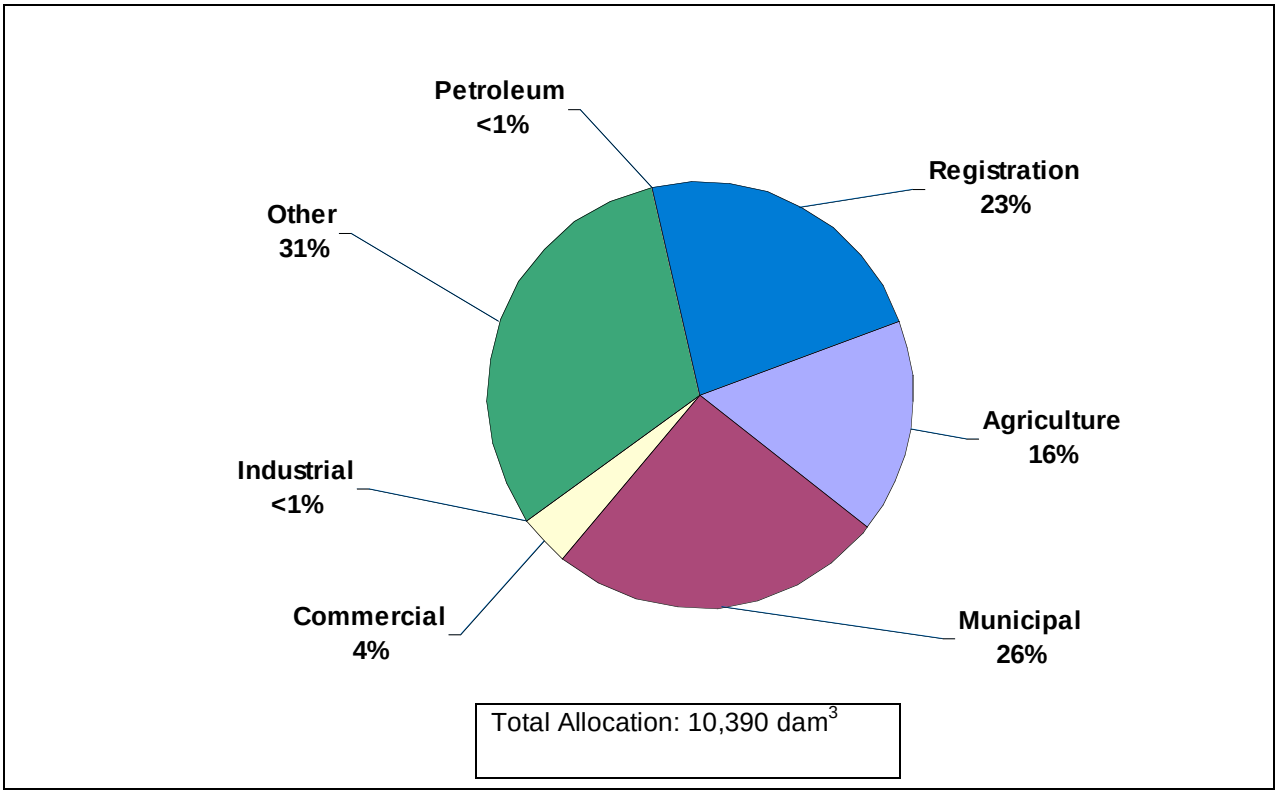
12.0 VERMILION

The Vermilion Sub-basin is about 7,860 km^2 in area and occupies approximately 14 percent of the North Saskatchewan Basin. In 2005, the sub-basin had a population of about 25,200 people, which represents just over 2 percent of the Basin population, with a population density of about 3.2 people per square kilometer. The Vermilion Sub-basin consists all or parts of 13 urban municipalities and eight rural municipalities.

An overview of current surface and groundwater allocations is provided in Figure 12-1. It shows that the agriculture sector (including registrations) accounts for 39 percent of total allocations or 4,060 dam^3. The other sector accounts for 31 percent of total allocation or 3,252 dam^3 while the municipal sector accounts for 26 percent of total allocation or 2,659 dam^3. The remaining allocations are for commercial, petroleum and industrial sectors. Total allocations in the sub-basin in 2005 were 10,390 dam^3, of which allocations of groundwater (5008 dam^3) accounted for 48 percent.

Figure 12-1 Distribution of Active Water Allocations in the Vermillion Sub-basin



Figures 12-2 and 12-3 show the location, allocation and sector of all active water licences in the Vermilion Sub-basin. The locations of registrations issued in this sub-basin are provided in Figure 12-4.

Figure 12-2 Vermilion Sub-basin Surface Water Licences

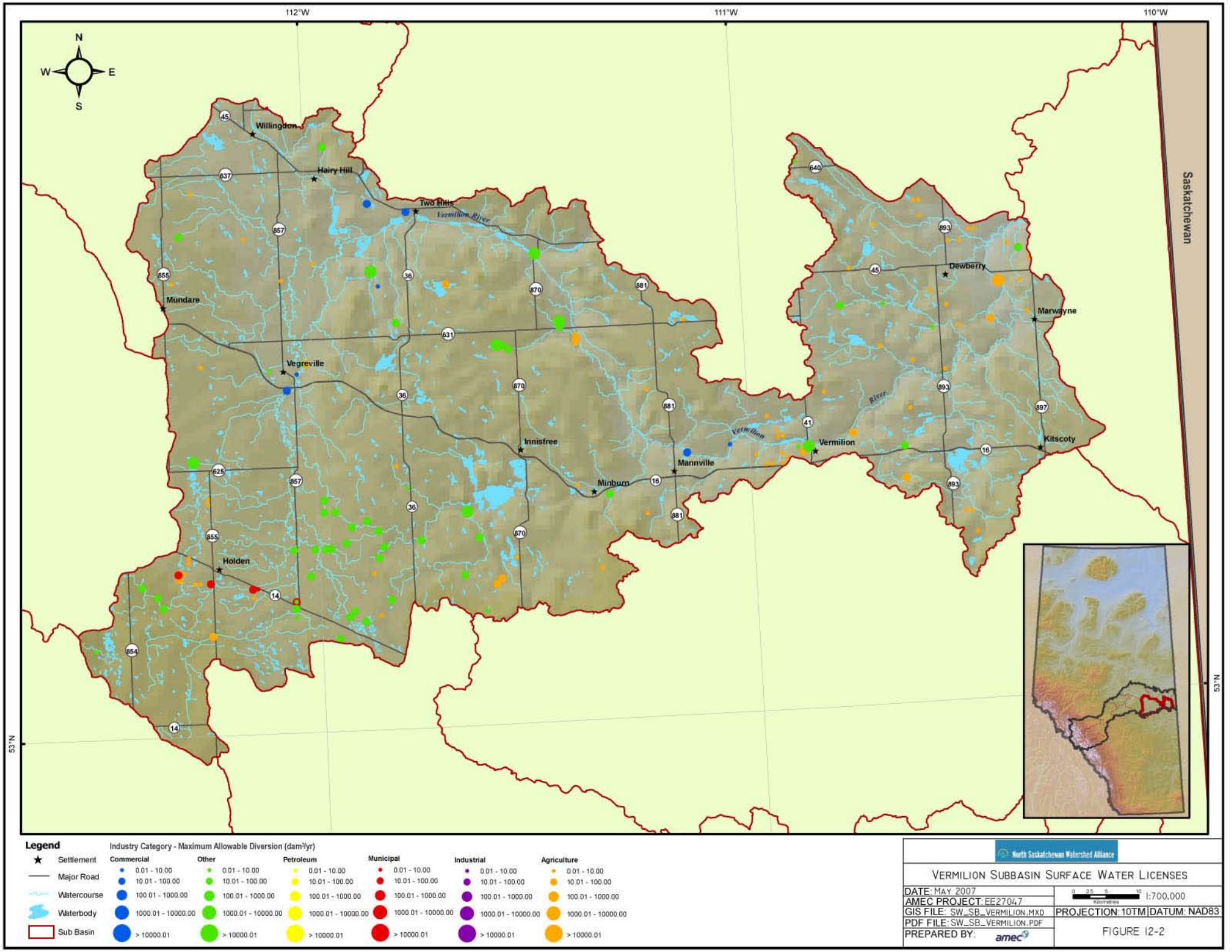

112°W
111°W
110°W
N
W
E
S
Saskatchewan
53°N
Willingdon
Hairy Hill
Two Hills
Vermilion River
Mundare
Vegreville
Innisfree
Minburn
Mannville
Vermilion
Kitscoty
Dewberry
Marwayne
Holden
45
637
857
855
36
870
881
631
625
854
14
640
893
897
41
16
Legend
Settlement
Major Road
Watercourse
Waterbody
Sub Basin
Industry Category - Maximum Allowable Diversion (dam³/yr)
Commercial
Other
Petroleum
Municipal
Industrial
Agriculture
0.01 - 10.00
10.01 - 100.00
100.01 - 1000.00
1000.01 - 10000.00
> 10000.01
North Saskatchewan Watershed Alliance
VERMILION SUBBASIN SURFACE WATER LICENSES
DATE: MAY 2007
AMEC PROJECT: EE27047
GIS FILE: SW_SB_VERMILION.MXD
PDF FILE: SW_SB_VERMILION.PDF
PREPARED BY: amec
0 2.5 5 10 Kilometres
1:700,000
PROJECTION: 10TM | DATUM: NAD83
FIGURE 12-2

Figure 12-3 Vermilion Sub-basin Groundwater Licences

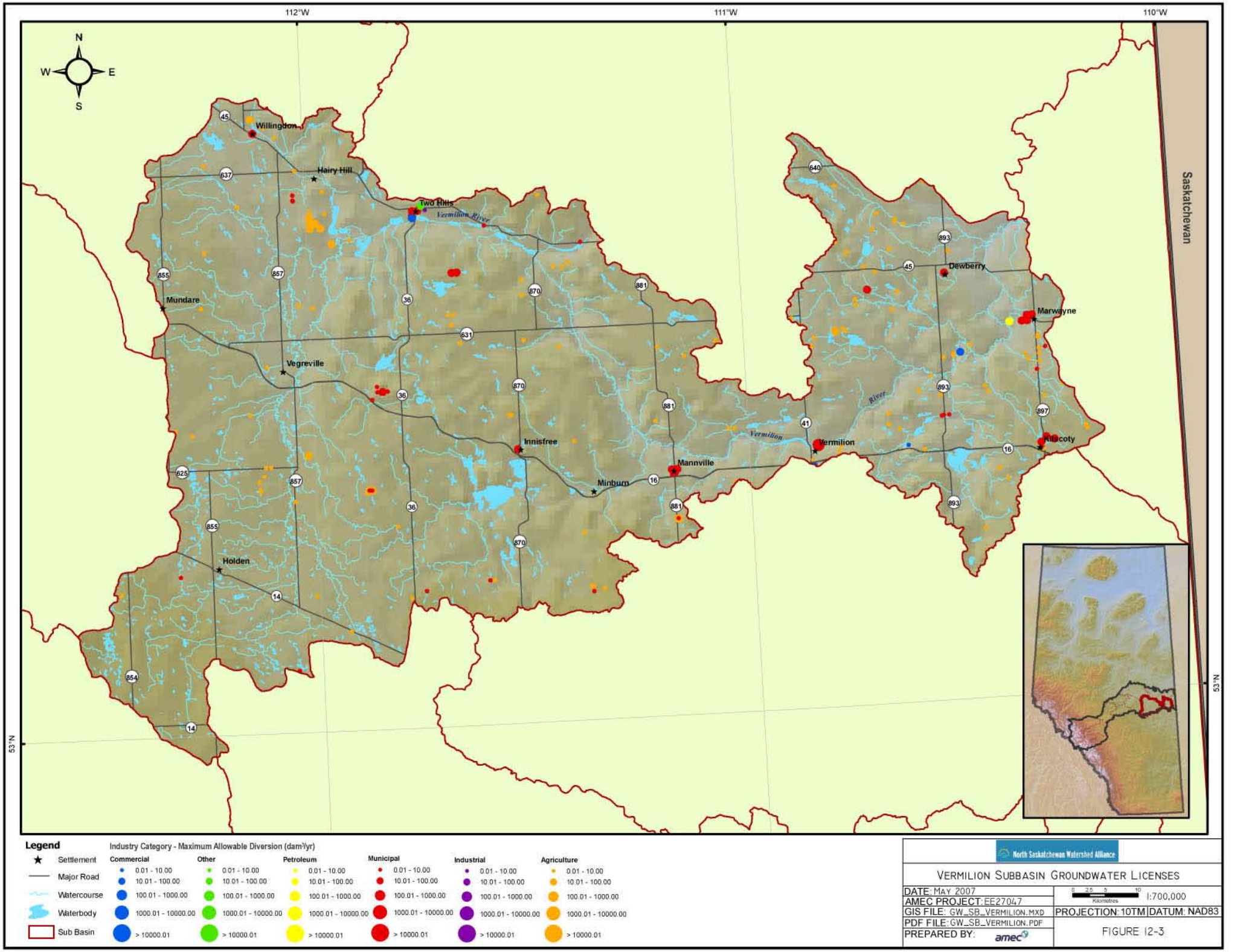
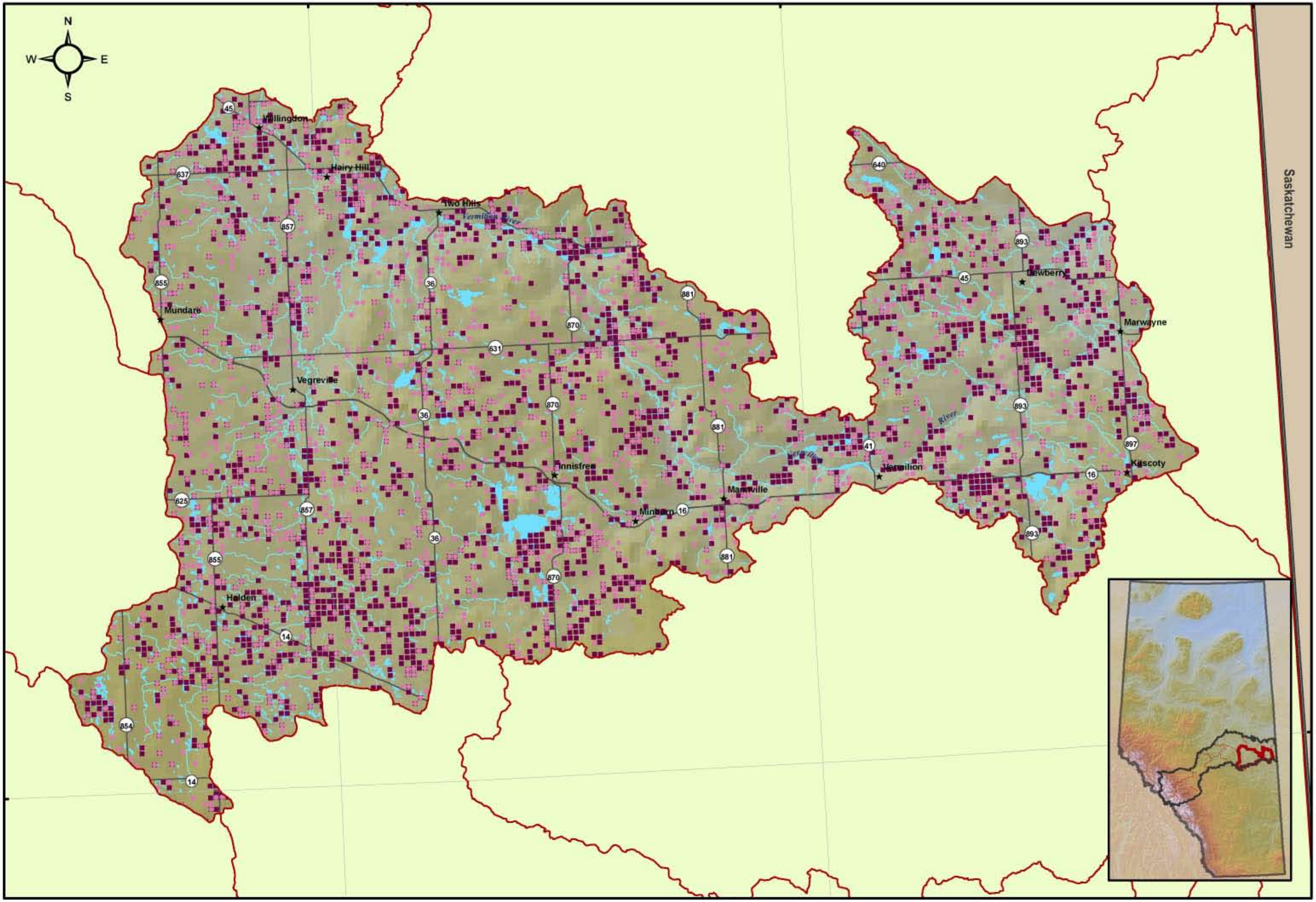

112°W
111°W
110°W
N
W
E
S
Saskatchewan
53°N
Willingdon
Hairy Hill
Two Hills
Vermilion River
Mundare
Vegreville
Innisfree
Mannville
Minburn
Holden
Dewberry
Marwayne
Vermilion
Kitscoty
Legend
Settlement
Major Road
Watercourse
Waterbody
Sub Basin
Industry Category - Maximum Allowable Diversion (dam³/yr)
Commercial
Other
Petroleum
Municipal
Industrial
Agriculture
0.01 - 10.00
10.01 - 100.00
100.01 - 1000.00
1000.01 - 10000.00
> 10000.01
North Saskatchewan Watershed Alliance
VERMILION SUBBASIN GROUNDWATER LICENSES
DATE: MAY 2007
AMEC PROJECT: EE27047
GIS FILE: GW_SB_VERMILION.MXD
PDF FILE: GW_SB_VERMILION.PDF
PREPARED BY: amec
Kilometres
1:700,000
PROJECTION: 10TM | DATUM: NAD83
FIGURE 12-3

Figure 12-4 Vermilion Sub-basin Registrations



Legend

Industry Category - Maximum Allowable Diversion (dam^3/yr)

- Settlement
- Major Road
- Watercourse
- Waterbody
- Sub Basin

Groundwater Registrations

- 0.01 - 6.25

Surface Water Registrations

- 0.01 - 6.25

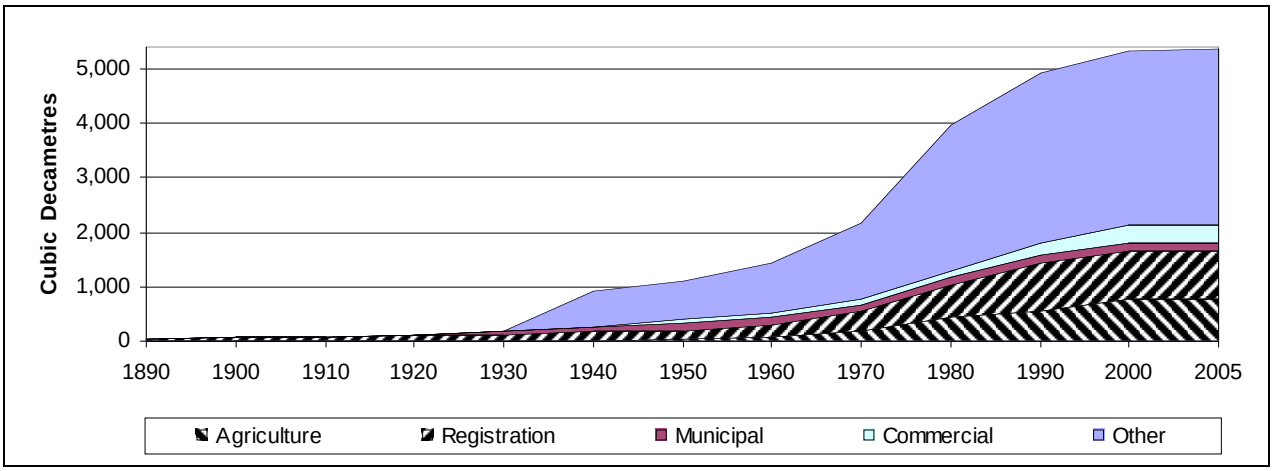
North Saskatchewan Watershed Alliance

VERMILION SUBBASIN REGISTRATIONS

DATE: MAY 2007	0 2.5 5 10 Kilometres 1:700,000
AMEC PROJECT: EE27047	
GIS FILE: RG_SB_VERMILION.MXD	PROJECTION: 10TM DATUM: NAD83
PDF FILE: RG_SB_VERMILION.PDF	
PREPARED BY: amec	FIGURE 12-4

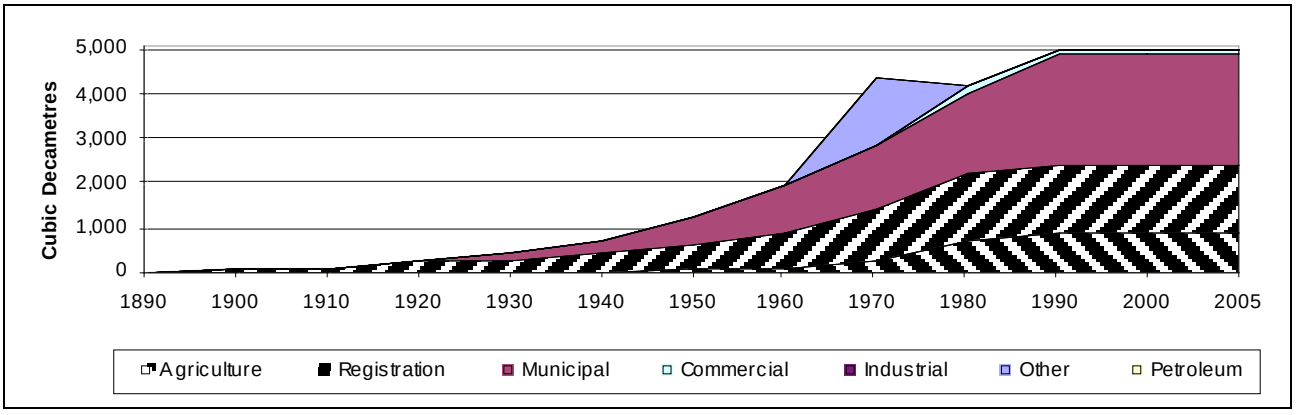
An historical perspective on water allocated among the sectors is provided in Figure 12-5 (surface water) and Figure 12-6 (groundwater). The two largest allocations for surface water in the Vermilion Sub-basin are for registrations and the other sector. Allocations for registrations were first issued in the 1890s, and these allocations steadily increased up to 2000 but have remained unchanged. Surface water allocations for the other and the remaining sectors were first issued in the 1920s, increased steadily over time, but have also remained relatively unchanged since 2000.

Figure 12-5 Historical Trends in Surface Water Allocation in the Vermilion Sub-basin



The largest allocations for groundwater are for registrations and the municipal sector. Allocations for registrations were with priority dates back to the 1890s, increased up to the 1980s, but have remained relatively unchanged since then. The municipal sector allocations were first issued in the 1920s and increased up to the 1990s but have remained unchanged since then. The allocations for the remaining sectors display similar growth patterns over the last two decades. Some groundwater was allocated to the other sector in the 1960s and 1970s but these licensees mostly expired prior to 1980.

Figure 12-6 Historical Trends in Groundwater Allocation in the Vermilion Sub-basin



12.1 Municipal and Residential Sector

12.1.1 Population

The population of Vermilion Sub-basin is more urban than rural (57 versus 44 percent, respectively), as shown in Table 12-1. Urban municipalities grew slowly from 2001 to 2006 at almost 3 percent. Rural municipalities declined slightly over the inter-censal period, by 0.2 percent.

Table 12-1 Population Distribution and Growth in the Vermilion Sub-basin

	2006		2001	2001 to 2006 Population Change
	Population	Percent	Population	Percent
Urban Municipality	14,246	56.5%	13,887	2.6%
Rural Municipality	10,981	43.5%	11,000	-0.2%
Total	**25,227**	**100.0%**	**24,887**	**1.4%**

Table 12-2 lists all municipalities situated in the Vermilion Sub-basin, their estimated 2006 sub-basin populations, and a summary of their water licence information.

Table 12-2 Municipal Populations and Water allocations within Vermilion Sub-basin

Municipal Name		2006 Population	Water Source	2005 Allocation (dam^3)
Urban	Town of Vegreville	5,519		
	Town of Vermilion	4,036	GROUNDWATER	1,312.8
	Town of Two Hills	1,047	GROUNDWATER	213.4
	Village of Mannville	782	GROUNDWATER	142.3
	Village of Kitscoty	709	GROUNDWATER	184.9
	Village of Marwayne	516	GROUNDWATER	127.1
	Town of Mundare	450		
	Village of Holden	398	SURFACE	123.3
	Village of Willingdon	295	GROUNDWATER	150.5
	Village of Innisfree	233	GROUNDWATER	27.1
	Village of Dewberry	196	GROUNDWATER	16.4
	Village of Minburn	65		
	Village of Hairy Hill	0		
Rural	County of Minburn No. 27	3,279		
	Beaver County	3,171	SURFACE	13.6
	County of Vermilion River	2,603	GROUNDWATER	65.7
	County of Two Hills No. 21	1,686	GROUNDWATER	69.0
	Lamont County	224		
	Camrose County	17		
	Flagstaff County	0		
	County of St. Paul No. 19	0		

The largest urban centre is the Town of Vegreville (5,519 residents), followed by the Town of Vermilion (4,036). County of Minburn No. 27 has the largest population of the rural

municipalities (3,279), followed by Beaver County (3,171) and County of Vermilion River (2,603).

12.1.2 Allocations

As of 2005, 75 municipal water licences had been issued to 21 licensees in the Vermilion Sub-basin. These licences allow maximum withdrawals of 2,659 dam^3 per year. As shown in Figure 12-1, municipal water uses account for 26 percent of licensed water allocations in the basin. As notes in Figure 2-1, the communities of Vegreville and Mundare each obtain their water from the Capital Region Vegreville Corridor Water Services Commission, which obtains its water from the North Saskatchewan River in Edmonton.

Surface water licences account for 6 percent or 155 dam^3 of total municipal water allocations in the sub-basin, of which 74 dam^3 is for other municipal use, 63 dam^3 is for urban use, and 19 dam^3 is for rural use.

Groundwater licences account for 94 percent or 2,504 dam^3 of total municipal water allocations. Urban users can withdraw up to 2,266 dam^3. Rural users can withdraw up to 154 dam^3 of groundwater and other users are allocated withdrawals totaling 84 dam^3.

Licensees that are not municipalities but have municipal water use licences within the Vermilion Sub-basin are shown in Table 12-3 It should be noted that the EMS database includes a licence for the Village of Lavoy, but the Village of Lavoy dissolved in 1999 and amalgamated with the County of Minburn No. 27.

Table 12-3 Additional Municipal Water Use Licensees in the Vermilion Sub-basin

Licensee	Water Source	Allocation (dam^3)
HUTTERIAN BRETHREN CHURCH OF PLAIN LAKE COLONY	GROUNDWATER	113.6
VILLAGE OF LAVOY	GROUNDWATER	38.2
HUTTERIAN BRETHREN CHURCH OF HOLDEN	SURFACE	18.5
	GROUNDWATER	9.3
HAIRY HILL HUTTERIAN COLONY LTD.	GROUNDWATER	8.6
HUTTERIAN BRETHREN CHURCH OF MIXBURN	GROUNDWATER	7.4
HUTTERIAN BRETHREN CHURCH OF VEGREVILLE	GROUNDWATER	7.4
HUTTERIAN BRETHREN CHURCH OF VIKING	GROUNDWATER	6.2
BURLINGTON RESOURCES CANADA LTD.	GROUNDWATER	2.5
YOUNG, EMELIA	GROUNDWATER	1.2

12.1.3 Licensed Water Use

Table 12-4 summarizes licensed water use for the municipal sector in the Vermilion Sub-basin. Under the terms of these licences, it is expected that 1,201 dam^3 will be used (i.e. 45 percent of allocations can be consumed and/or lost) with the remainder (55 percent or 1,458 dam^3) being returned. Seventy-eight percent of allocated urban surface water and 62 percent of allocated

urban groundwater is designated as return flow, whereas all other uses have no assigned return flow.

12.1.4 Actual Water Use

Three municipal licensees, the rural municipality of Beaver County, and the towns of Two Hills and Vermilion, reported their 2004 water and wastewater flows to MWWS. These three municipalities have a combined population of 8,254 people or 33 percent of the sub-basin population. Assuming that their water use characteristics are similar to other rural and urban municipalities within the sub-basin, combining their water use profiles to calculate the average per capita water diversions, returns and use and extrapolating the per capita values to the rest of the sub-basin population allows estimation of municipal water use for the whole sub-basin.

Per capita diversion among the three municipal licensees providing flow data was 141 m^3, per capita water use was 29 m^3 and per capita return was 112 m^3. All three licensees' withdrawals were well within their licensed allocations (Beaver County: 13 percent of allocation; Two Hills: 74 percent; Vermilion: 47 percent). Extrapolating these per capita values for the entire population of the sub-basin suggests 2715 dam^3 for water diversions (102 percent of licensed diversions), 2,157 dam^3 for water returns (148 percent of licensed returns) and 558 dam^3 for municipal water use (46 percent of licensed use). These total estimates are apportioned according to the licensed ratios, as shown in Table 12-4, to derive groundwater and surface water estimates for urban, rural and other municipal uses.

Table 12-4 Licensed Municipal Allocations and Use and Estimated Actual Use, Vermilion Sub-basin

Water Use	Source	Number of Licences	Licensed Allocation and Use (dam^3)			Estimated Actual Water Use (dam^3)		
			Allocation	Water Use	Return Flow	Diversion	Estimated Use	Return Flow
Urban*	Surface	2	62.9	13.6	49.3	64	6	72
	Groundwater	46	2,265.6	856.6	1,409.0	2,314	399	2,084
	Subtotal	**48**	**2,328.5**	**870.2**	**1,458.3**	**2,378**	**405**	**2,157**
Rural**	Surface	1	18.5	18.5	0.0	18	8	0
	Groundwater	20	153.8	153.8	0.0	157	72	0
	Subtotal	**21**	**172.3**	**172.3**	**0.0**	**176**	**80**	**0**
Other***	Surface	2	74.0	74.0	0.0	75	34	0
	Groundwater	4	84.1	84.1	0.0	85	39	0
	Subtotal	**6**	**158.1**	**158.1**	**0.0**	**161**	**73**	**0**
Total	Surface	5	155.4	106.1	49.3	158	49	72
	Groundwater	70	2,503.5	1,094.5	1,409.0	2,557	510	2,084
	Total	**75**	**2,658.9**	**1,200.6**	**1,458.3**	**2,715**	**558**	**2,157**

* Urban includes villages, summer villages, towns, cities, hamlets;
** Rural includes condominiums / townhouses / mobile homes / complexes, hotels / motels, cooperatives, farmsteads, single-multi homes, colonies and subdivisions
*** Other includes camps, institutions, senior/correctional centres, nursing/children's homes, hospitals

12.1.5 Future Water Use Forecasts

Figure 12-7 shows low, medium and high population projection scenarios for Vermilion Sub-basin based on Alberta Finance Census Division projections. The population forecasts in Figure 12-7 have been used to predict future municipal surface and groundwater use. The resulting forecasts of water use are provided in Table 12-5, and are based on the estimated per capita water use in 2005.

Figure 12-7 Vermilion Sub-basin Population Growth Forecasts

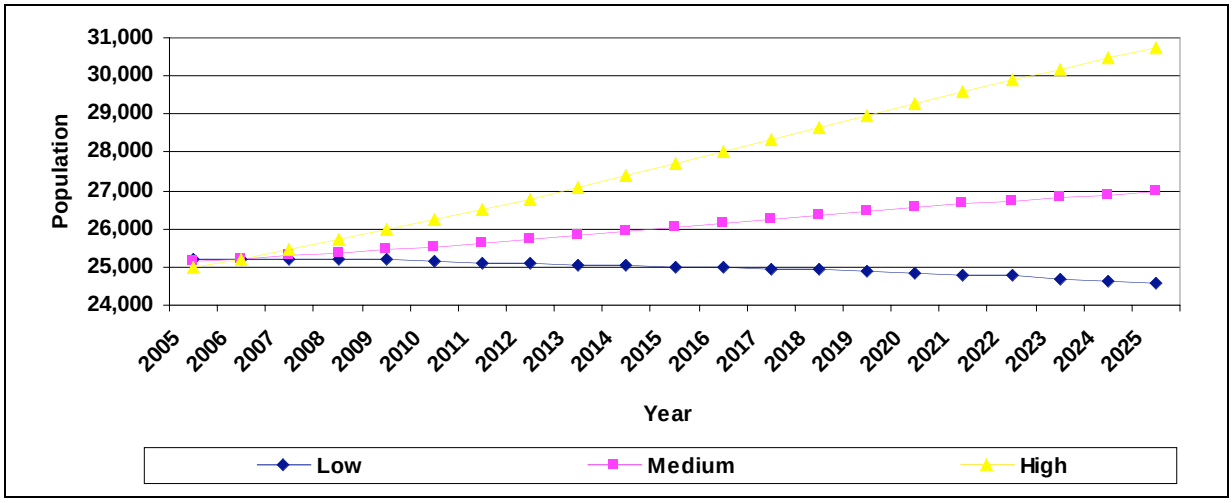


Table 12-5 Projected Municipal Water Use in the Vermilion Sub-basin

(dam^3)

Scenario	Source	2005	2010	2015	2020	2025
Low Population Growth	Surface	49	49	48	48	47
	Groundwater	510	509	505	502	496
	Total	**558**	**557**	**554**	**550**	**544**
Medium Population Growth	Surface	49	49	50	51	52
	Groundwater	510	518	528	538	546
	Total	**558**	**567**	**578**	**590**	**599**
High Population Growth	Surface	49	51	54	57	60
	Groundwater	510	535	565	597	627
	Total	**558**	**586**	**619**	**654**	**686**

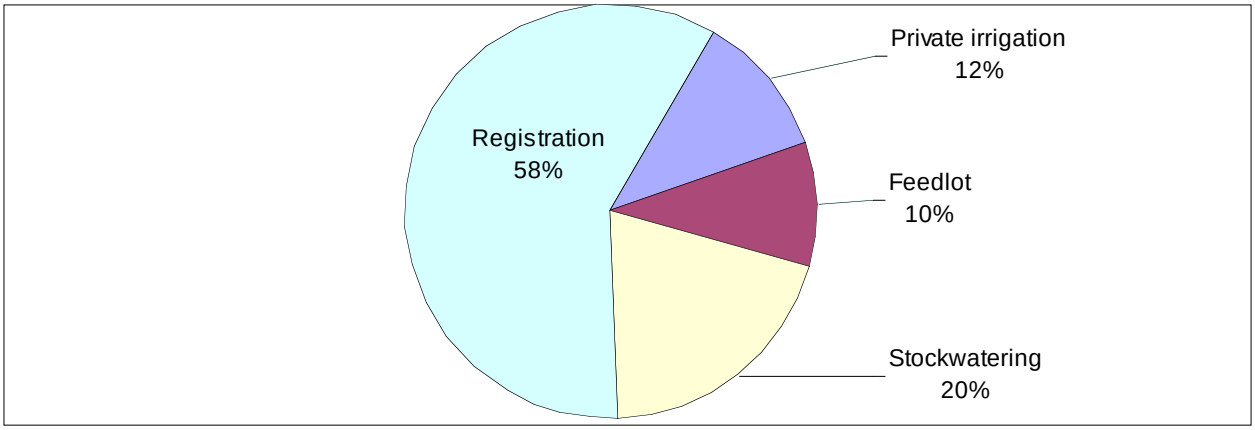
Under the Low Population Growth scenario, municipal water use in 2025 is expected to be 3 percent lower than at present and actual water use will be 45 percent of the current licensed use amount. Under the High Population Growth scenario, water use will increase by 23 percent over current levels and water use is expected to be 57 percent of the amount presently allowed in the licences.

12.2 Agriculture Sector

As of December 2005 a total of 1,660 dam^3 had been allocated to the agricultural sector in the Vermillion Sub-basin. This includes 4,962 registrations representing 2,392 dam^3 and 25 licences representing 1,668 dam^3 of water. Water allocated to agriculture accounts for 39 percent of all allocations in the Vermilion Sub-basin.

Figure 12-8 shows how this water is distributed among the different agricultural activities in the sub-basin. The largest allocation is for registrations (58 percent). Stockwatering accounts for 20 percent, private irrigation accounts for 12 percent and feedlots accounts for 10 percent of total allocations.

Figure 12-8 Water Allocation for Agricultural Activities in the Vermillion Sub-basin, 2005



A total of 2,996 registrations and 82 licences allow withdrawal of up to 1,660 dam^3 of surface water; this accounts for 41 percent of water allocations for the agricultural sector. Groundwater accounts for the other 59 percent of allocations; 2,399 dam^3 of groundwater has been allocated through 177 licences and 1,966 registrations.

12.2.1 Overview of Agriculture

Based on information from the 2001 Census of Agriculture, there were about 1,917 farms in the Vermilion Sub-basin (15.6 percent of North Saskatchewan total) with an average size of 909 acres. At the North Saskatchewan Basin level there are about 12,300 farms with an average size of 625 acres. Farms in the Vermilion Sub-basin cover an area of nearly 1.7 million acres; this is equivalent to about 7,047 km^2 or about 90 percent of the sub-basin. As shown in Table 12-6, 61 percent of the land in the basin is used to raise crops. About 30 percent of agricultural land is pasture. The rest of the lands are in summer fallow or other uses.

Table 12-6 Agricultural Land Use in the Vermilion Sub-basin, 2001

Land Use	Acres	Percent
Crop Land	1,059,771	60.9%
Summerfallow	75,007	4.3%
Tame/Seeded Pasture	211,953	12.2%
Natural Pasture	300,612	17.3%
Other	94,090	5.4%
Total	**1,741,433**	**100.0%**

The types of farming activity vary within the sub-basin. Table 12-7 shows the classification of farms based on the commodity groups that accounted for 51 percent or more of total gross farm receipts. The table shows that the Vermilion Sub-basin accounts for 16 percent of total farms in the North Saskatchewan. About 40 percent of the farms in the sub-basin raise beef cattle and about 35 percent are grain and oilseed farms. Field crop farms make up about 10 percent of the farms. Like the North Saskatchewan, cattle (beef) farms are the most common type of farm in the sub-basin, however, beef farms account for proportionately higher share. The general mix of other types of farms is different for both Vermilion and North Saskatchewan with most of the farms in the sub-basin focused on cattle, speciality and field crops.

Table 12-7 Classifications of Farms in the Vermilion Sub-basin and North Saskatchewan, 2001

Farm Type (Farms with Gross Receipts >$2,500)	Percent of Farms in the Sub-basin	Percent Share of North Saskatchewan	North Saskatchewan Farm Type (Percent)
Dairy Farms	0.5%	4.5%	1.9%
Cattle (beef) Farms	39.6%	14.0%	45.8%
Hog Farms	1.2%	13.5%	1.4%
Poultry & Egg Farms	0.7%	10.3%	1.1%
Wheat Farms	7.7%	29.5%	4.2%
Grain & Oilseed Farms	35.2%	29.1%	19.6%
Field Crop Farms	4.6%	8.6%	8.6%
Fruit Farms	0.1%	6.2%	0.2%
Misc. Specialty Farms	6.1%	7.6%	12.9%
Sum of Livestock Comb. Farms	3.0%	19.0%	2.6%
Sum of Vegetable Farms	0.0%	1.5%	0.1%
Sum of Other Comb. Farms	1.4%	15.4%	1.5%
Total	**100%**	**15.6%**	**100%**

12.2.2 Stockwatering

As noted in Table 12-7 about 42 percent of farms in the Vermilion Sub-basin were classified as livestock operations, primarily cattle. Estimated livestock populations for major species are provided in Table 12-8. The table shows that there are about 1.3 million cattle and calves

which, together, accounted for about 30 percent of the livestock population. Other livestock in the sub-basin included poultry, pigs, sheep and lamb, horses and ponies, bison, deer and elk.

Table 12-8 Estimated Livestock Populations in the Vermilion Sub-basin, 2001

Livestock Species	Vermilion	North Saskatchewan	% North Saskatchewan
Hens and Chicken	200,984	3,090,930	6.5%
Turkey	4,077	41,519	9.8%
Cattle	147,175	990,169	14.9%
Calves	57,791	365,725	15.8%
Pigs	39,833	232,169	17.2%
Sheep and Lamb	9,094	55,204	16.5%
Horse and Ponies	2,951	35,172	8.4%
Bison	3,019	18,906	16.0%
Deer	31	2,864	1.1%
Elk	776	6,426	12.1%

12.2.2.1 Water Allocation

Overall, 5,208 licences and registrations have been issued for livestock watering with total allocation amounting to 3,592 dam^3. In addition to these allocations, farmers are able to obtain up to 1,250 m^3 of water for household purposes. The numbers of such households in the sub-basin is not known. Furthermore, the numbers of "exempted agricultural" users are also not known in the sub-basin.

Table 12-9 summarizes current water licences and registrations issued for livestock according to the water source. It shows that surface water accounts for about 33 percent of allowable diversions for livestock and that registrations account for 67 percent of the allocations.

12.2.2.2 Licensed Water Use

Table 12-9 shows licences and registrations issued for livestock watering contain no allowances for return flow. The licences assume that all water withdrawals will be used.

12.2.2.3 Actual Water Use

There is no information in Alberta Environment's WURS that indicates the extent to which water allocations are actually used in the Vermilion Sub-basin. However, a reasonable estimate of water use can be derived using the actual animal population in the basin as shown in Table 12-8. Based on livestock populations for the Vermilion Sub-basin in 2001, the total water required for livestock was estimated to be 1,893 dam^3, or about 53 percent of the licensed allocation.[1] The calculations for this estimate are provided in Table 12-10 which shows livestock populations in the basin and the daily water requirements for various livestock species as provided by Alberta Environment in its "Guide to Calculate Quantities for Water for Raising Animals".[2] In terms of water requirements by species, cattle accounts for about 88 percent of the total, about 6 percent is required by pigs, and all other species accounted for the remaining 6 percent.

[1] This approach to estimating water use for stockwatering was employed in the 1986 Battle River Basin water use study undertaken by Stanley Associates in 1985.

[2] http://www3.gov.ab.ca/env/water/Legislation/Approvals_Licences/CalculationChart.doc.

The estimated actual consumption (1,893 dam^3) based on livestock populations shown in Table 12-10 however, do not include an allowance for the evaporative and seepage losses associated with storing water for livestock use. Typically, licensed consumption accounts for only 35 percent of surface water allocated for livestock use while losses account for 65 percent (Watrecon 2005).

Table 12-9 Estimated Livestock Water Requirements for 2001

Livestock Species	Animal Population	Daily Consumption (gallons)	Annual Use (dam^3)
Hens and Chickens	200,984	0.045	15.0
Turkey	4,077	0.15	1.0
Bulls	3,247	9.0	48.5
Milk Cows	787	30.0	39.2
Beef Cows	64,445	9.0	961.8
Heifers	23,127	6.0	230.1
Steers	10,622	6.0	105.7
Calves	57,791	3.0	287.5
Boars	214	6.5	2.3
Sows and Gilts - Breeding	3,908	6.5	42.1
Nursing and Weaner Pigs	14,253	0.5	11.8
Grower and Finishing Pigs	21,458	1.5	53.4
Sheep and Lambs	9,094	2.0	30.2
Horse and Ponies	2,951	10.0	48.9
Bison	3,019	2.0	10.0
Deer	31	10.0	0.5
Elk	776	3.5	4.5
Total			**1,892.6**

Since 67 percent of livestock water consumption comes from groundwater (no losses) and the balance comes from surface water with 65 percent losses, a total allocation of 2,232 dam^3 would be required to support the animal populations in Table 12-10. This water requirement is about 62 percent of the water allocation through licences and registrations.

12.2.2.4 Forecasts of Future Stockwatering Water Use

Future water use is dependent on future livestock population in the sub-basin. Information from the NRCB indicates that, as of December 31, 2005, there had been no applications from farmers throughout the sub-basin for new or expanding cattle and dairy operations. A study undertaken by Alberta Agriculture in the late 1990s also provides some insights regarding the potential for expansion of cattle. Figures 2-3 and 2-4 in Section 2.3 show areas where there is capability of supporting a 5,000-head back grounding operation and a 20,000-head operation. The figures show that there are some townships that meet all of the criteria for backgrounding operations only. For townships that meet some of the criteria limiting factors include groundwater and landscape. Based on Alberta Agriculture's assessment, it would appear that there are some opportunities for backgrounding operations in the Vermilion Sub-basin. Table 12-11 shows water use projections to 2025. By 2025, relative to 2005, water use is expected to 11 percent, 30 percent and 60 percent higher under Low, Medium and High Growth Scenarios respectively**.**

Table 12-10 Summary of Water Licences and Registrations Issued for Livestock Watering in the Vermilion Sub-basin,

Activity	Source	Number of Licences/ Registrations	Licensed Allocation and Use (dam^3)			Reported Actual Water Use	
			Allocation	Water Use	Return	Licensees Reporting	Reported Use (dam^3)
Feedlot	Surface	1	32.7	32.7	0.0	0	N/A
	Groundwater	10	358.7	358.7	0.0	0	N/A
	Subtotal	**11**	**391.4**	**391.4**	**0.0**	**0**	**N/A**
Registration	Surface	2,996	893.0	893.0	0.0	0	N/A
	Groundwater	1,966	1,498.7	1,498.7	0.0	0	N/A
	Subtotal	**4,962**	**2,391.8**	**2,391.8**	**0.0**	**0**	**N/A**
Stockwatering	Surface	69	268.2	268.2	0.0	0	N/A
	Groundwater	166	540.7	540.7	0.0	0	N/A
	Subtotal	**235**	**808.9**	**808.9**	**0.0**	**0**	**N/A**
Total	Surface	3,066	1,193.9	1,193.9	0.0	0	N/A
	Groundwater	2,142	2,398.1	2,398.1	0.0	0	N/A
	Total	**5,208**	**3,592.0**	**3,592.0**	**0.0**	**0**	**N/A**

Table 12-11 Projected Water Use for Livestock in the Vermilion Sub-basin
(dam^3)

Scenario	Source	2005	2010	2015	2020	2025
Low Growth	Surface	968	991	1,019	1,046	1,075
	Groundwater	1,264	1,295	1,330	1,366	1,404
	Total	**2,232**	**2,286**	**2,349**	**2,413**	**2,478**
Medium Growth	Surface	968	1,029	1,098	1,170	1,247
	Groundwater	1,264	1,344	1,433	1,528	1,628
	Total	**2,232**	**2,373**	**2,531**	**2,698**	**2,875**
High Growth	Surface	968	1,085	1,219	1,369	1,536
	Groundwater	1,264	1,417	1,592	1,788	2,005
	Total	**2,232**	**2,502**	**2,812**	**3,157**	**3,541**

12.2.3 Irrigation

The other major use of water for agricultural purposes is irrigation or crop watering. Irrigation in this sub-basin is done by private irrigators who have their own water licences and divert water using their own pumps and water distribution equipment.

When aggregate information from the 2001 Census of Agriculture for individual counties and municipal districts is modified to reflect river basin boundaries, the resulting estimates suggest that about 615 acres of land in the Vermilion Sub-basin were irrigated in 2001. Another approach for estimating irrigated acres involves dividing water allocations by irrigation water requirement of about 450 mm (18 inches) per acre. Based on this method it is estimated that water allocations are sufficient to support irrigation on about 385 acres. There is no information on the mix of crops grown by private irrigators; however, AAFRD has indicated that most private irrigation in Alberta is used to raise supplemental forages to feed livestock.

12.2.3.1 Water Allocation

There are 13 licences that allocate approximately 468 dam^3 for irrigation purposes. Almost all of this allocation is from surface water sources.

12.2.3.2 Licensed Use

Table 12-12 shows that all water withdrawn for irrigation purposes is expected to be consumed or lost and there will be no return flow.

.

Table 12-12 Irrigation Allocations and Use and Reported Actual Water Use, Vermilion Sub-basin

Activity	Source	Number of Licences/ Registrations	Licensed Allocation and Use (dam^3)			Reported Actual Water Use (dam^3)	
			Allocation	Water Use	Return	Licensees Reporting	Reported Use
Private irrigation	Surface	12	466.6	466.6	0.0	0	N/A
	Groundwater	1	1.2	1.2	0.0	0	N/A
	Subtotal	**13**	**467.8**	467.8	**0.0**	**0**	**N/A**
Total	Surface	12	466.6	466.6	0.0	0	N/A
	Groundwater	1	1.2	1.2	0.0	0	N/A
	Total	**13**	**467.8**	467.8	**0.0**	**0**	**N/A**

12.2.3.3 Actual Water Use

Neither Alberta Agriculture nor Alberta Environment has any information on actual water use by private irrigators. For the purposes of this study it is assumed that actual use is equal to licensed water use. However, actual water use in any given year will depend on how much of the crop water demand can be satisfied by natural precipitation. It is noteworthy that actual stockwatering use in the sub-basin (2,232 dam^3) is five times the amount of water used for crop watering.

12.2.3.4 Forecasts of Future Irrigation Water Use

With expansion of livestock, additional demand for livestock forage is expected. However, due to climatic conditions and poor returns on forage production additional forage production is not expected. It is assumed that available forage will be able to support modest increases in livestock populations. Irrigation water use is projected remain at 468 dam^3 over the forecast period.

12.2.4 Summary

In summary, current agricultural water use in the Vermilion Sub-basin is estimated to be about 2,699 dam^3, of which 83 percent is for stockwatering, including feed lots, and 17 percent is for irrigation. In the future, agricultural water demand in the basin is expected to increase as a result of expansion of livestock populations. Irrigation water use is expected to remain constant. Table 12-13 shows a summary of future agricultural water use.

Table 12-13 Projected Water Use for Agriculture in the Vermilion Sub-basin
(dam^3)

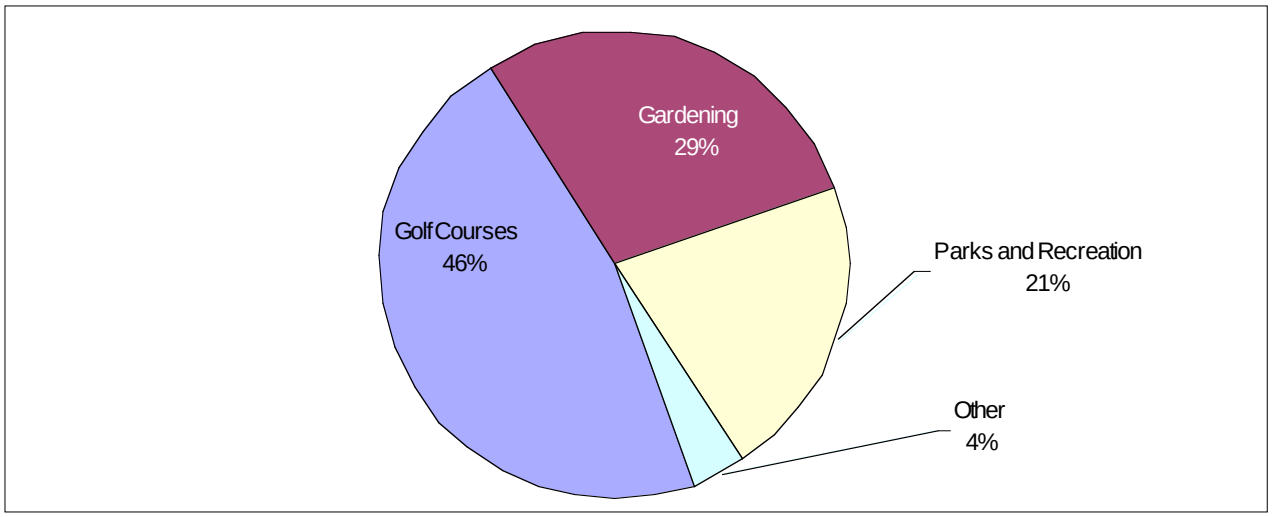
Scenario	Source	2005	2010	2015	2020	2025
Low Growth	Surface	1,435	1,458	1,486	1,513	1,542
	Groundwater	1,264	1,295	1,330	1,366	1,404
	Total	**2,699**	**2,753**	**2,816**	**2,880**	**2,945**
Medium Growth	Surface	1,435	1,496	1,565	1,637	1,714
	Groundwater	1,264	1,344	1,433	1,528	1,628
	Total	**2,699**	**2,840**	**2,998**	**3,165**	**3,342**
High Growth	Surface	1,435	1,552	1,686	1,836	2,003
	Groundwater	1,264	1,417	1,592	1,788	2,005
	Total	**2,699**	**2,969**	**3,279**	**3,624**	**4,008**

Agricultural water use in 2025 will be about 2,945 dam^3 (an increase of 9 percent from 2005) under Low Growth. Under High Growth, water use is projected to be 4,008 dam^3 by 2025; this represents an increase of 49 percent from 2005. For Medium Growth, agricultural water use in 2025 is expected to increase by 24 percent over current levels.

12.3 Commercial Sector

There are 11 licences that allow diversion of 418 dam^3 of water in the Vermilion sub-basin for commercial purpose. This allocation accounts for 4 percent of total allocations in the sub-basin.

Figure 12-9 Water Allocation for Commercial Activities in the Vermilion Sub-basin



12.3.1 Water Allocations

Figure 12-9 shows how this allocation is distributed among the various commercial sector activities, including golf courses (46 percent), gardening (29 percent), parks and recreation (21 percent) and, other (4 percent). Surface water accounts for 75 percent of allocations and the largest allocation is for gardening. Groundwater accounts for the remaining 25 percent of the allocations and the largest allocation is for golf courses.

12.3.2 Licensed Water Use

Table 12-14 provides a summary of licensed allocations, use and return for various activities within the commercial sector in the Vermilion sub-basin. The table shows that all of the licences assume that all withdrawals will be consumed or lost and that there will be no return flow.

12.3.3 Actual Water Use

At the present time Alberta Environment's Water Use Reporting System contains no information on actual water use in 2005 by any of the licensees in the commercial sector in the Vermilion sub-basin. Given the lack of information on actual water use, it is assumed that all licensees are withdrawing and using the full amount of water they are allowed. Although this assumption will overstate the actual commercial sector water use, this sector accounts for a relatively small proportion of total allocations in this sub-basin (4 percent) so overall water use estimates are not likely to be greatly affected.

Table 12-14 Licensed Commercial Allocations, Reported and Actual Water Use, Vermilion Sub-basin

Activity	Source	Number of Licences	Licensed Allocation and Use (dam^3)			Reported Actual Water Use (dam^3)		
			Allocation	Water Use	Return	Licensees Reporting	Reported Use	Percent of Allocation
Gardening	Surface	2	119.1	119.1	0.0	0	N/A	N/A
	Groundwater	0	0.0	0.0	0.0			
	Subtotal	**2**	**119.1**	119.1	**0.0**	**0**	**N/A**	**N/A**
Golf Course	Surface	2	94.6	94.6	0.0	0	N/A	N/A
	Groundwater	1	99.9	99.9	0.0	0	N/A	N/A
	Subtotal	**3**	**194.5**	194.5	**0.0**	**0**	**N/A**	**N/A**
Other	Surface	2	13.6	13.6	**0.0**	0	N/A	N/A
	Groundwater	1	1.2	1.2	**0.0**	0	N/A	N/A
	Subtotal	**3**	**14.8**	14.8	**0.0**	**0**	**N/A**	**N/A**
Parks and Recreation	Surface	2	87.2	87.2	**0.0**	0	N/A	N/A
	Groundwater	1	1.2	1.2	**0.0**	0	N/A	N/A
	Subtotal	**3**	**88.4**	88.4	**0.0**	**0**	**N/A**	**N/A**
Total	Surface	8	314.4	314.4	0.0	0	N/A	N/A
	Groundwater	3	102.4	102.4	0.0	0	N/A	N/A
	Total	**11**	**416.8**	**416.8**	**0.0**	**0**	**N/A**	**N/A**

12.3.4 Future Water Use Forecasts

Since most of the allocation (96 percent) is for three activities – golf courses, gardening and parks and recreation, forecasts of future demand will be based on those activities.

12.3.4.1 Golf Courses

The water demand forecast for golf courses follows the approach outlined in Watrecon (2005) which assumes that water demands will increase based on expansion of golf courses as a result of population growth. However, the population growth must reach a threshold that would sustain one additional nine hole course before an expansion is expected to occur (*i.e.*. golf course expansion is not linearly related to population growth). Using this assumption, and given the population growth rate in the Vermilion Sub-basin, golf course expansion is unlikely. Golf course water use is expected to remain unchanged at 195 dam^3 over the forecast period across all growth scenarios. This method also assumes that the proportion of surface and groundwater will not change over the forecast period relative to 2005.

12.3.4.2 Gardening

There has been growth in greenhouse operations in the sub-basin over the last decade, and this trend is likely to continue owing to large population centres in and around the sub-basin which provides a market for greenhouse products. Future water use is projected assuming an average annual growth rate ranging from 1.3 percent (Low Growth) to 3.2 percent (High Growth). Under the Medium Growth an annual increase of 2.6 percent is assumed; this is the average annual growth rate of greenhouse farms in the sub-basin between 1996 and 2001, as calculated using information in the Census of Agriculture. Projections using these assumptions are shown in Table 12-15.

By 2025 water use is expected to be 154 dam^3 under Low Growth which is a 30 percent increase from 2005. Under High Growth water use is expected to be 223 dam^3 by 2025, which is an 88 percent increase from 2005. Water use is expected to be 67 percent higher by 2025 under Medium Growth.

Table 12-15 Projected Water Use for Gardening, Vermilion Sub-basin
(dam^3)

Scenario	Source	2005	2010	2015	2020	2025
Low Growth	Surface	119	127	135	144	154
	Groundwater	0	0	0	0	0
	Total	**119**	**127**	**135**	**144**	**154**
Medium Growth	Surface	119	135	154	175	199
	Groundwater	0	0	0	0	0
	Total	**119**	**135**	**154**	**175**	**199**
High Growth	Surface	119	139	163	191	223
	Groundwater	0	0	0	0	0
	Total	**119**	**139**	**163**	**191**	**223**

12.3.4.3 Parks and Recreation

Future water use is expected to increase as a result of regional population growth. Projections are based on no annual growth for the Low Growth Scenario, 0.4 percent for the Medium Growth Scenario and 1.1 percent for the High Growth Scenario. The resulting projections are shown in Table 12-16.

Table 12-16 Projected Water Use for Parks and Recreation, Vermilion Sub-basin
(dam^3)

Scenario	Source	2005	2010	2015	2020	2025
Low Growth	Surface	87	87	87	87	87
	Groundwater	1	1	1	1	1
	Total	**88**	**88**	**88**	**88**	**88**
Medium Growth	Surface	87	89	91	92	94
	Groundwater	1	1	1	1	1
	Total	**88**	**90**	**92**	**93**	**95**
High Growth	Surface	87	92	97	103	108
	Groundwater	1	1	1	1	1
	Total	**88**	**93**	**98**	**104**	**109**

Water use is expected to remain unchanged from current use at 88 dam^3 under Low Growth. Under High Growth, water use is expected to be 110 dam^3 by 2025, which is a 25 percent increase. Water use is expected to be 8 percent higher by 2025 under Medium Growth.

12.3.5 Summary

A summary of the projected water demand for the commercial sector in the Vermilion Sub-basin is provided in Table 12-17. This forecast combines the estimates for golf course, gardening, and parks and recreation (which together account for 96 percent of allocation in the sub-basin), with the assumption that all of the water allocations for the remaining commercial activities are being fully utilized.

Table 12-17Projected Water Use for the Commercial Sector, Vermilion Sub-basin
(dam^3)

Scenario	Source	2005	2010	2015	2020	2025
Low Growth	Surface	314	322	330	339	349
	Groundwater	102	102	102	102	102
	Total	**416**	**424**	**432**	**441**	**451**
Medium Growth	Surface	314	332	353	375	401
	Groundwater	102	102	102	102	102
	Total	**416**	**434**	**455**	**477**	**503**
High Growth	Surface	314	339	368	402	439
	Groundwater	102	102	102	102	102
	Total	**416**	**441**	**470**	**504**	**542**

Table 12-18 Licensed Allocations, Estimated Actual Water Use for the Petroleum Sector, Vermilion Sub-basin

Activity	Source	Number of Licences	Licensed Allocation and Use (dam^3)			Estimated Water Use (dam^3)		
			Allocation	Water Use	Return	Water Use	Percent of Licensed Use	Percent of Allocation
Other Petroleum	Surface	0	0.0	0.0	0.0	0.0		
	Groundwater	1	1.5	1.5	0.0	1.5	100%	100%
	Subtotal	**1**	**1.5**	**1.5**	**0.0**	**1.5***	**100%**	**100%**
Total	Surface	0	0.0	0.0	0.0	0.0		
	Groundwater	1	1.5	1.5	0.0	1.5	100%	100%
	Total	**1**	**1.5**	**1.5**	**0.0**	**1.5**	**100%**	**100%**

* Estimates assume 100 percent consumption of licensed use.

Under the Low Growth Scenario, water use is projected to rise to 451 dam^3, an 8 percent increase from current levels by 2025. Under the High Growth Scenario, water use is projected to rise to 542 dam^3 which is a 30 percent increase by 2025. Water use is projected to increase by 21 percent from the current level by 2025 under Medium Growth.

12.4 Petroleum Sector

In the Vermilion Sub-basin, there is only one active groundwater licence which allocates about 2 dam^3 of water to the petroleum sector for other petroleum activities (Table 12-18). Petroleum allocations account for very little of the total allocations in the sub-basin. The sector's single licence was issued in the 1970s and it assumes the licensee will consume all of the water it withdraws.

There is no information on actual water use diversions or consumption for the single water licences for these activities. For the purposes of this analysis, it is assumed that the licensee is using its full entitlement.

Since 2005, one groundwater licence has been issued to other petroleum for 13 dam^3. Although this licence is scheduled to expire in 2015, it is expected to be renewed. Consequently, future water requirements for petroleum activities are not expected to change in the forecast period (Table 12-19).

Table 12-19 Forecast of Petroleum Water Use in the Vermilion Sub-basin
(dam^3)

Scenario	Source	2005	2010	2015	2020	2025
Low Production	Surface	0	0	0	0	0
	Groundwater	2	15	15	15	15
	Total	**2**	**15**	**15**	**15**	**15**
Medium Production	Surface	0	0	0	0	0
	Groundwater	2	15	15	15	15
	Total	**2**	**15**	**15**	**15**	**15**
High Production	Surface	0	0	0	0	0
	Groundwater	2	15	15	15	15
	Total	**2**	**15**	**15**	**15**	**15**

12.5 Industrial Sector

In the Vermillion Sub-basin, there is one active groundwater licence issued in the 1980s that allocates slightly more than 1 dam^3 of water to the industrial sector for other industrial activities (Table 12-20). Industrial allocation accounts for 10.9 percent of total allocations in the sub-basin. The licensee is expected to consume all of the water they divert (zero return flow).

There is no information on actual water use diversions or consumption for the groundwater licence and, for the purposes of this analysis, it is assumed that the licensee is using their full entitlement and will continue to do so for the duration of the forecast period.

Table 12-20 Licensed Allocations and Estimated Water Use for the Industrial Sector, Vermilion Sub-basin

Water Use	Source	Number of licences	Licensed Allocation and Use (dam^3)			Estimated Water Use (dam^3)		
			Allocation	Water Use	Return	Water Use	Percent of Licensed Use	Percent of Allocation
Other Industrial	Surface	0	0.0	0.0	0.0	0		
	Groundwater	1	1.2	1.2	0.0	1	100%	100%
	Subtotal	**1**	**1.2**	**1.2**	**0.0**	**1***	**100%**	**100%**
Total	Surface	0	0.0	0.0	0.0	0		
	Groundwater	1	1.2	1.2	0.0	1	100%	100%
	Total	**1**	**1.2**	**1.2**	**0.0**	**1**	**100%**	**100%**

* Actual water use is estimated to be 100 percent of licensed consumption.

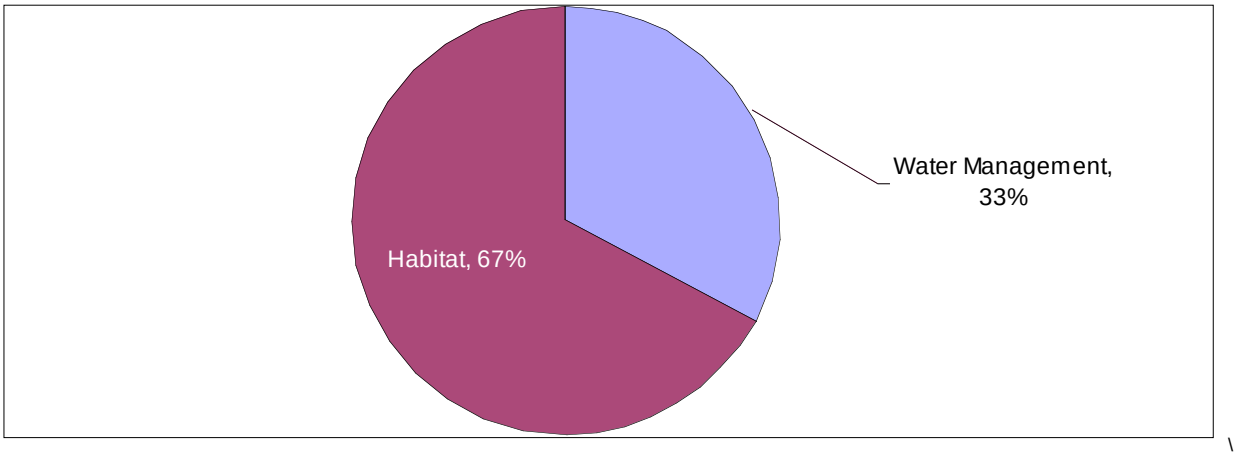
12.6 Other Sector

In the Vermilion Sub-basin 55 active licences allocate 3,252 dam^3 of water to the other sector. Of this, licensees are expected to consume about 96 percent and return 4 percent. The other sector activities account for about 31 percent of licensed water use in the Vermilion Sub-basin and 0.2 percent in the North Saskatchewan Basin. All of the water allocated for other sector activities is for surface water. Other sector uses in the Vermilion Sub-basin includes water management for flood control and lake stabilization, and fish, wildlife and habitat enhancement.

Water licences have been issued to Alberta Environment (2), Alberta Environmental Centre (1), Beaver County (1), Ducks Unlimited (44), Town of Vermilion (1), and private individuals (7).

Figure 12-10 illustrates the water use by other sector activities in the Vermilion Sub-basin. Table 12-21 summarizes the water allocation, use, and return associated with the licences for each activity in the Vermilion Sub-basin.

Figure 12-10 Other Sector Water Allocation by Use in the Vermilion Sub-basin



12.6.1 Water Management

In the Vermilion Sub-basin, 13 surface water licences have been issued for water management activities and they allow withdrawals of up to 1,068 dam^3 of water. Water management allocations commenced in the 1940s and have increased since then. The licences expect hat licence holders will consume all of the water they withdraw (Table 12-21)

There is no information on the actual water diversions and consumption for water management licences. For purposes of this analysis, it is assumed that the licence holders are using their full entitlement.

Table 12-21 Licensed Allocations and Estimated Actual Water Use for the Other Sector, Vermilion Sub-basin

Water Use	Source	Number of Licences	Licensed Allocation and Use (dam^3)			Estimated Water Use (dam^3)		
			Allocation	Water Use	Return	Water Use	Percent of Licensed Use	Percent of Allocation
Water Management	Surface	13	1,068.3	1,068.3	0.0	1,068	100%	100%
	Groundwater	0	0.0	0.0	0.0	0		
	Subtotal	**13**	**1,068.3**	**1,068.3**	**0.0**	**1,068***	**100%**	**100%**
Habitat	Surface	42	2,184.1	2,053.3	130.8	2,053	100%	94%
	Groundwater	0	0.0	0.0	0.0	0		
	Subtotal	**42**	**2,184.1**	**2,053.3**	**130.8**	**2,053***	**100%**	**94%**
Total	Surface	55	3,252.4	3,121.6	130.8	3,122	100%	96%
	Groundwater	0	0.0	0.0	0.0	0		
	Total	**55**	**3,252.4**	**3,121.6**	**130.8**	**3,122**	**100%**	**96%**

* Estimated water use assumes licence holders are consuming the full entitlement of their licences.

In the future, there is expected to be light growth in water requirements for water management projects in the Vermilion Sub-basin (Section 2.3.7). The forecasts in Table 12-22 assume that, under the High Growth Scenario, future water use will increase by three licences every five years and that water requirements for these projects will be similar to an average current Ducks Unlimited project. The Low Growth Scenario assumes that there is no change in water management projects. The Medium Growth Scenario assumes that new projects will be developed at half the rate of the High Growth Scenario.

Table 12-22 Forecast of Water Management Water Use in the Vermilion Sub-basin
(dam^3)

Scenario	Source	2005	2010	2015	2020	2025
Low Growth	Surface	1,068	1,068	1,068	1,068	1,068
	Groundwater	0	0	0	0	0
	Total	**1,068**	**1,068**	**1,068**	**1,068**	**1,068**
Medium Growth	Surface	1,068	1,233	1,398	1,563	1,728
	Groundwater	0	0	0	0	0
	Total	**1,068**	**1,233**	**1,398**	**1,563**	**1,728**
High Growth	Surface	1,068	1,398	1,728	2,058	2,388
	Groundwater	0	0	0	0	0
	Total	**1,068**	**1,398**	**1,728**	**2,058**	**2,388**

12.6.2 Habitat Enhancement

In the Vermilion Sub-basin, 42 surface water licences have been issued for wildlife and habitat enhancement projects allow withdrawals of up to 2,184 dam^3 of water. Habitat enhancement allocations commenced in the 1940s. Licensees are expected to consume 94 percent (2,053 dam^3) of the water they are allowed to withdraw.

There is no information on the actual water diversions and consumption for habitat enhancement licences. For purposes of this analysis, it is assumed that the licence holder is using their full entitlement.

In the future, there is expected to be light growth in water requirements for habitat enhancement projects in the Vermilion Sub-basin. The water use forecasts for habitat enhancement employ the same assumption as far water management projects (Section 12.6.1.). The resulting water use forecasts are provided in Table 12-23.

Table 12-23 Forecast of Habitat Enhancement Water Use in the Vermilion Sub-basin
(dam^3)

Scenario	Source	2005	2010	2015	2020	2025
Low Growth	Surface	2,053	2,053	2,053	2,053	2,053
	Groundwater	0	0	0	0	0
	Total	**2,053**	**2,053**	**2,053**	**2,053**	**2,053**
Medium Growth	Surface	2,053	2,218	2,383	2,548	2,713
	Groundwater	0	0	0	0	0
	Total	**2,053**	**2,218**	**2,383**	**2,548**	**2,713**
High Growth	Surface	2,053	2,383	2,713	3,043	3,373
	Groundwater	0	0	0	0	0
	Total	**2,053**	**2,383**	**2,713**	**3,043**	**3,373**

12.6.3 Summary

The other sector in the Vermilion Sub-basin is dominated by water allocated for habitat enhancement. These projects account for 67 percent of the water allocation and 66 percent of the licensed water use but, in terms of licensees, are largely indistinguishable from licensees issued for water management purposes.

In the future, there is expected to be light growth in the other sector projects in the Vermilion Sub-basin (see the Methods section). The forecasts in Table 12-24 combine the estimates for water management (Table 12-22) with forecasts for habitat enhancement (Table 12-23).

Table 12-24 Forecast of Other Sector Water Use in the Vermilion Sub-basin
(dam^3)

Scenario	Source	2005	2010	2015	2020	2025
Low Growth	Surface	3,121	3,121	3,121	3,121	3,121
	Groundwater	0	0	0	0	0
	Total	**3,121**	**3,121**	**3,121**	**3,121**	**3,121**
Medium Growth	Surface	3,121	3,451	3,781	4,111	4,441
	Groundwater	0	0	0	0	0
	Total	**3,121**	**3,451**	**3,781**	**4,111**	**4,441**
High Growth	Surface	3,121	3,781	4,441	5,101	5,761
	Groundwater	0	0	0	0	0
	Total	**3,121**	**3,781**	**4,441**	**5,101**	**5,761**

Table 12-24 shows that, by 2025, water demand for the other sector would remain constant under the Low Growth Scenario, increase by 42 percent for the Medium Growth Scenario, and by as much as 85 percent for the High Growth Scenario.

12.7 Summary

Table 12-25 provides a summary of licensed allocations and estimated water use for each of the water use sectors in the Vermilion Sub-basin. In total, existing licences and registrations allow a maximum of 10,390 dam^3 of water to be withdrawn. Of this total, it is expected that 85 percent

(8,802 dam^3) will be consumed or lost and the balance will be returned after use. Figure 12-11 shows the allocations, licensed use and actual use for the different sectors. Actual use (6,799 dam^3) is about 77 percent of licensed use. The largest water user is the other sector, which is estimated to have accounted for 46 percent to total water use. Figure 12-12 shows the forecasts to 2025 for all of the sectors under Medium Growth. By 2025 water use is expected to increase by about 4 percent under Low Growth (Table 12-26), about 31 percent under Medium Growth **(**Table 12-27), and about 62 percent under High Growth (Table 12-28).

Figure 12-11 Water Allocations and Actual Use, by Sector, Vermilion Sub-basin

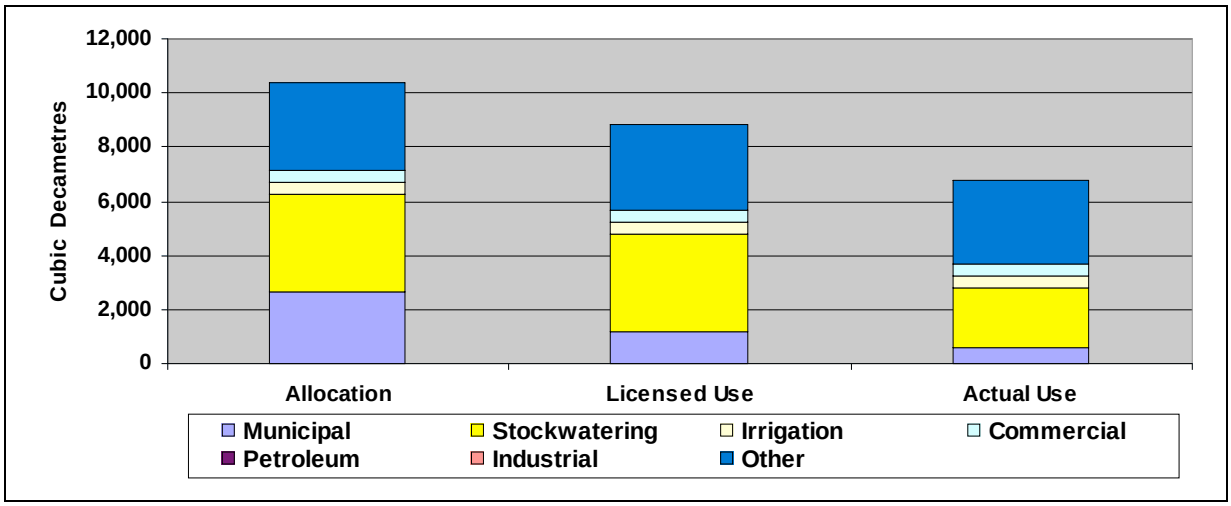


Figure 12-12 Forecast Water Use in Vermilion Sub-basin: Medium Scenario

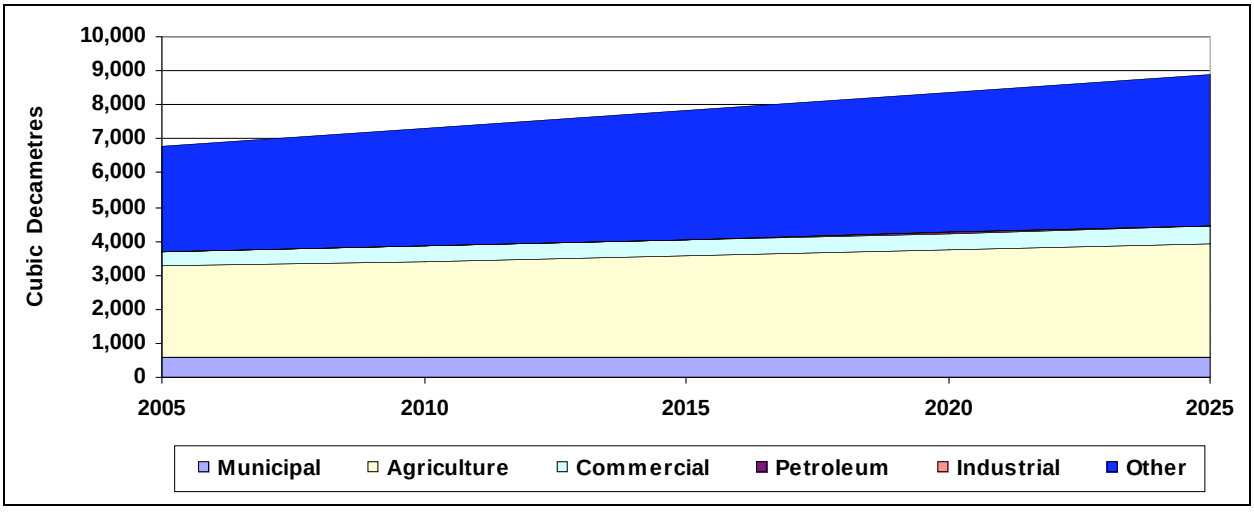


Table 12-25 Summary of Allocations and Estimated Water Use, Vermilion Sub-basin

Sector		Licensed Allocation and Use (dam^3)				Estimated Water Use (dam^3)		
		Allocation	Water Use	Return	Percent of Total Use	Use	Percent of Licensed Use	Percent of Total Use
Municipal		2,659	1,201	1,458	14%	558	46%	8%
Agricultural	Stockwatering	3,592	3,592	0	41%	2,232	62%	33%
	Irrigation	468	468	0	5%	468	100%	7%
Commercial		416	416	0	5%	416	100%	6%
Petroleum		2	2	0	0%	2	100%	0%
Industrial		1	1	0	0%	1	100%	0%
Other		3,252	3,122	130	35%	3,122	100%	46%
Total		**10,390**	**8,802**	**1,588**	**100%**	**6,976**	**79%**	**100%**

Table 12-26 Forecast Water Use, By Sector, Vermilion Sub-basin: Low Scenario
(dam^3)

Source	Sector	2005	2010	2015	2020	2025
Surface Water	Municipal	49	49	48	48	47
	Agricultural	1,435	1,458	1,486	1,513	1,542
	Commercial	314	322	330	339	349
	Petroleum	0	0	0	0	0
	Industrial	0	0	0	0	0
	Other	3,121	3,121	3,121	3,121	3,121
	Total	**4,919**	**4,950**	**4,985**	**5,021**	**5,059**
Groundwater	Municipal	510	509	505	502	496
	Agricultural	1,264	1,295	1,330	1,366	1,404
	Commercial	102	102	102	102	102
	Petroleum	2	15	15	15	15
	Industrial	1	1	1	1	1
	Other	0	0	0	0	0
	Total	**1,879**	**1,922**	**1,953**	**1,986**	**2,018**
Total	Municipal	559	557	554	550	544
	Agricultural	2,699	2,753	2,816	2,879	2,946
	Commercial	416	424	432	441	451
	Petroleum	2	15	15	15	15
	Industrial	1	1	1	1	1
	Other	3,121	3,121	3,121	3,121	3,121
	Total	**6,798**	**6,871**	**6,939**	**7,007**	**7,078**

Table 12-27 Forecast Water Use, By Sector, Vermilion Sub-basin: Medium Scenario
(dam^3)

Source	Sector	2005	2010	2015	2020	2025
Surface Water	Municipal	49	49	50	51	52
	Agricultural	1,435	1,496	1,565	1,637	1,714
	Commercial	314	332	353	375	401
	Petroleum	0	0	0	0	0
	Industrial	0	0	0	0	0
	Other	3,121	3,451	3,781	4,111	4,441
	Total	**4,919**	**5,328**	**5,749**	**6,174**	**6,608**
Groundwater	Municipal	510	518	528	538	546
	Agricultural	1,264	1,344	1,433	1,528	1,628
	Commercial	102	102	102	102	102
	Petroleum	2	15	15	15	15
	Industrial	1	1	1	1	1
	Other	0	0	0	0	0
	Total	**1,879**	**1,980**	**2,079**	**2,184**	**2,292**
Total	Municipal	559	567	578	590	599
	Agricultural	2,699	2,840	2,998	3,165	3,342
	Commercial	416	434	455	477	503
	Petroleum	2	15	15	15	15
	Industrial	1	1	1	1	1
	Other	3,121	3,451	3,781	4,111	4,441
	Total	**6,798**	**7,308**	**7,828**	**8,359**	**8,901**

Table 12-28 Forecast Water Use, By Sector, Vermilion Sub-basin: High Scenario
(dam^3)

Source	Sector	2005	2010	2015	2020	2025
Surface Water	Municipal	49	51	54	57	60
	Agricultural	1,435	1,552	1,686	1,836	2,003
	Commercial	314	339	368	402	439
	Petroleum	0	0	0	0	0
	Industrial	0	0	0	0	0
	Other	3,121	3,781	4,441	5,101	5,761
	Total	**4,919**	**5,723**	**6,549**	**7,396**	**8,263**
Groundwater	Municipal	510	535	565	597	627
	Agricultural	1,264	1,417	1,592	1,788	2,005
	Commercial	102	102	102	102	102
	Petroleum	2	15	15	15	15
	Industrial	1	1	1	1	1
	Other	0	0	0	0	0
	Total	**1,879**	**2,070**	**2,275**	**2,503**	**2,750**
Total	Municipal	559	586	619	654	686
	Agricultural	2,699	2,969	3,278	3,624	4,008
	Commercial	416	441	470	504	541
	Petroleum	2	15	15	15	15
	Industrial	1	1	1	1	1
	Other	3,121	3,781	4,441	5,101	5,761
	Total	**6,798**	**7,793**	**8,824**	**9,899**	**11,012**