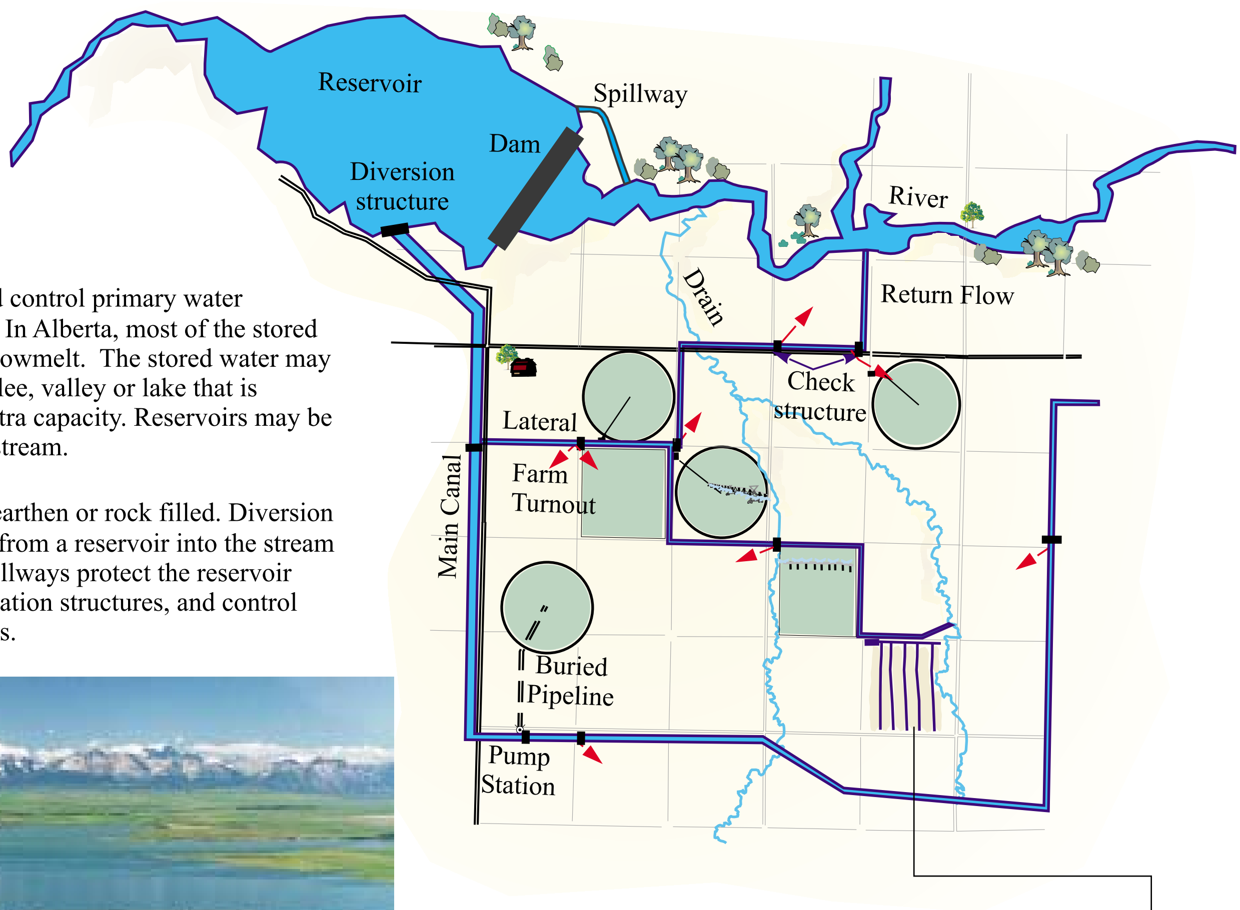
Alberta's Irrigation Infrastructure

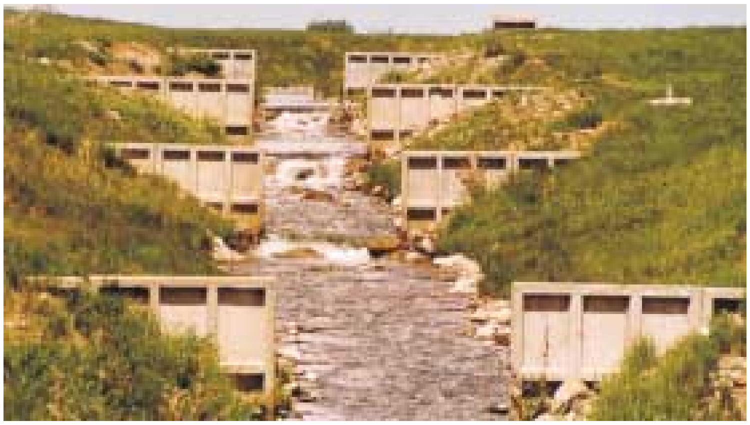


Reservoirs store and control primary water supplies for irrigation. In Alberta, most of the stored water is from spring snowmelt. The stored water may back into a natural coulee, valley or lake that is usually enlarged for extra capacity. Reservoirs may be built on-stream or off-stream.

Dams in Alberta are earthen or rock filled. Diversion structures direct water from a reservoir into the stream or diversion canal. Spillways protect the reservoir embankments and irrigation structures, and control the flow of flood waters.

Return flow channels carry excess irrigation water back to a river or reservoir. They can include natural drainage systems or man-made canals.

Border dykes make surface or flood irrigation more efficient. Water is supplied from a delivery ditch at the upper end of a graded field, using syphons or turnouts. Excess water is collected at the lower end of the field, then channeled to a return flow. The fields are usually levelled to follow a downslope of less than 2% to decrease erosion.



Drop structures placed at intervals along a channel stabilize it by changing its profile from a continuous steep gradient to a series of more gently sloping reaches.

Pipelines can be used to replace surface canals and to bring water from the canals to farm pivots. They are usually located underground.

Check structures are built into canals to raise and hold water at a specific level and facilitate upstream delivery.

Turnouts are used to divert water from a canal or other supply source. Multi-piped turnouts with motorized and computer-controlled gates are used to divert larger amounts of water. On-farm turnouts may be only gated culverts.

Gates are used to open and close turnouts and other diversion structures. Trash screens are often used to keep gates from clogging.

Getting water to the crops

Irrigation in Alberta is made possible through a complex infrastructure that diverts water from the province's streams and conveys it to the land. Water diverted from five major rivers and several smaller streams is stored in both on-stream and off-stream reservoirs, then conveyed to cultivated land and pastures through more than 7,500 kilometres of canals and pipelines.

In the St. Mary River Irrigation District (SMRID), for example, water is drawn from the Belly, Waterton and St. Mary rivers. Nine large and six small reservoirs store water for use during and beyond the crop growing season. The water is distributed through a grid of main and lateral canals and pipelines to 154,000 hectares of crops and to supply many thousands of livestock animals. In addition, the works of the SMRID convey water to several municipalities and industrial operations. Water for the Magrath, Raymond and Taber Irrigation Districts is also drawn from the St. Mary headworks and conveyance system.

The Oldman Reservoir, with a capacity of almost 500,000 cubic decametres of water, is the largest in the system. In contrast, Cavan Lake Reservoir, on Gros Ventre Creek, has a capacity of only 4,900 cubic decametres and supplies

ALBERTA'S IRRIGATION SYSTEM	Length of Distribution System	Land Under Irrigation (Assessed Hectares)
Irrigation Districts:		
Aetna	27 km	781
Bow River.	1,058 km	80,209
Eastern	1,784 km	111,267
Leavitt	56 km	1,862
Lethbridge Northern	650 km	49,526
Magrath	106 km	4,528
Mountain View	35 km	426
Raymond	247 km	13,055
Ross Creek	20 km	427
St. Mary River	1,719 km	138,712
Taber	364 km	31,110
United	227 km	6,992
Western	1,077 km	27,375
Private Licenses:	...	112,435
Total Assessed for Irrigation: 578,705 hectares		

Pipelines are rapidly replacing open irrigation canals in the irrigation districts.

water to 500 hectares of agricultural land in the Ross Creek Irrigation District near Medicine Hat.

Pine Coulee Reservoir, completed in 1999, has a capacity of more than 50,000 cubic decametres. It supplies water to 5,200 privately irrigated hectares and ensures a water supply for 4,500 area residents. The project features a diversion weir on Willow Creek which feeds water to an off-stream storage reservoir, reducing the potential for environmental impacts on the creek. During Willow Creek's low-flow periods, water from Pine Coulee Reservoir can also be diverted back to supplement creek flows.

The new Little Bow Reservoir is designed to reduce water diversions to the Little Bow River from the Highwood River during summer low-flow periods. The project ensures water supplies to existing privately irrigated land and makes irrigation available to an additional 8,000 hectares. It also secures municipal water supplies for the area's rural residents. A canal to Clear Lake from Mosquito Creek will stabilize water levels for a dozen nearby wetlands, improving recreational opportunities and wildlife habitat, while supporting private irrigation on another 1,500 hectares of agricultural land.

As has been noted, much of the system has undergone rehabilitation in the last few decades. Seepage has been almost eliminated through the lining of canals, and salinized and waterlogged lands have been reclaimed. Most of the irrigation districts have also initiated programs to replace open ditches with pipelines, reducing evaporation and seepage losses. Installation of underground pipelines allows the districts to expand their irrigated areas without using more water. Pipelines also make the water less susceptible to contamination, need less maintenance, and provide better water control. The water savings, reduced maintenance and opportunity to irrigate more land offsets the high capital investment of the work.

Canal bank slope and bed width designs have been standardized to lower maintenance costs and move water more effectively. Canals have also been aligned to facilitate more effective farm practices.

On-Farm Irrigation Systems

Improvements in on-farm irrigation equipment and management techniques in the last three decades have also led to increases in the irrigated land base and more sustainable agricultural practices. Water use efficiency — the ratio of the amount of water applied and retained within the active root zone to the total amount of water delivered into the on-farm irrigation system — has increased substantially.

The right choice of an on-farm water application system for a particular producer is based on topography, soil, the type of crops being grown, and the capital and labour available. Generally, surface or gravity flow irrigation is the least expensive to develop, averaging an investment of $750 to $900 per hectare. However, surface irrigation is more labour intensive to operate, has only low to moderate water application efficiencies, and may be more damaging to soils. Flooding a field can lead to salt build-up and the creation of waterlogged areas. It is also difficult to control the amount of water each part of a field receives when flooded. Thus, crops may be over or under-irrigated, reducing yields and sustainability. Surface irrigation is most efficient on levelled land, where slopes are moderate and controlled.

An average centre-pivot sprinkler installation costs about $1500-$1800 per hectare, but such sprinkler systems are far more water efficient and convenient. The amount of land under irrigation has more than doubled since their adoption. Surface irrigation, which remained the most common irrigation practice until about 1950, now accounts for less than 16% of all on-farm irrigation in Alberta. Fewer than 30% of irrigated farms use lateral-move or side-roll sprinkler systems and more than half now use centre pivot sprinkler systems.

Surge valves can reduce erosion, improve the overall efficiency of surface irrigation and substantially reduce the amount of water needed for optimal yields.

Surface irrigation

Surface irrigation uses gravity to get water from the canals to the crops. In early gravity-fed systems, the entire field was flooded, with water coming from a supply ditch, pipeline, or other source. In some cases, crops were planted in deeply furrowed rows and water was directed into the furrows.

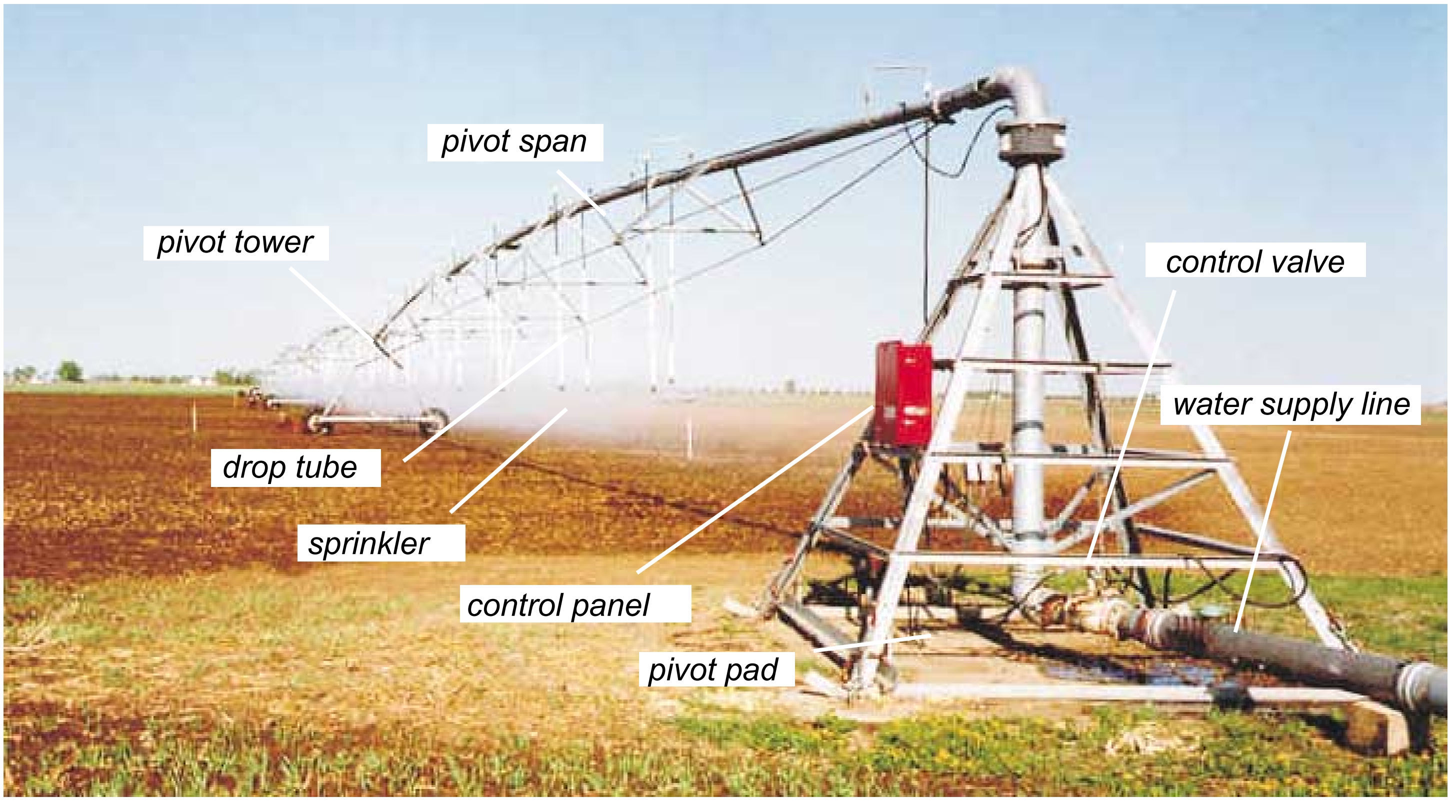
More modern approaches use gated pipe, surge valves and siphon tubes to reduce water use and runoff. Excess run-off water is channelled into tailwater dugouts, where it is pumped back to the field for re-use. The use of border dykes or levees to contain and control the flow of the water on the fields has greatly improved application efficiencies.

Surface irrigation is now used most often on smaller farms, or where lower-value crops are being irrigated. Where crops are grown in rows or beds, surface systems can apply the water directly into the furrows, keeping it off the fruit and leaves, and thereby reducing fungal growth.

Sprinkler systems

A typical sprinkler system in Alberta consists of a pump, a pipe to bring water to the field location (the mainline or supply line), pipes to distribute the water from the mainline to the sprinklers (laterals), and the sprinkler heads themselves. In many installations, the supply pipe is buried underground. In side-roll or lateral-move sprinkler systems, the lateral pipes act as an axle for a line of large wheels, which are moved across a field using a built-in engine and drive train. The laterals are stationery while irrigation takes place, and are then moved mechanically from set to set.

A typical on-farm pivot irrigation system



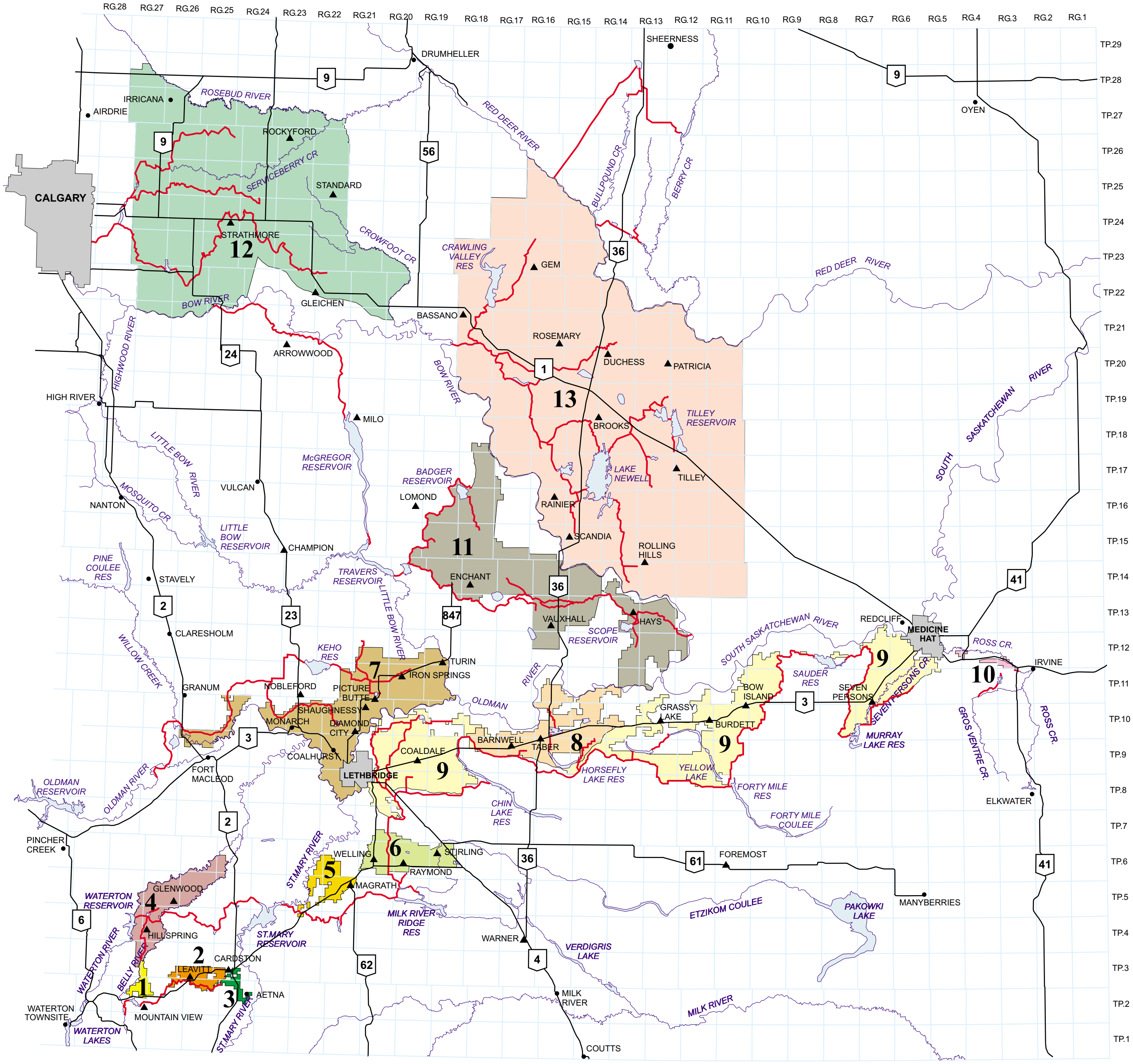
In centre-pivot sprinkler systems, the lateral is anchored to a pivot pad and rotates slowly on a swivel joint, creating a circle of irrigated crop. Centre pivots represent almost all new systems being purchased and can typically irrigate from 40 to more than 200 hectares, depending upon the lateral length. Where desired, a centre pivot system can be programmed to irrigate only a segment of a circular field. Rotation speed can also be slowed or increased to vary water application rates.

In-line pressure regulators can prevent over-watering as the topography of a field changes. For example, in low-lying areas of a field, regulators maintain constant pressure for consistent flow, compensating for the higher system pressure normally resulting from such variable terrain conditions. The systems can also be adapted with corner sections which rotate independently to more completely irrigate rectangular or odd-shaped fields. Such corner systems can increase the irrigated area under a centre pivot sprinkler by up to 15%.

Modern pumps and centre pivot systems offer considerable water and energy-saving opportunities, as well as water management flexibility to achieve optimum crop production. Pumping systems can deliver water to irrigate land at higher elevations than the canal source — land that was previously inaccessible to irrigation.

Drop tube sprinklers reduce evaporation losses by decreasing the distance between the sprinklers and the crop. They also allow for lower pressure operations that conserve energy inputs. Pump and pivot systems can be programmed to apply varying amounts of water, including fertilizers and pesticides, to different areas of a field, or to meet site-specific crop needs and soil conditions. They can also be automated to decrease labour demands. .

Modern irrigation pivot.



1 Mountain View Irrigation District
2 Leavitt Irrigation District
3 Aetna Irrigation District
4 United Irrigation District
5 Magrath Irrigation District
6 Raymond Irrigation District
7 Lethbridge Northern Irrigation District
8 Taber Irrigation District
9 St.Mary River Irrigation District
10 Ross Creek Irrigation District
11 Bow River Irrigation District
12 Western Irrigation District
13 Eastern Irrigation District

▲ Communities receiving irrigation water
● Communities not receiving irrigation water
— Headworks and major canals

Alberta's Irrigation Districts