CHAPTER 6: OLDMAN RIVER MAINSTEM

Elizabeth Hall Wetland – R. Coffey

Chapter 6: Oldman River Mainstem

The mainstem of the Oldman River (Figure 6.1) extends about 330 km from its mountainous headwaters near the continental divide to its confluence with the Bow River in the Prairie grasslands where the two rivers combine to form the South Saskatchewan River. The Oldman River contributes about 48% of the flow of the South Saskatchewan River at Medicine Hat. There are many tributaries, large and small which contribute to the Oldman River and which are addressed separately in other sections – this section deals specifically with the mainstem of the Oldman River and the areas that contribute flow directly to the river. In previous chapters, these have been shown as 'ungauged areas'.

In its natural state, the Oldman River is characterized by high spring flows from mountain snowmelt and runoff and low late summer, fall, and winter flows as the water source is reduced to groundwater baseflow and precipitation inputs. Of the total flow in the Oldman River, about 36% comes from the upper Oldman River (upstream of the Oldman River Dam) and upper tributaries (Castle and Crowsnest rivers), 32% is from the Belly and Waterton rivers, 25% is contributed by the St. Mary River, and 7% from other tributaries, such as Pincher Creek, Willow Creek and the Little Bow River.

Chief Mountain – OWC

Wagon Trails Near Fort Whoop-up – OWC

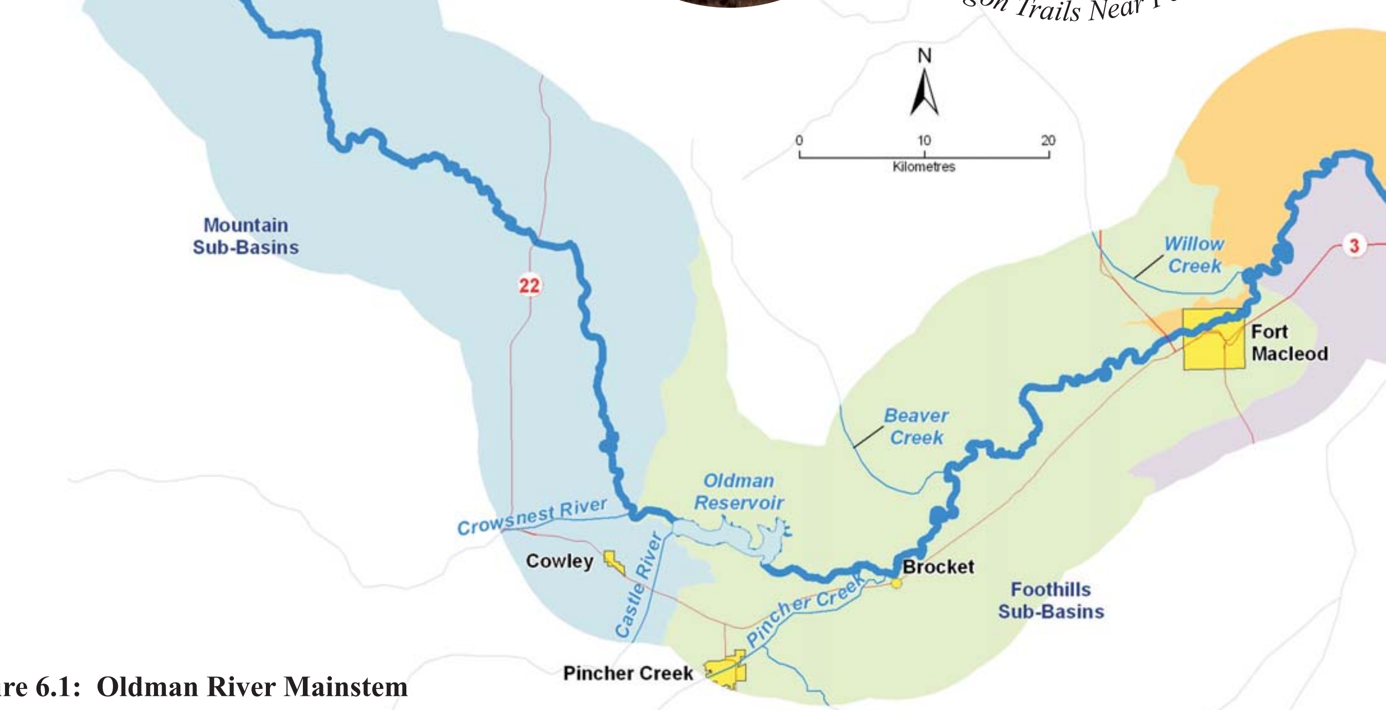


Figure 6.1: Oldman River Mainstem

Since 1991, the flow of the Oldman River has been regulated by the Oldman Reservoir, located near the transition from the mountains to the foothills at the confluence of the Crowsnest, Castle and Oldman rivers. The construction of the dam exemplifies the story of irrigation in southern Alberta as farmers wishing to capture some of the spring and early summer flow for mid and late summer use were pitted against fishermen, environmentalists, and aboriginal interests who wished to preserve the natural flow regime of the river. The Oldman River Dam project brought about an emerging understanding of environmental assessment in Canada and the division of authority and responsibility between federal and provincial governments and changed the interpretation of federal obligations. The story is complex and is still evolving as the benefits and the costs of the dam continue to be assessed.

The important fisheries resources of the Oldman River were a key element in concern about the decision to create a reservoir on the river (Cunningham 1988). The potential effects of controlled flow on the riparian cottonwood forests of the lower reaches of the river were also a focus of attention (Mahoney and Rood 1993).

6.1 Overview of Indicators

The Oldman River mainstem terrestrial area, just used for purposes of this report, is a 500-m wide corridor on either side of the Oldman River. This area was selected to represent the major land features of the floodplain between the valley banks, recognizing that the valley width is variable. Disturbances to this area may immediately affect water quantity and quality. Terrestrial and riparian information is summarized below by combining the information from the other Sub-basins (Chapters 2 to 5). Refer to these chapters for maps and tables that describe the terrestrial and riparian indicators.

6.1.1 Terrestrial and Riparian Ecology

Land Cover

The dominant land cover includes grassland, forest and agriculture. Within the 500-m wide corridor, 25% is accounted for by the surface of the Oldman River and Oldman Reservoir (Table 6.1).

Figure 6.1b: Oldman River Mainstem

Police Outpost Lake – OWC

Weir on Oldman River Below Lethbridge – OWC

Table 6.1: Land Cover in the Oldman River Mainstem

Land Cover	Area of Sub-basins (%)
Grassland	46
Water (including Reservoirs)	25
Forest (Coniferous & Deciduous)	17
Cultivated Land (Agriculture)	10
Rock/Barren	1
Shrubland	1
Urban	<1
Total	**100**

Grassland

Grasslands cover 46% of the Oldman River mainstem. These lands occur within the Foothills Fescue natural sub-region to the west of Fort Macleod, the Mixedgrass natural sub-region in the vicinity of Lethbridge, and the Dry Mixedgrass natural sub-region surrounding Taber (Figure 6.2).

The grassland communities of the Foothills Fescue consist of mountain rough fescue and Parry oat grass. The Mixedgrass characterizes the valley to the east of Fort Macleod, where needle-and-thread, porcupine grass, June grass, and northern and western wheatgrasses dominate. The Dry Mixedgrass is made up of blue grama, needle-and-thread, June grass, and western wheatgrass. As a result of periodic risk of flooding, the majority of the grassland areas are undisturbed and used mainly for grazing.

Cultivated Land

The Oldman River crosses seven municipal districts (MDs) and counties, and two Indian Reserves. These consist mainly of the MD of Pincher Creek, Peigan (North Piikani) Indian Reserve 147, Blood (Kainai) Indian Reserve 148, County of Lethbridge and MD of Taber (Figure 6.3).

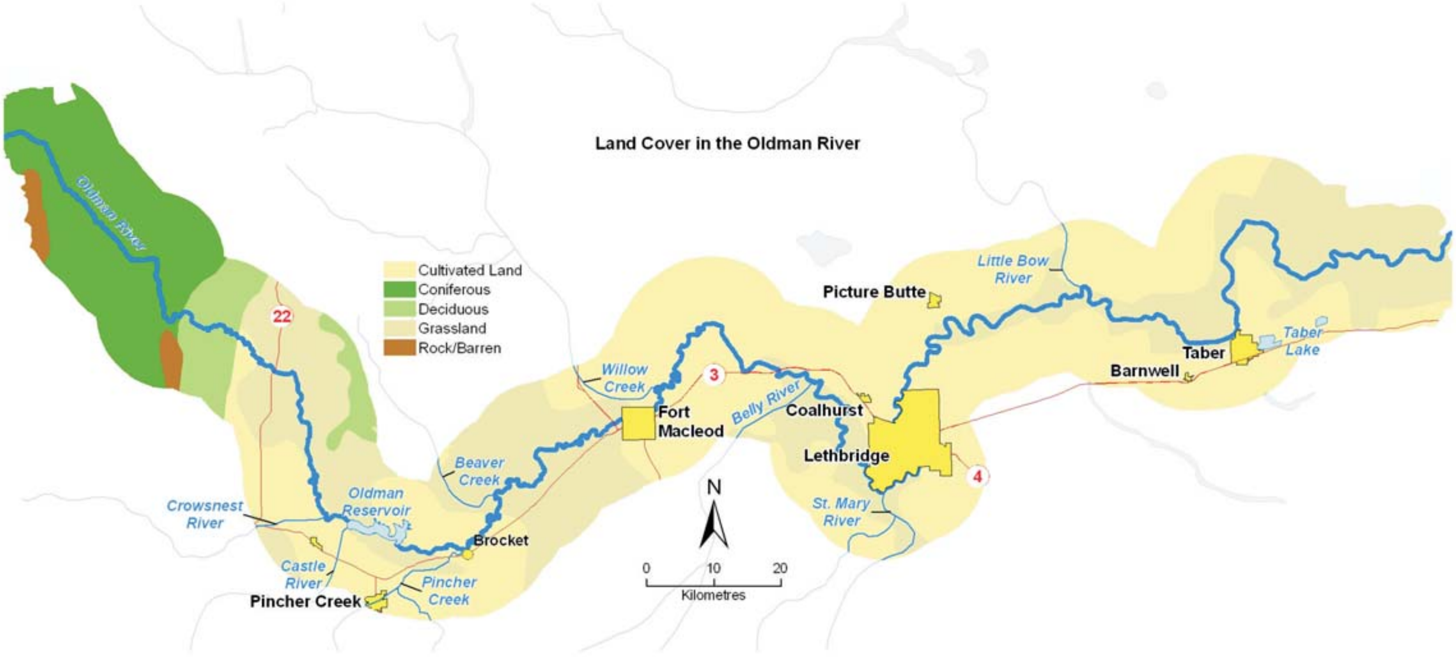


Figure 6.2: Land Cover within the Oldman River Mainstem

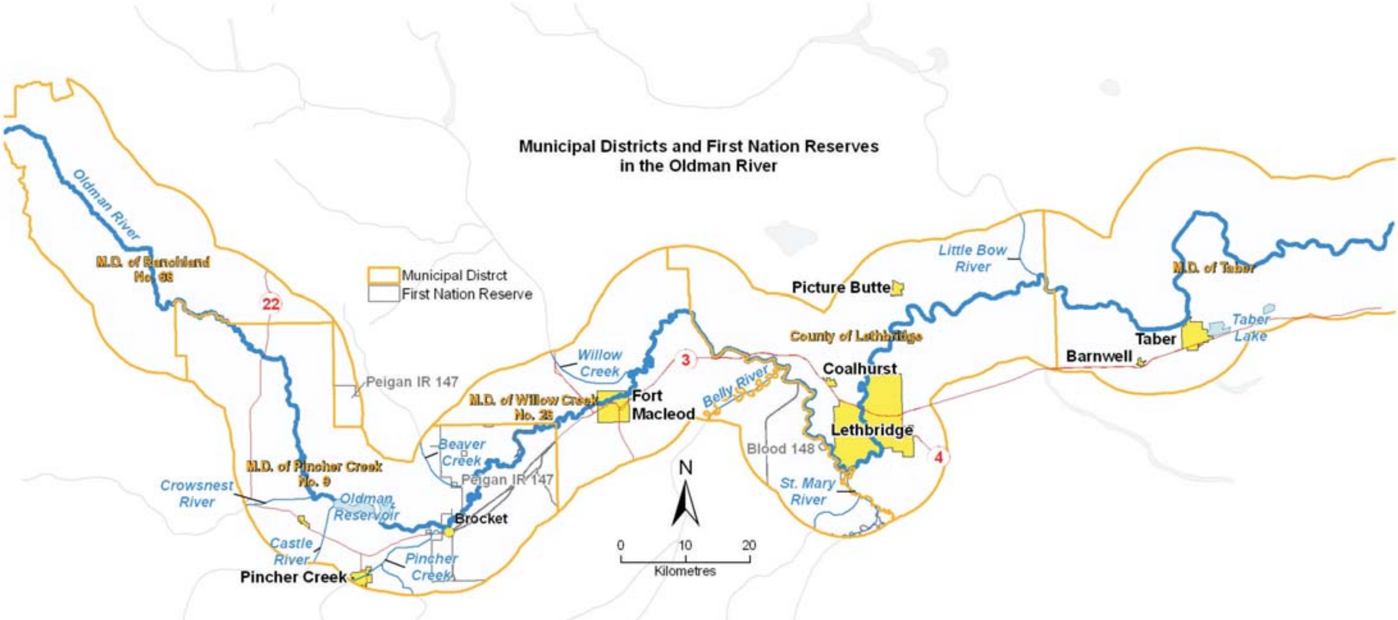


Figure 6.3: Municipal Districts and First Nation Reserves in the Oldman River Mainstem

Cereals and forage are the most common crops grown in the valley based on the proportions within each MD (Statistics Canada 2006). Irrigated areas are a small portion of the cultivated land. Common livestock raised in the area is similar to the other Sub-basins and is made up mainly of cattle, hogs and horses.

Forest

Coniferous and deciduous forests cover approximately 17% of the Oldman River mainstem. Most of the coniferous trees are found in the high elevations of the Sub-Alpine natural sub-region in the upper valley, while deciduous trees characterize the lower elevations in the central and eastern portions of the valley.

The western portion of the Oldman River mainstem is included within Forest Management Units (FMUs) made up of the larger CO2 (management unit of the Crowsnest Forest) with smaller areas of C5, B10 and CO1. Commercial forest harvesting operations are conducted by Spray Lakes Sawmills and a few quota holders.

The deciduous forests consist primarily of the thin strip of cottonwoods that extends east from the mountains along the Oldman River valley to the confluence with the Bow River. Through much of the mainstem, the cottonwoods form the only forest in an otherwise grassland environment and they are important for wildlife, fish, recreation and aboriginal culture (Bradley et al. 1991, Willms 1998). Three poplar species – balsam poplar, plains cottonwood and narrowleaf cottonwood – converge and hydridize in the valley. The cottonwoods are characterized by sparse to dense and very dense stands particularly in the reach between Brocket to below Lethbridge. Two reaches of the Oldman River show a decline in cottonwood stands since the 1880s. The reach immediately upstream of the Belly River confluence shows a decrease from dense to sparse; and the reach immediately upstream of the confluence with the Bow River shows a decline from sparse to negligible between the 1880s and 1980s. The reasons for the declines appear to be drought induced mortality due to water diversions and cultivation (Bradley et al. 1991).

Cottonwood forests have declined downstream from some dams in southern Alberta. This raised concern about the survival of the cottonwoods downstream from the Oldman River Dam. Studies indicated that it is the pattern of operation rather than the presence of dams *per se* that determines the downstream impact on cottonwoods (Rood and Mahoney 1991). The flow projections from the operation plan for the Oldman River Dam were analyzed and predicted to have minor impacts on cottonwoods. Subsequent monitoring studies confirmed that the operation of the dam is allowing for the establishment of cottonwood seedlings in years of above average flows (Lewis 1998, Rood et al. 1998).

In 1995 and 2005, high flows provided suitable areas for the establishment of cottonwood seedlings. The practice of flow management from dams called “ramping” was initiated in 1995. It aimed at restoring a more natural flow regime, and has resulted in good survival of cottonwood seedlings downstream of the Oldman River dam (Gill et al. 2007, Rood pers. comm. 2009).

Protected areas include recreation areas, natural areas, provincial parks and a heritage rangeland. Combined, these cover approximately 11% of the Oldman River mainstem with Oldman River Dam recreation sites occupying most of the area (Table 6.2). Human activities in these areas create disturbances such as camp sites, roads, and trails.

Rock and Barren Land

Approximately 1% of the Oldman River mainstem consists of the rock and barren land found on the high mountain elevations.

Shrubland

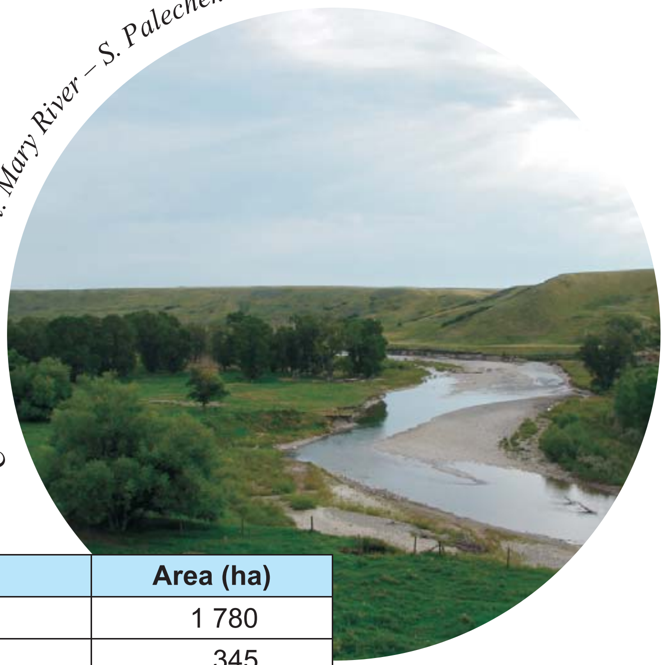
Shrubs (1%) are primarily found within the Foothills Parkland natural sub-region. Most of this portion of the Oldman River mainstem is used for grazing.

Urban Centers

The communities of Fort Macleod, Lethbridge and Taber cover <1% of the Oldman River mainstem. The community boundaries extend into the Oldman River valley, however, due to the risk of flooding, the land is generally used only for campgrounds, golf courses and recreational trails.

Soil Erosion

The majority of soil erosion risk is rated as low for 46% and negligible for 35% of the area. The techniques used for reducing soil erosion losses include rotational grazing and shelterbelts.



Cottonwoods Along St. Mary River – S. Palechek

Table 6.2: Recreational Areas, Ecological Reserves and Parks

Protected Area Type	Name	Area (ha)
Provincial Recreation Area	Five different areas	1 780
Natural Area	Beehive	345
Provincial Park	Bob Creek Wildland	235
Heritage Rangeland	Black Creek	60
Total		**2 420**

Riparian Health

Along the Oldman River, 21 sites were reviewed as part of the Riparian Health Assessment Program. The results indicate that: none are healthy, 57% are healthy but with problems, and 43% are unhealthy (Cows and Fish Program 2009). The results suggest the riparian health of the mainstem is worse than the average condition found throughout the Oldman watershed where 15% are healthy, 55% are healthy but with problems, and 30% are unhealthy.

Land Use

Human activities on the land create different disturbances throughout the Oldman River mainstem. Agricultural activities are the dominant land use followed by the Oldman Reservoir and infrastructure (Table 6.3).

Table 6.3: Land Use in the Oldman River Mainstem

Disturbance	Length (km)	km/km^2	Total Area Disturbed (ha)	% of Total Area
Agriculture				
Crops and pasture (tame and seeded)[1]			2 200	10
Infrastructure				
Roads	150	0.7	170	0.8
Railways	2	<0.1	2	<0.1
Powerlines	8	<0.1	16	<0.1
Pipelines	13	0.1	90	0.2
Cutlines	142	0.6	100	0.5
Wells – oil and gas			100	0.5
Wells – water (total: 76)				
Airfields and runways			0	0
Sewage lagoons			0	0
Gravel pits			60	<0.1
Subtotal			*538*	*2*
Urban				
Residential, commercial and light industrial developments			100	<0.1
Recreation				
Parks, recreation areas and campgrounds			150	<0.1
Surface Water Supply Sources				
Reservoir			1 370	6
Total Disturbance			**4 358**	**20**

[1] Irrigated land is a combination of grazing and cropped land, and does not include irrigation of native grassland since it is not disturbed. Area is included in "crops" category.
Note: these data are derived from StatsCan agriculture census data for an entire municipality, and for a specific year, i.e., 2006. The disturbances are therefore assumed to occur uniformly over the portion of each municipality that falls within each sub-basin.

Agriculture

Approximately 10% of the area is used for agricultural activities that are a combination of annually cropped or summerfallowed, and tame/seeded pasture land.

There are seven confined feeding operations (CFOs) in the valley, and most are located between Fort Macleod and Lethbridge. While data are available on the locations of CFOs, minimal information is available on the number of animals contained by these operations.

Infrastructure

Almost 2% of the Oldman River mainstem supports infrastructure, primarily linear developments. Roads (0.8%) produce the most linear disturbance, followed by cutlines (0.5%). Operating and abandoned oil and gas wells occupy 0.5% of the land. Road types include paved, gravel, unimproved and truck trails.

Recreation

Most of the human disturbance from recreational activities such as camping, fishing and hiking occur in the provincial parks and recreation areas scattered throughout, particularly the Oldman Recreation area. Less than 1% of the area is disturbed by campgrounds and picnic areas.

Surface Water Supply Sources

The Oldman Reservoir occupies approximately 6% of the area.

Urban

While the municipal boundaries of the towns of Fort Macleod and Taber and the City of Lethbridge occupy a large area, actual development is small at <0.1 of the area, being made up of camp grounds, golf courses and nature trails. For data on population trends see Chapters 2 to 5.

Total Land Use

Approximately 20% of the Oldman River mainstem is affected by human footprint. Agricultural activities make up the largest component (10%), followed by the Oldman Reservoir and minor amounts of linear development and wells.

6.1.2 Water Quantity

Natural and recorded flows along the Oldman River have been analyzed and trends in natural flows assessed at select locations. Both recorded and reconstructed natural flows are available at all stations except Oldman River near Fort Macleod, where recorded flow was discontinued in 1948. Five long-term natural flow hydrometric stations (Figure 6.4) were assessed on the Oldman River mainstem:

- Oldman River near Waldron's Corner;
- Oldman River near Brocket;
- Oldman River near Fort Macleod;
- Oldman River near Lethbridge; and
- Oldman River near the Mouth.

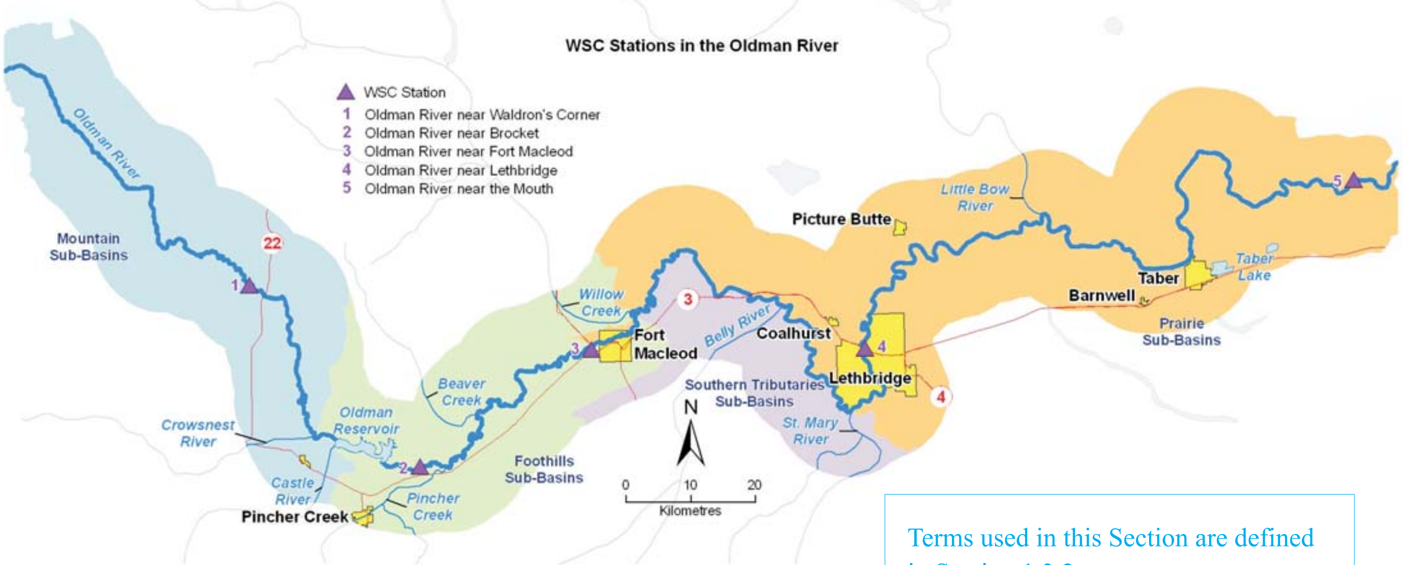


Figure 6.4: WSC Stations in the Oldman River

Terms used in this Section are defined in Section 1.3.2.

An analysis of stream flow characteristics and water quantity indicators was conducted for the five natural flow stations. The standard period of natural flow data (i.e., 1912 to 2001) is used for trend analysis.

Major storage and diversion works along the Oldman River include the Oldman River Dam and the Lethbridge Northern Irrigation District (LNID) diversion works. The Oldman Reservoir has a live storage capacity of 490 180 dam^3 (Alberta Agriculture and Rural Development 2007).

The LNID is located north of the Oldman River and west of the City of Lethbridge. The source of irrigation water for this district is the Oldman River and the licensed allocation is 412 557 dam^3. The LNID has diverted water for irrigation use since 1924. For the most recent 10 years, 1998 to 2007, the annual average diversion was 220 350 dam^3 (Figure 6.5).

The LNID has several reservoirs associated with irrigation and other uses. Table 6.4 summarizes the storage capacity of the reservoirs.

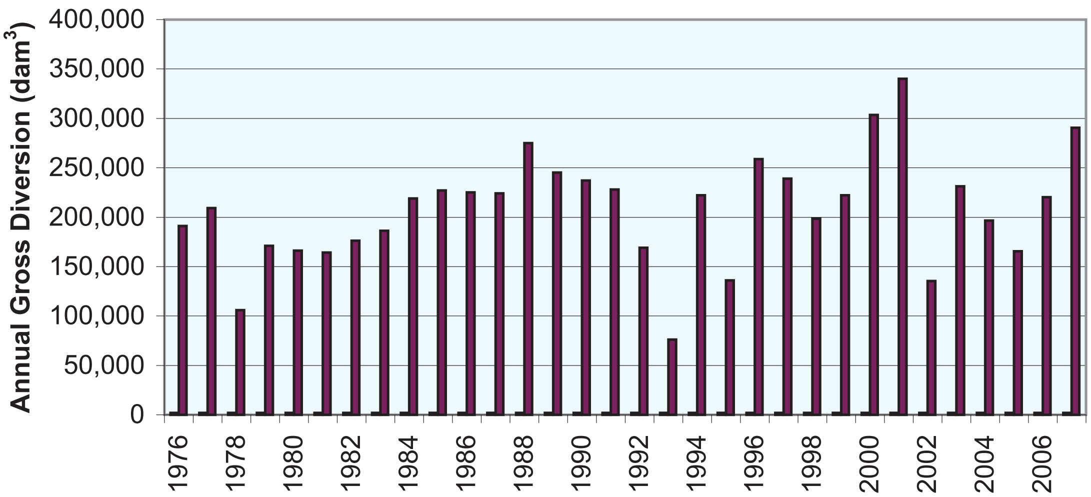


Figure 6.5: Gross Diversions from the Oldman River to the LNID through the Diversion Canal from 1976 to 2007

Table 6.4: Reservoirs Associated With Irrigation and Other Uses in the Oldman River Mainstem

Location	Reservoir	Capacity (dam^3)
Oldman River	Oldman Reservoir	490 180
Prairies Sub-basins (LNID)	Park Lake	740
	Keho Lake	95 635
	Picture Butte Lake	1 600
Total Storage		**588 155**

Source: Alberta Agriculture and Rural Development 2007.

Historic Note – Lethbridge Northern Irrigation District

Following nine years of hard work and research by land owners, the idea to divert water from the Oldman River to irrigate land in the "Coyote Flats", to the west and north of Lethbridge, was unanimously agreed upon, and the LNID was formed in 1919. Funding for the construction was found and guaranteed by the Alberta government. Construction began in 1921, and the first water was diverted in 1923, allowing irrigation of almost 9 000 ha the first season (LNID 1996). Currently, the 650 km of canals and conveyance works of the LNID provides water to about 50 000 ha of irrigated land (ARD 2009). Surface storage in the LNID is provided by Keho Lake Reservoir, Park Lake Reservoir, and Picture Butte Lake Reservoir.

Historic Note – Oldman River Dam

Alberta is committed under the Prairie Provinces Water Board Master Agreement on Apportionment to providing 50% of the natural flow of the South Saskatchewan River to Saskatchewan. Additionally, it was observed that about 60% of the annual flow in the Oldman River, which is a tributary to the South Saskatchewan River, occurred between May and July. To capitalize on the water available to Albertans, the provincial government realized that containment of some of the spring runoff for use during the summer low flow period was necessary. Following considerable research, the decision to build a dam on the Oldman River was reached.

Construction on the Oldman River Dam began in 1986, at a site just downstream of the confluence of the Castle, Crowsnest and Oldman rivers. The reservoir has useable storage of about 490 000 dam^3. The first spring runoff was received in 1991. The reservoir has become an integral part of water management in southern Alberta by providing water for municipal, domestic, irrigation, industrial and other needs. In addition, the reservoir provides operational flexibility to meet the needs of the riparian and aquatic environments.

A monitoring program was established in 1991 to, among other things, report on the environmental effects of the dam and downstream conditions (Lewis 1998). The Minister of Environment established the Oldman River Dam Environmental Advisory Committee to oversee the work of the monitoring committee, make recommendations on short- and long-term operation of the dam and assess the results of the mitigation and monitoring programs (Oldman River Dam Environmental Advisory Committee 2002). The committee reported in 2002 and was subsequently disbanded.

Oldman Dam – ARD

Hydrologic Characteristics

The recorded flow near Waldron's Corner (upstream of the Oldman Reservoir) is considered natural flow because the river is unregulated upstream of this site and water use is low. Since the recorded flows near Waldron's Corner are very close to natural flows, the Alberta Environment (AENV) extension simply filled in the gaps in the recorded period. The hydrologic characteristics of the Oldman River near Waldron's Corner are shown on Figure 6.6. The major peak in early June is likely the result of runoff entering the river from melting snowpack.

Recorded flows downstream of the Oldman River Dam are impacted by mainstem and tributary storage, flow regulation, and water use, and as a result, the recorded flows are considerably altered from natural flows. Alberta Environment has extended natural flows for the period from 1912 to 2001 period using statistical methods.

The Oldman River Dam is situated between the Waldron's Corner and Brocket monitoring stations and has regulated the downstream flows since 1991. Recorded flows on the Oldman River near Brocket (1992 to 2001) are similar to the natural flows during the winter, lower than natural flows during spring and early summer when the reservoir is filling, and higher than the natural flows due to releases from storage in months when irrigation demand is at its peak (Figure 6.7).

Oldman River near Waldron's Corner

Gross DA	km^2	1,450
Effective DA	km^2	1,450
Natural Discharge 1912-2001		
Mean Annual	dam^3	390,575
Upper Quartile	dam^3	479,194
Median	dam^3	382,836
Lower Quartile	dam^3	284,897
Median Yield		
Gross DA	dam^3/km^2	264
Effective DA	dam^3/km^2	264

DA = Drainage Area

Mean Discharge of the Oldman River near Waldron's Corner, 1992-2001

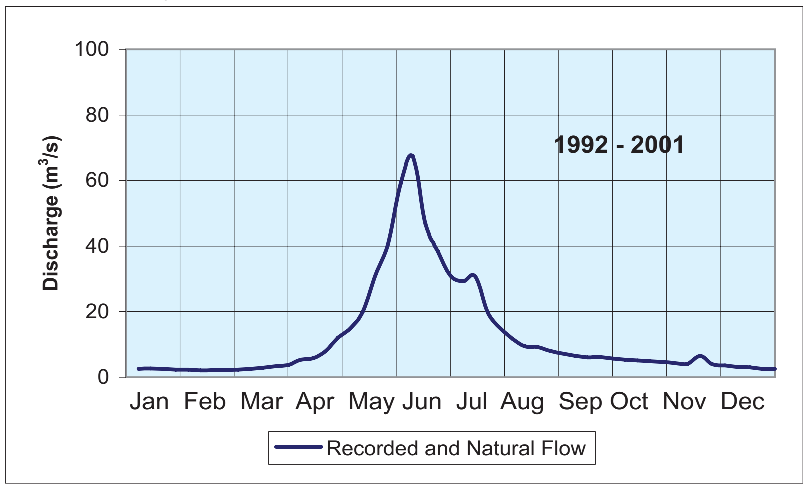


Figure 6.6: Oldman River Near Waldron's Corner Hydrologic Characteristics

Oldman River near Brocket

Gross DA	km^2	4,400
Effective DA	km^2	4,380
Natural Discharge 1912-2001		
Mean Annual	dam^3	1,251,061
Upper Quartile	dam^3	1,482,704
Median	dam^3	1,203,919
Lower Quartile	dam^3	952,019
Median Yield		
Gross DA	dam^3/km^2	274
Effective DA	dam^3/km^2	275

DA = Drainage Area

Mean Discharge of the Oldman River near Brocket, 1992-2001

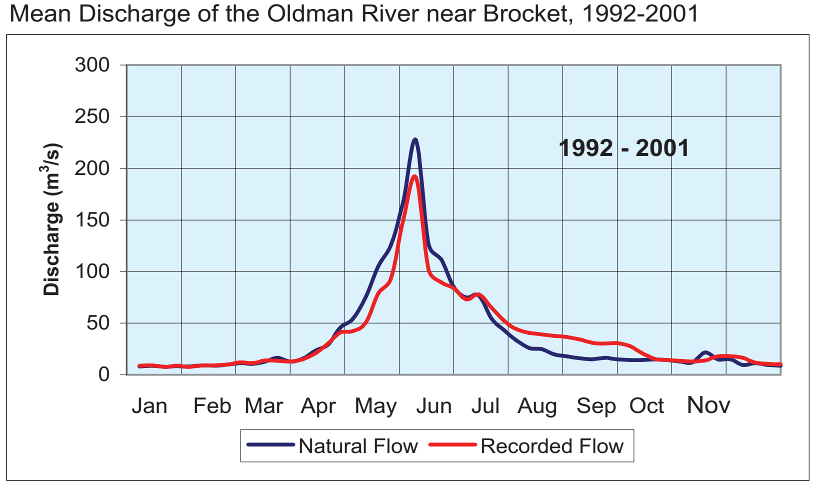


Figure 6.7: Oldman River Near Brocket Hydrologic Characteristics

Flows on the Oldman River near Fort Macleod were not monitored between 1949 and 2001, and so only natural flows determined by AENV (1912 to 2001) were assessed (Figure 6.8). Re-establishment of the hydrometric station would assist in determining the impact of diversions to the LNID and other water users on river flows. The LNID diversion is located between the Brocket and Fort Macleod monitoring stations and has impacted the downstream flows since 1923.

Recorded flows on the Oldman River near Lethbridge (1992 to 2001) are lower than the natural flows determined by AENV (1912 to 2001), especially during the peak flow period from May to August (Figure 6.9). The monitoring station on the Oldman River near Lethbridge is downstream of the confluence of the Belly and St. Mary rivers, which both have considerable regulation and diversions. The Waterton and St. Mary reservoirs regulate flow of the southern tributaries. Water from the Waterton and Belly rivers is diverted to the St. Mary Reservoir, from which it is diverted eastward to the Milk River Ridge Reservoir for distribution to irrigators and other water users. There are eight irrigation districts that use water from the Waterton, Belly and St. Mary rivers.

Oldman River near Fort Macleod

Gross DA	km^2	5,760
Effective DA	km^2	5,680
Natural Discharge 1912-2001		
Mean Annual	dam^3	1,310,366
Upper Quartile	dam^3	1,561,828
Median	dam^3	1,247,994
Lower Quartile	dam^3	978,063
Median Yield		
Gross DA	dam^3/km^2	217
Effective DA	dam^3/km^2	220

DA = Drainage Area
Recorded flow not available.

Mean Discharge of the Oldman River near Fort Macleod, 1992-2001

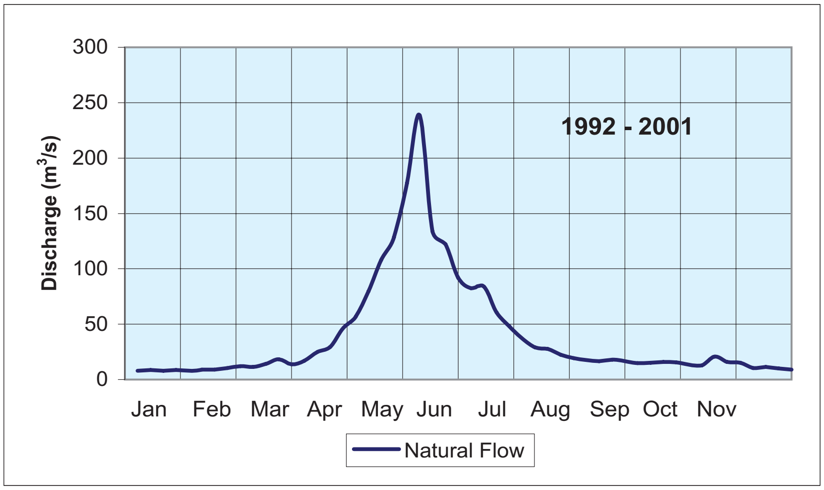


Figure 6.8: Oldman River Near Fort Macleod Hydrologic Characteristics

Oldman River near Lethbridge

Gross DA	km^2	17,000
Effective DA	km^2	15,500
Natural Discharge 1912-2001		
Mean Annual	dam^3	3,454,847
Upper Quartile	dam^3	4,181,722
Median	dam^3	3,338,748
Lower Quartile	dam^3	2,715,311
Median Yield		
Gross DA	dam^3/km^2	196
Effective DA	dam^3/km^2	215

DA = Drainage Area
Mean flow diverted out of the basin in US, 1992-2001 = 192,228 dam^3

Mean Discharge of the Oldman River near Lethbridge, 1992-2001

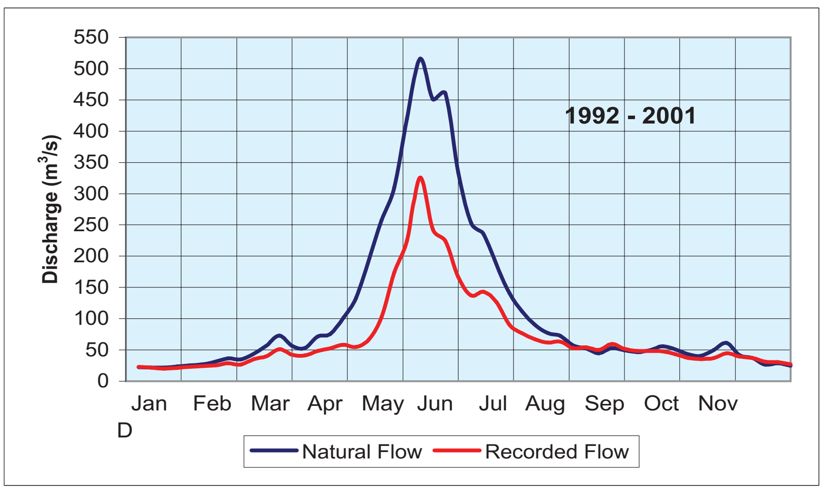


Figure 6.9: Oldman River Near Lethbridge Hydrologic Characteristics

Additionally, water is diverted in the United States from the St. Mary River to the Milk River, as part of the Boundary Waters Treaty and the 1921 Order of the International Joint Commission. All of these diversions and regulations in Sub-basins that contribute to the Oldman River have resulted in a considerable decrease in recorded flow as compared to natural flows (see Section 4.1.2 Water Quantity).

Recorded flows on the Oldman River near the Mouth (1992 to 2001) are nearly 40% lower than the natural flows during the peak runoff period (Figure 6.10). The reduced recorded flows observed in the Oldman River are due to the cumulative effect of regulation by the Oldman River, Waterton and St. Mary reservoirs, diversions and withdrawals for irrigation and other purposes.

The monthly distributions of flow at all Oldman River monitoring stations show a major peak in early June. The peak is likely caused by a combination of meltwater from the winter snow pack and spring precipitation events.

Oldman River near the Mouth

Gross DA	km^2	27,500
Effective DA	km^2	21,000
Natural Discharge 1912-2001		
Mean Annual	dam^3	3,470,738
Upper Quartile	dam^3	4,163,055
Median	dam^3	3,342,824
Lower Quartile	dam^3	2,772,757
Median Yield		
Gross DA	dam^3/km^2	10
Effective DA	dam^3/km^2	14

DA = Drainage Area
Mean flow diverted out of the basin in US, 1992-2001 = 192,228 dam^3

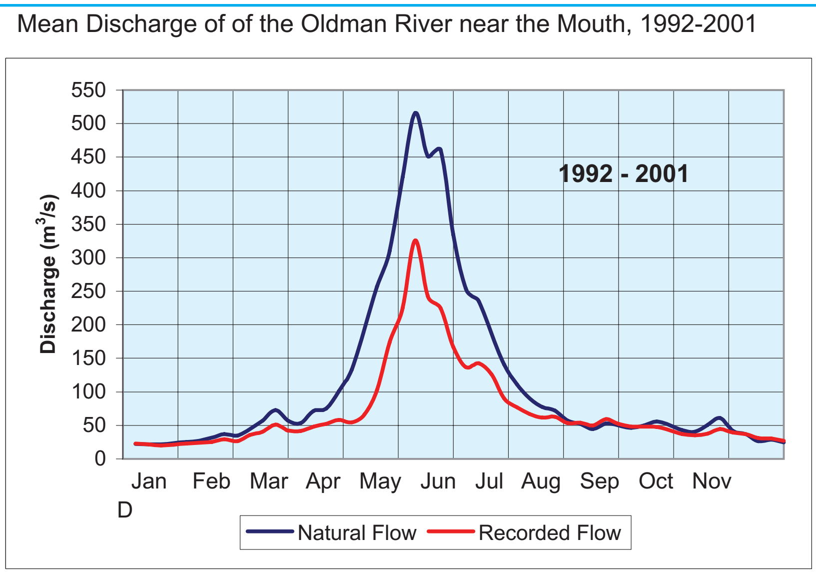


Figure 6.10: Oldman River Near the Mouth WSC Station Characteristics

Ice on the Oldman River – OWC

Streamflow Trends

Based on the Mann-Kendall test, annual natural flows on the Oldman River near Waldron's Corner (upstream of the Oldman River Dam) did not show any significant trends for the period from 1912 to 2001 (Figure 6.11). April flow records show a probable decreasing trend. A plot of annual flow at the monitoring station near Waldron's Corner showed no slope in the trend. Since recorded flow is approximately equal to natural flow at this location, the trend analysis could be extended to 2008. The Mann-Kendall test results for the extended period were not significantly different than for the 1912 to 2001 period.

Based on the Mann-Kendall test, annual flows on the Oldman River near Brocket did not show any significant trends for the period from 1912 to 2001 (Figure 6.12), however probable decreasing trends were identified in the November and December flow records. Annual flow at the monitoring station near Brocket showed an insignificant decreasing trend of 0.12%.

Oldman River near Waldron's Corner

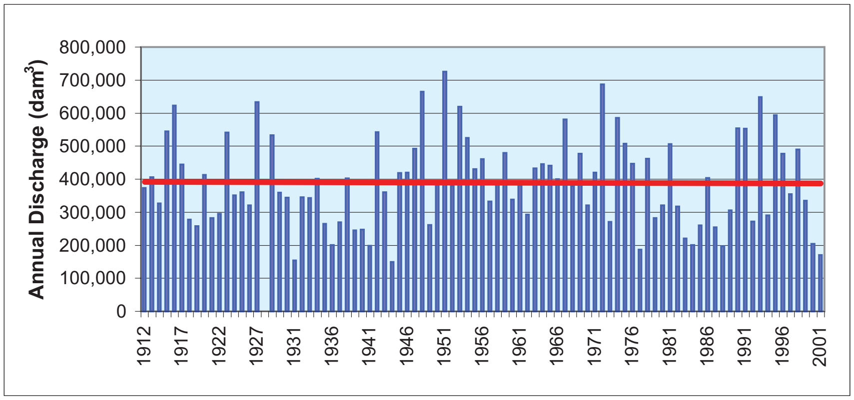
Mann-Kendall Trend Analysis

	MK-Stat	p-value
Annual	-0.07	0.95
Jan	0.02	0.99
Feb	-0.10	0.92
Mar	-1.10	0.27
Apr	-1.79	0.07
May	0.05	0.96
Jun	-0.05	0.96
Jul	-0.05	0.96
Aug	0.40	0.69
Sep	0.71	0.48
Oct	-0.08	0.94
Nov	-0.79	0.43
Dec	-0.93	0.35

Significant Trend

Probable Trend

Annual Natural Flow Volumes and Linear Trend Line



No evident annual trend.

Figure 6.11: Trends in Natural Flow – Oldman River Near Waldron's Corner

Oldman River near Brocket

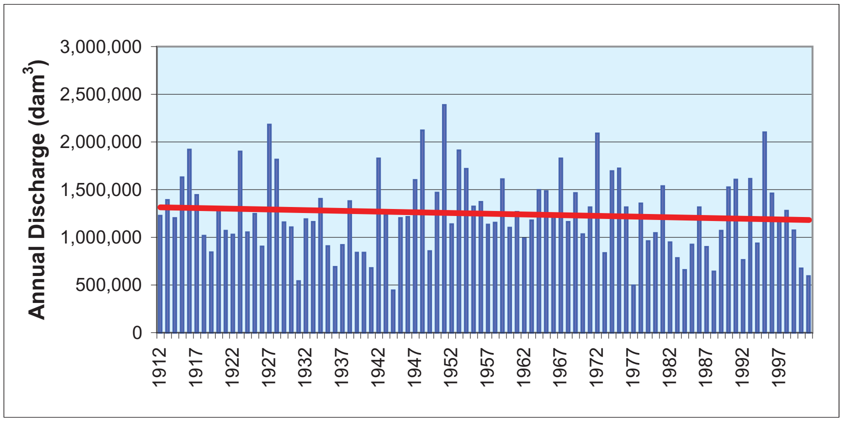
Mann-Kendall Trend Analysis

	MK-Stat	p-value
Annual	-0.95	0.34
Jan	-1.28	0.20
Feb	0.09	0.93
Mar	0.13	0.90
Apr	-1.28	0.20
May	-0.42	0.67
Jun	-0.90	0.37
Jul	-0.45	0.65
Aug	-0.61	0.54
Sep	-1.23	0.22
Oct	-1.43	0.15
Nov	-1.91	0.06
Dec	-1.66	0.10

Significant Trend

Probable Trend

Annual Natural Flow Volumes and Linear Trend Line



Average annual decrease in flow = 1508 dam^3, based on trend line slope.

Figure 6.12: Trends in Natural Flow – Oldman River Near Brocket

Annual flows on the Oldman River near Fort Macleod, did not show any significant trends based on the Mann-Kendall test for the period from 1912 to 2001 (Figure 6.13). A probable decreasing trend was identified in the November flows. Annual flow at the monitoring station near Fort Macleod showed an insignificant decreasing trend of 0.15%, according to the trend line slope.

The Mann-Kendall trend analyses of annual and monthly flows on the Oldman River at Lethbridge, and the Oldman River at the Mouth, did not show any significant trends for the period from 1912 to 2001 (Figures 6.14 and 6.15). According to the trend line slope, insignificant decreasing trends of 0.05% and 0.06%, respectively, were observed in the annual flows near Lethbridge and near the Mouth.

Oldman River near Fort Macleod

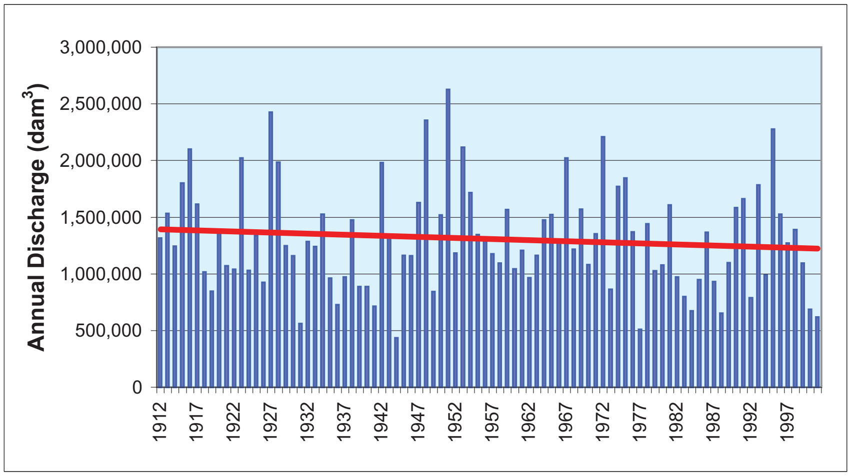
Mann-Kendall Trend Analysis

	MK-Stat	p-value
Annual	-0.94	0.34
Jan	-1.55	0.12
Feb	-0.08	0.94
Mar	-0.26	0.79
Apr	-1.40	0.16
May	-0.57	0.57
Jun	-0.99	0.32
Jul	-0.49	0.62
Aug	-0.41	0.68
Sep	-0.74	0.46
Oct	-1.14	0.25
Nov	-1.82	0.07
Dec	-1.49	0.14

Significant Trend

Probable Trend

Annual Natural Flow Volumes and Linear Trend Line



Average annual decrease in flow = 1907 dam^3, based on trend line slope.

Figure 6.13: Trends in Natural Flow – Oldman River Near Fort Macleod

Oldman River near Lethbridge

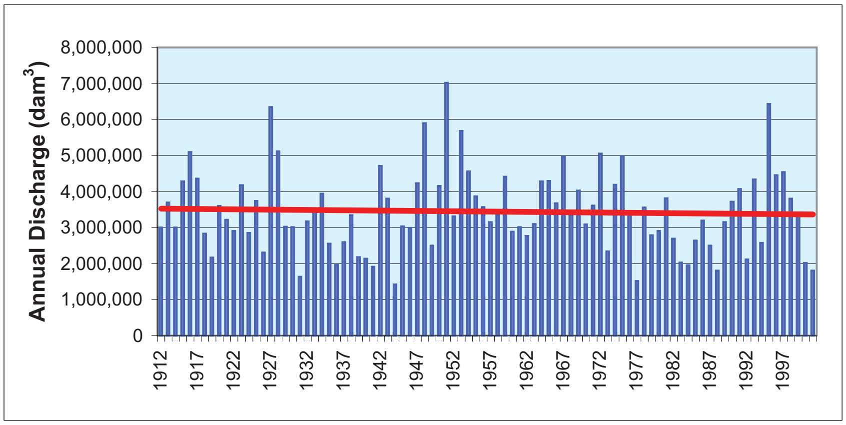
Mann-Kendall Trend Analysis

	MK-Stat	p-value
Annual	-0.39	0.70
Jan	-0.76	0.45
Feb	0.91	0.36
Mar	0.18	0.85
Apr	-1.40	0.16
May	-0.37	0.71
Jun	-0.47	0.64
Jul	-0.05	0.96
Aug	0.03	0.97
Sep	-0.72	0.47
Oct	-0.56	0.57
Nov	-0.74	0.46
Dec	-0.90	0.37

Significant Trend

Probable Trend

Annual Natural Flow Volumes and Linear Trend Line



Average annual decrease in flow = 1888 dam^3, based on trend line slope.

Figure 6.14: Trends in Natural Flow – Oldman River Near Lethbridge

Oldman River near the Mouth

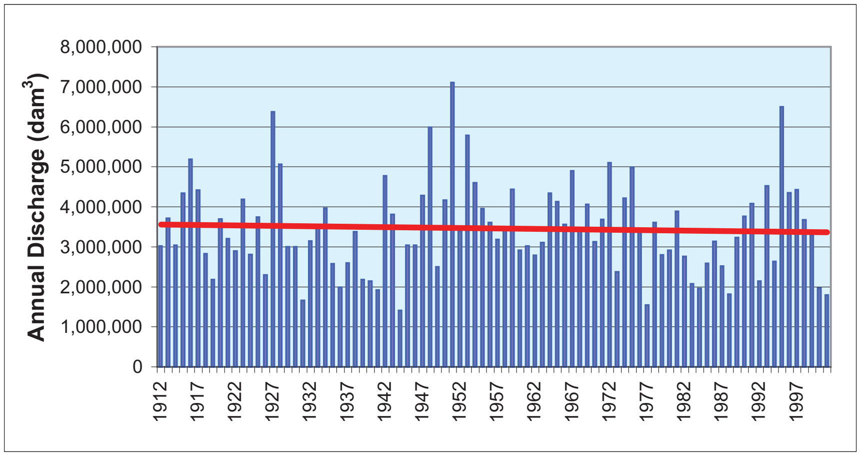
Mann-Kendall Trend Analysis

	MK-Stat	p-value
Annual	-0.47	0.64
Jan	-0.39	0.70
Feb	1.09	0.28
Mar	0.30	0.76
Apr	-1.74	0.08
May	-0.47	0.64
Jun	-0.44	0.66
Jul	-0.16	0.87
Aug	-0.02	0.98
Sep	-1.00	0.32
Oct	-0.61	0.54
Nov	-0.60	0.55
Dec	-0.72	0.47

Significant Trend

Probable Trend

Annual Natural Flow Volumes and Linear Trend Line



Average annual decrease in flow = 2126 dam^3, based on trend line slope.

Figure 6.15: Trends in Natural Flow – Oldman River Near the Mouth

West Lethbridge Above Oldman River – R. Coffey

Swainsons Hawk – R. Coffey

Pincushion Cactus – L. Pezderic

Licensed Allocation and Actual Use

Water use upstream of the Oldman Reservoir is primarily for agricultural purposes. Near Waldron's Corner, irrigation allocations are the largest water use but are negligible (<0.1%) compared to the median annual flows (Figure 6.16).

Surface water allocations on the Oldman River near Brocket are about 2% of the median natural flows with allocations distributed between irrigation, commercial, municipal and other uses (Figure 6.17). Allocated and actual use is dominated by commercial, irrigation and other uses.

Oldman River near Waldron's Corner

Purpose Sector	Allocation dam^3	Est. Actual Use dam^3
Irrigation	175	144
Other Agric	12	9
Municipal		
Commercial		
Industrial		
Other		
Totals	187	153
% of median flow	0.05	0.04

Distribution of Water Allocation and Actual Use by Purpose.

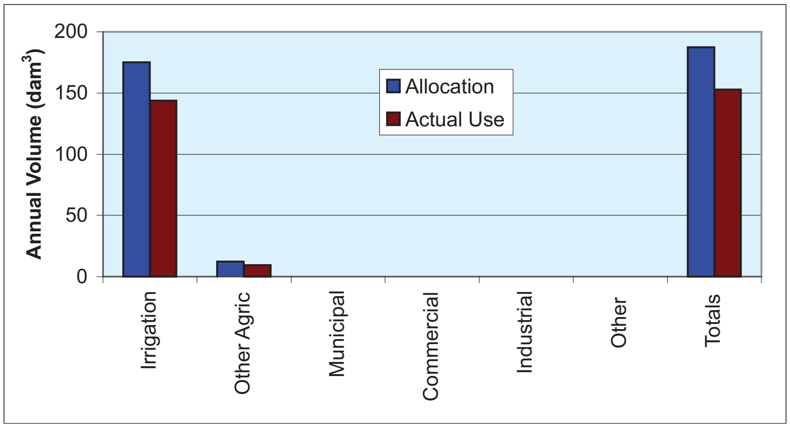


Figure 6.16: Water Demand – Oldman River Near Waldron's Corner

Oldman River near Brocket

Purpose Sector	Allocation dam^3	Est. Actual Use dam^3
Irrigation	6,421	5,265
Other Agric	414	310
Municipal	2,346	1,185
Commercial	7,492	2,170
Industrial	-	-
Other	8,044	8,044
Totals	24,716	16,974
% of median flow	2.1	1.4

Distribution of Water Allocation and Actual Use by Purpose.

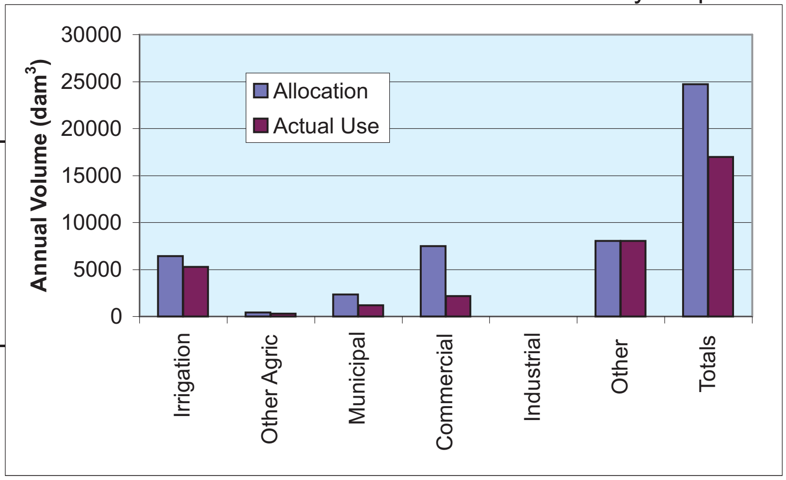


Figure 6.17: Water Demand – Oldman River Near Brocket

Surface water allocations on the Oldman River near Fort Macleod are about 37% of the median natural flows. Irrigation allocations comprise nearly 95% of allocations and 90% of actual uses are attributed to that purpose (Figure 6.18). The remaining 5% of allocations are split between commercial, municipal, agriculture and other uses. Actual uses are less than 50% of allocations, indicating that there is considerable potential for water use expansion within existing allocations.

Surface water allocations on the Oldman River near Lethbridge are about 57% of the median natural flows, however actual use is about 32%. Irrigation comprises nearly 91% of allocations and 90% of actual uses (Figure 6.19). The remaining 9% of allocations are divided primarily between commercial, municipal and other uses with other agricultural and industrial uses also withdrawing from the river. Because of the large difference between allocations and actual uses, there is potential for water use expansion within existing allocations.

Oldman River near Fort Macleod

Purpose Sector	Allocation dam^3	Est. Actual Use dam^3
Irrigation	422,530	186,958
Other Agric	7,194	5,395
Municipal	4,180	1,663
Commercial	20,788	15,466
Industrial	-	-
Other	8,133	8,133
Totals	462,825	217,616
% of median flow	37.1	17.4

Distribution of Water Allocation and Actual Use by Purpose.

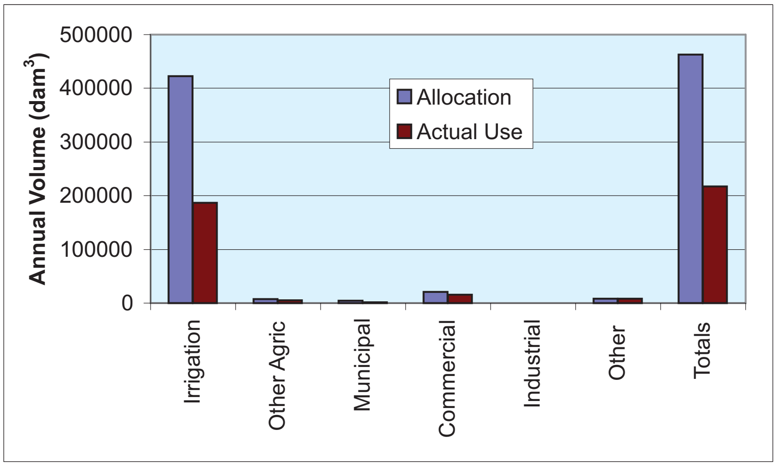


Figure 6.18: Water Demand – Oldman River Near Fort Macleod

Oldman River near Lethbridge

Purpose Sector	Allocation dam^3	Est. Actual Use dam^3
Irrigation	1,731,287	956,575
Other Agric	11,735	8,801
Municipal	53,989	8,581
Commercial	74,534	66,023
Industrial	1,537	1,537
Other	20,376	20,376
Totals	1,893,458	1,061,894
% of median flow	56.7	31.8

Distribution of Water Allocation and Actual Use by Purpose.

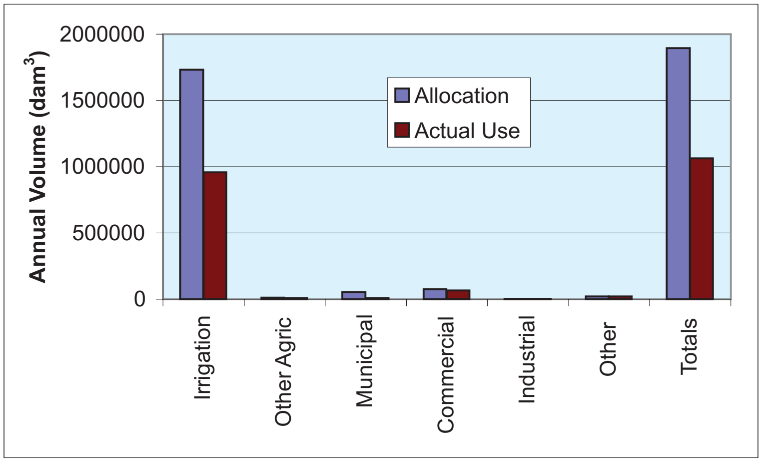


Figure 6.19: Water Demand – Oldman River Near Lethbridge

Surface water allocations on the Oldman River near the Mouth are about 60% of the median natural flows, however actual use is only about 39%. Irrigation is the dominant water use in the catchment and comprises nearly 91% of allocations and actual uses (Figure 6.20). The remaining 9% of allocations and uses are split between commercial, municipal, agriculture and other uses with a very small amount being used for industry. There is potential increases in water use within existing allocations, particularly in the irrigation water use sector.

Performance in Meeting Instream Needs

For the Oldman River near Waldron's Corner, Instream Objectives (IO) deficits occurred in 1.3% of the 120 months assessed (1992 to 2001)[6]. Recorded flows are approximately equal to natural flows at this location, so good performance would be expected. Instream objectives upstream of the Oldman Reservoir are based on Tennant-Tessman environmental flows which are sometimes greater than natural flows. Water Conservation Objectives (WCO) deficits were observed in 2.5% of the months assessed. Deficits in meeting the instream requirements at this location occurred in April, May and June (Figure 6.21).

Oldman River near the Mouth

Purpose Sector	Allocation dam^3	Est. Actual Use dam^3
Irrigation	1,815,175	1,184,863
Other Agric	15,582	11,686
Municipal	55,666	9,698
Commercial	75,800	67,136
Industrial	2,295	2,295
Other	26,921	26,921
Totals	1,991,439	1,302,600
% of median flow	59.6	39.0

Distribution of Water Allocation and Actual Use by Purpose.

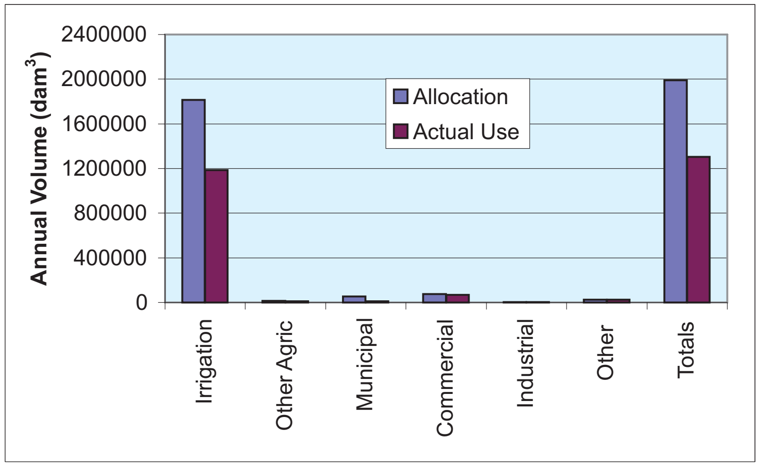


Figure 6.20: Water Demand – Oldman River Near the Mouth

Oldman River near Waldron's Corner

IO and WCO

IO is variable by week.

WCO = MAX(1.1*IO, 0.45*Qnat) m^3/s

Comments:

1 Recorded flow is approximately equal to
2 IO deficits occurred in 1.3% of the months
3 WCO deficits occurred in 2.5% of the
4 Deficits occurred in April, May and June..

Performance in Meeting the WCO and IO 1992-2001

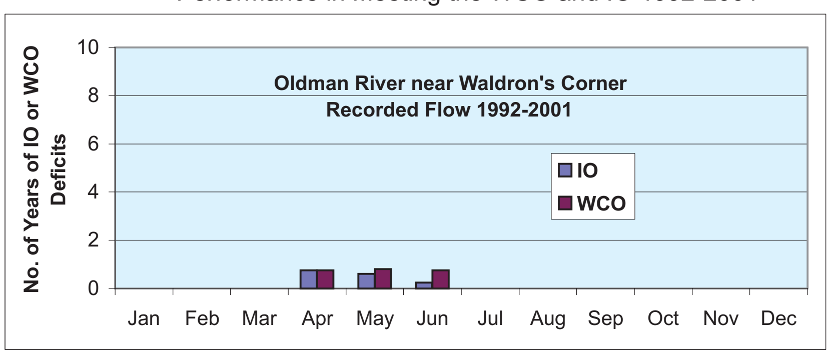


Figure 6.21: Performance in Meeting IO and WCO – Oldman River Near Waldron's Corner

[6] IOs, WCOs, and IFNs are described in Section 1.2.7. Generally, the recommended WCO is 45% of the natural flow or the existing IO plus 10%, whichever is greatest at any point in time. These values vary for different reaches of each stream, and usually vary seasonally. The actual IO or WCO used to assess performance is shown on the appropriate figure. The months where data was available to assess performance is also shown on the appropriate figure.

The performance in meeting the IO and WCO for the Oldman River near Fort Macleod could not be assessed since recorded flows were not available for the period 1992 to 2001.

Deficits in meeting the IO in the Oldman River near Lethbridge occurred in 2.6% of the months assessed, based on recorded flows. Water conservation objectives deficits were observed in 20.4% of the months assessed. Deficits in meeting the IO were most frequent in May. Water conservation objectives deficits were most frequent in the May to August period (Figure 6.23).

Deficits in meeting the IO in the Oldman River near the Mouth occurred in 1.6% of the months assessed, based on 1992 to 2001 recorded flows. Water conservation objectives deficits were observed in 16.4% of the months assessed. Deficits in meeting the WCOs were most frequent in May, June and July (Figure 6.24).

Oldman River near Brocket

IO and WCO

IO is variable.

WCO = MAX(1.1*IO, 0.45*Qnat) m^3/s

Comments:

1 IO and WCO are based on Segment 5 and
2 IO deficits occurred in 9.3% of the months
3 WCO deficits occurred in 18.0% of the
4 Deficits were most frrequent in winter

Performance in Meeting the WCO and IO 1992-2001

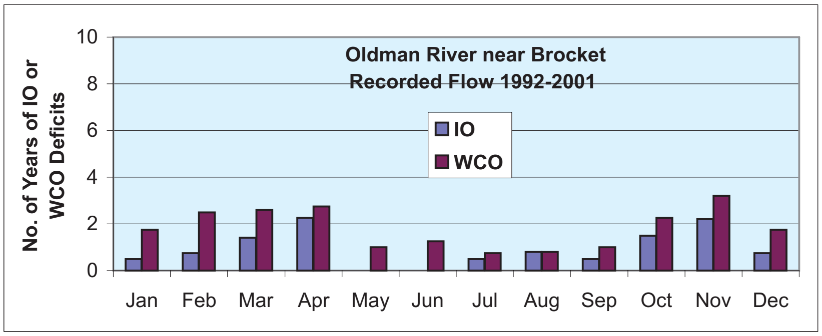


Figure 6.22: Performance in Meeting IO and WCO – Oldman River Near Brocket

Oldman River near Lethbridge

IO and WCO

IO is variable.

WCO = MAX(1.1*IO, 0.45*Qnat) m^3/s

Comments:

1 IO and WCO are based on Segment 1
2 IO deficits occurred in 2.6% of the months
3 WCO deficits occurred in 20.4% of the
4 Deficits were most frequent in summer

Performance in Meeting the WCO and IO 1992-2001

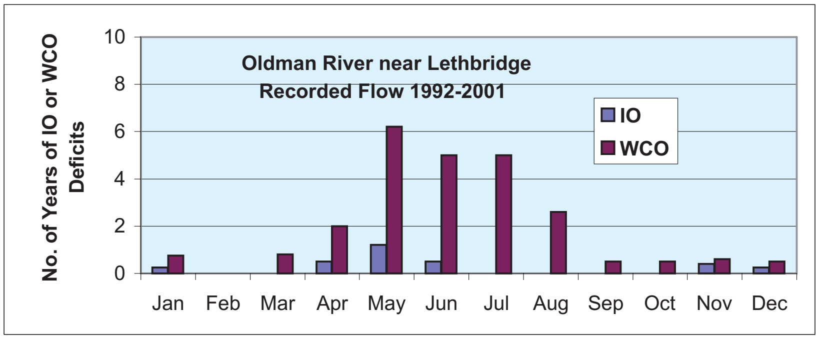


Figure 6.23: Performance in Meeting IO and WCO – Oldman River Near Lethbridge

Oldman River near the Mouth

IO and WCO
IO is variable.
WCO = MAX(1.1*IO, 0.45*Qnat) m^3/s

Comments:
1 IO and WCO are based on Segment 1
2 IO deficits occurred in 1.6% of the months
3 WCO deficits occurred in 16.4% of the
4 Deficits were most frequent in May, June

Performance in Meeting the WCO and IO 1992-2001

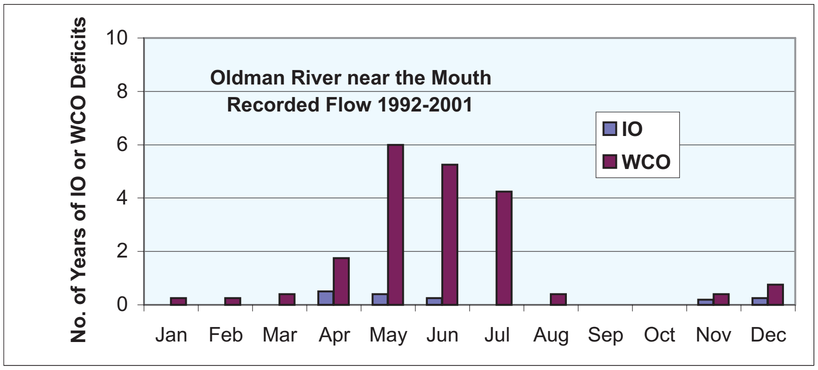


Figure 6.24: Performance in Meeting IO and WCO – Oldman River Near the Mouth

Irrigation and Municipal Water Use

The LNID is the only district supplied directly from the Oldman River. Its water use efficiency is included under the Irrigation Water Use Efficiency section (Section 7.3).

Communities using surface water from the Oldman River are:

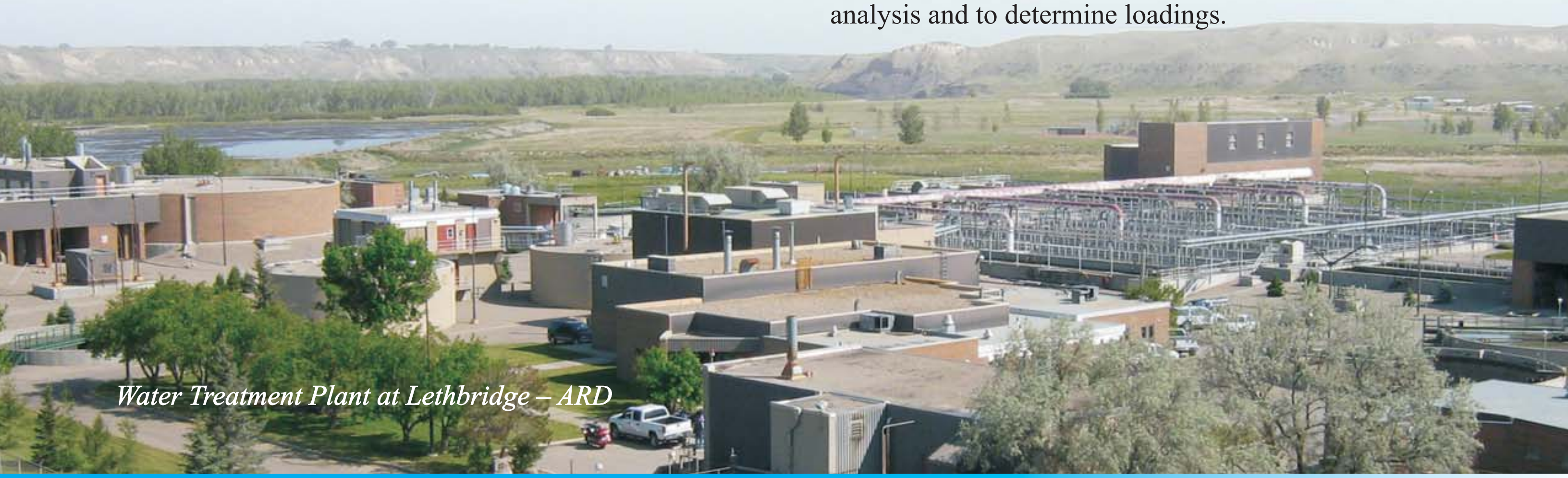
- Lethbridge;
- Fort Macleod;
- Coaldale;
- Coalhurst;
- Barons; and
- Nobleford.

Per capita surface water use for all communities in the entire Oldman watershed is summarized in the Municipal Water Use Efficiency section (Section 7.3).

6.1.3 Water Quality

Water quality monitoring has occurred along the Oldman River for many years for different purposes. Some monitoring programs were conducted to identify pollutant plumes in the river, some of them were undertaken to identify specific effects on the river, and others were designed to provide an overall picture of river health. The water quality monitoring stations assessed along the Oldman River are located near Waldron's Corner and Olin, downstream of the Oldman Reservoir, near Brocket, near Fort MacLeod, above Lethbridge, near Diamond City, above Picture Butte, north of Taber and below Taber near the confluence with the Bow River. These sites are distributed along the river as shown in Figure 6.25.

An increase in water quality monitoring efforts occurred around 1991 and continued until around 2005 at many sites. Three sites have more current water quality data, including the sites near Brocket, above Lethbridge and north of Taber. Data at several sites were combined along the river reach to enhance trend analysis and to determine loadings.



Water Treatment Plant at Lethbridge – ARD

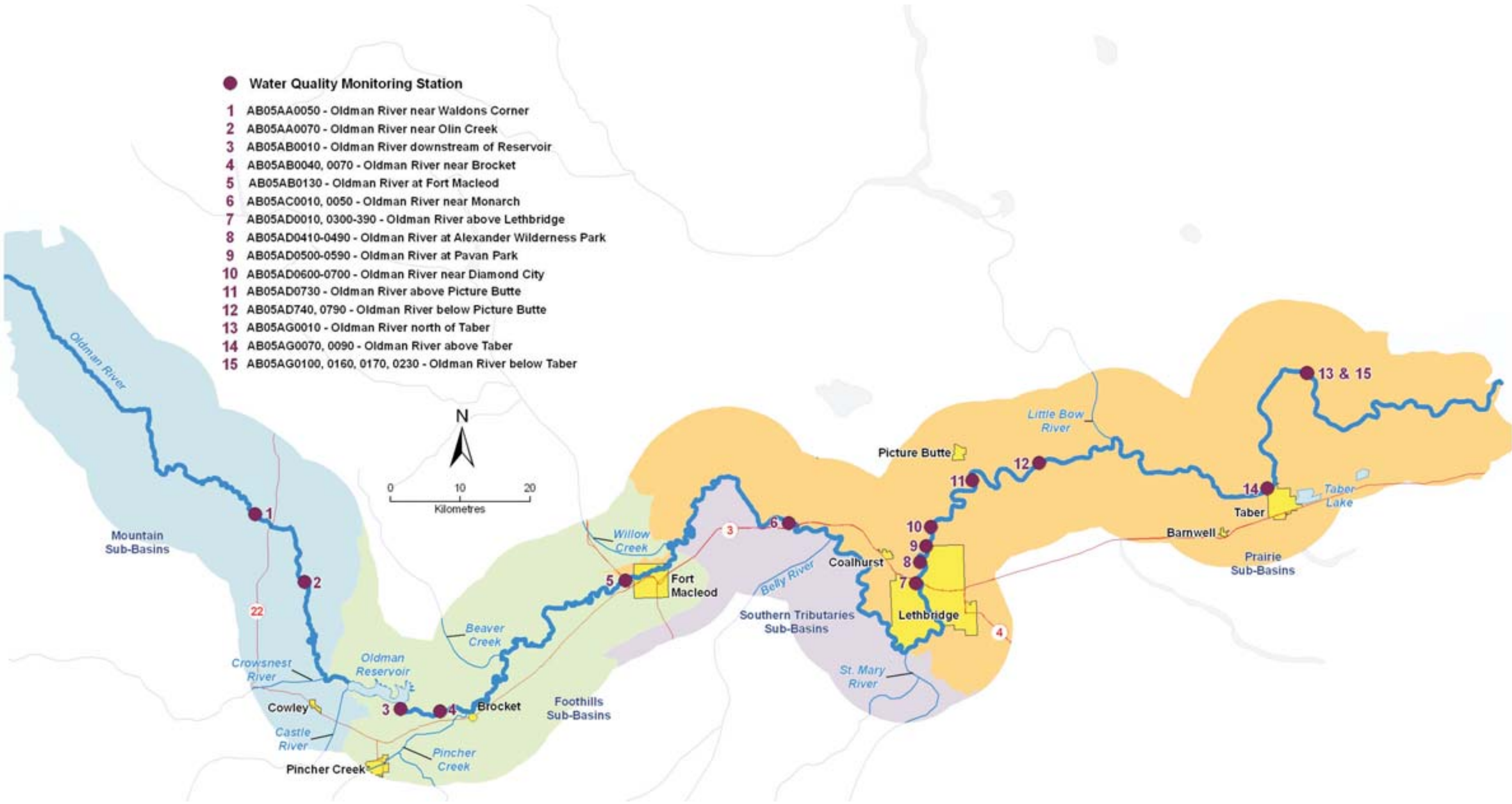


Figure 6.25: Water Quality Monitoring Stations in the Oldman River

Total Nitrogen

Total nitrogen was analyzed in the Oldman River mainstem. The temporal distribution of data collected along the Oldman River is shown in Appendix D.

The median total nitrogen concentration in the Oldman River mainstem did not exceed the guideline during the period from 1970 to 2008 with the exception of several sites in 2005, and one site in 1979 (Table 6.5).

Total nitrogen loadings for 1984, 1985, 1991, 1992, and 1998 to 2000 are indicated in Figure 6.26 for sites on the Oldman River. Loadings of total nitrogen increased in 1985 as compared to 1984, due to higher nitrogen concentrations. In 1991, loadings of total nitrogen were higher than in 1992 due to flow volumes at the sites upstream of Fort Macleod and higher concentrations in the downstream reaches. Loadings generally decreased due to decreasing concentrations during the period from 1998 to 2000.

Alberta Environment Surface Water Quality Guidelines for Protection of Aquatic Life threshold:

Total Nitrogen = 1.0 mg/L

Total Phosphorus = 0.05 mg/L

Table 6.5: Annual Median Total Nitrogen (mg/L) Guideline Adherence by Site

Monitoring Sites	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
OLDMAN RIVER NEAR WALDRON'S CORNER							< 1.0 *								< 1.0	< 1.0	< 1.0					< 1.0	< 1.0	< 1.0 *																
OLDMAN RIVER NEAR OLIN CREEK NORTH OF COWLEY																< 1.0									< 1.0	< 1.0	< 1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0		*				
OLDMAN RIVER D/S OF RESERVOIR BOTTOM RELEASE																						< 1.0	< 1.0	< 1.0 *	< 1.0	< 1.0	< 1.0	< 1.0 *	< 1.0	< 1.0	< 1.0		< 1.0	< 1.0		*				
OLDMAN RIVER NEAR BROCKET															< 1.0	< 1.0	< 1.0					< 1.0	< 1.0	< 1.0	*				< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0 *
OLDMAN RIVER AT FORT MACLEOD															< 1.0	< 1.0	< 1.0					< 1.0	< 1.0	< 1.0 *					< 1.0	< 1.0	< 1.0					1.0 - 5.0 *				
OLDMAN RIVER NEAR MONARCH																										< 1.0 *	< 1.0 *	< 1.0 *	< 1.0	< 1.0	< 1.0					1.0 - 5.0 *				
OLDMAN RIVER ABOVE LETHBRIDGE							< 1.0	< 1.0		1.0 - 5.0 *					< 1.0	< 1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0 *
OLDMAN RIVER AT PAVAN PARK																										< 1.0 *	< 1.0 *	< 1.0 *												
OLDMAN RIVER NEAR DIAMOND CITY																						< 1.0	< 1.0	< 1.0 *		< 1.0 *	< 1.0 *	< 1.0 *					< 1.0							
OLDMAN RIVER ABOVE PICTURE BUTTE																											< 1.0 *	< 1.0 *	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.0 - 5.0 *				
OLDMAN RIVER BELOW PICTURE BUTTE							< 1.0 *								< 1.0	< 1.0						< 1.0	< 1.0			< 1.0 *	< 1.0 *	< 1.0 *	< 1.0	< 1.0	< 1.0		< 1.0	< 1.0		1.0 - 5.0 *				
OLDMAN RIVER AT HWY 36 BRIDGE NORTH OF TABER																		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0 *
OLDMAN RIVER ABOVE TABER							< 1.0 *								< 1.0	< 1.0										< 1.0 *	< 1.0 *	< 1.0 *	< 1.0	< 1.0	< 1.0		< 1.0	< 1.0		1.0 - 5.0 *				
OLDMAN RIVER BELOW TABER							< 1.0	< 1.0							< 1.0	< 1.0	< 1.0									< 1.0 *	< 1.0 *	< 1.0 *	< 1.0	< 1.0	< 1.0					1.0 - 5.0 *				

* median not calculated, results shown are based on less than 3 samples

No Data
< 1.0 mg/L (below guideline)
1.0 - 5.0 mg/L
> 5.0 mg/L

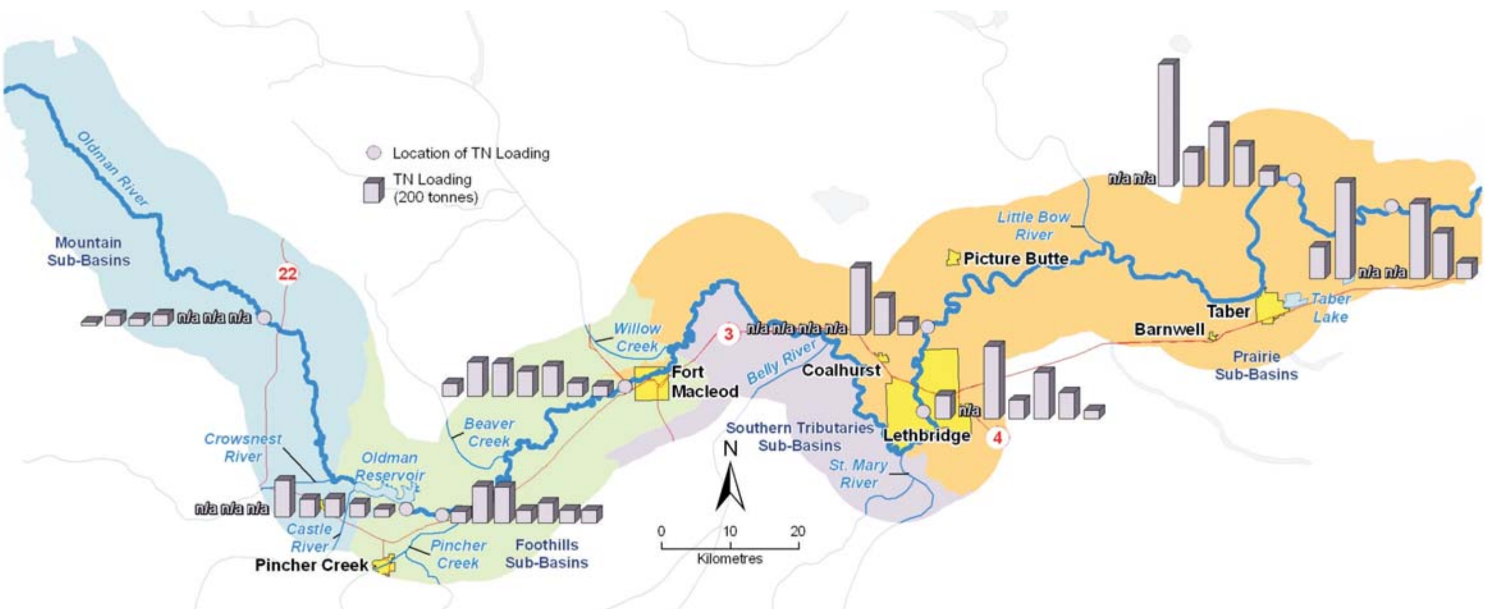


Figure 6.26: Total Nitrogen Loadings in the Oldman River (1984, 1985, 1991, 1992, 1998, 1999, 2000)

Phosphorus

Total phosphorus was analyzed at a number of locations on the Oldman River. The temporal distribution of total phosphorus data collected since 1970 is shown in Appendix D.

Total phosphorus in the Oldman River mainstem often exceeded the guideline (Table 6.6) during the period from 1970 to 1997. No exceedances in median total phosphorus concentrations have been observed since 1997 except peak concentrations during the 2005 high water event.

Total phosphorus loadings for 1984, 1985, 1991, 1995, 1998 to 2000 and 2002 are indicated on Figure 6.27 for eight locations along the Oldman River mainstem. Loadings of total phosphorus were higher in 1991 than any other year, for all locations sampled. The water quality monitoring site below Taber was not sampled in 1991; however in 1985, the loadings were much higher than any other year. Generally, concentrations tended to increase with distance downstream of the headwaters, and this increase as well as increase in flow volumes contributes to increased loadings at the sampled sites. In 1998 and 2002, the site near Diamond City exhibited higher loadings than the downstream sites due to increased concentrations of total phosphorus at that location. The increase in loadings of total phosphorus with distance downstream occurs due to combined effects of runoff and flow volumes into the Oldman River as it moves through the watershed. It can be generally acknowledged that improvement in phosphorus levels in the Oldman River downstream of Lethbridge can be attributed to improvements in municipal wastewater treatment in 1999.

Table 6.6: Annual Median Total Phosphorus (mg/L) Guideline Adherence by Site

Monitoring Sites	1970	1970	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
OLDMAN RIVER NEAR WALDRON'S CORNER																								*																
OLDMAN RIVER NEAR OLIN CREEK NORTH OF COWLEY																																				*				
OLDMAN RIVER D/S OF RESERVOIR BOTTOM RELEASE																								*				*								*				
OLDMAN RIVER NEAR BROCKET											*	*	*												*															*
OLDMAN RIVER AT FORT MACLEOD																								*												*				
OLDMAN RIVER NEAR MONARCH																										*	*	*								*				
OLDMAN RIVER ABOVE LETHBRIDGE																																								*
OLDMAN RIVER AT PAVAN PARK																								*		*	*	*												
OLDMAN RIVER NEAR DIAMOND CITY											*	*													*		*	*								*				
OLDMAN RIVER ABOVE PICTURE BUTTE																																								
OLDMAN RIVER BELOW PICTURE BUTTE							*																		*	*	*	*								*				
OLDMAN RIVER AT HWY 36 BRIDGE NORTH OF TABER																																								*
OLDMAN RIVER ABOVE TABER																										*	*	*								*				
OLDMAN RIVER BELOW TABER																											*									*				

* median not calculated, results shown are based on less than 3 samples

No Data
< 0.05 mg/L (below guideline)
0.05 - 0.5 mg/L
> 0.5 mg/L

Bird Watching at Stirling Lake – R. Coffey

Runoff – C. Dash

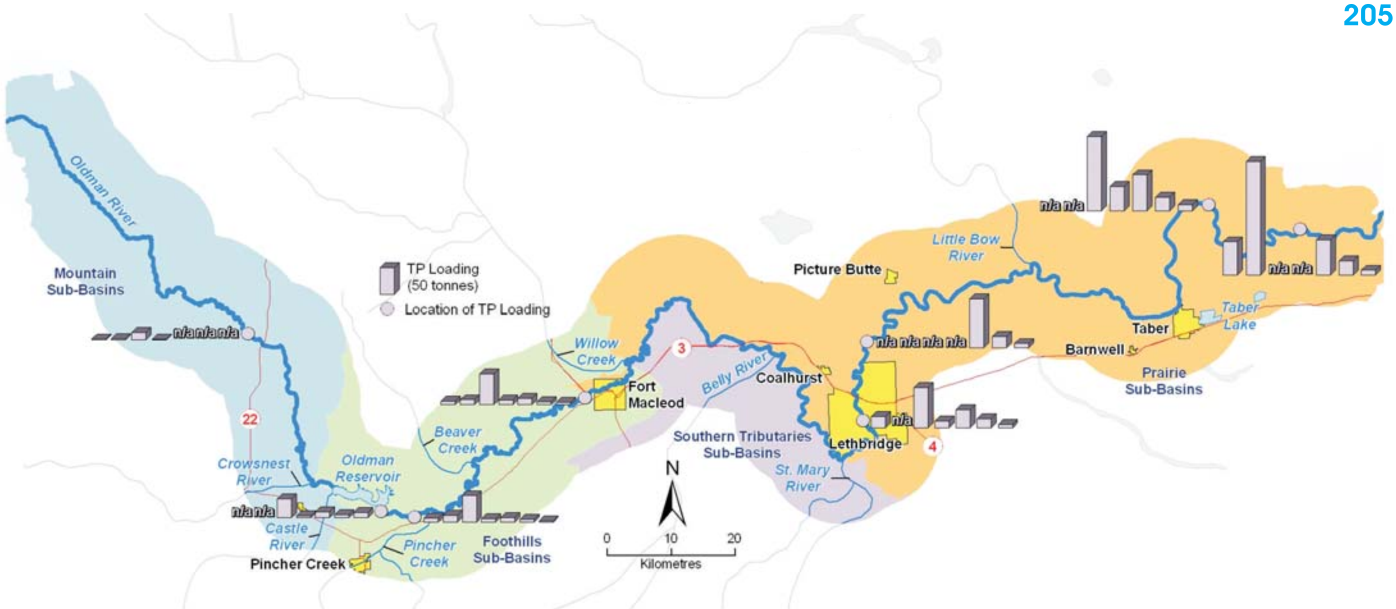


Figure 6.27: Total Phosphorus Loadings in the Oldman River (1984, 1985, 1991, 1992, 1998, 1999, 2000)

Total Suspended Solids

Total suspended solids (TSS) have been sampled on the Oldman River mainstem since 1971 (Appendix D).

The median annual TSS concentrations for stations in the Oldman River mainstem are compared to the medians for the same locations assessed over the whole period of observation and presented in Table 6.7. Long-term TSS values are generally quite low, indicating a system relatively low in suspended sediment content. Total suspended solids concentrations vary from year to year and sometimes are double the median concentrations. However, they are still at relatively low levels, which indicates that sediment-laden runoff into the Oldman River mainstem is not a concern at this time.

Total suspended solids loadings on the Oldman River mainstem (Figure 6.28) generally tend to increase as the river moves through the watershed and flow increases. However, for several years, the monitoring sites near Lethbridge had higher loadings than downstream. These particular increases in loadings were generally related to higher concentrations rather than higher flows. Contrary to this, higher flows caused increased loadings near Waldron's Corner and near Brocket in 1991, and above Lethbridge.

Table 6.7: Annual Median TSS (mg/L) Compared to Data Set Median

Monitoring Sites	Median	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
OLDMAN RIVER NEAR WALDRON'S CORNER	2																								*																
OLDMAN RIVER NEAR OLIN CREEK NORTH OF COWLEY	5																													*							*				
OLDMAN RIVER D/S OF RESERVOIR BOTTOM RELEASE	2																								*				*	*							*				
OLDMAN RIVER NEAR BROCKET	3											*	*	*												*				*											*
OLDMAN RIVER AT FORT MACLEOD	7																								*					*							*				
OLDMAN RIVER NEAR MONARCH	8																										*	*	*	*							*				
OLDMAN RIVER ABOVE LETHBRIDGE	9			*	*	*		*																																	*
OLDMAN RIVER AT PAVAN PARK	10																								*		*	*	*												
OLDMAN RIVER NEAR DIAMOND CITY	8											*	*	*														*	*	*							*				
OLDMAN RIVER ABOVE PICTURE BUTTE	172			*																																					
OLDMAN RIVER BELOW PICTURE BUTTE	9			*		*		*																			*	*	*	*							*				
OLDMAN RIVER AT HWY 36 BRIDGE NORTH OF TABER	7																																								*
OLDMAN RIVER ABOVE TABER	16			*		*																					*	*	*	*							*				
OLDMAN RIVER BELOW TABER	9		*	*		*			*																		*		*	*							*				

* median not calculated, results shown are based on less than 3 samples

- no data
- < median
- 0%-100% above median
- >100% above median

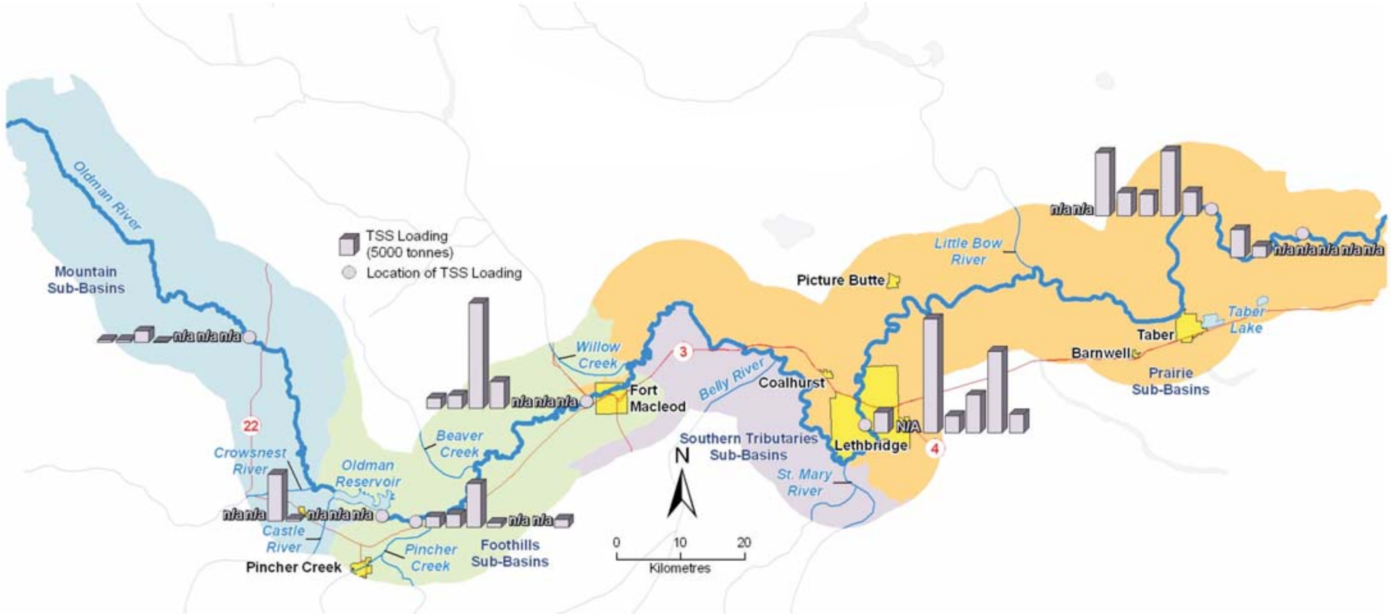


Figure 6.28: Total Suspended Solids Loadings in the Oldman River (1984, 1985, 1991, 1992, 1998, 1999, 2000)

Fecal Coliforms

The temporal distribution of fecal coliform data collected along the mainstem of the Oldman River is displayed in Appendix D.

Fecal coliform counts vary throughout the Oldman watershed; however exceedances in median annual counts along the mainstem of the Oldman River are not common. Median annual fecal coliform values exceeded guidelines at several sites in 1996 and 1997 and recently in 2005 (Table 6.8). All exceedances occurred in higher flow years and may be due to increased surface runoff. In most cases, such exceedances were observed once or twice and are likely uncommon.

Annual loadings of fecal coliforms in the Oldman River were assessed for 1984, 1985, 1991, 1992, 1998 to 2000 and 2002 (Figure 6.29). Loadings were highest in 1998 for seven of the eight sites assessed; however, above Lethbridge, loadings were highest in 1991 due to high fecal coliform counts. The high fecal coliform loadings observed in 1998 were due to both high concentrations and high flow volumes. Loadings were higher at the sampling site near Diamond City during all years with available data.

Alberta Environment Surface Water Quality Guidelines for Irrigation threshold:
Fecal Coliforms = 100 coliforms/100 mL

Water Sampling on the Oldman River – ARD

Table 6.8: Annual Median Fecal Coliform Count Guideline Adherence by Site

Monitoring Sites	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
OLDMAN RIVER NEAR WALDRON'S CORNER															< 100	< 100	< 100					< 100	< 100	< 100 *																
OLDMAN RIVER NEAR OLIN CREEK NORTH OF COWLEY																< 100									< 100	< 100	< 100		< 100	< 100	< 100	< 100	< 100	< 100		> 1000 *				
OLDMAN RIVER D/S OF RESERVOIR BOTTOM RELEASE																									< 100		< 100 *	< 100 *	< 100	< 100	< 100	< 100	< 100	< 100		100 - 1000 *				
OLDMAN RIVER NEAR BROCKET															< 100	< 100	< 100					< 100	< 100	< 100	< 100 *		< 100 *		< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100 *
OLDMAN RIVER AT FORT MACLEOD															< 100	< 100	< 100					< 100	< 100	< 100 *					< 100	< 100	< 100					> 1000 *				
OLDMAN RIVER NEAR MONARCH																											100 - 1000 *	100 - 1000 *	< 100	< 100	< 100					> 1000 *				
OLDMAN RIVER ABOVE LETHBRIDGE	< 100	< 100	< 100	< 100	< 100		< 100	< 100		< 100 *					< 100	< 100		< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100 *
OLDMAN RIVER AT PAVAN PARK																											100 - 1000 *	100 - 1000 *					100 - 1000							
OLDMAN RIVER NEAR DIAMOND CITY																											100 - 1000 *	100 - 1000 *	100 - 1000	< 100	< 100	< 100	< 100	< 100	< 100	> 1000 *				
OLDMAN RIVER ABOVE PICTURE BUTTE	> 1000 *	< 100 *	< 100	< 100																																				
OLDMAN RIVER BELOW PICTURE BUTTE	< 100	< 100	< 100	< 100	< 100 *		< 100 *								< 100	100 - 1000						100 - 1000	< 100			100 - 1000 *	100 - 1000 *	100 - 1000 *	< 100	< 100	< 100		< 100	< 100		> 1000 *				
OLDMAN RIVER AT HWY 36 BRIDGE NORTH OF TABER																		< 100	< 100	< 100	< 100	< 100	< 100	100 - 1000	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100 *
OLDMAN RIVER ABOVE TABER	< 100	< 100	< 100	< 100	< 100 *		< 100								< 100	< 100										< 100 *	< 100 *	100 - 1000 *	< 100	< 100	< 100		< 100	< 100		> 1000 *				
OLDMAN RIVER BELOW TABER	< 100	< 100	< 100	< 100	< 100		< 100	< 100							< 100	< 100	< 100									< 100 *	< 100	< 100 *	< 100	< 100	< 100					> 1000 *				

* median not calculated, results shown are based on less than 3 samples

No Data

< 100 per 100 mL (below guideline)

100 - 1000 per 100 mL

> 1000 per 100 mL

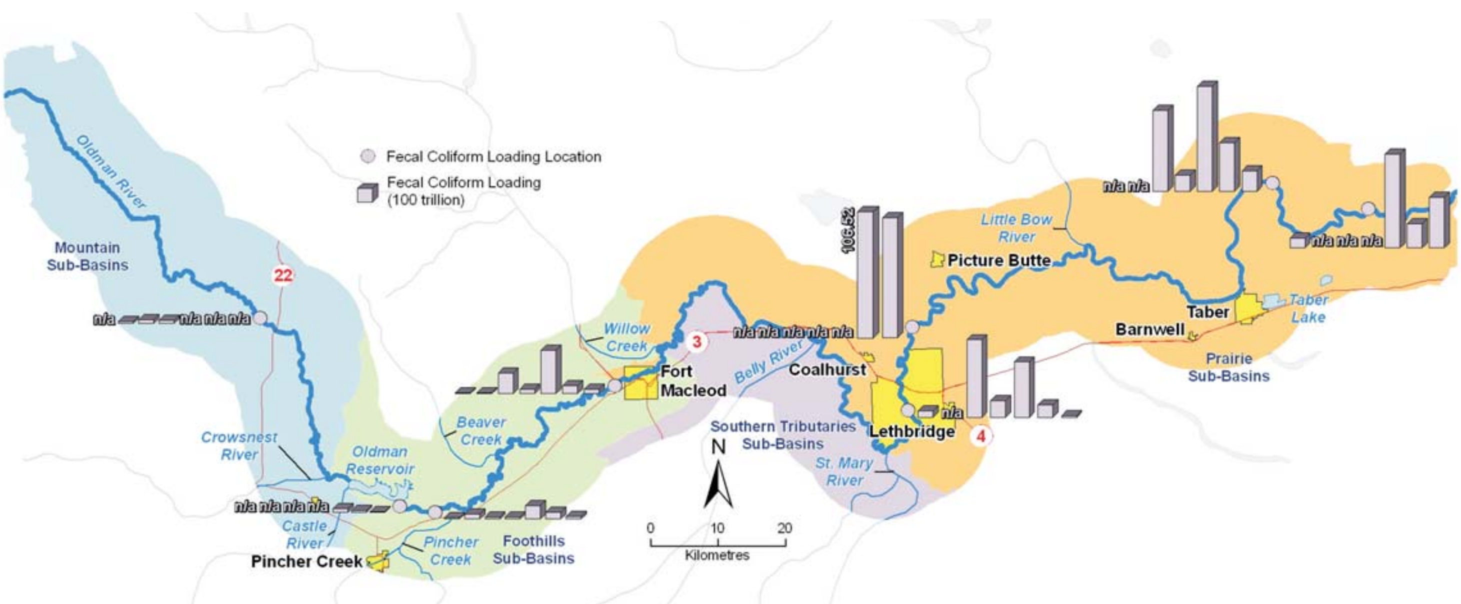


Figure 6.29: Fecal Coliform Loadings in the Oldman River (1984, 1985, 1991, 1992, 1998, 1999, 2000

Oldman River Mainstem Water Quality Overview for Non-Indicator Parameters

Temperature[2]

The median water temperature in the Oldman River, from 1998 to 2003, ranged from 3.6°C upstream of the reservoir to 8.7°C above Lethbridge and 9.6°C north of Taber. The maximum temperature in the Oldman River between 1998 and 2003 was 26.5°C southwest of Diamond City.

pH[2]

In the Oldman River, the pH ranged from 7.4 to 9.0 from 1998 to 2003. The median pH values at all stations along the Oldman River were relatively similar with a very small increase in pH observed in the downstream reaches as compared to the headwaters.

Dissolved Oxygen[2]

Median dissolved oxygen concentrations were somewhat lower in the downstream reaches of the Oldman River than in the upstream reaches, though maximum and minimum values did not show the same pattern. The median dissolved oxygen values in the Oldman River ranged from 9.97 mg/L to 11.6 mg/L during the period from 1998 to 2003.

Hardness[2]

During the period from 1998 to 2003, the Oldman River upstream of the reservoir had a median hardness level of 170 mg $CaCO_3$/L which is classified as "very hard" by Health Canada[3]. Downstream of the reservoir, median hardness was in the "hard" classification, ranging from 140 to 160 mg $CaCO_3$/L. Maximum hardness values along the Oldman River ranged from 170 to 250 mg $CaCO_3$/L and did not display any spatially related patterns.

Metals and Ions[2]

Metals concentrations were very low the Oldman River with median values of dissolved iron and manganese generally below detection levels. Ions measured between 1998 and 2003 included fluoride, chloride, and sulphate. Median dissolved fluoride concentrations in the Oldman River were consistently above the Guideline for the Protection of Aquatic Life (0.12 mg/L). Median chloride and sulphate concentrations in the Oldman River were well below all guideline levels.

Pesticides[2]

Pesticide concentrations in the Oldman River were generally below the water quality guidelines for the protection of aquatic life during the sampling period between 1998 and 2003. Exceedances of the guidelines for MCPA were observed at several sites downstream of Brocket in 1998, 2000, 2001 and 2002. Exceedances of the Dicamba guidelines also occurred downstream of Brocket in 1998, 2000, 2001 and 2002.

Water Quality Indices[1]

Water quality indices combine several indicators and using a predetermined scale assign a rating to the overall water quality. Along the Oldman River in 1998[2], the water quality index indicates that in the upstream reaches, water quality was quite good with a small decline around Fort Macleod. Improvements were observed near Lethbridge with another decline around the confluence with the Little Bow River. Near the confluence with the Bow River, the quality again improved. In 2002 fewer sites were evaluated, however fair water quality was observed downstream of Lethbridge and a slight increase in quality occurred near Taber.

Sources:

[1.] Oldman Watershed Council (OWC). 2005. Oldman River Basin Water Quality Initiative - Five Year Summary Report.

[2.] Saffran, K. 2005. Oldman River Basin Water Quality Initiative Surface Water Quality Summary Report April 1998 - March 2003, Oldman River Basin Water Quality Initiative.

[3] Health Canada 2009.

Guidelines: AENV 1999; CCME 2005.

6.2 Current Issues and Trends

6.2.1 Terrestrial and Riparian Indicators

Land cover along the floodplain and valley banks of the Oldman River mainstem is primarily grassland and forest. The western portion of the valley is dominated by forest of spruce, fir and pine which change to cottonwoods, grassland and minor cultivated areas moving east. Due to the risk of flooding, few facilities such as dwellings or CFOs occur in the valley. Erosion risk is rated low to negligible. Riparian health is below average for the watershed in part due to use of the area for winter grazing.

6.2.2 Water Quantity

In upstream reaches of the Oldman River recorded flows are equivalent to natural flows because the rivers are unregulated and have low water demands. In the lower reaches of the Oldman River, human activities such as flow regulation, irrigation, municipal and commercial demands affect flow. The Oldman River Dam captures some of the spring runoff to stabilize supplies throughout the low flow period. Additionally, the LNID withdraws water to supply irrigation to land north and west of Lethbridge. These controls and withdrawals affect downstream flows considerably so that flows downstream of the Oldman River Dam are quite different from natural flows. Near the mouth of the Oldman River, the average annual recorded flow is about 64% of the average annual natural flow for period 1992 to 2001 (Figure 6.10).

No significant annual trends in streamflow exist in the Oldman River mainstem, however, probable decreasing trends occurred at several locations in April, November and December.

The river performs well in meeting the IOs throughout its length, and almost always meets WCOs upstream of the Oldman River Dam. However, deficits in meeting WCOs downstream of the Oldman River Dam occur in 15 to 20% of the months, based on recorded flows from 1992 to 2001.

6.2.3 Water Quality

Total nitrogen concentrations were typically below water quality guidelines in the Oldman River and loadings generally decreased due to decreasing concentrations during the period from 1998 to 2000. Total phosphorus concentrations in the Oldman River have decreased in recent years with median values staying within the water quality guidelines. Thus, both nutrients showed lower concentrations in the mainstem compare to what was found in the tributaries.

Total suspended solids concentrations were relatively low in the Oldman River mainstem over the monitoring period as well. Concentrations above these median values were observed at values that were still lower compared to sites on the tributaries.

Fecal coliform counts were variable but exceedances in median annual counts along the mainstem of the Oldman River are not common.

Two major periods for trend assessments, of approximately 10 years each, were analyzed based on data availability. One for the period 1988 to 1997 and another for the period 1998 to 2005/2007 (Figures 6.30a and 6.30b). The second period has better spatial coverage and allows comparison with trends at other major sites, e.g., upstream and downstream from Lethbridge, downstream from Taber.

For the reach upstream from Lethbridge, the Oldman River mainstem can be characterized as showing no trend, with occasional decreasing tendencies for nitrogen and fecal coliform indicators. This situation is similar for both periods and does not change much between 1988 and recent years.

The water quality trends downstream from Taber changed from a neutral or decreasing pattern in nitrogen and TSS to an increasing tendency. In contrast to that, the trend in fecal coliform counts changed from increasing in 1988 to 1997 to neutral in the next decade and shows considerable improvement in water quality. These different water quality indicators and their trend characteristics are described below in more detail.

Total nitrogen concentrations in the Oldman River mainstem showed a decreasing trend (at a 90% confidence level) or no trend at monitoring stations near Olin Creek, downstream of the reservoir, and north of Taber during the periods from 1988 to 1997 (Figures 6.30a and 6.30b). From 1998 to 2008, increasing trends in total nitrogen were observed in the Oldman River above Lethbridge and north of Taber (90% confidence level); however, no trend was observed above Lethbridge from 1988 to 1997, and a decreasing trend, at a 90% confidence interval, was observed north of Taber during that time period. The more recent increasing trends above Lethbridge and north of Taber indicate increased nitrogen concentrations in recent years.

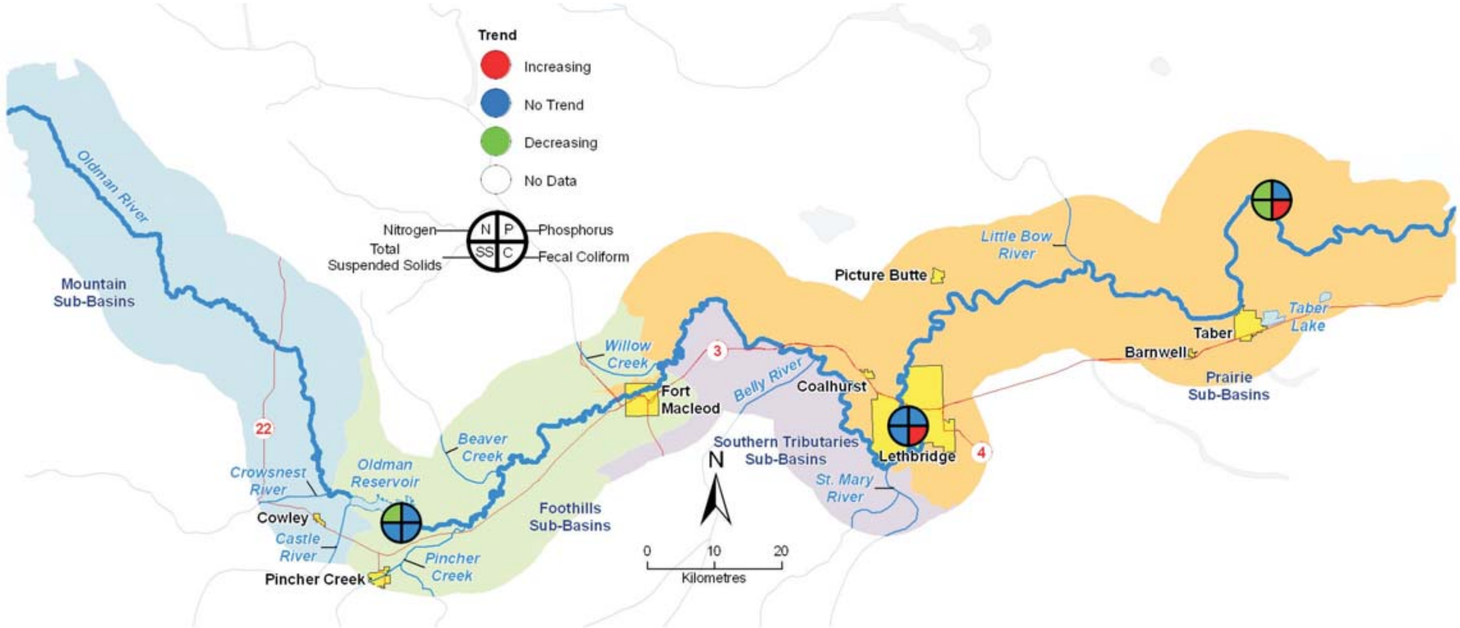


Figure 6.30a: Water Quality Trends in the Oldman River from 1988-1997

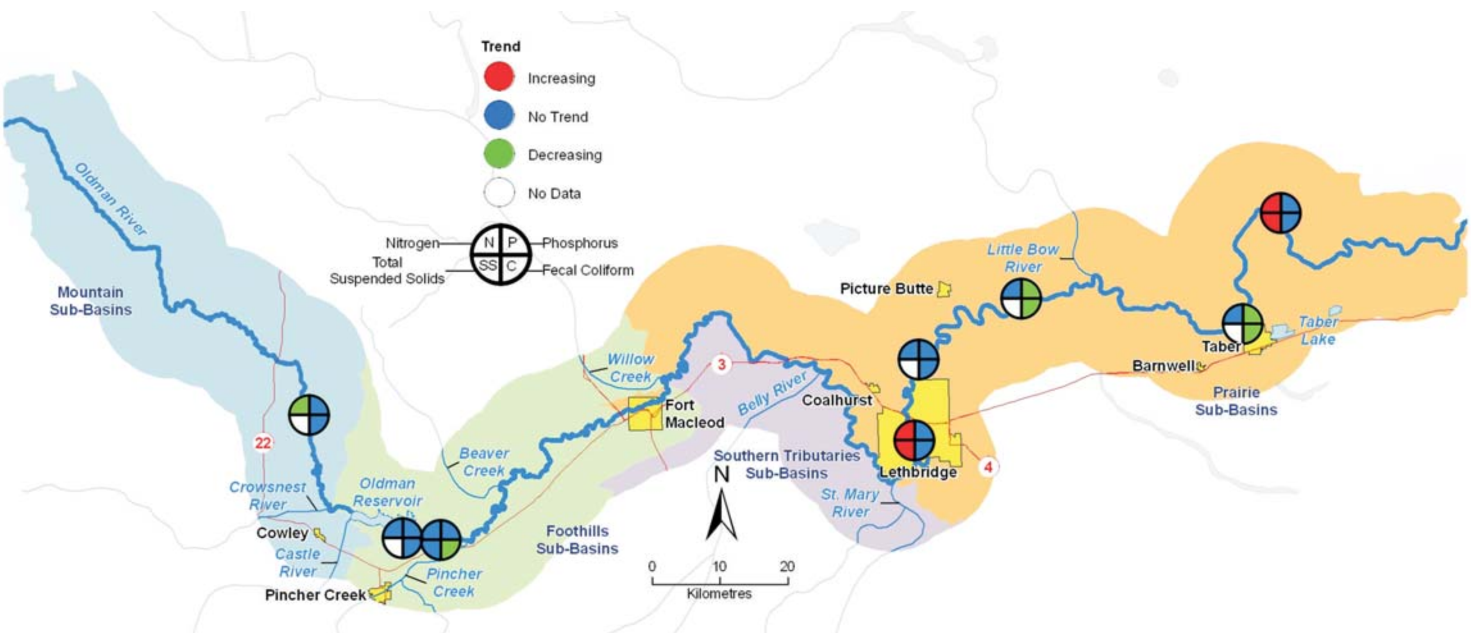


Figure 6.30b: Water Quality Trends in the Oldman River from 1988-2005/2007

Decreasing trends in total phosphorus concentrations were observed in the Oldman River mainstem at stations below Picture Butte and above Taber between 1998 and 2005 at 90% and 80% confidence levels, respectively (Figure 6.30b). No trends were observed at any other sites, between 1988 and 1997 or between 1998 and 2007. The presence of decreasing trends at the two downstream sites corroborates the decrease in concentrations observed (Table 6.6) and indicates an overall decrease in total phosphorus contribution to the Oldman River.

Trends in TSS concentrations varied according to location on the Oldman River mainstem and the period of sampling. Trends in TSS concentrations were not observed on the Oldman River near Brocket in the period from 1998 to 2007 or downstream of the reservoir from 1988 to 1997. No trends were observed from 1988 to 1997 at the monitoring stations on the Oldman River above Lethbridge, however, from 1998 to 2007 an increasing trend was observed at the same site with an 80% confidence level. On the Oldman River north of Taber, a decreasing trend was seen from 1988 to 1997 and an increasing trend in concentrations was observed from 1998 to 2007, at 90% and 80% confidence levels respectively. Other sites in the Oldman River did not have enough data coverage to determine trends. The variability in trends is likely due to the low concentrations of TSS in the Oldman River making every change significant.

Trends in median annual fecal coliform counts were analyzed for the periods from 1988 to 1997 and 1998 to 2007 (Figures 6.30a and 6.30b). In the instance that a site did not have sufficient data in 2006 to 2007, trends were assessed for the period from 1998 to 2005. Generally, no trends were observed at the sites assessed on the Oldman River mainstem from 1988 to 1997; however, increasing trends were observed near Lethbridge and north of Taber at 90% and 80% confidence levels respectively. Trend analysis for the period from 1998 to 2007 generally revealed no trends, however a decreasing trend was found near Brocket (80% confidence level). As well, both the site below Picture Butte and the site above Taber were assessed over the period from 1998 to 2005 and showed decreasing trends in fecal coliform counts at the 80% confidence level. Other sites in the Oldman River mainstem did not have enough data coverage to determine trends.

6.3 Summary

Overall, the Oldman River mainstem is rated as **Fair**. A summary of the observations and analyses of indicators and trends in the Oldman River mainstem is below.

Terrestrial (Good)

- Land cover of natural grassland and forest is 84%, rated good.
- Soil erosion risk is low, rated good.
- Riparian health is healthy but with problems, rated fair to poor.
- Linear developments cover 2% of area, rated fair.
- Total land use at 20%, rated good.

Water Quantity (Poor)

- Relatively high unit yields upstream of Lethbridge. Yields diminish through the grassland region east of Lethbridge.
- No significant trends in natural flow are evident.
- Minor allocations and water use upstream of Brocket, moderate between Brocket and the confluence of the Belly River, and high water use from Lethbridge to the mouth. At the mouth, allocations are about 60% and use is about 39% of median natural flow. The difference between allocation and use indicate that there is significant potential for expansion within existing allocations.
- Only minor IO deficits occur along the mainstem river throughout its length. The frequency of WCO deficits at Brocket is moderate, increasing to major at Lethbridge and the mouth. (Deficits at Fort Macleod could not be determined due to lack of recorded data.)

Water Quality (Good to Fair)

- Nutrients showed lower concentrations in the Oldman River compared to the tributaries.
- Total nitrogen concentrations are typically below water quality guidelines and loadings generally decreased due to decreasing concentrations.
- Total phosphorus concentrations have decreased in recent years and values are usually within the water quality guidelines.

- Total suspended solids concentrations are relatively low in the Oldman River mainstem and values are lower compared to the tributaries.
- Fecal coliform counts are variable along the Oldman River, but exceedances in median annual counts along the mainstem of the Oldman River are not common.
- The water quality trends near Lethbridge and downstream from Taber have changed from a neutral or decreasing pattern in nitrogen and TSS in 1988 to 1997 to an increasing trend since 1998.
- The trend in fecal coliform counts changed from increasing in 1988 to 1997 to neutral in the next decade and shows considerable improvement in water quality.

Similar to the Southern Tributaries Sub-basins, the Oldman River mainstem is heavily allocated. The current actual use plus the WCO is approximately equal to 25% of the natural flow. If the actual use increased by, say 50% (still well within the allocation), the use plus the WCO would exceed the median natural flow.

Management actions should be focused on continuing to monitor diversion rates, timing of withdrawals, and return flow volumes. This information is required to develop plans to manage future growth within existing allocations. Management plans may need to consider options to achieve a sustainable level in the future.

Water quality within the Oldman River mainstem is a function of the combination of inputs from all of the tributary streams. The concentrations of these inputs is diluted as you move downstream and stream volumes increase. Land use indicators show that riparian areas are not healthy. Improved storm water management has occurred in some municipalities. Irrigation district and municipal water use efficiencies within the watershed have decreased water withdrawals and/or increased return flows to the mainstem.

Management plans should focus on increasing the health of riparian areas, preserving the native grasslands, and increasing efforts with water use efficiencies. Overall the focus should be on good land stewardship actions.

Ranching in the Foothills – S. Palechek