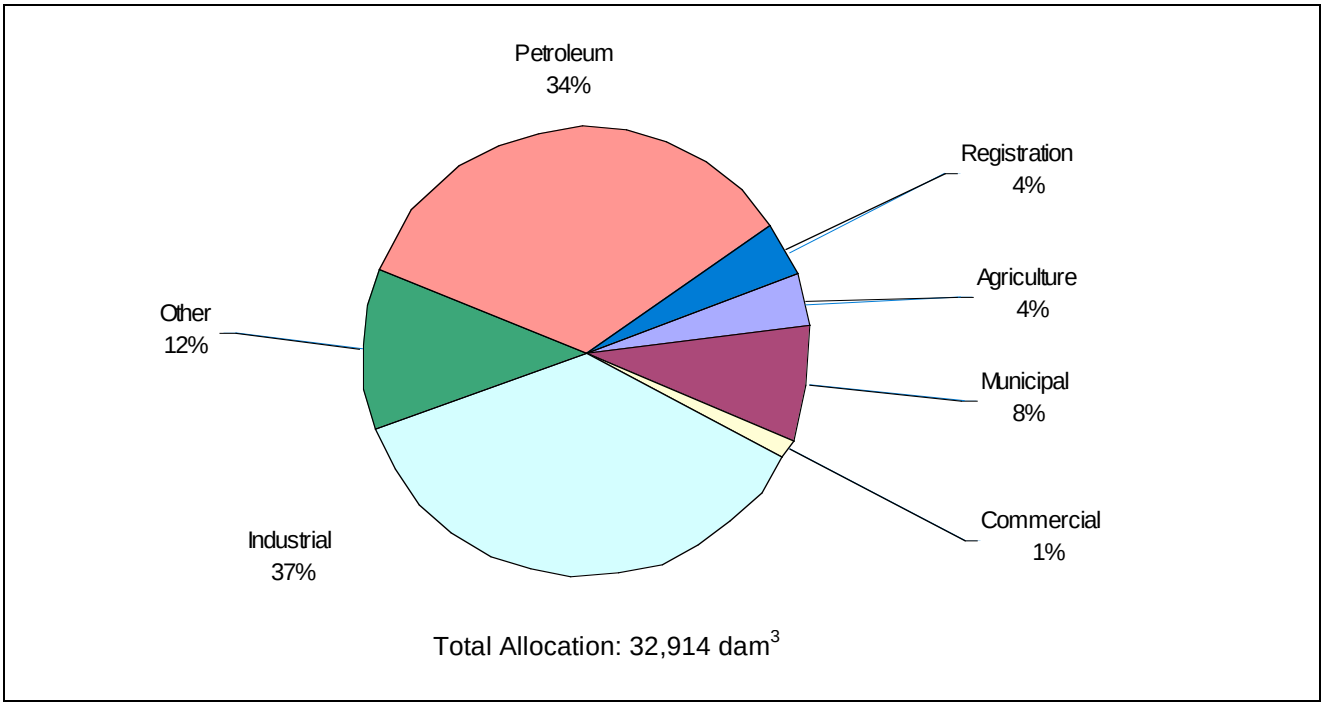
13.0 FROG

The Frog Sub-basin is about 5,470 km^2 in area and occupies approximately 10 percent of the North Saskatchewan Basin. In 2005, the sub-basin had a population of about 16,000 people, which represents less than 2 percent of the Basin population, with a population density of about 2.9 people per square kilometre. The Frog Sub-basin consists all or parts of six urban municipalities, six rural municipalities and four Aboriginal settlements.

An overview of current surface and groundwater allocations is provided in Figure 13-1. It shows that the industrial sector accounts for 37 percent of total allocations or 12,039 dam^3. The petroleum sector accounts for 34 percent of total allocations or 11,307 dam^3 while the other sector accounts for 12 percent of total allocations or 3,897 dam^3. The remaining allocations are for municipal, commercial, and agriculture sectors and registration. Total allocations in the sub-basin in 2005 were 32,914 dam^3 and surface water allocations (30,894 dam^3) accounted for 94 percent of the total.

Figure 13-1 Distribution of Active Water Allocations in the Frog Sub-basin



Figures 13-2 and 13-3 show the location, allocation and sector of all active water licences in the Frog Sub-basin. The locations of registrations issued in this sub-basin are provided in Figure 13-4.

Figure 13-2 Frog Sub-basin Surface Water Licences

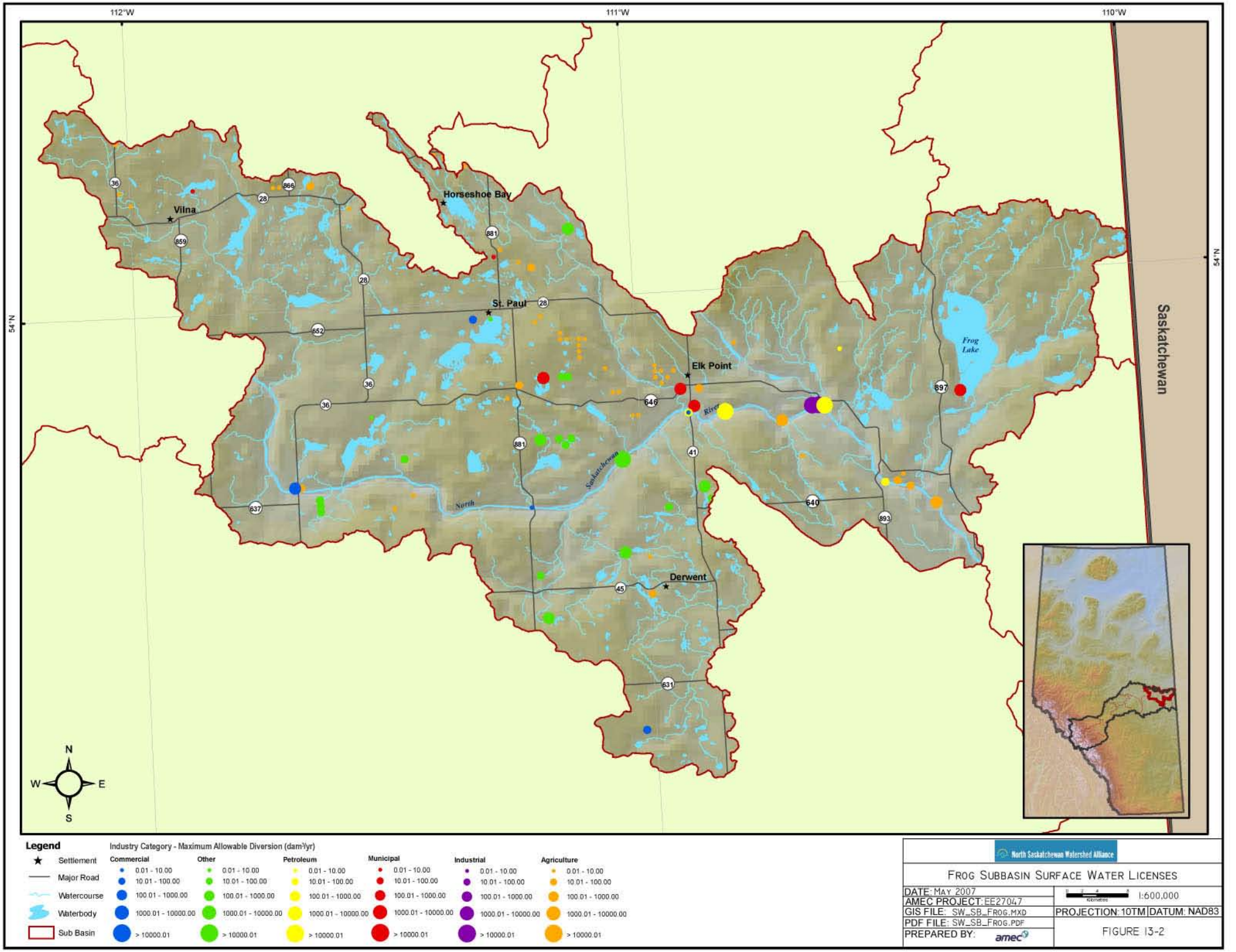
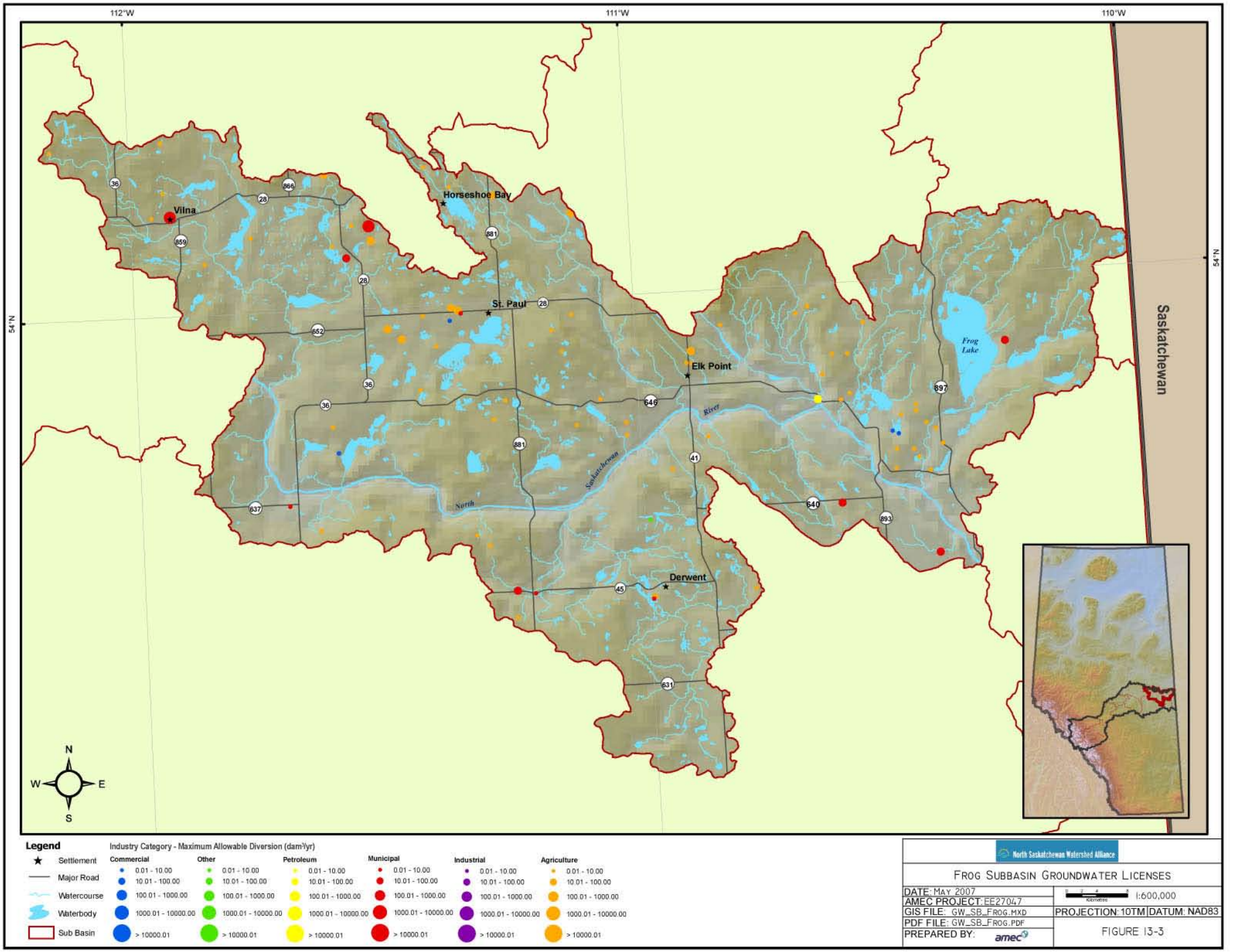

112°W
111°W
110°W
54°N
Saskatchewan
Vilna
Horseshoe Bay
St. Paul
Elk Point
Derwent
Frog Lake
North Saskatchewan River
36
28
866
859
881
852
646
897
41
640
893
637
45
631
N
W
E
S
Legend
Settlement
Major Road
Watercourse
Waterbody
Sub Basin
Industry Category - Maximum Allowable Diversion (dam³/yr)
Commercial
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
FROG SUBBASIN SURFACE WATER LICENSES
DATE: MAY 2007
AMEC PROJECT: EE27047
GIS FILE: SW_SB_FROG.MXD
PDF FILE: SW_SB_FROG.PDF
PREPARED BY: amec
Kilometres
1:600,000
PROJECTION: 10TM | DATUM: NAD83
FIGURE 13-2

Figure 13-3 Frog Sub-basin Groundwater Licences

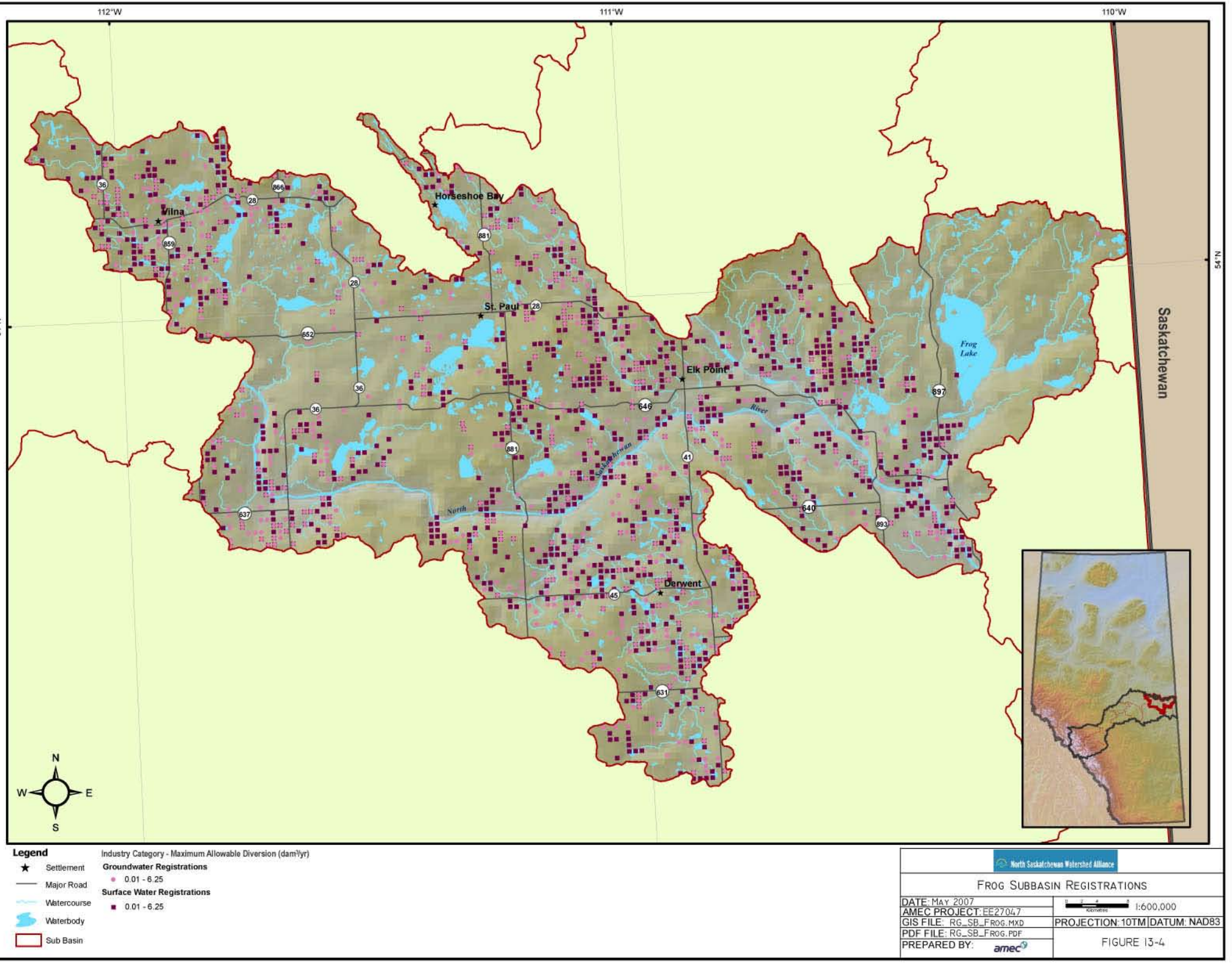


North Saskatchewan Watershed Alliance

FROG SUBBASIN GROUNDWATER LICENSES

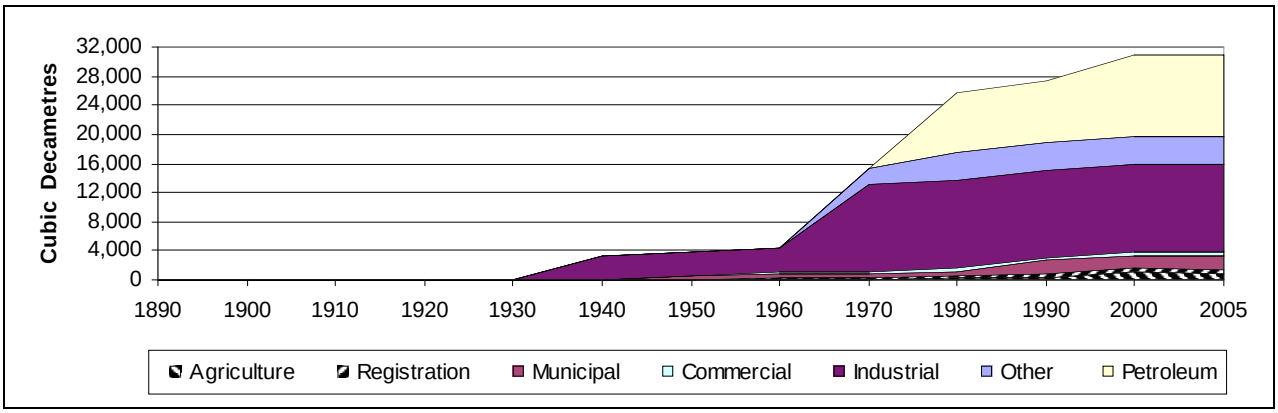
DATE: MAY 2007	1:600,000
AMEC PROJECT: EE27047	
GIS FILE: GW_SB_FROG.MXD	PROJECTION: 10TM | DATUM: NAD83
PDF FILE: GW_SB_FROG.PDF	
PREPARED BY: amec	FIGURE 13-3

Figure 13-4 Frog Sub-basin Registrations


112°W
111°W
110°W
54°N
Saskatchewan
Vilna
Horseshoe Bay
St. Paul
Elk Point
Derwent
Frog Lake
North Saskatchewan River
36
28
886
881
859
852
646
897
41
640
893
837
45
631
N
W
E
S
Legend
Settlement
Major Road
Watercourse
Waterbody
Sub Basin
Industry Category - Maximum Allowable Diversion (dam³/yr)
Groundwater Registrations
0.01 - 6.25
Surface Water Registrations
0.01 - 6.25
North Saskatchewan Watershed Alliance
FROG SUBBASIN REGISTRATIONS
DATE: MAY 2007
AMEC PROJECT: EE27047
GIS FILE: RG_SB_FROG.MXD
PDF FILE: RG_SB_FROG.PDF
PREPARED BY: amec
Kilometres
1:600,000
PROJECTION: 10TM | DATUM: NAD83
FIGURE 13-4

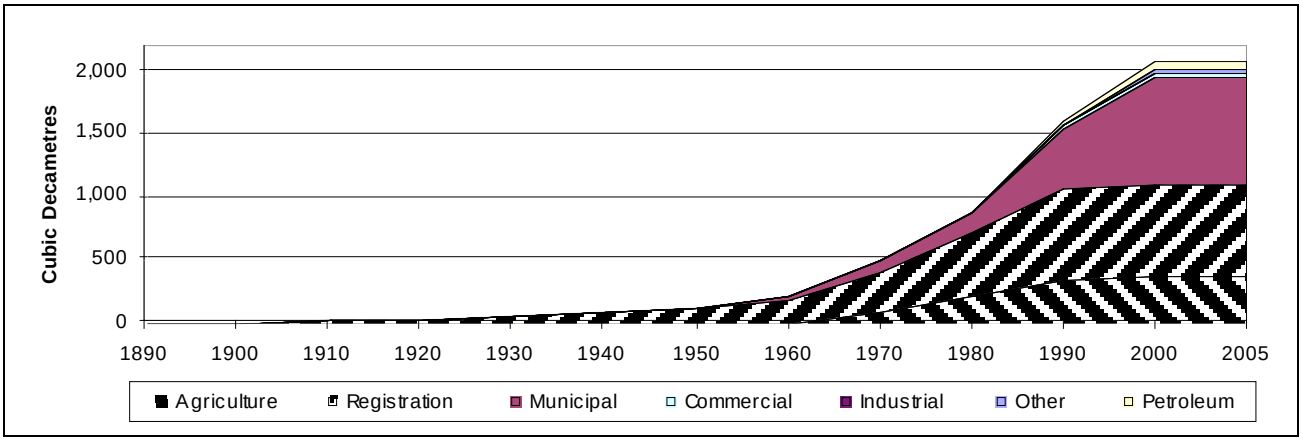
An historical perspective on water allocated among the sectors is provided in Figure 13-5 (surface water) and Figure 13-6 (groundwater). The two largest allocations for surface water in the Frog Sub-basin are the industrial and the petroleum sectors. Allocations for the industrial sector were first issued in the 1930s and remained relatively unchanged until the 1960s after which time the allocations increased substantially. Although the rate of increase has declined in recent years, industrial allocations have continued to gradually increase over the last decade. Surface water allocations for the petroleum sector were first issued in the 1970s and increased substantially up to 2000 have remained relatively stable since then. Allocations for the remaining sector show a similar pattern over the last decade.

Figure 13-5 Historical Trends in Surface Water Allocation in the Frog Sub-basin



The two largest allocations for groundwater in the Frog Sub-basin are for registrations and the municipal sector. Registrations were first issued for water use with priority dates in the 1900s and the allocations increased up to the 1990s but have remained unchanged since then. Groundwater allocations for the municipal sector were first issued in the 1950s, increased rapidly until 2000, and have remained unchanged since then. Allocations for the remaining sector show similar patterns over the last decade.

Figure 13-6 Historical Trends in Groundwater Allocation in the Frog Sub-basin



13.1 Municipal and Residential Sector

13.1.1 Population

The population of Frog Sub-basin is split between urban (47 percent) and rural (43 percent) municipalities, with a significant portion of the population (10 percent) living in Aboriginal settlements, as shown in Table 13-1. The population of the Aboriginal settlements has grown quickly (10 percent), while and urban municipalities have grown more slowly (4 percent). The population of the rural municipalities declined over the inter-censal period by almost 3 percent.

Table 13-1 Population Distribution and Growth in the Frog Sub-basin

	2006		2001	2001 to 2006 Population Change
	Population	Percent	Population	Percent
Urban Municipality	7,560	47.3%	7,260	4.1%
Rural Municipality	6,787	42.5%	6,989	-2.9%
First Nations and Métis Settlements	1,629	10.2%	1,487	9.6%
Total	**15,976**	**100.0%**	**15,736**	**1.5%**

Table 13-2 lists all municipalities situated in the Frog Sub-basin, their estimated 2006 sub-basin populations, and a summary of their water licence allocations. The largest urban centres are the Town of St. Paul (5,106 residents) and the Town of Elk Point (1,487). County of St. Paul No. 19 has the largest population of the rural municipalities (5,302), while Frog Lake First Nation is the most populous Aboriginal settlement (1,160).

Table 13-2 Municipal Populations and Water allocations within Frog Sub-basin

Municipal Name		2006 Population	Water Source	2005 Allocation (dam^3)
Urban	TOWN OF ST. PAUL	5,106	SURFACE	937.7
	TOWN OF ELK POINT	1,487	SURFACE	759.8
	VILLAGE OF MYRNAM	362	GROUNDWATER	48.1
	VILLAGE OF VILNA	274	GROUNDWATER	152.2
	SUMMER VILLAGE OF HORSESHOE BAY	214		
	VILLAGE OF DERWENT	117	GROUNDWATER	16.0
Rural	COUNTY OF ST. PAUL NO. 19	5,302	GROUNDWATER	144.1
	COUNTY OF TWO HILLS NO. 21	1,063	GROUNDWATER	14.8
	SMOKY LAKE COUNTY	255	GROUNDWATER	1.2
	COUNTY OF VERMILION RIVER	152	GROUNDWATER	73.0
	MUNICIPAL DISTRICT OF BONNYVILLE NO. 87	13		
	COUNTY OF MINBURN NO. 27	0		
Aboriginal	FROG LAKE FIRST NATION	1,160	SURFACE	135.7
	FISHING LAKE METIS SETTLEMENT	469	GROUNDWATER	292.0
	ELIZABETH METIS SETTLEMENT	0		
	SADDLE LAKE FIRST NATION	0		

13.1.2 Allocations

As of 2005, 22 municipal water licences had been issued to 21 licensees in the Frog Sub-basin. These licences allow maximum withdrawals of 2,627 dam^3 per year. As shown in Figure 13-1, municipal water uses account for 8 percent of water allocations in the basin.

Surface water licences account for 70 percent or 1,842 dam^3 of total municipal water allocations in the sub-basin, of which 1,833 dam^3 is for urban use and 9 dam^3 is for rural use.

Groundwater licences represent 30 percent or 785 dam3 of total municipal water allocations. Urban users can withdraw up to 657 dam^3. Other users can withdraw up to 84 dam^3 of groundwater and rural users are allocated up to 43 dam^3.

Licensees that are not municipalities but have municipal water use licences within the Frog Sub-basin are shown in Table 13-3. It should be noted that the EMS database classifies a licence for the Village of Edgerton as being in the Frog Sub-basin, but the licence was excluded from the analysis in this chapter because the Village is located on Ribstone Creek in the Battle River Basin.

Table 13-3 Additional Municipal Water Use Licensees in the Frog Sub-basin

Licensee	Water Source	Allocation (dam^3)
ALBERTA MUNICIPAL AFFAIRS	GROUNDWATER	37.0
881 HYDRO	SURFACE	7.4
LETOURNEAU, ANN	GROUNDWATER	6.2
WENGER, AMBROSE	SURFACE	1.2

13.1.3 Licensed Water Use

Table 13-4 summarizes licensed water use for the municipal sector in the Frog Sub-basin. Under these licences, it is expected that 1,871 dam^3 will be used (i.e. 71 percent of allocations can be consumed and/or lost) with the remainder (29 percent or 756 dam^3) expected to be returned. Thirty-six percent of allocated urban groundwater and 28 percent of allocated urban surface water is designated as return flow, whereas all other municipal uses are not expected to have any return flow.

13.1.4 Actual Water Use

Three municipal licensees, the rural municipality of St. Paul County No. 19, and the towns of St. Paul and Elk Point, reported their 2004 water and wastewater flows to MWWS. These three municipalities have a combined population of 11,895 or 75 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.

Annual per capita diversion among the three municipal licensees providing flow data was 142 m^3, per capita water use was 6 m^3 and per capita return was 136 m^3. This estimate of per capita water use is very small compared to other communities in the basin and it is unknown whether this may be due to the presence of homes that have their own private wells but are serviced by municipal wastewater facilities, by stormwater and/or groundwater contributions to wastewater flows, or by the presence of metering errors. Elk Point's and St. Paul County's withdrawals were well within their licensed allocations (21 and 46 percent, respectively), whereas the Town of St. Paul's diversions were 98 percent of its allocation. When these per capita values are extrapolated using the population of the sub-basin, estimated water use amounts to 2,261 dam^3 for water diversions (86 percent of licensed diversions), 2,166 dam^3 for water returns (287 percent of licensed returns) and 96 dam^3 for municipal water use (5 percent of licensed use). These total estimates are apportioned according to the licensed ratios, as shown in Table 13-4 to derive groundwater and surface water estimates for urban, rural and other municipal uses.

Table 13-4 Licensed Municipal Allocations and Use and Estimated Actual Use, Frog 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	5	1,833.2	1,316.3	516.8	1,578	67	1,481
	Groundwater	9	657.4	418.7	238.7	566	21	684
	Subtotal	**14**	**2,490.6**	**1,735.0**	**755.6**	**2,144**	**88**	**2,165**
Rural**	Surface	2	8.6	8.6	0.0	7	0	0
	Groundwater	2	43.2	43.2	0.0	37	2	0
	Subtotal	**4**	**51.8**	**51.8**	**0.0**	**44**	**2**	**0**
Other***	Surface	0	0	0	0			
	Groundwater	4	84.1	84.1	0.0	72	4	0
	Subtotal	**4**	**84.1**	**84.1**	**0.0**	**72**	**4**	**0**
Total	Surface	7	1841.8	1325.0	516.8	1,585	67	1,481
	Groundwater	15	784.7	545.9	238.7	675	28	684
	Total	**22**	**2,626.5**	**1,870.9**	**755.6**	**2,261**	**95**	**2,165**

* 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

13.1.5 Future Water Use Forecasts

Figure 13-7 shows low, medium and high population projection scenarios for the Frog Sub-basin based on Alberta Finance Census Division projections. The population forecasts in Figure 13-7 have been used to predict future municipal surface and groundwater use. The resulting forecasts of water use are provided in Table 13-5, and are based on the estimated per capita water use in 2005.

Figure 13-7 Frog Sub-basin Population Growth Forecasts

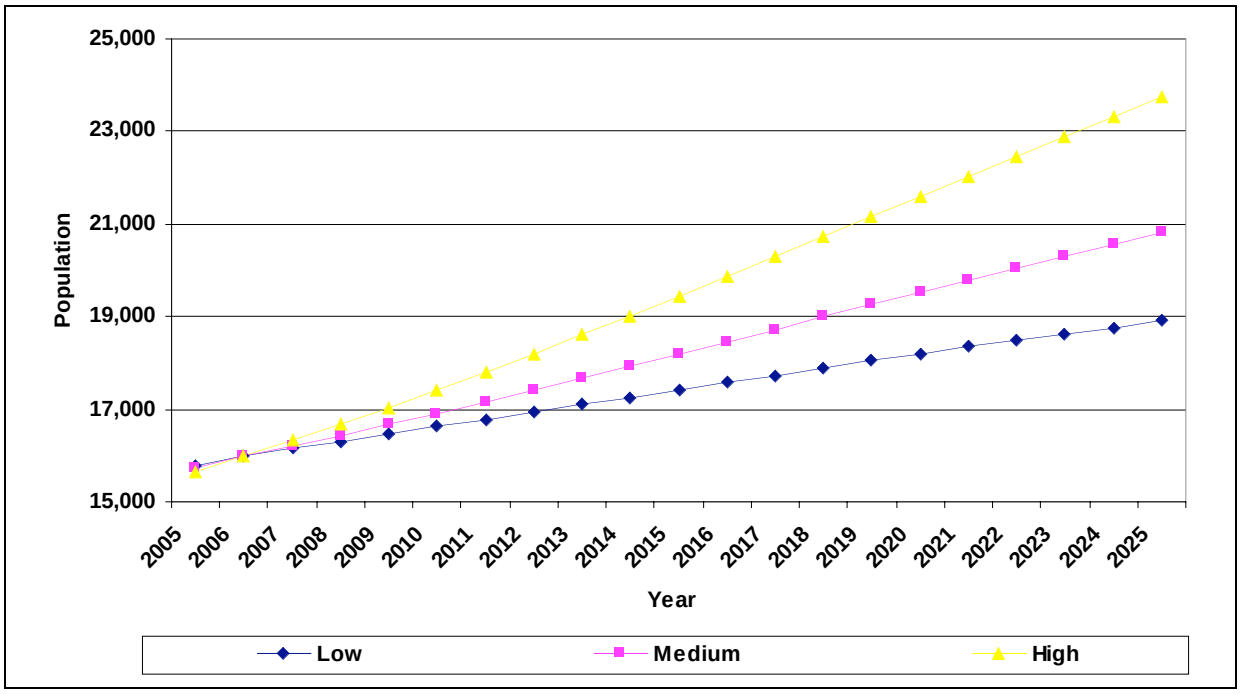


Table 13-5 Projected Municipal Water Use in the Frog Sub-basin

Scenario	Source	2005	2010	2015	2020	2025
Low Population Growth	Surface	68	71	73	75	77
	Groundwater	28	29	30	31	32
	Total	**96**	**100**	**103**	**106**	**108**
Medium Population Growth	Surface	68	72	76	81	84
	Groundwater	28	30	31	33	35
	Total	**96**	**102**	**108**	**114**	**119**
High Population Growth	Surface	68	75	82	89	97
	Groundwater	28	31	34	37	40
	Total	**96**	**105**	**116**	**126**	**136**

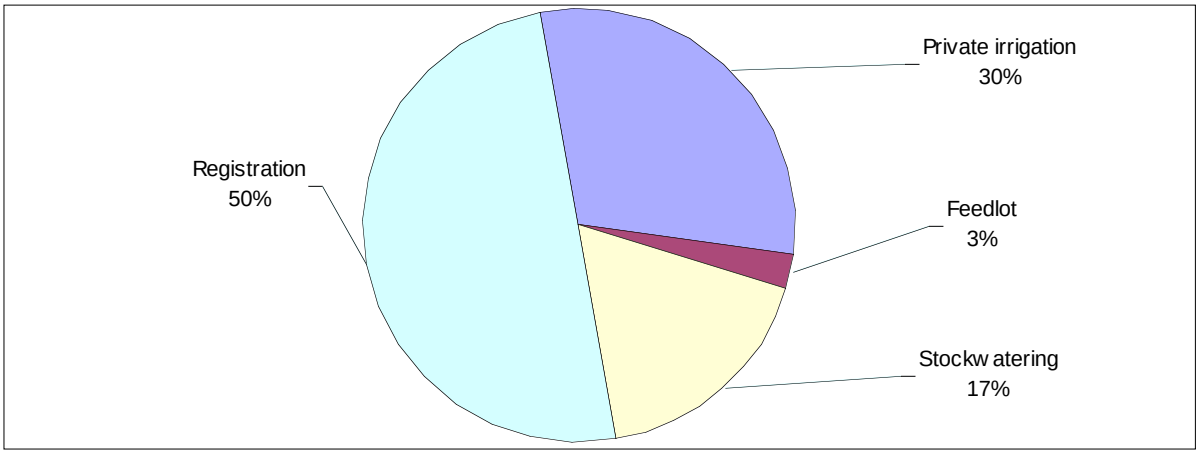
Under the Low Population Growth scenario, municipal water use in 2025 is expected to be 13 percent higher than at present and actual water use will be 6 percent of the current licensed use amount. Under the High Population Growth scenario, water use will increase by 42 percent over current levels and water use is expected to be 7 percent of the amount presently allowed in the licences.

13.2 Agriculture Sector

As of December 2005 a total of 2,556 dam^3 had been allocated to the agricultural sector in the Frog Sub-basin. This includes 2,452 registrations representing 1,278 dam^3 and 153 licences representing 1,278 dam^3 of water. Water allocated to agriculture accounts for 8 percent of all allocation in the Frog Sub-basin.

Figure 13-8 shows how this water is distributed among the different agricultural activities in the sub-basin. The largest allocation is for registrations (50 percent). Private irrigation accounts for 30 percent, stockwatering accounts for 17 percent, and feedlot accounts for 3 percent of total allocations for agriculture in the sub-basin.

Figure 13-8 Water Allocation for Agricultural Activities in the Frog Sub-basin, 2005



A total of 1,555 registrations and 69 licences allow withdrawal of up to 1,444 dam^3 of surface water; this accounts for 56 percent of water allocations for the agricultural sector. Groundwater licences and registrations account for the other 44 percent of allocations, with 1,112 dam^3 being allocated through 84 licences and 897 registrations.

13.2.1 Overview of Agriculture

Based on information from the 2001 Census of Agriculture, there were about 1,111 farms in the Frog Sub-basin (9 percent of North Saskatchewan total) with an average size of 917 acres. At the North Saskatchewan Basin level there are about 12,300 farms with an average size of 625 acres. Farms in the Frog Sub-basin cover an area of nearly one million acres; this is equivalent to about 4,122 km^2 or about 73 percent of the sub-basin. As shown in Table 13-6, 46 percent of the land in the basin is used to raise crops. About 43 percent of agricultural land is pasture. The rest of the lands are in summer fallow or other uses.

Table 13-6 Agricultural Land Use in the Frog Sub-basin, 2001

Land Use	Acres	Percent
Crop Land	473,172	46.5%
Summerfallow	34,673	3.4%
Tame/Seeded Pasture	152,692	15.0%
Natural Pasture	286,676	28.1%
Other	71,340	7.0%
Total	**1,018,553**	**100.0%**

The types of farming activity vary within the sub-basin. Table 13-7 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 Frog Sub-basin accounts for 9 percent of total farms in the North Saskatchewan. About 52 percent of the farms in the sub-basin raise beef cattle and about 19 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 similar for both Frog and North Saskatchewan.

Table 13-7 Classifications of Farms in the Frog 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	0.4%	1.9%	1.9%
Cattle (beef) Farms	51.7%	10.4%	45.8%
Hog Farms	1.8%	11.7%	1.4%
Poultry & Egg Farms	0.4%	3.8%	1.1%
Wheat Farms	3.2%	7.0%	4.2%
Grain & Oilseed Farms	19.2%	9.0%	19.6%
Field Crop Farms	10.8%	11.5%	8.6%
Fruit Farms	0.1%	4.3%	0.2%
Misc. Specialty Farms	7.8%	5.5%	12.9%
Sum of Livestock Comb. Farms	2.7%	9.5%	2.6%
Sum of Vegetable Farms	0.1%	8.6%	0.1%
Sum of Other Comb Farms	1.7%	10.7%	1.5%
Total	**100%**	**9.0%**	**100%**

13.2.2 Stockwatering

As noted in Table 13-7 about 54 percent of farms in the Frog Sub-basin were classified as livestock operations, primarily cattle. Estimated livestock populations for major species are provided in Table 13-8. The table shows that there are about 140,000 cattle and calves which, together, accounted for about 60 percent of the livestock population. Other livestock in the sub-basin included poultry, pigs, sheep and lamb, horses and ponies, bison, deer and elk.

13.2.2.1 Water Allocation

Overall, 2,594 licences and registrations have been issued for livestock watering with total allocation amounting to 1,789 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 13-8 summarizes current water licences and registrations issued for livestock according to the water source. It shows that surface water accounts for about 38 percent of allowable diversions for livestock and that registrations account for 71 percent of the allocations

Table 13-8 Estimated Livestock Populations in the Frog Sub-basin, 2001

Livestock Species	Frog	North Saskatchewan	% North Saskatchewan
Hens and Chicken	75,256	3,090,930	2.4%
Turkey	72	41,519	0.2%
Cattle	103,892	990,169	10.5%
Calves	34,147	365,725	9.3%
Pigs	15,678	232,169	6.8%
Sheep and Lamb	3,626	55,204	6.6%
Horse and Ponies	2,087	35,172	5.9%
Bison	1,772	18,906	9.4%
Deer	21	2,864	0.7%
Elk	457	6,426	7.1%

13.2.2.2 Licensed Water Use

Table 13-8 shows that license and registrations issued for livestock watering, including feed lots, have no allowances for return flow. The licenses and registrations assume that all diverted water will be consumed or lost.

13.2.2.3 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 Frog Sub-basin. However, a reasonable estimate of water use can be derived using the actual animal population in the basin as shown in Table 13-8. Based on livestock populations for the Frog Sub-basin in 2001, the total water required for livestock was estimated to be 1,196 dam^3, or about 67 percent of the licensed allocation.[1] The calculations for this estimate are provided also in Table 13-10 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 90 percent of the total, about 4 percent is required by pigs, and all other species accounted for the remaining 6 percent.

The estimated actual consumption (1,196 dam^3) based on livestock populations shown in Table 13-9 does 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).

[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.

Table 13-9 Summary of Water Licences and Registrations Issued for Livestock Watering in the Ram 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	0	0.0	0.0	0.0	0	N/A
	Groundwater	1	66.6	66.6	0.0	0	N/A
	Subtotal	**1**	**66.6**	**66.6**	**0.0**	**0**	**N/A**
Registration	Surface	1,555	548.1	548.1	0.0	0	N/A
	Groundwater	897	729.9	729.9	0.0	0	N/A
	Subtotal	2,452	1,277.9	1,277.9	0.0	**0**	**N/A**
Stockwatering	Surface	**58**	**128.6**	**128.6**	**0.0**	0	N/A
	Groundwater	83	315.5	315.5	0.0	0	N/A
	Subtotal	141	444.1	444.1	0.0	**0**	**N/A**
Total	Surface	1,613	676.6	676.6	0.0	0	N/A
	Groundwater	981	1,112.0	1,112.0	0.0	0	N/A
	Total	**2,594**	**1,788.6**	**1,788.6**	**0.0**	**0**	**N/A**

Table 13-10 Estimated Livestock Water Requirements for 2001

Livestock Species	Animal Population	Daily Consumption (gallons)	Annual Use (dam^3)
Hens and Chickens	75,256	0.045	5.6
Turkey	72	0.15	0.0
Bulls	1,902	9.0	28.4
Milk Cows	293	30.0	14.6
Beef Cows	38,111	9.0	568.8
Heifers	19,534	6.0	194.4
Steers	10,945	6.0	108.9
Calves	34,147	3.0	169.9
Boars	116	6.5	1.2
Sows and Gilts - Breeding	2,242	6.5	24.2
Nursing and Weaner Pigs	5,380	0.5	4.5
Grower and Finishing Pigs	7,940	1.5	19.8
Sheep and Lambs	3,626	2.0	12.0
Horse and Ponies	2,087	10.0	34.6
Bison	1,772	2.0	5.9
Deer	21	10.0	0.4
Elk	457	3.5	2.7
Total			**1,195.7**

Since 62 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 1,440 dam^3 would be required to support the animal populations in Table 13-10. This water requirement is about 80 percent of the water allocation through licences and registrations.

13.2.2.4 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 major new and expanded 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 factor is groundwater. Based on Alberta Agriculture's assessment, it would appear that there are some opportunities for backgrounding operations in the Frog Sub-basin. Table 13-11 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 13-11 Projected Water Use for Livestock in the Frog Sub-basin, (dam^3)

Scenario	Source	2005	2010	2015	2020	2025
Low Growth	Surface	696	713	732	752	773
	Groundwater	744	762	783	804	826
	Total	**1,440**	**1,475**	**1,515**	**1,557**	**1,599**
Medium Growth	Surface	696	740	789	841	897
	Groundwater	744	791	844	899	958
	Total	**1,440**	**1,531**	**1,633**	**1,741**	**1,855**
High Growth	Surface	696	780	877	984	1,104
	Groundwater	744	834	937	1,052	1,180
	Total	**1,440**	**1,614**	**1,814**	**2,036**	**2,285**

13.2.3 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 182 acres of land in the Frog 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 631 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.

13.2.3.1 Water Allocation

There are 11 licences that allocate approximately 767 dam^3 of surface water for irrigation purposes.

13.2.3.2 Licensed Use

Table 13-12 shows that there are no return flow allowances in allocations for irrigation; the entire allocation can be used.

13.2.3.3 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 (1,440 dam^3) is 1.9 times the amount of water used for crop watering.

Table 13-12 Irrigation Allocations and Use and Reported Actual Water Use, Frog 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	11	767.1	767.1	0.0	0	N/A
	Groundwater	0	0.0	0.0	0.0	0	N/A
	Subtotal	**11**	**767.1**	767.1	**0.0**	**0**	**N/A**
Total	Surface	11	767.1	767.1	0.0	0	N/A
	Groundwater	0	0.0	0.0	0.0	0	N/A
	Total	**11**	**767.1**	**767.1**	**0.0**	**0**	**N/A**

13.2.3.4 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 767 dam^3 over the forecast period.

13.2.4 Summary

In summary, current agricultural water use in the Frog Sub-basin is estimated to be about 2,207 dam^3, of which 65 percent is for stockwatering and 35 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 13-13 shows a summary of future agricultural water use.

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

Scenario	Source	2005	2010	2015	2020	2025
Low Growth	Surface	1,463	1,480	1,499	1,519	1,540
	Groundwater	744	762	783	804	826
	Total	**2,207**	**2,242**	**2,282**	**2,324**	**2,366**
Medium Growth	Surface	1,463	1,507	1,556	1,608	1,664
	Groundwater	744	791	844	899	958
	Total	**2,207**	**2,298**	**2,400**	**2,508**	**2,622**
High Growth	Surface	1,463	1,547	1,644	1,751	1,871
	Groundwater	744	834	937	1,052	1,180
	Total	**2,207**	**2,381**	**2,581**	**2,803**	**3,052**

Agricultural water use in 2025 would be about 2,366 dam^3 (an increase of 7 percent from 2005) under Low Growth. Under High Growth, water use is projected to be 3,052 dam^3 by 2025; this represents an increase of 38 percent from 2005. For Medium Growth, agricultural water use in 2025 is expected to increase by 19 percent over current levels.

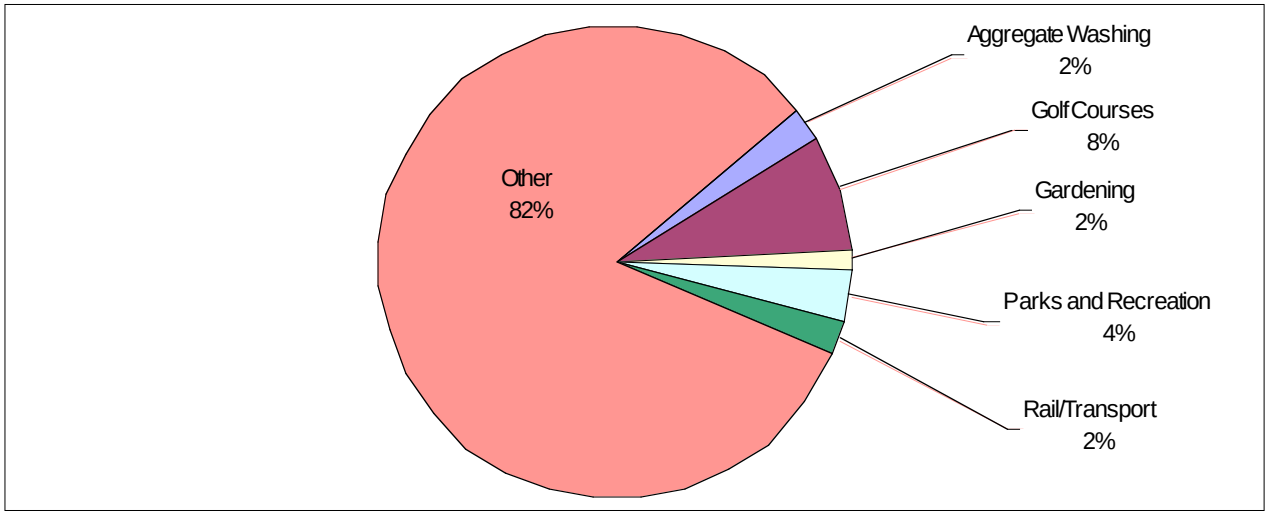
13.3 Commercial Sector

There are 11 licences that allow diversion of 488 dam^3 of water in the Frog sub-basin. This allocation accounts for about 2 percent of total allocations in the sub-basin.

13.3.1 Water Allocations

Figure 13-9 shows how this allocation is distributed among the various commercial sector activities, including other (82 percent), golf courses (8 percent), and parks and recreation (four percent). Aggregate washing, gardening and rail/transport each account for 2 percent of the allocations. Surface water accounts for 92 percent of allocations and the largest allocation is for other activity. Groundwater accounts for the remaining 8 percent of the allocations and the largest groundwater allocation is for parks and recreation

Figure 13-9 Water Allocation for Commercial Activities in the Frog Sub-basin



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13.3.2 Licensed Water Use

Table 13-14 provides a summary of licensed allocations, use and return for various activities within the commercial sector in the Frog sub-basin. The table shows that most commercial licensees are expected to consume all the water they withdraw. The exception is for other commercial uses, where about 84 percent of withdrawals are expected to be returned. Overall, commercial licences assume that about 339 dam^3 (70 percent of allocation) will be returned to surface water sources. Licences issued for other commercial activity account for all of the return flow.

13.3.3 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 commercial sector in the Frog 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 (1 percent) so overall water use estimates are not likely to be greatly affected.

13.3.4 Future Water Use Forecasts

Since most of the allocation (90 percent) is for two activities – other and golf courses; forecasts of future demand will be based on those activities.

Table 13-14 Licensed Commercial Allocations, Reported and Actual Water Use, Frog 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	1	7.4	7.4	0.0	0	N/A	N/A
	Groundwater	0	0.0	0.0	0.0			
	Subtotal	**1**	**7.4**	7.4	**0.0**	**0**	**N/A**	**N/A**
Golf Courses	Surface	1	31.8	31.8	0.0	0	N/A	N/A
	Groundwater	1	7.4	7.4	0.0	0	N/A	N/A
	Subtotal	**2**	**39.2**	39.2	**0.0**	**0**	**N/A**	**N/A**
Other	Surface	2	402.1	62.9	**339.2**	0	N/A	N/A
	Groundwater	1	1.4	1.4	**0.0**	0	N/A	N/A
	Subtotal	**3**	**403.5**	64.3	**339.2**	**0**	**N/A**	**N/A**
Parks and Recreation	Surface	0	0.0	0.0	**0.0**			
	Groundwater	3	17.3	17.3	**0.0**	0	N/A	N/A
	Subtotal	**3**	**17.3**	17.3	**0.0**	**0**	**N/A**	**N/A**
Rail/Transport	Surface	1	10.0	10.0	**0.0**	0	N/A	N/A
	Groundwater	0	0.0	0.0	**0.0**			
	Subtotal	**1**	**10.0**	10.0	**0.0**	**0**	**N/A**	**N/A**
Total	Surface	5	451.3	112.1	339.2	0	N/A	N/A
	Groundwater	6	37.0	37.0	0.0	0	N/A	N/A
	Total	**11**	**488.4**	**149.1**	**339.2**	**0**	**N/A**	**N/A**

13.3.4.1 Other

Water use for the other activity is assumed to remain unchanged from the current level of 64 dam^3, all from surface water sources, over the forecast period.

13.3.4.2 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 which will occur as a result of population growth. However, the population growth must reach a specified threshold before one additional nine hole course will be developed (*i.e.*. golf course expansion is not linearly related to population growth). Using this assumption, and given the population growth rate in the Frog Sub-basin, golf course expansion is unlikely. Golf course water use is expected to remain unchanged at 39 dam^3 over the forecast period across all growth scenarios. It is assumed that the proportion of surface and groundwater will not change over the forecast period relative to 2005.

13.3.5 Summary

A summary of the projected water demand for the commercial sector in the Vermilion Sub-basin is provided in Table 13-15. Note that this forecast combines the estimates for other and golf courses (which together account for 90 percent of allocation in the sub-basin), with the assumption that all the remaining commercial licensees are fully using their entitlements. Water use is not expected to change from current level of 149 dam^3 across all growth scenarios over the forecast period

Table 13-15 Projected Water Use for the Commercial Sector, Vermilion Sub-basin
(dam^3)

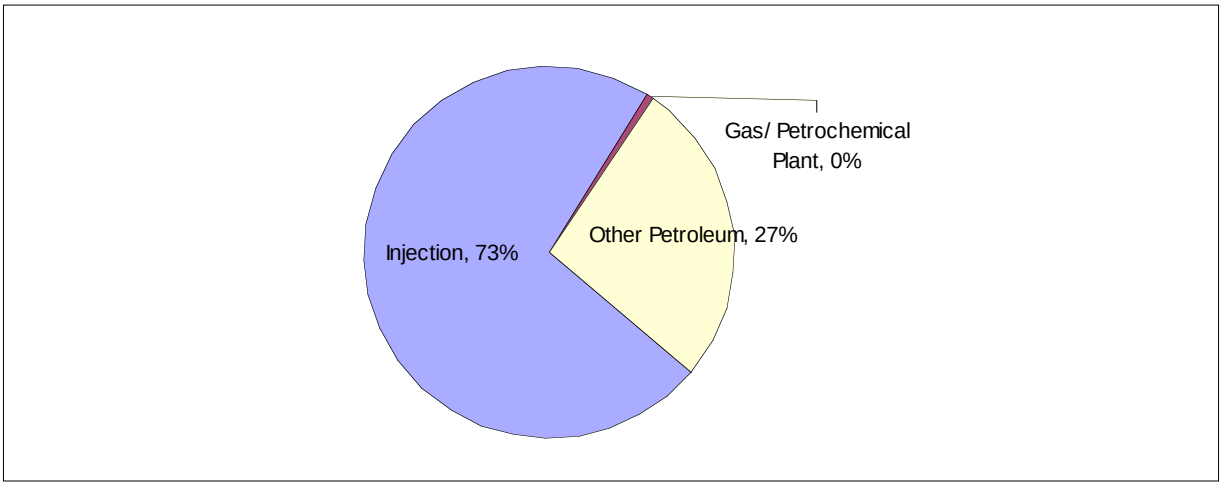
Scenario	Source	2005	2010	2015	2020	2025
Low, Medium, High Growth	Surface	112	112	112	112	112
	Groundwater	37	37	37	37	37
	Total	**149**	**149**	**149**	**149**	**149**

13.4 Petroleum Sector

In the Frog Sub-basin, 11 active licences allocate 11,307 dam^3 of water to the petroleum sector. Most petroleum water allocations are for injection and gas and petrochemical plants. There is a small amount of water for other petroleum activities (Figure 13-10).

Petroleum allocations accounts for just over 34 percent of total allocations in the sub-basin. More than (99 percent) of allocations for the petroleum sector are for surface water (11,257 dam^3).

Figure 13-10 Petroleum Water Allocation by Use in the Frog Sub-basin



13.4.1 Injection

Five water licences have been issued for injection activities in the Frog Sub-basin. They allow withdrawals of up to 8,229 dam^3 of surface water. Injection water allocations commenced in the 1990s. Licensees are expected to consume 100 percent of the water they withdraw.

Detailed summaries of reported water used for injection in the Frog Sub-basin have been prepared by Geowa based on EUB data and these are presented in Table 13-16. According to the reports submitted to the EUB, no water was diverted for injection purposes in 2005 and injection projects are assumed to not require water during the forecast period.

13.4.2 Gas/Petrochemical Plants

In the Frog Sub-basin, two groundwater licences that have been issued for gas and petrochemical plant activities withdrawals of up to 50 dam^3. Gas and petrochemical plant water allocations commenced in the early 2000s. Licensees are expected to consume all the groundwater they withdraw.

The two water licence holders reported using 31 dam^3 of groundwater in 2005 (WURS). In the absence of any other information about this component of the petroleum sector, it is assumed that water used by gas and petrochemical plants in the Frog Sub-basin will remain constant over the forecast period.

Table 13-16 Licensed Allocations, Estimated Actual Water Use for the Petroleum Sector, Frog 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
Injection	Surface	5	8,228.6	8,228.6	0.0	0	0%	0%
	Groundwater	0	0.0	0.0	0.0			
	Subtotal	**5**	**8,228.6**	**8,228.6**	**0.0**	**0***	**0%**	**0%**
Gas/ Petrochemical Plant	Surface	0	0.0	0.0	0.0			
	Groundwater	2	50.0	50.0	0.0	315	61%	61%
	Subtotal	**2**	**50.0**	**50.0**	**0.0**	**31****	61%	61%
Other Petroleum	Surface	4	3,028.7	3,028.7	0.0	3,029	100%	100%
	Groundwater	0	0.0	0.0	0.0			
	Subtotal	**4**	**3,028.7**	**3,028.7**	**0.0**	**3,029*****	100%	100%
Total	Surface	9	11,257.3	11,257.3	0.0	3,029	27%	27%
	Groundwater	2	50.0	50.0	0.0	31	61%	61%
	Total	**11**	**11,307.3**	**11,307.3**	**0.0**	**3,060**	**27%**	**27%**

* EUB water use data provided by Geowa.
** Estimates based on WURS data.
*** Estimated water use assumes licensees are consuming the full entitlement of their licences.

13.4.3 Other Petroleum

In the Frog Sub-basin, four surface water licences have been issued for other petroleum activities and they allow withdrawals of up to 3,029 dam^3. Water allocations for other petroleum purposes commenced in the 1990s. Licensees are expected to consume all the groundwater they withdraw. There is no information on actual water use diversions or consumption for these activities. For the purposes of this analysis, it is assumed that licensees are using their full entitlement (3,029 dam^3). In the absence of information about this component of the petroleum sector, it is assumed that water used by gas and petrochemical plants in the Frog Sub-basin will remain constant for the forecast period.

13.4.4 Summary

Of the water allocated in the Frog Sub-basin, 34 percent has been allocated to the petroleum sector. The majority of petroleum allocations (73 percent) are for injection activities but, in 2005 these activities reported that they did not use any water use. Other petroleum activities are allocated 3,029 dam^3 and are assumed to be using their full entitlement.

Water requirements for petroleum activities in the Frog Sub-basin are not expected to change in the forecast period. The overall water use projections for the petroleum sector are provided in Table 13-17.

Table 13-17 Forecast of Petroleum Water Use in the Frog Sub-basin
(dam^3)

Scenario	Source	2005	2010	2015	2020	2025
Low Production	Surface	3,029	3,029	3,029	3,029	3,029
	Groundwater	31	31	31	31	31
	Total	**3,059**	**3,059**	**3,059**	**3,059**	**3,059**
Medium Production	Surface	3,029	3,029	3,029	3,029	3,029
	Groundwater	31	31	31	31	31
	Total	**3,059**	**3,059**	**3,059**	**3,059**	**3,059**
High Production	Surface	3,029	3,029	3,029	3,029	3,029
	Groundwater	31	31	31	31	31
	Total	**3,059**	**3,059**	**3,059**	**3,059**	**3,059**

13.5 Industrial Sector

In the Frog Sub-basin, two surface water licences allocate 12,039 dam^3 of water to the industrial sector (Table 13-18). Industrial allocations account for 37 percent of total allocations in the sub-basin. The two surface water licences are for manufacturing and have been issued to the Canadian Salt Company Ltd.: one in the 1940s and another in the 1970s. The company is expected to consume 1,204 dam^3 of the water and the allocation includes an allowance for returning 10,835 dam^3. In 2005, the reported water use for both licences was 438 dam^3. Water use for industries that are located outside municipalities and require their own water licence is not expected to change for the period to 2025.

Table 13-18 Licensed Allocations and Estimated Water Use for the Industrial Sector, Frog 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
Manufacturing	Surface	2	12,038.8	1,203.9	10,834.9	438	36%	3%
	Groundwater	0	0.0	0.0	0.0	0		
	Subtotal	**2**	**12,038.8**	**1,203.9**	**10,834.9**	**438***	**36%**	**3%**
Total	Surface	2	12,038.8	1,203.9	10,834.9	438	36%	3%
	Groundwater	0	0.0	0.0	0.0	0		
	Total	**2**	**12,038.8**	**1,203.9**	**10,834.9**	**438**	**36%**	**3%**

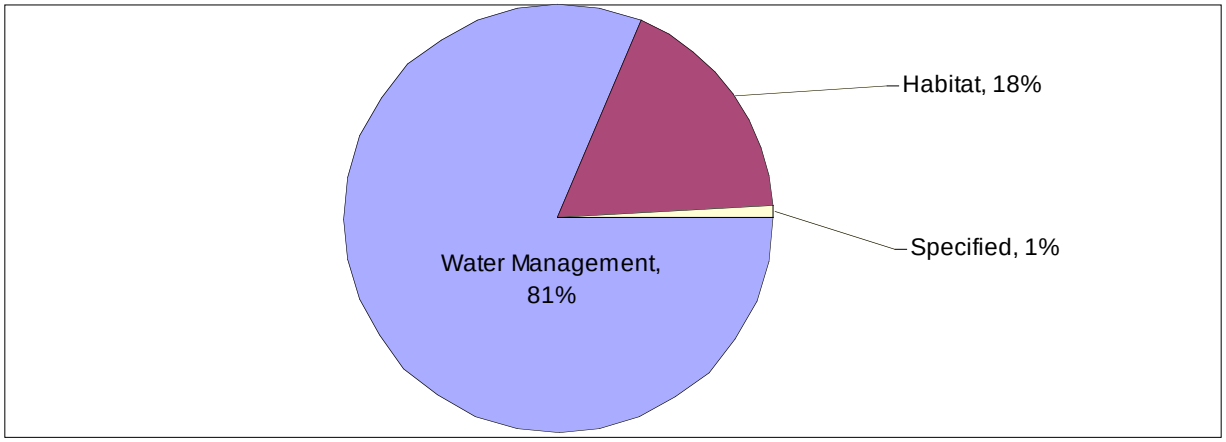
* Water use information is based on WURS data.

13.6 Other Sector

In the Frog Sub-basin, 24 active licences allocate 3,897 dam^3 of water to the other sector. These licences assume that about 57 percent of diversions will be returned after use. The other sector activities account for about 12 percent of licensed water use in the Frog Sub-basin. Almost all (99 percent) of the water allocated for other sector activities is for surface water. Other sector uses in the Frog Sub-basin includes water management for flood control and lake stabilization, fish, wildlife and habitat enhancement, and specified activities.

Water licences have been issued to Alberta Environment (1), Ducks Unlimited (20), the Town of St. Paul (1), and private individuals (2). Figure 13-11 illustrates the water use by other sector activities in the Frog Sub-basin. Table 13-19 summarizes the water allocation, use, and return associated with the licences for each activity in the Frog Sub-basin.

Figure 13-11 Other Sector Water Allocation by Use in the Frog Sub-basin



13.6.1 Water Management

In the Frog Sub-basin, 13 surface water licences have been issued for water management activities. The licences allow withdrawals of up to 3,171 dam^3 of water. Water management allocations commenced in the 1960s and increased in the 1970s and the 1980s. Licensees are expected to use 951 dam^3 and return 2,220 dam^3 after use.

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 holder is using their full entitlement. In the absence of information about this component of the other sector, it is assumed that water used by water management projects in the Frog Sub-basin will remain constant for the forecast period.

Table 13-19 Licensed Allocations and Estimated Actual Water Use for the Other Sector, Frog 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	3,171.3	951.0	2,220.3	951	100%	30%
	Groundwater	0	0.0	0.0	0.0	0		
	Subtotal	**13**	**3,171.3**	**951.0**	**2,220.3**	**951***	100%	**30%**
Habitat	Surface	9	690.1	690.1	0.0	690	100%	100%
	Groundwater	1	0.3	0.3	0.0	0		100%
	Subtotal	**10**	**690.4**	**690.4**	**0.0**	**690***	100%	**100%**
Specified	Surface	0	0.0	0.0	0.0	0		
	Groundwater	1	35.2	35.2	0.0	35	100%	100%
	Subtotal	**1**	**35.2**	**35.2**	**0.0**	**35***	100%	**100%**
Total	Surface	22	3,861.4	1,641.1	2,220.3	1,641	100%	42%
	Groundwater	2	35.5	35.5	0.0	35	100%	100%
	Total	**24**	**3,896.9**	**1,676.6**	**2,220.3**	**1,676**	100%	**43%**

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

13.6.2 Habitat Enhancement

In the Frog Sub-basin, nine surface water licences and one groundwater licence have been issued for wildlife and habitat enhancement projects. The licences allow for withdrawals of up to 690 dam^3 of surface water and 0.3 dam^3 of groundwater. Habitat enhancement allocations commenced in the 1980s for surface water and the early 2000s for groundwater. Licensees are expected to consume 100 percent of the water they are allowed to withdrawal.

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 absence of information about this component of the other sector, such as specific habitat development plans by Ducks Unlimited for this sub-basin, it is assumed that water used for habitat enhancement projects in the Frog Sub-basin will remain constant for the forecast period. Although one surface water licence by is scheduled to expire by 2010, it is assumed that this will be renewed.

Table 13-20 Forecast of Habitat Enhancement Water Use in the Frog Sub-basin
(dam^3)

Scenario	Source	2005	2010	2015	2020	2025
	Surface	690	690	690	690	690
	Groundwater	0	0	0	0	0
	Total	**690**	**690**	**690**	**690**	**690**

13.6.3 Specified Use

In the Frog Sub-basin, there is one surface water licence that has been issued to a private individual for use specified by the director. The licence allows for withdrawals of up to 35 dam^3 and was issued in the early 2000s. The licensee is expected to consume 100 percent of the water it is allowed to withdrawal.

13.6.4 Summary

The other sector in the Frog Sub-basin is dominated by water allocated for water management projects, which account for 81 percent of water allocations and 57 percent of the licensed water use. In the absence of information about the other sector, it is assumed that water used projects in the Frog Sub-basin will remain constant for the forecast period (Table 13-21).

Table 13-21 Forecast of Other Sector Water Use in the Frog Sub-basin

(dam^3)

Scenario	Source	2005	2010	2015	2020	2025
	Surface	1,641	1,641	1,641	1,641	1,641
	Groundwater	36	36	36	36	36
	Total	**1,677**	**1,677**	**1,677**	**1,677**	**1,677**

Under the above scenario, water use for water management in 2025 will decline by just under 3 percent from current levels.

13.7 Summary

Table 13-22 provides a summary of licensed allocations and estimated water use for each of the water use sectors in the Frog Sub-basin. In total, existing licences and registrations allow a maximum of 32,914 dam^3 of water to be withdrawn. Of this total 57 percent (18,764 dam^3) is expected to be consumed or lost. Figure 13-12 shows the allocations, licensed use and actual use for the different sectors. Actual use (7,626 dam^3) is about 41 percent of licensed use. The largest water user is the petroleum sector, which accounted for 40 percent of total water use. Figure 13-13 shows the forecasts to 2025 for all of the sectors under Medium Growth. By 2025 water use is expected to increase by about 2 percent under Low Growth (Table 13-23), about 6 percent under Medium Growth (Table 13-24), and about 12 percent under High Growth (Table 13-25).

Figure 13-12 Water Allocations and Actual Use, by Sector, Frog Sub-basin

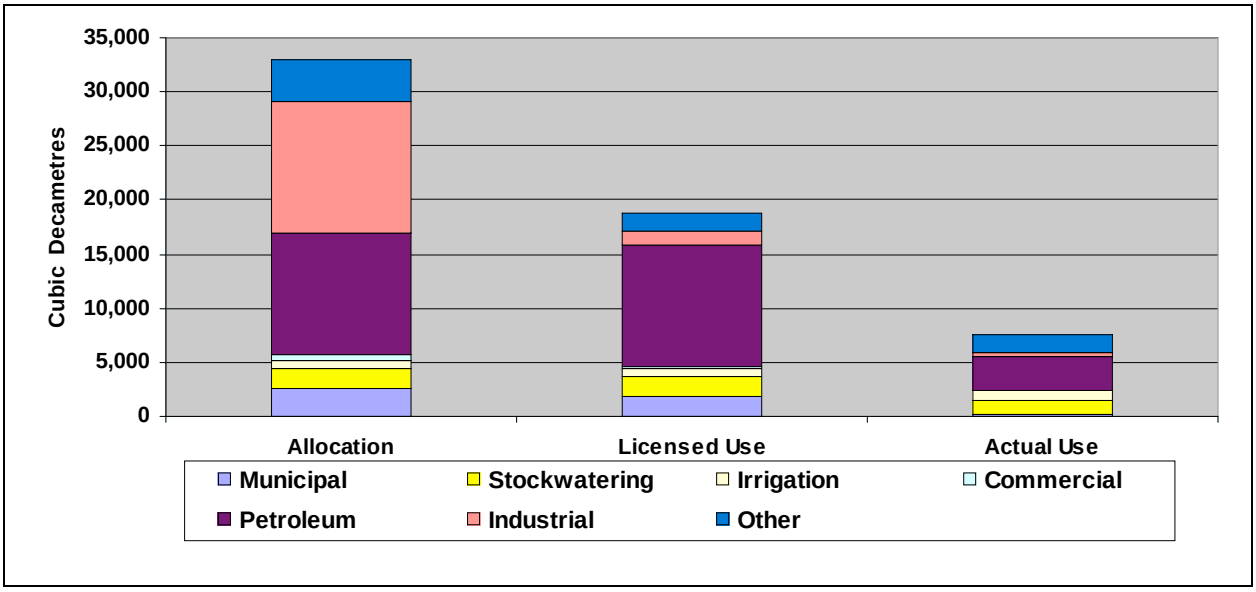


Table 13-22 Summary of Allocations and Estimated Water Use, Frog Sub-basin

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		2,627	1,871	756	10%	96	5%	1%
Agricultural	Stockwatering	1,789	1,789	0	10%	1,440	80%	19%
	Irrigation	767	767	0	4%	767	100%	10%
Commercial		488	149	339	1%	149	100%	2%
Petroleum		11,307	11,307	0	60%	3,059	27%	40%
Industrial		12,039	1,204	10,835	6%	438	36%	6%
Other		3,897	1,677	2,220	9%	1,677	100%	22%
Total		**32,914**	**18,764**	**14,150**	**100%**	**7,626**	**41%**	**100%**

Figure 13-13 Forecast Water Use in Frog Sub-basin: Medium Scenario

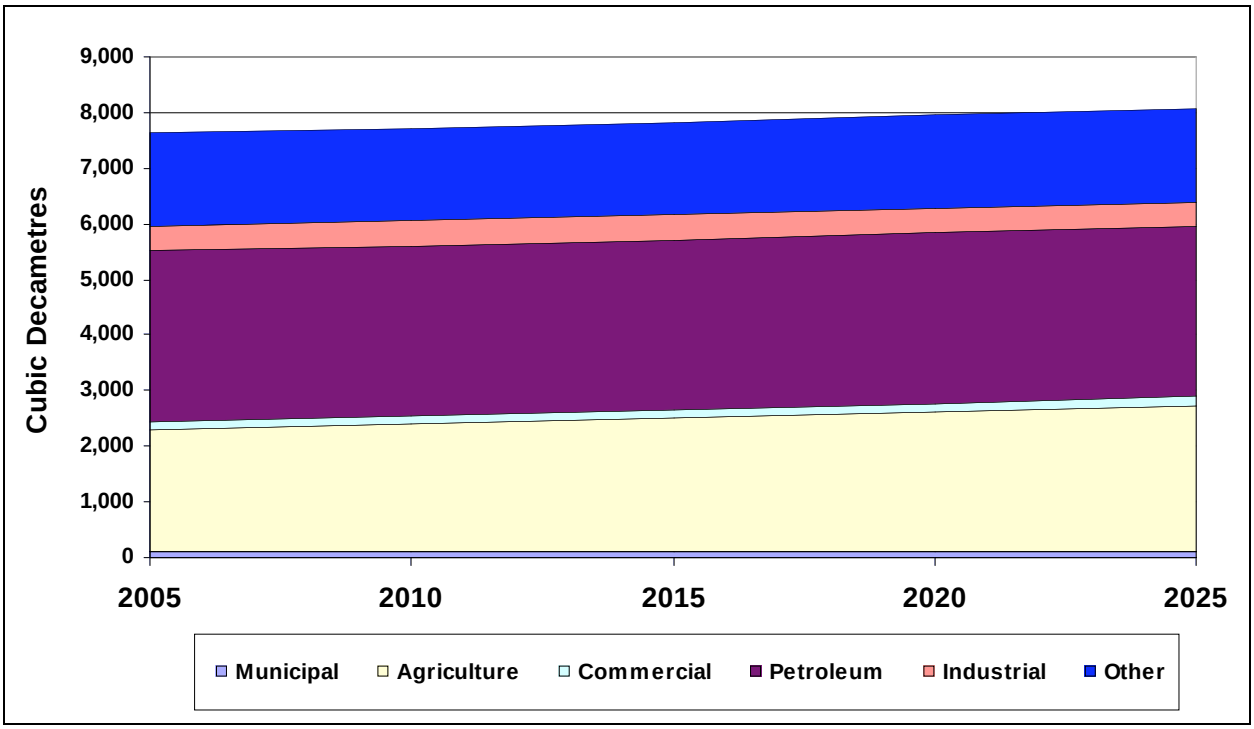


Table 13-23 Forecast Water Use, By Sector, Frog Sub-basin: Low Scenario
(dam^3)

Source	Sector	2005	2010	2015	2020	2025
Surface Water	Municipal	68	71	73	75	77
	Agricultural	1,463	1,480	1,499	1,519	1,540
	Commercial	112	112	112	112	112
	Petroleum	3,029	3,029	3,029	3,029	3,029
	Industrial	438	438	438	438	438
	Other	1,641	1,641	1,641	1,641	1,641
	Total	**6,751**	**6,771**	**6,792**	**6,814**	**6,837**
Groundwater	Municipal	28	29	30	31	32
	Agricultural	744	762	783	804	826
	Commercial	37	37	37	37	37
	Petroleum	31	31	31	31	31
	Industrial	0	0	0	0	0
	Other	36	36	36	36	36
	Total	**876**	**895**	**917**	**939**	**962**
Total	Municipal	96	100	103	106	109
	Agricultural	2,207	2,242	2,282	2,323	2,366
	Commercial	149	149	149	149	149
	Petroleum	3,060	3,060	3,060	3,060	3,060
	Industrial	438	438	438	438	438
	Other	1,677	1,677	1,677	1,677	1,677
	Total	**7,627**	**7,666**	**7,709**	**7,753**	**7,799**

Table 13-24 Forecast Water Use, By Sector, Frog Sub-basin: Medium Scenario
(dam^3)

Source	Sector	2005	2010	2015	2020	2025
Surface Water	Municipal	68	72	76	81	84
	Agricultural	1,463	1,507	1,556	1,608	1,664
	Commercial	112	112	112	112	112
	Petroleum	3,029	3,029	3,029	3,029	3,029
	Industrial	438	438	438	438	438
	Other	1,641	1,641	1,641	1,641	1,641
	Total	**6,751**	**6,799**	**6,852**	**6,909**	**6,968**
Groundwater	Municipal	28	30	31	33	35
	Agricultural	744	791	844	899	958
	Commercial	37	37	37	37	37
	Petroleum	31	31	31	31	31
	Industrial	0	0	0	0	0
	Other	36	36	36	36	36
	Total	**876**	**925**	**979**	**1,036**	**1,097**
Total	Municipal	96	102	107	114	119
	Agricultural	2,207	2,298	2,400	2,507	2,622
	Commercial	149	149	149	149	149
	Petroleum	3,060	3,060	3,060	3,060	3,060
	Industrial	438	438	438	438	438
	Other	1,677	1,677	1,677	1,677	1,677
	Total	**7,627**	**7,724**	**7,831**	**7,945**	**8,065**

Table 13-25 Forecast Water Use, By Sector, Frog Sub-basin: High Scenario
(dam^3)

Source	Sector	2005	2010	2015	2020	2025
Surface Water	Municipal	68	75	82	89	97
	Agricultural	1,463	1,547	1,644	1,751	1,871
	Commercial	112	112	112	112	112
	Petroleum	3,029	3,029	3,029	3,029	3,029
	Industrial	438	438	438	438	438
	Other	1,641	1,641	1,641	1,641	1,641
	Total	**6,751**	**6,842**	**6,946**	**7,060**	**7,188**
Groundwater	Municipal	28	31	34	37	40
	Agricultural	744	834	937	1,052	1,180
	Commercial	37	37	37	37	37
	Petroleum	31	31	31	31	31
	Industrial	0	0	0	0	0
	Other	36	36	36	36	36
	Total	**876**	**969**	**1,075**	**1,193**	**1,324**
Total	Municipal	96	106	116	126	137
	Agricultural	2,207	2,381	2,581	2,803	3,051
	Commercial	149	149	149	149	149
	Petroleum	3,060	3,060	3,060	3,060	3,060
	Industrial	438	438	438	438	438
	Other	1,677	1,677	1,677	1,677	1,677
	Total	**7,627**	**7,811**	**8,021**	**8,253**	**8,512**