

Alberta's Irrigation

A Strategy for the Future



Alberta's Irrigation – A Strategy for the Future

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Alberta Agriculture and Rural Development
Agriculture Centre
100, 5401 - 1 Avenue South
Lethbridge, Alberta T1J 4V6
(403) 381-5140

WEB SITE:

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1.0 Introduction

Alberta's agriculture industry, including primary production and value-added processing, is an integral contributor to the province's economic and social well-being. With the world's population expected to reach more than 9 billion by 2050, significant increases in food production will be required. In particular, the demand for high-quality foods, including meat, is increasing as developing world economies grow.

These demands will provide opportunities for Alberta's agriculture industry to become an even more important part of the provincial economy. Alberta is well-positioned to help meet the increasing food requirements and economically benefit from the changing global marketplace.

Alberta Agriculture and Rural Development's mission is to “provide the framework and services necessary for Alberta's agriculture and food sector to excel, to inspire public confidence in the quality and safety of food, and to lead the collaboration that enables resilient rural communities” (ARD 2014).

Strategic goals for Alberta Agriculture and Rural Development include (ARD 2014):

1. Alberta's agricultural industry is positioned for growth through access and development of new and existing markets;
2. Consumers have confidence and assurance that Alberta is an environmental steward and leader in farmed animal health and welfare, plant health, and safe food products;
3. Alberta's agriculture industry development initiatives maximize value and enable economic sustainability; and
4. Rural Alberta has the development opportunities necessary for ongoing economic success.

The department is committed to support these goals through policy development, research, extension, programs, and services that reinforce economic competitiveness and build lasting prosperity in Alberta's agriculture industry. The department delivers extension programs and services, research-based information, and innovative business tools to encourage industry adoption of beneficial practices. The department also continues to work on government initiatives and strategies and collaborates with key partners and stakeholders to implement key actions that contribute to Alberta's economic prosperity. The Canada-Alberta Growing Forward 2 Program is a key part of the department's effort to advance the agriculture industry in Alberta through a Federal/Provincial/Territorial policy framework that allows the continuation and/or creation of programs and services to support the agriculture industry to become more competitive in the market place, while adapting to environmental, social, and economic challenges for sustainable long-term growth and prosperity.



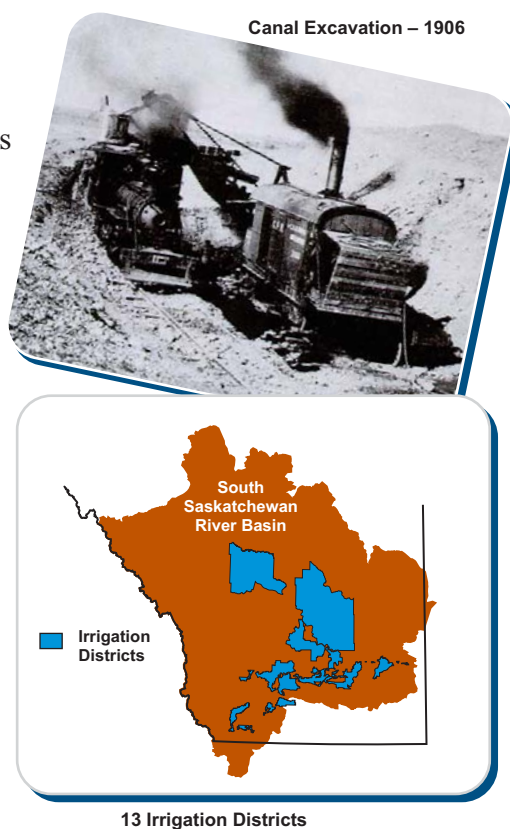
2.0 Alberta's Irrigation Industry

Alberta has developed a leading-edge dryland and irrigated agriculture industry. This partnership between dryland and irrigated agriculture provides opportunities for crop and livestock diversification and value-added processing, which provide a ready market for much of Alberta's primary agricultural production. Irrigation is practiced on about 680,000 hectares, which represents about 5 percent of Alberta's arable land base, and almost 70 percent of Canada's total irrigated area (ARD 2013). The irrigation industry produces 18 to 20 percent of the provincial agricultural gross domestic product. In addition, more than 30 percent of the province's value-added food processing returns are associated with Alberta's irrigation land base. The majority of Alberta's irrigation is located within the South Saskatchewan River Basin (Figure 1).

Irrigation in Alberta started in the 1890s, before Alberta became a province. Through innovation and leadership, irrigation steadily expanded to where almost 650,000 hectares (ARD 2013) or 15 percent of the South Saskatchewan Region's cultivated land base is currently irrigated. Water is supplied to irrigation producers by one of the 13 irrigation districts and through private licences. Irrigation infrastructure also provides water to processors, intensive livestock operations, about 50 towns and villages, wildlife habitat, and recreation facilities throughout the southern region.

The economic development resulting from a strong irrigation industry brings with it a number of challenges. Alberta's irrigation industry must adapt to rapidly changing circumstances related to availability, use, and management of water. This is a particular challenge in the South Saskatchewan Region, where competition and demand for good quality water are increasing as a result of population growth, economic development, and societal expectations on environment and health.

The Government of Alberta's decision to close the Bow, Oldman, and South Saskatchewan sub-basins in 2007 to applications for new water licences recognized that water supply is finite in this region, and it also identified the need to manage existing water supplies in the most effective and efficient way possible. The irrigation industry, as the largest consumer of water in Alberta, recognizes the importance of improving conservation, efficiency, and productivity of water use. The irrigation community is committed to meeting the Government of Alberta's Water for Life Strategy outcome of "ensuring that overall efficiency and productivity of water use in Alberta improves by 30 percent from 2005 levels by 2015" (GOA 2008). The irrigation industry also recognizes the value of providing water for the confined livestock industry and for the processing industries that can take advantage of the high-value irrigated crops grown in Alberta.



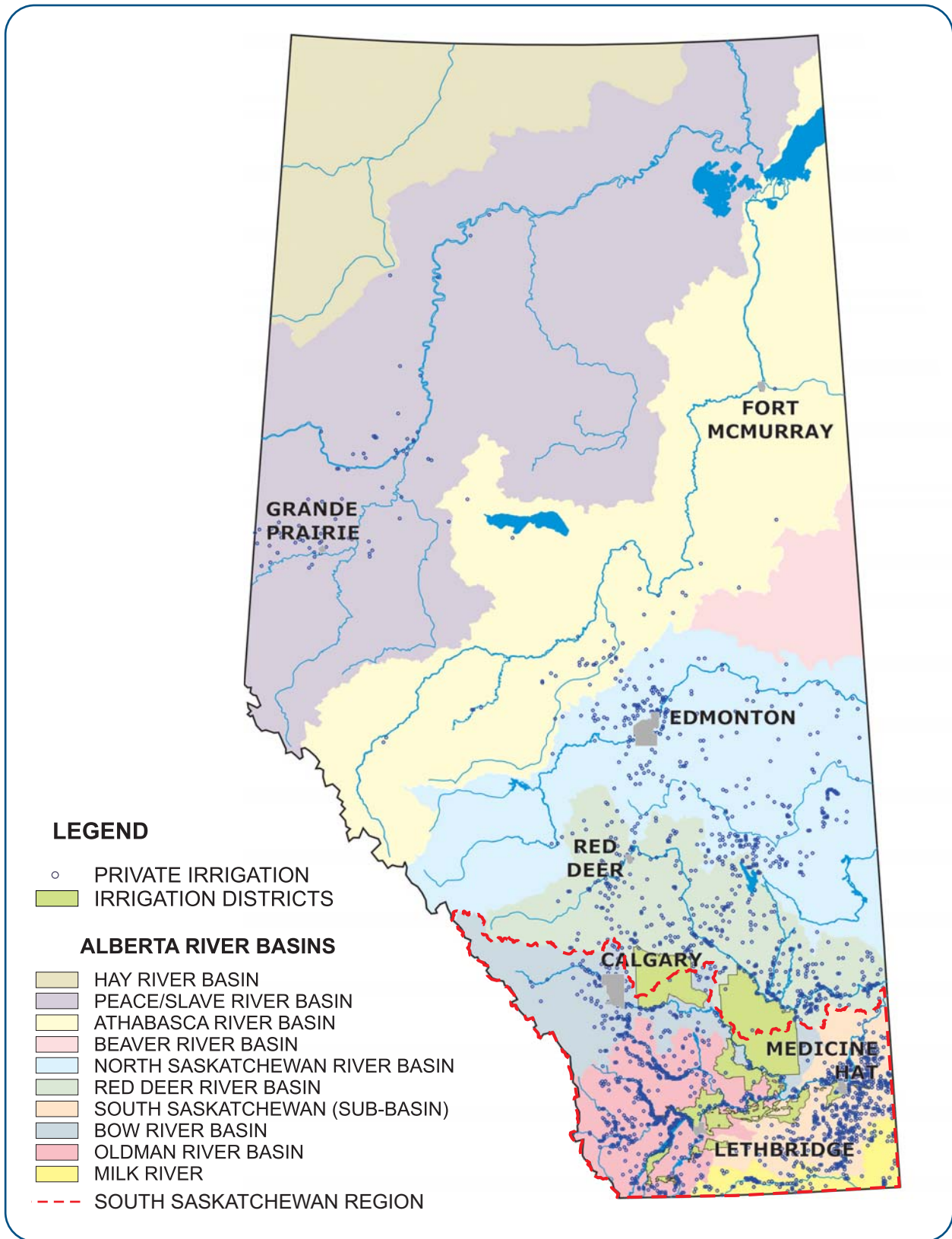


Figure 1. Irrigation Districts and Private Irrigation Projects in Alberta.

3.0 Strategies for the Future

Alberta's irrigation industry is a global leader in the efficient, productive, and sustainable use of water resources. The industry is committed to increasing its economic contribution in Alberta, while improving conservation, efficiency and productivity of water use, and promoting water supply options that will ensure long-term needs are met. Alberta Agriculture and Rural Development, through research, policies and programming, will continue to support the industry's ability to take advantage of enhanced economic opportunities, environmental stewardship, and contribute to vibrant rural communities.

Five key strategies reflect the department's blueprint for the future of the irrigation industry in Alberta.

1. **Productivity** – Increase the primary and value-added productivity of the water used by the irrigation industry.
2. **Efficiency** – Improve the efficiency of water conveyance and on-farm irrigation systems.
3. **Conservation** – Promote the effective use and management of water to ensure that only the water required for irrigation, and other uses supplied by irrigation infrastructure, is diverted from the rivers.
4. **Water Supply** – Assess management options for existing reservoirs and the potential for new reservoirs to enhance water security to meet future needs in the South Saskatchewan Region.
5. **Environmental Stewardship** – Manage the effects of irrigation on surface and ground water quality, and promote beneficial management practices for irrigation and handling of crops to ensure they are safe for consumption.

3.1 Productivity

Irrigation in Alberta allows for the production of a diverse range of cereal, oil seed, forage, and specialty crops. Irrigation has also made southern Alberta the world capital for seed canola production. The canola seed produced in southern Alberta is sold to producers for commercial canola production in North America and around the world.

Many of the high-value irrigated crops are processed into value-added products that are consumed nationally and exported throughout the world. Processing facilities provide employment and economic opportunities in the region. Forage and silage produced under irrigation are used to support the confined feeding industry, making the South Saskatchewan Region Canada's leader in cattle production and processing.

Cattle Feedlot



Meat Processing

Yields and quality of irrigated crops in Alberta have increased with time because of plant breeding programs, and research related to irrigation water management and agronomy. From 1980 to 2012 the irrigation productivity index has increased from about 4 kilograms of dry matter per cubic metre of water to about 11 kilograms of dry matter per cubic metre of water (Figure 2).

Alberta Agriculture and Rural Development works with the irrigation industry to promote the growth of a greater diversity of crops that can be processed in Alberta. Research and testing of new crop varieties are carried out in partnership with irrigation producers and processing companies to identify irrigated crops that are best suited for southern Alberta conditions.

Irrigation districts have amended their water licences to provide water for new agricultural processing industries that wish to operate in southern Alberta. Alberta Agriculture and Rural Development is working with the irrigation districts and other water suppliers to ensure that a sustainable supply of water is available and can be delivered to any potential food processing industry wishing to locate in Alberta.

Harvesting Sugar Beets



Irrigated Potato Production

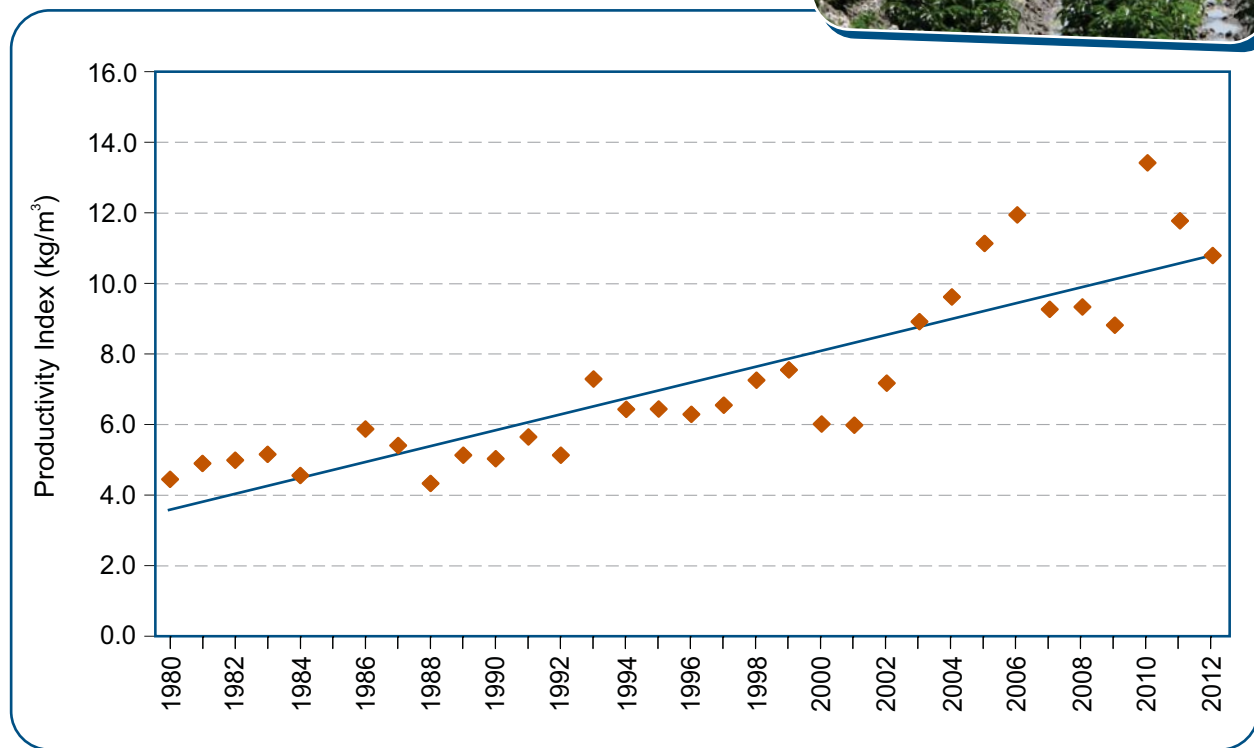
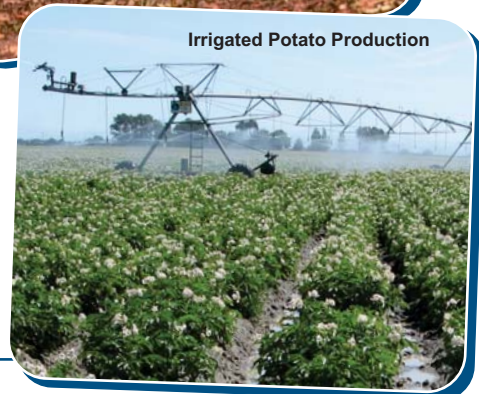


Figure 2. Irrigation Districts Water Use Productivity (1980 to 2012) (ARD 2013).

Future Strategies - Productivity

Alberta Agriculture and Rural Development will focus on four areas to increase the productivity of irrigation water for primary production and value-added processing.

1. **Primary Crop Production** – Focused research and demonstration programs will be implemented to further improve the productivity and quality of irrigated crops. Emerging technologies that provide more accurate and timely application of water, fertilizer, and pesticides will be developed and tested in partnership with irrigation producers.
2. **Value-Added Processing** – Working with economic development organizations such as SouthGrow and Lethbridge Economic Development, market research and promotion will be carried out in support of processing companies to locate within the irrigated areas of Alberta.
3. **Crop Diversification** – Continue to work with the irrigation industry to promote the production of a greater diversity of crops that can be processed in Alberta and shipped to world markets. Research and testing of new crop varieties will be carried out in partnership with irrigation producers and processing companies to identify crops that are best suited to succeed in Alberta.
4. **Water License Amendments** – Continue to work with irrigation districts to amend water licences and to provide timely water supplies that will encourage processing industries to locate in southern Alberta.

Strategy Target

1. **Irrigation Productivity** – The irrigation sector will exceed the 30 percent overall improvement in water-use efficiency and productivity outcome identified in the renewed Water for Life Strategy by 2015.

3.2 On-Farm Water Use Efficiency

A number of different irrigation application systems are used in southern Alberta, including gravity, wheel-roll sprinkler and pivot sprinkler systems. The introduction of sprinkler irrigation to Alberta in the late 1950s allowed producers to irrigate more efficiently and with less labor. This technology spurred a rapid increase in Alberta's irrigated acreage beginning in the 1970s (Figure 3). Ongoing advances in sprinkler irrigation technology resulted in significant improvements in on-farm irrigation efficiency, increasing from about 35 percent in 1965 to about 78 percent in 2012. (ARD 2011, 2013) This is considerably higher than the average world irrigation efficiency of about 43 percent.



Gravity Irrigation



Wheel-roll Irrigation

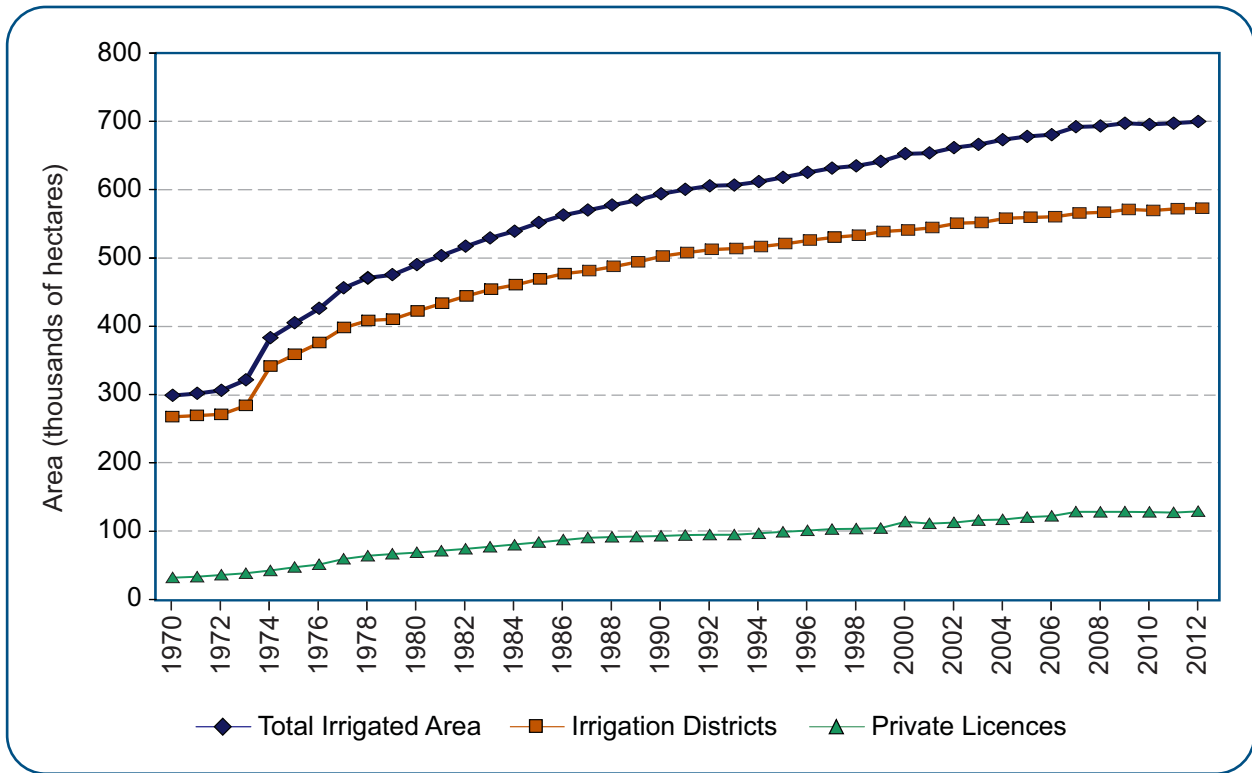


Figure 3. Growth in Irrigation in Alberta (1970 to 2012) (ARD 2013).

Pivots require less labour to operate, can be used to target specific amounts of irrigation to a field, and are better able to accommodate crop requirements throughout the growing season. The most common irrigation system currently used in the South Saskatchewan Region is the low-pressure, drop-tube pivot system (Figure 4), which is the most energy efficient, with a water application efficiency of about 84 percent. (ARD 2011)

In 2012, the replacement value of all on-farm irrigation systems in the 13 irrigation districts was about \$1 billion. From 1999 to 2012, irrigation producers invested \$375 million in improvements to on-farm irrigation infrastructure, with most investments going to purchase the most efficient low-pressure, drop-tube pivot systems (ARD 2013; Bennett et al. 2013). Improved on-farm irrigation technologies, such as higher efficiency sprinkler nozzles combined with best management practices, could increase irrigation application efficiencies from 78 percent in 2012 to at least 85 percent in the future.



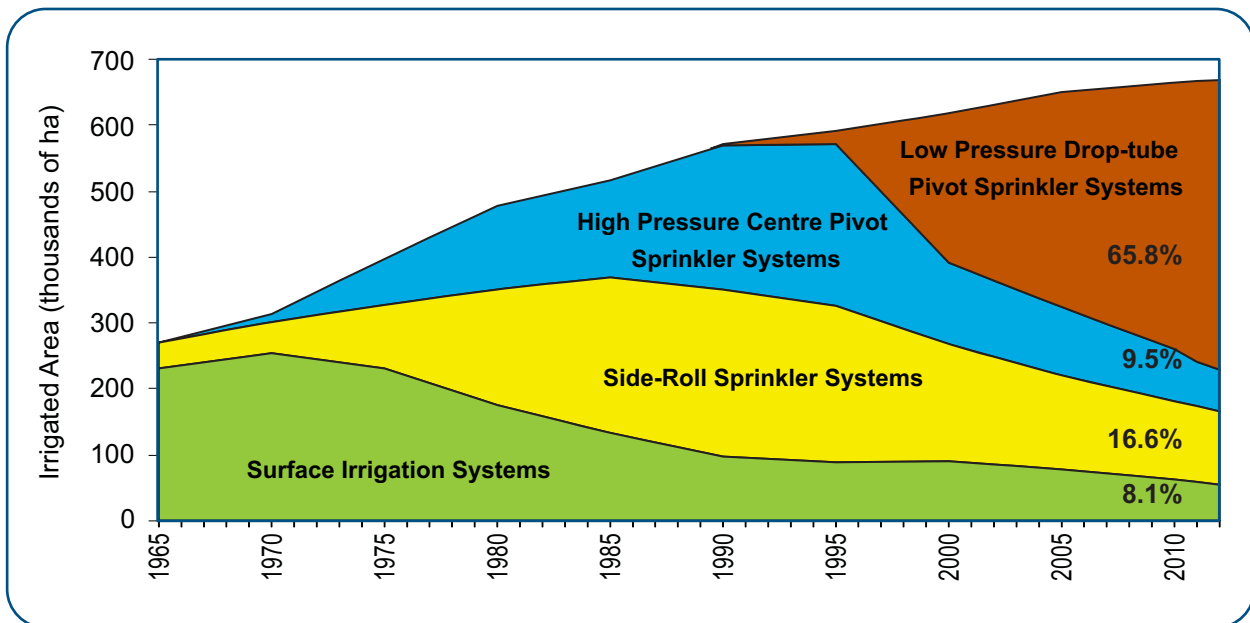


Figure 4. Irrigation Method Summary within the South Saskatchewan River Basin (1965 to 2012) (ARD 2013).

Future Strategies - On-Farm Water-use Efficiency

Alberta Agriculture and Rural Development will focus on two major program areas to increase on-farm irrigation efficiencies.

1. **On-Farm System Conversion** – Gravity, wheel-roll, and lower efficiency centre pivot irrigation systems are still used on about 180,000 hectares by irrigation producers within the 13 irrigation districts. Research and demonstration programs will be implemented to demonstrate the water and energy savings that producers can achieve by moving to low-pressure, drop-tube pivot irrigation systems or other high-efficiency systems. Incentive programs under the Canada-Alberta Growing Forward 2 Program will also promote change by producers to more efficient irrigation systems.
2. **Water Management** – Research and demonstration programs will be implemented to test new and emerging sprinkler and water management technologies that allow irrigation producers to more effectively apply irrigation water.

Strategy Target

1. **Irrigation Application Efficiency** – Average on-farm irrigation efficiency within the irrigation districts will increase from about 78 percent in 2012 to at least 85 percent by 2025 as a result of improved on-farm irrigation technologies and continued replacement of less efficient irrigation systems with low-pressure, drop-tube pivot systems.

3.3 Conservation

Alberta's irrigation industry provides potential for diversifying and adding value to the province's agricultural economy, but consumes the greatest amount of water in Alberta. Alberta has the potential to realize significant economic benefits from the increasing global demand for food, and the province's world-class irrigation industry can play a major part in that success. Alberta Agriculture and Rural Development and the irrigation industry recognize the need to promote technologies and practices that conserve water resources, and only divert the amount of water required for irrigation, municipal, industrial, environmental, and recreation use.

Alberta Agriculture and Rural Development and the irrigation industry work closely to assess current and future water supply requirements in light of climate change, improved crop genetics and agronomic practices, improved irrigation technologies, and the entrepreneurial vision of irrigation districts and producers. In 2012, 7,900 kilometres of canals and pipelines, worth an estimated \$3.5 billion, distribute water to the 555,000 hectares of irrigated land within the 13 irrigation districts (ARD 2013). Since 1969, Alberta Agriculture and Rural Development's Irrigation Rehabilitation Program has supported the transformation of the irrigation district water supply and distribution networks into one of the most efficient in North America. Of the approximately 7,900 kilometres of irrigation distribution infrastructure, about 49 percent are now in buried pipeline. Approximately 100 kilometres of pipe are currently being installed each year to replace open canals (Figure 5). The conversion of open canals to



Water Supply Canal

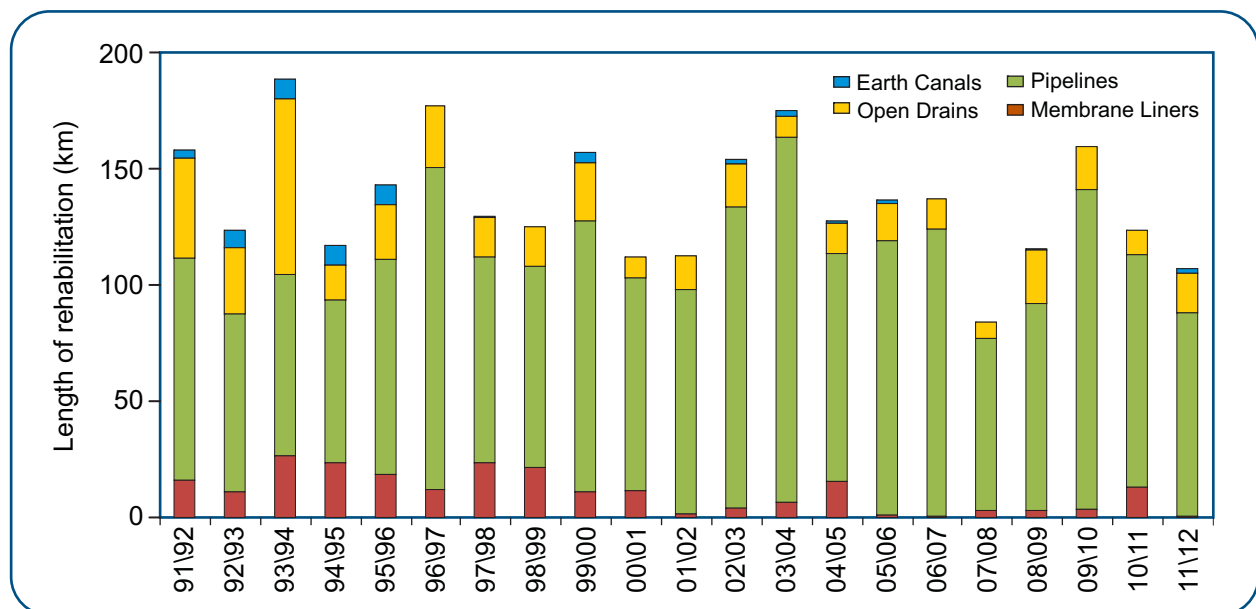


Figure 5. Length and Type of Rehabilitation Completed Under the Irrigation Rehabilitation Program (1991 to 2012) (ARD 2013).

pipelines resulted in reduced conveyance losses and enabled reclamation of saline and waterlogged land. Soil salinity and waterlogging were once significant problems in the irrigated areas, but have essentially been eliminated. As saline wetlands dry up, many irrigation districts have worked closely with Ducks Unlimited and other habitat conservation groups to create approximately 32,000 hectares of constructed prime wetland and upland habitat areas. It is estimated that all technically feasible open channel canals will be replaced with pipelines by 2035. In addition, beneficial management practices, such as membrane lining, gate automation, and spill management will improve efficiencies of open channel canals that are not technically feasible to convert into pipelines.

From 1999 to 2012, improvements to the irrigation conveyance infrastructure resulted in annual water savings of about 50 million cubic metres from canal seepage and evaporation. As a result of the improvements to canal distribution infrastructure and on-farm water-use efficiencies, the average annual depth of irrigation water diverted to irrigation districts has been reduced from more than 500 millimetres in 1991 to less than 400 millimetres in 2012 (Figure 6). This reduction is equivalent to about 200 million cubic metres of water annually that were not diverted for irrigation. This has allowed irrigation districts to expand while diverting less water (Figure 7).



Pipeline Installation

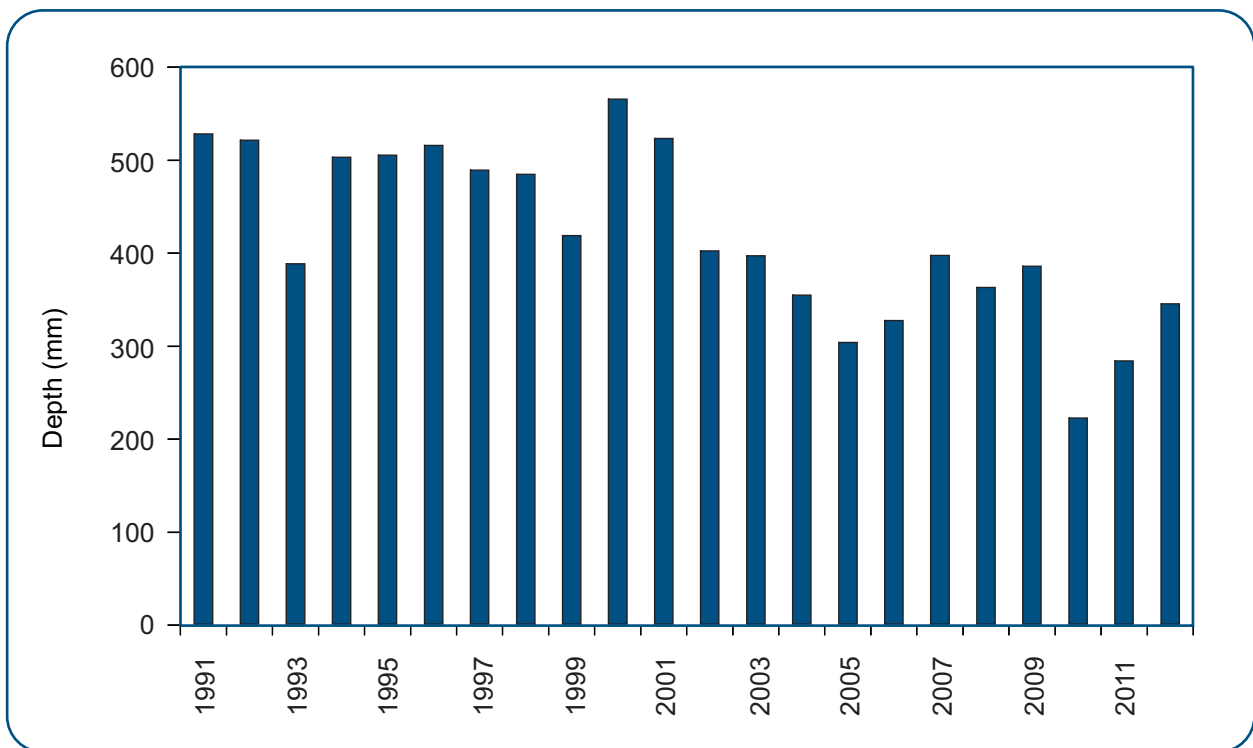


Figure 6. Average Depth of Irrigation Water Diversions (1991 to 2012) (ARD 2013).

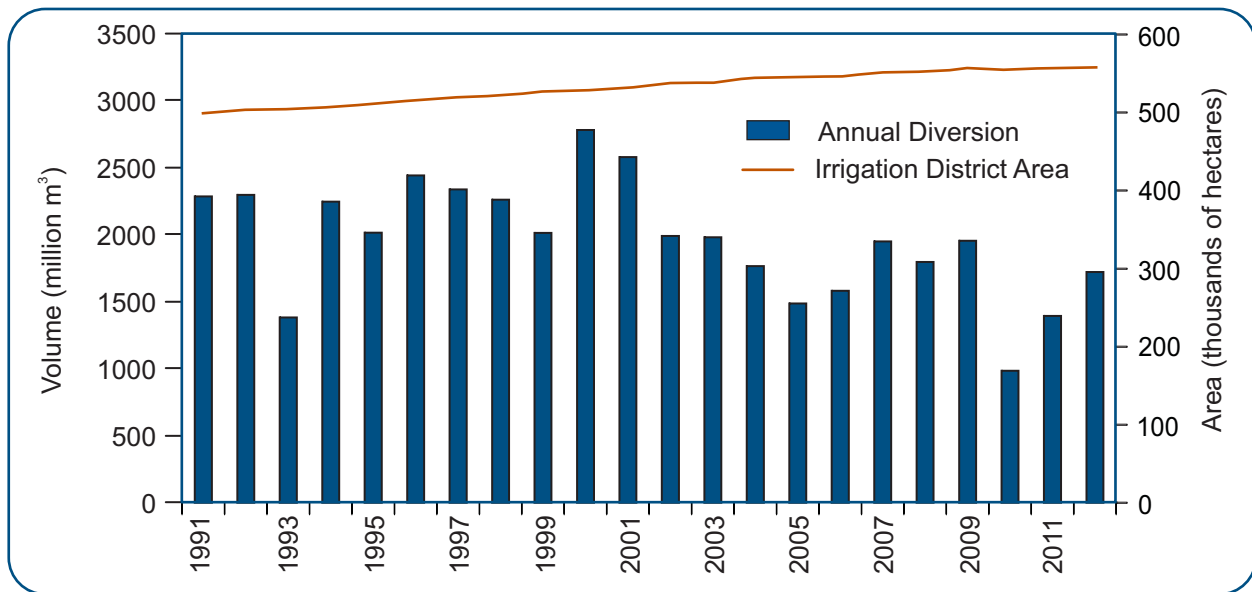


Figure 7. Increase in Irrigation District Area Compared to Annual Volume of Water Diverted by the Irrigation Districts (1991 to 2012) (ARD 2013).

Future Strategies - Conservation

Alberta Agriculture and Rural Development will focus on two areas that will minimize the volume of water that needs to be diverted from rivers to meet irrigation requirements.

1. **Irrigation Rehabilitation Program** – Continue to assess and develop management strategies under this valuable program to achieve the most effective and efficient water supply and distribution system possible. The future focus of this program will be on larger-scale pipeline systems that will allow irrigation districts to more effectively convert surface canals to buried pipeline systems, which will potentially reduce water and energy requirements for irrigation. In addition, beneficial management practices, such as membrane lining, gate automation, and spill management will improve efficiencies of open channel canals that are not technically feasible to convert into pipelines.
2. **Climate Change** – Assess future irrigated crop-water demands within changing climate scenarios to better understand how future precipitation and water supply from rivers may affect irrigation development.

Strategy Target

1. **Irrigation Distribution System Conversion** – All technically feasible open channel canals will be replaced with pipelines by 2035 to further reduce water conveyance losses. As a result, approximately 75 percent of the 7,900 kilometres of irrigation canals will be in pipelines and an additional 50 million cubic metres of water will be conserved annually.

3.4 Water Supply

Water supply in the South Saskatchewan Region is characterized by highly variable flows and frequent low flows. Combined with this natural variability are the potential effects of climate change, which are expected to result in less water in the southern region rivers and streams during the summer season. Capture and release of water runoff is critical in the management of water supply for nearly all uses in southern Alberta. There are currently about 50 on-stream and off-stream reservoirs in the South Saskatchewan Region, with a total storage capacity of about 3 billion cubic metres. Studies suggest that significant additional volumes of water could be stored and that new storage could reduce the risk to existing water users, the aquatic environment, and mitigate the effects of climate change.

Considerable leadership is being shown by all water users to increase conservation and efficiency of water use. However, population and industrial growth will result in increased demand for water from these sectors. To meet these needs, water licences could be transferred under the terms and conditions of the Water Act or they could provide water under agreement with an irrigation district. Most irrigation districts have amended their water licences to allow delivery of water for non-irrigation uses.

Approximately 96 million cubic metres of water can now be provided by irrigation districts to other users, including municipal, industrial, recreational, and wildlife habitat requirements from within existing allocations licensed to the irrigation districts. Any growth of the irrigation districts above the 555,000 hectares assessed for irrigation in 2012, will take place with water saved through gains in efficiency and conservation.

Improved management of existing reservoirs and development of additional water storage have been identified as potential solutions to offset future water shortages for the benefit of all users in the region. Work is being carried out in the Bow and Oldman River sub-basins to better assess these water management opportunities in order to delay or eliminate the need for new water storage reservoirs.



Oldman Reservoir



Manure Management



Irrigated Crop Production

Future Strategies - Water Supply

Alberta Agriculture and Rural Development will work with Environment and Sustainable Resource Development to balance irrigation requirements with the needs of the aquatic ecosystem and assess water storage alternatives that ensure adequate water is available to meet future demands within the South Saskatchewan River Basin.

1. **Reservoir Management** – Continue to work with Alberta Environment and Sustainable Resource Development, the irrigation community, and the University of Lethbridge to assess the potential to better manage on-stream reservoirs to enhance the health of aquatic and riparian ecosystems in the rivers.

2. **Water Storage** – Complete a water storage study to evaluate the opportunities and possible environmental effects of potential on-stream and off-stream water storage sites within the South Saskatchewan Region. The study will address the Water for Life Strategy goal of reliable, good quality water supplies for a sustainable economy, and will assess opportunities for additional storage to reduce the risk of water shortage to existing users, protect the aquatic environment, and mitigate effects due to climate change.

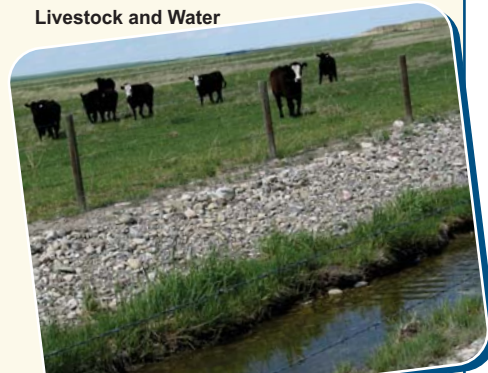
3. **Irrigation Expansion** – Work closely with the irrigation districts to develop technologies and systems that identify potential irrigation expansion above the 555,000 hectares assessed for irrigation in 2012, while balancing the needs of existing irrigation water users, other users, and the environment.

Strategy Target

1. **Irrigation Expansion** – As a result of improvements in irrigation water-use efficiencies, irrigation districts will expand by approximately 12% (70,000 hectares) by 2025.

2. **Water Storage** – A comprehensive study to assess potential water storage sites to improve water supply security within the South Saskatchewan Region will be completed by 2015.

Livestock and Water



Irrigation Canal



Irrigated Crop Production

3.5 Environmental Stewardship

Agriculture is practiced on about 20 million hectares of land in Alberta and represents a significant portion of the landscape in the settled areas of the province. In the 1980s, concerns began to emerge about the possible effects that the agricultural industry might be having on the quality of surface and ground water resources. Alberta Agriculture and Rural Development initiated extensive research and monitoring in the 1980s and 1990s that showed agricultural operations can negatively affect surface and ground water quality, particularly in areas where agricultural intensity is greatest. Since irrigation represents the most intensive agriculture in Alberta, there is special emphasis on water quality issues in irrigated areas.



Water Quality Monitoring

Excess nutrients, pesticides, and pathogens entering surface and ground water resources are of concern to the health of the aquatic ecosystem and food safety in areas where irrigation is practiced. Phosphorus loss from the land is a key concern for aquatic ecosystem health in surface water, including irrigation canals, streams, and rivers. Additionally, nitrogen leaching into shallow groundwater is a concern because of potential impacts on human health if the water is used as a drinking water source. Excess herbicides in irrigation water may reduce yields of sensitive irrigated crops and specific pathogens are a concern because of possible contamination of fresh produce grown under irrigated conditions. However, the vast majority of irrigated crops are not consumed raw and are either processed or fed to livestock.

The department works closely with the agriculture industry to accurately assess the specific causes of potential water resource contamination and to develop beneficial management practices that will minimize negative effects and ensure that food produced from irrigated crops continues to be safe for consumption. Alberta Agriculture and Rural Development is also working closely with Alberta Environment and Sustainable Resource Development to establish reasonable water quality guidelines for tributary streams and irrigation returns in support of the Cumulative Effects Management System that is being developed for the mainstem rivers.

Future Strategies - Environmental Stewardship

Alberta Agriculture and Rural Development will focus on six major areas that will minimize the effects of irrigated agriculture on surface and ground water quality and ensure that food produced from irrigated crops is safe for human consumption.

1. **Phosphorus Management** – Work with the agricultural industry to test beneficial management practices that are effective in maintaining or reducing phosphorus loading to rivers and can be practically implemented by agricultural producers. This strategy has been implemented in representative Alberta watersheds to demonstrate the type and magnitude of beneficial management practices required in a watershed to effectively maintain acceptable water quality.

2. **Safe Irrigated Crops** – Continue extensive monitoring of irrigation water quality within the irrigation districts to assess the quality of water being applied to crops. In addition, increase awareness among irrigation crop producers and the public about safe food handling practices to minimize potential impacts of pathogen contamination.

3. **Groundwater Quality** – Work with the intensive livestock industry to assess the effects of manure management practices on shallow groundwater quality and develop strategies to minimize these effects.

4. **Bacteria Source Tracking** – Develop technologies and assessment tools to identify the source of bacteria found in surface and ground water and develop targeted, practical mitigation solutions.

5. **Herbicide Effects** – Support research to determine the potential effects of herbicides in water on irrigated crop yield and the development of strategies to mitigate any adverse effects.

6. **Practice Change Incentives** – Through the Canada-Alberta Growing Forward 2 Program, provide incentives to agricultural producers to implement beneficial management practices that will minimize the adverse effects of agriculture on surface and ground water quality.



Water Quality Monitoring

Strategy Target

1. **Water Quality and Protection of Aquatic Environment** – Strategies to effectively manage nitrogen and phosphorus associated with confined feeding operations will be developed and implemented in selected Alberta watersheds by 2020.

2. **Groundwater Quality** – Complete an assessment of manure management effects on shallow groundwater quality and develop mitigation strategies by 2018.

3. **Water Quality and Food Safety** – A comprehensive assessment of irrigation water quality within the major irrigation districts will be completed by 2017. Develop the ability to identify the source (human, livestock, wildlife, environmental) of bacteria in surface and ground water to help in the implementation of effective mitigation practices by 2020.

4.0 Target Summary

Alberta Agriculture and Rural Development is developing strategies that will improve water conservation, productivity, efficiency and environmental sustainability of Alberta's irrigation agriculture industry.

Following are key targets that are expected to result from these strategies.

1. **Irrigation Productivity** – The irrigation sector will meet the 30 percent overall improvement in water-use efficiency and productivity outcome identified in the renewed Water for Life Strategy by 2015.
2. **Irrigation Application Efficiency** – Average on-farm irrigation efficiency within the irrigation districts will increase from about 78 percent in 2012 to at least 85 percent by 2025 as a result of improved on-farm irrigation technologies and continued replacement of less efficient irrigation systems with low-pressure, drop-tube pivot systems.
3. **Irrigation Distribution System Conversion** – All technically feasible open channel canals will be replaced with pipelines by 2035 to further reduce water conveyance losses. As a result, approximately 75 percent of the 7,900 kilometres of irrigation canals will be in pipelines and an additional 50 million cubic metres of water will be conserved annually.
4. **Irrigation Expansion** – As a result of improvements in irrigation water-use efficiencies, irrigation districts will expand by approximately 12% (70,000 hectares) by 2025.
5. **Water Storage** – A comprehensive study to assess potential water storage sites to improve water supply security within the South Saskatchewan Region will be completed by 2015.
6. **Water Quality and Protection of Aquatic Environment** – Strategies to effectively manage nitrogen and phosphorus associated with confined feeding operations will be developed and implemented in selected Alberta watersheds by 2020.
7. **Groundwater Quality** – Complete an assessment of manure management effects on shallow groundwater quality and develop mitigation strategies by 2018.
8. **Water Quality and Food Safety** – A comprehensive assessment of irrigation water quality within the major irrigation districts will be completed by 2017. Develop the ability to identify the source (human, livestock, wildlife, environmental) of bacteria in surface and ground water to help in the implementation of effective mitigation practices by 2020.

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