river flow volumes. The much large portion of mountain and high foothill lands in the Bow and Oldman basins accounts for their annual river volumes being more than double the Red Deer's.

4.2 Landscapes

The landscape features within the Red Deer River basin are varied. The western mountains give way to highly rolling foothills, then to undulating plains and the flatter prairie in the eastern portion of the basin. The western mountains approach elevations of 10,000 feet, while the foothills often range between 3,500 and 5,000 feet. A large portion of the central plain has elevations between 2,700 and 3,200 feet. Where the Red Deer River crosses the Saskatchewan border the prairie elevation is about 2,100 feet.

4.3 Natural Regions

Within the Red Deer River watershed there are 5 natural regions, being the Rocky Mountains, Foothills, Boreal Forest, Parkland and Grasslands (see Map 3). The Alberta government adopted the Natural Regions classification to identify representative ecosystem and biodiversity elements of importance to protected areas. The classification system emphasizes overall landscape patterns, which largely reflect climate, yet may be influenced by geological and soil factors.

Within the five major natural regions, there are 12 sub-regions, being:

Rocky Mountain Natural Region
- Alpine
- Sub-alpine

Foothills Natural Region
- Upper Foothills
- Lower Foothills

Boreal Forest Natural Region
- Dry Mixedwood
- Central Mixedwood

Parkland Natural Region
- Central Parkland
- Foothills Parkland

Grassland Natural Region
- Northern Fescue
- Foothills Fescue
- Dry Mixedgrass
- Mixedgrass

Map 3 shows the natural sub-regions within the Red Deer River watershed. Each of these sub-regions contributes differently to the flow of the Red Deer River and its quality. A description of the natural sub-regions can be found in the Red Deer Watershed Alliance 2009 report titled Red Deer River Watershed.

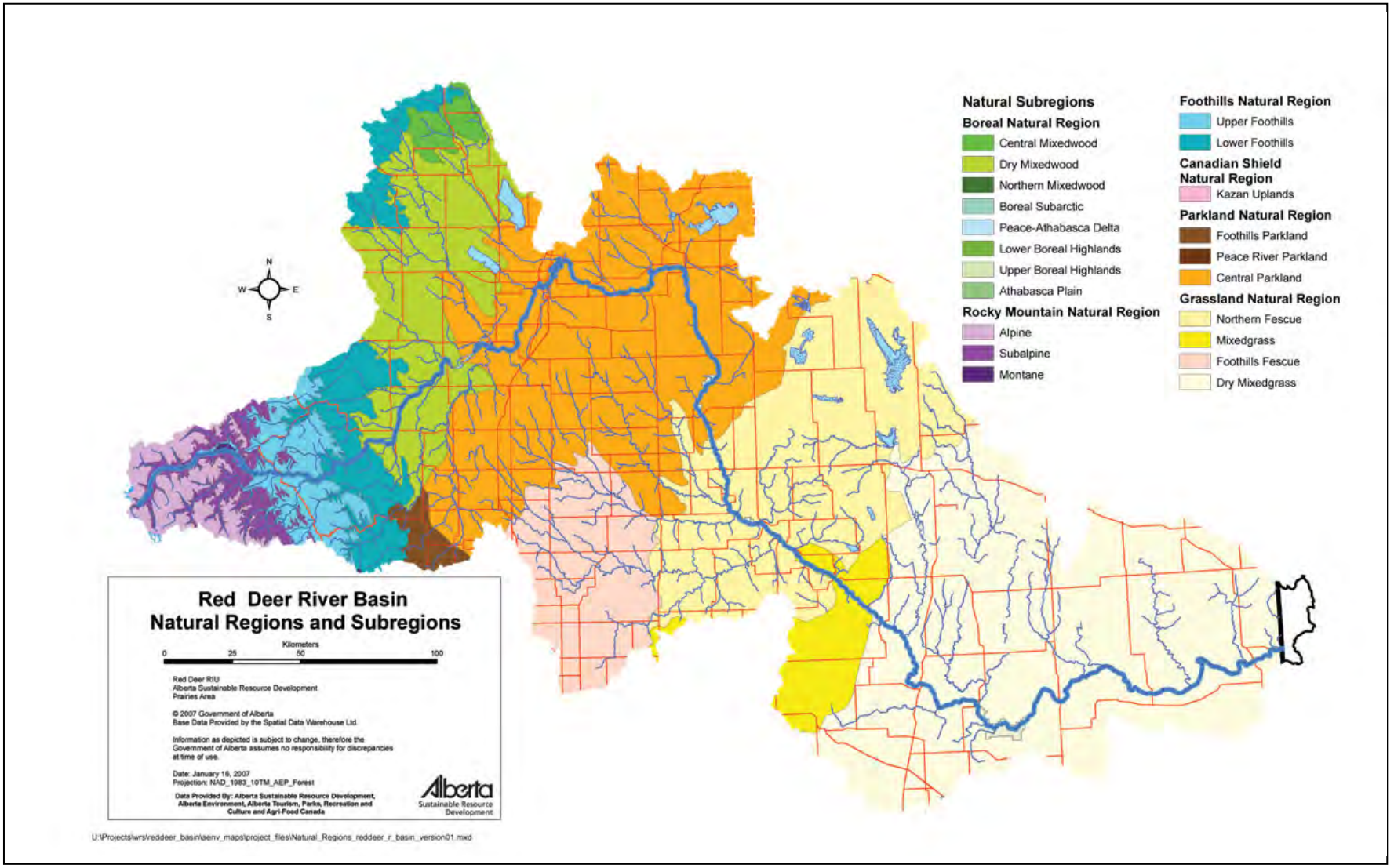
4.4 Population

The Red Deer River watershed is home to over 300,000 people, about one third living in the City of Red Deer. There are 57 urban centres and 17 rural municipalities within the basin, with the population density being highest along the Highway 2 corridor.

The drier eastern portion of the basin is more sparsely settled, as is the western foothills and mountains which is largely Green Area, being areas within the province largely withdrawn from settlement in order to protect the province's forests and source water.

Map 3 Natural Regions

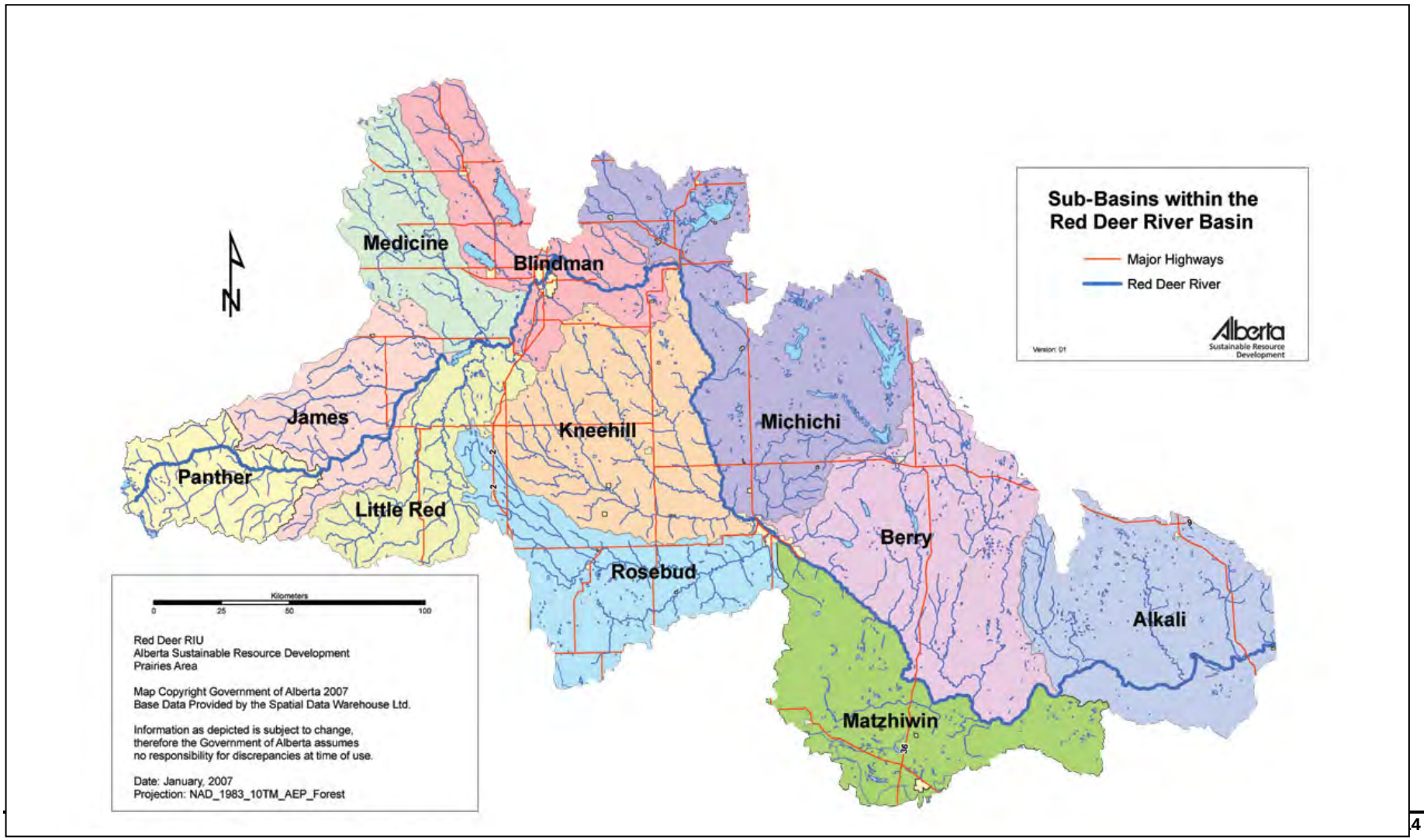
Source: Red Deer Watershed Alliance; Red Deer River Watershed, 2009



5.0 WATERSHED HEALTH

An initial major component of the Red Deer River Watershed Alliance's program to prepare an integrated watershed management plan for the watershed was the publication of a State of the Watershed Report. It provided a map of the sub-watershed of the Red Deer River, with eleven (11) being identified (Map 4).

Map 4 Subwatersheds of the Red Deer River Basin



Recent work by the RDRWA assessed the health of 15 sub-watersheds in the Red Deer River basin (see Map 5). The health evaluations were based on risk and condition indicators. The risk indicators were: wetland loss; riparian health; livestock manure production; urban, rural, agricultural and recreation developments; linear developments; oil and gas activities. Water quality condition indicators were: nutrients; bacteria; parasites; pesticides. Water Quantity condition indicators were: minimum flows to maintain ecological integrity. Biological condition indicators were: wildlife biodiversity; land cover.

The following is a summary of the of the health assessment. "Each subwatershed received an overall risk indicator and condition indicator rating, which together were used to determine an overall rating for each subwatershed. Based on risk indicators, four subwatersheds receive a rating of low (Panther, James, Raven, Little Red Deer), while the remaining eleven received a rating of medium. The four subwatersheds with a low rating are all in the upper reached of the Red Deer in the Rocky Mountains or foothills and are characterized by low population density and accessibility, and consequently low anthropogenic disturbances relative to the subwatersheds in the middle and lower reaches of the Red Deer River.

Consideration of the condition indicators is somewhat more complex, with two watersheds receiving a good rating (Panther and Alkali), eight subwatersheds receiving a fair rating (James, Raven, Little Red Deer, Buffalo, Threehills, Rosebud, Berry, Matzhiwin), and the remaining five subwatersheds receiving a poor rating (Medicine, Blindman, Waskasoo, Kneehills, Michini).

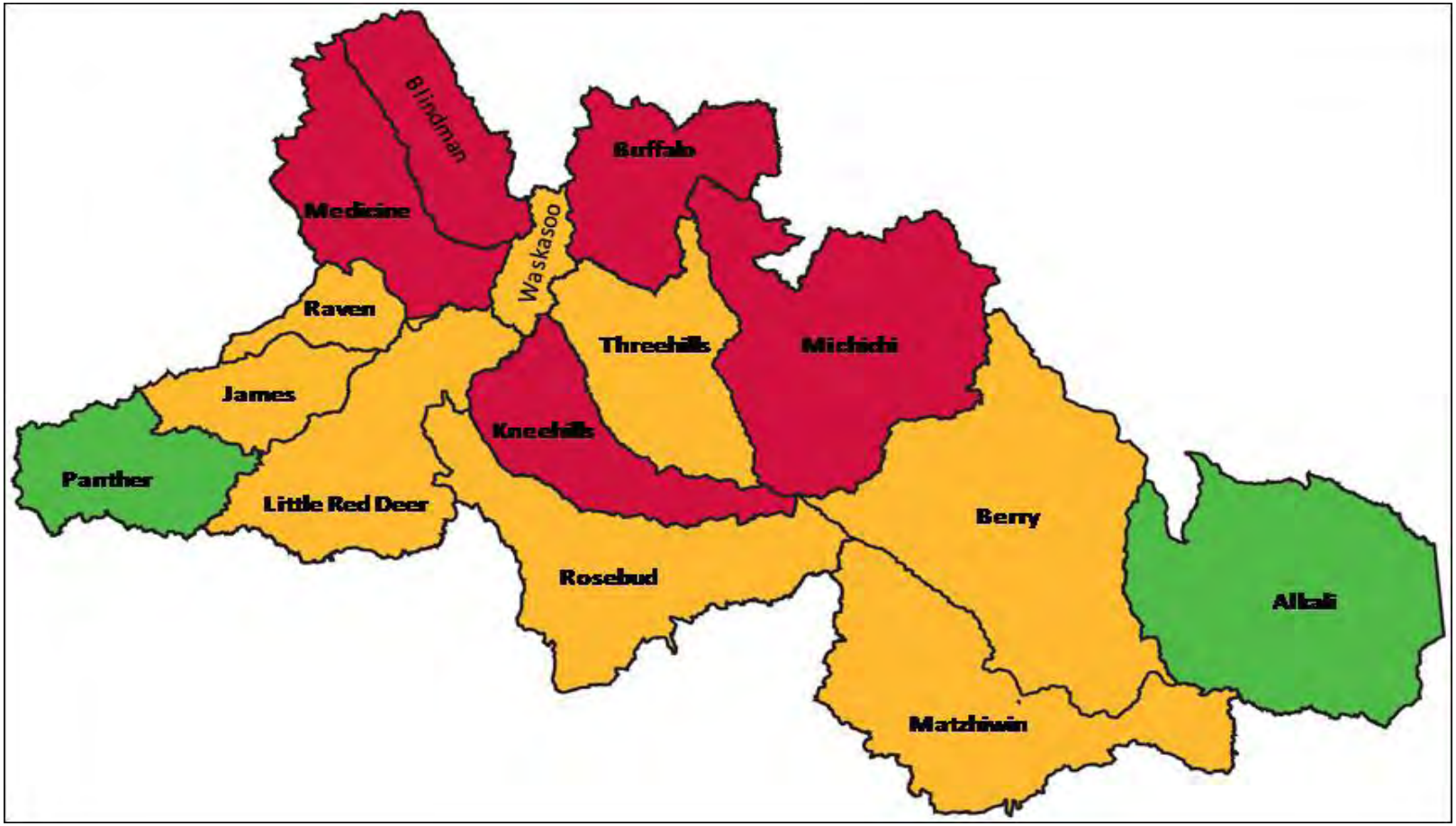
For the combined rating of risk and condition indicators, two subwatersheds received a rating of "A" (good) - Panther, Alkali, eight received a rating of "B" (medium) - James, Raven, Little Red Deer, Waskasoo, Threehills, Rosebud, Berry, Matzshiwin, and the remaining five received a rating of "C" (poor) - Medicine, Blindman, Buffalo, Kneehills, Michini) (see Map 5). The main characteristics contributing to a subwatersheds poor rating were linear development densities, resource exploration and extraction activities, nutrient concentrations in surface water and land conversion activities."

Note: Map 5 shows the combined health rating of the 15 subwatersheds but is the same map for condition indicator ratings.

Much more information on the health of the Red Deer River subwatersheds is available on the Red Deer River Watershed Alliance website (www.rdrwa.ca). The newest reference is the RDRWA's recently produced Blueprint: An Integrate Watershed Management Plan for the Red Deer River Watershed – Phase 1: Water Quality (see especially pages 21 and 38). The contents of Section 5 together with some water quality details in Section 6 indicate that the Red Deer River, and its tributaries, have been impacted by settlement and development. The river also carries some 'natural' occurring 'qualities' from groundwater and melt water sources, such as minerals. River conditions (water quality) are at risk, even more as development continues across the watershed. Demands in the future for more water, and the resultant increase of return flows, are only two examples.

2005 flood proximity to the Red Deer City Wastewater Treatment Facility

Map 5 Subwatersheds Health Assessment



Source: Red Deer River Watershed Alliance. State of the Watershed Report

6.0 WATER QUALITY

Note: the information in this section is taken from: http://aep.alberta.ca/water/reports-data/alberta-river-water-quality-index.aspx

6.1 Description

Alberta Environment and Parks (AEP) monitors surface water quality at many river and lake locations each year. The Alberta River Water Quality Index was developed specifically as a way to summarize physical, chemical and biological data into a simple descriptor of water quality. The Index provides a snapshot of annual water quality conditions in major rivers of the province.

Water quality index values are calculated annually for each site based on data collected monthly or quarterly from April to March. Sites are chosen to represent water quality conditions upstream and downstream of areas of significant human activity.

6.2 Methodology

The Alberta River Water Quality Index is based on the average of four sub-indices calculated annually for four variable groups:

- Bacteria (2 variables measured monthly)
- Metals (up to 22 variables measured quarterly)
- Nutrients (6 variables measured monthly)
- Pesticides (17 variables measured 4 times during open-water season).

Variables in the first three groups are compared to Alberta and federal water quality guidelines. Variables in the fourth group (pesticides) are evaluated based on if they can be detected in a water sample. This conservative approach was adopted because some pesticides do not yet have official guidelines and, unlike metals, nutrients and bacteria, pesticides do not occur naturally in the environment.

Following are the variables used in the River Water Quality Index:

Metals & Ions			
Aluminum	Copper	Molybdenum	Vanadium
Arsenic	Iron	Nickel	Zinc
Beryllium	Lead	Selenium	Cyanide
Boron	Lithium	Silver	Fluoride
Cadmium	Manganese	Thallium	
Cobalt	Mercury	Uranium	
Pesticides			
2,4-D	Picloram	Bromoxynil	Chlorpyrifos
MCPP	Dicamba	Cyanazine	Imazamethabenz
MCPA	Triallate	Malathion	Diuron
Diazinon	Atrazine	Methoxychlor	Dichlorprop
Lindane			
Nutrients & Related Variables			
Dissolved Oxygen	Total Phosphorus	Nitrite-Nitrogen (NO2-N)	
pH	Total Nitrogen	Ammonia Nitrogen	
Bacteria			
Fecal Coliforms	*Escherichia coli*		

The Index formula is based on three aspects of water quality that relate to water quality objectives:

- Scope (F1) - how many variables do not meet objectives?
- Frequency (F2) - how frequently do measurements not meet objectives?
- Amplitude (F3) - by how much do measurements not meet objectives?

6.3 Rating System

Index results are reported as a number between 0 and 100, where 100 represents the best quality, relative to objectives. The numbers are further ranked into five categories:

96 - 100	**Excellent -** Guidelines almost always met; best quality
81 - 95	**Good -** Guidelines occasionally exceeded, but usually by small amounts; threat to quality is minimal
66 - 80	**Fair -** Guidelines sometimes exceeded by moderate amounts; quality occasionally departs from desirable levels
46 - 65	**Marginal -** Guidelines often exceeded, sometimes by large amounts; quality is threatened, often departing from desirable levels
0 - 45	**Poor -** Guidelines almost always exceeded by large amounts; quality is impaired and well below desirable levels; worst quality

Index values are calculated for the four variable groups (metals, nutrients, pesticides and bacteria). These are then averaged, as in the following example, to produce an overall Quality Index:

Metals	Nutrients	Pesticides	Bacteria		Overall Index
83 Good	63 Marginal	76 Fair	42 Poor	=>	66 Fair

Water quality varies naturally from site to site and from year to year. For example, water quality may appear better in drier years, since dry conditions cause less surface runoff and fewer contaminants coming from the land to the river. However, most persistent trends can be linked to human influence.

Any activity that alters water quantity or affects inputs from point sources (e.g., sewage outfalls) or non-point sources (e.g., agricultural runoff) has the potential to influence water quality.

6.4 Red Deer River Ratings

Table 7 shows the index values at four points along the Red Deer River during 2013-14. Conditions do vary from year to year and season to season, often linked with precipitation events. At the upper three points (Highway 2, Nevis Bridge, Morrin Bridge) and on average for the most part the river reaches above those points, river water quality is indexed as good. At the lower point at Jenner the rating is only fair, largely due to high nutrient and especially, bacteria counts.

Table 7 Red Deer River Water Quality (2013-14)

Location	Metals	Nutrients	Bacteria	Pesticides	Average
Highway 2	100	80	100	93	93
Nevis Bridge	100	80	100	88	92
Morrin Bridge	100	80	100	93	93
Jenner	91	76	55	92	73

6.5 Using the Index

Index results are used to evaluate the general quality of river water. River water quality is reported because the effects of human activities are often more evident in rivers than they are in lakes. A number of natural and human factors can influence Index values. These include the volume of river flow, local geology, climatic conditions, the degree of development along rivers, non-point sources of runoff (such as agricultural fields) and point sources of effluent that discharge into rivers. These factors are considered in the protection of water quality and aquatic ecosystems as part of the watershed approach outlined in Alberta's *Water for Life* Strategy.

Over time, the River Water Quality Index should reflect the impact of activities that significantly change water quantity or cause changes in inputs to rivers from either point or non-point sources.

7.0 RED DEER RIVER WATER QUALITY: ISSUES AND STRESSES

7.1 Reported Issues and Stresses

Information Synthesis and Initial Assessment Study

While there are numerous natural and human influences on the quality of the Red Deer River Water, a 2007 AEH Information Synthesis and Initial Assessment Study for Alberta Environment synthesizes a number of key effects in the form of stresses and issues, from which the following is sourced.

For the river reach from the headwaters to Glennifer Lake the report indicates there is 'light' agriculture, forestry and oil and gas operations, including pipeline crossings.

For the Glennifer Lake to Red Deer reach, the noted stresses and issues are: non-point source inputs and relatively small municipal inputs; downstream scouring and erosion caused by Dickson Dam altering hydrology and the thermal regime; extensive livestock and agricultural operations (Medicine, Little Red and Blindman tributaries especially); hydrocarbon exploration and production, soil erosion and wetland reduction.

From Red Deer to Drumheller stresses and issues are: nutrient enrichment from the Red Deer waste water treatment plant; livestock and agriculture non-point sources; petrochemical plant processing facilities; extensive livestock operations; hydrological alterations from Dickson Dam. From Drumheller to the Saskatchewan border, the listed stresses and issues are: Drumheller waste water treatment plant; irrigation return flows from the Bow basin; extensive livestock operations; hydrological alterations from Dickson Dam; oil and gas operations and pipelines.

Major rain events and snowmelt contribute to increased sediment loads in the river, especially in the valley downstream from Content Bridge. The erosion from flood events also pose issues for water quality.

Dissolved oxygen levels are another issue, mostly downstream from Drumheller within the lower reaches of the river. Summer water temperatures are also another issue, especially in slower flowing and shallower portions of the middle to lower reaches of the river.

The South Saskatchewan River Basin in Alberta Water Supply Study

The South Saskatchewan River Basin in Alberta Water Supply Study provides some more specific information of the Red Deer River watershed issues and stresses, as summarized below.

Agriculture is the dominant land use throughout the basin, with the exception of the upper reaches in the mountain and foothills regions. As such, nutrients are an issue, particularly in wet years. Point source discharges in the sub-basin include municipal effluents and industrial releases. Municipal effluents are also a large source of nutrients, and there are two large municipal wastewater treatment plants in the basin at Red Deer and at Drumheller. The petrochemical plants at Prentiss and Joffre also contribute to the nutrient load of the river.

Summer water temperatures frequently reach 24°C and can approach 27°C, occasionally exceeding the tolerance of mountain whitefish. Dissolved oxygen levels can at times fall dangerously low during the winter months, particularly during ice cover. Dickson Dam operations are designed to address this problem by sustaining winter flows.

Riparian health of the Red Deer River is rated as 'healthy' in its upper reaches but rated 'healthy with problems' for most reaches further downstream. Bank alterations due to livestock and recreation, the often widespread occurrence of invasive plant species, and flow alterations by Dickson Dam are all issues affecting riparian health in this sub-basin.

7.2 Water Quantity and Water Quality

It is important to recognize the relation between water quality and water quantity. Alberta Environment and Parks in its Surface Water Quality webpage reports "The quantity of water also affects quality. Major rains and high-flow events typically wash sediment, nutrients, pesticides, bacteria and other substances off the land and into rivers, thereby lowering water quality. Conversely, the less water there is, the lower the capacity of a waterbody to dilute and assimilate wastes. Climate change, groundwater supply (and quality) and increased consumptive demands may therefore affect water quality in the future. These factors could also influence the timing of river flows, which could impact the suitability of habitat for aquatic life."

In the Red Deer River watershed three of the common events of water quantity impacting water quality of water quantity are: floods and the resulting erosion creating high amounts of sediments and pollutants, major rainfall events which carry urban stormwater and agricultural run-off into the river, and low flows (both late summer and winter) whereby river water conservation objectives are not met.

7.3 Stresses and Threats to Water Quality

There are numerous actions, both natural and human induced, that can threaten short term and long term water quality in the Red Deer River watershed. These include, but are not limited to:

1. Climate change
2. Development encroachment on sensitive lands
3. Drought
4. Erosion
5. Farm run-off (manure, crop spray residue)
6. Floods
7. Flood plain development
8. Forestry operations
9. Fuel handling and storage
10. Heavy metals
11. Impact on recharge areas
12. Impervious surfaces
13. Indiscriminant off-road vehicle activity
14. Industrial development/ Oil and gas operations
15. Irrigation return flow
16. Linear infrastructure (roads, pipelines, power lines, etc.)
17. Loss of natural cover
18. Pesticides (urban applications)
19. Pharmaceutical discards
20. Pipeline breaks/spills
21. Population growth - urban and rural
22. Riparian area loss
23. Rural non-farm development
24. Road salt
25. Sand and gravel operations
26. Sedimentation
27. Snow storage
28. Urban development
29. Wastewater and stormwater returns
30. Waste disposal
31. Watercourse crossings (esp. those poorly designed)
32. Wetland drainage/alteration.

Red Deer River flood 2005

8.0 WATER GOVERNANCE

8.1 The Three Levels of Government

Note: This Section is largely borrowed form the AUMA Water Primer and Discussion Paper as adapted from the North Saskatchewan River Watershed Alliance *Municipal Guide: Planning for a Healthy and Sustainable North Saskatchewan River Watershed.*

Each of the three levels of government – federal, provincial and local, have roles to play in the management and use of water, including protecting water sources and water quality (Table 8).

Table 8 Government Responsibilities

Jurisdiction	Water related Responsibilities	Major Acts and Policies
Federal Government	Federal responsibilities relate to matters of significant national economic importance and provincial and international transboundary matters. Responsibilities include: ▪ Fisheries ▪ Navigation ▪ Water on federal Lands (e.g. National Parks, aboriginal reserves and territories) ▪ International relations (i.e. boundary waters with the US) ▪ National policies and standards re: environmental and health related issues	Canada Water Act: contains provisions for formal consultations and agreements with provinces International River Improvements Act: provides for licencing of activities that may alter the flow of rivers from and into the United States (e.g. Milk River) Department of Environment Act: assignment of national leadership for water management to the Minister of Environment Canadian Environmental Protection Act: regulates many substances having deleterious impacts on water quality Fisheries Act: applies to fishing zones, territorial seas and inland water
Provincial Government	Provincial responsibilities lie primarily in the management of water resources (surface and groundwater). Responsibilities include: ▪ Water flow regulation ▪ Authorization of water use development ▪ Pollution control ▪ Power development (hydro and thermal) ▪ Management of natural resources ▪ Management and sale of public lands, including timber ▪ Penalties for violating provincial laws	Water Act: supports and promotes the conservation and management of water, including the wise allocation and use of water to sustain the environment and quality of life. Regulates all development and activities that may affect rivers, stream, lakes, wetlands and aquifers Environmental Protection and Enhancement Act: outlines an integrated approach to protect land, air and water, aiming to address potential problems before development is approved while requiring activities to be monitored based on environmental standards Public Health Act: provides for the protection of public health, including the protection of potable water supplies Safety Codes Act: sets out a variety of codes and standards, including for plumbing, private sewage systems, boilers.

Municipal Government	Municipal responsibilities focus on the day-to-day operation and management of water and wastewater infrastructure, and the management of land uses which can greatly affect water availability and quality. Responsibilities include: ▪ Development, operation and maintenance of water and wastewater systems ▪ Responsible for water bodies within the community (management greatly affected by the Water Act) ▪ Implement land use planning tools to reduce the impacts of development on water, riparian systems and aquatic habitat	Municipal Government Act: sets out that the purpose of a municipality is "to provide services, facilities and other things . . . necessary or desirable for all or parts of a municipality" and "to develop and maintain safe and viable municipalities". Treatment and distribution of water and wastewater has become core municipal services. It provides guidance for public utilities and water commissions. It also gives municipalities responsibility for bodies of water, including rivers, steams, lakes and wetlands, including to protect drainage courses, flood plains and land abutting water courses in order to prevent pollution. Alberta Land Stewardship Act: provides a means to plan for a future that balances economic, environmental and social objectives and enables sustainable development by responding to the cumulative effects of development. It enables the Land Use Framework and regional plans to be based on watersheds.

Much more detail on the federal, provincial and municipal responsibilities may be read in the RDRWA State of the Watershed and the NSWA Municipal Guide: Planning for a Healthy and Sustainable North Saskatchewan River Watershed.

8.2 Water Management in Alberta

Note: Information in Section 8.2 to 8.4 is taken from Alberta Government *Facts About Water in Alberta*. To learn more visit: www.environment.alberta.ca/01233.html

"For over 100 years, Albertans have withdrawn water from Alberta's rivers, lakes, and aquifers for a variety of human purposes. The province has had the responsibility for allocating water resources since the Natural Resources Transfer Agreement was passed in 1930, transferring federal control to provincial control. The Water Resources Act governed water management for close to 70 years (1931-1999) although several amendments were made over that time. In 1991, Alberta Environment reviewed the existing water policy and legislation in Alberta. Water legislation in other jurisdictions (e.g., Australia, United States) was also reviewed to identify alternative tools that might be applied in the Alberta context. Following this comprehensive review the Water Act was proclaimed in January, 1999.

The Water Act supports and promotes the conservation and management of water, including the wise allocation and use of water. It also recognizes the need for planning and enforcement components to achieve those desired outcomes expressed by Albertans. Albertan's views, and the corresponding legislation, have shifted from being mostly focused on allocation of water, to a planning approach with a goal of living within our means. Within each watershed, a limited amount of water can be withdrawn while still maintaining a healthy aquatic ecosystem.

Growth pressures coupled with our increased knowledge of what is needed to maintain healthy aquatic ecosystems, has created the need to renew how we use and allocate this renewable, but scarce resource. The current water allocation management system establishes priority based on 'first in time, first in right,' providing some certainty for users that invested in water licences in the past. During times of shortage, senior water licence holders are entitled to their allocation of water before more junior water licence holders, regardless of purpose. However, there are provisions in the Water Act that allow the Minister of Environment

to address issues in an emergency. The Water Act also provides a statutory top priority right to water use for household purposes that meet certain criteria, over all other water uses.

Before a water licence is issued to divert and use surface or groundwater, Alberta Environment considers:

- the water source;
- location of the diversion site; volume, rate, and timing of the water to be diverted;
- priority of the water right established by the licence;
- purpose (specified use) of the water;
- any conditions the diversion must adhere to;
- natural water supply;
- needs of the environment;
- existing licences; and
- apportionment agreements.

If the water licence application is approved, the applicant is granted a licence for a specific water allocation (amount, time of diversion, rate, and location). Note: Licences to divert water are not required for statutory household use, traditional agriculture use, fire-fighting, wells equipped with hand pumps, alternate watering systems that use surface water for grazing livestock, and some types of dugouts.

The Water Act allows agricultural water users who used water prior to January 1, 1999 and filed a registration prior to 2003 (to raise animals and to apply pesticides to crops), to register their water use, and to receive a priority number dating back to the time of first use. This registration process provided a fair mechanism of protecting traditional agriculture water uses."

8.3 Water Management Plans

Water management plans provide broad guidance for water management, set out clear directions regarding how water should be managed and specific actions. The planning process addresses multiple issues, involves stakeholders, and produces resource management recommendations. The results of planning must be consistent with the Water Act and other legislation, regulations, and policies.

Regarding water management plans, the Water Act includes provisions for:

- A Director under the Water Act to: create, authorize, and approve water management plans;.
- The Minister of Environment to: request that a water management plan be developed by the Director.
- The Lieutenant Governor in Council (Cabinet) to: approve a water management plan.

8.4 South Saskatchewan River Basin Water Management Plan

In August 2006, the Government of Alberta approved the water management plan for the South Saskatchewan River Basin. This plan sets water conservation objectives for the major rivers within the basin and provides a long-term vision for water management in southern Alberta. Approval of the plan was a monumental decision, as the Government of Alberta no longer accepts applications for new surface water licences for the Bow, Oldman, or South Saskatchewan sub-basins. This decision balances the needs of the environment with the needs of existing licence holders and obligations to downstream jurisdictions. In the South Saskatchewan River Basin, a new era of water management has begun in which water must be managed more carefully, given the significant pressures within the basin.

8.5 Closed and Open Systems

As the Bow and Oldman rivers are now closed, the Red Deer River system is the only river where new licences may be approved. However, for all rivers in the South Saskatchewan system, water from licence may be transferred to an applicant as a new licence.

9.0 SOURCE WATER PROTECTION

9.1 Definitions

Perhaps most often when thinking about water quality, people think of drinking water – the water we get from a tap. However, the quality of source water is a very important component in the quality of drinking water. The quality of source water impacts the cost of treating water so its meets drinking water health standards Source water quality influences the effectiveness and process costs of industries, irrigators and other major water users. As well, source water quality is vital to healthy ecosystems, including of course aquatic life and systems.

Source water is any untreated water found in rivers, streams, reservoirs, lakes and aquifers used for the supply of raw water for drinking water systems and for use by industries, irrigators and other water users.

Source water protection planning is a site-specific or area wide process designed to maintain or improve the conditions of water sources through a proactive actions. A multi-barrier approach is most common.

9.2 Source Water Protection Planning

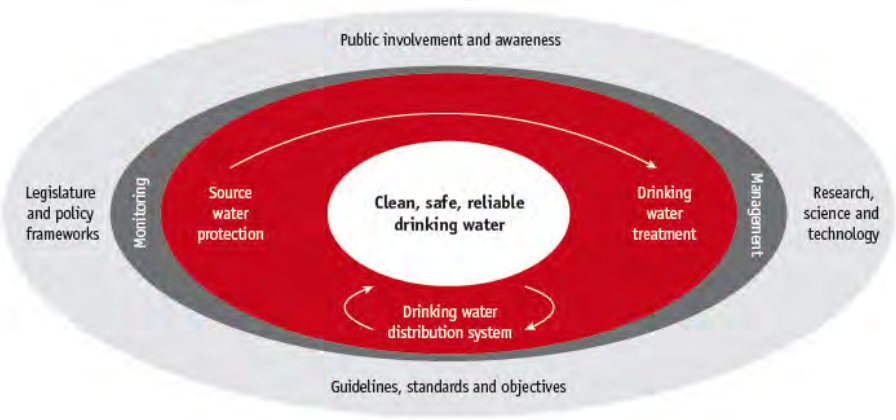
Ensuring drinking water quality is more than about water from the treatment plant to the tap. It has much to do with protecting source waters – the water that reaches the treatment plant.

In its DRAFT Guide to Source Water Protection Planning in the South Saskatchewan Region (Alberta), Alberta Environment and Parks writes: "Source water protection plans vary widely in their details, but their foundational elements are relatively consistent. Source water protection plans are commonly focused on ensuring safe, secure drinking water supplies and may be included as a component of a watershed management planning process. Although the protection of drinking water quality is the main focus . . . it is important to consider both the quality and quantity of water needed for consumption and a variety of other human uses, as well as for maintaining ecosystem health. Headwaters protection is an important consideration in this process."

The multi-barrier approach is an integrated system of procedures, processes and tools that collectively prevent or reduce the contamination of drinking water from source to tap in order to reduce risks to public health. Source water protection is the first step in the multi-barrier approach to ensuring safe, secure drinking water (see Figure 8).

Figure 8 Multi-barrier approach to Drinking Water Safety (1)

Figure 9 Multi-barrier approach to Drinking Water Safety (2)



Source: phac-aspc.gc.ca

Figure 9 shows the need to integrate four key components in the multi-barrier approach for source water protection and drinking water safety: (1) research, science and technology; (2) legislation and policy frameworks; (3) guidelines, standards and objectives; and (4) public involvement and awareness.

Source water protection planning has much to offer to protect the quality of water in rivers, lakes, wetlands and aquifers. The legislative framework for source water protection is shown in Table 9. It involves provincial, regional (including multi-municipal) and municipal levels of interest. It does not show that a considerable portion of the 'action' is at the local (sub-municipal) level.

Table 9 Source Water Protection Legislative Framework

Scale	Legislation	Policy
Provincial	Acts and regulations (e.g. Water Act, EPEA, ALSA)	Policies and strategies (e.g. Water For Life)
Regional	Regional Plans and frameworks	Guidelines and standards
Watershed	Water Management Plans	Watershed management plans
Multi-Municipal	Intermunicipal Development Plans	Source water protection plans
Municipal	Municipal Development Plans	Drinking water safety plans

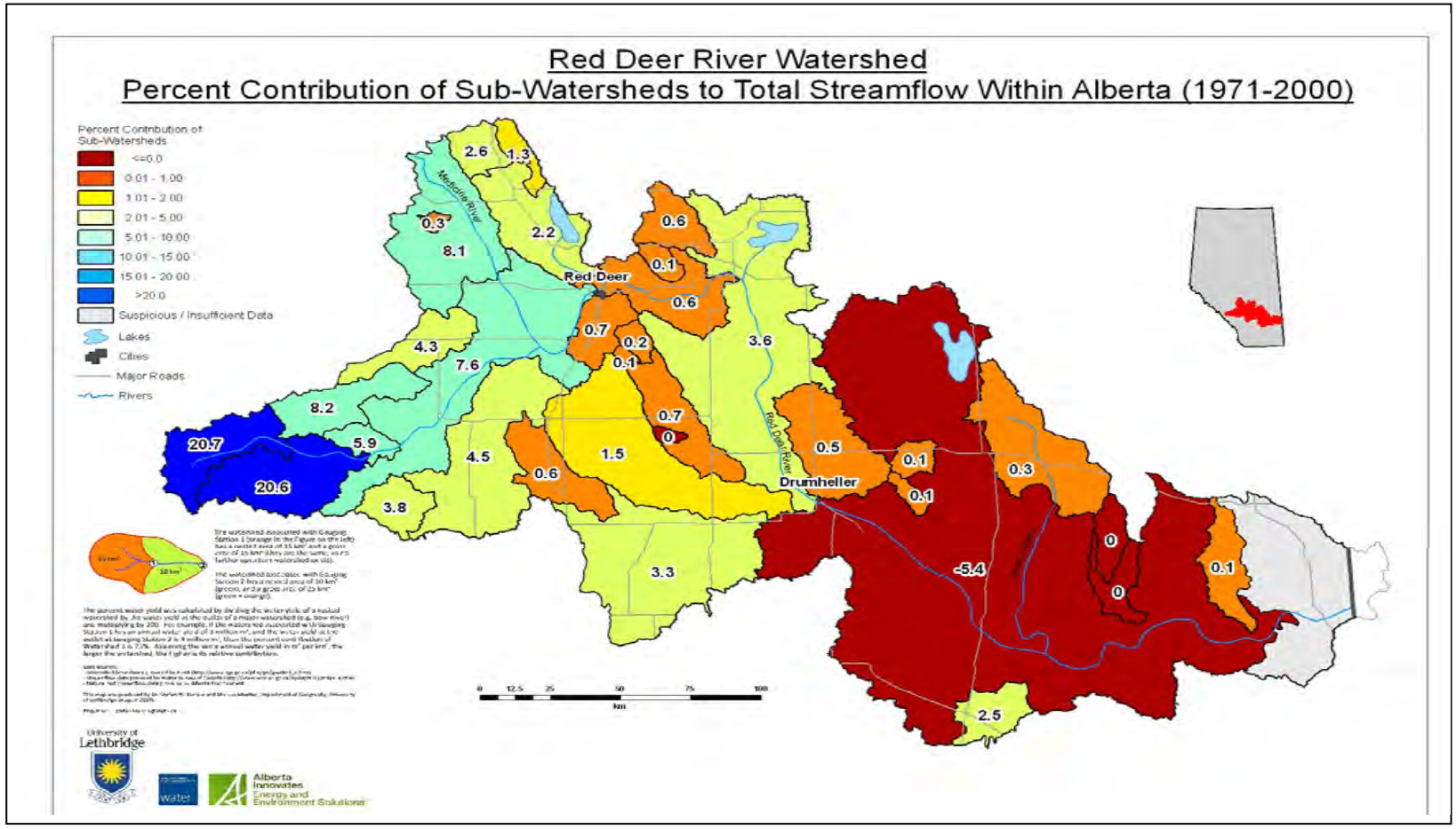
Source: adapted from Alberta Environment and Parks. 2015. DRAFT Guide to Source Water Protection Planning in the South Saskatchewan Region.

9.3 Sources of Water in the Red Deer River Watershed

Various portions of the Red Deer River watershed contribute significant differences to the flow of the Red Deer River. Map 6 shows the great range of contributions to the river by sub-watersheds.

The two upstream alpine areas, being the headwaters of the Red Deer River itself and a number of mountain tributaries, contribute 41.3%. At the Blindman River confluence with the Red Deer river, the contribution of the watershed to the flow of the Red Deer River is about 90%. Thus, the drier eastern half of the watershed contributes less than 10% of the flow of the Red Deer River.

Map 6 Sub-Watershed Contributions to Total Red Deer Streamflow



10.0 KEY NEEDS

10.1 Water Literacy

Our ability to use water prudently and to manage water for the combined beneficial interests of the economic, environmental and social needs of the people and communities (both natural and human) of the Red Deer River watershed can be greatly enhanced by an improved understanding of the many aspects of water.

The Alliance for Water Education provides fundamental definition for water literacy: "Water literacy means knowing where your water comes from and how you use it."

We too often think the use of water is to drink, wash clothes and dishes, to bathe in and flush the toilet and to water the lawn and garden. But the use of water is much more than that. The Alliance notes: "It's (water literacy) a simple concept but information about how all your water is supplied can be very complex. First, bringing water to you is not just delivering flow to the tap and toilet. Every item in your house required water to be created, so you are surrounded by their embedded water cost. Food, clothes, furniture, electronics – everything costs water to produce."

"Being water literate means having a basic understanding of:

- Groundwater and healthy watersheds - integrated water cycles with human demand as part of the system; groundwater recharge and consequences of overdrafting; up-to-date research on contaminants and how they travel through the water supply.
- Infrastructure: how we move and control surface water, process waste water.
- The energy-water connection.
- Water, health and sanitation.
- Water footprints and how to calculate them.
- Virtual water – the embedded water footprint of imported products and food. How water travels around the world to meet demand."

The Alliance for Water Education emphasizes: "Supplies of clean water define a society's priorities" and further states "Your supply of fresh water is going to decide your future. It will influence the jobs you will have, the food you eat, the products you buy, whether you might catch a disease and even whether there's electricity for this computer."

In support, the Alliance for Water Education quotes the World Business Council for Sustainable Development (WBCSD):

> "Everyone understands that water is essential to life. But many are only just now beginning to grasp how essential it is to everything in life – food, energy, transportation, nature, leisure, identity, culture, social norms, and virtually all the products used on a daily basis."

The importance of water literacy has been noted and is being acted on in Alberta. Through its water conversations in 2013, the Provincial Government heard that water literacy in Alberta needs to be improved. The Alberta Water Council noted "in the recently conducted GoA-led water conversation, Albertans identified the need to raise water literacy levels to allow them to contribute meaningfully to water management issues and to build capacity for water stewardship." (Alberta Water Council: Alberta Literacy Project Team Terms of Reference).

In 2014, the Alberta Water Council formed a Water Literacy Project Team which has the following objectives:

- Improve understanding of existing organizations with water literacy programs, products, assessments or research in Alberta, and/or similar resources available to Albertans from other jurisdictions.

- Improve understanding of successful approaches or best practices to assessing and enhancing water literacy.
- Development of a tool and an assessed a sample of Albertans' water literacy
- Recommendations on improving water literacy in Alberta.

The final report of the Project Team was printed in July 2016. A conclusion is: "If the goal is for Albertans to develop skills and take more action to protect and conserve water resources, practitioners need to design and deliver programs that focus on filling gaps in water topics, building skills and encouraging collective action. To improve water literacy efforts, practitioners should increase collaboration; develop and share tools and knowledge for program assessment; and better align topics, audiences, delivery areas and methods. Moreover, strengthening practitioner capacity and assessing water literacy among Albertans can enhance program planning, design and delivery efforts."

The Red Deer River Watershed Alliance, being the watershed planning and advisor to the Alberta Government, notably understands the importance of water literacy.

In the Alliance's recently produced Blueprint: An Integrate Watershed Management Plan for the Red Deer River Watershed – Phase 1: Water Quality, water literacy and participation is the core of the plan's first recommendation, being "Improve the understanding and strengthen the commitment of watershed users to protect water quality."

As reflected in the purposes of this Source Water Quality Primer (section 1.4), a key intention of the member municipalities of the Red Deer River Municipal Users Group is that this report meaningfully contributes to improved water literacy within the Red Deer River watershed, for municipalities and their constituent residents and businesses.

10.2 SOURCE WATER PROTECTION

As noted in Section 9 of this Primer, source water protection planning is a site-specific or area wide process designed to maintain or improve the conditions of water sources through a proactive actions. The condition of water sources (i.e. both the aquifers and the many landscapes and features in the watershed and how they are used and impacted) significantly affects the quality of source water that enters municipal water treatment systems.

Within the Red Deer River watershed, municipalities have not been idle regarding the management of watershed areas. A number of essential municipal roles of municipalities are fundamentally related to watershed management. These include, but certainly are not limited to:

- Wastewater treatment systems (municipal and regional) that meet provincial standards for return flows
- Stormwater systems that are being improved to reduce the impact of runoff into rivers and streams
- Rainwater harvesting, which is being encouraged by many municipalities for the on-site use of rainwater (e.g. gardens) thus reducing flows into stormwater systems and the use of municipal water
- Snow removal storage areas designed to capture pollutants (for safe disposal) during snow melt so the pollutants do not reach rivers and other water bodies.

Municipalities within the watershed also have undertaken many other programs regarding watershed management. Some of these include:

- Land stewardship e.g. Red Deer County – Alternative Land Use Services (ALUS) and Green Acreages; Mountain View County – Riparian and Ecological Enhancement Program; Clearwater County – Welcome to Our Back Yard; Special Areas – Minimal Disturbance

on Native Range Lands; County of Newell – on farm water management program

- Environmental plans e.g. Lacombe County Environmental Master Plan; Town of Olds Strategic Sustainability Plan
- Water Conservation e.g. City of Red Deer Water Conservation, Efficiency and Productivity Plan
- and studies (CEP, Environment)
- Municipal Development Plans (many communities) that address the conservation of sensitive environmental features and the appropriate use of land therein and nearby
- Assisting the formation and operation of the RDRWA, including membership on the Board of Directors.

There are many beneficial watershed and source water protection management practices remaining to be learned by communities within the Red Deer River watershed from elsewhere in Alberta, other Canadian provinces, other places in North America and around the world. Of course, learning is the first step – the application of learned beneficial practices is the second key step, followed by monitoring.

Recognizing this, the Red Deer Municipal Users Group is in the process of preparing a follow-up report to this Source Water Quality Primer report. It will essentially be an action report that contains a 'toolkit' comprised of a series of watershed conservation and source water protection tools. It will also identify some key actions that are seen to be needed within the watershed, by municipalities individually, by municipalities jointly and by municipalities with other levels of governments and groups having watershed interests. This may form the genesis of a source water protection plan for the Red Deer River watershed as part of the forthcoming parts of the RDRWA Watershed Management Plan. Importantly, a source water protection action plan is a significant step in the quest by the members of the Red Deer River Municipal Users Group to secure water for municipalities, both those within the watershed and those outside the watershed being served from the Red Deer River, to support far into the future sustainable communities.

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