Irrigation Sector Interim Progress Report
To the Alberta Water Council
Re: Conservation, Efficiency, Productivity Plan
2005 – 2012

"The Water for Life Action Plan stresses the need to demonstrate best management practices in all sectors to 'ensure an improvement in overall efficiency and productivity of water use in Alberta by 30% by 2015, based on 2005 levels. Improvements will occur when water demand decreases or when efficiency and productivity increases'."[1]

As per Recommendation 1b) in the Alberta Water council report "Sector Planning for Water Conservation, Efficiency and Productivity," March 2013, the irrigation sector has prepared this interim progress report based on data as of December 31, 2012. This interim report covering the period 2005 – 2012 inclusive, describes progress made by irrigation districts on targets set out in the Irrigation Sector Conservation, Efficiency, Productivity Plan, 2005 – 2015. The irrigation season and crop year for 2013 is just ending, so the 2013 data set is not yet available.

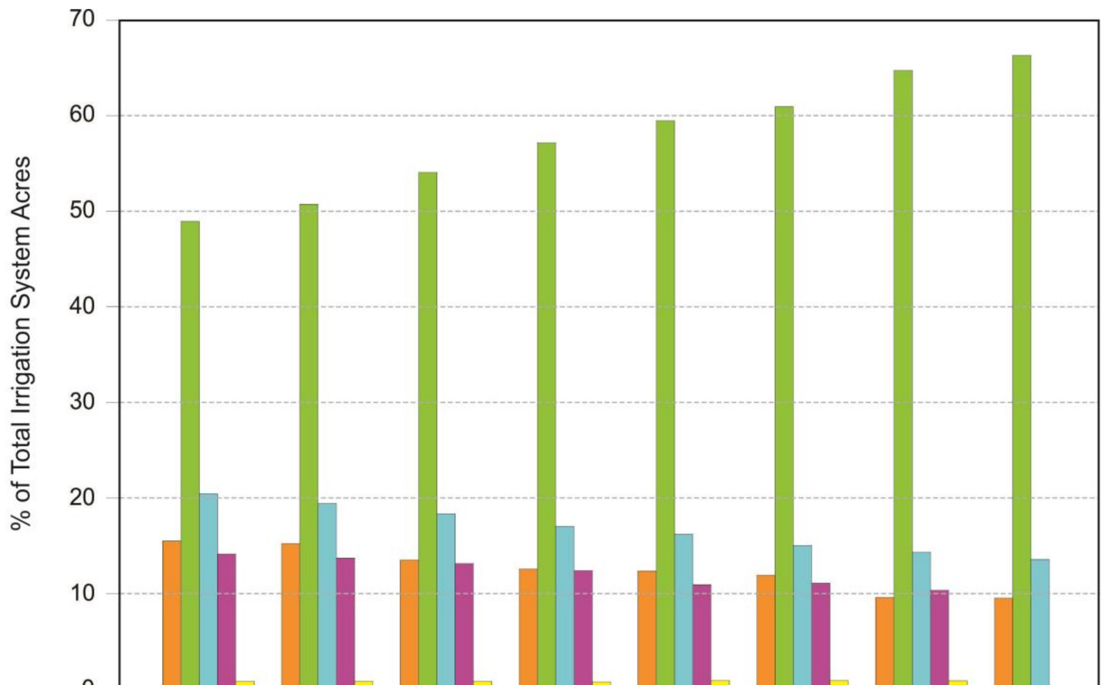
The first target in the Irrigation Sector CEP Plan, i.e., achieving the Water for Life Strategy goal of 30 per cent combined efficiency and productivity, will be discussed in this report after the other targets, as several are components of the 30 per cent goal.

Target 2. By the year 2015, 70% of irrigated lands in districts will be under best management practices, namely low pressure drop-tube centre pivots, an increase from the 47% documented in 2005.

Low-pressure drop-tube centre pivots (hereafter referred to as low pressure pivots) have the highest efficiency of any equipment that can economically irrigate the crops grown in Alberta. They are the current best management practice for irrigation given the crop mix and extent of land under irrigation in the Province. Applying water with a low pressure pivot results in 1) much less water lost to evaporation in the air and from the crop canopy than when irrigation water is applied using a high pressure system, and 2) less runoff and deep percolation below the rootzone than when using flood irrigation or wheel moves.

Wind speed and relative humidity are important factors in evaporative losses. For example, due largely to high winds in their area, scientists at one agricultural experimental station in Texas give the design efficiency for high pressure pivots in their area as only 60 per cent. Alberta Agriculture has listed design efficiencies as 84 per cent for low pressure pivots, 73 per cent for high pressure pivots, 69 per cent for wheel-moves, and 62 per cent for developed gravity (flood) irrigation systems. Much of the losses in gravity systems are due to poor uniformity of application and water running off the end of the field. Little to no water runs off fields irrigated with a pivot, unless a heavy rainfall and/or excessive slopes are involved. Research has found that the vast majority of pivot irrigators in Alberta do not apply enough water to maximize yields, i.e., they do not over-irrigate so deep percolation and runoff are negligible.

Figure 1 shows that the acreage irrigated with low pressure pivots in Alberta has increased to include 65.8% of the irrigated area. Through the “Growing Forward” program, Alberta Agriculture and Rural Development has reintroduced an incentive program for farmers to replace less efficient equipment with low pressure pivots. The incentive is $5,000 toward the cost of a pivot, which is typically $100,000. We are on-target to meet our goal of 70% by 2015, but it will be close. The added incentive through the Growing Forward Program, district incentives, and the drive for energy efficiency and water uniformity will continue to promote adoption of this best management technology.



		2005	2006	2007	2008	2009	2010	2011	2012
High Pressure Pivot	Acres	201,601	198,011	176,421	164,072	160,665	156,784	126,864	126,430
Low Pressure Pivot		635,880	660,168	705,260	747,187	773,538	802,173	856,707	879,651
Wheelmove		265,897	252,831	239,140	222,247	210,606	198,043	189,410	179,837
Gravity		183,811	178,411	171,487	162,063	141,885	145,879	136,709	126,217
Other		10,600	10,579	10,380	9,870	11,935	11,826	11,626	12,444

Figure 1. Acreage under the main on-farm irrigation systems in Alberta, 2005-2012.

Target 3. On a ten-year rolling average, the irrigation districts will keep diversions at or below the year 2005 reference benchmark of 2.186 billion m^3 per year.

This is a key conservation target which indicates how much water remains in the rivers that could otherwise be legally diverted. The volume of district licences total 3.45 billion m^3 of water. Figure 2 shows that the 10-yr running average diversion rate has declined from the 2.186 billion m^3 in 2005 to approximately 1.7 billion m^3 in 2012, i.e., roughly 0.5 billion m^3 more water stayed in rivers. Target No. 3 has not only been met, but has been exceeded. Figure 3, showing the average precipitation at three key points in the irrigated region, illustrates that this downward trend in diversion is not a response to rainfall patterns. For information purposes, Figure 4 shows a water balance for the districts in 2012 (not a 10-year running average).

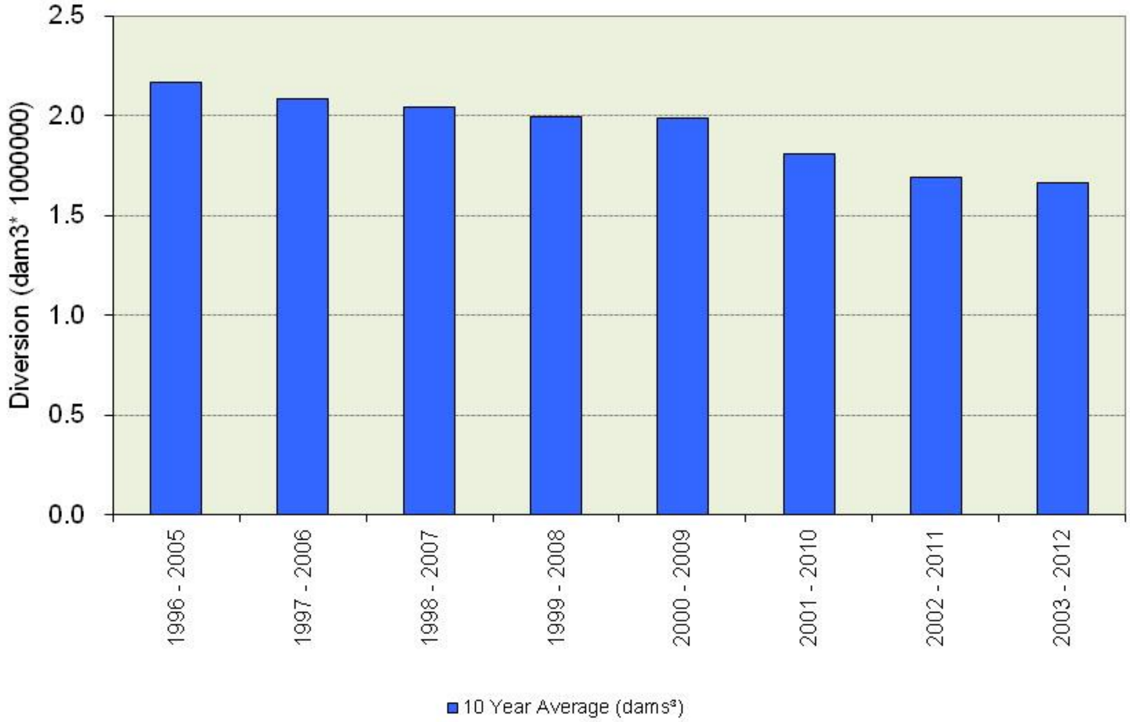


Figure 2. Diversion rate (Billion m^3 or dam^3 x 1 million; 10-year running average) for irrigation in districts.

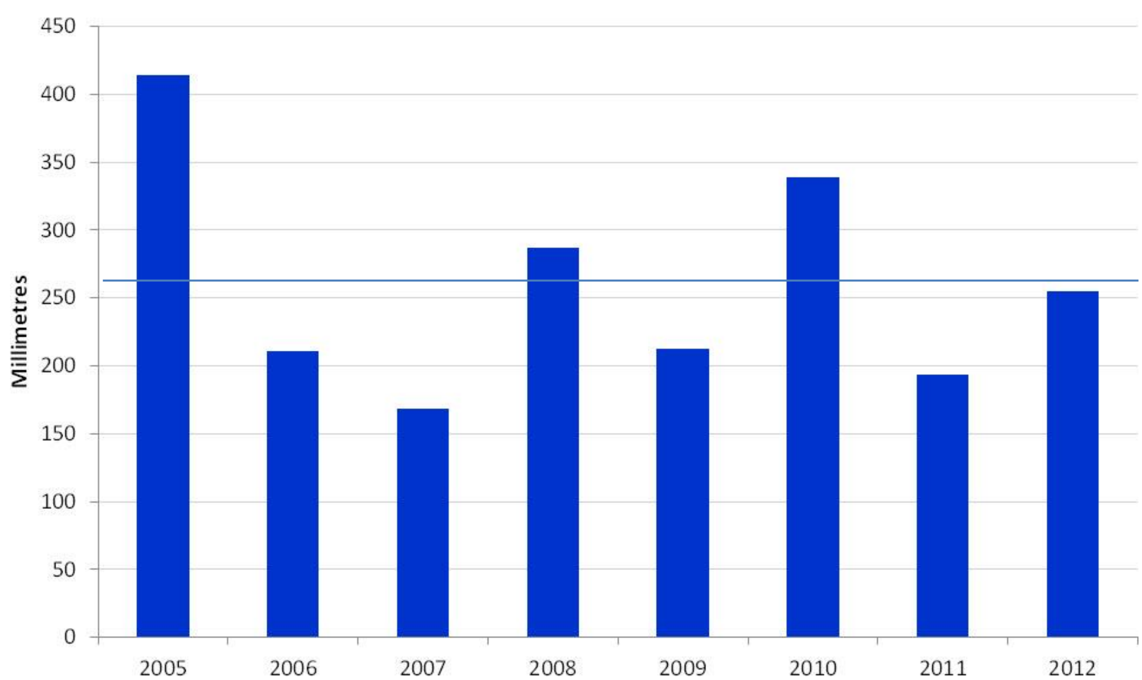


Figure 3. Growing season precipitation (mm) received in the irrigated region of Alberta, (average of Brooks, Bow Island and Lethbridge). The horizontal line is mean precipitation 1970-2012, i.e. 258 mm.

Water Balance Category	OLDMAN RIVER BASIN	BOW RIVER BASIN	IRRIGATION DISTRICTS
Gross Diversion	690,000	707,100	1,397,100
Storage	10,600	(2,700)	7,900
TOTAL DISTRICT USE	**700,600**	**704,400**	**1,405,000**
Delivered for Irrigation	502,800	427,600	930,400
Other Use	22,600	54,000	76,600
Canal & Reservoir Seepage	14,300	16,000	30,300
Canal & Reservoir Evaporation	54,500	71,300	125,800
Return	106,400	135,500	241,900
TOTAL DISTRICT OPERATIONS	**700,600**	**704,400**	**1,405,000**

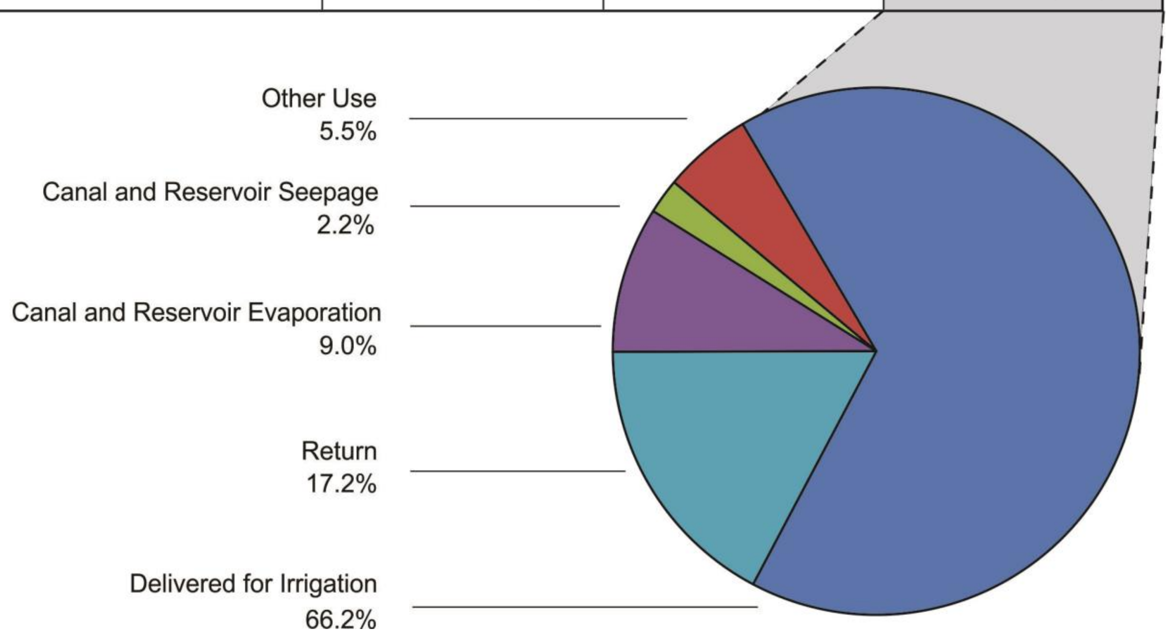


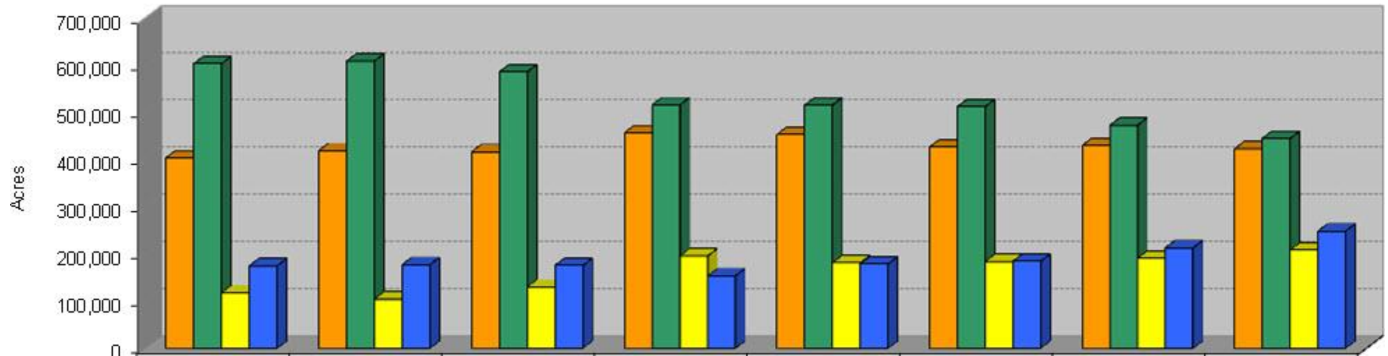
Figure 4. Water balance for irrigation districts in Alberta, 2012. (Units are ac-ft. Times by 1233 to convert to m^3).

The reduction in the diversion rate is the result of a number of factors:

a) The changeover to low pressure pivots with the resulting reduced evaporation and other losses,
b) The replacement of smaller canals (laterals) with pipelines, saving losses from evaporation, seepage and water use by plants along the laterals,
c) The lining of major canals so they do not seep,
d) Installation of automatic flow monitoring and control equipment to better control of flows to and within irrigation districts, and
e) The growing of crops that require less water, particularly replacing forages with oilseeds.

Photos of high pressure wheel move, low pressure pivot on beans, low pressure pattern on canola crop, pipeline delivery to pivot, small open ditch lateral, pipeline installation.

Figure 5 shows the reduction in forages and the increase in oilseeds and specialty crops.



	2005	2006	2007	2008	2009	2010	2011	2012
Cereals	403,826	419,112	416,594	456,907	453,637	426,825	429,805	423,112
Forages	603,520	608,972	585,966	516,321	515,957	512,310	473,073	444,967
Oil Seeds	118,181	104,359	129,990	195,962	181,309	183,895	191,154	208,167
Specialty	175,127	177,486	175,669	153,962	179,008	184,500	213,149	248,461

Figure 5. Crop area (acres) based on four crop categories

Forages require 150 to 200 mm more water than do many of the oilseed and specialty crops for optimum growth so water savings through this shift to more water-efficient crops may save upwards of 0.1 billion m^3 per annum.

With improved on-farm technologies and a switch to more pipelines instead of open ditches, increased automation in the canal and pipeline delivery system, and more water efficient crops, accumulated effects have resulted in a very noticeable decline in diversions.

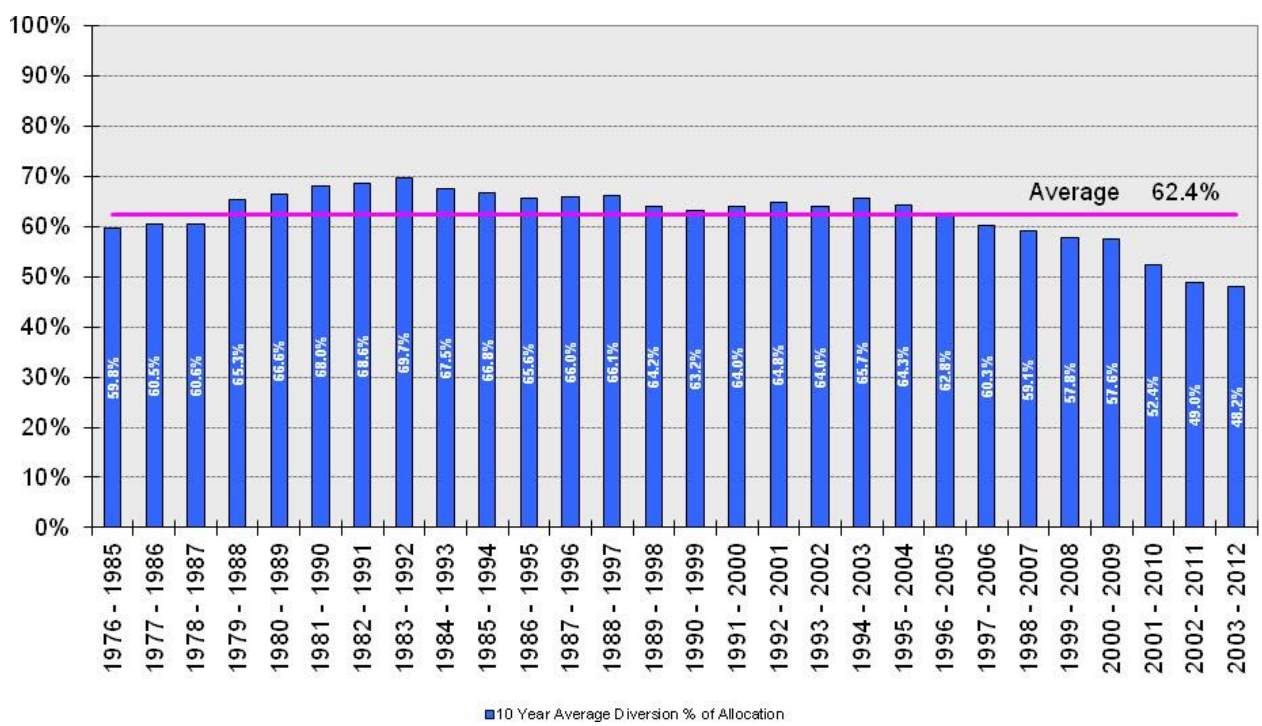


Figure 6. Historical diversion rate to districts (% of licenced volume, 10-year running average).

Target 4. Within regulations and utilizing water conserved through efficiency gains anticipated through these CEP efforts in the irrigation system, the irrigation sector will make additional water available for other uses such as food processing, environmental objectives, rural water networks, agribusiness, and other water sharing.

Irrigation District	Other Purposes* (ac-ft)	Total Licensed Volume (ac-ft)
AID	700	9,000
BRID	2,380	450,000
EID	5,000	762,000
LID	1,000	12,000
LNID	39,068	334,450
MID	740	34,000
MVID	n/a	8,000
RCID	n/a	3,000
RID	4,500	81,000
SMRID	12,000	722,000
TID	8,000	158,000
UID	1,000	66,210
WID	3,500	158,400
Total	**77,888**	**2,798,060**

Table 1. Amount of water from district licenses assigned to other purposes.

Irrigation districts were created to supply water to communities, farm households, livestock operations, and industry as well as to crops. In collaboration with Ducks Unlimited and other conservation agencies over the past 75 years, districts have helped create and supply water to 33,000 ha of wetlands and other habitat projects. In recent years, certain districts have also supplied water to rural water co-ops. Nowadays, in order to supply water to other users, districts must use licence purpose amendments and/or water licence transfers. Water allocated to “Other Purposes” now amounts to 2.8 per cent of the districts’ licenced volume. Districts are a vital source of water in rural areas, and supply water to 40 communities, several major rural water co-ops, and a multiplicity of livestock operations, habitat projects, plus some agri-business.

Target 5. Growth in irrigation districts will occur using saved water.

In 2005 the assessment rolls of the thirteen irrigation districts amounted to 1,342,473 acres. In 2012, the assessment rolls totaled 1,371,930 acres or a growth of 29,457 acres as per Figure 7. This growth of 2.2% has been accommodated through the saving of water as a result of efficiency improvements. To date, Target 5 has been met.

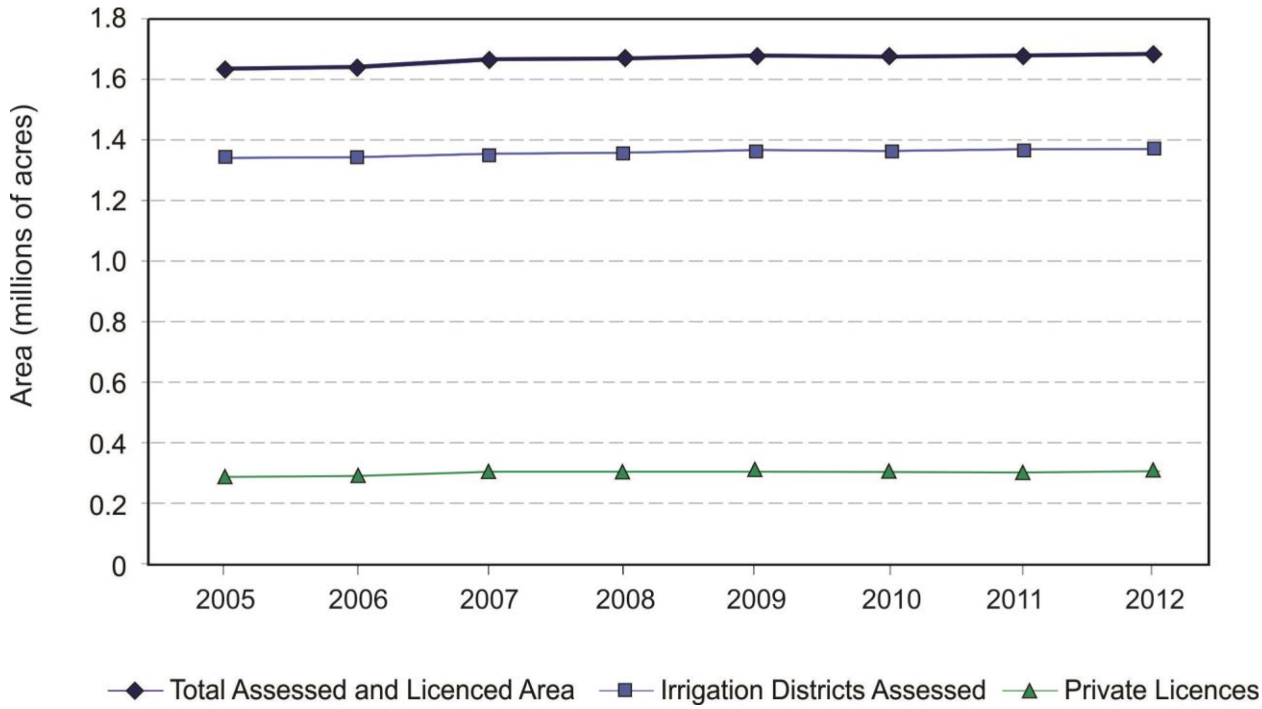


Figure 7: Growth in district assessment rolls (area of irrigated land), 2005-2012.

Target 6. On a ten-year rolling average through 2015, irrigation districts will reduce the volume of water diverted from Alberta's rivers, lakes and streams per unit of irrigated area to a level below the 2005 benchmark of 441 mm; and

Target 7. The irrigation sector will achieve a 15% increase in efficiency, relative to 2005 levels, by the end of 2015.

In Figure 8, it is easy to see that Target 6 has been achieved. With water-saving enhancements to the delivery system and on-farm irrigation systems, plus changes in crop mix, the diversion per unit of irrigated land has declined quite sharply. This decline is greater than anticipated by the districts during the development of this target.

Water diversion per unit of irrigated land is a significant measure of efficiency gains, accumulating all factors into one easy-to-view number. Using this number as an indicator of overall efficiency, the gain in efficiency from 2005 through 2012 has been 22 per cent.

In the future, the rate of decline in diversion will flatten out as the more-easily achieved efficiency gains will already be achieved and as the level of diversion per unit of land needed to supply optimum crop growth is approached. Crops need a certain amount of water to grow and to produce optimum yields. Both quantity and quality of crop production are water-dependent. A series of drier-than-normal years could also cause a temporary increase the diversion depth per unit area.

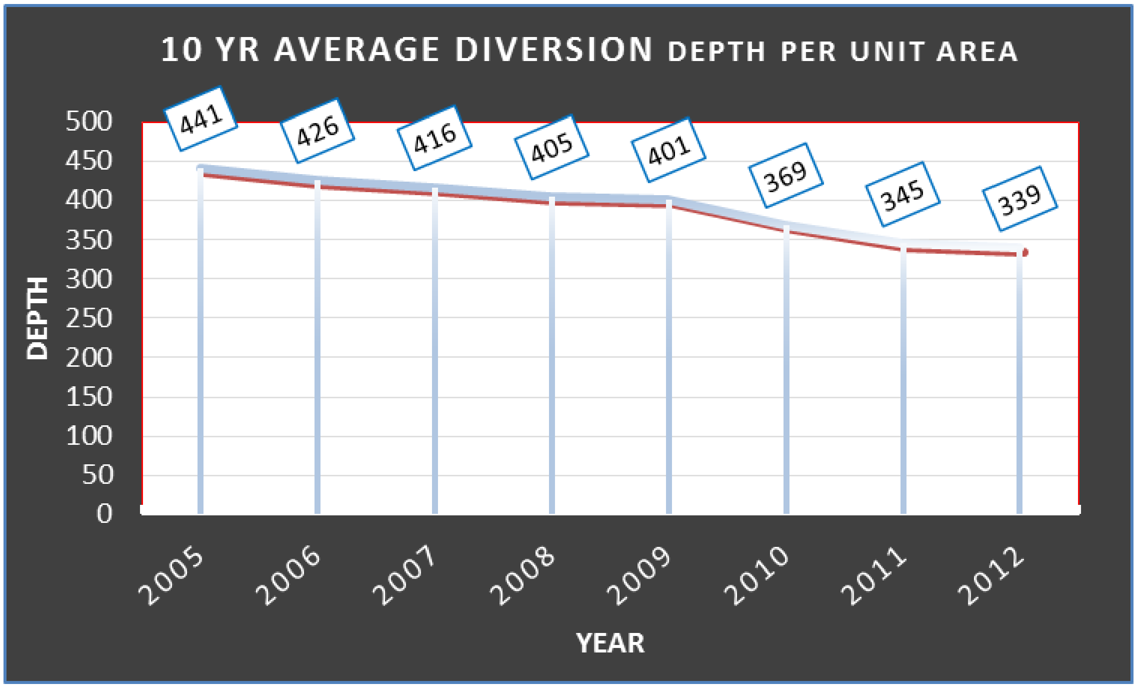


Figure 8. Depth of water (mm) applied per unit of irrigated land, 2005-2012.

Other efficiency gain indicators include the amount of irrigation infrastructure rehabilitated. A major effort in this regards continues in the districts by replacing earthen ditches with pipelines, effectively eliminating losses from evaporation, seepage, and water-use by ditch-bank plants. Where canals are too large to put into pipes, they are lined to eliminate seepage. Figure 9 shows the number of kilometres of infrastructure rehabilitated as of 2005 and the increase over the 2005-2012 period. Nearly 1,000 km of infrastructure has been enhanced in that time frame, the vast majority being the installation of pipelines, at a rate of over 100 kilometres per year.

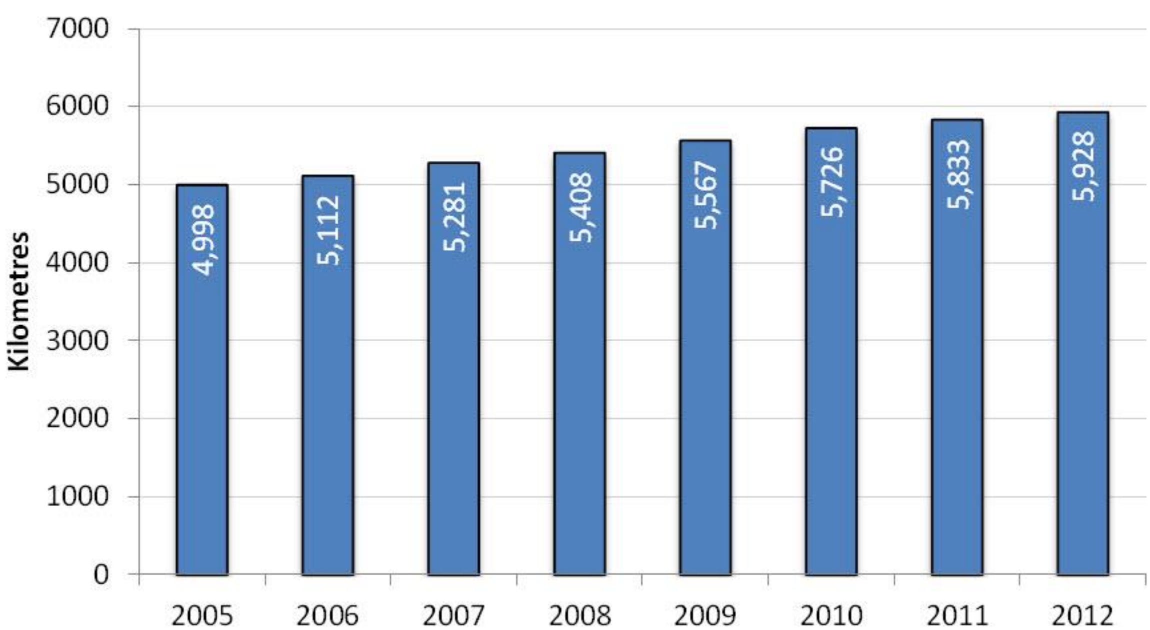


Figure 9. Length of delivery system, canals and laterals, that have been replaced with pipe or lined.

Target 8. The irrigation sector will increase its productivity by 15% from the reference yield of 2005, based on the indicator crops of sugar beets, potatoes, and soft white wheat.

Yield per unit area, divided by the volume of irrigation water diverted per unit area provides a measure of productivity, or a productivity index, namely the number of kilograms of agricultural product produced per cubic metre of water diverted. The following chart shows the productivity index of three irrigated crops, for which long-term data are available. These three crops, potato, sugar beet, and soft white wheat, are historic indicators of productivity for the irrigation industry. The on-farm yield data are courtesy of the respective commodity associations.

Variability in yield is evident in the chart and is the result of a multitude of factors such as precipitation, hours of bright sunshine, wind speed and erosion of seedlings, crop variety, seeding dates, amount and timing of irrigation water and fertilizer applied, pest abundance and control, and harvest conditions. A best fit line was calculated for the data to show the trend. The slope of the regression line is 0.22 kg/m^3 per year. Over the period of 2005 through 2012, there is a great deal of fluctuation in yields, but using the regression line as an indicator, productivity has increased more than 17% over that time frame. Using 10-year running averages, the productivity index for the 1980s was 4.9; during the 1990s it was 6.4; during the first decade of the new millennium, 8.8; and for the years 2003 through 2012, 10.5.

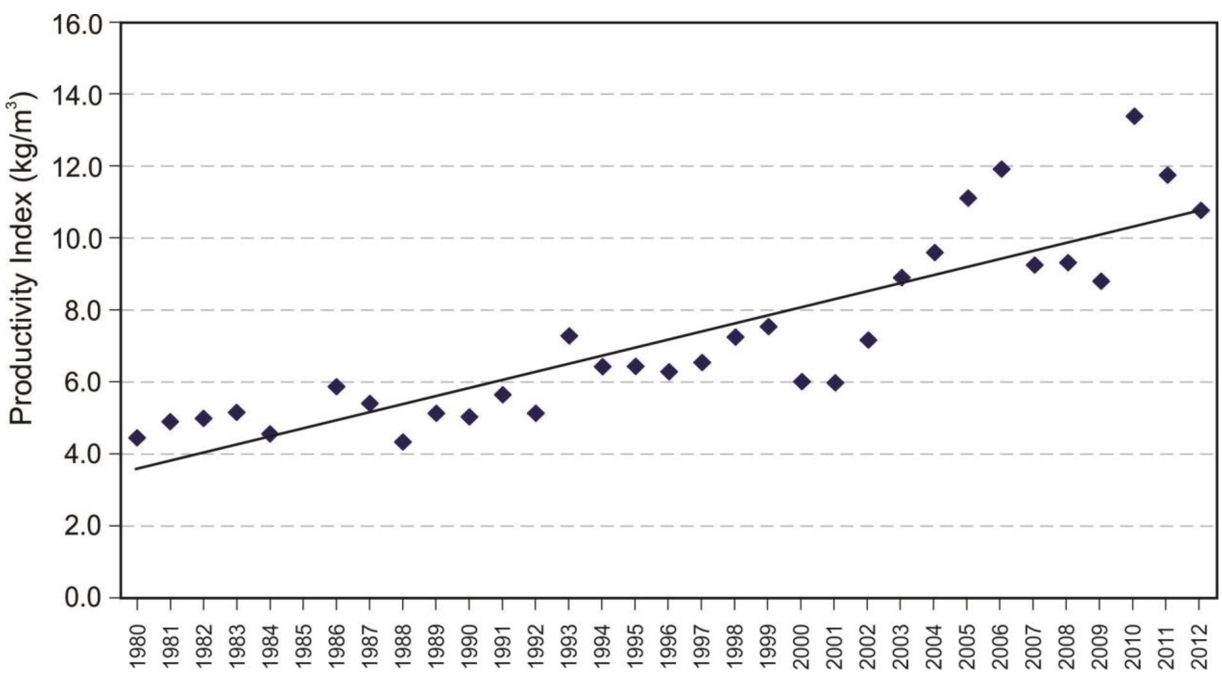


Figure 10. Productivity index (kg/m^3) sugar beet, potato, and soft white wheat in the irrigation districts.

Target 1. The irrigation sector will achieve a 30% increase in combined Conservation, Efficiency and Productivity from 2005 through 2015.

Adding the 22 per cent efficiency gain and the 17 per cent productivity gain shows a total CEP gain of 39 per cent, which exceeds the 30% target. CEP efforts will continue in the irrigation sector to continually enhance productivity and efficiency in the irrigation sector.

Work with Other Stakeholders

Members of the AIPA collaborate with a number of other stakeholders on important water issues.

a) To enhance and restore riparian vegetation in the Waterton and Oldman River valleys, the University of Lethbridge, Alberta Environment and Sustainable Resource Development, Alberta Agriculture and Rural Development, and members of AIPA have worked together to release water into the river systems to ensure establishment of cottonwood seedlings by slowing down the river recession rate to that needed for seedling establishment.
b) AIPA members participate on the Boards of the Oldman Watershed Council, the Southeast Watershed Alliance, and the Bow River Basin Council.
c) Alberta Agriculture and Rural Development and AIPA members are collaborating on a five-year water quality study in and around irrigation districts to determine whether the quality of water being received by irrigation districts meets water quality guidelines and to what degree irrigated agriculture impacts water quality of local rivers.
d) The University of Saskatchewan, Alberta Agriculture and Rural Development, and AIPA members are collaborating in a study of the impact of manure, in feedlots and applied to land, on groundwater quality, particularly on the nitrate content of the groundwater.
e) Members of AIPA have made a commitment to supply water to communities prior to supplying water for irrigating crops in the situation of a drought.
f) Members of AIPA participated in the modeling of the Bow River and are now participating in the modeling of the South Saskatchewan River Basin to discover ways to enhance aquatic ecosystems and meet social and economic needs.
g) Members of AIPA are participating as committee team members in the Phosphorus Management of the Bow River project headed up by Alberta Environment and Sustainable Resource Development.
h) An AIPA member has participated on Alberta Environment and Sustainable Resource Development's Wetland Policy stakeholder committee.

Acknowledgement: Charts in this report were prepared by Bob Winter and Bonnie Hoffer of the Basin Management Branch of Alberta Agriculture and Rural Development, and by Laurie Gallup of the Bow River Irrigation District from data collected/submitted by the member districts of AIPA and by Basin Management Branch staff monitoring the Irrigation Rehabilitation Program. These charts add a great deal to the visualization of the data reported herein and are very much appreciated.

References:
[1] (page 28 of "Sector Planning for Water Conservation, Efficiency and Productivity" Alberta Water Council, March 2013.)