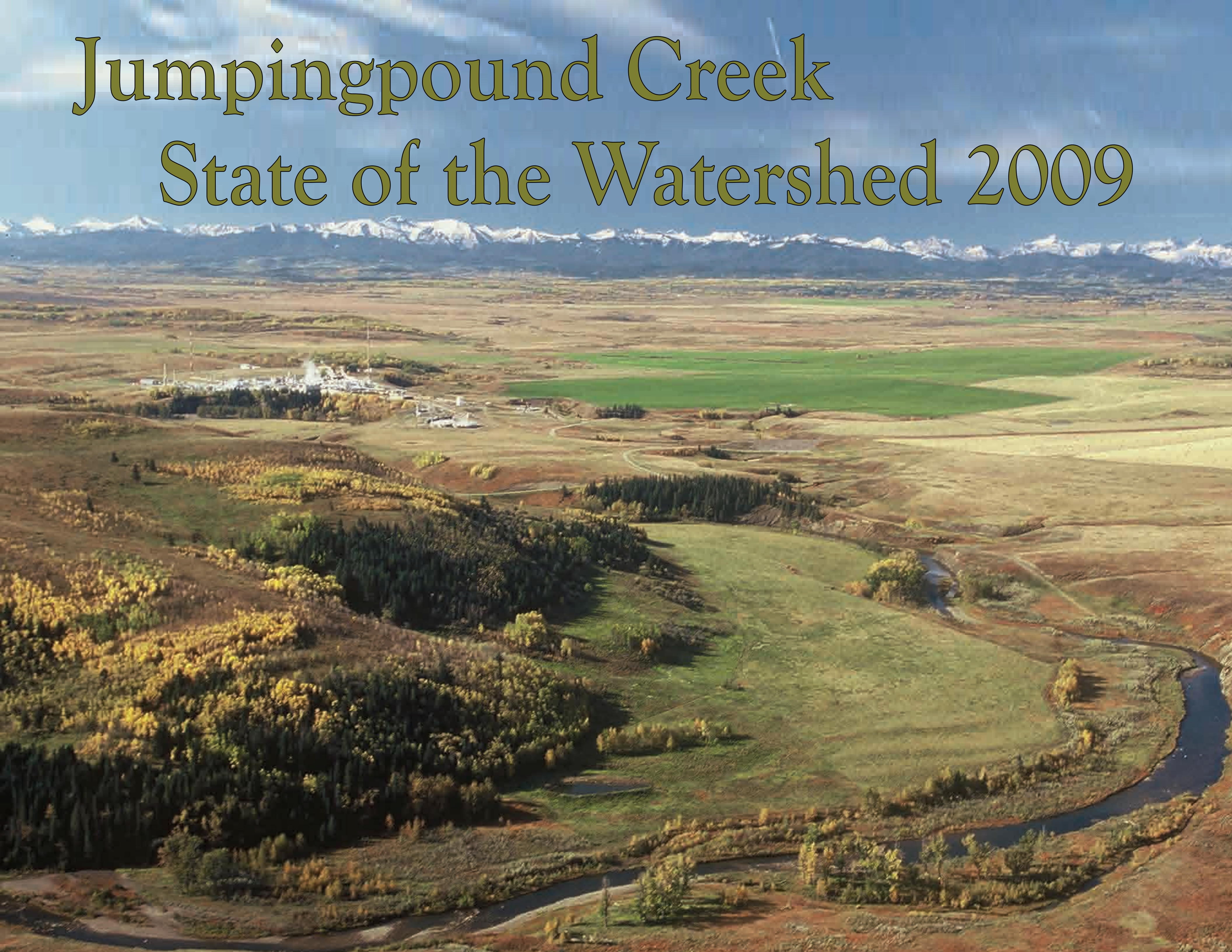
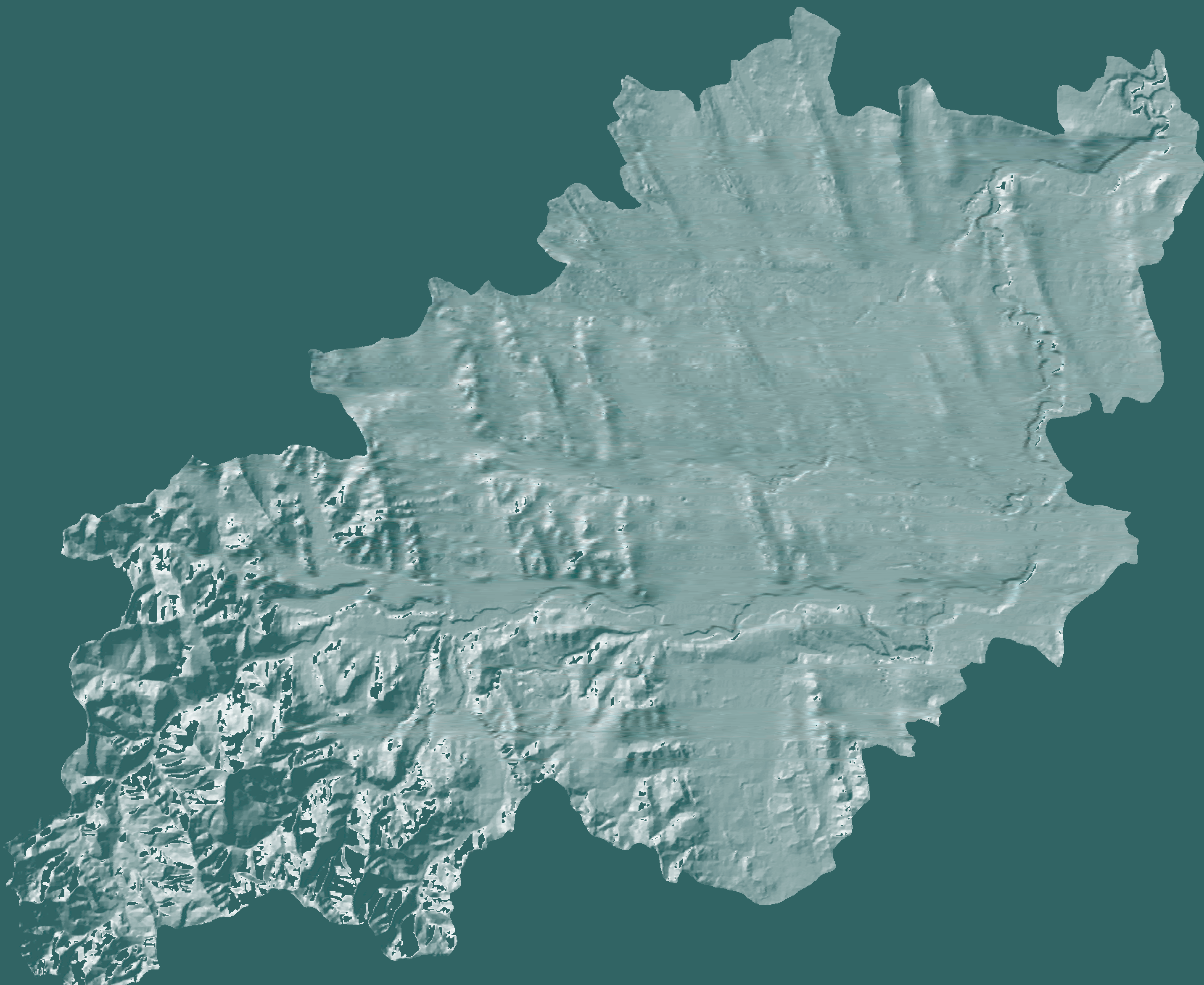
Jumpingpound Creek State of the Watershed 2009





Jumpingpound Creek
State of the Watershed Report
2009

Prepared by the
Jumpingpound Creek Watershed Partnership

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1.0 INTRODUCTION

Jumpingpound Creek Watershed Partnership

The Jumpingpound Creek Watershed Partnership (JCWP) is a multi-stakeholder group represented by local landowners, non-government, government and industry representatives. The Partnership is represented by a 10 member Steering Committee who are interested in watershed management.

During the next two years, the main focus of the JCWP will be to facilitate the Jumpingpound Creek Integrated Watershed Management Plan process, in partnership with all watershed stakeholders, to ensure good water quality and ample water quantity to sustain future generations. The watershed management plan will encourage good management of watershed resources that will benefit the people living and working in the watershed, as well as the wildlife and unique vegetation relying on Jumpingpound Creek, its tributaries and wetlands.

The State of the Watershed Report

This State of the Watershed (SOW) report is the first step in watershed management planning. It identifies water and land resources and documents the current pressures from human use that are placed on these natural resources. It identifies indicators that can be monitored through time to help direct management of water and land in a way that will maintain the health of the watershed into the future. Ultimately, the State of the Watershed report acts as a decision support tool for land managers.

The Jumpingpound Creek State of the Watershed report describes the watershed, administration, geography, aquatic resources, including water supply (i.e., surface and groundwater), water quality, riparian areas, wetlands, fisheries and wildlife. Land use practices in the watershed are also described.

"Watershed management will be important to maintain water and land resources in Jumpingpound Creek for future generations."

Jumpingpound Creek Watershed

The Jumpingpound Creek watershed encompasses an area of approximately 604 km^2 and is located west of the City of Calgary, and south and west of the Town of Cochrane (Map 1).

Jumpingpound Creek bisects the watershed, flowing northeast a distance of about 87 km before joining the Bow River. The watershed is a diverse landscape having elevations ranging from 1,123 m at the confluence of the Bow River to 2,492 m at the highest peak.

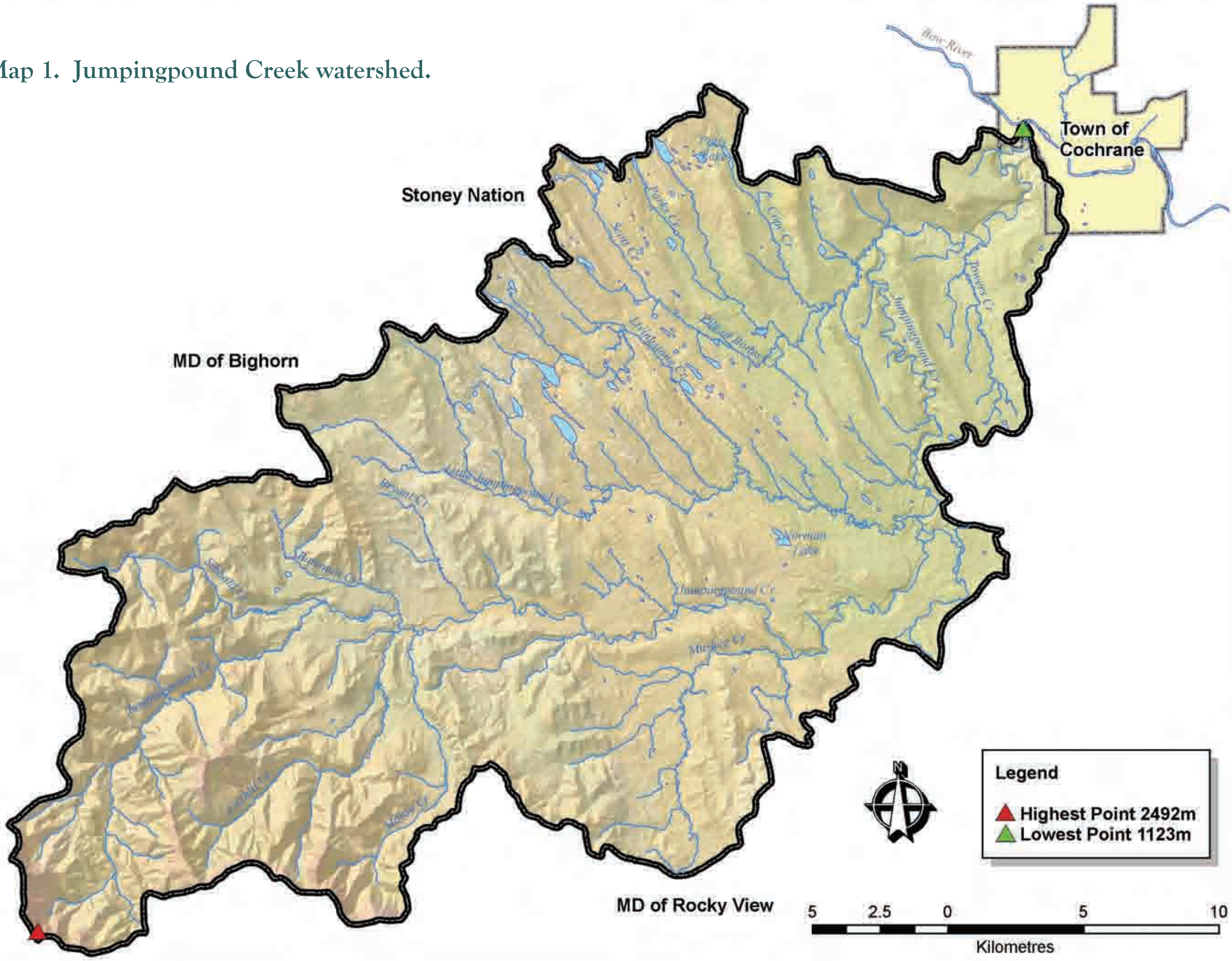
Jumpingpound Creek rises in the Rocky Mountains, in the Alpine and Subalpine Natural Subregions. A number of permanent and intermittent creeks join Jumpingpound Creek from the north and the south. The most notable permanent creeks include Coxhill, Moose and Muskeg creeks to the south and Little Jumpingpound Creek to the north (Map 1).

North of Highway 1, tributaries are generally intermittent, contributing large flow volumes during wet years, and virtually no flow in average and dry years. Intermittent creeks include Scott Creek, Park Creek and Cope Creek which flow in a southeastern direction, and Towers Creek which flows north.


Cope Creek


Jumpingpound Creek

Map 1. Jumpingpound Creek watershed.



Administration

The watershed is currently managed by five jurisdictions. These are the Town of Cochrane, MD of Rocky View, MD of Bighorn, Stoney Nation and the Kananaskis Improvement District (Map 2).

The MD of Rocky View administers the largest area within the Jumpingpound Creek watershed (221 km^2). The Kananaskis Improvement District makes up the second largest jurisdiction encompassing 38% of the total watershed area. The MD of Bighorn and Stoney Nation each administer about 10% of the watershed area and the Town of Cochrane manages less than 1% of the watershed, at the confluence of Jumpingpound Creek and the Bow River.

Population. There are an estimated 1,381 people who live in the Jumpingpound Creek watershed (M. Buckley, pers. comm.; Statistics Canada Census 2006).

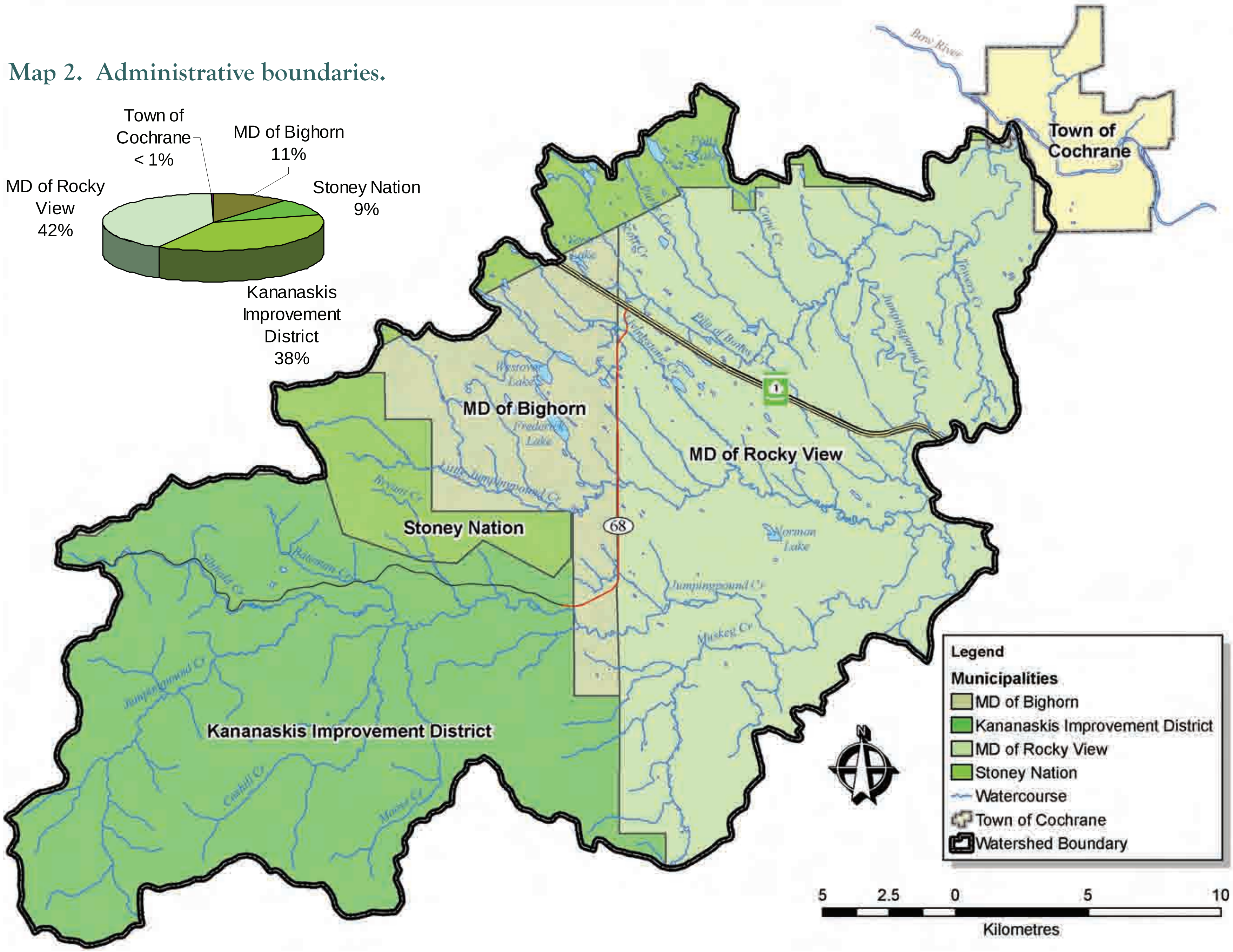
The majority of the population (929 people) live within the boundaries of the MD of Rocky View. Approximately 377 people reside in the watershed within the Town of Cochrane boundary. Only 44 people live within the MD of Bighorn and an estimated 28 people live within the Stoney Nation boundary.

Overall, population density is low at 2.3 people per km^2. In part, this is due to the large portion of the watershed situated within the Kananaskis Improvement District.

Jumping Pound vs. Jumpingpound

There has always been some confusion regarding the spelling of Jumpingpound Creek. Historically, Jumping Pound (two words) has referred to the hamlet of Jumping Pound or the Jumping Pound community. Jumpingpound (one word) is used to describe the watercourse—Jumpingpound Creek. As you pass over the Jumpingpound Creek bridge on Highway 1, you will see both spellings depending on the direction you are travelling.

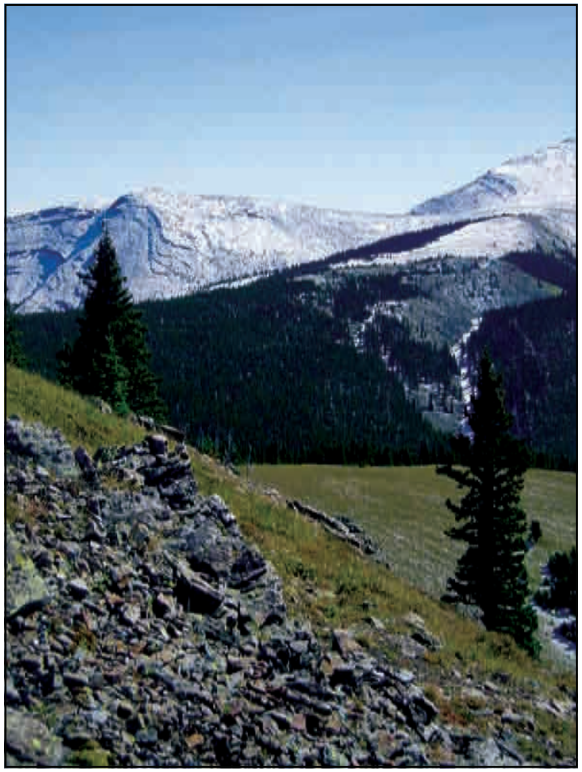
Map 2. Administrative boundaries.



2.0 GEOGRAPHY

2.1 Bedrock Geology

Bedrock geology in the Jumpingpound Creek watershed consists of interbedded sandstone, siltstones, shale and coal of the Tertiary-Cretaceous Brazeau Formation (40 to 135 million years old) and Alberta Group (Map 3). Some of the south-western portions of the watershed consist of undifferentiated siltstones and limestones of the Mesozoic age (65 to 225 million years old) (Borneuf 1980) (Map 3).



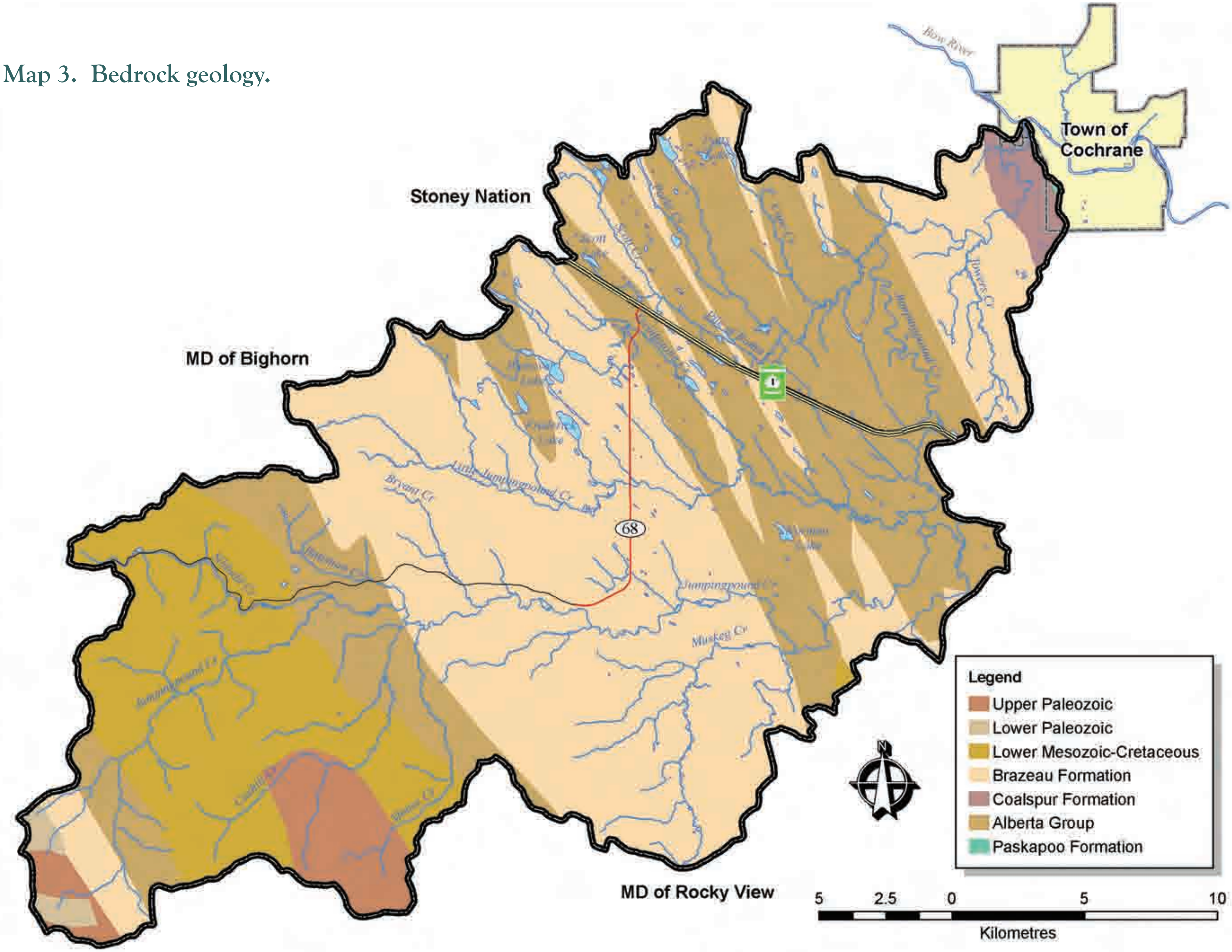
Steep, upthrust limestones, dolomites, conglomerates, shales and siltstones of Paleozoic and Mesozoic age geologically define the Alpine Natural Subregion (See Section 2.3 for Natural Subregion descriptions). Exposed bedrock is dominant in this area.

Mesozoic and Paleozoic limestones and dolomites form the underlying bedrock, along with

quartzites, shales and sandstones of the Subalpine Natural Subregion.

The Montane Natural Subregion is composed of non-marine Cretaceous sandstones, siltstones and shales (Alberta Group). Glacial and river erosion has carved major valleys through Mesozoic and Paleozoic dolomitic and limestone formations and Cretaceous sediments. Rock strata are generally oriented perpendicular to water flow (Natural Regions Committee 2006).

Map 3. Bedrock geology.



2.2 Surficial Geology

Surficial geology, also referred to as quaternary geology, refers to those unconsolidated geologic materials lying on top of the bedrock. These materials were deposited by melting glaciers and commonly consist of sand, gravel, glacial tills, clay and silt. The following provides an overview of a few of the most dominant deposits found in the Jumpingpound Creek watershed (Map 4).

Colluvium. Most of the upper reach of Jumpingpound Creek is composed of colluvium deposits. The composition is determined by the underlying bedrock and ranges from predominantly weathered carbonates in the Rocky Mountains to weathered sandstone, siltstone and shale in the Foothills. The colluvium material often has poor to well defined layering parallel to slope (Bayrock and Reimchen 1980).

Slightly leached till (7 and 7b). The lower half of the watershed is comprised of slightly leached till that is a silty sand till. Clasts (rocks built up of fragments of pre-existing rocks through weathering and erosion) are carbonate in ground moraine and lateral moraine (7) or in an undifferentiated moraine (7b)

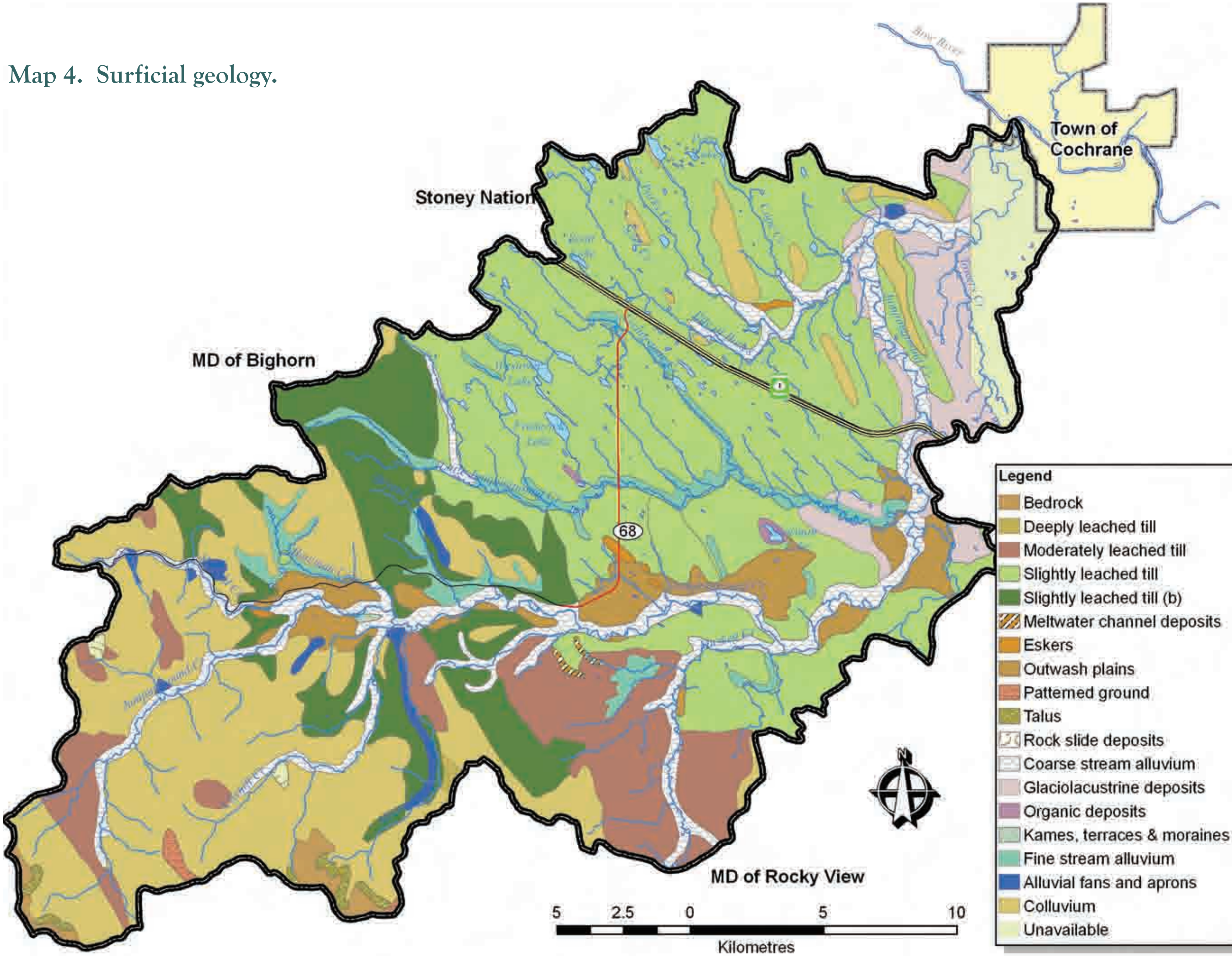
Alluvial fans and aprons. These deposits are found where steep gradient streams emerge from mountainous terrain. Moose Creek is bordered by these sediment deposits that range from large blocks to sand and minor fine material.

Coarse stream alluvium. Most of the Jumpingpound Creek floodplain area is composed of coarse stream alluvium. This deposit is a non-glacial fluvial sediment deposited along most streams in the Rocky Mountains and Foothills. It forms terrace and valley bottom deposits. Sediment consists of gravelly sand to gravel. In places it is overlain by 0.25 to 2 m of fine alluvium. Clasts are generally well-rounded carbonates and quartzites in the Mountains, but in the Foothills contain some clasts derived from Mesozoic clastics.

Fine stream alluvium. The main tributaries to the north of Jumpingpound Creek (i.e., Little Jumpingpound, Livingstone and Bateman creeks) consist of fine stream alluvium. This is non-glacial fluvial sediment deposited along the banks of small streams, in places over-lying coarse stream alluvium on the larger streams. Generally deposits consist of sand to clay with local minor gravel or organic material.

Glaciolacustrian deposits. Sediment deposited in glacial lakes that generally consist of clayey silt with minor sand. These deposits are mainly found near Towers Creek, in the north-eastern part of the watershed.

Map 4. Surficial geology.



2.3 Natural Regions and Subregions

Natural regions classify land areas according to regional climatic variations and broad vegetation groups. Soil groups are also generally defined by natural region characteristics.

Two natural regions and four sub-regions are represented in the Jumpingpound Creek watershed. These are the Rocky Mountain Natural Region comprised of the Subalpine, Alpine and Montane Natural Subregions. Only a tiny fraction (< 1%) of the Jumpingpound Creek watershed is defined by the Alpine Natural Subregion. This area is located at the headwaters of Jumpingpound Creek, in the southern tip (Map 5). The Subalpine Natural Subregion includes all areas below the Alpine Natural Subregion and above the Montane Natural Subregion (Map 5).

The Parkland Natural Region is comprised of the Foothills Parkland Natural Subregion (Map 6). The following discussion of Natural Region characteristics is based on a compilation by the Natural Regions Committee (2006).

Climate

The Rocky Mountain Natural Region has on average the coolest summers, shortest growing season, highest mean annual precipitation and snowiest winters of any Region (Table 1). Within the Natural Region, climates are highly variable.

The high elevation Alpine and Subalpine Natural Subregions generally receive more annual precipitation and have snowier winters than any other Subregion. Short, cool, wet summers and long, cold winters with heavy snows are typical of the Subalpine Natural Subregion. Strong winds that control snow deposition, evapotranspiration and temperature regime are further characteristics of the high elevation Subregions.

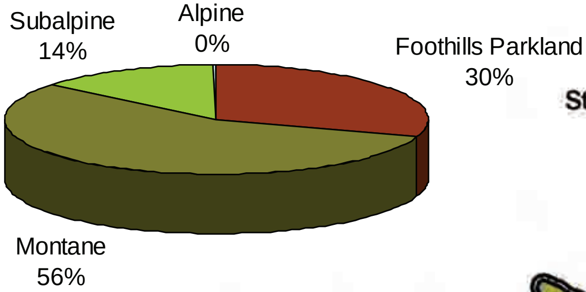
Mild summers, high summer precipitation, frequent Chinook winds and warm winters are characteristics of the Montane Natural Subregion.

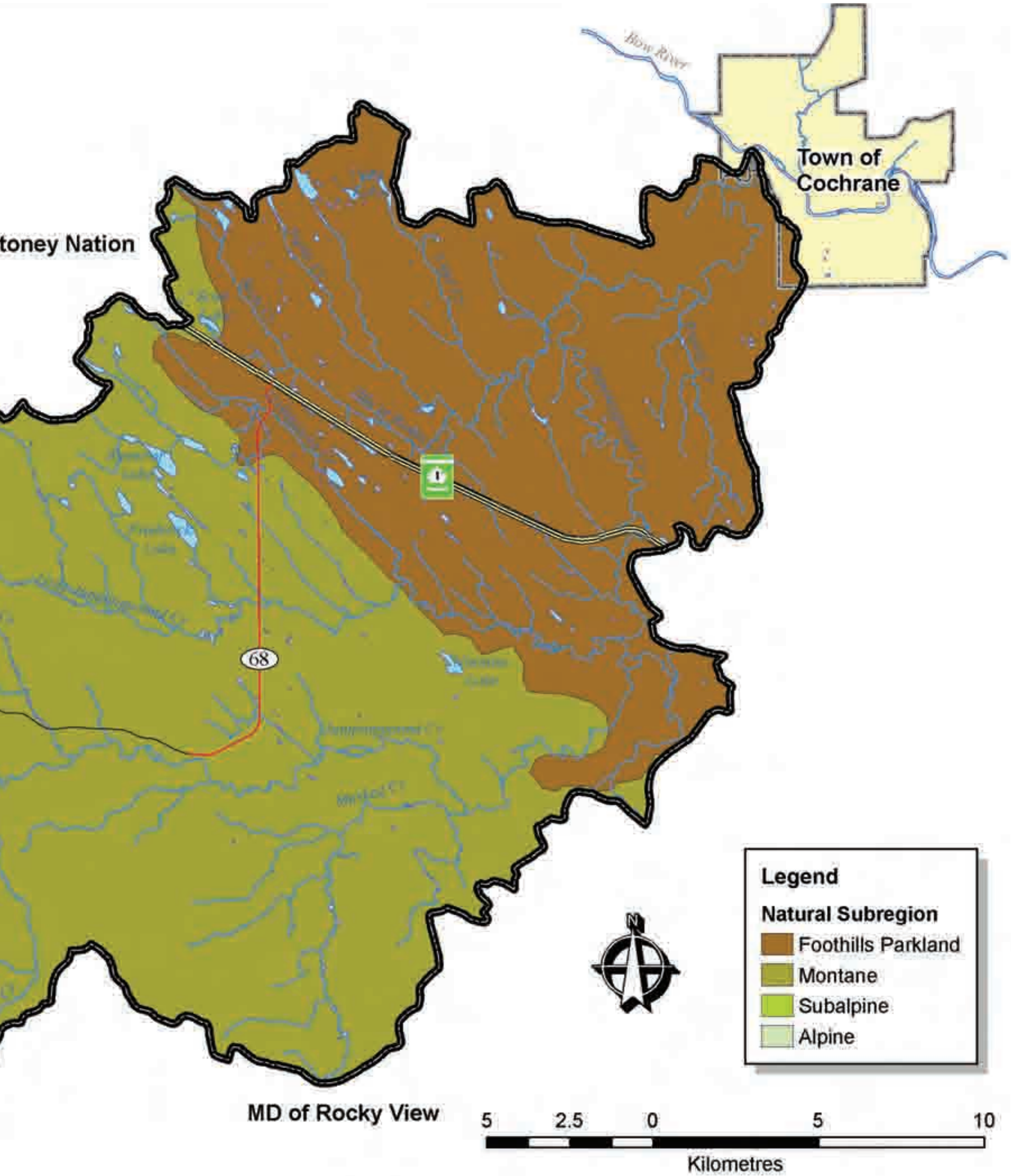
The Foothills Parkland Natural Subregion has the highest precipitation, warmest winters, and shortest, coolest growing season of any of the parkland Natural Subregions. Proximity to the mountains and frequent Chinooks influences these characteristics. This Natural Subregion is climatically more similar to the Foothills Fescue and Montane Natural Subregions than it is to the other Parkland Natural Subregions. Maximum precipitation occurs in June, but May

Table 1. Summary of climate parameters for the Natural Subregion. (Natural Regions Committee 2006).

Climate Parameter	Alpine	Sub-Alpine	Montane	Foothills
Mean annual temperature, °C	-2.4	-0.1	2.3	3.0
Mean temperature,	8.7	11.3	13.9	14.7
Mean temperature,	-12.6	-11.7	-10.0	-9.6
Growing degree days >5 °C,	317	668	1017	1158
Mean frost-free period, days	40	55	64	76
Mean annual precipitation, mm	989	755	589	517
Growing season precipitation, mm	472	419	382	377

Map 5. Natural subregions.





and July are also rainy months. The relatively short growing season restricts till cropping activities, and much of the area either produces hay crops or is under native cover.

Soil

There is very little soil development in the Alpine Natural Subregion, largely due to harsh climates, unstable parent materials, frequent disturbances that rework soil profiles and low biological activity due to acidic litter and low temperatures. Bedrock exposures or nonsoils dominate in this Subregion (Natural Regions Committee 2006).

Cold temperatures, high precipitation and coarse, often unstable parent materials over steeply sloping bedrock promote the development of Eutric and Dystric Brunisols in the Subalpine Natural Subregion. On less pronounced terrain somewhat finer textured soils developed, including Orthic and Brunisolic Grey Luvisols. Wetland soils are usually Gleysols, but occasionally Organic soils occur (Map 6).

In the Montane Natural Subregion, Orthic Black Chernozems are typical under grasslands with Orthic Dark Gray Chernozems more dominant in the wooded areas. On moister northern slopes and higher elevations, Grey Luvisols are significant. Bedrock exposures (nonsoils) also occur.

In the valleys, Eutric Brunisols are the dominant soil on fluvial and glaciofluvial deposits. Regosols are typical of both fluvial terraces adjacent to the rivers and side slopes where erosion or slope movement has recently occurred. Valley side soils may also include Luvisols and Dystric Brunisols where slopes are stable enough to allow soil development. Gleysols and Organic soils are typically associated with fens.

In the Foothills Parkland Natural Subregion, deep Orthic Black Chernozems with surface humus horizons at least 15 cm thick are most common and are associated with grassland and open woodland vegetation. Orthic Dark Grey Chernozemic soils are typically associated with forested areas (Map 6).

Seepage areas on lower slope positions and depressions support willow shrublands. Because the water is usually well oxygenated, the soils are classed as moist Chernozems rather than Gleysols. Orthic Gleysols occur in the wettest, most poorly drained areas.

Vegetation and Land cover

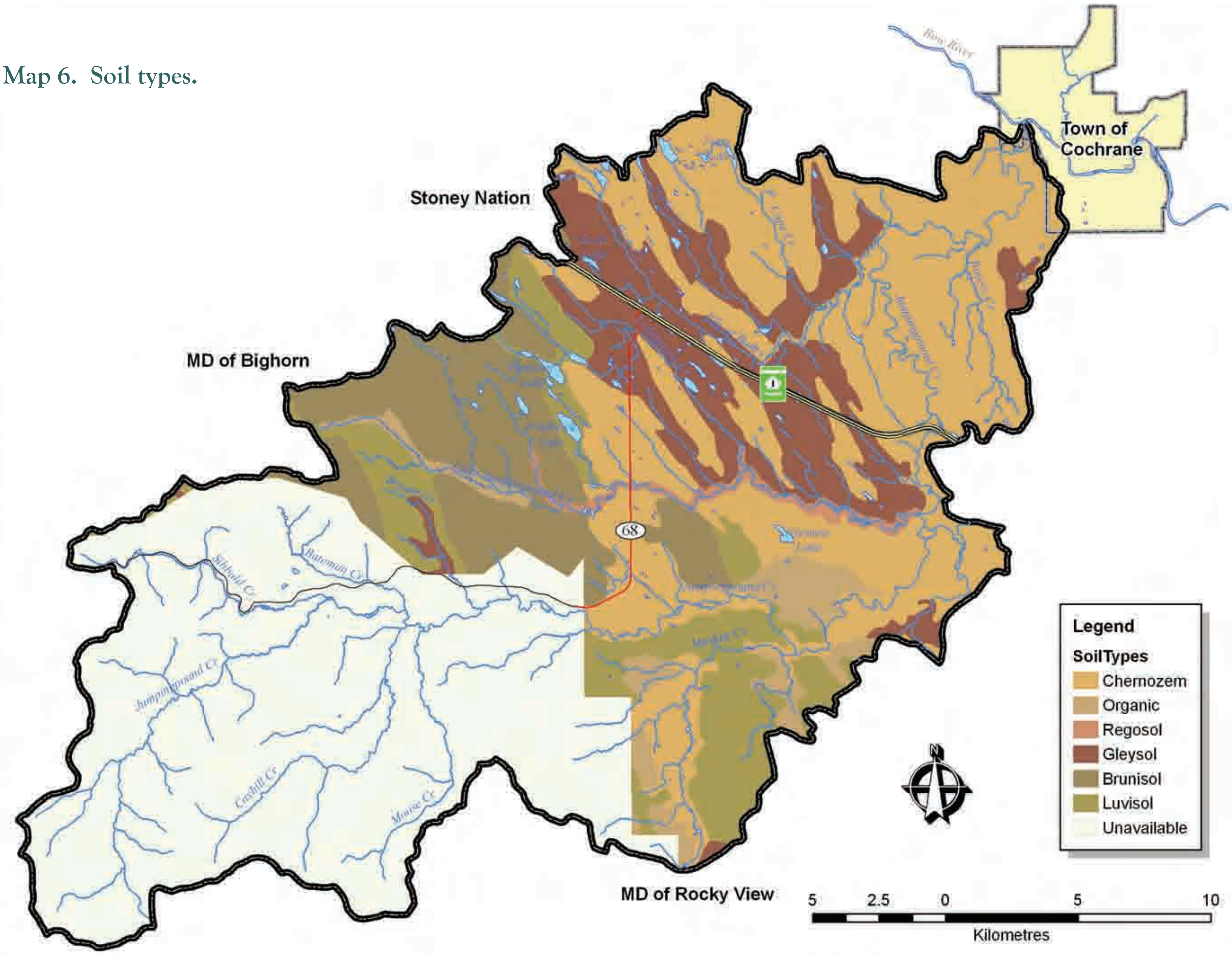
Vegetation in the Jumpingpound Creek watershed reflects the extreme topography, parent material and regional climate of the Natural Regions and Subregions.

Unlike most other Natural Subregions in Alberta, fire does not have a strong influence on plant community in the Alpine Subregion. On the driest, coldest and most exposed locations only lichens grow on rock faces or mineral soils in a “stonefield–lichen” complex (Table 2). Black alpine sedge–forb snowbed may be found where snow accumulates and melts by mid-summer. Next to streams and near seeps below snowbeds, willow–bog birch shrublands and colourful alpine meadow communities with a variety of grasses and forbs are found (Natural Regions Committee 2006).

The Subalpine Natural Subregion is characterized by closed fire-origin lodgepole pine forests with Engelmann spruce and subalpine fir. These stands become more open near the forest line and include subalpine larch and whitebark pine (Table 2). Rummholz islands define the upper limits of the Subalpine Natural Subregion.

The Montane Natural Subregion is a mix of grasslands and deciduous–coniferous forests on southerly and westerly aspects, and predominantly coniferous forests on northerly aspects and at higher elevations. Exposed, rocky

Map 6. Soil types.



ridgetops and upper slopes are vegetated by open limber pine and Douglas fir stands, with an understory of ground juniper, bearberry and mountain rough fescue (Table 2).

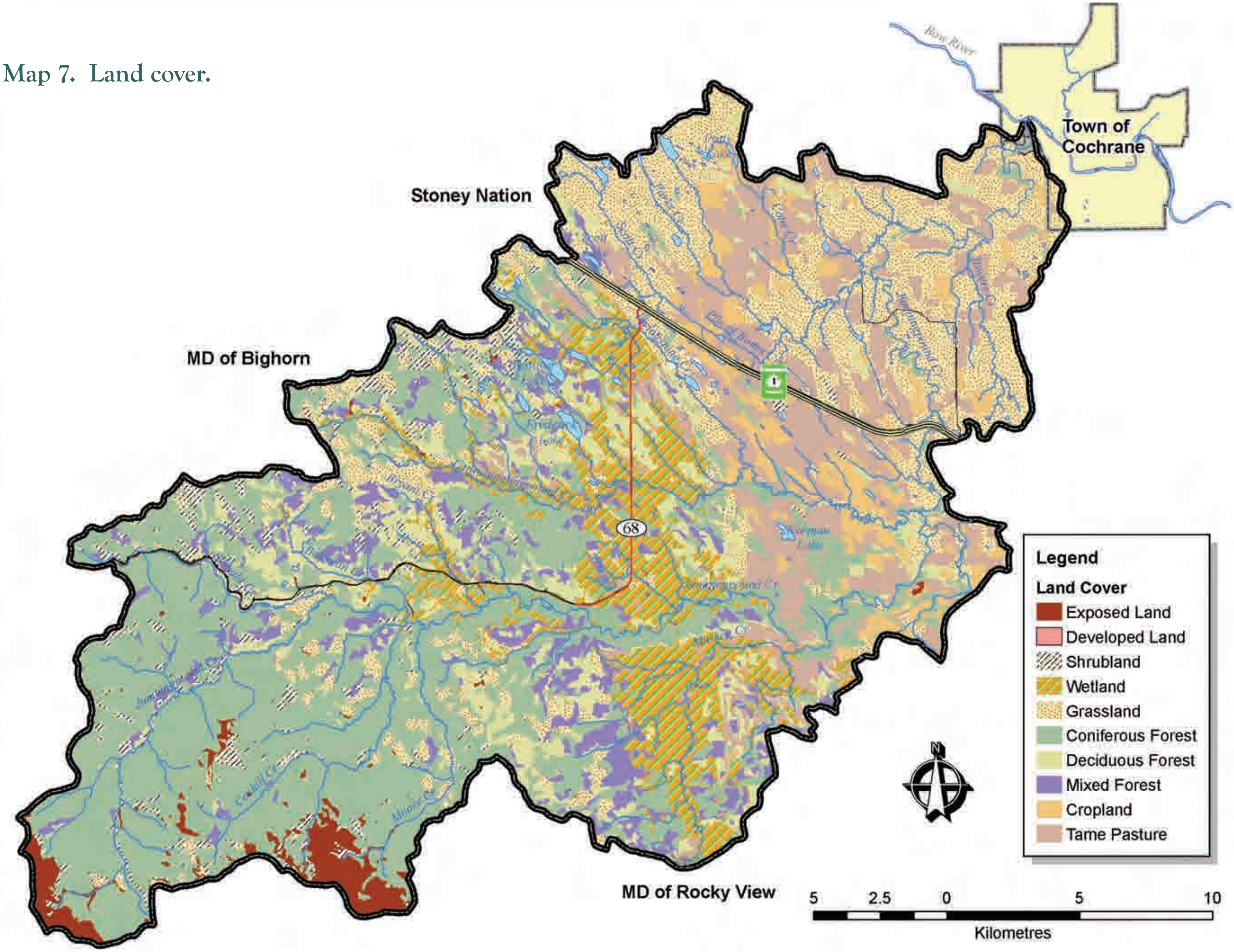
Dry sites of the Foothills Parkland Subregion consist of grasslands. Aspen stands like those in the Montane Natural Subregion occur on moister, cooler northerly aspects and in seepage areas. The northern part of the Foothills Parkland is dominated by beaked willow with a significant tall herb component.

Map 7 shows the major land cover types found in the Jumpingpound Creek watershed. Developed lands are generally roadways and a small

Table 2. Summary of some of the species found in the four Natural Subregions represented in the Jumpingpound Creek watershed.

Type	Alpine	Subalpine	Montane	Foothills Parkland
Canopy	willow, dwarf birch,	lodgepole pine, Engelmann spruce, subalpine fir, subalpine larch, white bark pine	aspen, lodgepole pine, Douglas fir, white spruce, limber pine	aspen, dense tall willow, balsam poplar, plains cottonwood, occasional white spruce and Douglas fir
Under-storey	lichens, white mountain avens, alpine fescues, bog-sedge, heather, sedge snowbed 	bearberry, hairy wild rye, mountain rough fescue, false azalea, grouseberry, Canada buffaloberry, low bilberry, pine reed grass, feather-mosses, white-flowered rhododendron, thimbleberry	bearberry, Canada buffaloberry, hairy wild rye, pine reed grass, forbs, mountain rough fescue, bluebunch wheatgrass, Parry's oatgrass, ground juniper, bluebunch fescue 	snowberry, silverberry, beaked willow, wild red raspberry, Saskatoon, wild white geranium, meadowsweet, prickly rose, herbs. Glacier lilies, tufted hair grass, sedge, mountain rough fescue, Parry's oatgrass, bluebunch fescue, needle-and-thread grass, mountain rough fescue, bluebunch fescue

Map 7. Land cover.



3.0 HISTORY AND SETTLEMENT

3.1 Settlement

Traditional land use in the Jumpingpound Creek watershed has been most extensively investigated in the headwaters and upper portions of the watershed. Archeological evidence has been recorded from the headwaters to areas very near the confluence with the Bow River.

First Humans

The first sign of human presence in the watershed was identified by the discovery of a stone projectile point at Sibbald Flats. The point dates back to between 11,000 and 9,200 years Before Present (B.P.) (Tsuu T'ina Nation and Husky Oil 1995). Other prehistoric finds in the Jumpingpound Creek watershed include the remains of a dog, which were linked to a winter camp site approximately 1,500 years old, several prehistoric buffalo jumps and teepee rings (Friesen 1978). Teepee ring sites have been found with just two or three rings, near the confluence, as well as with a number of rings that would mark a large community. The name "Jumpingpound" is thought to have come from the great number of buffalo jumps located near the creek.

First Nations

Evidence suggests that bands of Kutenai First Nations people have resided on the Eastern Slopes of this area for a long period of time. Other cultural groups, who generally occupied either the plains or mountainous regions, would have also used this area during the same period. These various groups may have coexisted in this region or used the area during alternating seasons.

Other First Nations peoples recorded to inhabit the area of the Jumpingpound Creek include groups of Siksika (Blackfoot), Kainaa (Blood), Pikani (Peigan), Tsuu T'ina (Sarcee), Cree and Stoney-Nakoda (Sioux). Some traditional Stoney oral history declares that the Stoney people have occupied the Rocky Mountain foothills for "time immemorial" (Flynn-Burhoe 2008). Research, however, indicates that the migration westward, following separation from the Sioux, would have the Stoney people arriving in Alberta in the 1700s and in the Jumping Pound area in the late 1700s to early 1800s (Dempsey 1997; Cochrane and Area Historical Society 1977). The Tsuu T'ina are thought to have traveled to the area from northern forests approximately 600 years ago. Early written records of the Tsuu T'ina's association with the foothills and eastern slopes have been noted by fur traders in the 1700s.

Tsuu T'ina

Traditional travel routes throughout the region generally followed the Elbow River and Jumpingpound Creek (Figure 1). These trails, and others, connected at a central location where a single trail continued into the headwaters of Jumpingpound Creek. Tsuu T'ina elders recall

Chief Walking Buffalo, also known as Tatanga Mani and George McLean, 1871-1967. Photo credit: Bruno Engler

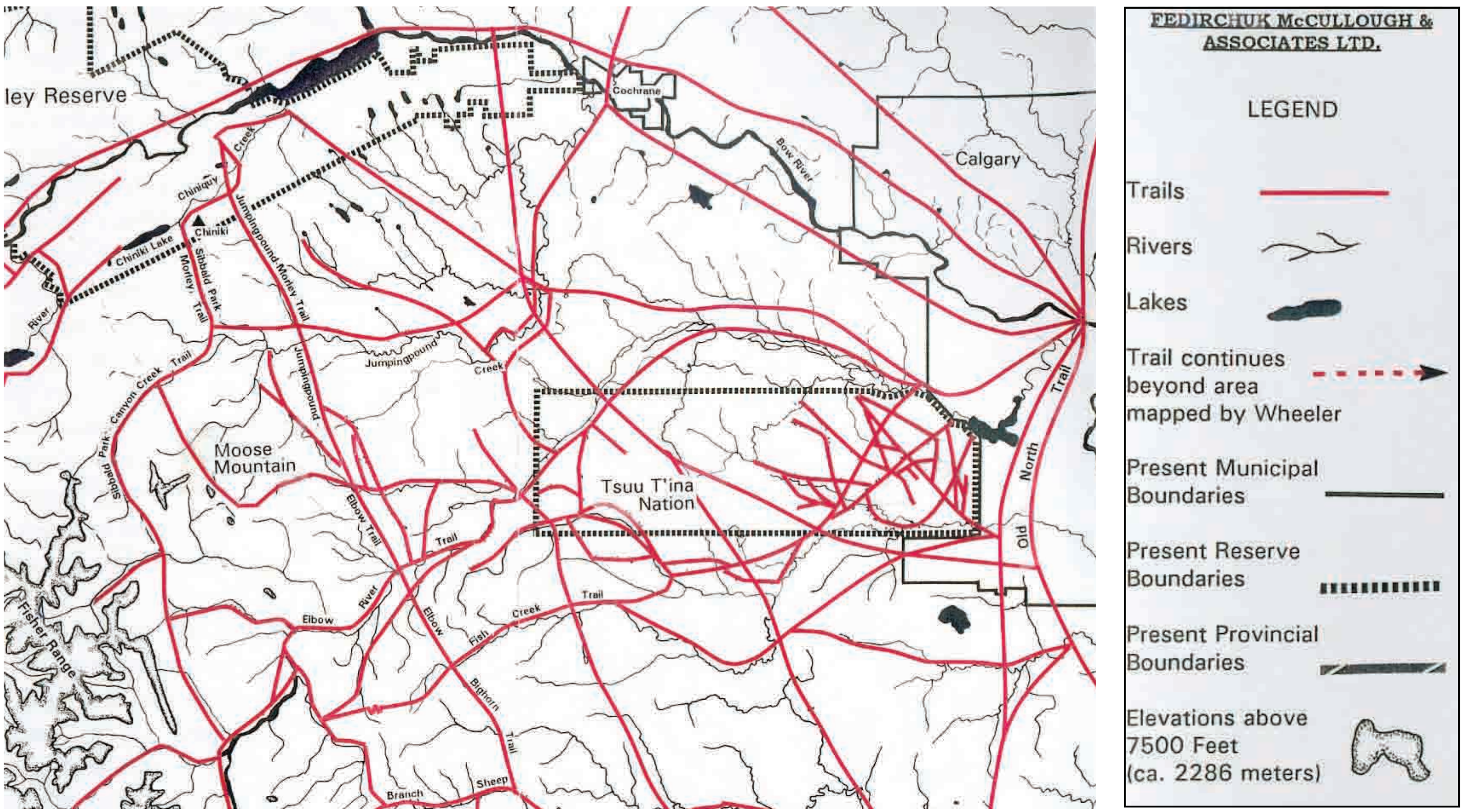
Chief Walking Buffalo was born in 1871. His mother died shortly after and he was adopted by missionary John McLean. At various times he was a scout, an interpreter, a student and a blacksmith, but he was always a philosopher, an advocate for peace and understanding. He spread his messages around the world visiting 27 countries. He always returned to share his messages at home.

that the people often hunted near and fished in various watercourses including Jumpingpound Creek. During these times, the hunters would often camp at Sibbald Flats (Tsuu T'ina Nation and Husky Oil 1995).

First Nations people also used, and continue to use the upper portions of the Jumpingpound Creek watershed for its abundant plant biodiversity. Many berries, roots and medicines were gathered and used by First Nations groups. In an assessment of the Moose Mountain area, it was determined that at least 97 plant species were recognized for use by Tsuu T'ina elders (Tsuu T'ina Nation and Husky Oil 1995). The collection and use of these plants varied by season but would have included willow and sweet pine. Uses included food, beverage, medicinal, spiritual and utilitarian purposes.

In Tsuu T'ina traditional belief, many sacred objects and experiences are associated with Moose Mountain. Visits to the mountain were often made for visionary experiences and sacred materials to include in medicine bundles.

Figure 1. Historic trails in the Jumpingpound Creek region (Tsuu T'ina Nation and Husky Oil 1995).



The sacred Sundance Pipe is thought to have also come from the mountains at the upper portion of the watershed. Often, plants, animal and rock materials that would be used for spiritual practice could only be collected at certain times of the year or in particular places.

Although traditional practices were suppressed, many continue to be practiced today and the association with the Moose Mountain area continued well after the establishment of the Tsuu T'ina reserve in 1883. Tsuu T'ina groups would continue to camp, hunt and carry out other activities in the Moose Mountain area throughout the 1940s (Tsuu T'ina Nation and Husky Oil 1995).

> "this other side of Moose Mountain there is this camp these they even had their Sundance's there a long time ago...them flats there (Sibbald Flats). That was a long time ago-sacred ceremony."
>
> - from a Tsuu T'ina Elder, 1920-
>
> (Tsuu T'ina Nation and Husky Oil 1995)

Stoney-Nakoda and First Europeans

The Stoney people were among the first to trade with the British on the shores of the Hudson Bay. With new equipment and allied with the Cree, the Stoneys continued west where some bands remained in southern Saskatchewan and other bands continued to the slopes of the Rocky Mountains where they arrived with or shortly following the Cree. The first Europeans in the area described the Stoneys as very hospitable and excellent hunters. Many local names in the area come from Cree words or their Stoney equivalent.

In the mid to late 1800s missionaries began to greatly influence the Stoney people and in 1873 a permanent mission was built for the Stoneys at Morleyville, now known as Morley. The Stoney bands who continued to live in the area of Jumpingpound Creek and the Bow River continued to hunt elk, deer and moose but also traveled seasonally to hunt buffalo. (Dempsey 1997). As with Tsuu T'ina, the Stoney-Nakoda made use of the many plant species in the area for food, medicinal and spiritual practices as well as for various implements.

The first European to visitor the area was likely David Thompson, who explored from Rocky Mountain House south to the Highwood River and crossed the Jumpingpound Creek in November 1800. During this trip Thompson records seeing buffalo bulls and bighorn sheep in the area (Cochrane and Area Historical Society 1977).

At the signing of Treaty 7, in 1877, the Stoney people were the only group under the direct influence of a missionary. It is through the influence of Rev. John McDougall that the three Stoney bands of Bearspaw, Chiniki and Goodstoney were centered on the reserve surrounding the site of Morleyville, a portion of which lies within the Jumpingpound Creek watershed. Around this same time the Cochrane Ranch was established and settlers began to come to southern Alberta. These settlers built up cattle ranches between Morley and the Cochrane ranch site (Cochrane and Area Historical Society 1977).

The Establishment of Agriculture and Recent History

It was with the settlement at the Cochrane Ranch and the arrival of the Canadian Pacific Railway, that most of the cattle ranches in the watershed were established. It was not, however, only settlers that transformed land use in the area to agriculture. Following the establishment of the reserve at Morley, the Stoney people were encouraged by Rev. McDougall to take up the life of farming and ranching (Cochrane and Area Historical Society 1977). Many did so, further establishing the Jumping Pound area as an agricultural region.

By this time John Palliser had already been advised of the Kananaskis area and had been hired by the British government to explore the Canadian West. During this trip, the first geological study in the area occurred. Although gold was sought in the area, it was the discovery of coal seams in the Kananaskis that triggered much excitement. Many surveys and various mining operations took place throughout the Kananaskis valley until 1976 when the Kananaskis Provincial Park and Kananaskis Country were established (Bachusky 2008).

The Kanansikis Improvement District was established in 1996 and is the only municipality in Alberta that is located within a provincial park. The district provides services to its residents as well as works closely with Alberta Tourism, Parks and Recreation. Within Kananaskis, there are many recreation opportunities as well as lands leased by cattle ranchers for grazing.

The agricultural practices that have dominated land use in the area for the past 125 years have consisted mostly of traditional grazing of native pasture. Rarely has land been cultivated or otherwise developed, particularly along the banks of the Jumpingpound Creek. Today most of the ranches that continue to raise cattle in the watershed are the same ranches and families that arrived in the 1880s and are now into their fifth and sixth generations.

The Stoney-Nakoda economy is now based on art and craft, labouring, lumber, and various other professions but continues to include a large amount of mixed farming and agriculture.

As land use in the Jumpingpound Creek watershed has changed throughout the centuries, traditional uses are still being practiced in varying degrees today. The watershed has historically provided for local communities, first for First Nations people and then for European settlers. It continues to provide for the descendents of these people today.

Start of Lone Star

The Lone Star Ranch received its name from John Copithorne in the early 1900s. John, with his eldest son Jim, and brother Sam (in photo to the left), built a log house on the top of the hill from its present location. The ranch could only be accessed from the flat of the Jumpingpound Creek. One winter night as John and a friend were returning to the house in the dark, he spotted the light shining brightly in the window. John turned to his companion and exclaimed, "Look at the Lone Star."

The original ranch house burned down during a clean-up after a roundup. A match was accidently thrown into the many papers gathered up from the men's lunches. The house was rebuilt below the hill and is still used as a summer cabin today.

- Cochrane and Area Historical Society 1977

3.2 Accesss

The Jumpingpound Creek watershed has few linear road disturbances relative to adjacent areas to the north, south and east (Table 3, Map 8).

Highway 1 is the main transportation corridor that bisects the watershed from northwest to southeast (Map 8). This corridor is the main route into the Rocky Mountains and receives heavy traffic during all seasons.

Highway 68 provides access into the southern part of the watershed, into the Kananaskis Improvement District. The first section of this Highway was recently paved.

There are few gravel roads that stem from these two main transportation routes. Most of the gravel road access is for rural residents. There is a small percentage of road networks used strictly for resource and recreation activity (14 km) (Table 3).

There is some local concern with the new pavement as it promotes more traffic and higher vehicle speeds that can increase risks to wildlife.

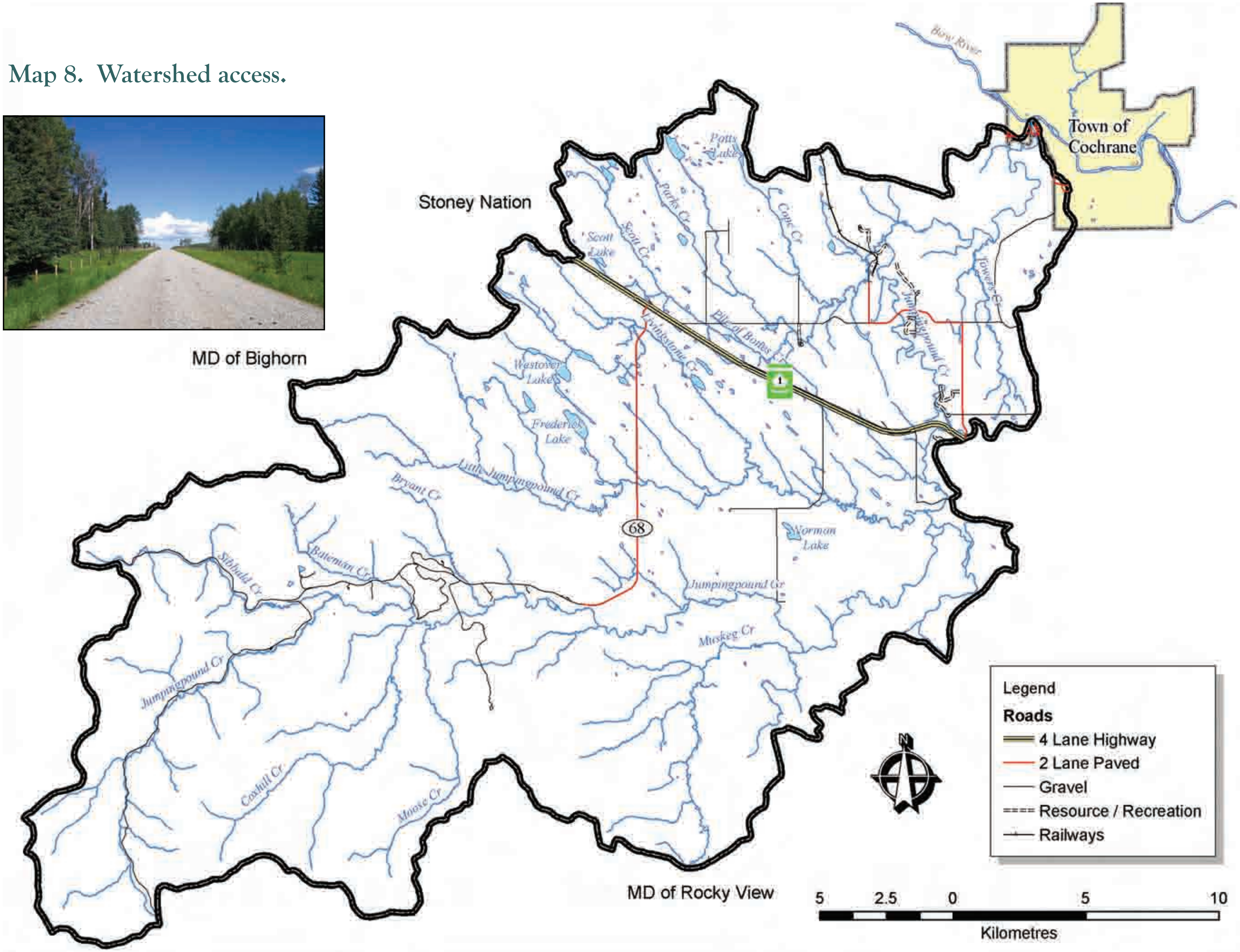
Table 3. Distribution of roads in the watershed.

Road Type	Length (km)
4 Lane Highway	30.7
2 Lane Paved	32.4
2 Lane Gravel	127.6
1 Lane Gravel	34.9
Resource/Recreation	14.5
Total	**240.1**

Road mortality is one of the largest threats to many species of wildlife in Alberta.

Grizzly bears suffer higher mortality in areas with more linear access features, and are prevented from effective use of their habitat. The status of recreational fish populations declines dramatically in parallel with increased access (ACTWS 2004). Appropriate access management planning will be essential.

Map 8. Watershed access.



4.0 AQUATIC RESOURCES

4.1 Water Supply and Demand

Surface Water

Jumpingpound Creek and its tributaries are an important source of water for humans, livestock and wildlife. There are a number of small tributaries that originate in the Kananaskis Improvement District that contribute to flow in Jumpingpound Creek. Some of the these creeks flow year round, while others are considered ephemeral or only occurring during spring snow melt and periods of heavy rainfall.

The Water Survey of Canada has operated three hydrometric stations that measure discharge (flow rates through time) in the Jumpingpound Creek watershed (Table 4, Map 9).

Weekly Flows. Figure 2 shows average weekly flows calculated for the period 1912-2001. Generally flows begin to rise in late February to early March and peak near the end of May and early June as snow melts from higher elevations. Flow continues to decrease throughout the summer months. In summer (May-October), flows average 3.2 m^3/s and minimum flows measured 0.04 m^3/s. In winter (November-March) flows average 0.33 m^3/s. Minimum flow in winter can occasionally be zero.

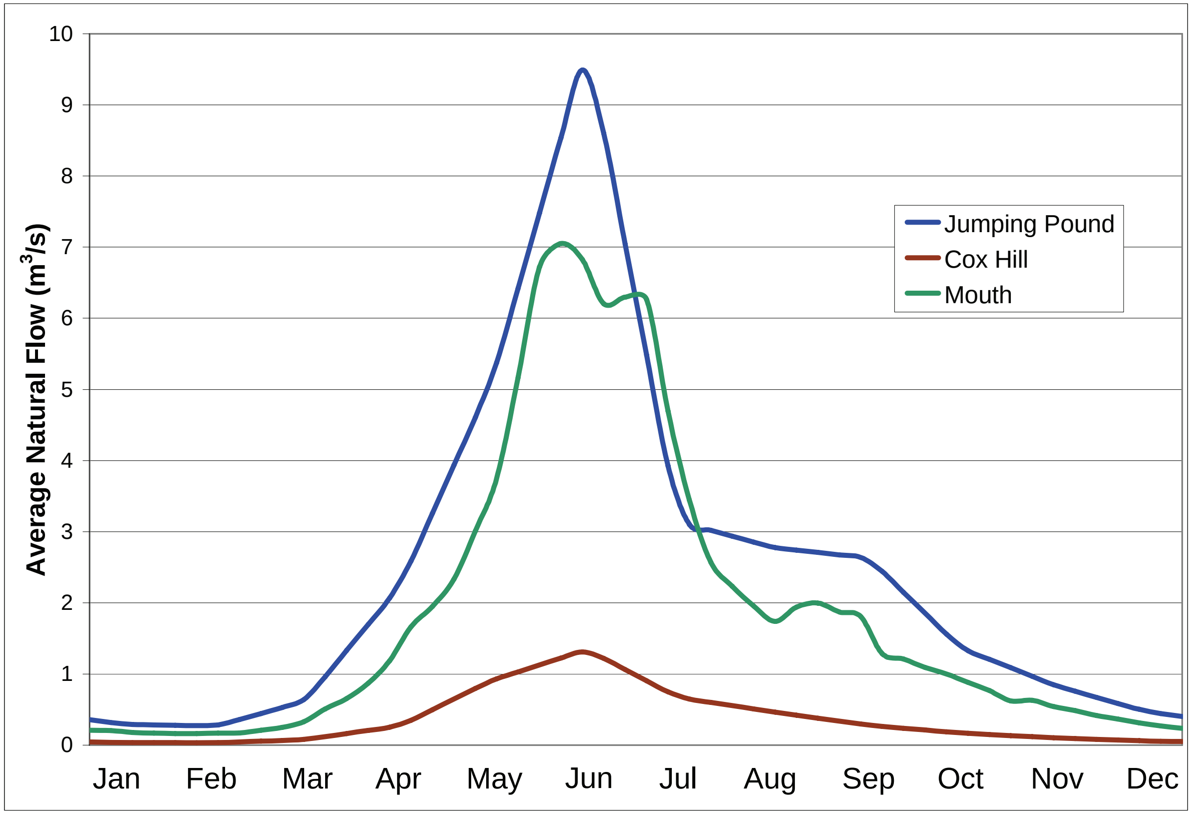


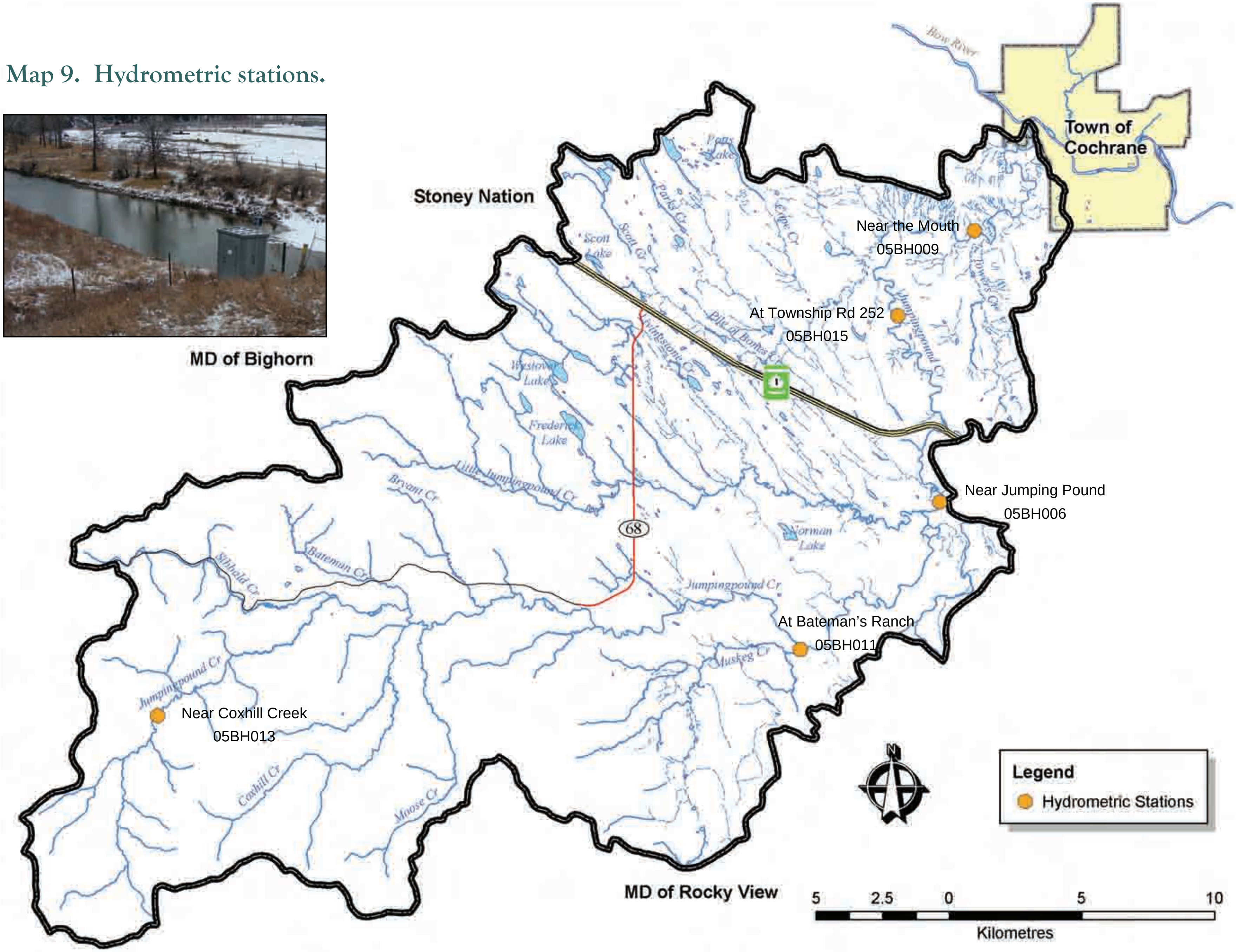
Figure 2. Average weekly natural flows (1912-2001) in the Jumpingpound Creek watershed.

Table 4. Water Survey of Canada flow monitoring stations and period of record.

Station ID	Location	Start Date	End Date	Data Type
05BH013	Near Cox Hill Creek	July 15, 1976	October 31, 2007	Daily, May to October
05BH006	Near Jumping Pound	June 1, 1908	August 31, 1933	Daily, May to October
05BH009	Near the Mouth	July 28, 1965	May 1, 2006	Daily, January to December

Similar trends are observed at the flow monitoring stations at Jumping Pound and at Cox Hill Creek. Flow at Cox Hill Creek reaches just over 1 m^3/s in June and then decreases to zero in the winter months. Flows appear higher at Jumping Pound compared to at the Mouth. This may be due to spring inputs in the upper

Map 9. Hydrometric stations.



reaches, irrigation withdrawals in the lower reaches and improvements in monitoring equipment during the more recent record period.

Annual Flow Volume. Annual flow volume in Jumpingpound Creek varies considerably by year. Average annual flow volume at Jumpingpound Creek near the mouth is 58,835 dam^3 (Figure 3). The minimum recorded flow at this station is 17,542 dam^3, occurring in 1985 (Figure 3). The years 1915 and 1916 have the highest recorded flows. The year 2006 was also a high flow year at just over 150,000 dam^3.

Surface Water Demand. There are a total of 12 surface water licenses and 233 surface water registrations held in the Jumpingpound Creek watershed. These are mainly concentrated in the northern half of the watershed, with two licenses situated in the Kananaskis Improvement District (Table 5, Map 10). The total licensed water volume amounts to 893 dam^3. Estimated actual use of the license volume, however, is a little less than half of this volume (419 dam^3). Registration allocations amount to 66 dam^3, with actual use reported as 14 dam^3.

Commercial uses make up 86% of the licensed allocations and stockwater makes up just 3% of the allocations (Table 5).

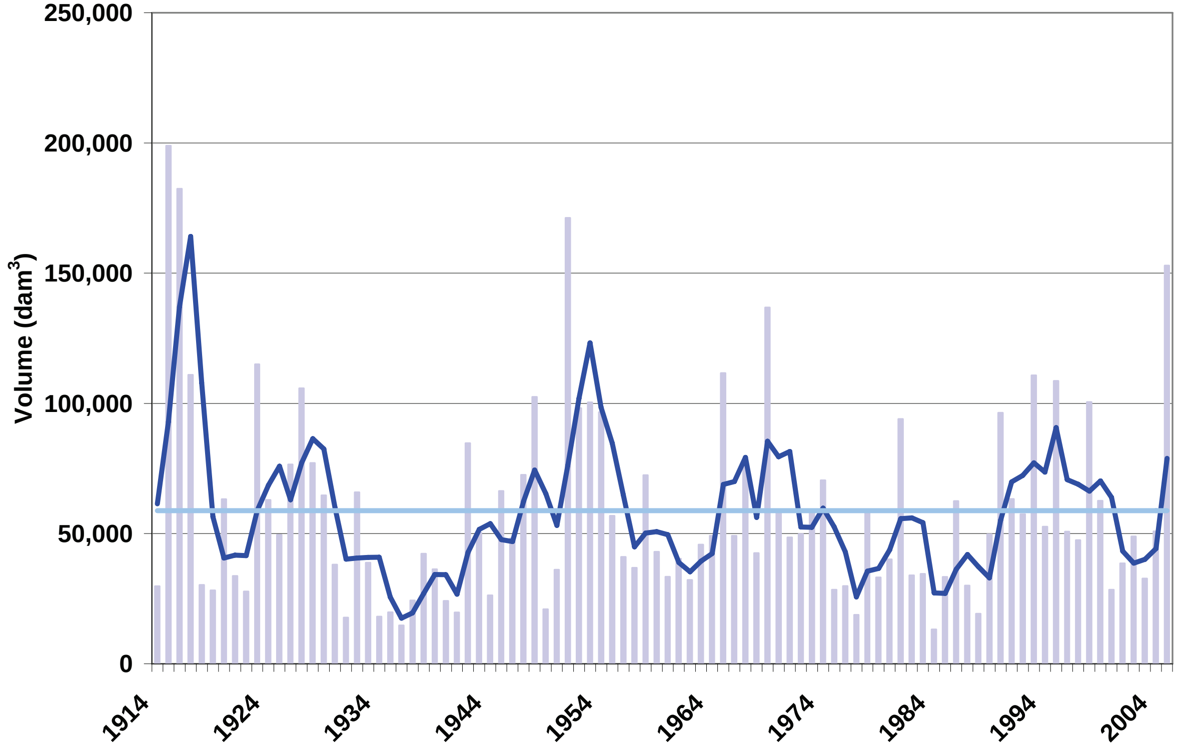
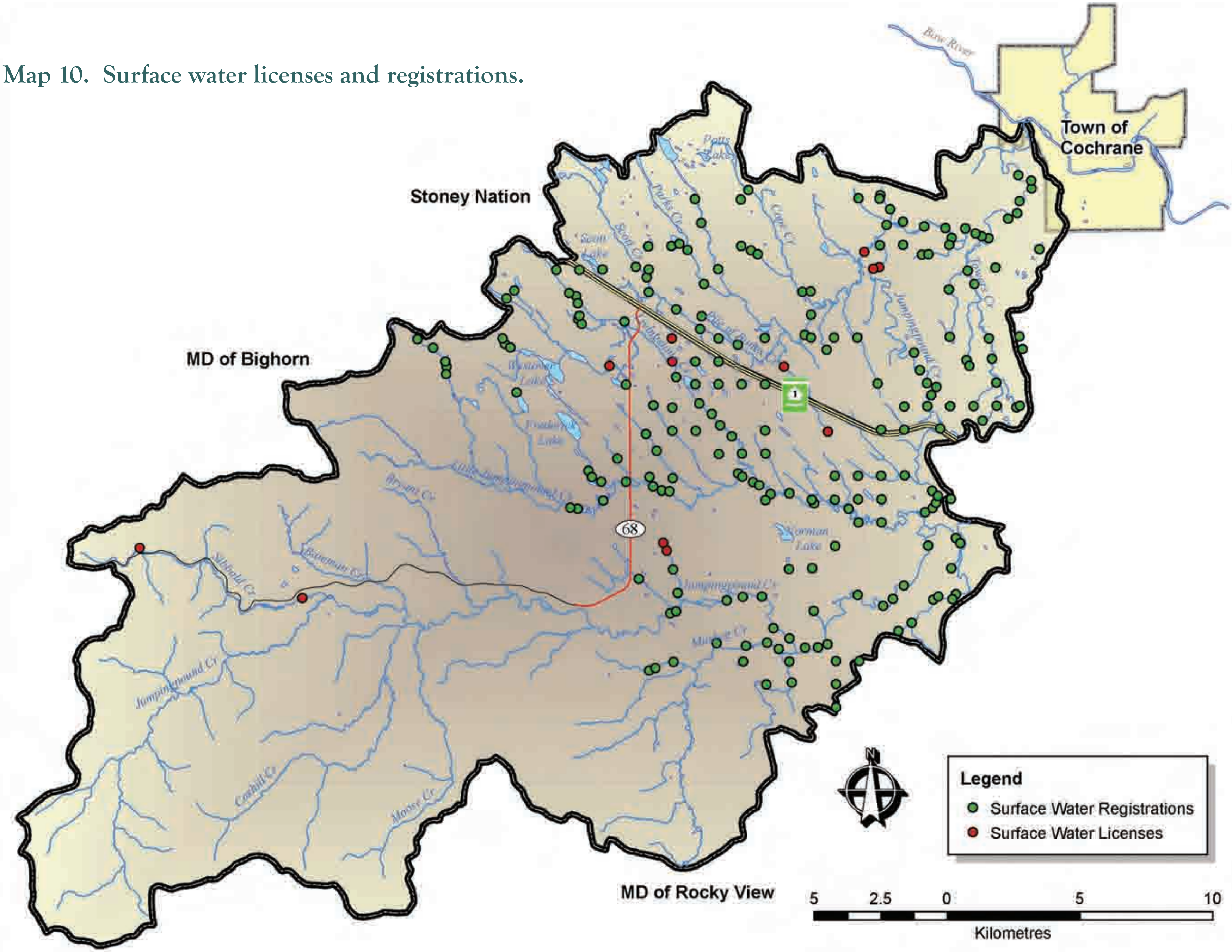


Figure 3. 3-Year moving average (dark line) vs. average volume (light line) for naturalized flows (bars) at Jumpingpound Creek near the Mouth from 1912 to 2006.

Table 5. Surface water license and registration allocations (AENV database 2006).

Type	# of Licenses	Allocations dam^3	Actual Use dam^3	Returns dam^3
Commercial	3	767	372	157
Stockwater	6	94	15	-
Water/Fish Management	3	32	32	-
Registration	233	66	14	-
Total	**245**	**959**	**433**	**157**

Map 10. Surface water licenses and registrations.



Groundwater

Groundwater is an increasingly important part of the water supply equation, as surface water license restrictions are implemented.

Well Yields. The majority of the Jumpingpound Creek watershed has the potential for long-term well yields of 6.9 to 35 m^3 per day (Ozoray and Barnes 1978). In areas adjacent to Jumpingpound Creek and Little Jumpingpound Creek where river channel gravel deposits are present, possible yields of 35 to 160 m^3 per day are expected. Hydrogeological Consultants Limited (2002) determined well yields from short duration pumping test data to lie between 4.9 to 160 m^3 per day, with bedrock well yields ranging from less than 9.8 m^3 to 69 m^3 per day.

Within the Jumpingpound Creek watershed, AMEC (2009) indicated that 330 driller's logs reported test pumping rates ranging from 0.13 to 260 m^3 per day, averaging 65 m^3 per day. Of the 330 logs, 114 identified rates ranging from 33 to 65 m^3 per day.

Well Completion Depths and Static Water Level. The depth of wells ranged from 1 to 213 m below ground surface. A depth of 0 m was reported from 12 wells, with average depth at approximately 51 m. The most frequently reported depth was 91.5 m. More than 50% of the wells were between 20 and 60 m deep.

Recorded static water levels in wells were below ground level at the time of measurement, except for 36 wells that reported water levels of zero. Only three wells indicated that a flowing well was present. Static water levels ranged from 1 to 122 m below top of casing, with more than 65% of the reported levels less than 20 m below top of casing.

Flow Patterns. Overall, the watershed is an area of groundwater recharge with local discharge zones occurring in the central area of the watershed (Ozoray and Barnes 1978). These discharge zones occur mainly in Twp. 24, Rge. 5 and the southern-half of Twp. 25, Rge. 5 near Highway 1. Some flowing wells and springs were noted mainly in the southern and western-most parts of the watershed. One spring located in Sec. 31, Twp. 24, Rge. 6, W5M had a measured flow of 900 L per minute (Ozoray and Barnes 1978) (Map 11). These springs exist in areas of relatively pronounced elevation changes in the Alpine and Subalpine areas of the watershed where the water table may intersect ground surface along steep slopes. The springs may also be related to the occurrence of limestones with "karst" features, where groundwater may flow within conduit systems formed by fracturing and dissolution.

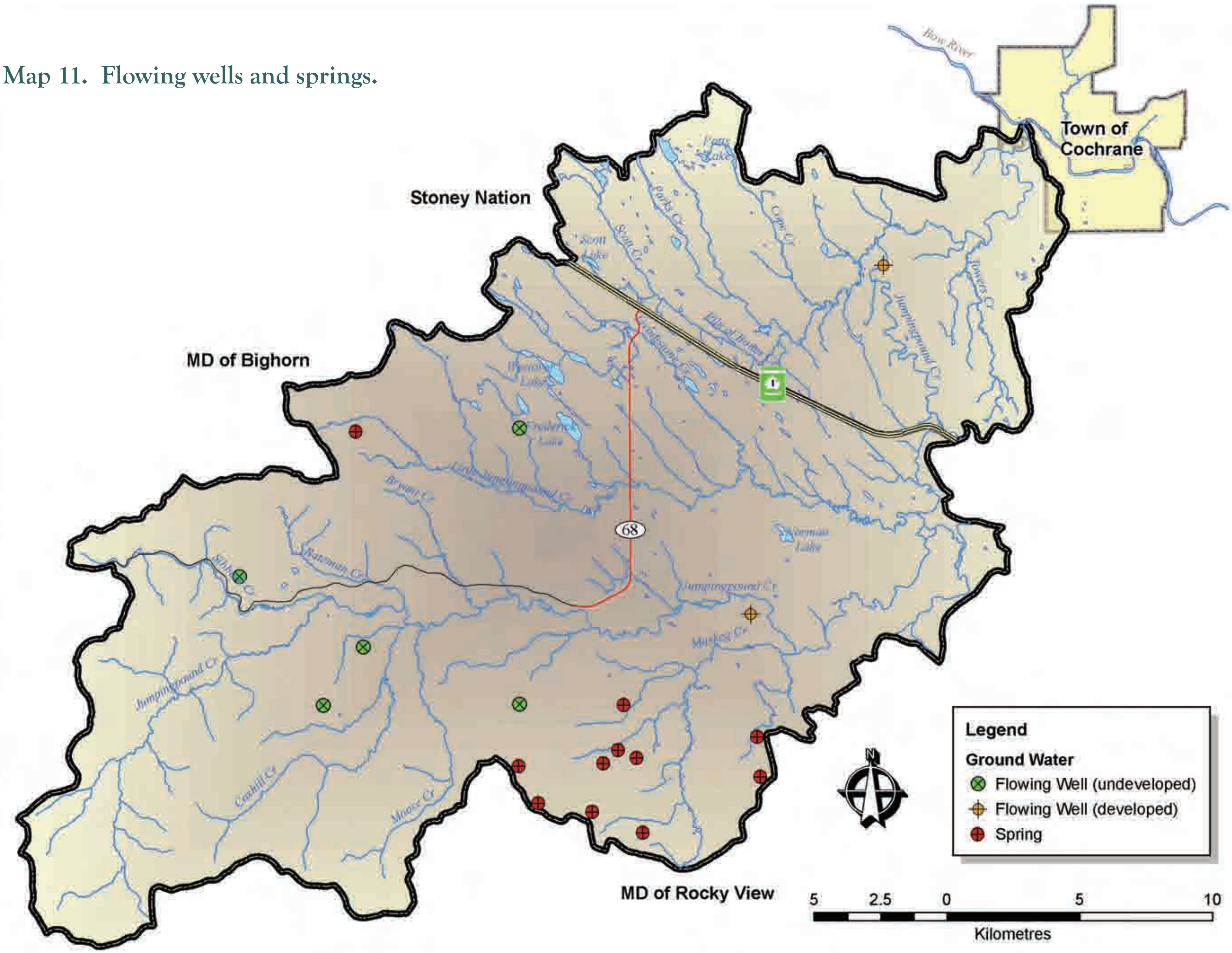
In general, groundwater follows topography within the watershed, flowing east to northeast toward the Bow River.

Groundwater Demand. Alberta Environment's water well database lists about 520 well records for the watershed. There are 49 active groundwater licenses representing a total allocation of 116 dam^3 per year (Map 12). Licenses with annual allocations are allocated for stockwater (96 dam^3), commercial/industrial use (3 licenses equaling 5 dam^3), recreation (3 licenses equaling 6 dam^3) and residential community (2 licenses equaling 9 dam^3)

Seventy registrations are documented with an allocated withdrawal of 32 dam^3 (Map 12).

Approximately 470 wells are not licensed. If each of these well were active and withdrew the maximum allowance per household of 1.25 dam^3 per year, the unlicensed diversion for domestic use would amount to 588 dam^3, annually.

Map 11. Flowing wells and springs.



Groundwater-Surface Water Interactions

Determination of baseflow is an important aspect of water resource management as it can be considered a reasonable approximation of the groundwater contribution to streamflow. In addition, it is an indicator of the groundwater resource capacity in a watershed during times of stress (e.g., drought). Baseflow is the portion of streamflow coming directly from groundwater sources. Remaining streamflow is contributed by surface runoff from precipitation and meltwater.

AMEC (2009) evaluated baseflow contributions to Jumpingpound Creek. The authors found that during low-flow periods, such as occurs during winter months, baseflow dominates streamflow (Figure 4). During the spring and summer months, rain events provide runoff water which adds to the baseflow to increase streamflow and enable recharge of the groundwater aquifers.

The Baseflow Index (BFI), which describes the proportion of streamflow contributed by baseflow, was calculated for the Jumpingpound Creek at the Mouth and it was determined that 68% of streamflow originates from groundwater (Figure 5). Similar baseflow contributions were observed at Jumpingpound Creek near Jumping Pound (64%) and Jumpingpound Creek near Cox Hill (70%).

Water quality results for surface water and groundwater also indicates an interaction between these two water sources. The concentrations of minerals, metals and ions in the groundwater as compared to surface water indicates that groundwater plays a significant role in the chemistry of Jumpingpound Creek streamflow.

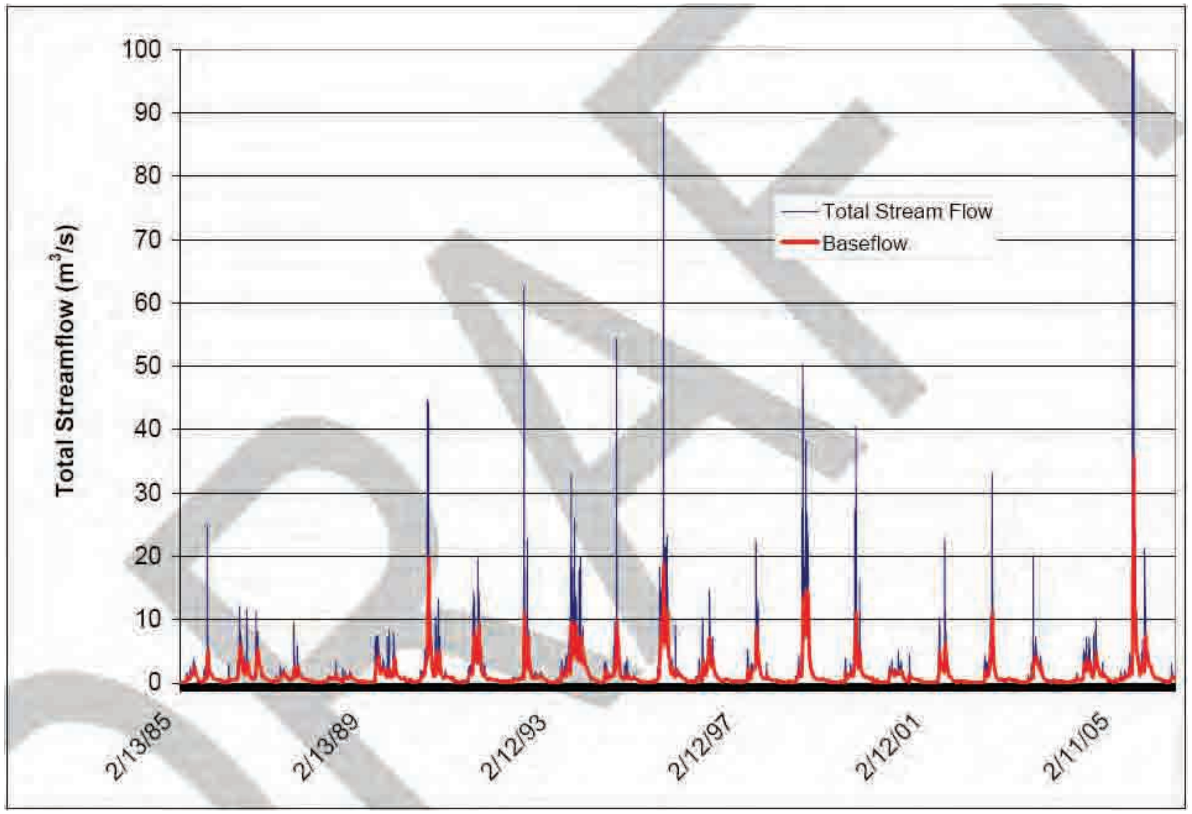


Figure 4. Baseflow separation using filters method at Jumpingpound Creek near the Mouth (05BH009) from 1985-2006.

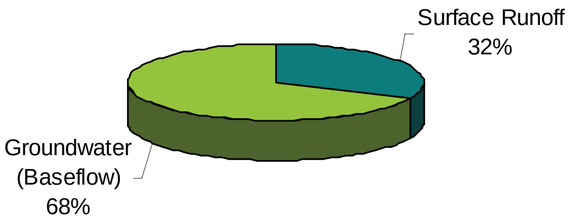
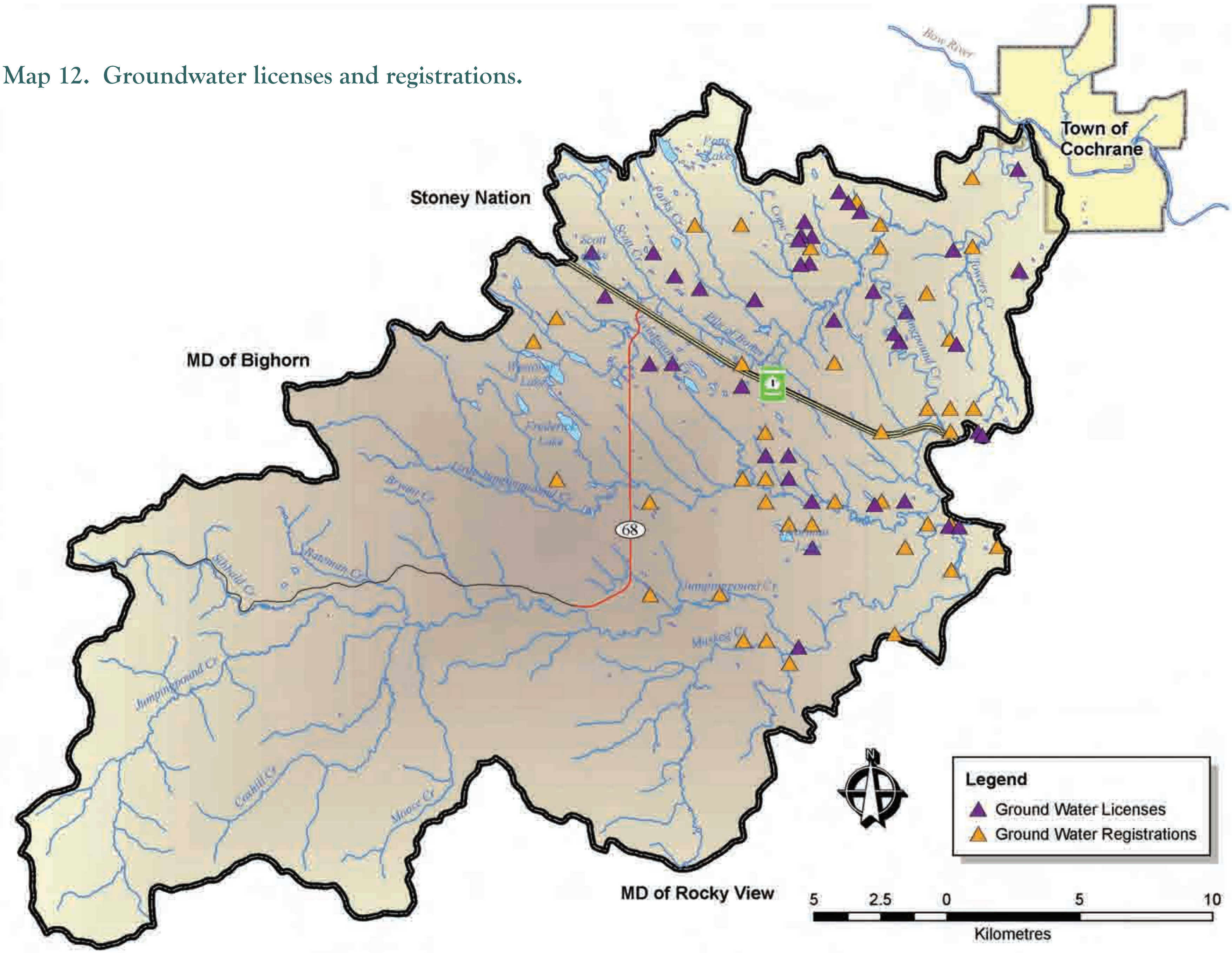


Figure 5. Volume of total streamflow contributed by groundwater and surface runoff.

Map 12. Groundwater licenses and registrations.



4.2 Water Quality

Surface Water

Water quality is an increasing concern as more demands are placed on the resource through municipal, industrial and agricultural developments. Water quality is a good indicator of how well the uplands are being managed. In rural watersheds, such as Jumpingpound Creek, water chemistry of special interest includes nutrients, sediment, bacteria, pesticides and herbicides.

Alberta Environment monitors water quality throughout the province. In the Jumpingpound Creek watershed, 9 sites have been monitored at various times and frequencies since 1974 (Table 6, Map 13). Typically, monitoring periods at a single location were under 4 years. The following is taken from AMEC (2009).

Dissolved Oxygen. Dissolved oxygen within surface water is important for the survival of aquatic life. Concentration below 5 mg/L can cause stress in fish populations and concentrations of about 1 to 2 mg/L can cause fish kills. Dissolved oxygen concentrations in Jumpingpound Creek are well above the acute 1-day minimum freshwater life guideline of 5 mg/L. Recorded dissolved oxygen concentrations indicate that algae and aquatic plant growth have not become excessive.

Nutrients. Nutrients can cause excessive growth of algae and aquatic plants, which can cause large fluctuations in dissolved oxygen due to photosynthesis (which increases oxygen) and respiration and decay (which decreases oxygen). Generally, nitrogen and phosphorus concentrations met the freshwater aquatic life guidelines of 1.0 mg/L and 0.05 mg/L, respectively. Total nitrogen concentrations range from 0.04 to 0.8 mg/L with the exception of a single event in 1993. Average total phosphorus concentration was 0.03 mg/L.

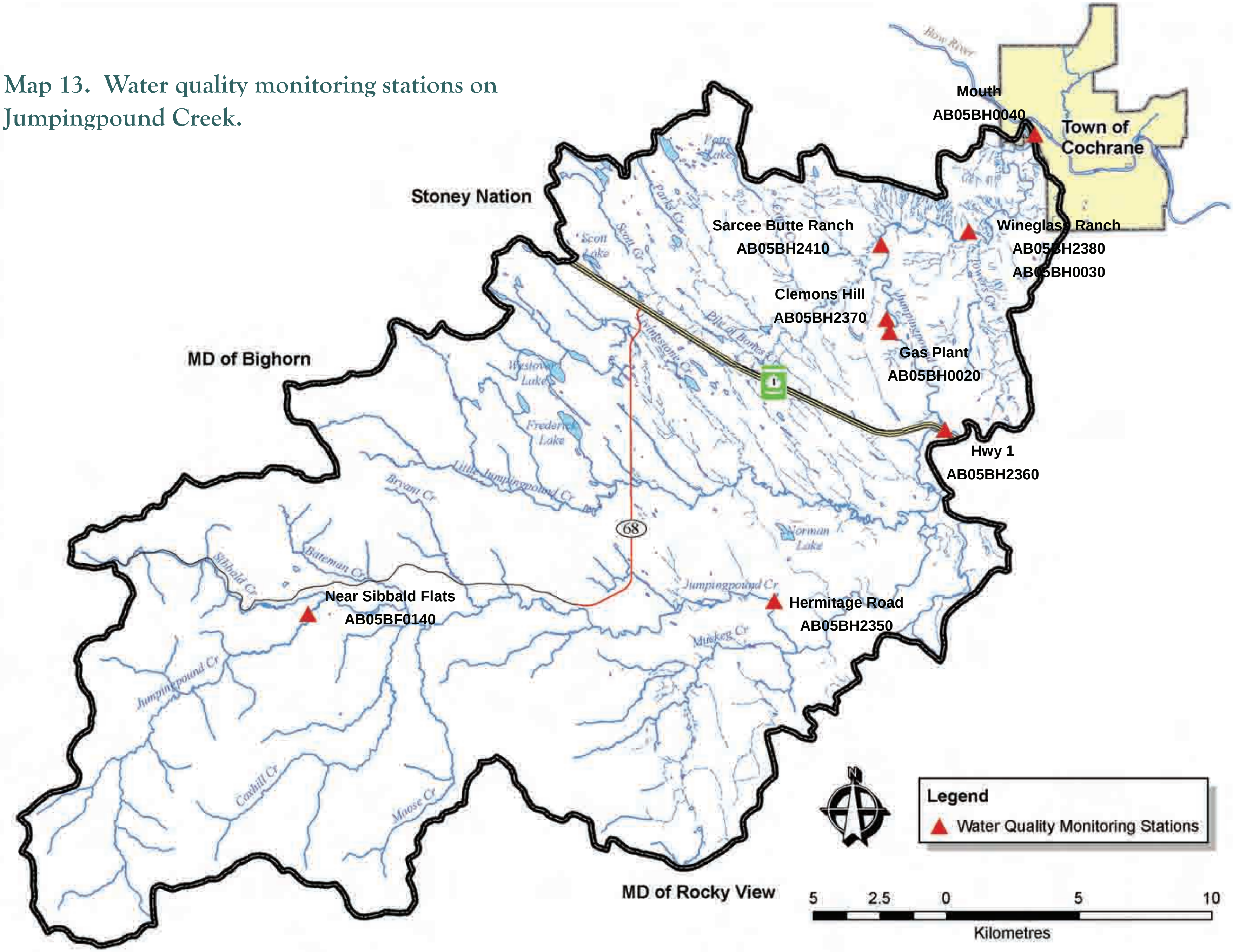
Bacteria. Fecal coliforms are detectable in surface water contaminated by mammal or bird feces. Fecal coliforms, if ingested, can cause infections, hepatitis A and viral and bacterial gastroenteritis. Fecal coliforms ranged from 0 to 920 colonies per 100 mL. The surface water quality guideline for recreation is less than 200 colonies per 100 mL fecal coliforms. The irrigation guidelines are more restrictive as counts should not exceed 100 colonies per 100 mL.

Salts and Minerals. Total dissolved solids (TDS) from weathering and dissolution of rocks and soils are naturally occurring in fresh, sur-

Table 6. Monitoring periods and frequencies at Alberta Environment water quality stations on Jumpingpound Creek.

Station ID	Location	Start Date	End Date	Interval
AB05BF0140	Near Sibbald Flats	July 14, 1978	June 25, 1979	Weekly, bi-weekly,
AB05BH2350	At Hermitage Road	March 25, 1997	May 15, 1997	Daily, bi-weekly
AB05BH2360	At Highway 1	March 25, 1997	May 15, 1997	Weekly, bi-weekly
AB05BH2370	At Clemons Hill	March 25, 1997	May 15, 1997	Weekly, bi-weekly
AB05BH0020	Above gas plant	May 5, 1973	February 3, 1976	Bi-weekly Jul-Oct
AB05BH2410	At Sarcee Butte Ranch	April 27, 1998	March 30, 1999	Monthly
AB05BH0030	Below confluence with	June 26, 1974	February 3, 1976	Spot checks
AB05BH2380	Upper side of Wineglass Ranch	March 25, 1997	March 30, 1999	Weekly, bi-weekly, monthly
AB05BH0040	Near mouth	July 21, 1993	May 15, 1997	Daily, weekly, bi-weekly, spot checks

Map 13. Water quality monitoring stations on Jumpingpound Creek.



face water systems. TDS is the concentration of dissolved minerals in water and is often used to estimate salinity. Total dissolved solids concentrations were within the CCME irrigation guideline of 500 mg/L and ranged from 151 to 376 mg/L. TDS concentrations were highest in low-flow periods and lowest during spring runoff in June. This may indicate that a disproportionate amount of TDS in Jumpingpound Creek is coming from groundwater contributions.

Calcium and magnesium are measures of water hardness and are the 5th and 8th most abundant natural elements, respectively. Surface waters in areas with significant limestone deposits are prone to hard water, due to weathering and erosion. The water hardness in Jumpingpound Creek ranges from 140 to 323 mg/L, which is in the hard to very-hard range.

Metals. Several metals and minerals were sampled in Jumpingpound Creek. Most metals that were measured met irrigation and freshwater aquatic life guidelines (CCME). Chromium, iron, lead and mercury occasionally exceeded the freshwater aquatic life guideline. Chromium exceeded the CCME irrigation guideline of 4.9 mg/L above the Gas Plant in 1973 and 1974 near the Mouth in 1994 and 1996. Iron exceeded the CCME freshwater aquatic life guideline (0.3 mg/L) above the Gas Plant once each during 1973 and 1974 and near the Mouth in 1993, during a single event. Lead only exceeded the CCME freshwater aquatic life guideline (0.004 mg/L) above the Gas Plant from 1973 to 1976.

Pesticides. Currently no pesticide data is available. Overall, pesticide and herbicide use in the watershed is low and limited to spot spraying of certain undesirable species such as field scabious or toad flax (J. Buckley, pers. comm.).

Overall, surface water quality meets guidelines for irrigation, recreation and livestock watering. The few exceedences that did occur in the watershed were associated with single events. In future, increases in exceedences can measure changes in land use management.

Groundwater

Groundwater quality in the Jumpingpound Creek watershed is highly variable and can be considered good to poor. Three groundwater assessments have characterized groundwater quality at various times since 1978.

In general, total dissolved solids concentrations ranged from 200 to over 1,000 mg/L (Ozoray and Barnes 1978; AMEC 2009). Groundwater in surficial aquifers is generally characterized by TDS concentrations less than 500 mg/L, while bedrock aquifers are higher, averaging 500 to 1,000 mg/L. Five wells near Highway 1 and Hermitage Road had TDS concentrations between 1,400 and 3,800 mg/L.

Groundwater chemistry is mainly calcium bicarbonate type; however, in areas high in TDS, sodium-bicarbonate predominates.

Sodium, chloride, nitrate, iron, total dissolved solids, hardness and pH were among the parameters that exceeded Guidelines for Canadian Drinking Water Quality (Health Canada 2003).

Of the 50 wells having detailed chemistry data available:

- □ 20 wells exceeded the aesthetic objectives for total dissolved solids (< 500 mg/L).
- □ 21 wells contained iron concentrations between 0.31 and 3.3 mg/L, and one well reported an iron concentration of 25.7 mg/L.
- □ 7 wells had pH values above 8.5 (the maximum recommended pH (Health Canada 2003).
- □ 6 wells contained chloride concentrations in excess of the GCDWQ of 250 mg/L.
- □ 4 wells were characterized by a hardness of

more than 500 mg/L (maximum 859 mg/L). Although there is no specific guideline for hardness, concentrations greater than 500 mg/L are generally considered unacceptable for domestic use.

- Coliform bacteria were detected in 2 wells in 2007. The maximum acceptable concentration for coliforms in drinking water is zero; however, total coliform count is not necessarily an indication of fecal contamination, as some species occur naturally on vegetation and soils. No sample tested positive for *E.coli*, an indicator of fecal contamination.

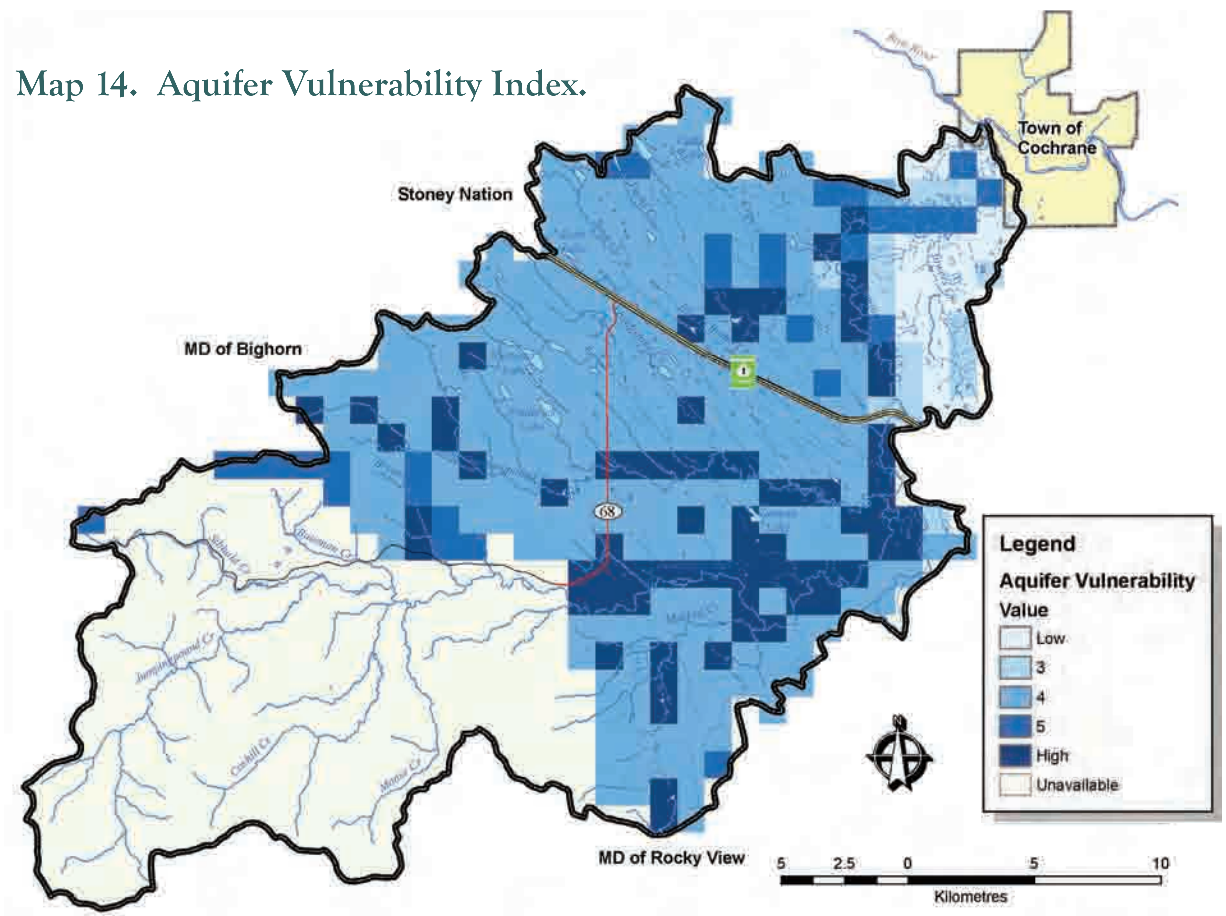
Overall, aesthetic exceedences are not a major obstacle for the potential use of local groundwater for drinking water supply; however, water treatment is recommended for individual wells of concern. Water with a TDS concentration above 1,000 mg/L is a health concern. The presence of coliform bacteria indicates possible contamination from fecal material; however, without detection of *E.Coli*, it may be attributed to naturally occurring bacteria on plants and soil. Groundwater wells showing positive numbers of total coliforms should be re-tested to ensure the presence is not persistent and that no fecal contamination is present.

Aquifer Vulnerability

The Aquifer Vulnerability Index is a method used to assess the vulnerability of aquifers to surface contaminants (Map 14). In the assessment, the depth to the aquifer and the types of geological materials above them are considered. The ratings indicate the potential of surficial materials to transmit contaminated water to the aquifer over a period of time. The AVI ratings are classed in a range from low to high. An area with a low class rating implies that water percolating through the surficial materials in this area takes a long time to reach the aquifer (in the range of thousands of years). In an area with high rating, contaminated water may reach the aquifer within tens of years (AAFRD 2005).

The potential risk for groundwater contamination is moderate across much of the Jumpingpound Creek watershed. Areas that have higher risk are mainly adjacent to Jumpingpound Creek, Little Jumpingpound Creek and areas along Potts Creek. The area surrounding Towers Creek has a low aquifer vulnerability rating.

Map 14. Aquifer Vulnerability Index.



4.3 Riparian Health

Riparian Areas

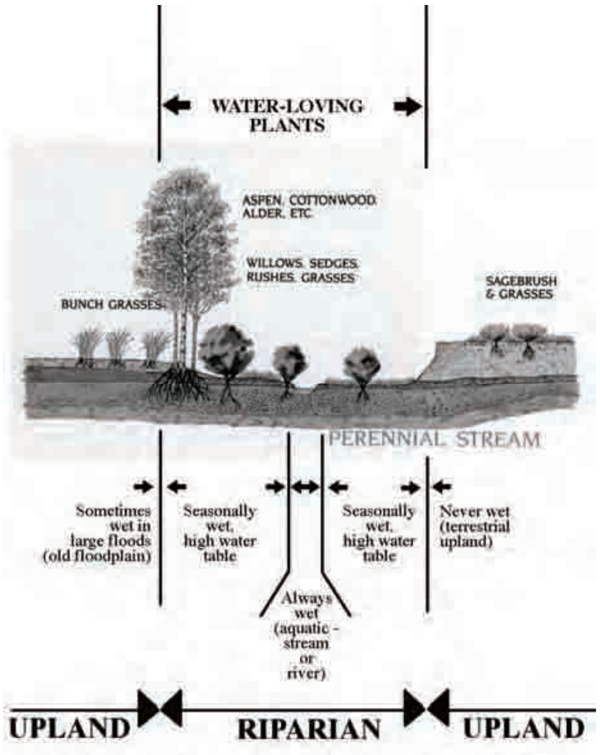
Riparian areas are the portions of the landscape strongly influenced by water and are characterized by water-loving vegetation along rivers, streams, lakes, springs, ponds and seeps (Figure 6). Riparian areas can be described as the “green zones” around lakes and wetlands and bordering rivers and streams.

When in a properly functioning condition or healthy state, riparian areas are one of the most ecologically diverse ecosystems in the world. Healthy riparian areas sustain fish and wildlife populations, provide good water quality and stable water supplies, and support people on the landscape. In doing so, they have a role in the environment that is disproportionately important to the amount of area that they encompass (approximately 2-5% of the landscape).

What makes a riparian area healthy?

Riparian areas are like a jigsaw puzzle and each individual piece or component is critical to the successful function of the entire system. How the individual pieces (e.g., vegetation composition, especially deep-rooted plant species, soils and wildlife) function together affects the health of the riparian ecosystem including the stream, its watershed, and overall land-

Figure 6. Diagrammatic representation of a riparian area.



scape health and productivity.

A healthy riparian area has:

- successful reproduction and establishment of seedling, sapling and mature trees and shrubs (if the site has potential to grow them),
- floodplains with abundant plant growth, stream banks and shore areas with deep rooted plant species (e.g., trees and shrubs),
- very few, if any, invasive plants (e.g., Canada thistle),
- very few structurally altered or eroded stream banks, and
- the ability of regular (i.e., approximately 1-3 years) high flow levels to access a floodplain appropriate to the size of the stream or river.

When riparian health is compromised it is likely that one or more of the pieces has been impacted by natural or human-caused disturbances such as development, recreation, grazing, flooding or fire. Riparian areas with extensive impacts are usually rated as unhealthy, because of modification of the pieces mentioned above. Riparian areas with moderate levels of impacts will typically fall within the healthy but with problems category, while those with very few or no impacts will normally be rated as healthy.

Assessing Riparian Health

Riparian health inventories and riparian health assessments are two tools used to determine the ecological function or health of riparian ecosystems. A riparian health inventory is a detailed assessment of the vegetative, soil and hydrological characteristics of riparian areas.

Riparian health assessments, on the other hand, are derived from the riparian health inventory and provide comprehensive information about the diversity, structure and health of plant communities within a project area. The riparian health assessment generates a score, rating riparian areas as either healthy (score 80 to 100%), healthy but with problems (score 60 to 79%) or unhealthy (score less than 60%). This examination provides a better understanding of the health of riparian areas, where to concentrate efforts if improvements in riparian management are required, and what land use practices are currently maintaining riparian health.

Jumpingpound Creek Riparian Health Inventory

Health Inventory Results

To date, riparian health inventories have been conducted by Cows and Fish along the downstream reaches of Jumpingpound Creek in the M.D. of Rocky View (i.e., Reaches 1 and 2). Six inventories were conduced in 1999 along a portion of Reach 1. An additional two inventories were conducted along this reach in 2000. In 2007, seven sites were assessed along Reach 1 (including two of the sites previously assessed in 1999) and eleven sites were assessed along Reach 2.

Results from the 2007 assessment were very positive, with a good proportion of sites rated as being in "Healthy" condition (39%), and the remainder rated as "Healthy but with Problems" (61%). None of the sites assessed in 2007 were considered to be "Unhealthy". Another positive finding was that health improvements were noted along the lower reaches of the creek. Three sites previously assessed as "Unhealthy" in 1999 had improved to "Healthy, but with Problems" over an eight year period following careful attention to improved riparian area management.

In general, the majority of the sites in Reach 2 (upstream of Highway 1) were in Healthy condition, while the majority of sites in the downstream reach of the creek (downstream of Highway 1), were rated as "Healthy but with Problems". The level of landscape alteration due to human development pressures and more intensified forms of land uses increase along the downstream reach of the creek in and around Cochrane, Alberta.

All of the sites assessed in 2007 along Reaches 1 and 2 were located on private land used primarily for livestock grazing. The finding that almost 40% of these sites are in Healthy condition, speaks to the use of good land stewardship and grazing management practices. Maintaining the upper reaches of Jumpingpound Creek in a healthy state will benefit downstream water users in Cochrane and Calgary.

Prior to the introduction of cattle, bison provided the greatest seasonal grazing pressures on riparian areas within the project area. Currently, livestock grazing continues to be the dominant land use influencing riparian health along the majority of Jumpingpound Creek and adjacent land. However, activities such as logging, gravel extraction, oil and gas exploration and pipeline developments, and minor amounts of recreational activity are other ongoing land uses in the project area. Urban expansion and rural residential development pressures are increasing in the watershed, particularly near Cochrane. These land uses will likely have more influence on riparian health in the near future.

Health inventories have not been conducted to date along the upper headwater reaches of Jumpingpound Creek; the majority of this portion of the creek lies within Public Land in the Kananaskis Improvement District (K-Country). Recreation, livestock grazing, forestry and sourgas drilling and pipeline developments are permitted land uses in K-Country.

Indicators of Health

Vegetation Cover

Native plants help to perform many riparian functions such as trapping sediment and stabilizing banks, absorbing and recycling nutrients, reducing evaporation rates and providing shelter and forage for livestock and wildlife. All of the riparian areas inventoried in 2007 in the Jumpingpound Creek watershed have adequate amounts of plant cover along the streambanks and floodplains.

A rich biodiversity of plant life is especially important for providing varied rooting depths for improved soil stabilization, year-round availability of nutritious forage types, and enhanced riparian area resiliency to disease, drought, floods and other natural disturbances. No less than 189 native plant species were inventoried along Jumpingpound Creek. This total includes 42 deep rooted woody plants such as white spruce (*Picea glauca*), balsam poplar (*Populus balsamifera*), aspen (*Populus tremuloides*) and numerous native shrubs. In particular, willows (*Salix* sp.) and red-osier dogwood (*Cornus stolonifera*) shrubs are fairly common in the Jumpingpound riparian area, two indicators of a healthy and vigorous riparian plant community.

Non-Native Plants (Invasive and Disturbance-Caused Plants)

One of the threats to native plant diversity and riparian function occurs when there is an increase in non-native "disturbance-caused" and "invasive" plants. These plants tend to take hold in areas with natural or human-caused disturbances. A total of 25 disturbance-caused species and 6 invasive species (all provincially designated "noxious weeds") were found in the Jumpingpound Creek watershed.

"Disturbance-caused" plants such as smooth brome (*Bromus inermis*), Kentucky bluegrass (*Poa pratensis*) and timothy (*Phleum pratense*) are especially prevalent in the Jumpingpound Creek watershed, particularly in the downstream reaches of the creek. Although these grasses do have good forage value early in the season, their shallow roots are not well suited to providing sufficient binding rootmass to the banks of a large foothills stream such as Jumpingpound Creek. Disturbance plants tend to spread most readily in moist, nutrient rich sites. They also compete well in areas that experience repeated grazing without sufficient rest between disturbances. Smooth brome, Kentucky bluegrass and timothy have been seeded historically in hayfields, pastures and road ditches in the Jumpingpound Creek watershed, creating a prolific seed source that has spread rapidly into natural and disturbed riparian habitats in the watershed.

"Invasive" plants are those that are listed by the *Weed Control Act of Alberta* as restricted or noxious weeds. They are non-native species that spread rapidly and are difficult to control. These plants can have severe economic and ecological consequences because they tend to have poor to no forage value. As a result they decrease land productivity, damage wildlife habitat, and reduce biodiversity.

The most prevalent invasive plant in the watershed is Canada thistle (*Cirsium arvense*). This noxious weed was present in all of the sites inventoried in 1999 and 2007; however, it was far more abundant in the downstream reach of the creek (Reach 1). Canada thistle was only found in trace amounts along Jumpingpound Creek south of the Trans-Canada Highway (Reach 2). The second most abundant invasive species, smooth perennial sow-thistle (*Sonchus arvensis*), was also most prevalent in the downstream reach of the creek (where it was found in 62% of the 13 sites assessed). Trace amounts of tall buttercup (*Ranunculus acris*) and bladder campion (*Silene cucubalus*) were found exclusively in Reach 1 (in 23% and 8% of the sites, respectively). Finally, a trace occurrence of yellow toad flax (*Linaria vulgaris*) and leafy spurge (*Euphorbia esula*) was recorded in a total of three sites along Reach 2. Of these species, the presence of leafy spurge is especially concerning given its potential to spread rapidly, dramatically impacting biodiversity and landscape productivity with potentially significant economic impacts.

Complete elimination of invasive and disturbance-caused plants is not realistic; however, with a combination of sound land management practices and weed control measures, the prevalence of these plants could be reduced. Weed control is primarily the responsibility of the landowner or lease holder with the majority of control coordination originating with the local Municipal District. Frequent, ongoing monitoring is necessary to control weeds and prevent small infestations from spreading. Reducing bare soil and ground disturbance, and maintaining the health and vigour of native plant communities, are also key factors in preventing the establishment and spread of invasive and disturbance-caused plants. Compared to predominantly grass landscapes, dense tree and shrub communities are more resilient to encroachment by weed species that tend to be shade intolerant. Refer to Section 4.4 for a profile of invasive plants.

Tree and Shrub Establishment, Regeneration and Browse Pressure

Trees and shrubs play a very important role in riparian health and function, particularly along foothills streams like Jumpingpound Creek that are subject to high flows in the spring following snowpack melt. Streambanks subject to high water velocities and flow volumes benefit from the excellent bank stabilization provided by deep-rooted trees and shrubs. Deep rooted woody plants also play a major role in the uptake of nutrients that could otherwise degrade water quality. Their overhanging canopies protect the soil from erosion and provide shelter to wildlife and livestock. Even when dead, decaying logs continue to provide erosion protection, wildlife habitat structure and nutrient cycling.

Trees and shrubs cover approximately 70% of the Jumpingpound Creek riparian area in

Reach 2 and the upstream portion of Reach 1. This intact forest canopy is one of the main reasons for the excellent health of a large proportion of the watershed. The dominant tree cover is a mix of white spruce and balsam poplar with interspersed pockets of aspen. The dominant shrubs in the understory are silverberry (*Elaeagnus commutate*), river alder (*Alnus tenuifolia*) and buckbrush (*Symphoricarpos occidentalis*). As many as 12 willow species also occur in the watershed.

A good indicator of the longevity and health of a riparian forest is the presence of woody plants in all age classes, especially young age classes. To maintain age class structure, at least 15% of the total cover of preferred trees and shrubs should be comprised of seedlings and saplings. There are no concerns with the reproduction of preferred trees and shrubs in the portion of Jumpingpound Creek inventoried in 2007. Successful preferred tree and shrub establishment and regeneration was observed in all of the sites inventoried. The woody plant community also appeared alive and vigorous overall, with normal amounts of dead and dying branches, indicating that disease or moisture stress is not a concern and that browse levels are not excessive.

Light browse pressure from livestock (and to a lesser degree wildlife) was observed in 61% of the sites inventoried in 2007. Woody plants can sustain low levels of use but increased browsing can deplete root reserves and inhibit establishment and regeneration. Only one of the sites inventoried in 2007 along Reach 1 had signs of overall heavy use including presence of umbrella-shaped mature shrubs and flat-topped or hedged seedlings and saplings.

Managing the timing and intensity of livestock use will help reduce potential for persistent heavy browse of preferred woody species. Trees and shrubs that are considered preferred in terms of riparian health also tend to be those that are most palatable to livestock (e.g. red-osier dogwood [*Cornus stolinifera*]). Monitoring fall and winter use of riparian areas is especially important, since tree and shrub browse tends to be highest in this period after grasses have matured or in spring before grass begins growth.

Streambank Rootmass Protection

The role of deep rooted streambank vegetation is to maintain the integrity and structure of the bank by dissipating energy, resisting erosion and trapping sediment to build and restore banks. Healthy, well vegetated riparian areas slow the rate of erosion and balance erosion in one area by increasing (or building) banks through deposition further downstream. If unstable banks are occasional, limited to a few outside meander bends, and the banks revege-

are at risk of increased erosion.

Eleven of the 18 sites (61%) assessed in 2007 are covered with adequate amounts (>65%) of deep, binding root mass. Portions of Jumpingpound Creek that are vulnerable to erosion are generally those areas with reduced tree and shrub cover and higher amounts of disturbance-caused plants. Signs of bank erosion and channel migration are evident along some portions of the creek. This is primarily due to natural process and overall bank stability is not significantly impacted by human influences.

tate within one year, erosion rates are considered normal. Much of the streambank inventoried for Jumpingpound Creek had adequate amounts of deep, binding root mass; however, there were a few areas of concern where banks

Bare Ground and Physical Alterations

When a streambank is physically altered, the system may become unstable. Erosion can increase and mobilize channel and bank materials and water quality can deteriorate. Moist, fine-textured riparian soil is especially susceptible to erosion and compaction from activities like vehicle traffic, livestock hoof shear and trailing, recreational trails, timber harvest, and landscaping. Soil compaction reduces the water-holding abilities of riparian soil and consequently impacts water storage and aquifer recharge. This can in turn affect filtration, nutrient uptake, floodplain maintenance and primary productivity. Increased erosion and compaction can also lead to increased bare ground exposure, increasing potential for weeds to move into an area.

Overall, the streambanks of Jumpingpound Creek are in excellent condition with only about 4% of the streambank within Reach 1 and 2 having structural alterations caused by human activities. Approximately 70% of the alterations are due to grazing activities and 15% due to logging. The remainder is mostly a result of minor amounts of oil and gas activities, vehicle trails and rip rap (large rocks used for erosion protection) at bridges. Only one site had more

than 15% of bank length structurally altered by human activity.

The amount of bare ground along Reaches 1 and 2 is also minimal, approximately 4%. Most bare ground is attributed to natural processes (sediment deposition from recent flood events). Only one site inventoried had more than 5% bare ground caused by human activity (i.e., trailing from livestock, roads, etc.).

Avoiding use of riparian areas during sensitive times of the year can reduce potential for soil compaction and erosion. Riparian areas are especially vulnerable to trampling when streambanks or shorelines are saturated with moisture, such as early in the spring following snowmelt. Depending on the severity of impacts, areas that have been minimally structurally altered can recover fairly quickly if given sufficient rest and time to re-establish vegetation. A first step in the restoration process is the recovery of native plants that function to trap sediment, strengthen and rebuild streambanks.

Stream Channel Incisement (Down-cutting) and Stability

Periodic flood events are important to disperse moisture throughout the riparian area for the maintenance of riparian vegetation. Flooding also spreads the energy of moving water over the riparian area, allowing sediment to be deposited and creating new areas for seedling establishment. High water events periodically access the highest terraces of the floodplain in the Jumpingpound Creek watershed. This is a good sign that Jumpingpound Creek is not downwardly incised (or down-cut).

Although little incisement has occurred, lateral (or side-ways) erosion of streambanks along Jumpingpound Creek is naturally occurring. This natural process of erosion along outside meander bends, results in downstream deposition of sediment on the point bars of meander lobes. This process drives the natural meander migration and subsequent point bar formation along the creek. Meander migration is typically not a management concern, except where the process is unnaturally accelerated due to lack of deep-binding rootmass protection along the streambank.

Data Gaps and Recommendations

Ongoing monitoring of riparian health is generally recommended every three to five years to assess whether riparian health is improving, declining or remaining stable. Riparian health assessments are a useful tool for land managers to identify and address concerns. Another simple monitoring technique is to simply visit a few "hot-spots" of concern and take photographs of these sites each year to assess changes through time in response to land management changes.

Although riparian health inventories have been conducted along the downstream reaches of Jumpingpound Creek, it would be beneficial to conduct additional health assessments along the headwater reaches of the creek. This assessment would provide Alberta Sustainable Resource Development, Public Lands Division with baseline information to assist with land use monitoring and management.

Landowners that are interested in having riparian health inventories conducted on their property are encouraged to contact Cows and Fish (the Alberta Riparian Habitat Management Society) for more information (www.cowsandfish.org).

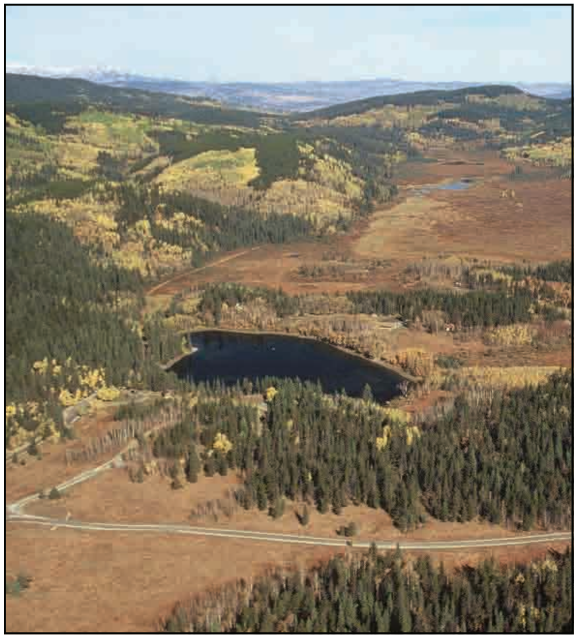
As land uses continue to change in the Jumpingpound Creek watershed, careful consideration should be given to maintaining appropriate riparian area buffers. With changes in the dynamics of land use such as intensified rural residential development, and the continuing expansion of Cochrane, come threats posed by land fragmentation, native vegetation clearing and increased human access along the creek. These types of developments can contribute to increased run-off with an increase in impermeable paved surfaces, affecting groundwater recharge and taxing the filtration and absorption abilities of riparian areas. This in turn can impact surface water quality and impact channel morphology as increased flows increase the erosive power of water. Another associated threat is the potential for human-caused disturbances to increase micro-sites for invasive species establishment and proliferation, and increased potential for new invasive species to be introduced into the watershed. These threats all need to be taken into consideration by managers responsible for land use planning in the watershed.

Maintaining or improving all of the key pieces of riparian health is a goal for sustainable water-

4.4 Invasive Plants

Invasive plants are a threat to the Jumpingpound Creek watershed. This is largely due to the historical infestations on provincial lands within the watershed and the complex transportation corridor that transects the watershed.

The transportation corridor (Trans Canada Highway, CP Rail and the Bow River) transecting the Jumpingpound watershed has provided the opportunity for invasive species that are well-established in British Columbia to enter the Jumpingpound watershed. Sporadic sitings of spotted knapweed, ox-eye daisy, blueweed and scentless chamomile occur just west of Jumpingpound on roadways, riparian areas and rail lines. Escaped ornamentals such as golden clematis and wild caraway are also present or nearby. And finally, Canada thistle and perennial sow thistle, introduced in the early 1990s, sporadically infest many native pastures throughout the watershed.



West of Jumpingpound, survey and control measures have increased over the past three years through a partnership called the "Bow Corridor Invasive Plants Initiative". This partnership of stakeholders from Banff to Calgary (provincial government departments, industry, municipal governments, towns and villages) have coordinated survey and control efforts to reduce the spread of invasive plants into adjacent lands (including much of the Jumpingpound watershed.) Continued vigilance by this Initiative will be important to prevent new infestations into the Jumpingpound watershed. Within the watershed, stakeholders are aware of the threat invasive present, and are working to control existing infestations and prevent new ones.

Efforts continue to be made to address the historical and ongoing invasive plant infestations in the watershed. The Sibbald /Jumpingpound area is an historical invasive plant site that has had sporadic control work committed to the main offender field scabious. Hand picking field scabious within five meters of an open body of water was completed and the. herbicide Transline was applied by spot spraying up to five meters of an open body of water. The horse corral located in Sibbald Flats is hand picked and not treated with herbicide. Areas treated with herbicide include: Sibbald Flats, the meadow located down the trail of Dawson Trailhead, the meadow west of Sibbald Lake Campground and reclaimed trails in the demonstration forest (ASRD 2008).

In addition to the main infestation site at Sibbald Flats described above, rangelands in close proximity have also been infested. Ranchers attempt to prevent the spread through grazing strategies and herbicide use, with less than optimal success. Highway treatments have been sporadic and uncoordinated until recent years, so infestations have spread westward in particular.

Canada Thistle (Cirsium arvense)

Provincial Designation: Noxious

Although now common in Canada, Canada thistle is an invasive weed introduced to North America from Europe. It is a colony-forming

Canada Thistle

perennial that spreads by wind borne seeds and by its aggressive creeping root system. Its extensive, deep root system allows it to survive drought periods and access moisture and nutrients below the roots of native plants. Dense colonies of Canada thistle shade out and displace native plants.

Canada thistle is prevalent in disturbed sites throughout the M.D. of Rocky View, creating an abundant seed source that has contributed to its spread along Jumpingpound Creek. It quickly takes hold in areas of naturally-caused bare soil after flooding as well as in human-caused or heavily grazed areas. In riparian areas, dense Canada thistle infestations can impact wildlife by reducing the availability and quality of forage and nesting cover.

Leafy Spurge (*Euphorbia esula)*

Provincial Designation: Noxious

Leafy spurge is an aggressive, persistent, deep-rooted perennial that grows on a range of soil types and in dry to wet climates. It reproduces from extensive creeping roots and by producing an abundance of seeds that are easily dispersed by birds, wildlife, human, and in rivers and streams. These characteristics and its ability to secrete toxins into the soil to impede growth of other plants, allow it to outcompete native plants. Another management concern is that all parts of a leafy spurge plant contain a milky latex that is poisonous to cattle and other animals and can cause blistering and irritation of human skin. It can cause scours


Leafy Spurge

and weakness if eaten by cattle, and death if ingested in larger amounts.

Although leafy spurge is currently not a significant concern along Jumpingpound Creek, if left unchecked, this species can spread rapidly with potentially staggering economic impacts. This noxious weed has become a significant concern to land managers in the northern United States and increasingly in British Columbia and Manitoba. In the northern United States it is estimated that range managers lose over 100 million dollars annually in lost production. The ecological damages posed by leafy spurge, while difficult to assign a dollar amount, are no less significant. By outcompeting native plants and forming large monocultures, this species poses a threat to biodiversity, threatening both abundant and sensitive native plant species and wildlife that rely on these plants for their survival.

Field Scabious (Knautia arvensis (L.) Duby)

Provincial Designation: Noxious

Description: Field scabious is a simple perennial that reproduces and spreads by seed. It has pale purple to blue flowers in dense heads composed of numerous, tube-shaped florets. Stems can grow up to 1.3 metres tall and are sparsely branched. Very often the entire plant (including the flower buds) is covered in short,


Field Scabious

L. Allen

stiff hairs. The leaves are opposite and deeply divided into 5-15 narrow segments. Field scabious is a non-native plant of European origin. It is a very effective competitor, and is difficult to remove once established. It can quickly take over pastures where competition by desired native species is reduced. Although this plant is not poisonous to livestock, it is very unpalatable when mature with little nutritional value. Cattle will eat young plants before they bolt.

Spotted Knapweed (Centaurea maculosa)

Provincial Designation: Restricted

Description: Spotted knapweed is primarily a biennial plant – producing a rosette the first year and a flowering bolt the second – but can also be a short-lived perennial, blooming for a few years before dying.

Stems are often upright and branched, growing up to 1.5 m tall. Knapweeds have become well known because of their almost wholesale degradation of large tracts of rangeland in the northwestern US and parts of southern BC. While livestock and wildlife will graze knapweed early in its growth form, it becomes unpalatable and can out-compete a native range community. Knapweed is not yet established in the Jumpingpound watershed, but is moving down the transportation corridor from the west.

Spotted Knapweed

Wild Caraway (Carum carvy)

Municipal Designation: Noxious; Provincial: Nuisance

Description: Wild caraway is a biennial plant, producing a low growing rosette of leaves in its first year of growth, and then a flowering stalk (bolt) in the second year – it can even bolt and flower a third year before dying. It develops a narrow taproot and grows in a widerange of soil types. Bolting plants can tolerate some spring flooding and seedlings can survive light frosts. Stems are erect, branched, and grow 60 to 90 cm tall. There can be several stems per plant. Leaves are alternate and very finely divided (carrot-like). The leaves of first-year rosettes can be very similar to yarrow, a native plant. Flowers are white, but occasionally pinkish, and occur in groups at the top of stems (compound umbels). 'Wild' caraway is grown in western Canada as a spice crop, however it escaped cultivation and has been invading pastures, rangeland and natural areas for several years now. It is not utilized by livestock and can quickly displace nearly all other vegetation where infestations go uncontrolled. Infestations in forage crops have led to weed seed dispersal in baled hay. The plant is easiest to control in its first year of growth with a residual herbicide. Once bolting has started, the plant becomes much more difficult to control – especially if it has been allowed to go to seed more than once.


Wild Caraway

4.5 Wetlands

Wetlands are similar to riparian areas in that saturated soils promote the growth of water-loving vegetation. Wetlands are considered lentic (or non-flowing) riparian environments.

Wetlands have an important role to fulfill in the Jumpingpound Creek watershed. Covering an area approximately 63.5 km^2, wetlands provide diverse habitats for a wide array of wildlife. Moose, grizzly bear, Trumpeter Swans and a variety of amphibians make their home in these environments. In addition to habitat, wetlands provide a host of functions that help maintain a healthy watershed. Wetlands:

- ☐ Control and attenuate flood water,
- ☐ Store flood water and slowly release this water into the creeks throughout the summer months to maintain baseflows,
- ☐ Recharge groundwater,
- ☐ Filter water and improve quality by retaining nutrients and sediments,
- ☐ Provide forage under well-managed conditions, and
- ☐ Provide recreation opportunities.

There are five types of wetlands in Alberta: Peatlands (bogs and fens) and non-peatlands (marshes, ponds and swamps). Three of these types of wetlands are represented in the Jumpingpound Creek; these are fens, marshes and ponds or open water wetlands.

Peatlands (bogs and fens) are also referred to as muskeg. Bogs are acid peat deposits that generally contain a high water table, have no significant inflow or outflow streams and support acidophilic or acid-loving vegetation, particularly mosses (Mitsch and Gosselink 1993).

Fens receive most of their water from groundwater. The water is less acidic and contains more nutrients than bogs. Like bogs, fens also have a high accumulation of peat (> 40 cm), but because they are less acidic, they can accommodate more vegetation, like sedges, grasses and wildflowers. Fens can look like open, grassy fields or can be wooded. Peat formed in bogs and fens accumulates as partially decayed plant matter in muskeg environments.

Map 15 shows a large band of land classified as general wetlands in the Jumpingpound Creek watershed that is oriented in the north-south direction. This wetland area is likely to be a fen environment. Although the vegetation may look terrestrial, the underlying water table is high which provides excellent growing conditions for grasses and species of willows. The assumption that this area is a fen environment is supported by the large number of springs that are found in this area and the high aquifer vulnerability noted in Map 14, Section 4.2.

North of Highway 1, wetlands are generally open water and are typical of the prairie pothole environment where numerous, unconnected and saucer-like depressions dot the landscape. These depressions contain a wetland similar to a shallow pond or marsh, characterized by emergent vegetation adapted to wet soils, including cattails (*Typha spp*.) and bulrushes (*Scirpus spp*.). The amount of water that these wetlands hold depends on the amount of recent precipitation, but often they rely on spring runoff (Kantrud et al. 1989). Some of the prairie potholes that do not re-appear annually due to limited precipitation or drought are seeded to annual crops.

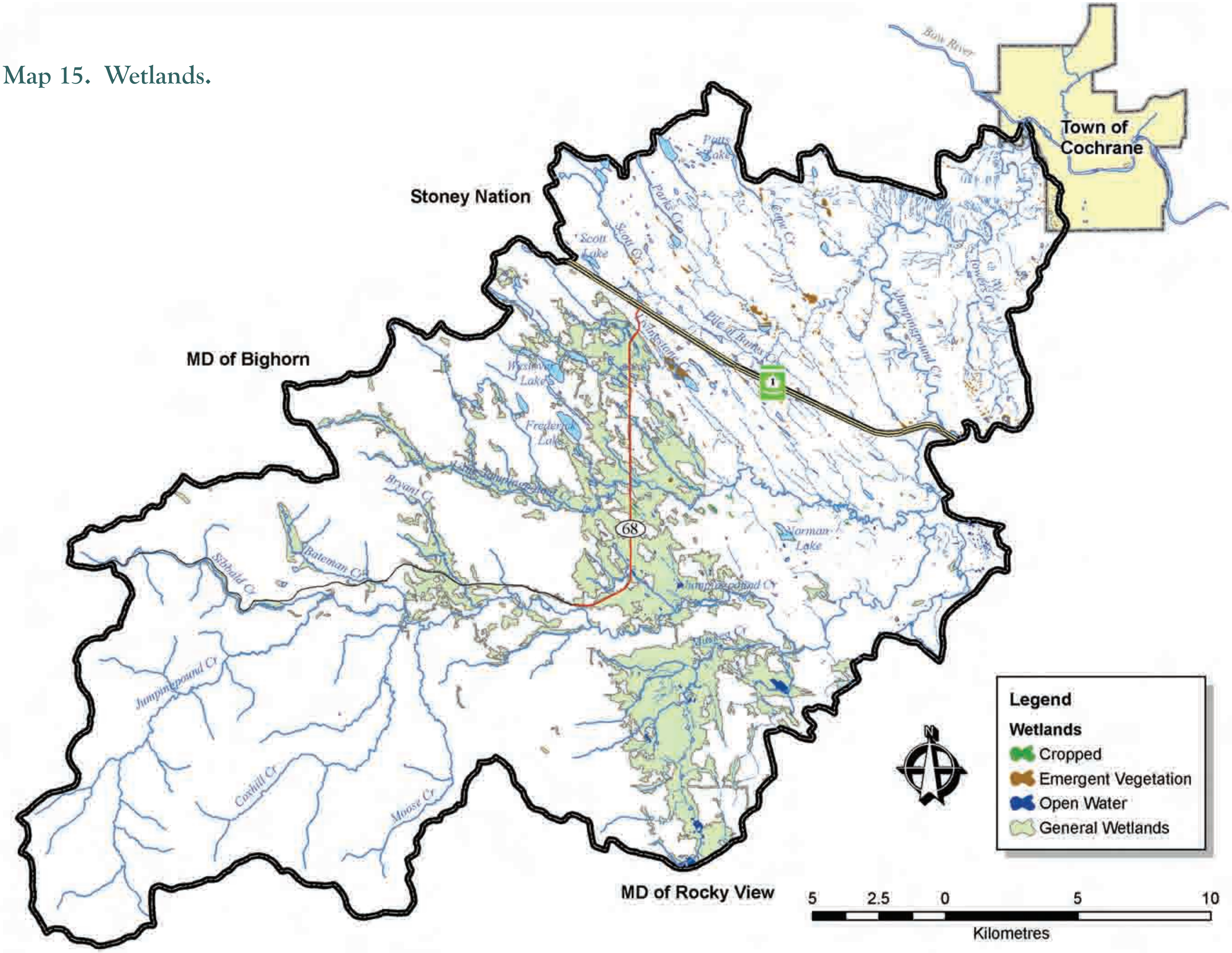
Open water wetlands are generally deeper than prairie potholes or marshes and tend to have water for longer durations.

The rapid rate of wetland loss in Alberta due to land conversion and drainage is a constant concern and has spurred the Province to develop an Alberta Wetland Policy.

Data Gaps and Recommendations

The groundwater hydrology in Jumpingpound Creek is not well understood. Fen environments are unique and contribute to the over-all water balance in the watershed (groundwater was estimated to contribute 68% of total flows). Further studies of this area is required to prevent future impacts on hydrology and groundwater quality.

Map 15. Wetlands.



4.6 Fisheries

Jumpingpound Creek and its many tributaries contain a valuable fishery. Bateman, Coxhill, Pine and Sibbald creeks, among others, are all trout-bearing as they have the necessary habitat required for spawning and rearing young.

Critical habitat features in the Jumpingpound Creek watershed include:

- ☐ Gravel/cobble bottom
- ☐ Deep overwintering pools including beaverponds
- ☐ Instream cover (small and large woody debris, boulders)
- ☐ Healthy riparian areas
- ☐ Available food source
  - - benthic invertebrates
  - - terrestrial insects
- ☐ Good quality water
  - - cold water (< 20°C)
  - - high oxygen concentrations
  - - low suspended sediments

Fisheries and aquatic habitat data has been collected for Jumpingpound Creek and some of the main tributaries at various times since 1947. Table 7 summarizes the different sport and forage fish that have been captured in the creek during fish surveys.

Table 7. Summary of fish species found in the Jumpingpound Creek watershed.

Type	Common Name
Sport Fish	brook trout, bull trout, brown trout, cutthroat trout, mountain whitefish, rainbow trout, burbot, cutthroat trout x rainbow trout hybrid
Forage Fish	brook stickleback, lake chub, longnose dace, longnose sucker, mountain sucker, white sucker, trout-perch, pearl dace

Fisheries Survey Results

The Jumpingpound Creek watershed has been divided into four reaches suitable for fisheries management (Figure 7).

Reach 1— Confluence with the Bow River to Hwy 1. Pile of Bones Creek is a tributary.

Reach 2—Upstream of Hwy 1 to the Forest Reserve Boundary. Little Jumpingpound, Muskeg and Pine creeks are tributaries.

Reach 3– Upstream of the Forest Reserve Boundary to the confluence of Sibbald Creek. Bryant, Moose, Coxhill, Bateman and Sibbald creeks are tributaries. Sibbald Lake and Sibbald Meadows Pond also occur in this reach.

Reach 4– Upstream of confluence of Sibbald Creek to headwaters. A number of small unnamed tributaries are found in this reach.

Information for each of these reaches was compiled in an extensive literature review that reported on the fishery inventory, fish habitat, spawning activity, riparian habitat, water quality, angling use and habitat enhancement where applicable (Norris 2003). The following summary of fisheries in the Jumpingpound Creek watershed is based on this extensive report.

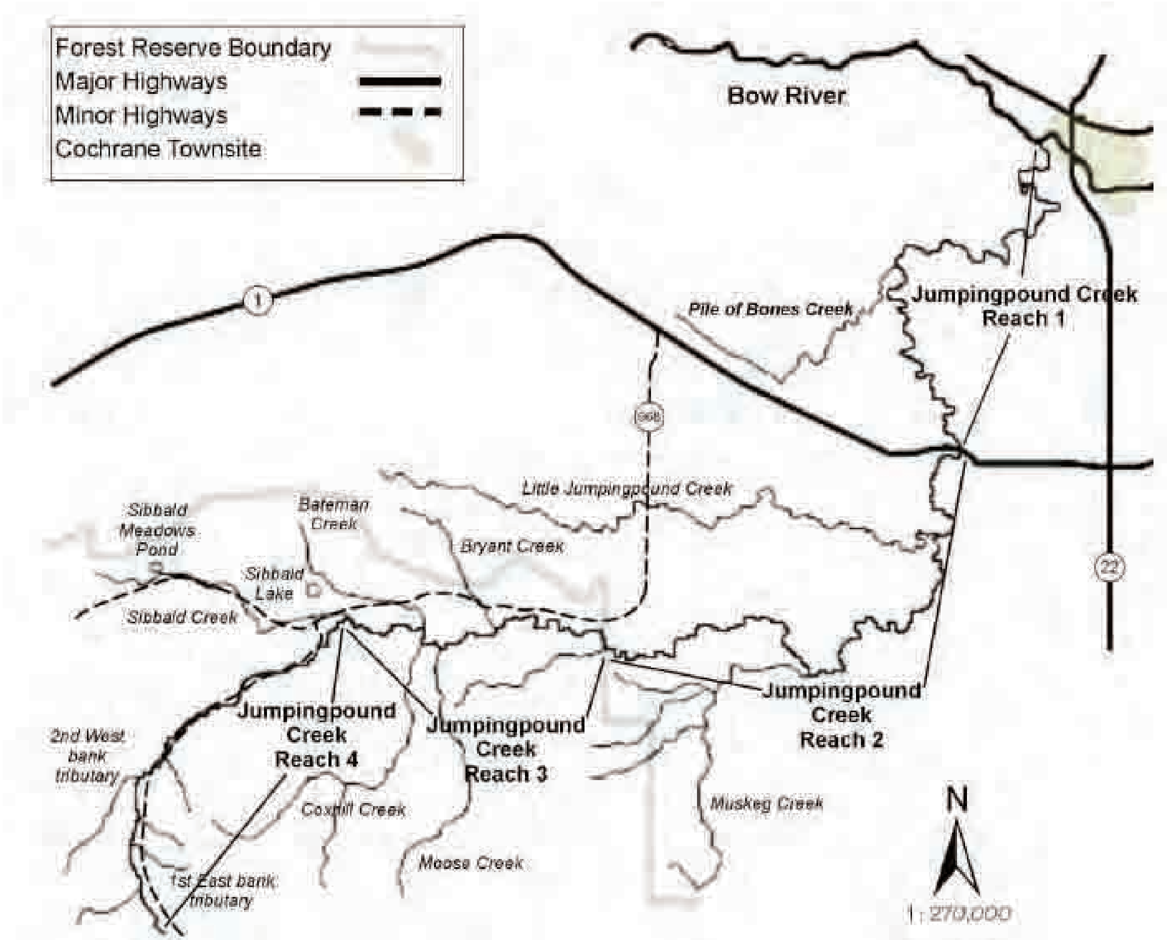


Figure 7. The four reaches defined for fisheries management in Jumpingpound Creek and its tributaries.

Jumpingpound Creek

Reach 1

Fish Inventory. Reach 1 was an important part of Alberta Environment's fish stocking program in the early half of the 20th century. From 1929 to 1948, Reach 1 was stocked with rainbow trout and cutthroat trout, with brook trout in 1949 and with rainbow trout from 1960 to 1964 (Fish and Wildlife 1990).

In 1986 and 1987, Rees (1988) reported that rainbow trout were the most abundant and widely distributed sport fish in this reach. Three size classes were represented in this study that suggested spawning and rearing habitat was present in this reach for Bow River rainbow trout. This finding was supported by Culp and Glozier (1989) who observed that the number of fish species was highest and sizes were greatest in the downstream section of the reach, closest to the Bow River and by Culp et al. (1996) who observed spawning rainbow trout and young-of-year rainbow trout present. The highest density of rainbow trout tended to be in areas where woody debris was present. Other species occurring in this reach include mountain whitefish, cutthroat trout, brook trout, bull trout, burbot (occasionally), brown trout, longnose dace, trout-perch, white sucker, longnose sucker, lake chub, brook stickleback and spoonhead sculpin.

Habitat Assessment. In 1947, Miller found that this reach was wider, deeper, warmer and carried a higher silt load than upstream reaches. Culp and Glozier (1989) reported similar findings and further observed that there was a low amount of cover compared to upstream reaches. In 1986, Culp et al. (1996) reported little instream woody debris existed, fine woody debris input was sparse and instream retention was reduced because of the wide width. Maximum water temperature was 26.4°C on July 29, 2000, with daily stream temperatures reaching higher than 24°C from July 13 to August 10, 2000 (Woods 2001). Baayens (2001) found the average daily high water temperature for July was 20.6°C, August 20.2°C and September 20.6°C in 2001. Beaver activity in this reach was reported by a number of biologists.

Reach 1 is an important spawning area for rainbow trout from the Bow River. Some spawning by brown trout has been documented and the reach may provide spawning habitat for mountain whitefish.

Habitat Enhancement. A number of projects have been initiated to improve habitat conditions in Reach 1 (Table 8).

Table 8. Summary of habitat enhancements projects in Reach 1 of Jumpingpound Creek.

Year	Enhancement
1987	14 scour holes (about 12 m long by 5 m wide by 1.5 m deep) created to deepen and provide cover/holding pools for spawning trout.
1988	Two beaver dams were removed that were causing siltation of streambed.
1991	Logwall was installed to stabilize the streambank from erosion; rock v-weirs were installed to extend the riffle areas and increased pool habitat; existing pools were excavated to provide deeper holding, rearing over-wintering areas.
1996	Addition of fine woody debris to increase habitat availability for rainbow
2000	One-hundred acre conservation easement restricting development activities along Jumpingpound Creek.
2001	Two small, unauthorized manmade dams constructed from rocks and sticks were removed to facilitate fish passage.

Reach 2

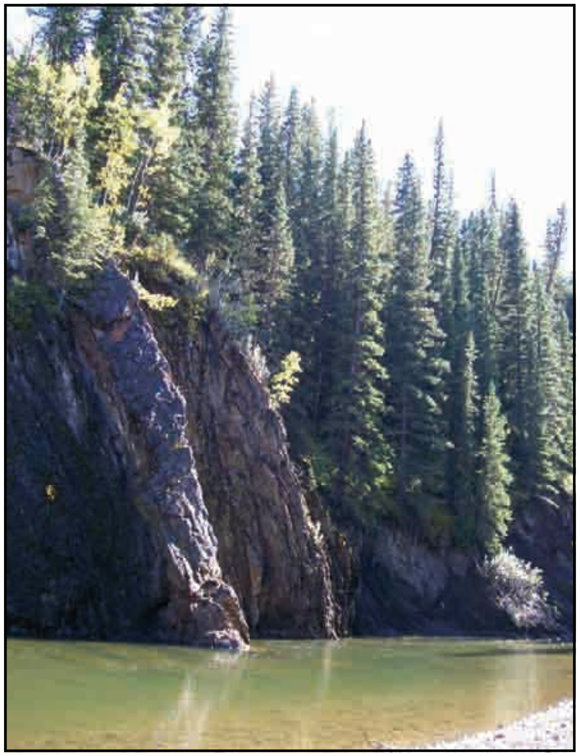
Fish Inventory. In 1962, rainbow trout and cutthroat trout were the most abundant fish in Reach 2. By 1981, cutthroat trout were less common and rainbow trout and mountain whitefish more common. Other fish in Reach 2 include bull trout, brook trout, longnose sucker, white sucker, mountain sucker, longnose dace, lake chub and trout-perch.

Habitat Assessment. Miller (1947) reported that this reach lacked pools, cover and food for fish. In 1985, Nibourg observed relatively stable banks, deep water for cover, surface turbulence, submerged aquatic vegetation, logs and log jams.

In 1990, Beers noted that an increase in fish density suggested that trout spawning and survival of emerging fry was below the carrying capacity of the surrounding habitat.

Heavy beaver activity was noted in this reach (Miller 1947, Cooke 1982).

Spawning Activity. Numerous authors noted spawning potential for rainbow trout, cutthroat trout and brook trout (Weibe 1979, Stelfox 1980, Nibourg 1985, Golder Associates 2001). Rainbow trout redds were found throughout this reach, with the most abundant immediately upstream of the Highway 1 bridge (Woods 2000). Bow River rainbow trout migrate from the Bow River upstream to this reach to spawn and return to the Bearspaw Reservoir for the remainder of the year to overwinter (Golder Associates 2001).



Reach 3

Fish Inventory. In the early 1960s, the Reach 3 fishery consisted or rainbow trout, cutthroat trout, mountain whitefish with small numbers of bull trout and brook trout. By the late 1970s, the community was dominated by brook trout, particularly in the lower part of the reach, with cutthroat trout becoming more abundant at higher elevations. White suckers are the only forage fish documented in Reach 3.

Habitat Assessment. Cooke (1982) observed the stream channel contains numerous pools and overhanging banks that provide good fish habitat. Average stream flow velocity was 0.7 m/s. Cover consists of boulder/cobble substrate, deep pools, overhanging vegetation and large woody debris. The substrate consists mainly of small cobble and large gravel. At the confluence with Bateman Creek, summer feeding, rearing and possibly overwintering habitat for all stages of trout and whitefish was observed (Tera Environmental Consultants 1998).

Spawning Activity. Weibe (1979) reported suitable spawning substrates and the potential for spring-spawning, especially downstream of the confluence with Bateman Creek. Stelfox (1980) noted suitable spawning habitat near the Forest Reserve Boundary for brook trout and bull trout.

Reach 4

Fish Inventory. In the 1960s, cutthroat trout and rainbow trout were equally abundant in this reach but by the mid-1980s, cutthroat trout was the dominant sport fish. Other sport fish reported in this reach (in decreasing abundance) include brook trout, bull trout, rainbow trout and mountain whitefish. No forage fish have been reported in Reach 4 (Norris 2003). .

Fish Habitat. Similar to Reach 2 and Reach 3, Miller (1947) reported a lack of food, pools and cover in this reach. Thompson (1969) observed boulder and rubble substrates, stable banks, an average stream flow velocity of 0.2 m/s in August. The same author reported a riffle to pool ratio of nearly 4:1. Nibourg (1985) found that this reach was dominated by riffles, boulder/rubble substrate, surface turbulence, overhanging vegetation and log jams. Cooke (1982) observed some siltation in this reach from a road which runs alongside the creek. The same author noted that small tributaries that enter creek from under the road were very silty. Steep overhanging banks provided good cover. In June and July 1980, average stream flow velocity was 0.8 m/s (Cooke 1980). Colder water temperature were documented compared to downstream reaches (Culp and Glozier 1989).

Spawning Activity. Nibourg (1985) reported that this reach is an important spawning and rearing area for cutthroat trout. It also has potential for spawning rainbow trout, brook trout and bull trout (Weibe 1979; Stelfox 1980).

Tributaries to Jumpingpound Creek

Pile of Bones Creek

Pile of Bones Creek is the lowermost tributary to Jumpingpound Creek, with its confluence located in Reach 1. Although Pile of Bones Creek may have water that is too warm to support a trout fishery, it does contain a large number of sucker and minnow species (Wileman 1952). In June 2005, white sucker, longnose dace and brook stickleback were captured in the creek (FWMIS database). Wileman (1952) also noted that aquatic life is reduced downstream of the refinery. In November 1987, Rees (1988) reported that the Pile of Bones Creek had no water flow upstream of the Shell Gas Processing Plant, suggesting that flow in the main creek is supplied from the gas plant (cooled boiler water). In January 2000, a small fish kill occurred in the creek downstream of the Shell gas plant and was comprised of small rainbow trout and mountain whitefish. The fish kill was due to low oxygen in the stream (Golder Associates 2000). Golder Associates (2000) also noted that there was no flow in the creek above the gas plant.

Little Jumpingpound Creek

The confluence of Little Jumpingpound Creek is located in Reach 2 of Jumpingpound Creek. In 1946, Little Jumpingpound Creek was stocked with 5,000 cutthroat trout (Fish and Wildlife 1990). Cutthroat trout were observed by Wileman (1952) to be concentrated in beaver ponds. The last documentation of cutthroat trout was in 1964 (Cunningham 1964). Later studies have documented many forage fish but no sport fish (Nibourg 1985; Golder Associates 1997). Fish sampling in 1983, 2003 and 2004 captured white sucker, mountain sucker, longnose sucker, brook stickleback, lake chub, longnose dace and pearl dace (FWMIS database). Also captured in 2003 were 4 brook trout.

Miller (1947) observed deep pools and good cover but warm stream temperatures, heavy silt deposits and poor food supply were limiting fish habitat in Little Jumpingpound Creek. In fall of 1979, Stelfox (1980) documented some pools but no flow. Golder Associates (1997) rated Little Jumpingpound Creek as poor in terms of fish habitat due to poor water quality,

high summer temperatures, beaver activity and livestock impacts. Further, the gradient is low, flow is intermittent and shallow, and substrate is primarily fine sand/silt with some debris. The lower reach is characterized by shallow, intermittent flow, algae covered silt/gravel, with cover provided by submerged vegetation, undercut banks, overhanging vegetation, rocks and water depth. The lower reach is a highly sinuous channel with numerous oxbow lakes and beaverponds (Norris 2003). The upper reach is contiguous beaverponds, with stagnant, algae-covered water, a highly meandering channel, with cover provided by overhanging vegetation, undercut banks and aquatic vegetation (Norris 2003). The creek has limited fish habitat potential for sport fish (Stelfox 1980; Nibourg 1985). In 2002, 4200 cutthroat trout fry were stocked into Little Jumpingpound Creek (FWMIS database).

Muskeg Creek

The confluence of Muskeg Creek is located in

Reach 2 of Jumpingpound Creek. Cutthroat trout were abundant in Muskeg Creek until a 1945 winterkill (Miller 1947). In 1952, 9,000 cutthroat trout were stocked (Fish and Wildlife 1990). Wileman (1952) did not find cutthroat trout in the creek, but found a tributary to Muskeg Creek that supported a native cutthroat trout population. In 1962, cutthroat trout were observed as common (Cunningham 1962) with rainbow trout and bull trout also present. In 2002, 3,400 cutthroat trout fry were stocked into beaverponds (Norris 2003). Fish sampling in 2003 captured brook trout, white sucker, lake chub, longnose dace, pearl dace and brook stickleback (FWMIS database). There are no reports of spawning in Muskeg Creek (Norris 2003).

Various authors have reported variable habitat conditions. Cool water temperature, deep pools and cover with an abundant food supply provides good habitat (Miller 1947, Fernet 1990) to marginal trout habitat (Cunningham 1962, Nibourg 1985). Water quality has not been documented in Muskeg Creek.

Pine Creek

The confluence of Pine Creek is located in Reach 2 of Jumpingpound Creek. Brook trout, cutthroat trout, rainbow trout, bull trout, white sucker, longnose sucker and longnose dace have been documented in Pine Creek (Norris 2003). The creek was dominated by cutthroat trout in the 1960s; however, brook trout appear to have increased in the creek since the 1960s, particularly in the lower reach (Norris 2003).

Good cover is provided by deep water, undercut banks, beaverponds, submerged cover and overhanging vegetation (Norris 2003). Although trout were documented to comprise more than 50% of the population, trout comprised less than 10% of the total weight, due to the abundance of age-0 and 1 trout (Nibourg 1985). In the lower reach, spawning habitat is limited by silt and angular substrate but rearing habitat is present. In the upper reach, suitable spawning habitat is present (Norris 2003).

Bryant Creek

The confluence of Bryant Creek is located in Reach 3 of Jumpingpound Creek. Fisheries potential in Bryant Creek is documented as low (Weibe 1979; Stelfox and Nibourg 1983; Nibourg 1985). Low flow and water levels in ponds is a limiting factor to overwintering habitat. Three of 12 ponds were surveyed within 2.1 km of Hwy 968 (Stelfox and Nibourg 1983). All three ponds had low water levels and limited fisheries potential. No further stocking of beaverponds was recommended unless: 1) the pond's surface area was known, 2) the pond was capable of overwintering fish or is close enough to road access to allow for management as a put and take fishery, and 3) the pond lacked or had inadequate natural reproduction. The other nine ponds identified were not visited Spawning activity is limited in Bryan Creek by low water velocities and unsuitable substrate. The riparian vegetation is willow and muskeg/meadow providing little shade. Summer water temperature may also limit sport fish potential as the water temperature was 13°C in

late May 1979 (Norris 2003).

Moose Creek

The confluence of Moose Creek is located in Reach 3 of Jumpingpound Creek. Cutthroat trout (998) were stocked in a beaver pond and the headwaters in 1952 (Wileman 1952). Cunningham (1962) documented cutthroat trout, rainbow trout, bull trout, brook trout and mountain whitefish in Moose Creek. In 1981 and 1983, no fish were captured in the lower reach (Nibourg 1985). Between 1950 and 1980, the dominant species shifted from cutthroat trout to cutthroat trout and rainbow trout, to brook trout

(Norris 2003). Fish sampling in 1978, 2003 and 2005 captured brook trout and cutthroat trout (FWMIS database).

In 1947, Miller (1947) reported numerous pools and riffles, excellent cover and cold stream temperatures which provide good fish habitat, although little food was present. Substrate has been reported as primarily boulders and coarse rubble, although silts reaches have also been observed (Norris 2003). Barriers, stream crossings and insufficient overwintering discharges result in low fish densities in Moose Creek (Tripp et al, 1979, Nibourg 1985). There is potential for good spawning and rearing habitat for brook trout along this creek (Stelfox 1980; Nibourg 1985). Tripp et al. (1979) observed some sedimentation at six stream crossings.

Coxhill Creek

The confluence of Coxhill Creek is located in Reach 3 of Jumpingpound Creek. The fishery in Coxhill Creek is dominated by brook trout, with cutthroat trout and rainbow trout also present (Golder Associates 1997). In 1962, the fishery was dominated by cutthroat trout (Cunningham 1962).

Substrate in Coxhill Creek is mainly boulders and coarse rubble (Tripp et al. 1979; Nibourg 1985). Golder Associates (1997) reported three waterfalls approximately 3 km upstream of the confluence with Jumpingpound Creek which are impassable to fish. They also noted that the midsection of the creek is ephemeral during the open water season.


Sibbald Lake

There is spawning habitat for brook trout and cutthroat trout in the lower reach below the falls (Norris 2003). Upstream of the falls, there are deep pools and coarse substrate and good spawning habitat (Nibourg 1985).

Bateman Creek

The confluence of Bateman Creek is located in Reach 3 of Jumpingpound Creek. Bateman Creek contains cutthroat trout, bull trout, rainbow trout, brook trout and brook stickleback (FWMIS database, Tripp et al. 1979). In the 1960s, the fish population was dominated by cutthroat trout; however, by the late 1970s the dominant species was brook trout followed by cutthroat trout. Bateman Creek has numerous beaverdams throughout its entire reach (Tripp et al. 1979; Stelfox 1980; Nibourg 1985). The beaverpond complexes were stocked with 2,280 rainbow trout in 1965 and 200 to 2,000 rainbow trout every year from 1976 to 1986 (Fish and Wildlife 1990). Eight of the 13 beaverponds were initially thought to provide overwintering habitat and were stocked (Stelfox and Nibourg 1983); however, Nibourg (1985) determine the beaverdams were not capable of overwintering fish. Similar to Bryant Creek, no further stocking of beaverponds was recommended unless stocking criteria were met (e.g. ability to overwinter fish) (Stelfox and Nibourg 1983). There is limited spring-spawning potential in Bateman Creek due to intermittent water velocities and unsuitable substrates (Weibe 1979). However, there may be potential fall-spawning and rearing habitat for bull trout and brook trout (Stelfox 1980; Nibourg 1985).

Cutthroat Trout

Sibbald Creek

The confluence of Sibbald Creek is located in Reach 3 of Jumpingpound Creek. Brook trout, rainbow trout, cutthroat trout, bull trout and white sucker occur in Sibbald Creek (FWMIS database). From 1941 through 1948, 29,000 rainbow trout and 1,000 cutthroat trout were stocked in Sibbald Creek (Fish and Wildlife 1990). From 2000 to 10000 rainbow trout were stocked each year from 1960 through 1988 in various beaverpond complexes. From 1990 to 1996 stocking into beaverpond complexes was dominated by brook trout and cutthroat trout with some rainbow trout. From 2000 to 2006, stocking into Sibbald Creek was dominated by cutthroat trout with some rainbow trout. Twelve beaverponds provide overwintering habitat and five have historically been stocked (Stelfox and Nibourg 1983). Sibbald Creek is a sinuous, deeply channeled and slow flowing. Cover is provided in the lower reach by deep water, undercut banks, and overhanging vegetation (Nibourg 1985). The lower reach of Sibbald Creek has been identified as having potential brook trout and bull trout spawning habitat with the upper reach having limited spawning potential due to silt accumulations although some spawning by brook trout and cutthroat trout occurs in the upper reach (Nibourg 1985). Nibourg (1985) noted siltation due to Sibbald Creek Trail use.

Sibbald Lake

Sibbald Lake is located within Reach 3 of Jumpingpound Creek. Sibbald Lake is a naturally occurring lake with a surface area of 3.1 ha, a mean depth of 2 m and a maximum depth of 3 m. Sibbald Lake was stocked with 2000 to 8000 rainbow trout every year from 1947 to 1988 (Fish and Wildlife 1990). Lake winterkills occurred from 1961 through 1963 (Cunningham 1962; Cunningham 1964). Complete winterkills were documented during the winters of 1982 through 1986 and summerkill occurred in 1992. The lake water level can drop by more than 1.1 m particularly in drought conditions (Fish and Wildlife unpublished files).

In 1977, a water control structure was constructed at the outlet of Moose Lake to store water for later use and increase water levels in Sibbald Lake (Associated Engineering Services Ltd. 1976). From 1996 to 2008, the lake was stocked each year with an average of 1700 rainbow trout (16 to 24 cm long). The lake is managed as a put-and-take fishery and is a popular lake for angling.

Sibbald Meadows Pond

Sibbald Meadows Pond is located within Reach 3 of Jumpingpound Creek. Sibbald Meadows Pond is a man-made pond with a surface area of 3.6 ha, and a depth of 1 to 4.5 m. The pond is on Sibbald Creek and was built by excavating an area where beaver ponds occurred. Sibbald Meadows Pond has been stocked with rainbow trout since 1983. From 1996 to 2008, the lake was stocked each year with an average of 4000 rainbow trout (16 to 25 cm long); although in 2003, 2005 and 2007 the lake was stocked with 4000 cutthroat trout (15 to 18 cm long). A complete winterkill was documented during the winter of 1984/85 (Fish and Wildlife unpublished files). However, Sibbald Meadows Pond provides suitable fish habitat with abundant and available food, and good overwintering habitat.

Sibbald Meadows Pond is managed as a put-and-take fishery and is popular with anglers.

2nd West Bank Tributary

This small tributary is located in the uppermost headwaters of Jumpingpound Creek in Reach 4. Nibourg (1985) did not observe fish in this tributary, but noted favourable habitat characteristics that included good spawning gravel, good flow and springs. Fish sampling in 2003 captured cutthroat trout (FWMIS database).

1st East Bank Tributary

This small tributary is located in the uppermost headwaters of Jumpingpound Creek in Reach 4. Cooke (1982) and Nibourg (1985) observed small trout in this reach. Nibourg (1985) reported good substrate with gentle gradient and algae-covered rocks. The same author suggests that this is an important spawning and rearing area that was supported by numerous fry observations above a hanging culvert in 2002. Fish sampling in 2003 captured cutthroat trout (FWMIS database).

Fisheries Management Implications

Limiting factors. Drought years may increase summer water temperature above critical thresholds for trout in lower Jumpingpound Creek, Little Jumpingpound Creek and Bryant Creek.

Fish Management Targets. A maximum summer water temperature of 20°C in Jumpingpound Creek and its tributaries should be a target.

Fish Habitat Protection. The Jumpingpound Creek and its main tributaries are designated a Class C waterbody. No instream work can be conducted in these creeks from September 1 to August 15 to protect fish habitat.

Best Management Practices

There are a number of things that governments, industry and landowners can do to protect and enhance fish habitat in the Jumpingpound Creek watershed. These include:

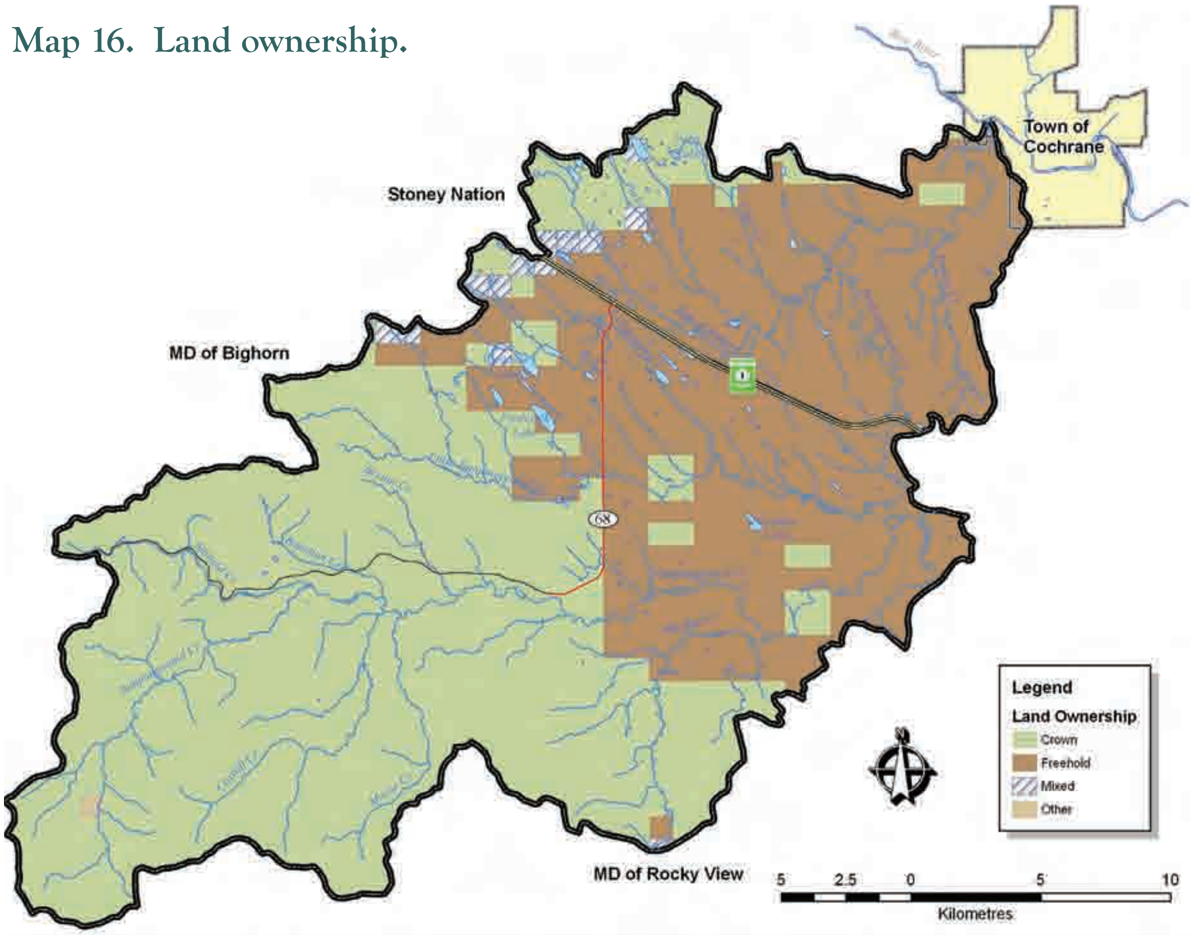
- Establish and maintain riparian management areas for cattle grazing,
- Maintain healthy riparian areas that have stable banks supported by deep rooted vegetation,
- Consider using natural bio-engineering (e.g., willow cuttings, wattle fences) to stabilize and repair areas of eroded streambanks. Organizations such as Cows and Fish, Trout Unlimited Canada and Alberta Sustainable Resource Development may be able to provide assistance with restoration designs,
- Provide off-stream watering sites so that cattle do not wade in streams which can damage streambanks and introduce bacteria and nutrient contamination,
- Build and maintain secure and stable roads with appropriate drainage structures such that runoff from gravel roads and bridges is directed away from streams,
- Build or improve stream crossings to maintain fish passage (i.e., single-span bridges or open-bottom culverts),
- Minimize or eliminate the use of pesticides and fertilizers adjacent to streams,
- Protect natural surface drainage patterns, and
- Comply with applicable legislation such as the provincial *Water Act,* and the *Environmental Protection and Enhancement Act* and the federal *Fisheries Act*.

5.0 LANDUSE

There is wide range of landscapes and resources in the Jumpingpound Creek watershed that lends itself to a variety of land uses. Land use activities range from forestry, livestock grazing and recreation in the headwaters to natural resource extraction and farming and ranching in the mid to lower reach. Urban development is taking place in the most downstream reach of the Jumpingpound Creek, near the confluence of the Bow River. The following sections summarize land use activities in the watershed.

Land ownership is shared mainly between the Crown, owning 59% or 350.7 km^2 of land in the watershed, and private landowners (freeholds) who own 40% of the land area (Map 16). About 1% is classified as mixed ownership. In 2001, the Nature Conservancy of Canada purchased land near the confluence of Jumpingpound Creek and the Bow River. This area is a unique part of the Jumpingpound valley, comprised of dramatic escarpment areas. Now named the Tokijarhpabi Nature Reserve, this area is protected in the watershed.

Map 16. Land ownership.



The Tokijarhpabi Nature Reserve was purchased in 2002 from Tokijarhpabi Holding Ltd. who felt that this land was valuable for its historical, environmental and educational resources. This nature reserve provides habitat for a diverse range of species including coyote, red fox, grey wolf, black bear, grizzly bear, cougar, Canada lynx and bobcat. Annual weed pulls are organized by the Nature Conservancy at this site to control Canada thistle and other invasive weeds that threaten native plants.

5.1 Agriculture

Rangeland

Range Reference Areas

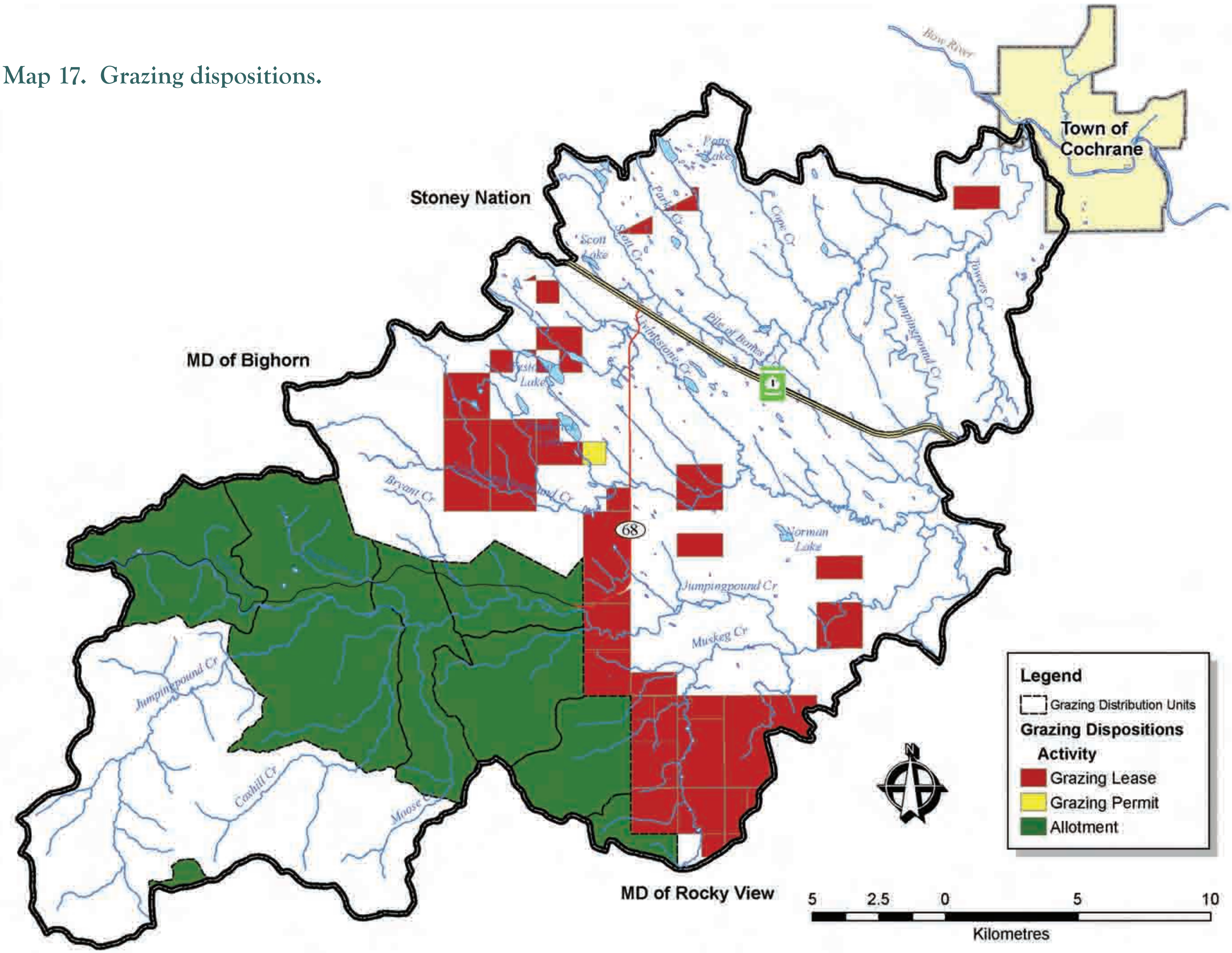
Alberta Sustainable Resource Development (ASRD), Rangeland Management Branch has developed the Range Reference Area Program for long-term monitoring of the rangeland resource. This program includes fenced and unfenced range reference area sites (RRAS) where species composition and forage production are monitored in the presence and absence of disturbance.

Presently, there are 183 RRAS located throughout the province. Many of these sites have been monitored since 1953. ASRD has invested significant time and resources to protect, maintain and monitor these sites. Information collected from these areas is used to make decisions that support a healthy environment with benefits for Albertans. These sites assist to:

- determine range health and long-term range trend on species composition and forage productivity,
- determine the effects of livestock and wildlife grazing on biomass production, rangeland soils and plant species composition,
- determine the characteristics of succession in the presence and absence of disturbance for each ecological site (range site), and
- provide outdoor classrooms and demonstration sites for range managers, ranchers, students and the public.

In the Jumpingpound Creek watershed, ASRD has one Range Reference Area at Sibbald Flats (SW 13-24-7-W5). This reference area was established in 1984 within the Montane Natural Subregion of Alberta. This reference area represents the Rough fescue (*Festuca campestris*)-Idaho fescue (*Festuca idahoensis*)-Parry oat grass (*Danthonia parryii*) plant community. This community is the Modal grassland community type on Black Chernozemic soils in the foothills of southern Alberta. Outside of the

Map 17. Grazing dispositions.



exclosure, the plant community is at a lower successional state compared to within the exclosure; it represents the Kentucky bluegrass (*Poa pratensis*)-Rough fescue community. Long-term disturbance leads to declines in rough fescue and an increase in Kentucky bluegrass.

This reference area provides information to land managers about the overall performance of the range landscape relative to climatic variability and general stewardship practices. For example, reference area data will show the year to year variation in grass yields and in the residual amount of litter that is likely to be present under moderate levels of grazing. If forage yields or litter reserves show a sharp decline at one or more reference sites, it alerts resource managers to the need for special drought management practices to safeguard rangeland health and minimize the negative impacts of drought.

The rough fescue-Idaho fescue-Parry oat grass plant community typically produces approximately 1850 lbs/acre of forage biomass. The litter thresholds for healthy sites in the Montane Natural Subregion is 780-1200 lbs/acre.

The Modal grassland plant community for the Foothills Parkland is the Foothills Fescue/ Parrys Oatgrass/Idaho Fescue plant community. It's very similar to the modal plant community in the Montane Natural Subregion. Average production for this plant community is 1702 lbs/ acre with litter thresholds for healthy sites on Black Loamy soils at 800-1200 lbs/acre.

Rangeland Management in the Jumpingpound Creek Watershed

The rangelands within the Jumpingpound watershed are some of the most diverse in Alberta. The ecological diversity of this area creates a landscape that consists of a mosaic of different vegetative communities. This diversity means that these lands are valued for a multitude of uses, including summer range for livestock, prime habitat for many species of wildlife, productive watersheds, wood fibre production and recreation.

Sustainable rangeland resource management begins with the effective application of range management principles and practices by the grazing disposition holder. Many ranching families reflect multi-generational knowledge in their stewardship practices. Further commitment to a high standard of rangeland resource management is established through a system of periodic and renewal inspections carried out by Rangeland Management Branch of Alberta Sustainable Resource Development. Professional Rangeland Agrologists inspect and assess rangeland health on dispositions (Map 17) and engage in management discussions with disposition holders. Management agreements and tenure conditions are employed to ensure desirable management practices are in effect to achieve sustainable rangeland use.

Grazing disposition holders manage rangelands to maintain range and riparian health within defined parameters. Disposition holders must address shortcomings in range resource management as reflected in rangeland health. They are required to modify range management practices to deal with identified management problems (e.g., reduce stocking rates, improve livestock distribution, avoid grazing during vulnerable periods or provide more growing season rest to address specific range resource management needs). Some key management issues include:

- Health and Function of Riparian Areas - Grazing managers have a critical responsibility to address any riparian area management issues that may exist on their grazing disposition.
- Management of Invasive Species – Management of invasive species, particularly noxious weeds, is an ongoing due diligence issue for grazing disposition holders. Sound range management practices will reduce the potential for weed invasion.

Environmental performance of rangelands has traditionally been measured with vegetation and soil indicators. Prior to 2002, the Province of Alberta applied a variety of systems to rate rangeland condition including the "Stocking Guide" first published in 1966. The new range health assessment system (Adams et. al 2003) has been adopted across the province to address developments in range science and the need for a more robust and transparent set of indicators for rating rangeland health. The core measure of sustainable rangeland management applied to public grazing dispositions is rangeland health with associated evaluation criteria of riparian health assessment. With background knowledge about the local soils and vegetation, range health is rated for an ecological site type in relation to the reference plant community and by scoring five questions that address selected indicators of range health. These include:

a) **Integrity and Ecological Status –** Each ecological site will produce a characteristic kind and amount of vegetation, called a reference plant community. Is the plant community native or modified to non-native species? Has grazing management maintained the plant community or are there shifts in species composition to less desirable or weedy plant species?

b) **Plant Community Structure –** Are the expected plant layers present or are any missing or significantly reduced, revealing a possible reduction in plant vigour?

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

d) **Site Stability –** Is the site stability maintained or is the ecological site subject to accelerated erosion? This indicator is applied to recognize situations where management practices may have increased soil erosion beyond levels that may be considered normal for the site.

e) **Noxious Weeds –** Are noxious weeds present on the site? When a site is rated, the combined score of all five indicators is expressed as percent health score ranking the site as healthy, healthy with problems or unhealthy.

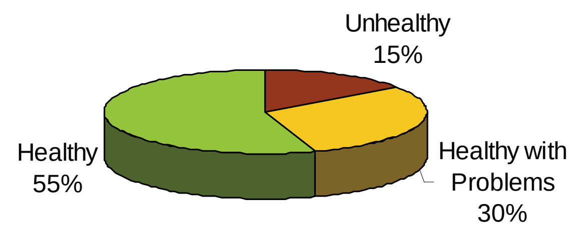


Figure 8. Pooled rangeland health assessment data for the Jumpingpound Creek watershed for the period 2003 to 2008, Rangeland Management Branch, Alberta Sustainable Resource Development.

ASRD implemented the new system of rangeland health assessment in 2003 and as data accumulates from grazing inspections and range surveys, they will be able to obtain a broad impression of overall rangeland health on public land. Figure 8 shows that overall 55% of the landscape rates in healthy, about 30% is healthy but with problems and 15% is unhealthy (data from 140 sites).

Data Gaps and Recommendations

Although Alberta Sustainable Resource Development monitors the health of public land, information regarding the health of private lands is limited. Programs should be initiated that encourage monitoring (range health assessments) on private lands.

Cropland

Crop production in the Jumpingpound Creek watershed is limited by cooler temperatures and a shorter growing season compared to farmland located farther east.

Most of the cropland in the watershed is seeded with either oats or barley (Map 18). Historically, canola has been grown in the area, but not for at least 30 years (J. Buckley, pers. comm.).

Tame pasture consists of smoothe brome grass or meadow brome grass mixed with alfalfa (Map 18). There are some pastures seeded with orchard grass, but these are somewhat unique.

Crops are generally seeded on a 2 to 5 year rotation. At the end of rotation, fields are re-seeded back to forage crops for a period of greater than ten years. This rotation allows soils to rejuvenate and reduces undesirable species and the need for herbicides.

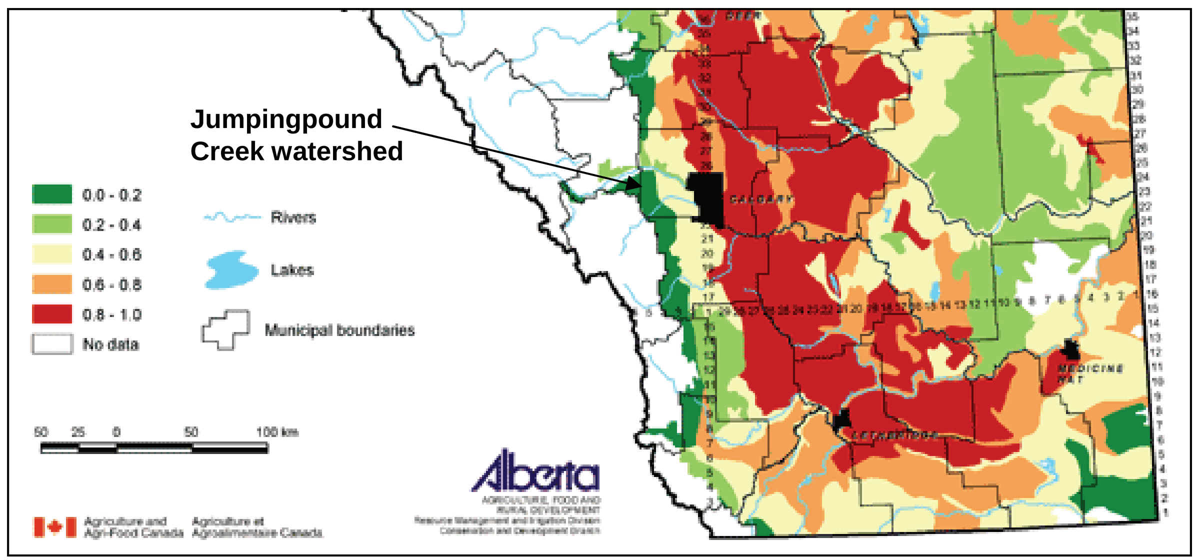
Agricultural Intensity Indexes

Fertilizer use, chemical use and manure production have been used as components of an Agricultural Intensity Index developed through the Alberta Environmentally Sustainable Agriculture (AESA) Water Quality Monitoring Program (Anderson et al. 1999; Johnson and Kirtz 1998). The identification of agricultural intensity was conducted on a provincial scale to provide an estimate of the degree to which agriculture may affect nutrient or chemical levels in surface and groundwater (i.e., fertilizer and chemical use).

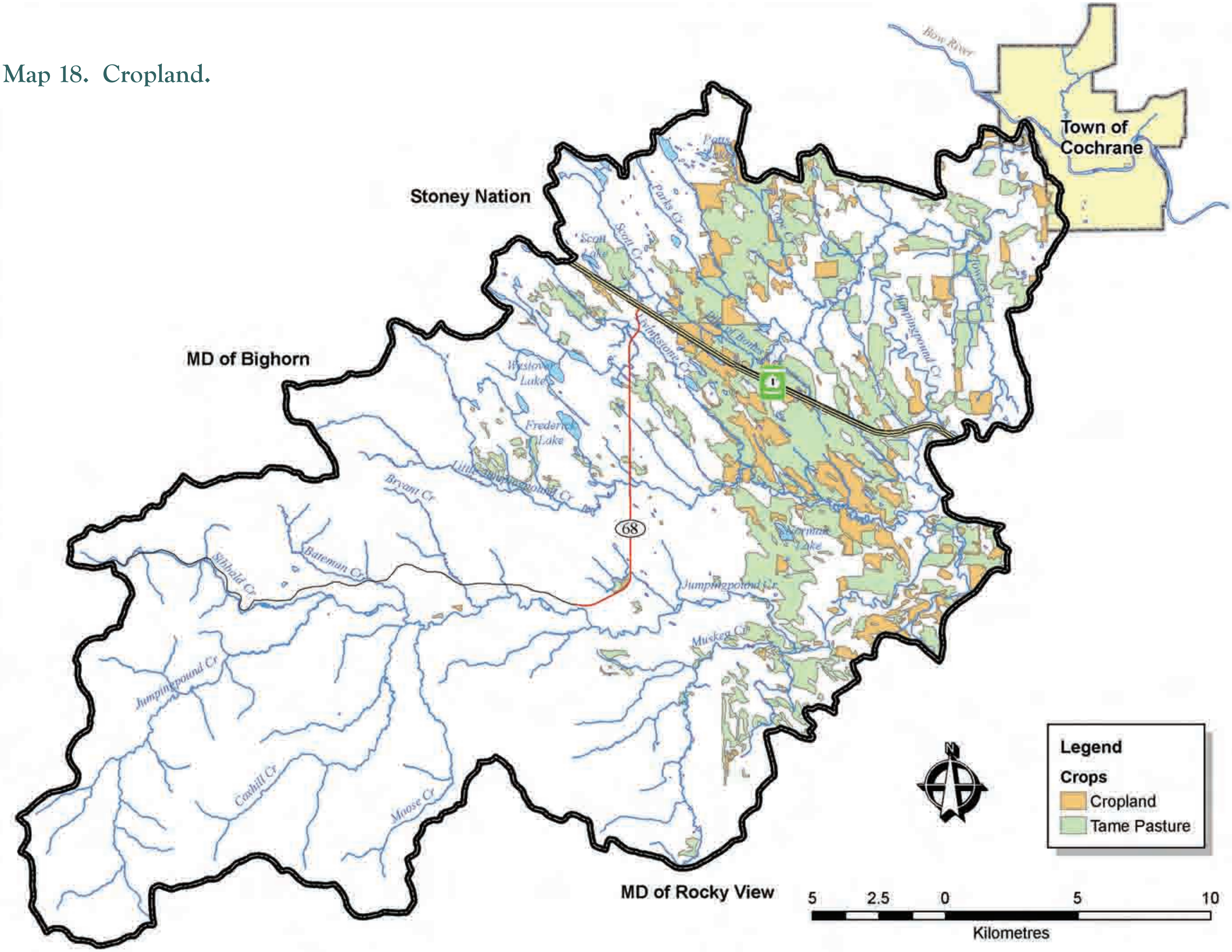
Information from the 2001 Census of Agriculture was processed to derive the volume in tonnes for each Soil Landscapes of Canada (SLC) polygon. That amount was divided by the SLC area (square km) to result in a ratio of the fertilizer and chemical used, or the amount of manure produced per unit area (Alberta Agriculture and Food 2005).

The classes shown on the maps generated for this project are ranked between 0 (lowest) and 1 (highest) (Alberta Agriculture and Food 2005). Figure 9 shows the Chemical Expense Index for southern Alberta. Compared to areas farther east, the relative expense of farm chemicals (e.g., herbicides, insecticides and fungicides) used by farmers and ranchers in the Jumpingpound Creek watershed is low (0.0-0.2 range) (Figure 9).

Figure 9. Chemical Expense Index for the agricultural area of Alberta.



Map 18. Cropland.



5.2 Resource Extraction

Oil and Gas

Oil and gas activity has been prevalent in the Jumpingpound Creek watershed since the 1930s. The first well was drilled by R.A. Brown in 1937 and was dry. The second well was drilled in 1942 by Shell and was also dry (J. Proud, pers. comm.). Shell discovered the Jumping Pound gas field in 1944, and has been active in the watershed ever since, along with Husky Energy (established in the early 1990s) and Petro-Canada.

Currently, Shell Canada operates a large gas plant, the Jumping Pound Complex, in the northern part of the watershed, near the confluence of the Bow River. Since becoming operational, the plant has increased capacity and efficiency to allow increased recovery of natural gas by-products such as ethane, butane, propane and sulphur. This plant supplies much of Calgary with a significant portion of its natural gas heating.

The Jumping Pound Gas Complex employs approximately 100 people and processes about 4.4 million cubic metres of raw gas per day, or 57% of its licensed capacity of 7.7 million cubic metres per day.

Maintaining Air Quality

Alberta Environment and the Energy Resources Conservation Board administer the environmental regulations that Shell is responsible for meeting. The Jumping Pound Complex is designed to meet or exceed these regulations.

Air emissions are monitored continuously at both the incinerator stack, for amounts of sulphur dioxide being emitted and on the ground, for ground-level concentrations of sulphur dioxide and hydrogen sulphide. The results, plus wind speed and direction, are recorded in the plant control room. If ground-level readings are detected, plant throughput is adjusted to maintain ambient air quality.

In addition to having the largest water license in the watershed, Shell supports local watershed management planning initiatives to help maintain viable resources.

There are 151.8 km of oil and gas pipeline in the watershed (Table 9). The main distribution networks are associated with the Shell-Jumpingpound Gas Plant. One pipeline originates in the headwaters in the Kananaskis Improvement District.

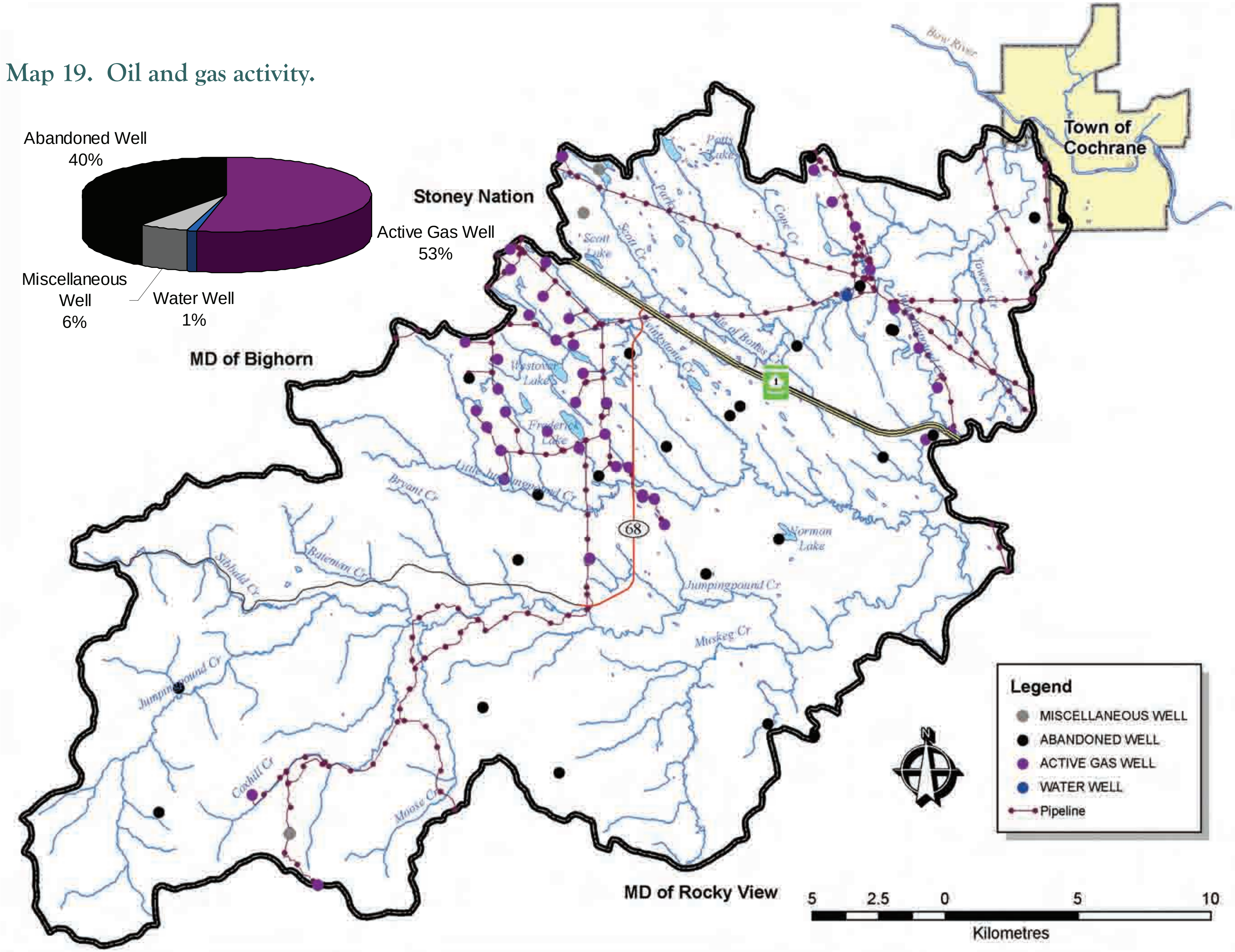
Table 9. Length of pipeline by jurisdiction.

Jurisdiction	km of pipelines
MD of Bighorn	35.88
Stoney Nation	15.84
Kananaskis Improvement District	32.55
MD of Rocky View	67.52
Town of Cochrane	0
Total Length	**151.79**

Half of the 48 gas wells drilled in the watershed are located within the MD of Bighorn (Map 19). The MD of Rocky View contains almost half of the 36 abandoned oil and gas wells present in the watershed, as well as the single water well associated with oil and gas activity. Abandoned wells make up 40% of the total number of wells in the watershed.

New well activity in the Jumpingpound Creek watershed is low. Shell Canada reports just one new well development annually (J. Proud, pers. comm.). Husky Energy reports that any new developments are likely to be small and efforts will be made to contain them to existing footprints (C. Engstrom, pers. comm.).

Map 19. Oil and gas activity.



Gravel

Gravel is a valuable resource for municipal and provincial governments as it forms the basis of the road network in Alberta. Unfortunately, some of the best sources of gravel are located in the floodplains of streams and rivers.

Gravel pit activity is regulated by Alberta Environment's *Environmental Protection and Enhancement Act* and subject to the Code of Practice for pits. Pits are defined as an opening, excavation or working of the surface or subsurface of the land to remove any sand, gravel, clay or marl.

In the Jumpingpound Creek watershed, gravel deposits are found in the form of coarse stream alluvium that makes up the majority of the Jumpingpound Creek stream corridor (Map 4, Section 2.2). Most of the deposits are a mixture of sand and gravel, with one deposit that is noted as strictly sand and two that are noted as strictly gravel (Map 20).

Alberta Transportation maintains one gravel pit in the MD of Bighorn on the west side of Highway 68 (D. Tannas, pers. comm.) (Map 20).

The MD of Rocky View also has one existing gravel pit located on the eastern edge of the watershed, downstream of the Jumpingpound Creek and Muskeg Creek confluence.

The province has directed municipalities to consider natural resource extraction in their planning. Municipalities are encouraged to identify, in consultation with the appropriate provincial land management agency and the Alberta Geological Survey, areas where the extraction of surface materials (e.g., sand and gravel) should be a primary land use.

The MD of Rocky View's Municipal Development Plan speaks to natural resource extraction activities. Section 6.5 of the MDP states: "When considering a proposal for natural resource use, the Municipality shall review the:

a) surrounding land uses and the possible impact which may result from the extraction of a natural resource;

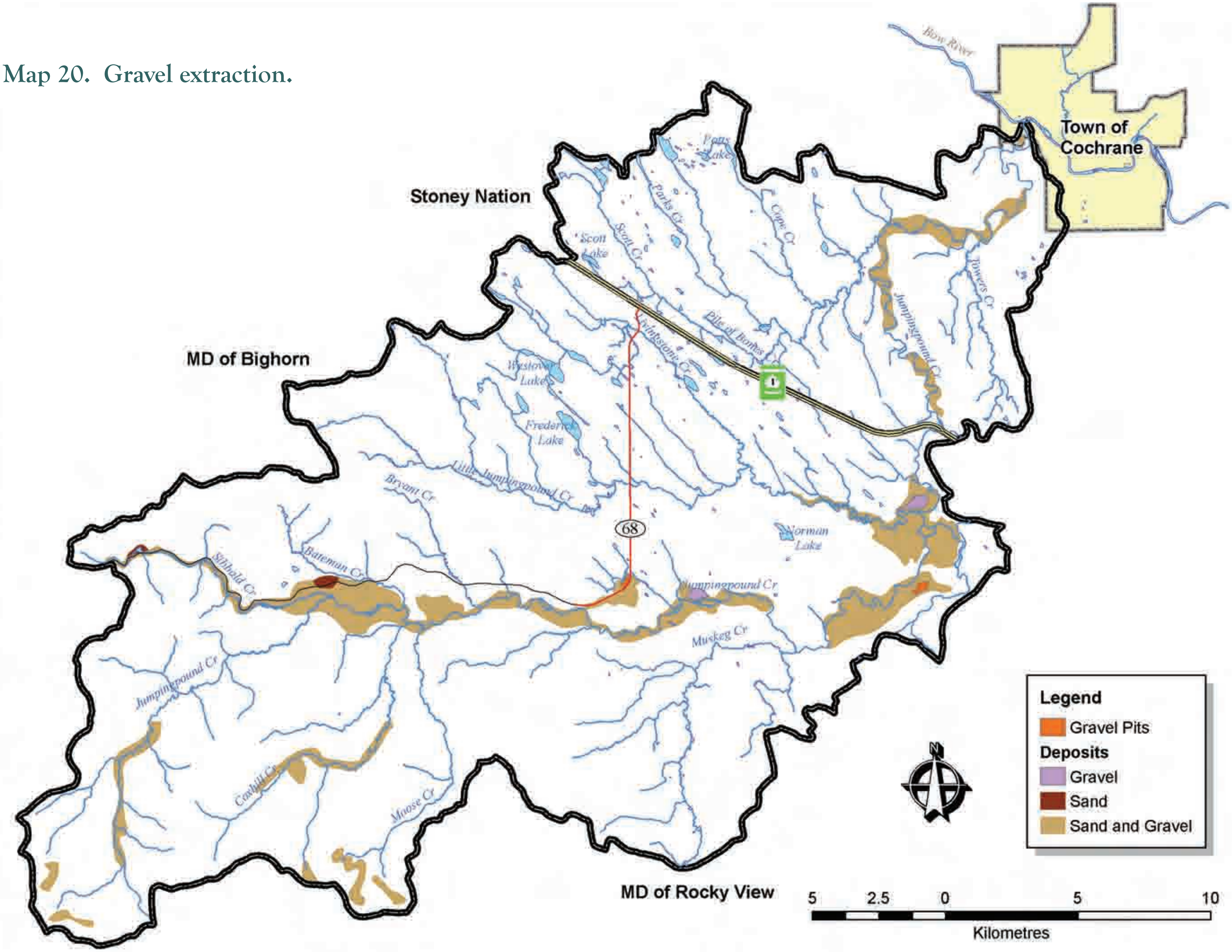
b) balance of social and economic benefits to the community resulting from the proposed development; and

d) reclamation plan for the lands (among other considerations" (Section 6.5.4; MD of Rocky View 1998).

Data Gaps and Recommendations

A large volume of groundwater contributes to baseflow in Jumpingpound Creek. Further studies are needed to fully understand the implications of gravel resource extraction on watershed hydrology.

Map 20. Gravel extraction.



5.3 Forestry

Spray Lake Sawmills

Spray Lake Sawmills (SLS) have operated and harvested timber in the Jumpingpound Creek watershed, Kananaskis and area since 1943. In 1966 the government of Alberta developed the Timber Quota System. SLS operated under this system until 2001 when the government consolidated quota operations and turned the management of the southern forests over to individual companies, such as SLS (Kulcsar 2009). Under this system, forestry management in the Kananaskis area falls under the SLS' 20-year Forest Management Agreement (FMA). This FMA is administered by the Minister of Sustainable Resource Development (SRD) and is governed by the policies laid out by ASRD (Douglas 2007).

Forest Management Plans must be submitted to the government for approval and are required to contain certain components as laid out by the Government of Alberta. These requirements include; the creation of area specific ground rules for timber harvest, guidelines to reforest, and forest fire prevention plans (Kulcsar 2009).

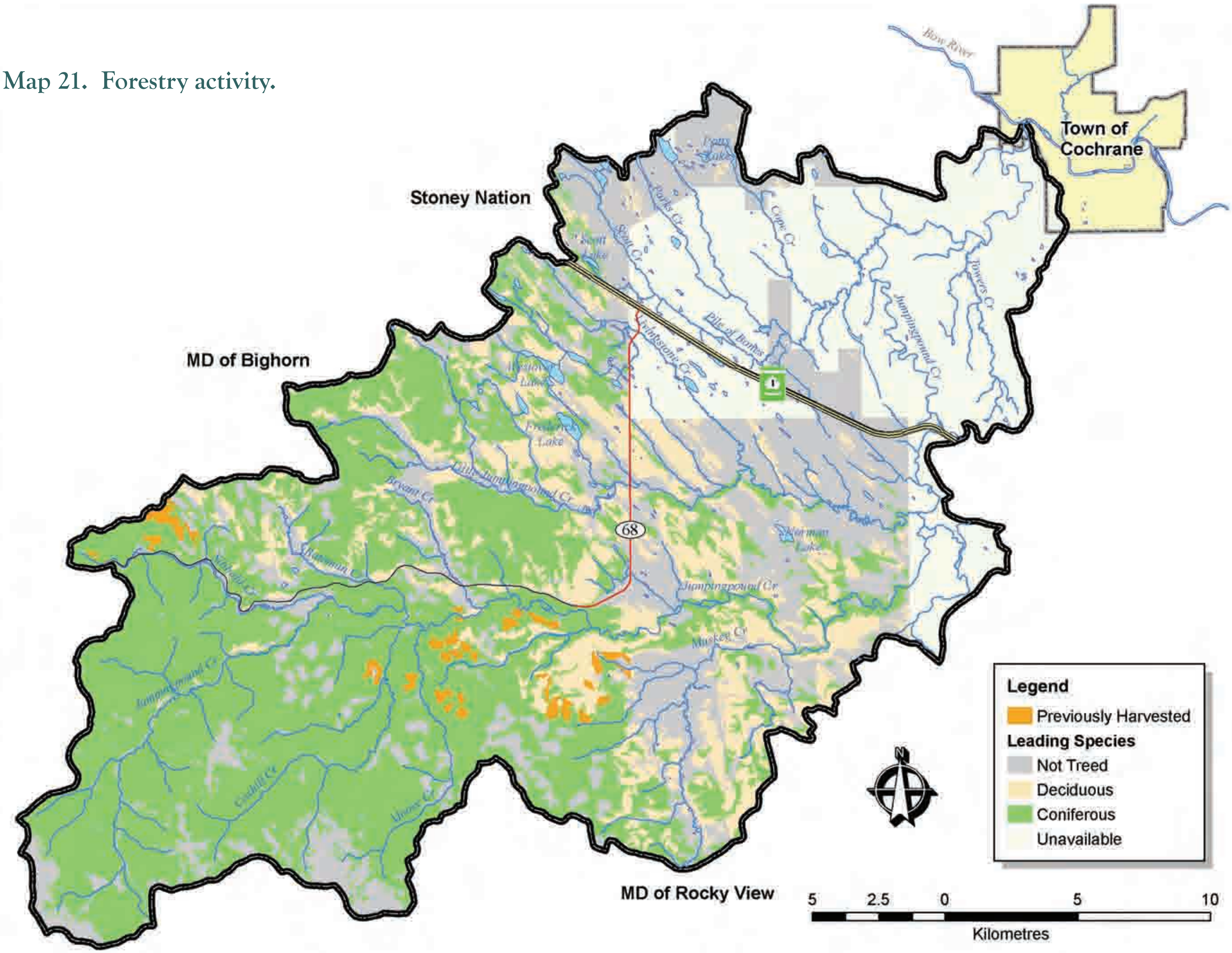
Protection of water values is one of, or the most regulated component of the forestry business. Much attention is given to maintaining water values from the planning stage through to ground operations (Kulcsar 2009). The SLS Forestry Management Agreement states that the Minister can withdraw land from the forestry area for a variety of reasons including; if an area cannot be logged without causing substantial harm to the water table, lakes, streams, rivers or other bodies of water (Spray Lake Sawmills Forestry Management Agreement).

SLS is committed to sustainable forest management; a long-term goal to maintain natural ecosystems, communities and native species in the FMA in balance with social and economic needs. (Spray Lake Sawmill Forestry Management Agreement 2001-2026).

Spray Lake Sawmill is currently updating their Forest Management Plan. More detailed information can be found at the Spray Lake Sawmills website at www.spraylakesawmills.com or at the Sustainable Resource Development Website at www.srd.gov.ab.ca.

Map 21 shows the forested area of the Jumpingpound Creek watershed. Previously harvested areas encompass an area of about 5.1 km^2. The area located on the western edge of the watershed shows tree harvest from 2007 to present.

Map 21. Forestry activity.



Threats to the Forestry

Mountain Pine Beetle

The mountain pine beetle (*Dendroctonus ponderosae* Hopkins) is a member of the bark beetle family, and is the most damaging insect pest of pine trees in western North America.

Adult beetles are black and small (5-7 mm long). The larvae look like small maggots under the bark. Each female lays 60-80 eggs, enabling populations to grow very quickly. There are often enough insects emerging from one tree to attack 15 additional trees.

Mountain pine beetles mass attack and kill mature pine trees within a year. In mid-summer, the adults bore into suitable host trees and lay eggs in the bark. The larvae hatch and feed within the bark of the tree. Larvae develop into pupae, then into adults and fly to the next host. The lifecycle normally takes one year to complete. The following spring, the needles of the attacked tree fade to yellow and then to reddish-brown. Blue-stain fungi, introduced by adult beetles at time of attack, along with insect feeding, kill the tree by cutting off paths for nutrients and water (Spray Lake Sawmills and Alberta Sustainable Resource Development websites).

In the past, most of Alberta was outside the mountain pine beetle's normal range of distribution due to the harsh winter conditions. However, with the recent milder winters, these beetles have been more successful in parts of Alberta. Modern fire suppression over the last 50 years has resulted in large areas of pine forests with over mature trees, which are more susceptible to beetle attack.

Mature pine forests along the eastern slopes, are most vulnerable to mountain pine beetle attack. If the beetles are not managed while the populations are low, severe damage to pine stands can result. Outbreaks can destroy thousands of hectares of mature pine forest in a single year. In 2004, over 7 million hectares were infested in B.C.

Spray Lake Sawmills has undertaken a modeling exercise to assess forest stand susceptibility to the beetle. The modeling together with consultation with Sustainable Resource Development, has shown Jumpingpound Creek, the West Ghost and East Ghost to be the highest priority areas for the development of pine beetle harvest plans. Harvest plans proposed by Spray Lake Sawmills are designed to reduce the continuity of susceptible pine in the path of the advancing beetle.

Harvests planned to commence in summer 2007 are within the company's Forest Management Area. Logs infested with mountain pine beetle are only to be transported between October 1 and June 15 to help minimize the spread of mountain pine beetle during times when the beetle may be emerging from infested trees. Beetle infested wood will be managed by sequencing the hauling of infested stands outside of the critical summer months. Infested wood will be segregated from clean wood and manufactured prior to June 15, before the next beetle emergence.

Stands will be stratified according to their species composition with a generalized target of reforesting to the same species mix as was harvested. Research has shown that young regenerated pine stands have a low level of susceptibility to the pine beetle and a broader age class should reduce beetle impacts. Reforestation and reclamation activities will be completed within two years of harvesting.

5.4 Urban Development

As population in the province increases, urban and rural municipalities are tasked with planning for new commercial, residential and industrial developments. The Town of Cochrane has rapidly increased in size and is considered one of the fastest growing centres in Alberta. From 2001 to 2006, the population in the Town of Cochrane increased by 14.3%, greater than the provincial growth rate of 10.6% (Statistics Canada 2009).

Urban development alters the landscape, displacing native vegetation for impervious materials (i.e., pavement). Impervious surfaces increase overall runoff volumes.

New development is generally confined to the lower reach of Jumpingpound Creek near the confluence with the Bow River. There are also a number of acreages and rural residential areas that have been developed, mainly in the downstream reach, north of Highway 1.

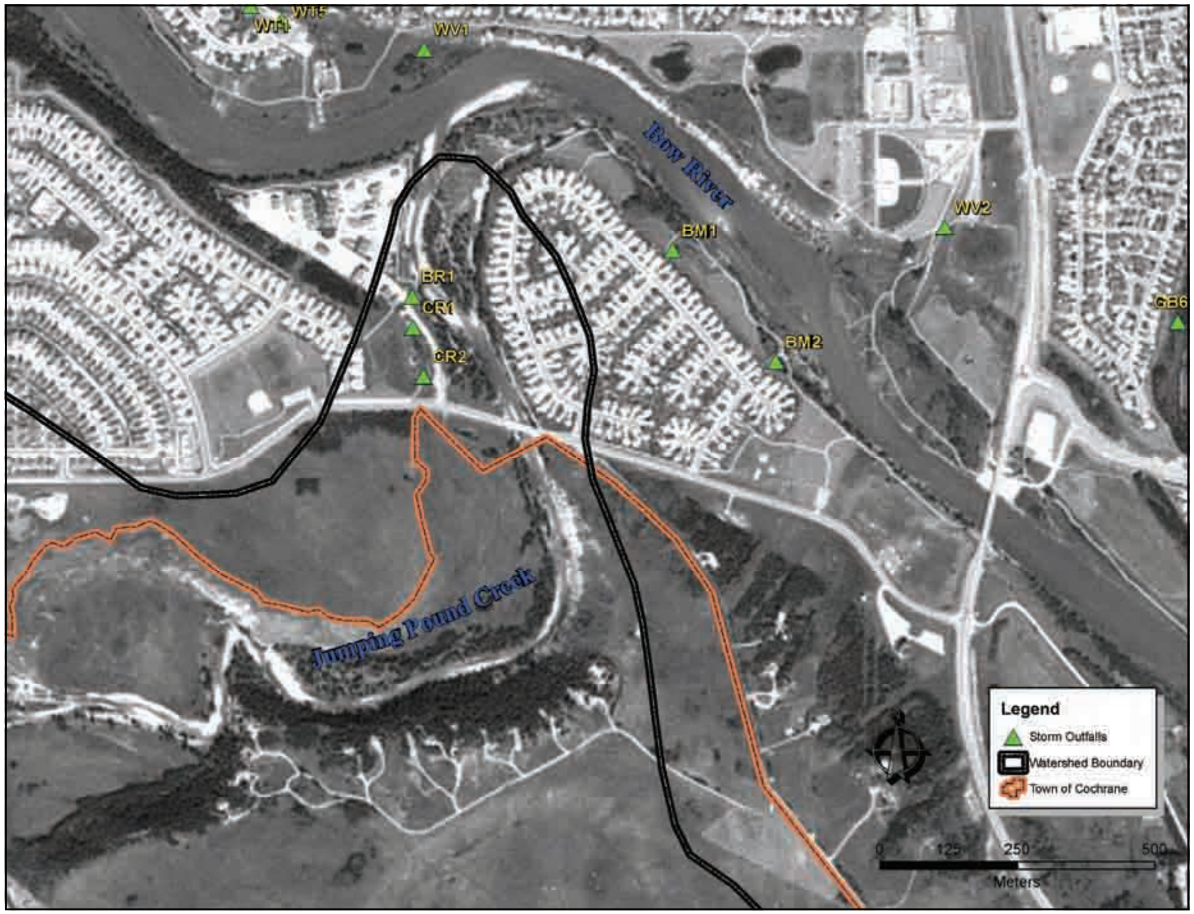
Stormwater from the residential area to the west of Jumpingpound Creek is directed to the creek via three stormwater outfalls (BR1, CR1 and CR2) (Figure 10). Stormwater is first captured in retention ponds where sediments and other contaminants are able to settle from the water column prior to its release to Jumpingpound Creek.

Stormwater release is a concern in this reach, as increased flows can result in streambank erosion. The Town of Cochrane has taken measures to stabilize the bank, but high flows and limited riparian vegetation may undermine this effort in the future.

Data Gaps and Recommendations

The impact of increased flow volumes and water quality from stormwater outfalls should be determined and remediation efforts for eroded streambanks that include bioengineering should be considered.

Figure 10. Aerial image showing the Jumpingpound Creek confluence with the Bow River and the three stormwater outfalls located in this reach.



5.5 Recreation

People have enjoyed recreating in the Jumpingpound Creek watershed since it was settled. Families gathered on the banks of Jumpingpound Creek for picnics, and to swim and to fish during the summer months. In winter, the creek became the local skating rink.

There are still many recreation opportunities in the Jumpingpound Creek watershed. Located west of two major centres (i.e., the City of Calgary and the Town of Cochrane), the watershed is accessible to people seeking outdoor opportunities.

Fishing, hiking, mountain biking, wildlife and bird watching, horseback riding and camping are all activities that are enjoyed in the watershed.

Alberta's parks and protected areas are managed under various types of legislation, including the *Provincial Parks Act* and the *Wilderness Areas, Ecological Reserves, Natural Areas and Heritage Rangelands Act*. There are eight different classifications that provide varying degrees of protection and a range of opportunities for outdoor recreation.

Provincial Parks. Provincial Parks preserve natural heritage; they support outdoor recreation, heritage tourism and natural heritage appreciation activities that depend upon and are compatible with environmental protection.

- Provincial parks protect both natural and cultural landscapes and features.
- They are distinguished from wildland parks by their greater range of outdoor recreation facilities, the extent of road access, and the interpretive and educational programs and facilities that are available to visitors.
- Outdoor recreation activities that promote appreciation of a park's natural heritage and cultural features are encouraged.
- Provincial parks offer a variety of outdoor recreation opportunities and support facilities.

Interpretive and educational programs that enhance visitor understanding and appreciation of, and respect for, Alberta's natural heritage (without damaging natural values) are offered


Jumpingpound Creek, 1933.


1930

in some provincial parks; these programs serve visitors of diverse interests, ages, physical capabilities and outdoor skills.

Only a portion of the Bragg Creek Provincial Park is found in the southeastern part of Jumpingpound Creek watershed (Map 22).

Natural Areas. Natural areas preserve and protect sites of local significance and provide opportunities for low-impact recreation and nature appreciation activities.

- Natural areas include natural and near-natural landscapes of regional and local importance for nature-based recreation and heritage appreciation.
- Natural areas are typically quite small, however, larger sites can be included in this class.

Most natural areas have no facilities and in those that do, facilities are minimal and consist mainly of parking areas and trails.

There is one natural area designated in the Jumpingpound Creek watershed. This area is known as Ole Buck Mountain (Map 22).

Recreation Areas. Recreation areas support outdoor recreation and tourism; they often provide access to lakes, rivers, reservoirs and adjacent Crown land.

- Recreation areas support a range of outdoor activities in natural, modified and man-made settings.
- They are managed with outdoor recreation as the primary objective.
- Some areas are intensively developed, while others remain largely undeveloped.

Many recreation areas play a significant role in management of adjacent Crown land and water by localizing the impact of development.

(Alberta Tourism, Parks and Recreation 2009) http://tpr.alberta.ca/parks/landreferencemanual/landclassdescriptions.aspx

There are ten provincial recreation areas in the upper watershed that offer a variety of services (Map 22). Areas are designated for camping, hiking on maintained trails and fishing. Some of the most popular areas are:

- ☐ Stoney Creek (12.96 ha; group camp)
- ☐ Lusk Creek (13.74 ha; trailhead, picnic)
- ☐ Sibbald Meadows Pond (9.95 ha; fishing, picnic)
- ☐ Crane Meadow (3.56 ha; reclaimed)
- ☐ Sibbald Lake (72.51 ha; campground, trailhead, picnic, interpretive signs)
- ☐ Dawson (2.36 ha; campground, trailhead, picnic)
- ☐ Sibbald Viewpoint (7.86 ha; picnic, trailhead, interpretive sign)
- ☐ Pine Grove (27.32 ha; group camp)
- ☐ Jumpingpound Creek (12.59 ha; parking)
- ☐ Pinetop (4.92 ha; picnic, trailhead)

Fishing. The most popular fishery is located in Sibbald Lake and Sibbald Meadows Pond which have been developed as a put and take

Deer Ridge

fishery. These two waterbodies reduce the fishing pressure on some of the more fragile tributaries that provide important spawning and rearing habitat for Jumpingpound Creek, as well as the Bow River.

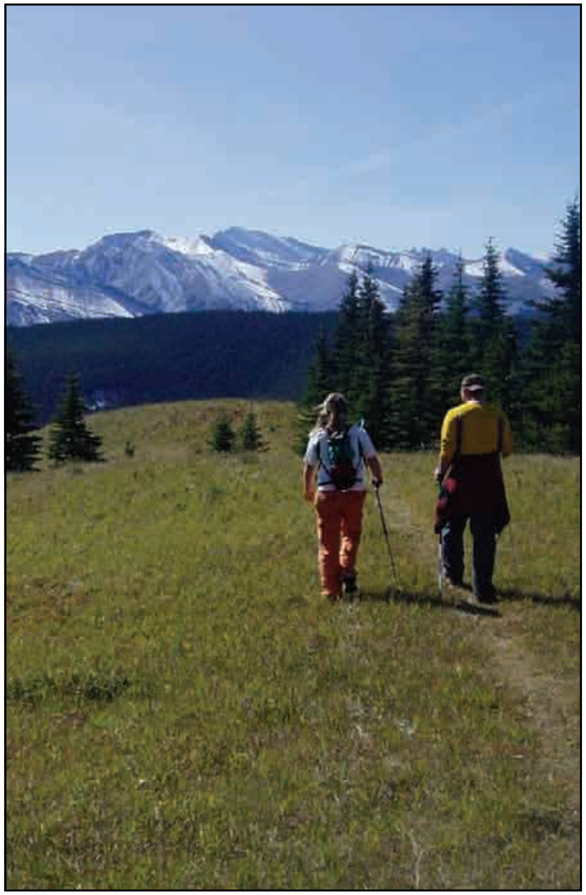
Although access is somewhat limited by private land ownership, many people enjoy fishing in Jumpingpound Creek. Sport fish include many species of trout (i.e., cutthroat trout, rainbow trout and brook trout), mountain whitefish and burbot.

Hiking. Hiking is another popular recreation activity in the watershed. Hiking opportunities are mainly confined to the western side of the watershed, in Kananaskis Country. Sibbald Creek Trail and Jumpingpound Mountain

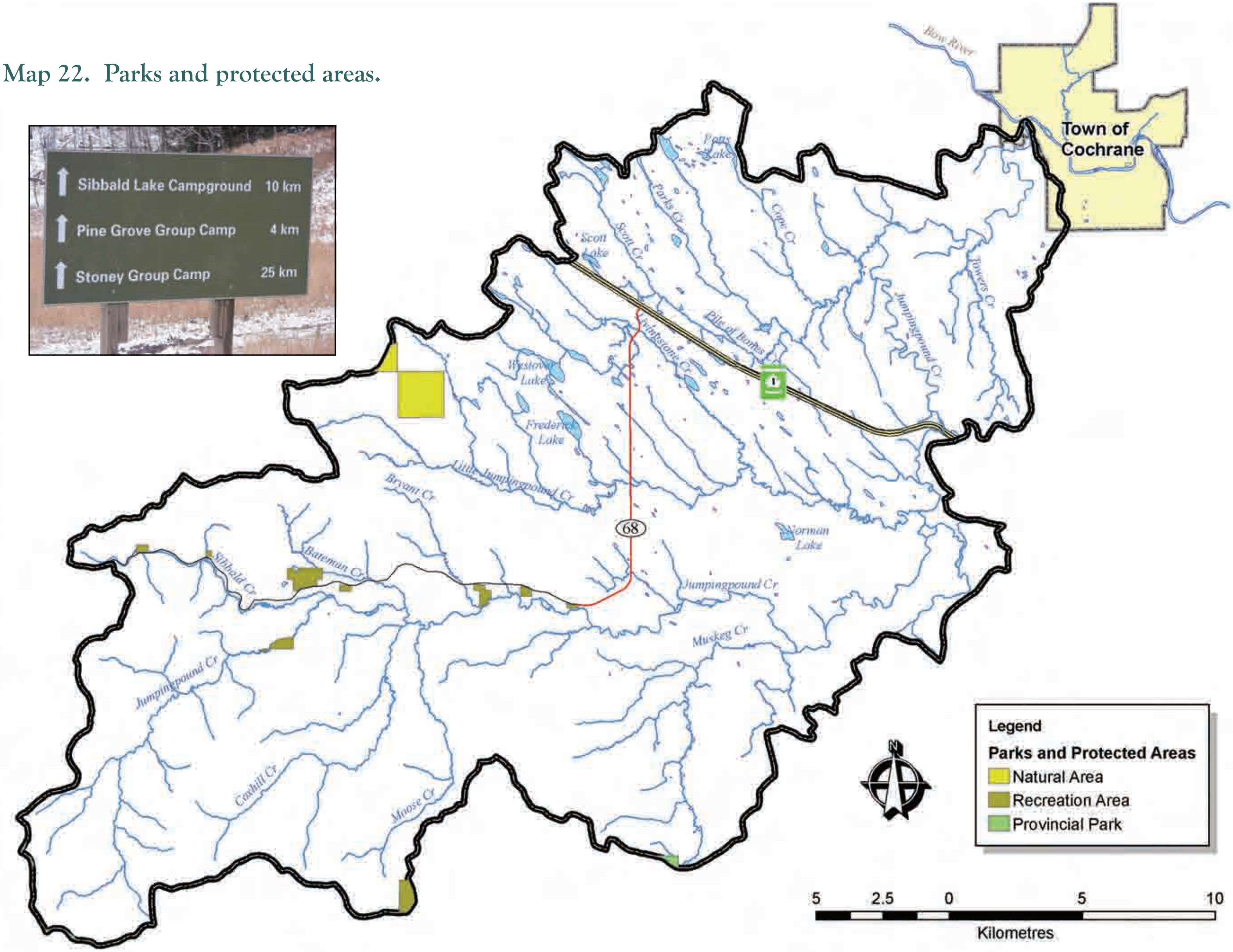
Recreation Related Management Plans

Bragg Creek Provincial Park. 2008. Draft Management Plan. Alberta Tourism, Parks and Recreation.

Kananaskis Country Provincial Recreation Areas Management Plan—Final Terms of Reference March 2008



Map 22. Parks and protected areas.



6.0 HISTORICAL RESOURCES

The *Historical Resources Act* defines historical resources as "any work of nature or of humans that is primarily of value for its paleontological, archaeological, prehistoric, historic, cultural, natural, scientific or aesthetic interest" (ATPRC 2007).

Each historical resource and the land parcel on which it is located have been assigned a historical resource value (HRV) ranging from 1 to 5. Table 10 summarizes these categories and explains their significance.

The highest value, HRV 1, is assigned to the most important historical resources in the Province, those that have been designated as Provincial Historic Resources under the *Historical Resources Act* (ATPRC 2007). Development is restricted on these lands, whether publicly or privately owned. HRV 1 also applies to lands owned by Alberta Tourism, Parks, Recreation and Culture for historical resources protection and promotion purposes.

Lands classified as HRV 5 have high potential for historical resources but none have been recorded.

Map 23 shows the historic resources within the Jumpingpound Creek watershed. Historic resources in the watershed include tipi rings, campsites, stone features and kill sites.

Table 10. Summary of Historic Resource Values and their significance.

HRV	Historic Resource Sensitivity
1	Provincial Historic Resource and/or lands that are owned by Alberta Tourism, Parks, Recreation and Culture for the purpose of protecting and/or promoting historical resources
2	Registered Historic Resource
3	Significant Historic Resource
4	Previously recorded historical resources that must be avoided and require additional historical resource studies
5	High potential lands

There is one site in the watershed with an HRV 1 designation. This area encompasses Sibbald Flats and areas to the North of Hwy 68. The history at this site dates back about 9,000 years and is significant for religious/ceremonial reasons (E. Damkjar, pers. comm.). Another adjacent parcel of land to the north is designated HRV 3, a significant historic resource.

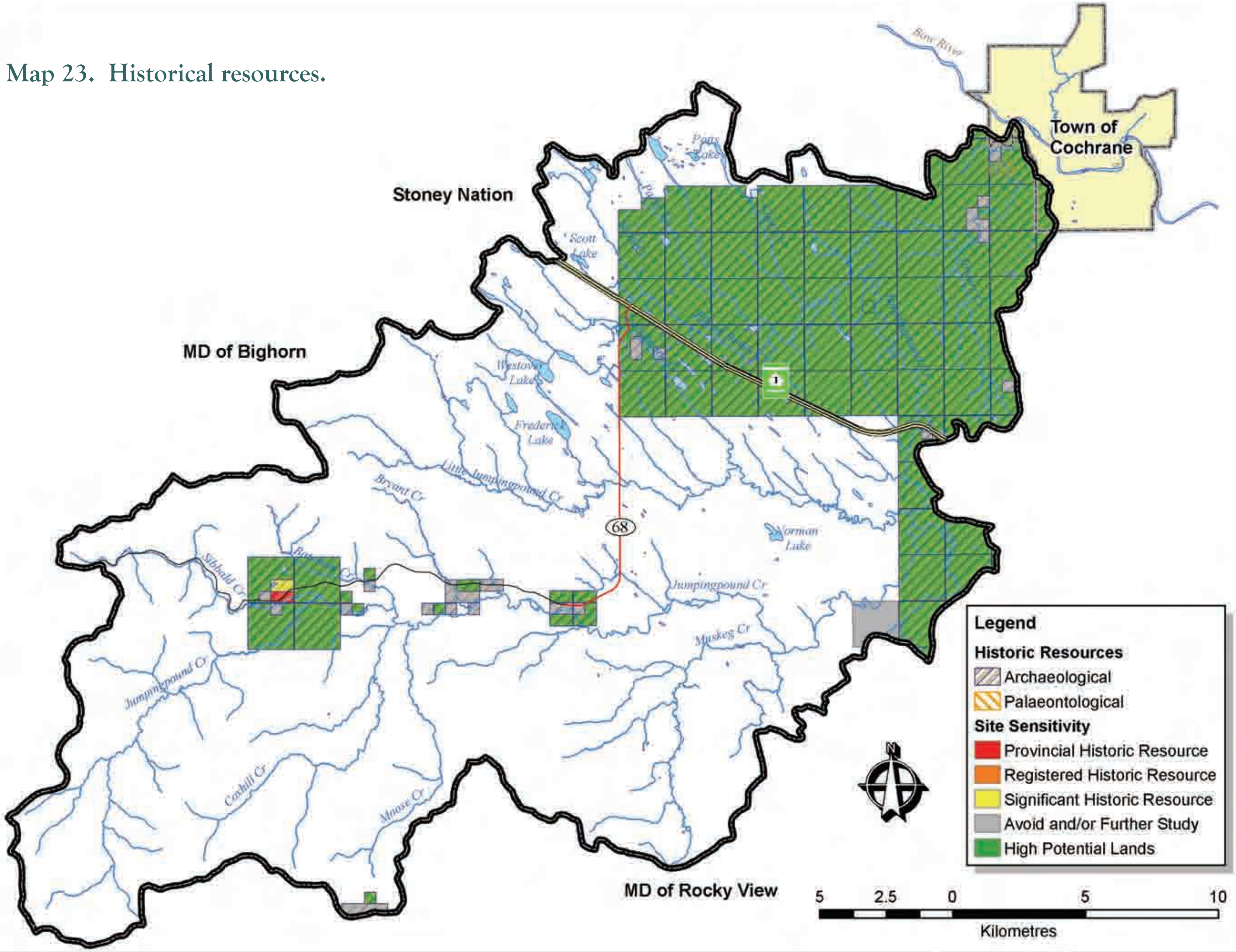
Lands that should be avoided and that are subject to further study (HRV 4) are located mainly along Hwy 68 west, although there are also areas bordering the south and south-east watershed boundary.

Approximately 144 km^2 (95%) of land having an HRV rating is classified as HRV 5 which encompasses the majority of land north of Highway 1 to the Bow River (Map 23). Tipi rings and campsites make up the majority of the findings.

There are no registered historic resources (HRV 2) designated in the watershed.

Sibbald Flats—Historical Resource Value of 1.

Map 23. Historical resources.



7.0 WILDLIFE

Introduction

The headwaters of the Jumpingpound Creek watershed originate in the Rocky Mountain Natural Region (Alpine, Subalpine and Montane Natural Subregions) and flow north into the Parkland Natural Region (Foothills Parkland Natural Subregion). This diverse landscape provides habitat for a variety of large and small mammals, ungulates, birds, waterfowl and amphibians.

The vegetation found in the four Natural Subregions, defined in Section 2.3, provide insight into the type of species that can be found in the Jumpingpound Creek watershed. In the Rocky Mountain Natural Region, a highly diverse and complex mosaic of habitats exist, therefore a high diversity of species is expected. On the other hand, the Parkland Natural Region contains highly productive cropland and is characterized by cultivated fields. The remaining native vegetation is generally an aspen-grassland or willow-grassland mosaic (Natural Regions Committee 2006). There are few wildlife species unique to the Parkland Natural Region as habitats often overlap with adjacent Natural Regions.

Wildlife studies specific to the Jumpingpound Creek are limited to the Trumpeter Swan. Annual bird surveys are conducted for Sibbald Flats by volunteers.

Larger scale studies linking wildlife to preferred habitat have been conducted by the Alberta Sustainable Resource Development—Fish and Wildlife Division. These studies that provide references regarding wildlife habitat suitability have been extrapolated to the Jumpingpound Creek watershed for certain species.

There are some key species that are indicative of the overall health of a watershed. For instance, the absence of top predators such as grizzly bear, cougar and wolves may indicate a land use conflict. Another example is the use of wetlands by moose, Trumpeter Swans and amphibians such as the long-toed salamander or spotted frog. All of these species rely on wetland habitats and their absence may be associated with declining wetland health. Grassland areas provide habitat for a variety of birds, including Sharp-tailed Grouse. These species are discussed in more detail.

Table 11 lists the mammals and amphibians that have been observed or are expected to live in the Jumpingpound Creek watershed.

Table 11. Summary of the wildlife species found in the Jumpingpound Creek watershed.

Wildlife	Species
Large Mammals	black bear, grizzly bear, cougar, Canada lynx and bobcat, coyote, red fox, grey wolf, moose, elk, white-tailed deer, mule deer, bighorn sheep, mountain goat
Small Mammals	Columbian ground squirrel, pika, hoary marmot, beaver, muskrat
Amphibians	western toad, spotted frog, long-toed salamander

Grey Wolf (*Canis lupus*)

Residence. Permanent resident

Status. The grey wolf is listed as "Secure" in Alberta (ASRD 2005).

Characteristics. Wolves are the largest member of the wild dog family and may weigh up to 60 kg or larger. Wolves are social animals found in packs numbering from two to over 20. Pack size tends to be largest in winter.

Habitat requirements. The wolf has adapted to a wide range of habitats and, in Alberta, has successfully repopulated most of the forested areas in the western and northern portions of the province. The Jumpingpound Creek pro-

vides good habitat for grey wolves with an ample supply of moose, deer and elk as prey.

Stressors. Since the mid to late 1800s, grey wolves have had many negative encounters with humans. The first encounters were with fur trappers who used poison to kill wolves. Then wolf bounties were used to protect wild game and domestic livestock. In the 1950s there was an estimated population of just 500 to 1,000 animals in Alberta. In 1951, snares were legalized, and cyanide "coyote-getters" were distributed to forestry personnel (Forestry, Lands and Wildlife 1991). Grey wolves continue to threaten livestock today and control measures are taken.

Cougar (*Felis concolor*)

Residence. Permanent resident

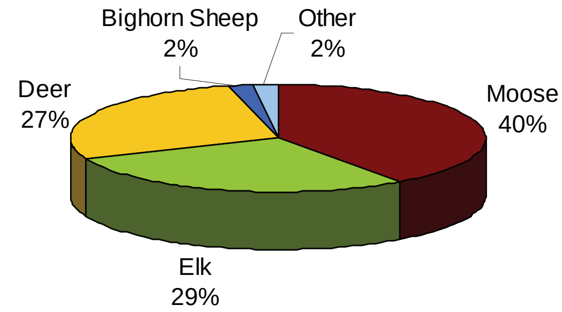
Status. The cougar is listed as "Sensitive" in Alberta (ASRD 2005).

Characteristics. The cougar is the largest of North America's wild cats. Adult males average from 60 to 70 kg and females weigh from 40 to 50 kg . From nose to tip of tail, a large cougar may be as long as 3 m (10 ft.).

Habitat requirements. South of the Bow River, cougar are found in the Alpine, Subalpine, Montane and Foothills Parkland Natural Subregions. Home ranges can be over 400 km^2 for males and 30 km^2 for females. Studies have shown that summer and winter ranges vary, and often these two ranges are not contiguous. In Alberta, deer, elk and moose comprise most of the cougar's food supply. By biomass however, moose calves prove to be of greatest importance (Figure 11).

Stressors. Cougars are hunted from December through to February, with an open hunt reserved for First Nations people on Crown land. Landowners also have the authority to kill cougar if they threaten life or livestock. Cougar mortality also results from road kill. There is also inter-specific competition between resident males and young wandering males that may result in cougar losses (P. Young, pers. comm.)

Figure 11. Prey biomass consumed by cougars in the Sheep River area (1981 to 1989) (Forestry, Lands and Wildlife 1992).



Cougars feeding on a recent deer kill in the Jumpingpound Creek watershed. Images were taken early in the morning. The left photo shows four cougars which is likely a mother with three kittens since cougars are generally solitary animals.

Grizzly Bear (*Ursus arctos*)

Residence. Permanent resident

Status. The grizzly bear is considered a species that "May be at Risk" in Alberta (ASRD 2005) and is of "Special Concern" nationally (COSEWIC).

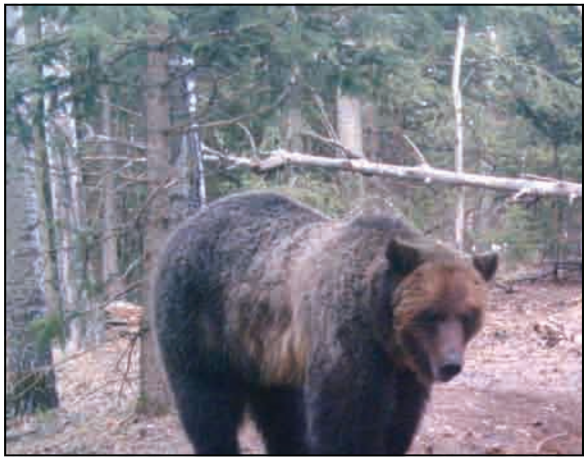
Characteristics. Grizzly bears are larger than black bears and their fur colour ranges from blonde to brown. Grizzly bears are distinguished by their distinctive shoulder hump and facial disk. Males weigh approximately 200-300 kg, while females are smaller at 100-200 kg.

The grizzly bear's natural diet includes grasses, sedges, forbs, roots, berries, nuts, fish, carrion, rodents, ungulates, birds and insects (AGBRT 2008). Bears sharing habitat with humans can also consume garbage, livestock and grains.

Grizzly bears cover large areas in search of food and often return to good foraging areas on a seasonal basis. Multiple food sources must be available within a home range to compensate for major fluctuations in food availability within and among years (AGBRT 2008). Consequently, home ranges are large, ranging from 500 to nearly 5000 km^2 for males and 150 to 3000 km^2 for females.

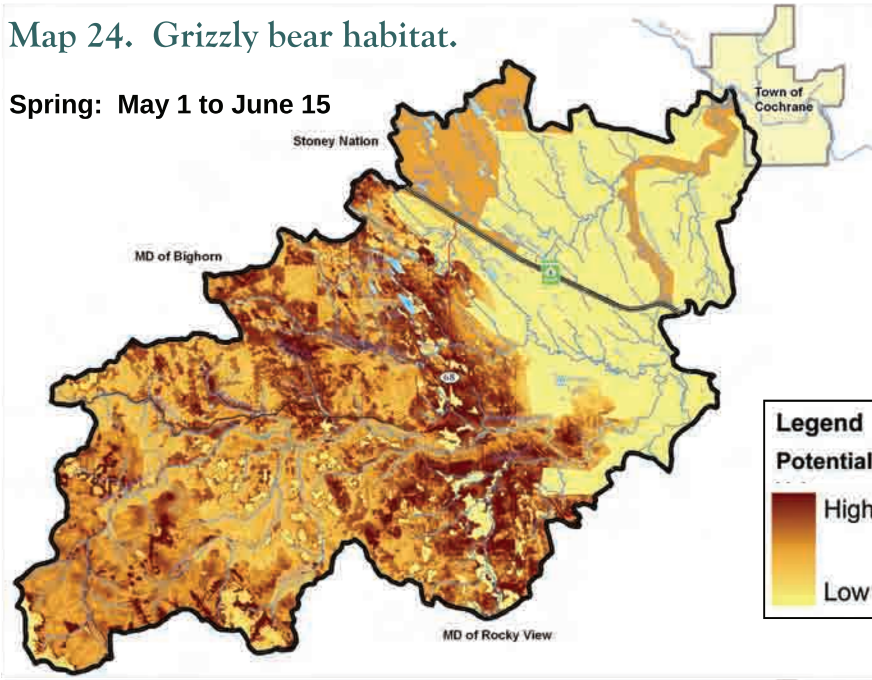
Habitat requirements. The Jumpingpound Creek watershed provides high potential lands for grizzly bear habitat. Map 24 shows the habitat suitability for the watershed according to season. Although there is not specific data regarding actual use of these lands, there is a band in the Jumpingpound Creek watershed that spans north-west to south-east showing high potential for supporting grizzly bears from May 1 to July 31. In the fall, August 1 to October 15, grizzly bear habitat appears to shift to two areas in the watershed; one area to the south and the other to the northwest (Map 24).

Stressors. The main threat to grizzly bears is the loss of habitat as humans encroach into their territory. Human-grizzly bear encounters may also result in mortality if the bears lose their fear of humans. Access roads can also divide important habitats, and increase human-bear encounters. According to local knowledge, grizzly bears may be moving further west and northwest from the Moose Mountain area every year.



This grizzly bear was captured on camera in the Jumpingpound Creek watershed using a motion sensor. Photo A was taken at 1:00 am and Photo B at 7:00 am.

Map 24. Grizzly bear habitat.



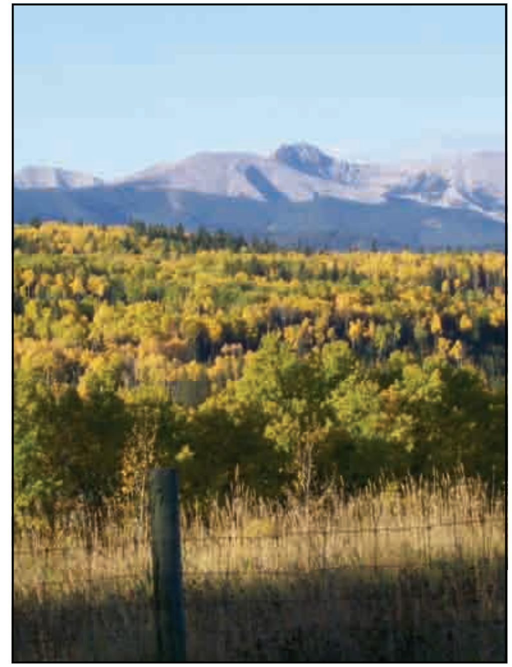
Spring: May 1 to June 15

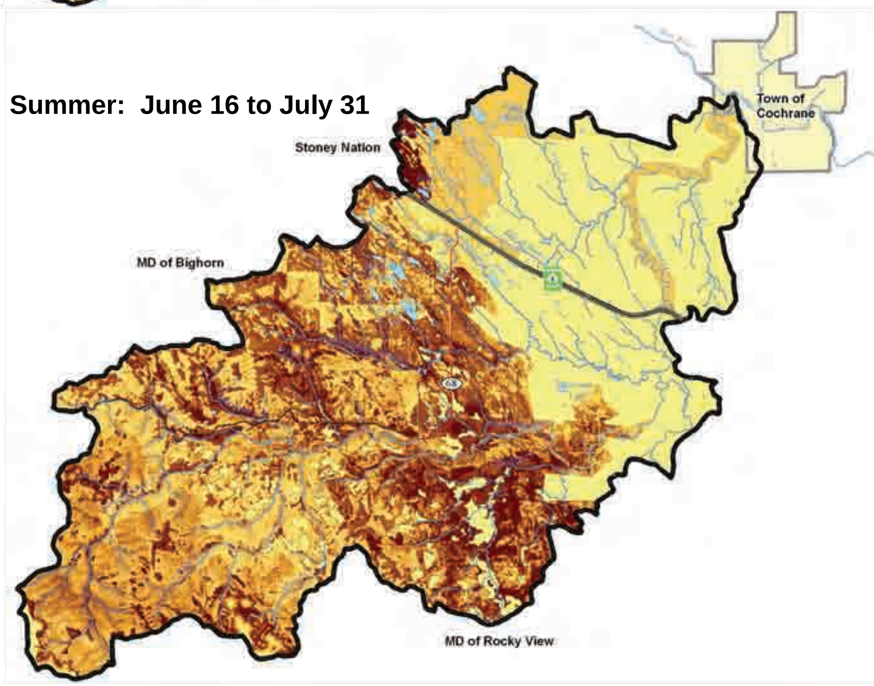
Legend

Potential Grizzly Bear Habitat

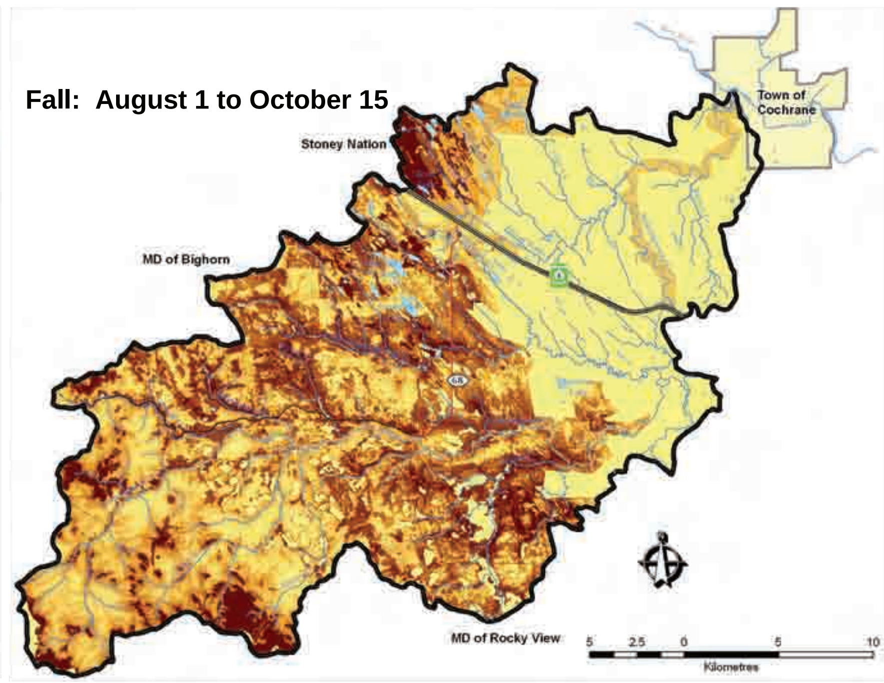
High : 10

Low : 1





Summer: June 16 to July 31



Fall: August 1 to October 15

Moose (*Alces alces*)

Residence. Permanent resident

Status. The moose is listed as "Secure" in Alberta (ASRD 2005).

Characteristics. The moose is the largest member of the deer family, world-wide. Bulls can weigh over 450 kg and stand 2.3 m at the shoulder. Cows average about 350 kg. Bulls have broad, palm-like antlers that can measure as much as 1.8 m from tip to tip.

Habitat requirements. Moose are common throughout most Natural Regions in Alberta, except for the prairie and parkland. Areas of preferred habitat include muskegs, brushy meadows and small groves of aspen or coniferous trees, particularly where such habitat adjoins lakes, ponds or streams. During the spring and summer, moose feed on aquatic plants and browse on the tender shoots of willow, birch and poplar. In the spring, moose also seek aspen bark, aquatic vegetation and minerals from natural salt licks. During the winter, moose browse near the edges of dense forests where there is less snow.

The expansive muskeg areas found in the Jumpingpound Creek watershed is prime habitat for moose.

Stressors. Predation by wolves and cougar, road mortality, hunting and loss of habitat are the main threats to moose populations.

Elk (*Cervus elaphus*)

Residence. Permanent resident

Status. The elk is listed as "Secure" in Alberta (ASRD 2005).

Characteristics. Bull elk can weigh close to 450 kg and cows up to 70 kg. The large sweeping antlers on the dark brown head of a bull elk distinguish it from all other deer. The elk is the only member of the deer family in Alberta that collects a harem.

Habitat requirements. Elk prefer areas of woodland mixed with open grassland. Such habitat is found at forest edges and in mountain meadows. Elk usually graze on forbs and grasses, although they will browse on aspen bark and twigs in winter when food is scarce. These ungulates are found mainly in the foothills and mountains regions and migrate from high summer ranges to winter ranges in lower valleys and foothills.

Stressors. Predation by wolves and cougar, road mortality, hunting and loss of habitat are the main threats to elk populations.

Birds

Nature Calgary conducts an annual bird survey in a radius around The City of Calgary's limits. Included in the survey is Area 19: Sibbald Flats which encompasses Jumpingpound Creek.

Data collected in 2006 and 2007 shows 89 and 86 different bird species observed in the watershed, respectively. The total number of birds observed during the same time period was 1,105 and 1,217. A species list of birds observed during these two years is provided in Table 12.

Peregrine Falcon.

The Peregrine Falcon is listed as "At Risk Threatened" in Alberta (ASRD 2005) and "Threatened" nationally (COSEWIC). Peregrine Falcons typically nest on cliffs close to riparian or marsh habitats (APFRT 2005). In southern Alberta, nests are often located on clay or sandstone cliffs along major river systems.

Historically, the Peregrine Falcon has nested in the lower reach of Jumpingpound Creek, however no recent observations have been made.

Table 12. List of bird species observed in the annual bird survey for Area 19: Sibbald Flats, Jumpingpound Creek. Data is combined species lists from 2006 and 2007.

Waterfowl	Swainson's Hawk	Black-billed Magpie	Orange-crowned Warbler
Canada Goose	Red-tailed Hawk	American Crow	Yellow Warbler
Wood Duck	American Kestrel	Common Raven	Yellow-rumped Warbler
Gadwall	**Rails and Coots**	**Larks and Swallows**	Townsend's Warbler
American Wigeon	Sora	Tree Swallow	Northern Waterthrush
Mallard	American Coot	Bank Swallow	MacGillivray's Warbler
Blue-winged Teal	**Shorebirds**	Cliff Swallow	Common Yellowthroat
Cinnamon Teal	Killdeer	Barn Swallow	Wilson's Warbler
Northern Shoveler	Lesser Yellowlegs	**Chickadees, Nuthatches & Wrens**	**Sparrows & Allies**
Green-winged Teal	Spotted Sandpiper	Black-capped Chicadee	Chipping Sparrow
Canvasback	Wilson's Snipe	Mountain Chicadee	Clay-colored Sparrow
Redhead	Wilson's Phalarope	Boreal Chicadee	Vesper Sparrow
Ring-necked Duck	Black Tern	Red-breasted Nuthatch	Savannah Sparrow
Lesser Scaup	**Doves**	House Wren	Le Conte's Sparrow
Bufflehead	Rock Pigeon	Winter Wren	Song Sparrow
Common Goldeneye	**Owls**	**Kinglets**	Lincoln Sparrow
Barrow's Goldeneye	Barred Owl	Golden-crowned Kinglet	White-throated Sparrow
Hooded Merganser	**Woodpeckers**	Ruby-crowned Kinglet	White-crowned Sparrow
Common Merganser	Red-naped Sapsucker	**Bluebirds and Thrushes**	Dark-eyed Junco
Ruddy Duck	Northern Flicker	Western Bluebird	**Blackbirds & Allies**
Common Loon	Olive-sided Flycatcher	Mountain Bluebird	Red-winged Blackbird
Pied-billed Grebe	**Flycatcher**	Townsend's Solitaire	Western Meadowlark
Horned Grebe	Least Flycatcher	Swainson's Thrush	Yellow-headed Blackbird
Red-necked Grebe	Western Kingbird	American Robin	Brewer's Blackbird
Great Blue Heron	Eastern Kingbird	Varied Thrush	Brown-headed Cowbird
Osprey	**Shrikes and Vireos**	**Starlings**	**Finches**
Hawks and Eagles	Warbling Vireo	European Starling	Pine Siskin
Bald Eagle	**Jays and Crows**	**Warblers and Tanagers**	American Goldfinch
Northern Goshawk	Gray Jay	Tennessee Warbler	House Sparrow

Trumpeter Swan (*Cygrus buccinators*)

Residence. Migratory

Status. *Endangered* in 1987; *Threatened* in 1997

Characteristics.

Habitat Requirements. Breeding Trumpeter Swans select wetland habitats that have adequate space for take-off, accessible forage, shallow depths (<1m), stable water levels, unpolluted fresh water, emergent vegetation, potential suitable nesting structure and low human disturbance. Habitats supplying high abundance of invertebrates and aquatic plants typically have the highest swan production. Important food items include the stems, roots and shoots of horsetail (*Equisetum spp.*), pondweeds (*Potamogeton spp*.), sedges (*Carex spp*.) among other vegetation (Trumpeter Swan Recovery Team 2006).

Trumpeter Swans are sensitive to loud vehicle traffic near their habitat. High levels of human-caused disturbance can make lakes or wetlands unsuitable for nesting or breeding.

Trumpeter Swans rely heavily on certain wetlands during staging, migration and moulting to meet their high nutritional demands. Key migration wetlands in the Jumpingpound Creek watershed include Jumping Pound wetlands, Sibbald Flats, Sibbald Flats East ponds and Pile of Bones Creek.

Dr. L. Hills has been monitoring Trumpeter Swans in the watershed since 1992. The main spring migration in this area occurs from March 25 to May 10, with peak migration from April 15 to April 27. Swans use this area again in the Fall from the end of September to the beginning of December.

Since 1992, utilization of ponds in the Jumpingpound Creek watershed has increased. In general, numbers have increased from a maximum daily count of 100 to about 300 once or twice per season (L. Hills, pers. comm.). The total number of Trumpeter Swans counted during the spring migration ranges from 1,000 to 1,500 birds (L. Hills, pers. comm.). Sometimes individuals will stay for two weeks. The Jumpingpound Creek ponds are attractive due to the rich food supply of pondweed.

Stressors. Loss of wetland habitat that is essential for migrating, breeding and non-breeding Trumpeter Swans is a constant threat. Migration stopover sites in southern Alberta are critical as they allow swans to build energy reserves required for successful migration and breeding. In the Jumpingpound Creek watershed, extensive surveys of staging Trumpeter Swans indicate that this area is a major migration stopover site. However, the extent of their future use may be limited by intensive grazing of shorelines, deteriorating water quality and permanent wetland alteration. Competing interests for water may also threaten certain wetland habitats.

Feeding patterns in Sibbald Pond (East) following utilization by Trumpeter Swans.

Sharp-tailed Grouse (*Tympanuchus phasianellus*)

Residence. Permanent resident

Status. Listed as "Sensitive" in Alberta (ASRD 2005).

Characteristics. Beginning in April, males will gather at dawn and dusk on ancestral dancing grounds and defend territory within the lek with gobbles, strutting, and fighting. The males carry out dancing duels for nearby females by rapidly stamping their feet, lowering their heads, ruffling their plumage and releasing booming sounds from inflated purple neck sacs on the side of their neck. The females, appearing passive and disinterested, move into the lek for mating.

Habitat requirements. The sharp-tailed grouse is relatively common throughout the grassland, central parkland and Peace River parkland regions. In the grassland region it is found in open prairie, shrubby sandhills, coulees, and margins of water courses. In the parkland region it favors farmland and open woodland. Population abundance is dependent on open grassland and shrubland during mating season. The retention of undisturbed grassland habitat is essential for continued population welfare.

Dancing grounds or "leks" have been observed in the Jumpingpound Creek watershed, north of Highway 1 (J. Wieleczko, pers. comm.).

Stressors. Sharp-tailed Grouse are declining in numbers and range due to habitat loss.

Photos donated by C. Schaupmeyer.

Long-Toed Salamander (*Ambystoma macrodactylum*)

Residence: Permanent resident. Hibernates during the winter.

Status: The long-toed salamander is listed as "Sensitive" in Alberta (ASRD 2005).

Characteristics: The long-toed salamander is slender, all black or dark brown with an irregular yellow-orange stripe down the center of its back and tail. They have long, slender toes with the fourth toe on hind foot longer than the others. Adult length is typically 8 to 12 cm long.

Habitat requirements: Most long-toed salamanders are found in the Subalpine and Montane Natural Subregions of Alberta. These areas are characterized as having relatively short summers with pronounced precipitation.

Long-toed salamanders require both aquatic and terrestrial habitat. Shallow lakes or ponds with boggy edges and abundant aquatic vegetation is used for breeding (Graham and Powell 1999). Closed-canopy lodgepole pine and Douglas-fir associations provide the best surrounding habitat. Terrestrial long-toed salamanders spend most of their time below ground, often in small mammal burrows. In the summer, juvenile and adults find shelter under rocks, decaying logs or other debris in areas with high soil moisture near relatively permanent water bodies. Although little is known about overwintering habits, they appear to congregate in small groups buried 50 to 70 cm below the surface in loose gravel with relatively high soils moisture where temperatures do not fall below 2°C (Graham and Powell 1999).

Although suitable habitat exists, little is actually known about the long-toed salamander population in the Jumpingpound Creek watershed.

Known Stressors: Fragmentation of terrestrial habitat and breeding ponds by human disturbances (e.g., roads) limits success. Habitat may also be impacted directly by forestry or mining activities or indirectly by agricultural chemicals.

Long-toed salamander larvae are generally not found in ponds with predatory fish such as rainbow trout. Stocking game fish in breeding ponds may negatively affect long-toed salamander populations (Graham and Powell 1999).

8.0 STEWARDSHIP

Ranchers of the Jumping Pound

Ranchers of the Jumping Pound formed in 2002 as a way for agricultural producers to share information relative to Jumpingpound Creek which flowed through each members property.

The vision of the society "is a ranching community where continuation of our life choices support sustainable agriculture and are in harmony with the environment."

Members of the society have undertaken over 20 individual riparian health assessments which have contributed to the larger Community Health Assessment. They have also completed Environmental Farm Plans, implemented many Beneficial Management Practices and are now creating a photographic record of significant locations on Jumpingpound Creek and within their area of operation.

The Ranchers of the Jumping Pound were instrumental in facilitating the initial steps that lead to the formation of the Jumpingpound Creek Watershed Partnership and the Terms of Reference for the Jumpingpound Creek Integrated Watershed Management Plan.

Branches and Banks

Branches and Banks is a local volunteer group operating in the Town of Cochrane. The group has organized an annual tree planting and cleanup day for over 13 years. Volunteers have planted close to 32,000 trees along the streambanks of creeks flowing through the town.

Individual Stewards

There are a number of individual conservationists or naturalists who may not live in the Jumpingpound Creek watershed, but have a strong interest in its environment.

Mr. George Loades is a real estate agent from Calgary with a love of bluebirds. In the 1980s George and his father were advised of the declining Mountain Bluebird population and began building houses especially for them.

George's area of focus includes Bluebird paths in the Jumpingpound Creek watershed. He has maintained these birdhouses and banded Mountain Bluebirds in the watershed for over 20 years.

Dr. Len Hills is another individual with strong connections to the Jumpingpound Creek watershed. Len is a retired University professor who has been counting Trumpeter Swans in the watershed during spring and fall migration since 1992. He hopes to publish his work one day.

Nature Calgary also hosts an annual bird count and a few of their volunteer's have been documenting birds near Sibbald Flats for a number of years.

Individuals like these volunteers contribute a wealth of knowledge to the limited understanding of biodiversity in the watershed. There are likely many more people who devote their time to understanding how the human footprint impacts our environment.

These photos were taken at Jumpingpound Creek A) pre-1960 and B) 2008. Interesting, cattle are still grazed at this site today, however grazing management practices have changed to allow for the proliferation of riparian vegetation such as willows and sedges.

9.0 SUMMARY AND CONCLUSIONS

Overall, Jumpingpound Creek is a relatively healthy watershed that is rich in natural resources. In the headwaters, an active forest harvesting company is operating under a defined management plan. Designated parks and recreation areas help to manage public access. Oil and gas activity is growing, but at a slow pace (i.e., about one new well per year). Active groups and dedicated individuals promote land stewardship in the watershed. Water resources are currently meeting human and environmental needs in terms of quantity and quality. Riparian assessments have documented improvements in riparian health that will support biodiversity. The proximity of the Jumpingpound Creek watershed to two major centres, could result in an influx in population in the years to come. Managing new groundwater developments will be critical. Since the watershed is currently closed to new surface water licenses, greater pressure on groundwater stores is expected.

Some areas that will need to be considered in the future are those related to groundwater - surface water interactions. A recent study found that groundwater contributes about 68% of the baseflow in Jumpingpound Creek.

A greater understanding of the role of wetlands in the watershed will be essential to maintaining water balance in the watershed. Wetlands store water and release it slowly throughout the year.

Resource extraction (i.e., sand and gravel, oil and gas) should be thoroughly assessed prior to development and located in areas that will not impact local hydrology and wildlife or increase access in the watershed.

The key to managing this watershed in the future will be to balance social and economic needs with those of the environment. Table 13 summarizes the findings of the State of the Watershed Report 2009.

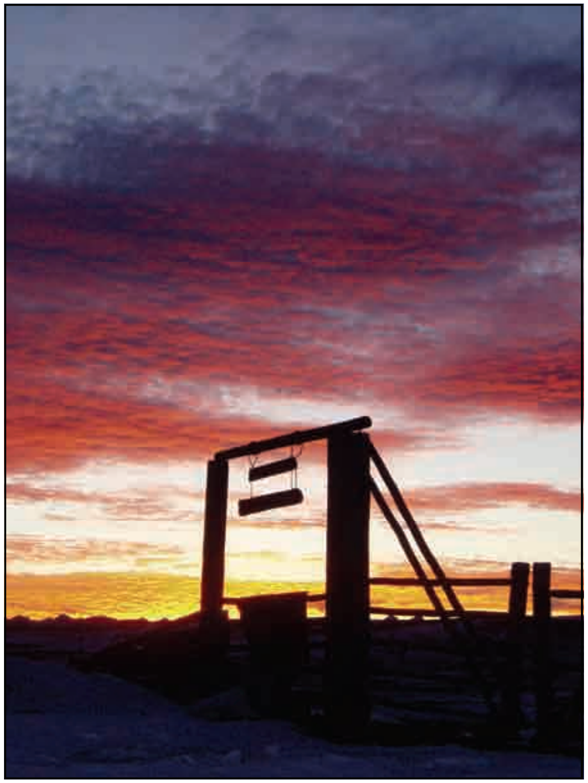


Table 13. Summary of indicators and their status in the Jumpingpound Creek watershed.

Indicator	Measure	Status	Potential Threats	Opportunities
Population	Number/Density	1,381 people or 2.3 people per km^2	Potential changes in landuse.	Planning.
Linear Disturbances	Roads	240.1 km	Fragmentation of landscape.	Maintain current road network to high standards
	Pipelines	151.8 km	Fragmentation of landscape.	Slow growth.
Water Supply	Surface Water Supply and Demand	Currently meeting human and environmental needs.	Water license transfers altering designated uses.	Planning.
	Groundwater Supply and Demand	Currently meeting human and environmental needs.	Limited data. Increased pressure due to restrictions on new surface water licenses and transfers.	Planning.

Table 13. Continued...

Indicator	Measure	Status	Potential Threats	Opportunities
Water Quality	Dissolved Oxygen	Always meets guidelines.	Limited data. Potential changes in landuse.	Improved monitoring.
	Nutrients	Occasional guideline exceedences linked to storm events.	Increased nutrients from stormwater in lower reach.	Improved monitoring.
	Fecal Coliforms	Exceedences occur fairly frequently, not always linked to storm events.	Limited data available.	Improved monitoring.
	Metals	Infrequent exceedences by a few metals (i.e., chromium, iron and lead).	Limited data available.	Improved monitoring.
	Pesticides	Unknown.	No data available.	Improved monitoring.
Fisheries	Fish habitat and fish populations	Appears healthy overall, with a few specific problem areas.	Limited data. Increased fishing pressure with improved access. Decrease in water quality and temperature with landuse changes.	Planning.
Riparian Areas	Health	39% of sites Healthy; 61% of sites Healthy but with Problems; 0% of sites Unhealthy. Positive trend in health status since 2001.	Limited data available for the headwaters.	Additional riparian health assessments in the watershed.
Landuse	Agriculture Rangeland Health, Cropland	55% of sites Healthy; 30% of sites Healthy with Problems; 15% of sites Unhealthy. Relatively small area of cropland in a forage-crop rotation.	Limited data available.	Increased rangeland monitoring.
	Oil and Gas, Well density	Slowly expanding—48 active wells.	Limited data available.	Utilize existing rights-of-ways.
	Forestry Previously harvested area	Activity guided by an approved Forest Management Plan.	Limited data available. Mountain Pine Beetle infestations and forest fire.	Planning. Proactive forest harvesting to combat Mountain Pine Beetle.
Wildlife	Population estimates or Presence/Absence	Large carnivores present. Ungulates present. Trumpeter swans present and numbers increasing. Sharp-tailed grouse breeding grounds.	Limited data available. Increased access to prime habitat. Alteration of habitat through changes in landuse.	
Stewardship	Involvement	Highly involved watershed stewardship group with active membership.	Complacency. A lack of action and progress can lead to declining membership.	Increasing membership.

10.0 REFERENCES

Alberta Agriculture and Food (AAF). 2005. Agricultural Land Resource Atlas of Alberta. Online Resource Accessed May 2009 at http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex10332

Alberta Chapter of the Wildlife Society (ACTWS). 2004. Access Management on Public Lands in Alberta's Green Zone. A Position Paper. 4 pp.

Adams, B.W., G. Ehlert, C. Stone, M. Alexander, D. Lawrence, M. Willoughby, D. Moisley, C. Hincz, and A. Burkinshaw. 2003. Range Health Assessment for Grassland, Forest, and Tame Pasture. Public Lands and Forests Division, Alberta Sustainable Resource Development. Pub. No. T/044.

Alberta Grizzly Bear Recovery Team (AGBRT). 2008. Alberta Grizzly Bear Recovery Plan 2008-2013. Alberta Sustainable Resource Development, Fish and Wildlife Division, Alberta Species at Risk Recovery Plan No. 15. Edmonton, AB. 68 pp.

Alberta Northern Leopard Frog Recovery Team (ANLFRT). 2005. Alberta Northern Leopard Frog Recovery Plan 2005-2010. Alberta Sustainable Resource Development, Fish and Wildlife Division, Alberta Species at Risk Recovery Plan No. 7. Edmonton, AB. 26 pp.

Alberta Peregrine Falcon Recovery Team (APFRT). 2005. Alberta Peregrine Falcon Recovery Plan 2004-2010. Alberta Sustainable Resource Development, Fish and Wildlife Division, Alberta Species at Risk Recovery Plan No. 3. Edmonton, AB. 16 pp.

Alberta Trumpeter Swan Recovery Team (ATSRT). 2006. Draft Alberta Trumpeter Swan Recovery Plan, 2005-2010. Alberta Sustainable Resource Development, Fish and Wildlife Division, Alberta Species at Risk Recovery Plan No. 11. Edmonton, AB. 29 pp.

ASRD. 2005. The General Status of Alberta Wild Species 2005. Alberta Sustainable Resource Development, Government of Alberta. Database accessed on March 2009. http://srd.alberta.ca/fishwildlife/speciesatrisk/default.aspx

Alberta Sustainable Resources Development. website. Mountain Pine Beetle in Alberta. http://srd.alberta.ca./forests/health/pestalerts/mountainpinebeetles.aspx

ASRD. 2008. Invasive Plants of the Southern Rockies – Year End Summary on Partnerships, Progress, Control and Survey, 2008.

Alberta Tourism, Parks, Recreation and Culture (ATPRC). 2007. Listing of Significant Historical Sites and Areas, September 2007 edition. Historic Resources Management Branch, Alberta Tourism, Parks, Recreation and Culture, Edmonton, AB.

Alexander, M. and C. Demaere. 2009. Range Plant

Community Types and Carrying Capacity for the Foothills Parkland Subregion. Lands Division, Alberta Sustainable Resource Development. First Approximation.

AMEC Earth & Environmental (AMEC). 2009. Balancing Water Supply in the Jumpingpound Creek Watershed. Final Report. Jumpingpound Creek Watershed Partnership, AB. 97 pp. + Appendix.

Associated Engineering Services Ltd. 1976. Sibbald Lake improvement project. Prepared for Alberta Parks and Recreation, Parks and Wildlife, Calgary, Alberta.

Bachusky, J. 2008. History of Kananaskis, Alberta. Internet Resource. http://www.canmorealberta.com/directory/about/history/kananaskis.html Accessed on April 3, 2009.

Baayens, D.M. 2001. 2001 Temperature monitoring in selected southern Alberta streams. Prepared by the Alberta Council, Trout Unlimited Canada, Calgary, Alberta. 6 pp.

Bayrock, L.A. and T.H.F. Reimchen. 1980. Surficial Geology of Alberta Foothills and Rocky Mountains. Sheet No. 1. Alberta Environment and Alberta Research Council.

Beers, C. E. 1990. Effect of density, microhabitat and food on growth and survival of rainbow trout fry, *Onchorhynchus mykiss* Richardson. Masters of Science Thesis, University of Calgary, Department of Biological Sciences, Calgary, Alberta. 148 pp.

Borneuf, D. 1980. Hydrogeology of the Kananaskis Lake Area, Alberta. Alberta Research Council, Report 79-4, 13 pp. + Map.

Buckley, M. Chief Administrative Officer, MD of Bighorn, January 2009.

Cochrane and Area Historical Society. 1977. Big Hill Country. Friesen and Sons Ltd., Calgary, Alberta. 804 pp.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC).

Cooke, C. 1982. Jumpingpound Creek streambank evaluation report. Prepared by Alberta Energy and Natural Resources, Fish and Wildlife Division, Fisheries Habitat Management Section, Calgary, Alberta.

Culp, J. M. and N. E. Glozier. 1989. Longitudinal trends in rainbow trout abundance, production and fish habitat in a foothills stream. Prepared for Alberta recreation, Parks and Wildlife Foundation, Calgary, Alberta. Prepared by Department of Biological Sciences, University of Calgary, Calgary, Alberta. 10 pp.

Culp, J. M., G. J. Scrimgeour and G. D. Townsend. 1996. Simulated fine woody debris accumulations in a stream increase rainbow trout fry abundance. Transactions of the American Fisheries Society. 125:472-479.

Cunningham, E.B. 1961. Jumpingpound Creel Census, 1961. Prepared by Alberta Fish and Wildlife Division, Calgary, Alberta. 7 pp.

Cunningham, E.B. 1962. 1962 Jumpingpound Creel Census. Prepared by Alberta Fish and Wildlife Division, Calgary, Alberta. 15 pp. + app.

Cunningham, E.B. 1964. Jumpingpound Creel Census Station, 1963 and 1964. Prepared by Alberta Fish and Wildlife Division, Calgary, Alberta. 31 pp. + app.

Damkjar, E. Head, Cultural Land Use Studies, Archaeological Survey Section, Old St. Stephen's College.

Dempsey, H. A. 1997. Indian Tribes of Alberta. Glenbow-Alberta Institute, Calgary, Alberta. 108 pp.

Douglas, N. 2007. Alberta's Southern Eastern Slopes: Forests or Forestry. Wild Lands Advocate 15(1): 12-16.

Engstrom, C. Environmental Biologist, Husky Energy, May 11, 2009.

Fernet, D. A. 1990. An overview of the Bow River Fishery in the Calgary, Alberta Region. Prepared for Alberta Forestry, Lands and Wildlife, Fish and Wildlife Division, Red Deer, Alberta. Environmental Management Associates. Calgary, Alberta. 74 pp.

Fish and Wildlife. 1990. 1948-1990 Stocking Records – Elbow District, Jumpingpound Drainage. Internal files Alberta Fish and Wildlife Division, Calgary, Alberta.

Fish and Wildlife Management Information System (FWMIS) database. Internet Mapping Tool (online). http://xnet.env.gov.ab.ca/imf/imf.jsp?site=fw_mis_pub

Flynn-Burhoe, M. 2008. Digitage of Nakoda-Stoney Sibbald Flat. Internet Resource Accessed at http://www.oceanflynn.wordpress.com/2008/06/21/nakoda-stoney-sibbald/ Accessed on April 3, 2009.

Forestry, Lands and Wildlife. 1991. Management Plan for Wolves in Alberta. Wildlife Management Planning Series Number 4. Forestry, Lands and Wildlife, Fish and Wildlife Division. Edmonton, Alberta. December 1991. 89 pp.

Forestry, Lands and Wildlife. 1992. Management Plan for Cougars in Alberta. Wildlife Management Planning Series Number 5. Forestry, Lands and Wildlife, Fish and Wildlife Division. Edmonton, Alberta. April 1992. 91 pp.

Golder Associates Ltd. 1997. Assessment of potential impact to fisheries resources associated with the Husky Oil's proposed Moose Mountain Pipeline. Prepared for Husky Oil, Calgary, Alberta. Prepared by Golder Associates Ltd., Calgary, Alberta. 44 pp. + app.

Golder Associates Ltd. 2000. Winter fish kill investigation at Pile of Bones Creek – Shell Canada Jumping Pound Gas Plant. Prepared by Golder Associates Ltd., Calgary, Alberta. 9 pp.

Golder Associates Ltd., 2001. Seasonal movements and identification of overwintering areas for an isolated population of rainbow trout: a radio-telemetry study 1994-1995. Prepared for Alberta Environment, Canmore, Alberta. Prepared by Golder Associates Ltd., Calgary, Alberta. 16 pp. + app.

Graham, K.L. and G.L. Powell. 1999. Status of the Long-toed Salamander (*Ambystoma macrodactylum*) in Alberta. Alberta Environmental Protection, Fisheries and Wildlife Management Division, and Alberta Conservation Association, Wildlife Status Report No. 22, Edmonton, Alberta.

Health Canada. 2003. Summary of Guidelines for Canadian Drinking Water. April.

Hills, L., Dept. of Geoscience & Dept. of Archaeology, University of Calgary, May 4, 2009.

Hydrogeological Consultants Ltd. 2002. M.D. of Rocky View No. 44 Part of the South Saskatchewan River Basin Tp 021 to 029, R 25 to 29, W4M & Tp 023 to 029, R 01 to 06, W5M Regional Groundwater Assessment. Prepared for the M.D. of Rocky View and Agriculture and Agri-Food Canada.

Kantrud, H.A., J.B. Millar and A.G. van der Valk. 1989. Vegetation of Wetlands of the Prairie Pothole Region in Northern Prairie Wetlands, A. van der Valk, (Ed.). Iowa State University Press, Ames, Iowa. pp. 132-187.

Kulcsar, E. Forestry Manager, Spray Lake Sawmills, May 1, 2009.

MD of Rocky View. 1998. Municipal Development Plan. Bylaw C-4840-97 Adopted on July 6, 1998. 53 pp. + Appendices.

Miller, R.B. 1947. The Jumping Pound and tributaries. Prepared by the University of Alberta, Edmonton, Alberta. 7 pp.

Natural Regions Committee. 2006. Natural Regions and Subregions of Alberta. Compiled by D.J. Downing and W.W. Pettapiece. Government of Alberta. Pub. No. T/852.

Nibourg, J.H. 1985. Inventory of fish populations and fish habitat in the Jumpingpound Creek watershed, a progress report. Prepared by Alberta Energy and Natural Resources, Fish and Wildlife Division, Calgary, Alberta. 38 pp. + app.

Mitsch, W.J. and J.G. Gosselink. 2003. Wetlands. Van Nostrand Reinhold, New York, NY. 722 pp.

Norris, K. 2003. Jumpingpound Creek and the middle Bow River: A literature review. Prepared by: Alberta Council, Trout Unlimited Canada (Calgary). Prepared for: Jumpingpound Chapter, Trout Unlimited Canada (Cochrane). 86 pp.

Ozoray, G.F. and R. Barnes. 1978. Hydrogeology of the Calgary-Golden Area, Alberta. Alberta Research Council, Report 77-2, 38 pp. + Map.

Rees, K. 1988. A fisheries phase II survey of Jumpingpound Creek (6-4-26-4W5). Prepared by Alberta Forestry, Lands and Wildlife, Fish and Wildlife Division, Calgary, Alberta. 33 pp. + app.

Richardson, R.J.H., C.W. Langenberg, D.K. Chao and D.W. Fietz. Coal Compilation Project - Entrance NTS 83F/5. Open File Report 1990-02. Alberta Geological Survey.

Rowell, P. and D.P. Stepnisky. 1997. Status of the Peregrine Falcon (*Falco peregrinus anatum*) in Alberta. Alberta Environmental Protection, Wildlife Management Division, Wildlife Status Report No. 8, Edmonton, Alberta. 23 pp.

Spray Lake Sawmill Forestry Management Agreement. http://www.srd.alberta.ca/forests/pdf/spraylakesawmills/Chapter1.pdf Accessed May 1, 2009.

Spray Lake Sawmills. Mountain Pine Beetle Information. http://www.spraylakesawmills.com/Woodlands/MountainPineBeetleInformation/Default.aspx

Stelfox, J.D. 1980. Kananaskis Country fall spawning survey. Prepared by Alberta Energy and Natural Resources, Fish and Wildlife Division, Calgary, Alberta. 25 pp. + app.

Stelfox, J.D. and J.H. Nibourg. 1983. Inventory of beaverponds in Kananaskis Country: A progress report. Prepared for Alberta Energy and Natural Resources, Fish and Wildlife Division, Calgary, Alberta.

Tera Environmental Consultants Ltd. 1998. Alternate open cut for Jumpingpound Creek – Number 2 crossing. August 14, 1998, letter to Husky Oil, Calgary, Alberta, from Tera Environmental Consultants Ltd., Calgary, Alberta. 9 pp.

Thompson, G.E. 1969. Bow River Forest Stream Surveys, Prepared by Alberta Fish and Wildlife Division, Calgary, Alberta. 30 pp.

Tripp, D.B., P.T.P. Tsui and P.J. McCart. 1979. Baseline Fisheries Investigations in the Mclean Creek ATV and Sibbald Flat Snowmobile Areas (Volume I). Prepared for Alberta Recreation, Parks and Wildlife, Fish and Wildlife Division, Calgary, Alberta. Prepared by Aquatic Environments Limited, Calgary, Alberta. 254 pp.

Tsuu T'ina Nation and Husky Oil. 1995. Moose Mountain Traditional Native Cultural Properties Study. Husky Oil, Calgary, Alberta.

Wieliczko, J. Wildlife Biologist. Formerly with Alberta Conservation Association, May 11, 2009.

Weibe, A.P. 1979. Kananaskis Country spring spawning survey. Prepared by Alberta Energy and Natural Resources, Fish and Wildlife Division, Calgary, Alberta. 20 pp. + app.

Wileman, R.A. 1952. Stream Report – Jumping Pound creek and tributaries. Prepared by Alberta Fish and Wildlife Division, Calgary, Alberta. Sheet No. 6. 1 p.

Willoughby, M., M. Alexander, and B. Adams. 2008. Range Plant Community Types and Carrying Capacity for the Montane Subregion. Lands Division, Alberta Sustainable Resource Development. Pub. No. T/136.

Woods, G. 2000. Jumpingpound Creek Spawning Survey 2000. Prepared by Bow Valley Habitat Development, Cochrane, Alberta

Woods, G. R. 2001. Water temperature and annual volume discharge study – Jumpingpound Creek 2000 Fisheries Project, TransAlta Corporation. Prepared for TransAlta Utilities Corporation, Calgary, Corporation. Prepared by Bow Valley Habitat Development, Cochrane. 16 pp. + app.

Young, P. Area Wildlife Biologist, Fish & Wildlife, Alberta Sustainable Resource Development, May 11, 2009.

Maps

The Jumpingpound Creek Watershed Partnership provides this information without warranty or representation as to any matter including but not limited to whether the data/information is correct, accurate or free from error or defect.

Map 1. Jumpingpound Creek watershed. Base data provided by Alberta Sustainable Resource Development. Produced by Town of Cochrane, Cochrane, AB. May 2009.

Map 2. Administrative boundaries. Base data provided by Alberta Sustainable Resource Development. Produced by Town of Cochrane, Cochrane, AB. May 2009.

Map 3. Bedrock geology. Base data provided by Alberta Sustainable Resource Development. Produced by Town of Cochrane, Cochrane, AB. May 2009.

Map 4. Surficial geology. Surficial Geology from by R.L. Bayrock and T.H.F. Reimchen: Energy Resources Conservation Board / Alberta Geological Survey (ERCB/AGS) . Produced by Town of Cochrane, Cochrane, AB. May 2009.

Map 5. Natural subregions. Natural subregions derived from the report: Natural Regions and Subregions of Alberta, compiled by Downing and Pettapiece, for the Alberta Natural Region Committee, Government of Alberta, 2006. Produced by Town of Cochrane, Cochrane, AB. May 2009

Map 6. Soil types. Soils obtained from AGRASID 3.0, 2001, Alberta Soil Information Centre, Agriculture and Agri-Food Canada and Alberta Agriculture and Food. Produced by Town of Cochrane, Cochrane, AB. May 2009

Map 7. Land cover. Data provided by Agriculture and Agri-Food Canada. Produced by Town of Cochrane, Cochrane, AB. May 2009

Map 8. Watershed access. Base data provided by Alberta Sustainable Resource Development. Produced by Town of Cochrane, Cochrane, AB. May 2009

Map 9. Hydrometric stations. Base data provided by Alberta Sustainable Resource Development. Data provided by AMEC Earth and Environmental. Produced by Town of Cochrane, Cochrane, AB. May 2009

Map 10. Surface water licenses and registrations. Base data provided by Alberta Sustainable Resource Development. Data provided by AMEC Earth and Environmental. Produced by Town of Cochrane, Cochrane, AB. May 2009

Map 11. Groundwater licenses and registrations. Base data provided by Alberta Sustainable Resource Development. Data provided by AMEC Earth and Environmental. Produced by Town of Cochrane, Cochrane, AB. May 2009

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Map 14. Aquifer groundwater vulnerability. Data provided by Alberta Agriculture and Food through Alberta Sustainable Resource Development. Produced by Town of Cochrane, Cochrane, AB. May 2009

Map 15. Wetlands. Data provided by Agriculture and Agri-Food Canada and the MD of Rocky View. Produced by Town of Cochrane, Cochrane, AB. May 2009

Map 16. Land ownership. Base data provided by Alberta Sustainable Resource Development. Produced by Town of Cochrane, Cochrane, AB. May 2009

Map 17. Grazing dispositions. Base data provided by Alberta Sustainable Resource Development. Produced by Town of Cochrane, Cochrane, AB. May 2009

Map 18. Cropland. Data provided by Agriculture and Agri-Food Canada. Produced by Town of Cochrane, Cochrane, AB. May 2009

Map 19. Oil and gas activity. Base data provided by Alberta Sustainable Resource Development. Produced by Town of Cochrane, Cochrane, AB. May 2009

Map 20. Gravel extraction. Sand Budney, H.D., Edwards, W.A.D., Berezniuk, T. and Butkovic, L. (2004): Sand and gravel deposits with aggregate potential, Calgary, Alberta (NTS 82O); Alberta Energy and Utilities Board, EUB/AGS Map 273, scale 1:250 000. Produced by Town of Cochrane, Cochrane, AB. May 2009

Map 21. Forestry activity. Data provided by Spray Lake Sawmills and Alberta Sustainable Resource Development. Produced by Town of Cochrane, Cochrane, AB. May 2009

Map 22. Parks and protected areas. Base data provided by Alberta Sustainable Resource Development. Produced by Town of Cochrane, Cochrane, AB. May 2009

Map 23. Historic resources. Base data provided by Alberta Sustainable Resource Development. Produced by Town of Cochrane, Cochrane, AB. May 2009

Map 24. Grizzly bear habitat. Base data and habitat data provided by Alberta Sustainable Resource Development. Produced by Town of Cochrane, Cochrane, AB. May 2009

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Page 79. S. Riemersma (left); D. Tannas (right)

Page 80. G. Court

Page 81. L. Hills

Page 82. C. Schaupmeyer

Page 83. Unknown

Page 84 and 85. L.A. Eklund

Page 87. C. Arnett

Page 91. L.A. Eklund

Metric and Imperial Unit Conversions

SI Units (Metric)	Imperial Units
Area	
1 hectare (ha)	= 2.471 acres
1 square kilometre (km^2)	= 0.386 square miles
Length	
1 millimeter (mm)	= 0.039 inches
1 metre (m)	= 3.281 feet
1 kilometre (km)	= 0.621 miles
Volume	
1 litre (l) = 0.001 cubic metres	= 0.0353 feet
1 cubic metre (m^3)	= 35.315 cubic feet
1 cubic decameter (dam^3) = 1000 cubic metres	= 0.811 acre feet
Flow Rate	
1 cubic metre per day (m^3/day)	= 0.153 imperial gallons per minute (gpm)
Yield	
1 kilogram per hectare (kg/ha)	= 0.892 pounds per acre (lbs/acre)

"Lots of people hardly even feel real soil under their feet, see plants grow except in flower pots, or get far enough beyond the street lights to catch the enchantment of a night sky studded with stars. When people live far from scenes of the Great Spirits making, its easy for them to forget his laws."

Chief Walking Buffalo, 1958

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