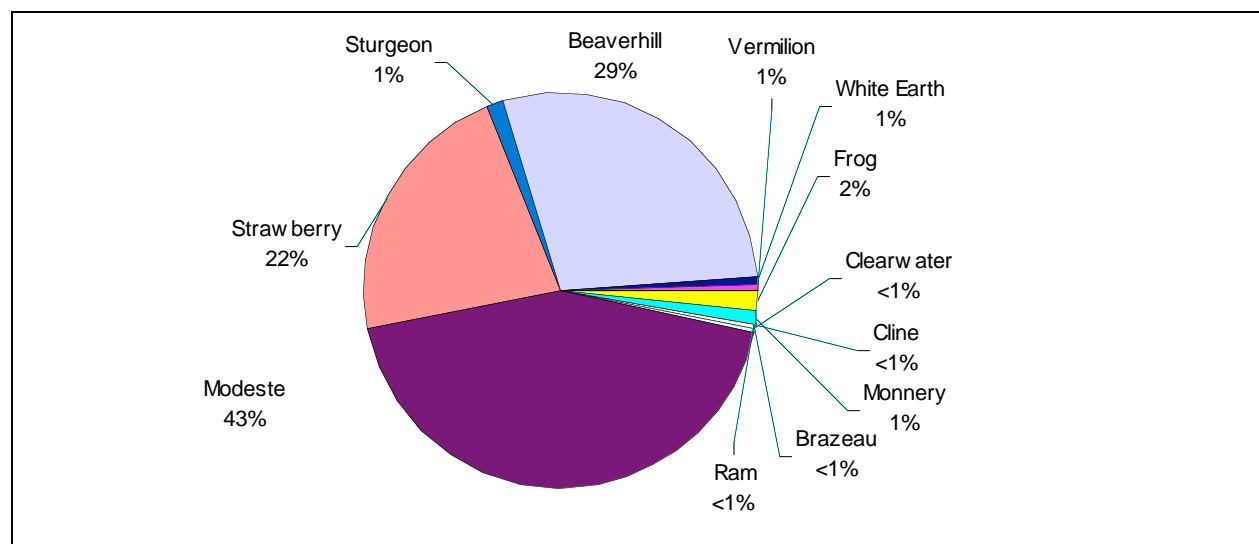


15.0 NORTH SASKATCHEWAN

In 2005, a total of about 1.99 million dam³ of water has been allocated in the North Saskatchewan through licences and registrations. Of this total, 1.95 million dam³ or 98 percent was for surface water. As shown in Figure 15-1, water allocations in the three sub-basins, Modeste (43 percent), Beaverhill (29 percent) and Strawberry (22 percent), together accounted for about 95 percent of water allocations in the North Saskatchewan River Basin. Water allocations in the three largest sub-basins are dominated by allocations for the industrial sector. Water allocations in the western sub-basins, Brazeau, Ram and Clearwater, are dominated by the petroleum sector while the commercial sector accounts for most of the Cline Sub-basin allocations. In the Sturgeon Sub-basin, most of the allocations are for the other sector while the commercial sector is the largest allocation in the White Earth Sub-basin. The agriculture sector is the largest allocation for the Vermilion Sub-basin while the commercial sector is the largest allocation for the Frog Sub-basin. The municipal sector accounts for the largest allocation in the Monnery Sub-basin.

Figure 15-1 Summary of Water Allocations by Sub-basin



Details of provincial water allocations and use for each of the major categories of water use are provided in the remainder of this section.

15.1 Municipal Sector

15.1.1 Population

In 2006, the North Saskatchewan Basin had a population of 1.15 million people. As shown in Table 15-1, the majority of the population (83 percent) resided in cities, towns, villages or summer villages while 10 percent lived in rural municipalities, seven percent lived in the specialized, mixed urban and rural municipality of Strathcona County, and less than one percent lived on First Nation Reserves or in Métis Settlements.

The majority of the basin population (89 percent) is concentrated in three sub-basins comprising the Capital Region: Beaverhill; Strawberry and Sturgeon. The other two sub-basins with significant populations are Modeste (three percent) and Vermilion (two percent). All other sub-basins had populations that accounted for less than two percent of the North Saskatchewan Basin total.

Table 15-1 Population Distribution and Growth in the North Saskatchewan Basin, 2006

Sub-basin	2006 Population		Composition				Population Growth 1996 to 2001
	Population	Percent of North Saskatchewan Basin	Urban	Specialized	Rural	Aboriginal	Percent
Beaverhill	586,101	51.0%	85.3%	14.1%	0.6%	0.0%	10.3%
Strawberry	303,012	26.3%	94.4%	0.0%	5.0%	0.5%	10.3%
Sturgeon	134,393	11.7%	78.3%	0.0%	20.4%	1.3%	10.9%
Modeste	32,113	2.8%	26.0%	0.0%	70.5%	3.5%	8.2%
Vermilion	25,227	2.2%	56.5%	0.0%	43.5%	0.0%	1.4%
White Earth	17,872	1.6%	35.7%	0.0%	64.3%	0.0%	-5.0%
Monnery	17,113	1.5%	93.0%	0.0%	6.1%	0.9%	19.0%
Frog	15,976	1.4%	47.3%	0.0%	42.5%	10.2%	1.5%
Ram	14,273	1.2%	48.2%	0.0%	48.3%	3.6%	5.8%
Brazeau	2,077	0.2%	0.0%	0.0%	79.1%	20.9%	-2.9%
Clearwater	1,659	0.1%	0.0%	0.0%	100.0%	0.0%	2.8%
Cline	348	0.0%	0.0%	0.0%	100.0%	0.0%	-30.3%
Total	1,150,165	100.0%	82.7%	7.2%	9.6%	0.6%	9.7%

Between 2001 and 2006, the North Saskatchewan Basin population grew by almost 10 percent. In absolute terms, the Capital Region experienced the largest population increase, with the addition of almost 100,000 people corresponding to greater than 10 percent growth. Monnery Sub-basin, however, had the highest growth rate, at 19 percent, due to rapid growth of the City of Lloydminster on the Alberta-Saskatchewan border. More rural sub-basins experienced lower growth or population decline. In absolute terms, the White Earth Sub-basin lost the most people (944), while the Cline Sub-basin had the highest relative population loss (-30 percent).

15.1.2 Water Allocations

As of 2005, 241 municipal water licences had been issued to 105 licensees in the North Saskatchewan Basin. These licences allow diversions of up to 163,848 dam³ for municipal purposes. The majority of municipal allocations (157,990 dam³ or 96 percent) were for surface water. Almost 100 percent of these allocations were for urban municipalities. A total of 5,858 dam³ of groundwater has been allocated for municipal use, with urban municipalities accounting for 83 percent, rural communities accounting for 10 percent and other municipal uses accounting for 7 percent. Table 15-2 summarizes the municipal licence allocations for each sub-basin.

Table 15-2 Licensed Municipal Allocations and Use and Estimated Actual Water Use, North Saskatchewan Basin

River Basin	Source	Licensed Allocation		Licensed Use		Licensed Return		Actual Use Estimate		Licence Utilization
		dam ³	Percent of Basin	dam ³	Percent of Basin	dam ³	Percent of Allocation	dam ³	Percent of Basin	
Cline	Surface	0		0		0		2	0.0%	
	Groundwater	0		0		0		7	0.3%	
	Total	0		0		0		9	0.1%	
Brazeau	Surface	0		0		0		13	0.2%	
	Groundwater	0		0		0		41	1.8%	
	Total	0		0				54	0.6%	
Ram	Surface	2,316	1.5%	254	0.6%	2,062	89%	554	7.8%	218%
	Groundwater	72	1.2%	72	2.6%	0	0%	182	8.0%	253%
	Total	2,388	1.5%	326	0.7%	2,062	86%	736	7.9%	226%
Clearwater	Surface							10	0.1%	
	Groundwater	18	0.3%	18	0.7%	0	0%	51	2.2%	283%
	Total	18	0.0%	18	0.0%	0	0%	62	0.7%	344%
Modeste	Surface	3,965	2.5%	2,625	6.1%	1,341	34%	365	5.2%	14%
	Groundwater	358	6.1%	187	6.8%	170	47%	26	1.1%	14%
	Total	4,323	2.6%	2,812	6.1%	1,511	35%	391	4.2%	14%
Capital Region	Surface	135,803	86.0%	37,033	85.8%	98,770	73%	5,267	74.5%	14%
	Groundwater	0	0.0%	0	0.0%	0	0%	0	0.0%	
	Total	135,803	82.9%	37,033	80.6%	98,770	73%	5,267	56.4%	14%
Strawberry (outside Capital Region)	Surface	1,730	1.1%	347	0.8%	1,383	80%	69	1.0%	20%
	Groundwater	245	4.2%	60	2.2%	185	76%	20	0.9%	33%
	Total	1,975	1.2%	407	0.9%	1,568	79%	89	1.0%	22%
Sturgeon (outside Capital Region)	Surface	2	0.0%	2	0.0%	0	0%	6	0.1%	300%
	Groundwater	956	16.3%	528	19.1%	428	45%	1,233	54.3%	234%
	Total	958	0.6%	530	1.2%	428	45%	1,239	13.3%	234%
Beaverhill (outside Capital Region)	Surface	796	0.5%	240	0.6%	556	70%	187	2.6%	78%
	Groundwater	54	0.9%	26	0.9%	28	52%	17	0.7%	65%
	Total	850	0.5%	266	0.6%	584	69%	204	2.2%	77%
White Earth	Surface	250	0.2%	102	0.2%	148	59%	72	1.0%	71%
	Groundwater	822	14.0%	208	7.5%	614	75%	146	6.4%	70%
	Total	1,072	0.7%	310	0.7%	762	71%	217	2.3%	70%
Vermilion	Surface	155	0.1%	106	0.2%	49	32%	49	0.7%	46%
	Groundwater	2,504	42.7%	1,095	39.6%	1,409	56%	510	22.5%	47%
	Total	2,659	1.6%	1,201	2.6%	1,458	55%	558	6.0%	46%
Frog	Surface	1,842	1.2%	1,325	3.1%	517	28%	67	0.9%	5%
	Groundwater	785	13.4%	546	19.7%	239	30%	28	1.2%	5%
	Total	2,627	1.6%	1,871	4.1%	756	29%	95	1.0%	5%
Monnery	Surface	11,131	7.0%	1,152	2.7%	9,979	90%	409	5.8%	36%
	Groundwater	44	0.8%	28	1.0%	17	38%	10	0.4%	36%
	Total	11,175	6.8%	1,180	2.6%	9,996	89%	419	4.5%	36%
Total	Surface	157,990	96.4%	43,186	94.0%	114,805	73%	7,070	75.7%	16%
	Groundwater	5,858	3.6%	2,768	6.0%	3,090	53%	2,271	24.3%	82%
	Total	163,848	100.0%	45,954	100.0%	117,895	72%	9,340	100.0%	20%

15.1.3 Licensed Water Use

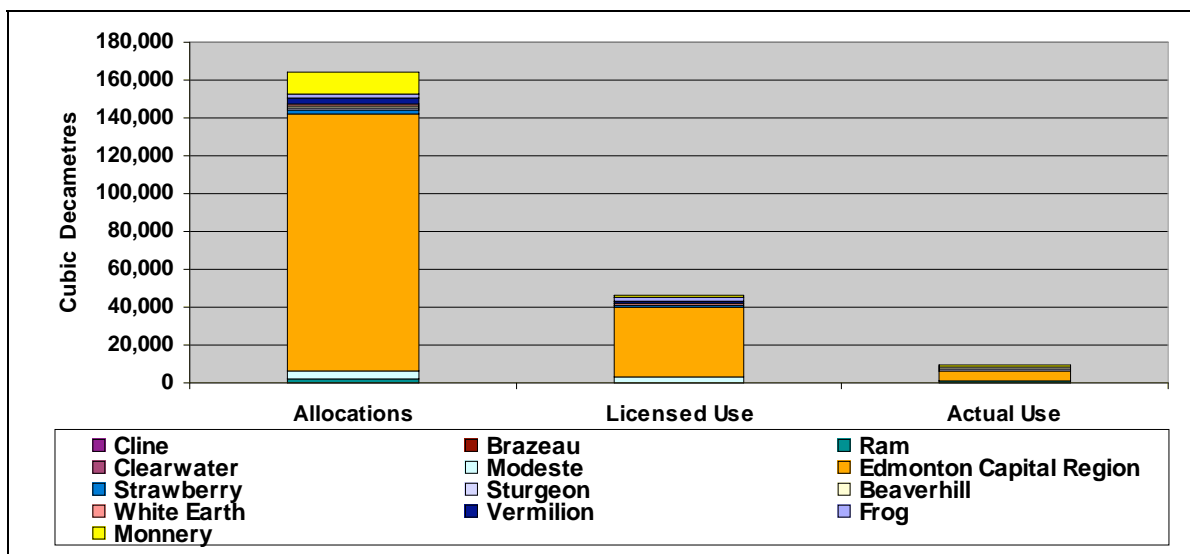
Under the terms of licences issued for municipal purposes, 28 percent of allocations can be consumed or lost (45,954 dam³), with the remainder (72 percent or 117,895 dam³) being returned. Return flow allowances in licences vary from sub-basin to sub-basin, ranging from 89 percent in the Monnery Sub-basin to zero in the Clearwater Sub-basin.

15.1.4 Actual Water Use

Table 15-2 also contains estimates of actual municipal water use. For municipalities served by the Edmonton Capital Regional water system, municipal water use estimates were developed by creating a water balance model based on information from the Municipal Water and Wastewater Survey (MWWS), EPCOR, the City of Edmonton and the Capital Region Wastewater Treatment Plant. As not all municipal and residential water use requires licences, estimates of water use in other parts of the basin were calculated by multiplying average annual per capita water use information taken from the MWWS by the population of each sub-basin.

Using these approaches it is estimated that municipal water use in the North Saskatchewan Basin was about 9,340 dam³ in 2005. This reflects the difference between what municipalities are estimated to have withdrawn and what they are estimated to have returned. Almost 56 percent of total municipal water use occurred in the Edmonton Capital Region, while another 16 percent occurred in the Beaverhill, Strawberry and Sturgeon for populations not served by the Edmonton Capital Region. Other sub-basins that account for more than 2 percent of municipal water use in the basin include the Vermilion (6 percent), Ram (8 percent), Monnery (4 percent) and Modeste (4 percent). Figure 15-2 shows the difference between allocations, licensed use and estimated actual use for the municipal sector.

Figure 15-2 Municipal Allocations, Licensed Use and Actual Use, North Saskatchewan Basin



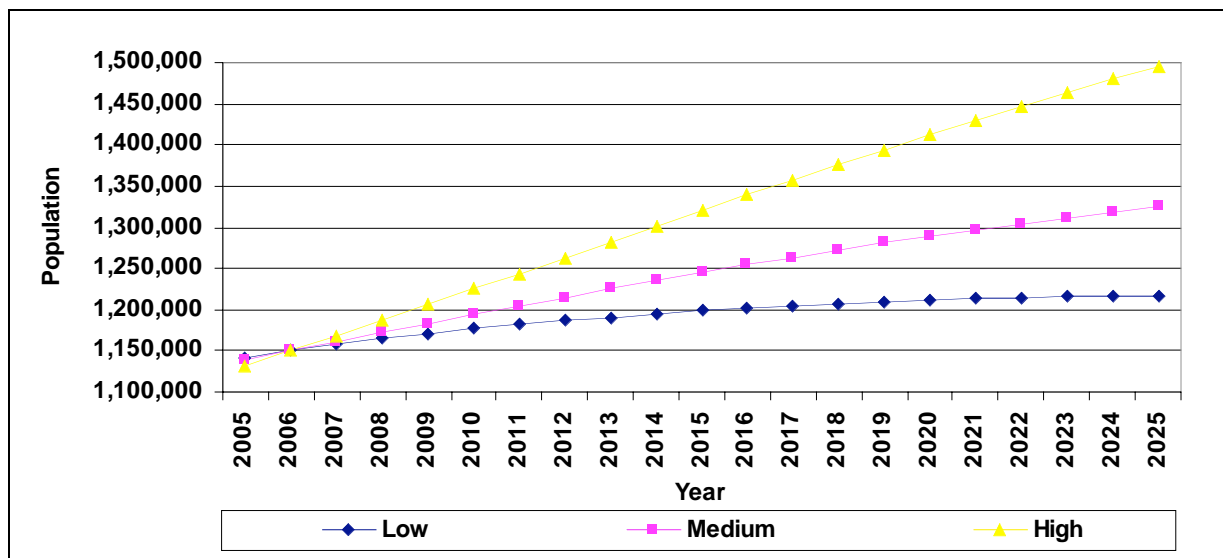


The water use estimates can also be compared to current allocations to gauge license utilization. These utilization rates are shown in Table 15-2, which shows that, on average, municipal use was 20 percent of what licences assume will be used. Water use in the Capital Region water use was only 16 percent of licensed use. However, in sub-basins where there are large rural populations, actual water use may exceed licensed municipal use. As a result, licence utilization rates exceeded 100 percent in the Ram, Clearwater and Sturgeon sub-basins and water use was reported in the Cline and Brazeau sub-basins, even though no municipal licences have been issued in these sub-basins. The lowest utilization rate was reported for Frog Sub-basin, at 5 percent, although this estimate was influenced by two municipalities that reported higher returns than diversions, possibly because of unlicensed ground to surface water transfers, groundwater or stormwater contributions to wastewater flows, and/or metering errors.

15.1.5 Forecasts of Future Water Use

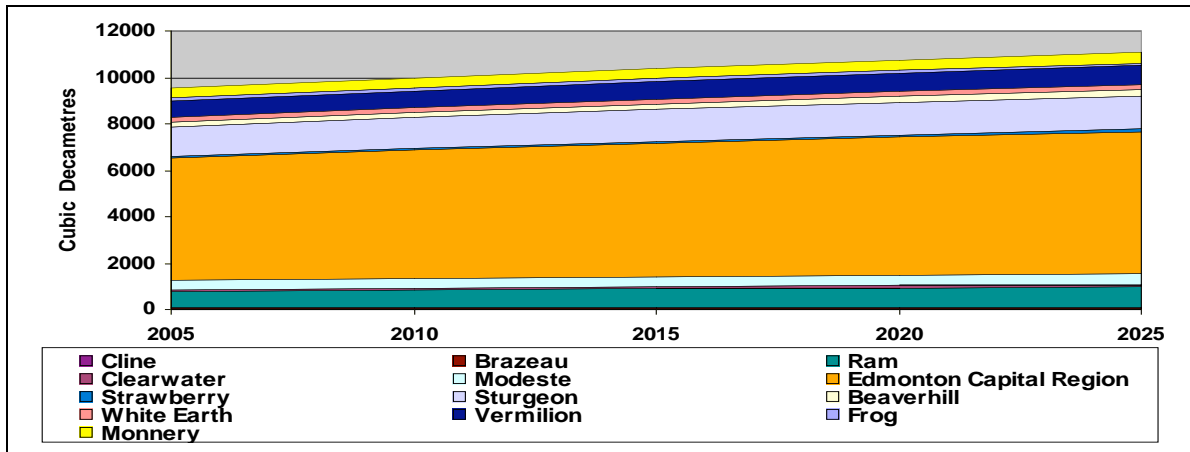
Figure 15-3 shows low, medium and high population projections modified for the North Saskatchewan Basin based on Alberta Finance Census Division projections. These population forecasts have been used to predict future municipal water use in each of the 12 sub-basins.

Figure 15-3 North Saskatchewan Basin Population Growth Forecasts



For the North Saskatchewan Basin, expected water use under the Medium Growth scenario will increase to 10,789 dam³. This represents a 16 percent increase over current municipal water use. Figure 15-4 shows how this expected increase in water use will be distributed among the various sub-basins. In absolute terms, it shows that the majority of the growth in municipal water use is expected in the Edmonton Capital Region sub-basins which, by 2025, would account for the same proportion of municipal water use in the basin (85 percent) that it does now.

Figure 15-4 North Saskatchewan Municipal Water Use Forecasts, 2005-2025: Medium Growth Scenario



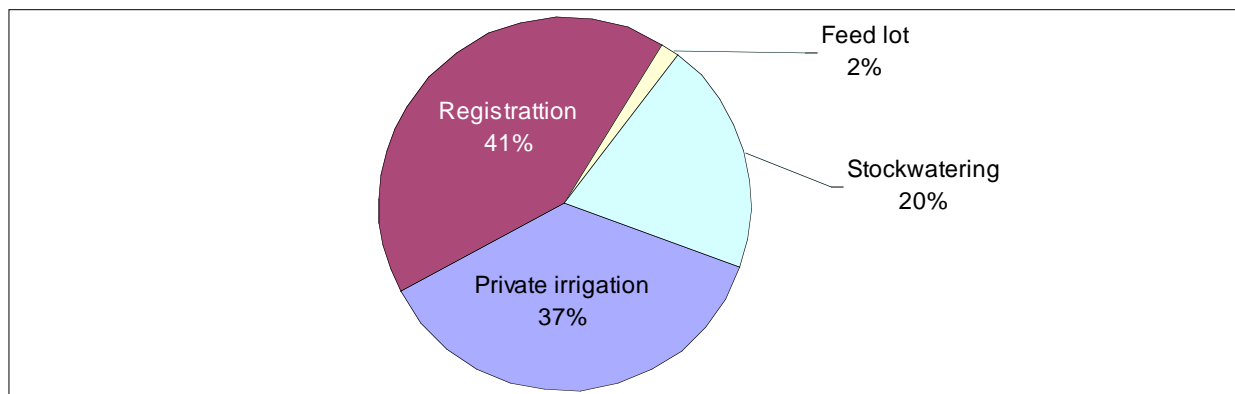
Under the Low Growth scenario, municipal water use in 2025 is projected to be 6 percent higher than in 2005. Under the High Growth scenario, water use would be 32 percent higher in 2025 than in 2005.

15.2 Agriculture Sector

Water allocations for agricultural sector include registrations and licences issued for irrigation, feedlots and stockwatering. As of 2005, registrations and licences allow withdrawals of up to 26,407 dam³, and this accounts for 1.3 percent of total water allocations in the North Saskatchewan. Registrations account for about 41 percent of the total agricultural allocations.

Figure 15-5 shows how water allocations are distributed among the major agricultural activities for which licences and registrations are issued. The largest allocation is for registration (41 percent). Private irrigation accounts for 37 percent of agricultural allocations while allocations for stockwatering, feedlots and registration together make up the remaining 24 percent.

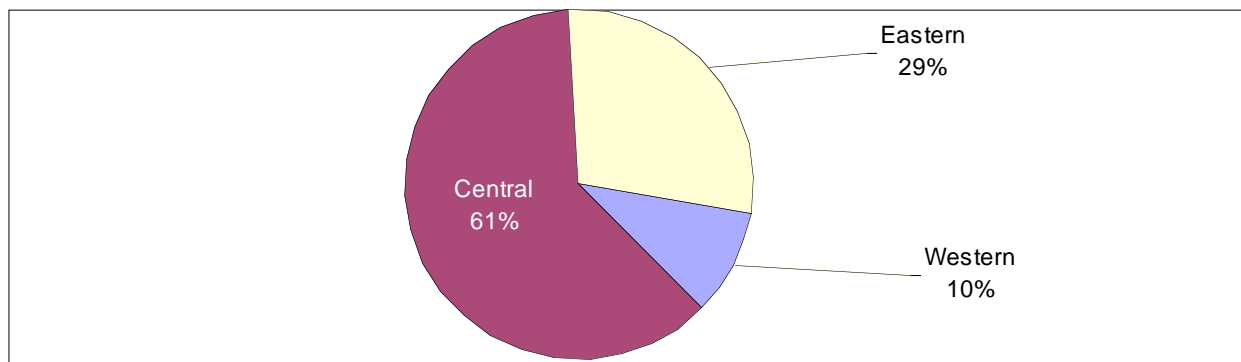
Figure 15-5 Water Allocation for Agricultural Activities in the North Saskatchewan



15.2.1 Water Allocation

Figure 15-6 summarizes the distribution of agricultural water allocated among the sub-basins. The western sub-basins, consisting of Cline, Brazeau, Ram, Clearwater and Modeste, account for 10 percent of the allocations. The central sub-basins, consisting of Strawberry, Strugeon, Beaverhill and White Earth, account for 61 percent of the allocations. The eastern sub-basins, consisting of Vermilion, Frog and Monnery, account for the remaining 29 percent of the allocations.

Figure 15-6 Licensed Agricultural Allocations Among the Sub-basins



A total of 11,013 registrations and 546 licences allow withdrawals of up to 15,692 dam³ of surface water; this accounts for 59 percent of all water allocated to the agricultural sector. Licences issued for groundwater account for 41 percent of allocations; 8,372 registrations and 982 licences have been issued to withdraw up to 10,715 dam³ of groundwater.

15.2.2 Licensed Water Use

Table 15-3 shows that licences and registration allow withdrawals of up to 16,698 dam³ for livestock watering and all of the water can be used. In combination, the Beaverhill, White Earth and Vermilion sub-basins account for about 55 percent of licensed use for stockwatering in the North Saskatchewan Basin.

Information on licences issued for irrigation and crop watering is provided in Table 15-4. This shows that up to 9,693 dam³ of surface water and 19 dam³ of groundwater have been allocated for irrigation and crop watering. There are no return flow requirements for any of the groundwater allocations but 1.4 percent of surface water allocations (137 dam³) are expected to be returned. Beaverhill, Sturgeon and White Earth sub-basins together accounted for about 80 percent of licensed use for crop watering in the North Saskatchewan Basin.

15.2.3 Actual Water Use

For stockwatering, actual use is about 90 percent of licensed use, although actual surface water use exceeds licensed use by about 15 percent. This occurs because not all stockwatering requires licences or registrations.

Actual water use by livestock has been estimated based on the animal populations in each basin in 2001, their daily water requirements, and an allowance for evaporation and seepage from surface water sources. Using this approach it is estimated that livestock actually consumed 15,018 dam³ of water in 2005. Although stockwatering allocations have not been issued for the Cline or Brazeau sub-basins, small amounts of water are being used for stockwatering. In the other sub-basins, licence utilization ranged from 70 percent (Frog Sub-basin) to 321 percent (Sturgeon Sub-basin). The Beaverhill, White Earth and Vermilion sub-basins together accounted for about 55 percent of actual use but 41 percent of cattle population in the North Saskatchewan Basin. Figure 15-7, shows the allocation, licences use and actual use for the sub-basins.

In terms of water used for irrigation and crop watering, the water use estimates in Table 15-4 assume that irrigators used their full entitlements so licence utilization was 100 percent. Beaverhill, Sturgeon and White Earth sub-basins together accounted for about 80 percent of actual water used for crop watering. The difference between allocations, licensed and use and actual use is shown in Figure 15-7.

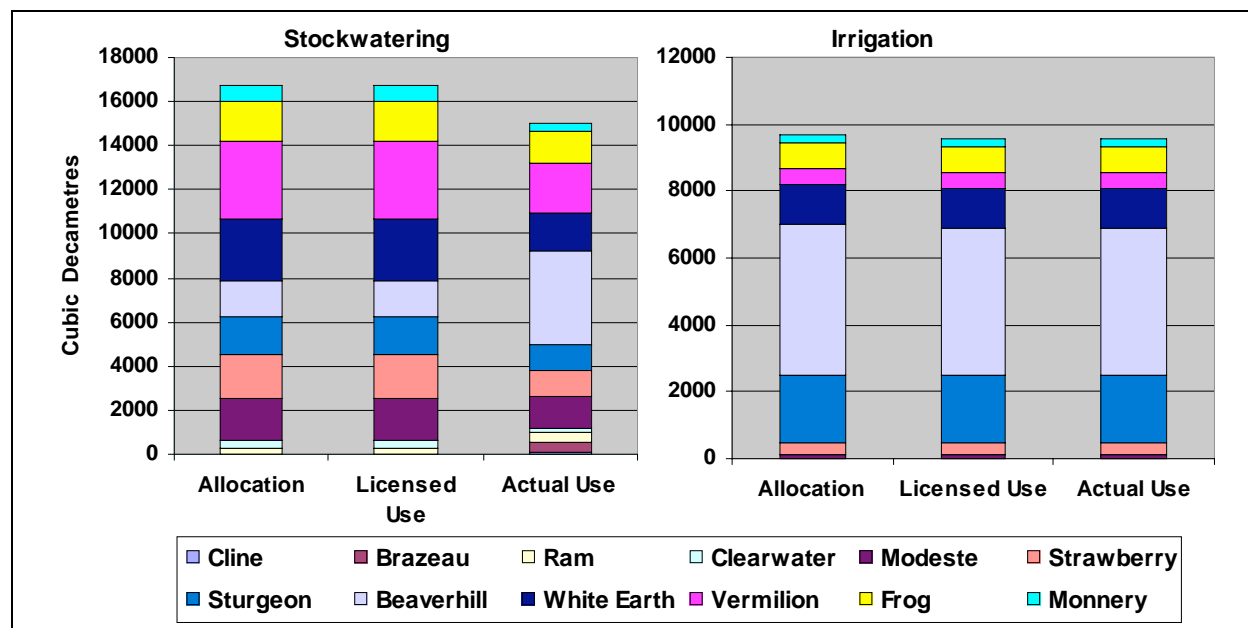
Table 15-3 Water Allocation and Use for Livestock Watering in the North Saskatchewan Sub-basins

Sub-basin	Water Type	Licensed Allocation and Use (dam ³)			Actual Use (dam ³)	Licence Utilization	Percent Actual Use of North Saskatchewan	Cattle Population	Percent of animal population in North Saskatchewan
		Allocation	Licensed Use	Return Flow					
Cline	Surface	0	0	0	0	N/A			
	Groundwater	1	1	0	128	12800%	1.6%	10,656	0.9%
	Total	1	1	0	128	12800%	0.9%		
Brazeau	Surface	1	1	0	0	0%	0.0%		
	Groundwater	1	1	0	395	39500%	4.9%		
	Total	1	1	0	395	39500%	2.6%		
Ram	Surface	79	79	0	158	200%	2.3%	32,073	2.6%
	Groundwater	216	216	0	283	131%	3.5%		
	Total	295	295	0	441	149%	2.9%		
Clearwater	Surface	89	89	0	76	85%	1.1%	14,663	1.2%
	Groundwater	227	227	0	127	56%	1.6%		
	Total	316	316	0	203	64%	1.4%		
Modeste	Surface	582	582	0	577	99%	8.3%	95,968	7.7%
	Groundwater	1,307	1,307	0	844	65%	10.4%		
	Total	1,889	1,889	0	1,421	75%	9.5%		
Strawberry	Surface	565	565	0	473	84%	6.8%	73,944	5.9%
	Groundwater	1,414	1,414	0	769	54%	9.5%		
	Total	1,980	1,980	0	1,242	63%	8.3%		
Sturgeon	Surface	560	560	0	491	88%	7.1%	68,547	5.5%
	Groundwater	1,169	1,169	0	666	57%	8.2%		
	Total	1,729	1,729	0	1,157	67%	7.7%		
Beaverhill	Surface	720	720	0	2,309	321%	33.3%	237,650	19.0%
	Groundwater	915	915	0	1,908	209%	23.6%		
	Total	1,635	1,635	0	4,217	258%	28.1%		
White Earth	Surface	1,244	1,244	0	972	78%	14.0%	117,295	9.4%
	Groundwater	1,557	1,557	0	790	51%	9.8%		
	Total	2,800	2,800	0	1,762	63%	11.7%		
Vermilion	Surface	1,194	1,194	0	968	81%	14.0%	160,020	12.8%
	Groundwater	2,398	2,398	0	1,264	53%	15.6%		
	Total	3,592	3,592	0	2,232	62%	14.9%		
Frog	Surface	677	677	0	696	103%	10.1%	104,931	8.4%
	Groundwater	1,112	1,112	0	744	67%	9.2%		
	Total	1,789	1,789	0	1,440	80%	9.6%		
Monnery	Surface	290	290	0	205	71%	3.0%	306,197	24.5%
	Groundwater	380	380	0	175	46%	2.2%		
	Total	670	670	0	380	57%	2.5%		
TOTAL	Surface	6,001	6,001	0	6,925	115%	46.1%	1,248,819	100%
	Groundwater	10,697	10,697	0	8,093	76%	53.9%		
	Total	16,698	16,698	0	15,018	90%	100.0%		

Table 15-4 Water Allocation and Use for Crop Watering in the North Saskatchewan Sub-basins

Sub-basin	Water Type	Licensed Allocation and Use (dam ³)			Actual Use (dam ³)	Licence Utilization	Percent Actual Use of North Saskatchewan	Irrigated Acres	Percent of Irrigation Acres in North Saskatchewan
		Allocation	Licensed Use	Return Flow					
Cline	Surface	0	0	0	0	N/A	0.0%	0	0.0%
	Groundwater	0	0	0	0	N/A	0.0%		
	Total	0	0	0	0	N/A	0.0%		
Brazeau	Surface	0	0	0	0	N/A	0.0%	0	0.0%
	Groundwater	0	0	0	0	N/A	0.0%		
	Total	0	0	0	0	N/A	0.0%		
Ram	Surface	27	27	0	27	99%	0.3%	22	0.3%
	Groundwater	0	0	0	0	N/A	0.0%		
	Total	27	27	0	27	99%	0.3%		
Clearwater	Surface	0	0	0	0	N/A	0.0%	0	0.0%
	Groundwater	0	0	0	0	N/A	0.0%		
	Total	0	0	0	0	N/A	0.0%		
Modeste	Surface	72	72	0	72	100%	0.8%	60	0.8%
	Groundwater	0	0	0	0	N/A	0.0%		
	Total	72	72	0	72	100%	0.8%		
Strawberry	Surface	359	359	0	359	100%	3.8%	295	3.7%
	Groundwater	0	0	0	0	N/A	0.0%		
	Total	359	359	0	359	100%	3.7%		
Sturgeon	Surface	2,023	2,023	0	2,023	100%	21.2%	1,672	20.9%
	Groundwater	11	11	0	11	99%	57.9%		
	Total	2,034	2,034	0	2,034	100%	21.2%		
Beaverhill	Surface	4,537	4,407	130	4,407	100%	46.1%	3,731	46.7%
	Groundwater	0	0	0	0	N/A	0.0%		
	Total	4,537	4,407	130	4,407	100%	46.0%		
White Earth	Surface	1,192	1,184	7	1,184	100%	12.4%	985	12.3%
	Groundwater	6	6	0	6	100%	31.6%		
	Total	1,198	1,191	7	1,191	100%	12.4%		
Vermilion	Surface	467	467	0	467	100%	4.9%	385	4.8%
	Groundwater	1	1	0	1	980%	5.3%		
	Total	468	468	0	468	100%	4.9%		
Frog	Surface	767	767	0	767	100%	8.0%	631	7.9%
	Groundwater	0	0	0	0	N/A	0.0%		
	Total	767	767	0	767	100%	8.0%		
Monnery	Surface	250	250	0	250	100%	2.6%	206	2.6%
	Groundwater	0	0	0	0	N/A	0.0%		
	Total	250	250	0	250	100%	2.6%		
TOTAL	Surface	9,693	9,556	137	9,556	100%	99.8%	7,987	100.0%
	Groundwater	19	19	0	19	99%	0.2%		
	Total	9,712	9,575	137	9,575	100%	100.0%		

Figure 15-7 Agricultural Allocations, Licensed Use and Actual Use, North Saskatchewan



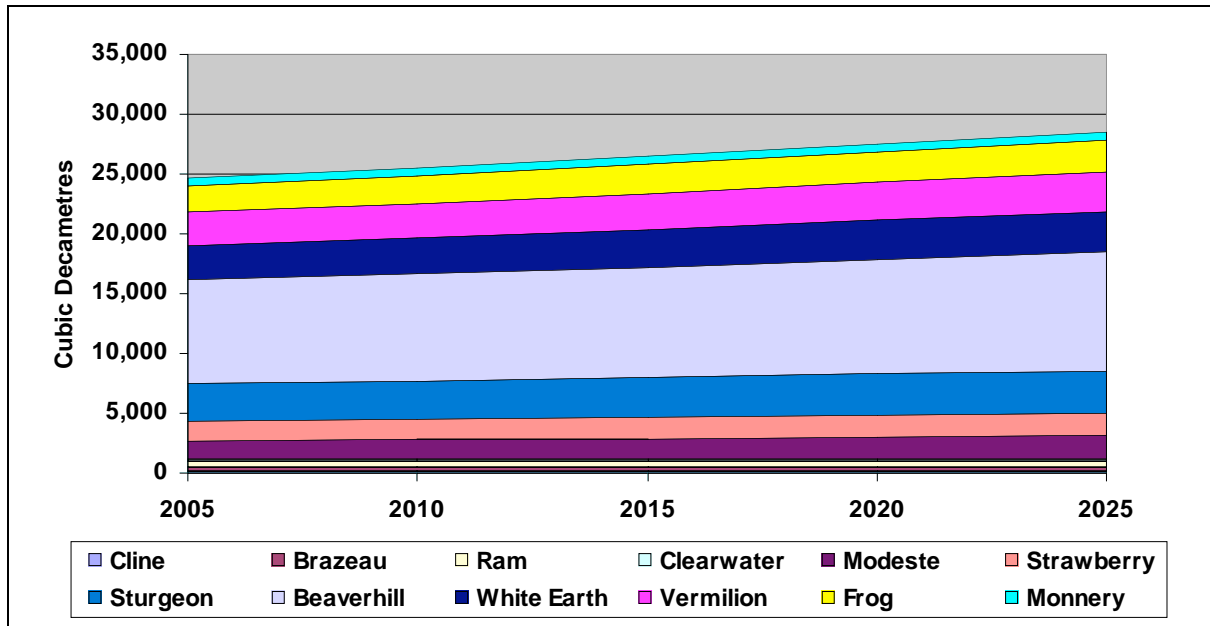
15.2.4 Water Use Forecasts

Forecasts of future water use for stockwatering were based on estimated increases in cattle populations in each sub-basin. Based on assessments completed by AAFRD (Section 2.3), the potential for the development of intensive cattle operations varies among the sub-basins, based on differences in landscape, silage supplies and water availability. The potential for increased livestock population was also assessed based on the number of applications to the NRCB for intensive livestock development. Based on this information, it was estimated that livestock populations and water demand will increase annually at rates of between zero percent and 2.2 percent per year. The higher rate represents the annual average increase in cattle population in Alberta between 1958 and 2005.

Future water demand for irrigation water use is expected to remain unchanged from current levels as there is limited land base to expand forage production.

Water use forecast for the agriculture sector under the Medium Growth Scenario is shown in Figure 15-8. Under this scenario, water use in 2025 is projected be 28,059 dam³, which represents an increase of 17 percent from 2005 and is more than current allocations. The forecast assumes that the current distribution of groundwater (68 percent) and surface water (32 percent) will remain the same over the forecast period. Three sub-basins, Beaverhill (35 percent), Sturgeon (13 percent), and White Earth (12 percent), together are expected to account for 60 percent of water use by 2025.

Figure 15-8 Projected Water Use for Agriculture to 2025 in the North Saskatchewan Sub-basins



15.3 Commercial Sector

A total 254 licences have been issued for commercial purposes and they allow diversions of up to 15,834 dam³ of water. These allocations account for less than 1 percent of total water allocation in the North Saskatchewan River Basin.

15.3.1 Water Allocation

Water allocations for the commercial sector include a variety of activities. As shown in Figure 15-9 the most important activities in terms of water allocations include gardening (28 percent), aggregate washing (25 percent), golf courses (24 percent), and parks and recreation (10 percent). Allocations for these purposes together account for 87 percent of commercial allocations.

Figure 15-9 Water Allocation by Volume for Commercial Sector Activities in the North Saskatchewan

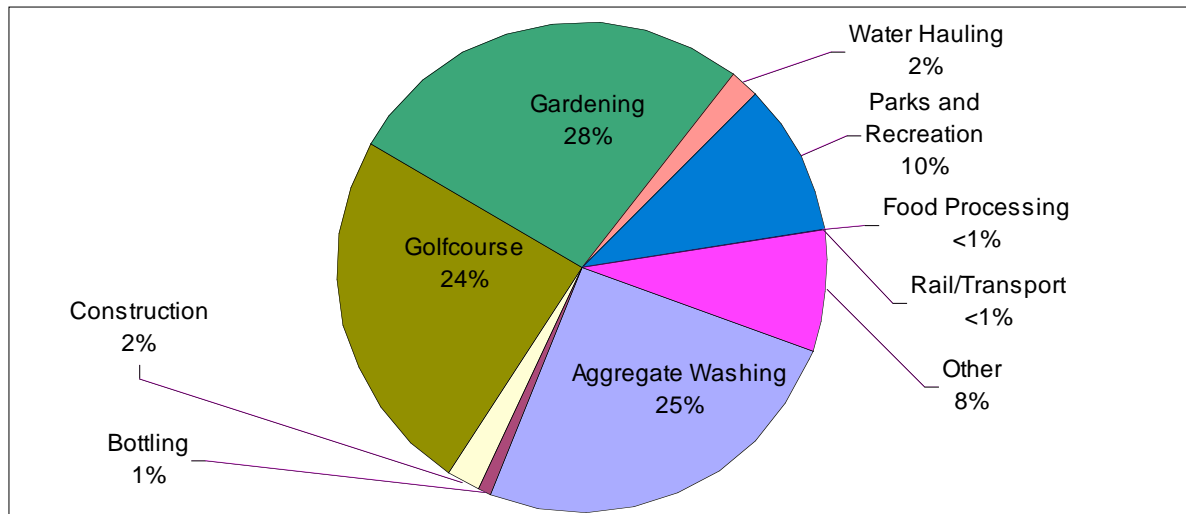
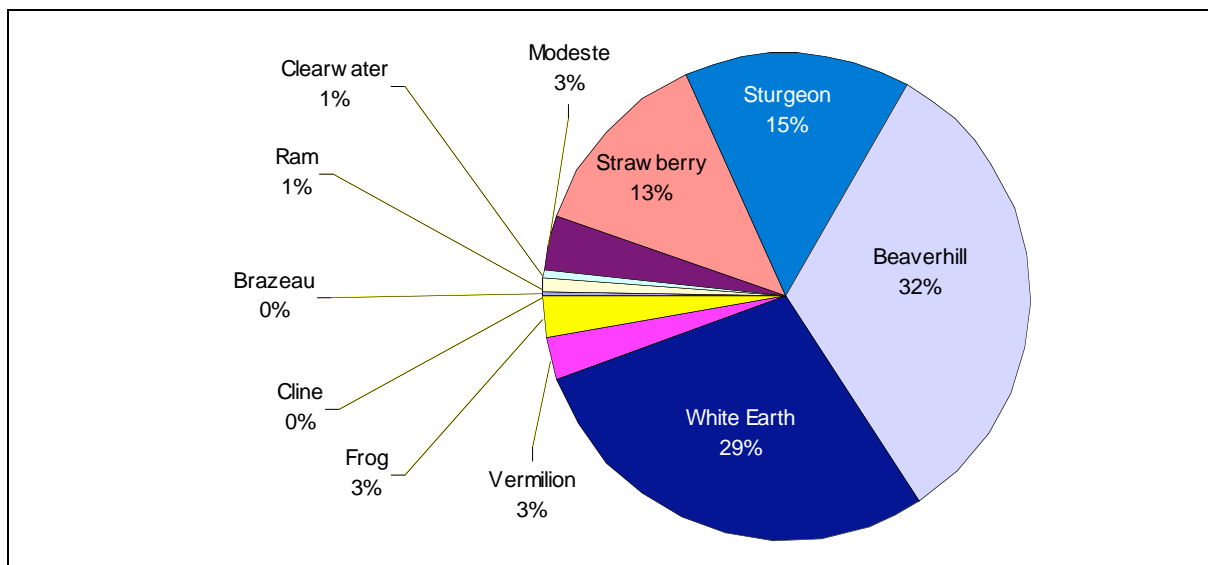


Figure 15-10 shows how commercial water allocations are distributed among the sub-basins. Four basins account for 89 percent of total commercial allocations. These include the Beaverhill Sub-basin (which accounts for 32 percent of commercial allocations), the White Earth Sub-basin (29 percent) and the Strawberry Sub-basin (13 percent).

Figure 15-10 Distribution of Commercial Water Allocation Among the Sub-basins



Most allocations of water for commercial purposes (90 percent) are for surface water. There are 171 surface water licences that allow diversions of up to 14,354 dam³. Groundwater accounts for 12 percent (1,480 dam³) of allocations for commercial purposes. Table 15-5 provides a

summary of water licences issued for commercial purposes for each of the sub-basins, while Table 15-6 shows the licence information for individual commercial activities.

15.3.2 Licensed Water Use

Licences issued for commercial purposes assume that 79 percent of withdrawals will be used and the remainder (3,270 dam³) will be used. Only surface licences have allowances for return flows, and the extent of return flows varies by sub-basin. Licences issued in four sub-basins account for all of the return flow allowances - Clearwater (73 percent), Frog (10 percent), White Earth (9 percent), and Vermilion (8 percent).

15.3.3 Actual Water Use

Very few of the commercial operations with water licences reported their water use in 2005. Thus, for purposes of estimating total water use the North Saskatchewan, it was assumed that commercial licensees were withdrawing and using their full entitlements. While this assumption may overstate actual water use in the North Saskatchewan, the error will be relatively small because allocations to this sector account for less than 1 percent of total allocations. Table 15-5 shows that estimated water use by the commercial sector amounted to 12,563 dam³. Because of the regional differences in return flow requirements, the distribution of actual commercial water use among the sub-basins is slightly different than the distribution of commercial allocations. Figure 15-11 shows the actual water use relative to allocations and licensed use.

Figure 15-11 Commercial Allocations, Licensed Use and Actual Use, North Saskatchewan Sub-basins

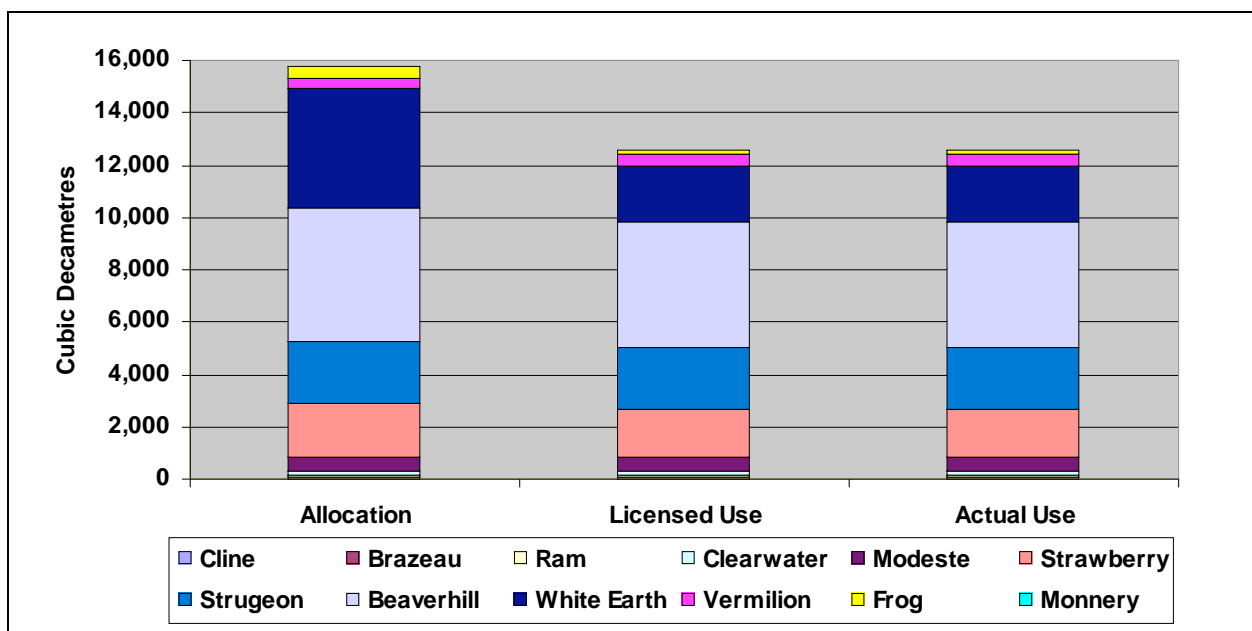


Table 15-5 Water Allocation and Use for the Commercial Sector by Sub-basin in the North Saskatchewan

Sub-basin	Source	Number of Licences	Licensed Allocation and Use (dam ³)			Estimated Use (dam ³)	Licence Utilization	Percent of Sector
			Allocation	Water Use	Return			
Cline	Surface	2	49	49	0	49	100%	0.4%
	Groundwater	2	10	10	0	10	100%	0.7%
	Total	4	59	59	0	59	100%	0.5%
Brazeau	Surface	0	0	0	0	0		0.0%
	Groundwater	1	2	2	0	2	100%	0.1%
	Total	1	2	2	0	2	100%	0.0%
Ram	Surface	5	93	93	0	93	100%	0.8%
	Groundwater	8	34	34	0	34	100%	2.3%
	Total	13	126	126	0	126	100%	1.0%
Clearwater	Surface	2	48	48	0	48	100%	0.4%
	Groundwater	6	45	45	0	45	100%	3.0%
	Total	8	93	93	0	93	100%	0.7%
Modeste	Surface	13	501	501	0	501	100%	4.5%
	Groundwater	4	44	44	0	44	100%	3.0%
	Total	17	545	545	0	545	100%	4.3%
Strawberry	Surface	28	1,996	1,758	238	1,758	100%	15.9%
	Groundwater	10	56	56	0	56	100%	3.8%
	Total	38	2,052	1,813	238	1,813	100%	14.4%
Sturgeon	Surface	44	1,728	1,728	0	1,728	100%	15.6%
	Groundwater	25	643	643	0	643	100%	43.4%
	Total	69	2,372	2,372	0	2,372	100%	18.9%
Beaverhill	Surface	49	5,031	4,729	303	4,729	100%	42.7%
	Groundwater	9	96	96	0	96	100%	6.5%
	Total	58	5,127	4,824	303	4,824	100%	38.4%
White Earth	Surface	15	4,142	1,752	2,391	1,752	100%	15.8%
	Groundwater	9	411	411	0	411	100%	27.8%
	Total	24	4,553	2,163	2,391	2,163	100%	17.2%
Vermilion	Surface	8	314	314	0	314	100%	2.8%
	Groundwater	3	102	102	0	102	100%	6.9%
	Total	11	417	417	0	417	100%	3.3%
Frog	Surface	5	451	112	339	112	100%	1.0%
	Groundwater	6	37	37	0	37	100%	2.5%
	Total	11	488	149	339	149	100%	1.2%
Monnery	Surface	0	0	0	0	0		0.0%
	Groundwater	0	0	0	0	0		0.0%
	Total	0	0	0	0	0		0.0%
Total	Surface	171	14,354	11,083	3,271	11,083	100%	88.2%
	Groundwater	83	1,480	1,480	0	1,480	100%	11.8%
	Total	254	15,834	12,563	3,271	12,563	100%	100.0%

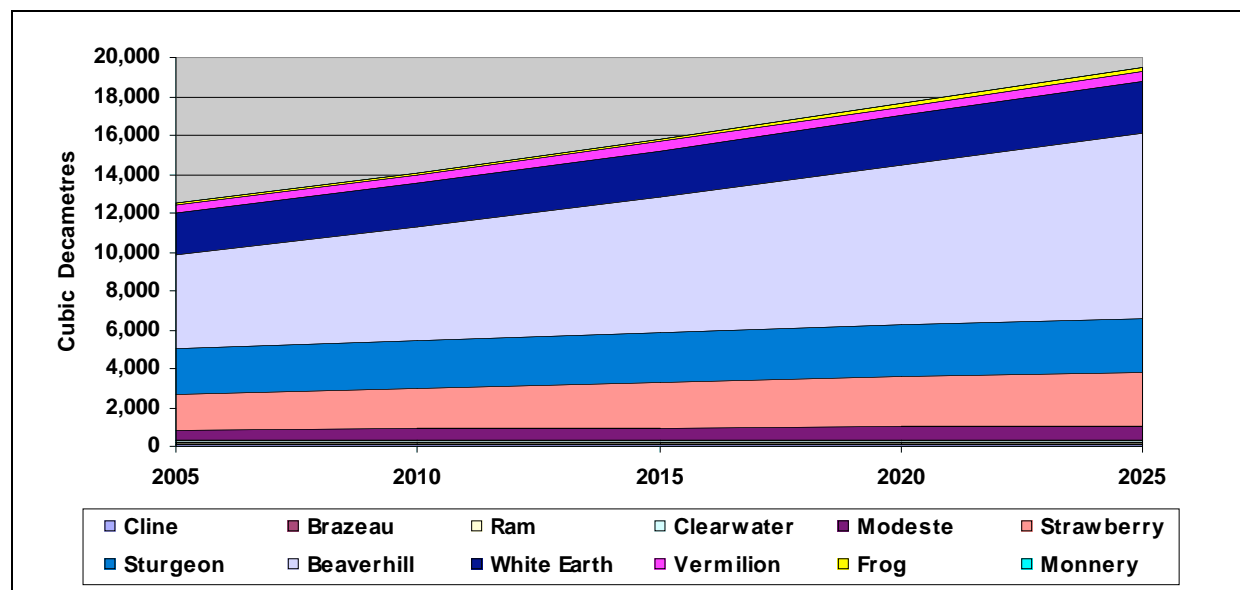
Table 15-6 Water Allocation and Use for the Commercial Sector by Activity in the North Saskatchewan Sub-basins

Activity	Source	Number of Licences	Licensed Allocation and Use (dam ³)			Estimated Use (dam ³)	Licence Utilization	Percent of Sector
			Allocation	Water Use	Return			
Aggregate washing	Surface	17	3,682	1,258	2,424	1,258	100%	11.3%
	Groundwater	9	347	347	0	347	100%	23.4%
	Total	26	4,029	1,605	2,424	1,605	100%	12.8%
Bottling	Surface	7	118	118	0	118	100%	1.1%
	Groundwater	4	42	42	0	42	100%	2.8%
	Total	11	160	160	0	160	100%	1.3%
Construction	Surface	6	345	77	269	77	100%	0.7%
	Groundwater	2	7	7	0	7	100%	0.5%
	Total	8	352	83	269	83	100%	0.7%
Food processing	Surface	0	0	0	0	0	100%	0.0%
	Groundwater	2	11	11	0	11	100%	0.7%
	Total	2	11	11	0	11	100%	0.1%
Gardening	Surface	47	4,258	4,258	0	4,258	100%	38.4%
	Groundwater	11	36	36	0	36	100%	2.4%
	Total	58	4,295	4,295	0	4,295	100%	34.2%
Golf Courses	Surface	45	3,350	3,350	0	3,350	100%	30.2%
	Groundwater	9	464	464	0	464	100%	31.4%
	Total	54	3,814	3,814	0	3,814	100%	30.4%
Other	Surface	14	1,247	908	339	908	100%	8.2%
	Groundwater	7	16	16	0	16	100%	1.1%
	Total	21	1,263	924	339	924	100%	7.4%
Parks and Recreation	Surface	34	1,343	1,105	238	1,105	100%	10.0%
	Groundwater	32	222	222	0	222	100%	15.0%
	Total	66	1,566	1,327	238	1,327	100%	10.6%
Rail/transport	Surface	1	10	10	0	10	100%	0.1%
	Groundwater	1	7	7	0	7	100%	0.5%
	Total	2	17	17	0	17	100%	0.1%
Water Hauling	Surface	0	0	0	0	0	100%	0.0%
	Groundwater	6	329	329	0	329	100%	22.2%
	Total	6	329	329	0	329	100%	2.6%
Total	Surface	171	14,354	11,083	3,271	11,083	100%	88.2%
	Groundwater	83	1,480	1,480	0	1,480	100%	11.8%
	Total	254	15,834	12,563	3,271	12,563	100%	100.0%

15.3.4 Water Use Forecasts

The assumptions used to forecast future water use by the commercial sector are different for each basin and reflect the mix of commercial activities in each basin. For some activities, such as golf courses and parks and recreation, the forecasts are tied to population growth rates. For sectors such as aggregate washing, projections are based on expected economic growth rates, which tend to be slightly higher than population growth. Annual growth in water use by the commercial sector is predicted to range from 0 to 3.2 percent per year. However, even at the highest rate of growth, the resulting increases in water use by the commercial sector will not appreciably affect water use in Alberta because the commercial sector currently accounts for less than one percent of total allocation. Future water use forecast for the commercial sector under Medium Growth is shown in Figure 15-12. By 2025 water use is expected to be 19,395 dam³; this is an increase of 55 percent over current licensed use and exceeds existing allocations by about 3,500 dam³. This forecast assumes that current distribution of ground and surface water allocations would be the same over the forecast period. The Strawberry, Sturgeon and Beaverhill sub-basins are expected to continue to account for the majority of water use for the commercial sector in the North Saskatchewan.

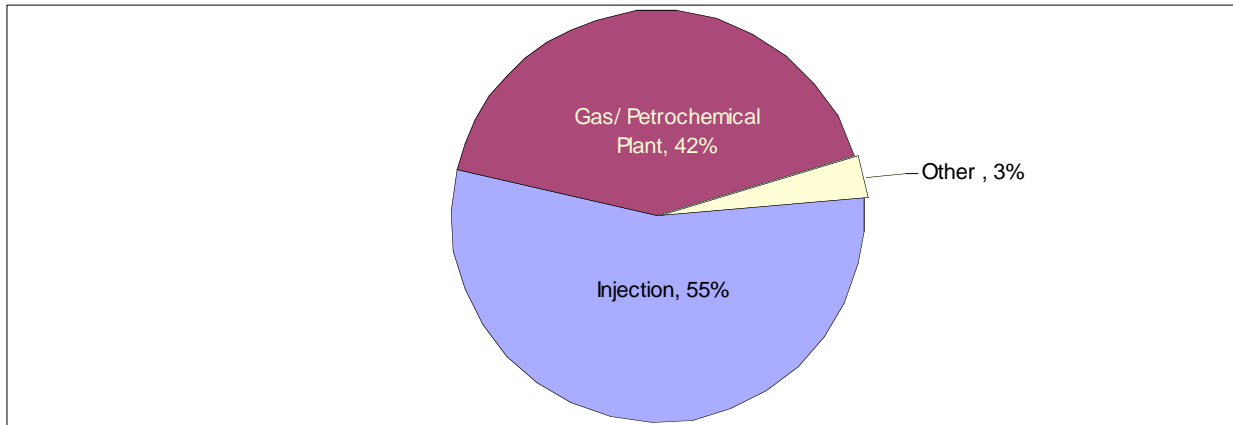
Figure 15-12 Projected Water Use for Commercial Sector to 2025 in the North Saskatchewan



15.4 Petroleum Sector

In 2005, water licences issued to the petroleum sector in the North Saskatchewan allow up to 93,345 dam³ to be withdrawn for use. This sector accounts for about five percent of total water allocations in the province. The majority of allocations for the petroleum industry (95 percent) are for surface water. The petroleum sector includes water allocations for oilfield injection, gas and petrochemical plants, and various other activities. As shown in Figure 15-13 the majority of allocations are for gas and petrochemical plants (55 percent).

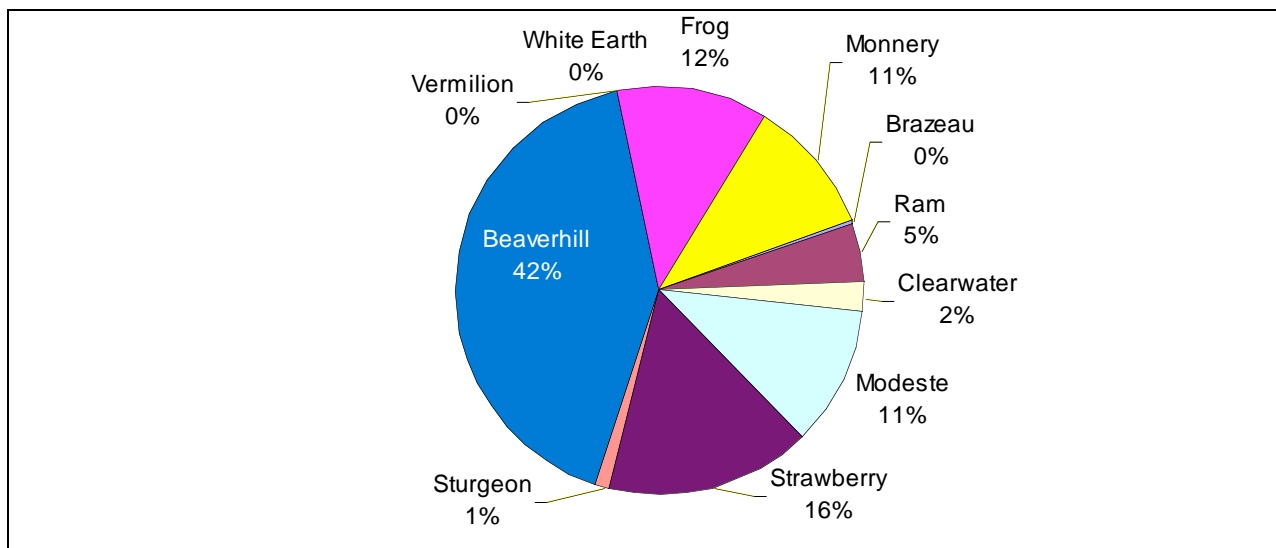
Figure 15-13 Petroleum Water Allocations in Alberta by Activity



15.4.1 Water Allocations

Figure 15-14 shows how water allocations for the petroleum sector are distributed among the various sub-basins. It shows that 42 percent of water allocations for the petroleum sector are in the Beaverhill where a number of gas and petrochemical plants are located. Other basins where large amounts of water have been allocated to the petroleum sector include the Strawberry (16 percent), Frog (12 percent), Modeste (11 percent) and Monnery (11 percent). Relatively small amounts of water have also been allocated to the petroleum sector in all other sub-basins expect for Cline.

Figure 15-14 Petroleum Water Allocation in the North Saskatchewan Basin



Most allocations of water to the petroleum sector (95 percent) are for surface water. There are 60 surface water licences that allow diversions of up to 88,828 dam³. Groundwater accounts for less than 5 percent (4,517 dam³) of allocations. Table 15-6 provides a summary of water

licences issued to the petroleum sector for each of the sub-basins. Table 15-7 shows the water licence information for each of the activities within the sector.

15.4.2 Licensed Water Use

Under the terms of licences issued to the petroleum sector, 88 percent of withdrawals are expected to be used. The remainder (11,260 dam³) is expected to be returned. Return flow allowances in licences range are only included in surface water licences. The return flow allowances are generally consistent among the sub-basins, but vary according to the activity. For example, licences issued for oilfield injection assume that less than 1 percent of withdrawals will be returned while licences issued to gas/petrochemical plants assume that 21 percent of withdrawals will be returned. The difference between allocations and licensed water use is shown in Figure 15-15.

15.4.3 Actual Water Use

Estimates of actual water use for the petroleum sector came from various sources. Water use estimates for oilfield injection was based on an assessment prepared by Geowa based on EUB data. According to the Geowa, 3,752 dam³ of fresh water was diverted for injection purposes in 2005, including 2,561 dam³ of surface water and 1,191 dam³ of groundwater. This information suggests that the petroleum sector was only using 10 percent of licensed water use for oilfield injection. This low utilization occurs because oil production from some of the older fields has declined over time, with the result that less and less water is required each year to offset oil production.

Water use information for gas/petrochemical plants was based on information from AENV's WURS database. The database contains water use information for 29 of the 42 water licences. These licences account for 82 percent of the licensed allocations and 83 percent of the licensed use. For those licences where no information is available, the licence holder was assumed to have used the full entitlement of their licences in 2005. Based on this assumption, the total water use by gas/petrochemical plants in 2005 is estimated to be 29,023 dam³, consisting of 29,498 dam³ of surface water and 525 dam³ of groundwater.

There was no information on water use for other petroleum activities so it was assumed that these activities were using their full allocations. The allocations included 3,029 dam³ of surface water and 5 dam³ of groundwater.

Estimates of water use for each of the sub-basins are provided in Table 15-15. It shows that activities in the Beaverhill Sub-basin accounted for 60 percent of all water use by the petroleum sector, and this is largely attributable to water use by the gas and petrochemical plants. The only other sub-basins where large amounts of water are being used by the petroleum industry is the Monnery Sub-basin which accounts for 19 percent of water use by the petroleum sector in the North Saskatchewan Basin.

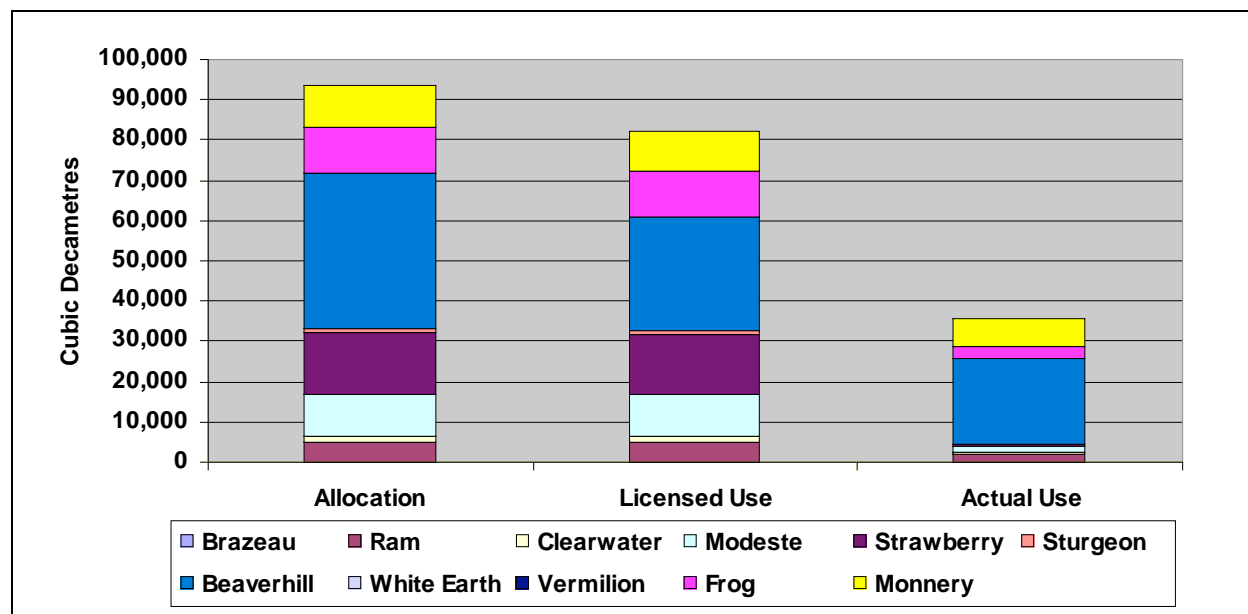
Table 15-7 Water Allocation and Use for the Petroleum Sector by Sub-basin in North Saskatchewan Basin

Sub-basin	Water Type	Licensed Allocation and Use (dam ³)			Estimated Use (dam ³)	Licence Utilization	Percent of Alberta Use
		Allocation	Licensed Use	Return Flow			
Cline	Surface	0	0	0	0		0.0%
	Groundwater	0	0	0	0		0.0%
	Total	0	0	0	0		0.0%
Brazeau	Surface	0	0	0	0		0.0%
	Groundwater	204	204	0	47	23%	2.7%
	Total	204	204	0	47	23%	0.1%
Ram	Surface	3,132	3,132	0	1,272	41%	3.7%
	Groundwater	1,416	1,416	0	577	41%	33.5%
	Total	4,547	4,547	0	1,849	41%	5.2%
Clearwater	Surface	635	635	0	0		0.0%
	Groundwater	1,237	1,237	0	448	36%	26.0%
	Total	1,872	1,872	0	448	24%	1.3%
Modeste	Surface	9,041	9,041	0	1,085	12%	3.2%
	Groundwater	1,370	1,370	0	537	39%	31.2%
	Total	10,414	10,414	0	1,622	16%	4.5%
Strawberry	Surface	14,925	14,564	361	238	2%	0.7%
	Groundwater	155	155	0	12	8%	0.7%
	Total	15,080	14,719	361	250	2%	0.7%
Sturgeon	Surface	999	999	0	252	25%	0.7%
	Groundwater	0	0	0	0		0.0%
	Total	999	999	0	252	25%	0.7%
Beaverhill	Surface	38,883	27,985	10,899	21,395	76%	62.8%
	Groundwater	0	0	0	0		0.0%
	Total	38,883	27,985	10,899	21,395	76%	59.7%
White Earth	Surface	0	0	0	0		0.0%
	Groundwater	1	1	0	1	83%	0.1%
	Total	1	1	0	1	83%	0.0%
Vermilion	Surface	0	0	0	0		0.0%
	Groundwater	2	2	0	2	133%	0.1%
	Total	2	2	0	2	133%	0.0%
Frog	Surface	11,257	11,257	0	3,029	27%	8.9%
	Groundwater	50	50	0	31	62%	1.8%
	Total	11,307	11,307	0	3,059	27%	8.5%
Monnery	Surface	9,955	9,955	0	6,817	68%	20.0%
	Groundwater	80	80	0	68	85%	4.0%
	Total	10,035	10,035	0	6,885	69%	19.2%
Total	Surface	88,828	77,568	11,260	34,088	44%	95.2%
	Groundwater	4,517	4,517	0	1,721	38%	4.8%
	Total	93,345	82,085	11,260	35,809	44%	100.0%

Table 15-8 Water Allocation and Use for the Petroleum Sector by Activity in North Saskatchewan Basin

Activity	Source	Number of Licences	Licensed Allocation and Use (dam ³)			Estimated Use (dam ³)	Licence Utilization	Percent of Sector
			Allocation	Water Use	Return			
Injection	Surface	39	35,534	35,172	361	2,561	7%	7.5%
	Groundwater	63	3,501	3,501	0	1,191	34%	69.2%
	Total	102	39,035	38,673	361	3,752	10%	10.5%
Gas/Petrochemical Plant	Surface	17	50,266	39,367	10,899	28,498	72%	83.6%
	Groundwater	25	1,011	1,011	0	525	52%	30.5%
	Total	42	51,276	40,376	10,899	29,023	72%	81.0%
Other Petroleum	Surface	4	3,029	3,029	0	3,029	100%	8.9%
	Groundwater	2	5	5	0	5	100%	0.3%
	Total	6	3,034	3,034	0	3,034	100%	8.5%
Total	Surface	60	88,828	77,568	11,260	34,088	44%	95.2%
	Groundwater	90	4,517	4,517	0	1,721	38%	4.8%
	Total	150	93,345	82,085	11,260	35,809	44%	100.0%

Figure 15-15 Allocations, Licensed Use and Actual Use for the Petroleum Sector, Alberta



The data in Table 15-7 suggest that the overall licence utilization rate was only 44 percent but, as noted above, gas and petrochemical plants have much higher utilization rates (72 percent) than injection projects (10 percent). Outside the Beaverhill and Monnery sub-basins, which are home to most of the gas/petrochemical plants and have utilization rates of 77 percent and 68 percent, respectively, the average utilization was only 34 percent.

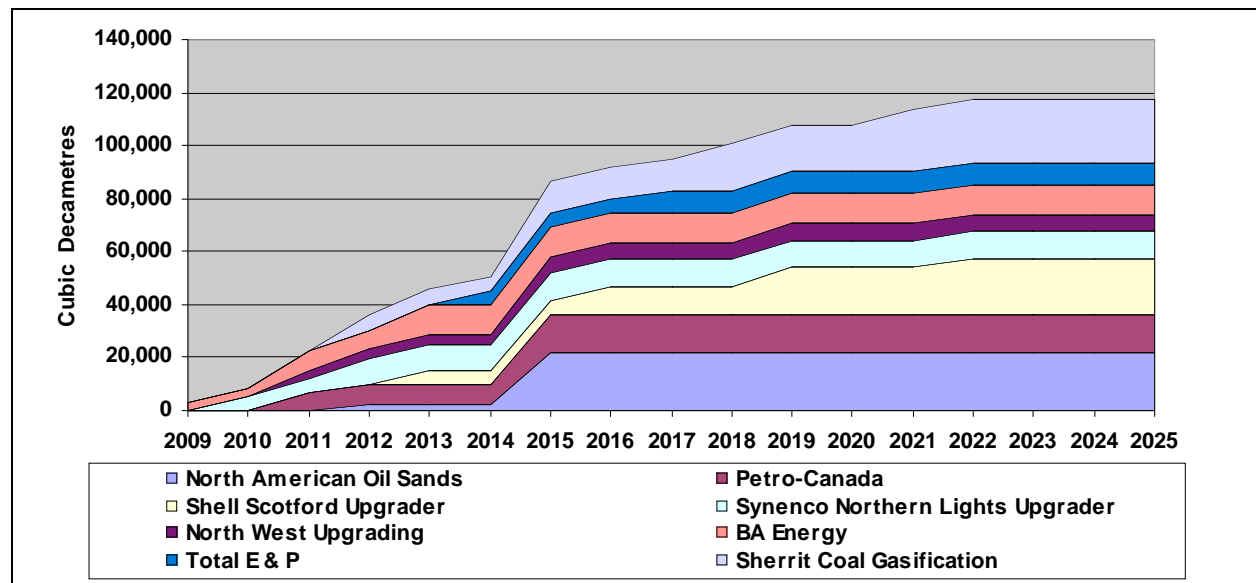
15.4.4 Forecasts of Future Water Use

Future water use for the petroleum sector is expected to rise significantly in the next few years as a number of new upgraders are constructed to process bitumen from the oilsands. The forecasts include allocations for seven upgraders and one coal gasification plant. These plants and their estimated water requirements are summarized in Table 15-9. Once completed, the seven bitumen upgraders and the coal gasification may require more than 117,100 dam³ of water per year in terms of gross diversions. Figure 15-16 shows how these water requirements for these new facilities will evolve over time, based on the proposed schedule for project development and expansions.

Table 15-9 List of Proposed Upgraders & Gas Plants in the North Saskatchewan Basin

Company	Name of Project	Status	Timeline for Operations	Amount of Product	Water Required (dam ³)
BA Energy	Upgrader Project	Phase 1 Approved in 2005	Phase 1 - 2009 Phase 2 - 2011 Phase 3 - 2013	Phase 1 – 77,500 BPD Phase 2 – +91,125 BPD Phase 3 - +91,125 BPD	3384 dam ³ – 2009 7363 dam ³ – 2011 11,350 dam ³ - 2013
North American Oil Sands Corporation	Upgrader Project	Proposed Terms of Reference	Phase 1 - 2012 Phase 2 - 2015	Phase 1- 75,000 BPD Phase 2- 250,000 BPD	2,628 dam ³ per year by 2012 21,640 dam ³ per year by 2015
Petro-Canada	Fort Hills Sturgeon Upgrader Project	EIA submitted	Phase 1 - 2011 Phase 2 & 3 - 2014/15	Phase 1- 165,000 BPD Phase 2&3 340,000 BPD	14,454 dam ³ per year diverted from NSR at capacity
Shell Canada	Scotford Upgrader 2 Project	Proposed Terms of Reference	Phase 1 – 2013 Phases 2, 3 & 4 - unknown	Phase 1 - 100,000 bbl/day Phases 2,3 & 4 – 100,000 bbl/day each	21,024 dam ³ per year (Estimated based on Scotford's current licensed and production capacity).
Total E & P	Upgrader Project	Public Disclosure Issued	Phase 1 - 2013/14 Phase 2 - unknown	Phase 1 – 130,000 BPD Phase 2 – 70,000+ BPD	Estimated. 5,200 dam ³ increasing to 8,000 dam ³ per at capacity from NSR
Synenco Energy Inc.	Northern Lights Upgrader Project	EIA/ Application submitted	Phase 1 – 2010 Phase 2 - 2012	Phase 1 - 50,000 BPD Phase 2 – 50,000 BPD	10,300 dam ³
North West Upgrading Inc.	North West upgrader Project	EIA submitted	Phase 1 - 2010 Phases 2&3 - 2015	Phase 1-77,000 BPD Phase 2&3 -154,000 BPD	6,570 dam ³
Total Water Requirements for Upgraders at Capacity					93,334 dam³
Sherritt International Corporation	Dodds-Roundhill Coal Gasification Project	Preparing Terms of Reference	Phase 1 – 2012 Phases 2, 3 & 4 unknown	Phase 1 - 270 MM scfd of pipeline grade hydrogen Phases 2, 3 & 4 270 MMscfd of hydrogen each	Phase 1 - 2,400 to 9,500 dam ³ per year likely from NSR Other phases would have similar requirements
Total Water Requirements for Upgraders at Capacity					117,134 dam³

Figure 15-16 Water Requirements for Proposed Upgraders



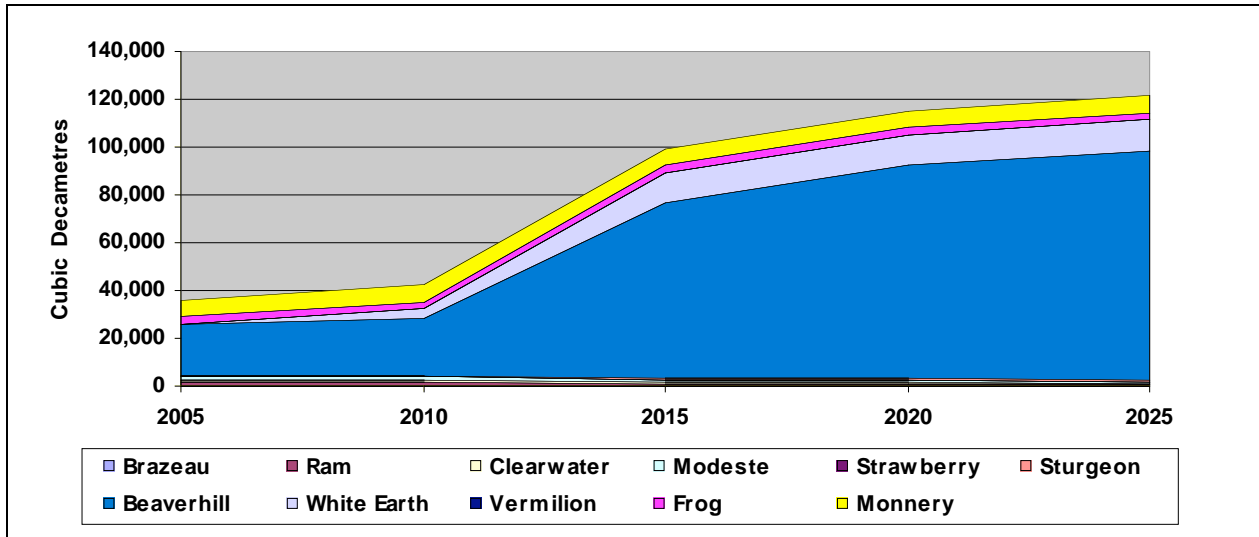
As some of the water will be used for cooling purposes, there will be some potential for return flow. According to the application by Petro-Canada¹, between 72 and 80 percent of water diversions will be consumed and the balance will be returned after use. On the assumption that 25 percent of water will be returned, estimated water use when all new industrial operations are operating at capacity will be about 87,850 dam³.

At the same time as the gas and petrochemical activities are increasing, conventional crude oil production declining as existing fields mature and there are fewer new finds, water use for injection purposes will decline. The most recent forecast from the EUB and CAPP have oil production decreasing by between 30 and 38 percent between 2005 and 2015, and a further decline of about 23 percent by 2020, and it is expected that water use will decline by the same amount.

Estimates of future water use by the petroleum sector in the North Saskatchewan are shown in Figure 15-17. It shows the projections under the Medium Growth scenario, and suggests the overall demand for water in the Alberta will nearly triple over the period until 2015 and continue to increase, although at a slower rate through to 2025. Estimated water use in 2015 is estimated to be 99,385 dam³, which is 278 percent of current levels. By 2025, water use by the petroleum sector will be 121,302 dam³, which is 339 percent of current levels. Figure 15-17 shows that most of the increase will be in the Beaverhill Sub-basin, where five of the upgraders and the coal gasification plant will be located, with some additional water use in the White Earth Sub-basin, where the other two upgraders are proposed.

¹ Petro-Canada (2007) Fort Hills Sturgeon Upgrader Project Application. Available at http://www.petro-canada.ca/pdfs/5_Water_Management.pdf

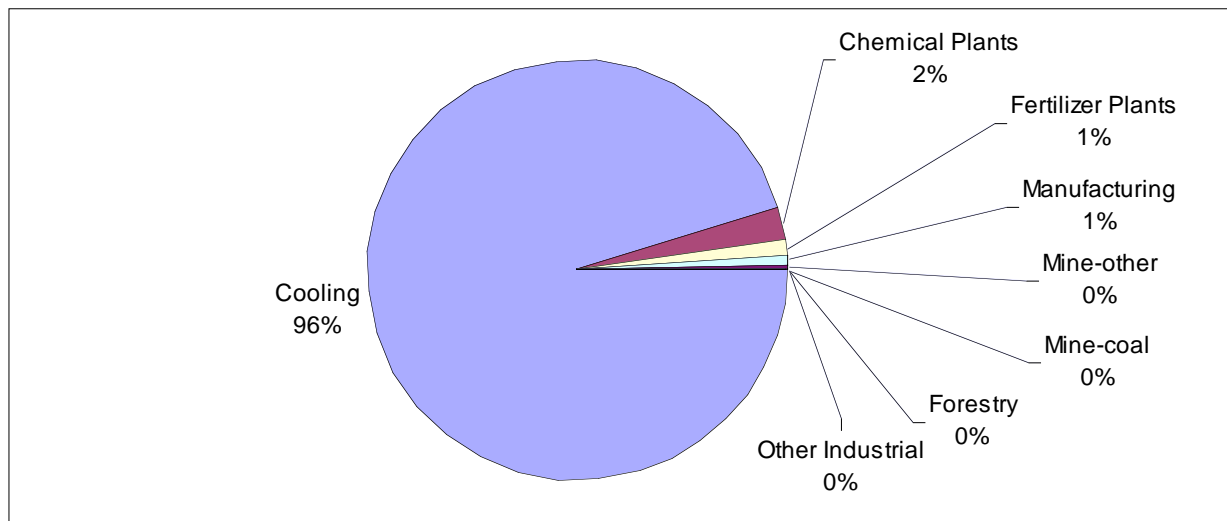
Figure 15-17 Projected Water Use for Petroleum Sector Medium Scenario



15.5 Industrial Sector

Industrial water licences account for about 83 percent of the water allocations in the North Saskatchewan Basin. In the basin, 71 water licences have been issued for industrial use and these allow withdrawals of up to 1,660,574 dam³. Almost all water allocations for the industrial sector are for surface water (1,659,880 dam³). As shown in Figure 15-14, the industrial sector includes water allocations for cooling, forestry chemical plants, fertilizer plants, manufacturing, mining other than coal, coal mining, and other industrial activities. It shows that 96 percent of allocations are for cooling (power plants). Allocations for all other industrial sectors each account for 2 percent or less of industrial allocations.

Figure 15-18 Industrial Water Allocations in the North Saskatchewan Basin by Activity



15.5.1 Water Allocations

As illustrated in Figure 15-19, most of the water allocations for the industrial sector are in the Modeste Sub-basin, which has a large number of license issued for cooling requirements by the large thermal power plants owned by EPCOR and TransAlta. Another 31 percent of allocations are for the Beaverhill Sub-basin and 17 percent for the Strawberry. Small amounts of water have been issued for industrial purposes in the remaining sub-basins. No industrial water licences have been issued for the Cline, Brazeau, and White Earth sub-basins. Details of the industrial licences for each of the sub-basins are provided in Table 15-10.

Figure 15-19 Industrial Water Allocation in the North Saskatchewan by Sub-basin

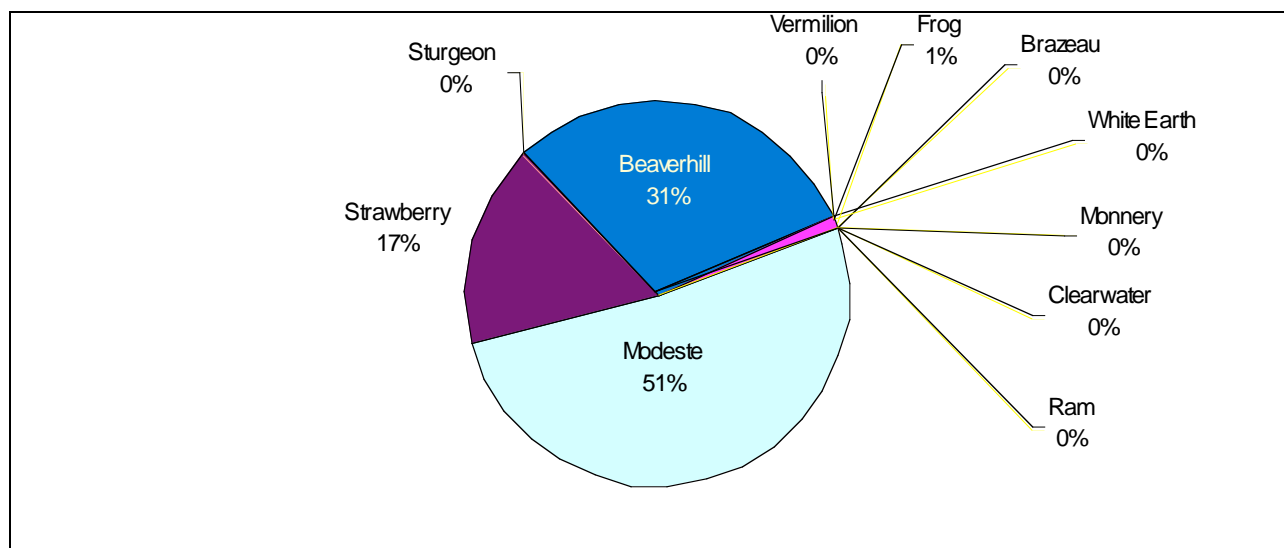


Table 15-11 shows that 95 percent of the allocations are for cooling purposes for thermal power generation or for air conditioning; nearly all of these allocations are for surface water. The majority of these thermal power plants are in the Modeste Sub-basin, but there are also plants in the Strawberry, Sturgeon, Beaverhill, and Monnery sub-basins. Another 2 percent of allocations are for the chemical plants which have been issued exclusively in the Beaverhill Sub-basin.

15.5.2 Licensed Water Use

Water licences issued for industrial purposes assume that up to 207,594 dam³ of water will be lost or consumed (13 percent) but that the vast majority of withdrawals (1,452,981 dam³ or 88 percent) will be returned after use. The return flow allowance in licences is highest for the cooling sector (1,428,068 dam³). Although power plants are licensed for very large amounts of water, these licences assume that 90 percent of surface water allocations and 92 percent of groundwater allocations will be returned.

Table 15-10 Water Allocation and Use for the Industrial Sector by Sub-basin in the North Saskatchewan Basin

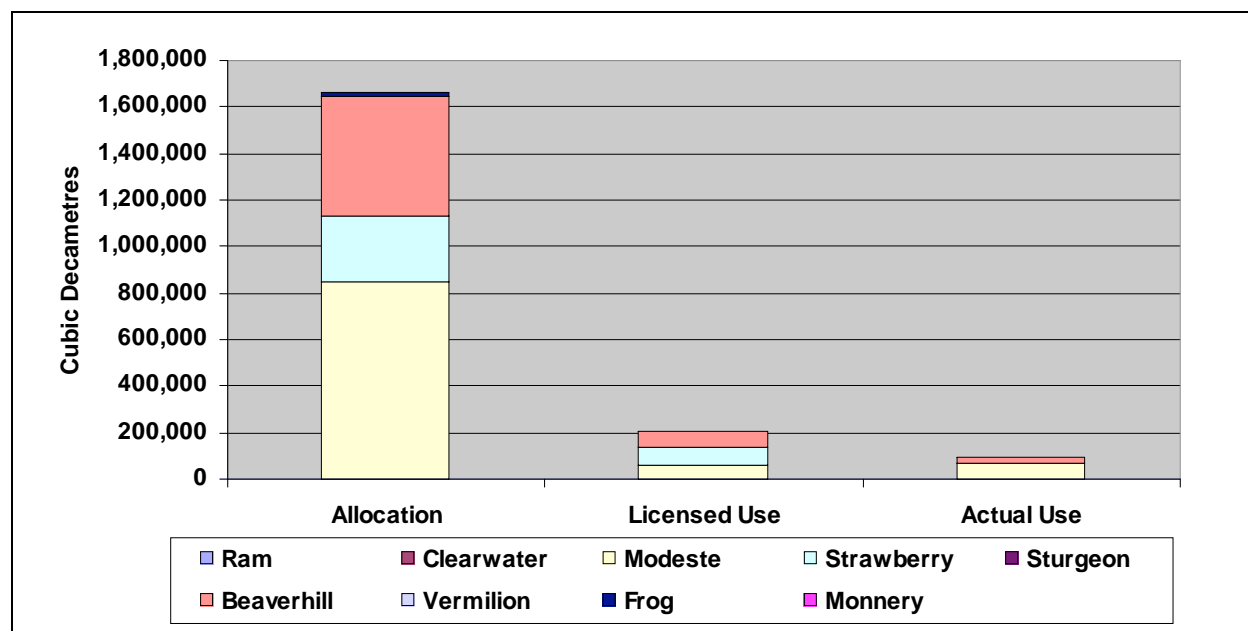
Sub-basin	Water Type	Licensed Allocation and Use (dam ³)			Estimated Use (dam ³)	Licence Utilization	Percent of Alberta Use
		Allocation	Licensed Use	Return Flow			
Cline	Surface	0	0	0	0		0.0%
	Groundwater	0	0	0	0		0.0%
	Total	0	0	0	0		0.0%
Brazeau	Surface	0	0	0	0		0.0%
	Groundwater	0	0	0	0		0.0%
	Total	0	0	0	0		0.0%
Ram	Surface	0	0	0	0		0.0%
	Groundwater	5	5	0	5	100%	0.4%
	Total	5	5	0	5	100%	0.0%
Clearwater	Surface	0	0	0	0		0.0%
	Groundwater	53	53	0	8	15%	0.6%
	Total	53	53	0	8	15%	0.0%
Modeste	Surface	851,190	62,376	788,814	64,399	103%	69.9%
	Groundwater	65	65	0	831	1284%	62.2%
	Total	851,255	62,441	788,814	65,230	104%	69.8%
Strawberry	Surface	281,715	70,214	211,501	148	0%	0.2%
	Groundwater	243	243	0	243	100%	18.2%
	Total	281,958	70,457	211,501	391	1%	0.4%
Sturgeon	Surface	2	2	0	2	100%	0.0%
	Groundwater	66	66	0	66	100%	4.9%
	Total	68	68	0	68	100%	0.1%
Beaverhill	Surface	514,935	73,184	441,751	27,133	37%	29.5%
	Groundwater	178	178	0	178	100%	13.3%
	Total	515,113	73,362	441,751	27,312	37%	29.2%
White Earth	Surface	0	0	0	0		0.0%
	Groundwater	0	0	0	0		0.0%
	Total	0	0	0	0		0.0%
Vermilion	Surface	0	0	0	0		0.0%
	Groundwater	1	1	0	1	83%	0.1%
	Total	1	1	0	1	83%	0.0%
Frog	Surface	12,039	1,204	10,835	438	36%	0.5%
	Groundwater	0	0	0	0		0.0%
	Total	12,039	1,204	10,835	438	36%	0.5%
Monnery	Surface	0	0	0	0		0.0%
	Groundwater	83	3	80	3	100%	0.2%
	Total	83	3	80	3	100%	0.0%
Total	Surface	1,659,880	206,980	1,452,901	92,120	45%	98.6%
	Groundwater	694	614	80	1,335	217%	1.4%
	Total	1,660,574	207,594	1,452,981	93,456	45%	100.0%

Table 15-11 Water Allocation and Use for the Industrial Sector by Activity in the North Saskatchewan Basin

Activity	Source	Number of Licences	Licensed Allocation and Use (dam ³)			Estimated Use (dam ³)	Licence Utilization	Percent of Sector
			Allocation	Licensed Water Use	Return			
Cooling	Surface	22	1,583,540	155,552	1,427,988	64,998	42%	70.6%
	Groundwater	2	88	7	80	7	95%	0.5%
	Subtotal	24	1,583,627	155,559	1,428,068	65,005	42%	69.6%
Forestry	Surface	0	0	0	0	0	#DIV/0!	0.0%
	Groundwater	5	86	86	0	806.7	941%	60.4%
	Subtotal	5	86	86	0	806.7	941%	0.9%
Chemical Plants	Surface	6	39,348	30,094	9,254	12,960	43%	14.1%
	Groundwater	1	6	6	0	6	109%	0.4%
	Subtotal	7	39,353	30,099	9,254	12,966	43%	13.9%
Fertilizer Plants	Surface	5	19,455	16,558	2,897	11,654	70%	12.7%
	Groundwater	5	173	172	1	173	101%	13.0%
	Subtotal	10	19,628	16,730	2,898	11,828	71%	12.7%
Manufacturing	Surface	4	12,187	1,352	10,835	586	43%	0.6%
	Groundwater	7	304	304	0	304	100%	22.8%
	Subtotal	11	12,491	1,656	10,835	890	54%	1.0%
Mine-other	Surface	4	5,278	3,351	1,926	1,849	55%	2.0%
	Groundwater	2	6	6	0	6	98%	0.4%
	Subtotal	6	5,284	3,357	1,926	1,855	55%	2.0%
Mine-coal	Surface	1	12	12	0	12	98%	0.0%
	Groundwater	2	31	31	0	31	101%	2.3%
	Subtotal	3	43	43	0	43	100%	0.0%
Other Industrial	Surface	1	61	61	0	61	101%	0.1%
	Groundwater	4	2	2	0	2	95%	0.1%
	Subtotal	5	63	63	0	63	101%	0.1%
Total	Surface	43	1,659,880	206,980	1,452,901	92,120	45%	98.6%
	Groundwater	28	694	614	80	1,335	217%	1.4%
	Total	71	1,660,574	207,594	1,452,981	93,456	45%	100.0%

Other than manufacturing and cooling, most other industrial activities are expected to consume a higher proportion of their withdrawals. For example, chemical plants are assumed to use all of their groundwater licences and 76 percent of surface water diversions. Similarly, licences issued to fertilizer plants expect that 99 percent of groundwater withdrawals and 85 percent of surface water allocations will be consumed. However, licences issued to manufacturing assume that only 11 percent of surface water diversions will be used while 100 percent of groundwater will be consumed. The difference between industrial allocations and licensed water use is shown in Figure 15-20.

Figure 15-20 Allocations, Licensed Use and Actual Use for the Industrial Sector, North Saskatchewan Basin



15.5.3 Actual Water Use

Information on actual water use was drawn from a variety of sources. Estimates of water used for power plants were taken from AENV's WURS database which includes information for 16 of 22 surface water licences. Analysis of the data indicates that plants with surface water allocations were using an average of 4.1 percent of their allocations and 42 percent of the water that they are expected to consume. This low utilization is because two plants in Edmonton (Rossdale Power Plant and the University of Alberta) reported withdrawing no water while the Cloverbar Plant is being redeveloped and also required no water. In addition, water licences are issued to allow thermal power plants to operate at 100 percent of capacity but this never occurs over an entire year.

The WURS database also had water use information for five of seven licences issued for chemical plants, nine of 10 licences for fertilizer plants, and three of the six licences issued for mining other than coal. Available information showed that chemical plants with surface water allocations were using an average of 5 percent of their licensed water use, fertilizer plants used

an average of 70 percent of their surface water entitlements, and mines other than coal reported using 55 percent of their licensed use.

The WURS database did not include much information on actual water use by industries for cooling groundwater licences, chemical plant groundwater licences, manufacturing groundwater licences, mining-other than coal groundwater licence, and other industrial activities both surface and groundwater. For these uses, it was assumed that licensees were using the full amounts of their allocations.

Based on the available information and the assumptions noted above, it is estimated that actual industrial water amounted to 93,456 dam³, including 92,120 dam³ of surface water and 1,335 dam³ of groundwater. Actual water use amounted to 45 percent of licensed use. Based on reported use by one forestry operation in the Modeste Sub-basin, groundwater utilization is estimated to have actually exceeded the allocation.

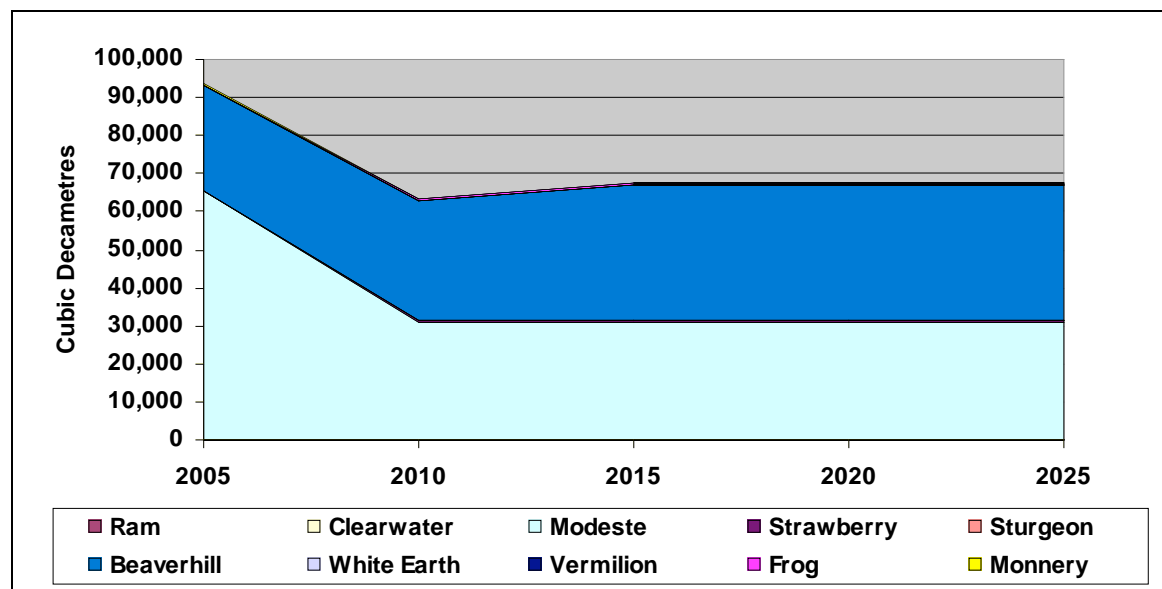
For the Ram, Vermilion, and Monnery sub-basins, industrial water users were estimated to be using all of their entitlements. However, this estimate reflects the assumptions used for those industrial activities that did not report actual water use. For the other sub-basins where actual water use was reported for the major industrial activities, licence utilization rates were typically in the range of less than 1 percent (Strawberry Sub-basin) to 37 percent (Beaverhill Sub-basin).

15.5.4 Forecasts of Future Water Use

Over the next 20 years the water demand for cooling activity is expected to decrease. This anticipated reduction is due to the retirement of one thermal power plant (Wabamun) and renovations of existing plants (Clover Bar, Sundance, and Keephills) that will improve water use efficiency. Estimates of water use for cooling were based on discussions with companies and power demand forecasts provided by the Alberta Electric System Operator which suggests that power production in Alberta will increase by 3280 MW between 2005 and 2015, and by 3100 MW between 2015 and 2025. Very little information is available for all other industrial activities, so it assumed that water use by forestry, chemical plants, fertilizer plants, mining, and manufacturing will remain constant over the period to 2025.

Estimates of future water use by the industrial sector in the North Saskatchewan under the Medium Growth scenario are shown in Figure 15-21. Under this scenario, industrial water use is expected to drop by 2010, increase slightly, and then constant after 2015. Estimated water use in 2025 is estimated to be 67,360 dam³; this is about 28 percent less than current use. Figure 15-21 shows that there will be decreased water use in the Modeste Sub-basin, due to the plant closure, while industrial water use will increase in the Beaverhill Sub-basin as the Clover bar plant resumes operation.

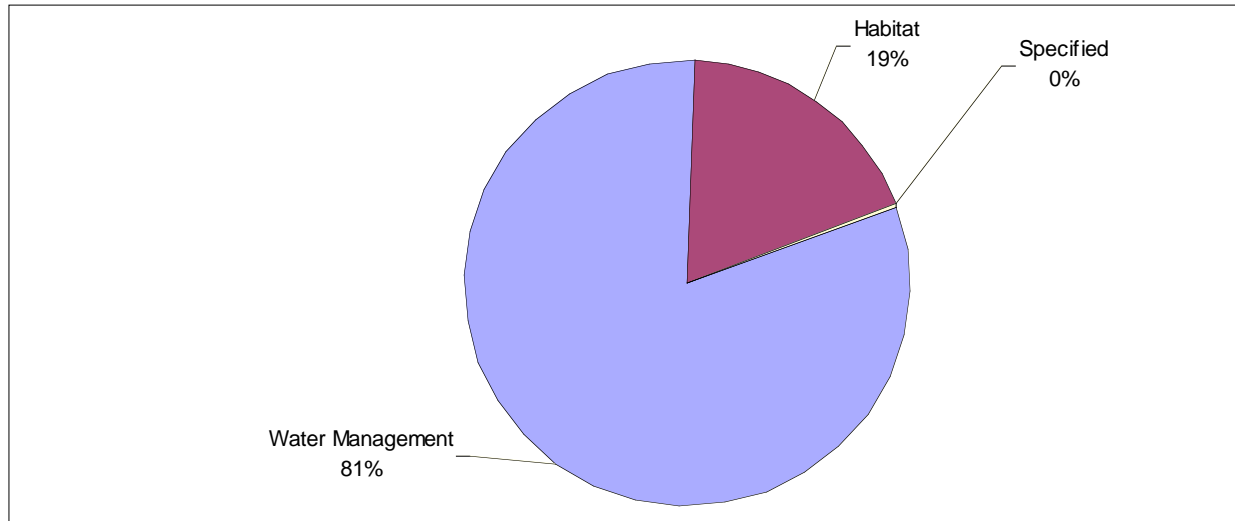
Figure 15-21 Projected Water Use for Industrial Sector



15.6 Other Sector

In the North Saskatchewan Basin, 212 water licences have been issued for other purposes such as water management, habitat enhancement, and use specified by director. These licences allow withdrawals of up to 36,009 dam³. Water allocations to the other sector account for less than 2 percent of all allocations in the North Saskatchewan Basin. As shown in Figure 15-22, the majority of allocations to the other sector are for water management, including flood control and lake stabilization; these account for 81 percent of total allocations for the other sector. The other sector also includes allocations for fish, wildlife and habitat enhancement (19 percent), and for water conservation and uses specified by a director with AENV (less than 1 percent). The majority (94 percent) of allocations to the other sector is for surface water (33,914 dam³). It should be noted that the majority of licences for water management and habitat enhancement have been issued to various rural municipalities, Alberta Environment and Ducks Unlimited. Although water management and habitat enhancement have been analyzed separately, there may actually be no significant differences between the two categories of licences.

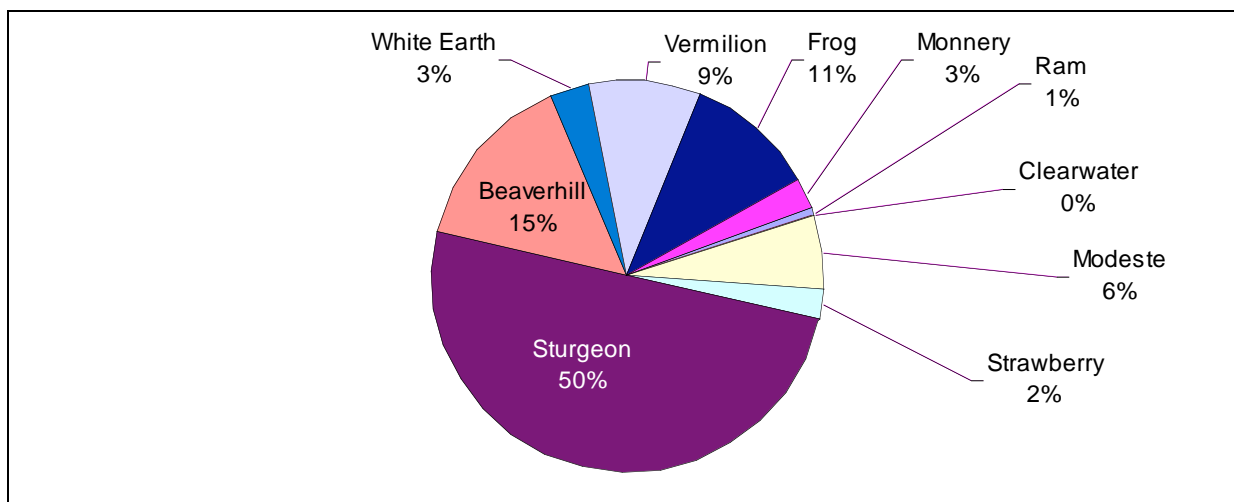
Figure 15-22 Other Sector Water Allocations in the North Saskatchewan by Activity



15.6.1 Water Allocations

Figure 15-23 shows that more water has been allocated for other purposes in the Sturgeon Sub-basin than in any other basin. The Sturgeon Sub-basin accounts for 50 percent of allocations for other purposes. Other river basins with large allocations of water for other purposes include the Beaverhill (15 percent), Frog (11 percent), Vermilion (9 percent), and Modeste (6 percent). Very small amounts of water have been allocated to this sector in the White Earth, Monnery, Strawberry, Ram, and Clearwater sub-basins. No water licences have been allocated to the other sector in the Cline and Brazeau sub-basins.

Figure 15-23 Other Water Allocation in North Saskatchewan by Sub-basin



Details of the licences issued to the other sector in the North Saskatchewan are provided in Table 15-12 for each sub-basin and for each activity in Table 15-13. Overall, groundwater accounts for about 6 percent of allocations for other purposes. No groundwater licences have been issued in the Ram, Clearwater, Vermilion, and Monnery sub-basin. Groundwater allocations account for a moderate percentage of the licences in the sub-basin of Beaverhill (14 percent), Sturgeon (7 percent), and Strawberry (4 percent).

15.6.2 Licensed Water Use

Table 15-12 shows that licences issued for water management purposes assume that 76 percent of surface water allocations and 9 percent of groundwater allocations will be used, and that the balance will be returned after use. Licences issued for habitat enhancement purposes assume that 98 percent of surface water withdrawals and 6 percent of groundwater withdrawals will be returned. Licences assume that water management projects will use 71 percent of surface water withdrawals but only 6 percent of groundwater withdrawals. There are no return flow allowances in licences issued for director–specified activities. In total, licences issued for other purposes assume that up to 26,083 dam³ will be used, consisting of 25,900 dam³ of surface water and 184 dam³ of groundwater. The difference between allocations and licensed use for licences issued to the other sector are shown in Figure 15-24.

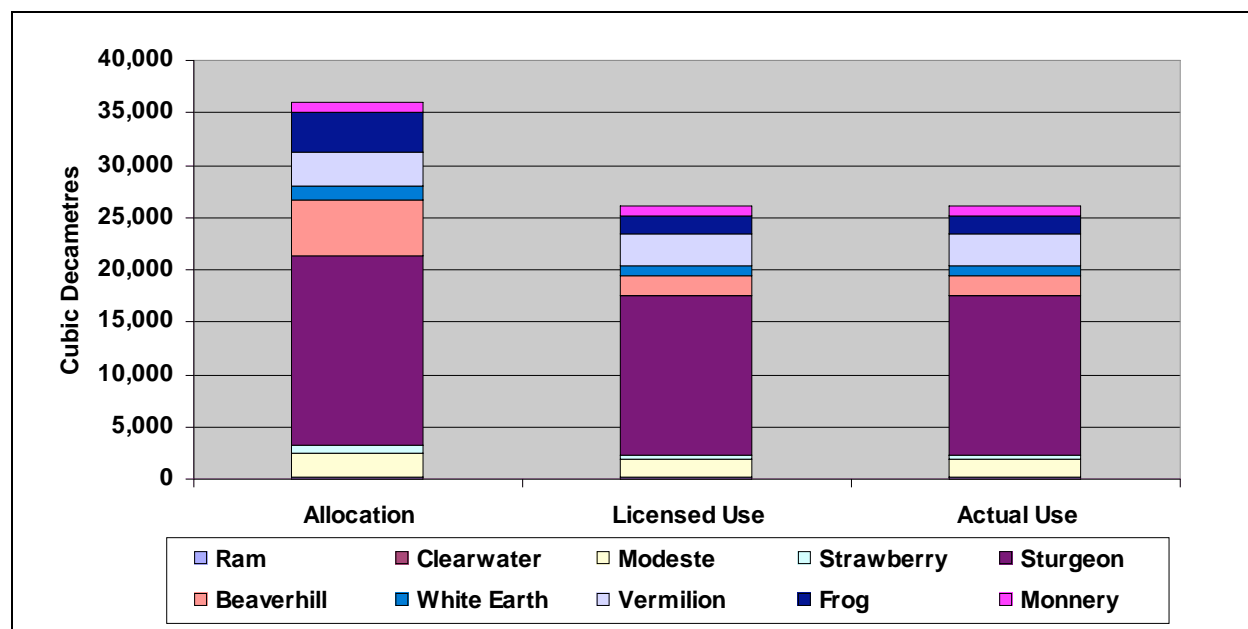
Table 15-12 Water Allocation and Use for the Other Sector by Sub-basin in the North Saskatchewan Basin

Sub-basin	Water Type	Licensed Allocation and Use (dam ³)			Estimated Use (dam ³)	Licence Utilization	Percent of Alberta Use
		Allocation	Licensed Use	Return Flow			
Cline	Surface	0	0	0	0		0.0%
	Groundwater	0	0	0	0		0.0%
	Total	0	0	0	0		0.0%
Brazeau	Surface	0	0	0	0		0.0%
	Groundwater	0	0	0	0		0.0%
	Total	0	0	0	0		0.0%
Ram	Surface	244	236	0	236	100%	0.9%
	Groundwater	0	0	0	0		0.0%
	Total	244	236	8	236	100%	0.9%
Clearwater	Surface	4	4	0	4	100%	0.0%
	Groundwater	0	0	0	0		0.0%
	Total	4	4	0	4	100%	0.0%
Modeste	Surface	2,194	1,634	561	1,634	100%	6.3%
	Groundwater	2.5	2.5	0	3	100%	1.6%
	Total	2,197	1,636	561	1,636	100%	6.3%
Strawberry	Surface	801	460	341	460	100%	1.8%
	Groundwater	37	9	28	9	100%	4.9%
	Total	838	469	369	469	100%	1.8%
Sturgeon	Surface	16,770	15,016	1,754	15,016	100%	58.0%
	Groundwater	1253.6	135.1	1118.5	135	100%	73.4%
	Total	18,024	15,151	2,872	15,151	100%	58.1%
Beaverhill	Surface	4,682	2,023	2,659	2,023	100%	7.8%
	Groundwater	766	1.2	765	1	100%	0.5%
	Total	5,448	2,024	3,424	2,024	100%	7.8%
White Earth	Surface	1,183	842	341	842	100%	3.3%
	Groundwater	0.2	0	0.2	0		0.0%
	Total	1,183	842	341	842	100%	3.2%
Vermilion	Surface	3,252	3,122	131	3,122	100%	12.1%
	Groundwater	0	0	0	0		0.0%
	Total	3,252	3,122	131	3,122	100%	12.0%
Frog	Surface	3,861	1,641	2,220	1,641	100%	6.3%
	Groundwater	35.5	35.5	0	36	100%	19.6%
	Total	3,897	1,677	2,220	1,677	100%	6.4%
Monnery	Surface	922.6	922.6	0	923	100%	3.6%
	Groundwater	0	0	0	0		0.0%
	Total	922.6	922.6	0	923	100%	3.5%
Total	Surface	33,914	25,899	8,007	25,899	100%	99.3%
	Groundwater	2,095	184	1,911	184	100%	0.7%
	Total	36,009	26,083	9,918	26,083	100%	100.0%

Table 15-13 Water Allocation and Use for the Other Sector by Activity in North Saskatchewan Basin

Activity	Source	Number of Licences	Licensed Allocation and Use (dam ³)			Estimated Use (dam ³)	Licence Utilization	Percent of Sector
			Allocation	Water Use	Return			
Water Management	Surface	81	27,236	19,372	7,864	19,379	100%	74.8%
	Groundwater	8	1,995	127	1,868	127	100%	69.0%
	Total	89	29,230	19,499	9,731	19,507	100%	74.8%
Water Conservation	Surface	109	6,627	6,477	151	6,477	100%	25.0%
	Groundwater	10	65	21	44	21	100%	11.4%
	Total	119	6,692	6,498	167	6,497	100%	24.9%
Director-Specified Activities	Surface	3	51	51	0	51	100%	0.2%
	Groundwater	1	35	35	0	35	100%	19.0%
	Total	4	87	87	0	87	100%	0.3%
Total	Surface	193	33,914	25,899	8,007	25,899	100%	99.3%
	Groundwater	19	2,095	184	1,911	184	100%	0.7%
	Total	212	36,009	26,083	9,918	26,083	100%	100.0%

Figure 15-24 Allocations, Licensed Use and Actual Use for the Other Sector, North Saskatchewan



15.6.3 Actual Water Use

There is no information on actual water diversions and consumption for any of the licences issued to the other sector. For purposes of this analysis, it is assumed that licensees are using their full entitlement.

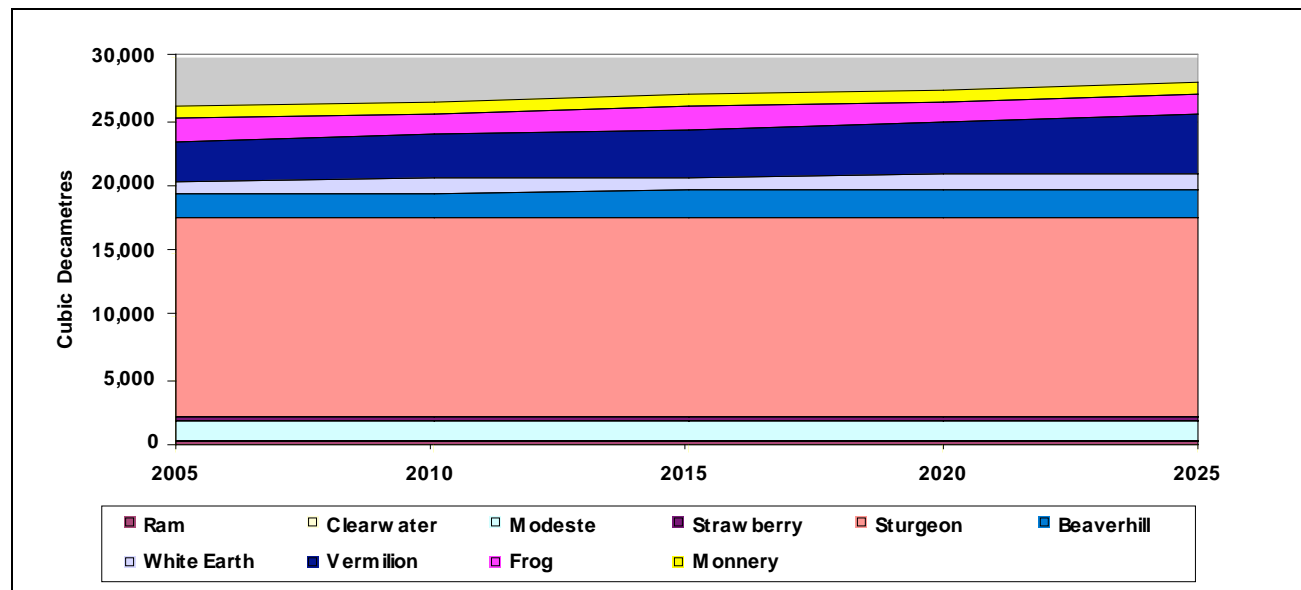
15.6.4 Forecasts of Future Water Use

Forecasts of future water use by the other sector are based on consultations with Ducks Unlimited and Alberta Environment. Neither organization has formal forecasts of their future water needs or for the counties. The number of projects that Ducks Unlimited will implement depends on a number of factors such as their budget, the state of the economy, and environment objectives. It is anticipated that there will be an increased emphasis on restoring drained wetlands to pre-drainage or natural conditions. These types of projects will not require new water licences. In terms of new water licences, Ducks Unlimited foresees an increase of about one or two new water licences per year (Randy Cummer, pers. comm. June 12, 2007). The emphasis will likely be on the Beaverhill, White Earth or Vermilion sub-basins. The forecasts assume that the current ratio of Ducks Unlimited Licences in each of these three basins for the distribution of new projects. Based on discussions with AENV, water use for projects licensed to AENV for other purposes is not expected to change over the forecast period.

Estimates of future water use by the other sector in Alberta are shown in Figure 15-25 for the Medium Growth Scenario. . Estimated water use in 2025 is estimated to be 28,113 dam³; this is

an 8 percent increase from the current use. Most of the increase will occur in the Beaverhill, White Earth and Vermilion sub-basins where Ducks Unlimited is most interested in developing additional projects. Under the Low Growth and High Growth scenarios, water use for the other sector could remain constant or increase by 14 percent by 2025.

Figure 15-25 Projected Water Use for the Other Sector, Medium Scenario

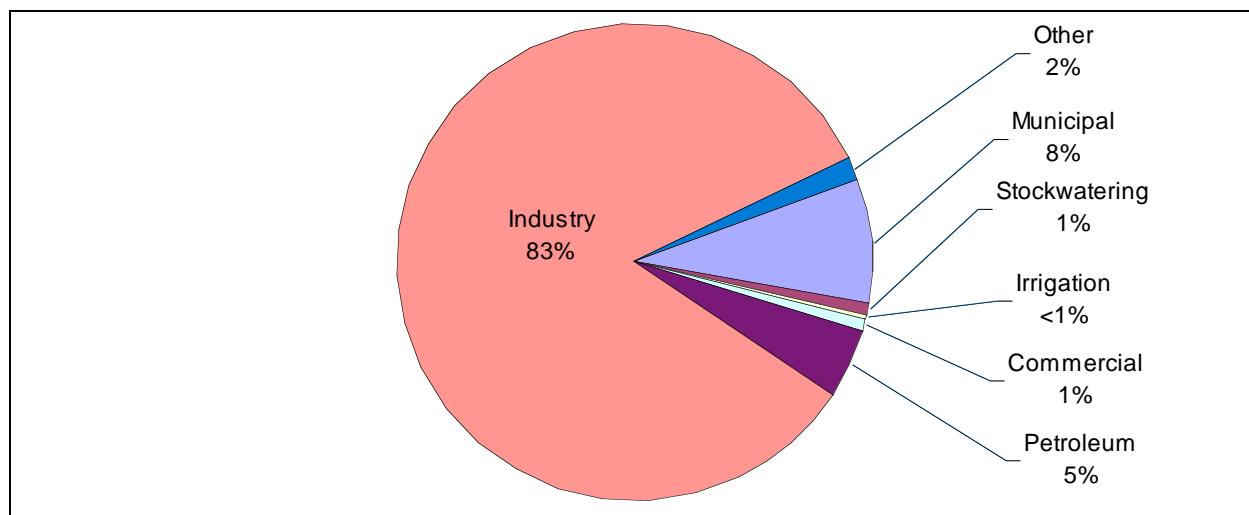


15.7 SUMMARY

As of 2005, total water allocations in the NSRB for all purposes amounted to 1.99 million dam³. As shown in Figure 15-26, the industrial sector has been allocated the most water (83 percent of the total). The municipal sector has the second highest allocations (8 percent), followed by the petroleum sector (5 percent), the other sector (2 percent), the commercial sector (1 percent), and the agricultural sector (stockwatering and irrigation) (1 percent).

While allocations are a measure of the amount of surface and groundwater that can be withdrawn, many licences, especially for surface water include an allowance for some water to be returned after use. Thus, expected use is less than the allocations, and this difference varies from activity to activity. As shown in Figure 15-27, the return flow allowance in licences issued for stockwatering, irrigation and the petroleum sector is very low, ranging from zero to 12 percent of the allocations. For these sectors, licensed use is equivalent to 96 percent, 96 percent and 77 percent, respectively. Licences issued for the commercial and other sectors assume that 79 and 70 percent of withdrawals will be consumed. The highest return flow allowances are in licences issued to the municipal and industrial sectors. On average, municipal licences expect that 27 percent of withdrawals will be consumed, and 73 percent will be returned. The highest return flow allowances are included in licences issued to the industrial sector where an average of 88 percent of withdrawals is expected to be returned. Overall, licences issued in the NSRB assume that about 20 percent of withdrawals will be used. Thus, current licences and registrations expected that 400,534 dam³ of water will be used.

Figure 15-26 Summary of Water Allocations by Sector in the NSRB, 2005



In terms of water source, surface water accounts for most of the return flow however, groundwater withdrawals are typically returned to surface water sources with the municipal and the other sectors accounting for almost of this return. This groundwater return to surface water sources increases the availability of surface water in some sub-basins.

Figure 15-27 Licensed Allocation and Use and Actual Water by Activity

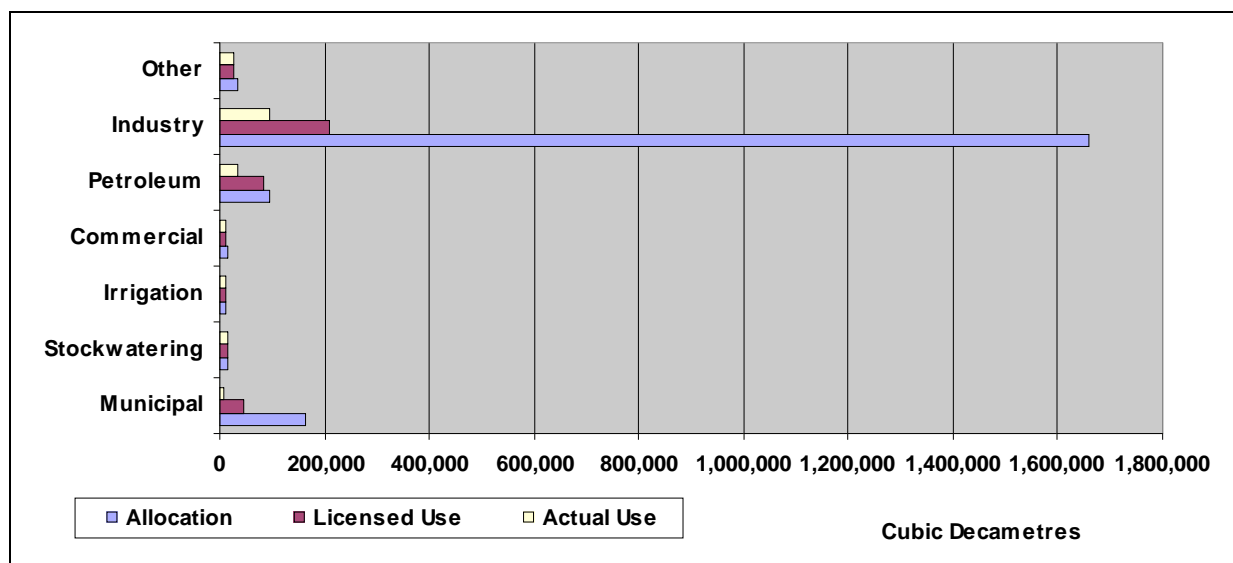


Table 15-14 shows the allocations and licensed use for each of the sectors. It shows that although the industrial sector accounted for 83 percent of allocations, this sector accounted for 52 percent of expected water consumption due to the very high return flow requirements. The petroleum sector accounted for 5 percent of allocations but more than 20 percent of expected

use while the municipal sector accounted for 8 percent of allocations but 12 percent of licensed use.

Table 15-14 Summary of Allocation and Use by Sector in the North Saskatchewan Basin

Sector	Allocation		Licensed Use		Return Flow dam ³	Estimated Actual Use		Licence Utilization
	dam ³	Percent	dam ³	Percent		dam ³	Percent	
Municipal	163,848	8.2%	45,956	11.5%	117,879	9,340	4.6%	20.3%
Stockwatering	16,698	0.8%	16,698	4.2%	0	15,018	7.4%	89.9%
Irrigation	9,712	0.5%	9,575	2.4%	137	9,575	4.7%	100.0%
Commercial	15,792	0.8%	12,562	3.1%	3,270	12,562	6.2%	100.0%
Petroleum	93,344	4.7%	82,085	20.5%	11,260	35,810	17.7%	43.6%
Industry	1,660,575	83.2%	207,594	51.8%	1,452,981	93,457	46.3%	45.0%
Other	36,010	1.8%	26,085	6.5%	9,925	26,085	12.9%	100.0%
Total	1,996,018	100.0%	400,534	100.0%	1,595,452	201,846	100.0%	50.4%

Based on available information on actual water use in 2005 and various assumptions about water use by licensees who did not report their use, it is estimated that licensees only used 50 percent of the amounts of water that they are expected to use. The actual water use is estimated to be 201,846 dam³. Table 15-14 also shows the licence utilization rates for each of the sectors. It shows that the highest utilization occurred in the commercial, other, and agricultural (irrigation and stockwatering) sectors, but this reflects the assumption that, in the absence of any actual information, licensees were using their full allocation. Better actual use data were available for some sectors and the estimates of license utilization ranged from 20 percent for the municipal sector, 44 percent for the petroleum sector, and 45 percent for the industrial sector. The difference between actual water use and licensed water use is also shown in Figure 15-27.

Actual water use over the next 20 years is predicted to increase by about 37 percent. The Medium Growth forecast is shown in Figure 15-28. There will be a significant increase in water use in the petroleum sector as additional upgraders begin operations after 2010. Industrial water use is expected to decline as the result of the closure of a couple of thermal power plants. By 2025 the proportion of water used by the industrial sector will decline by two percentage points relative to 2005 while the percentage of water use by the municipal, agriculture, commercial, and other sectors will remain the same as at present.

Figure 15-28 Projected Water Use by Sector

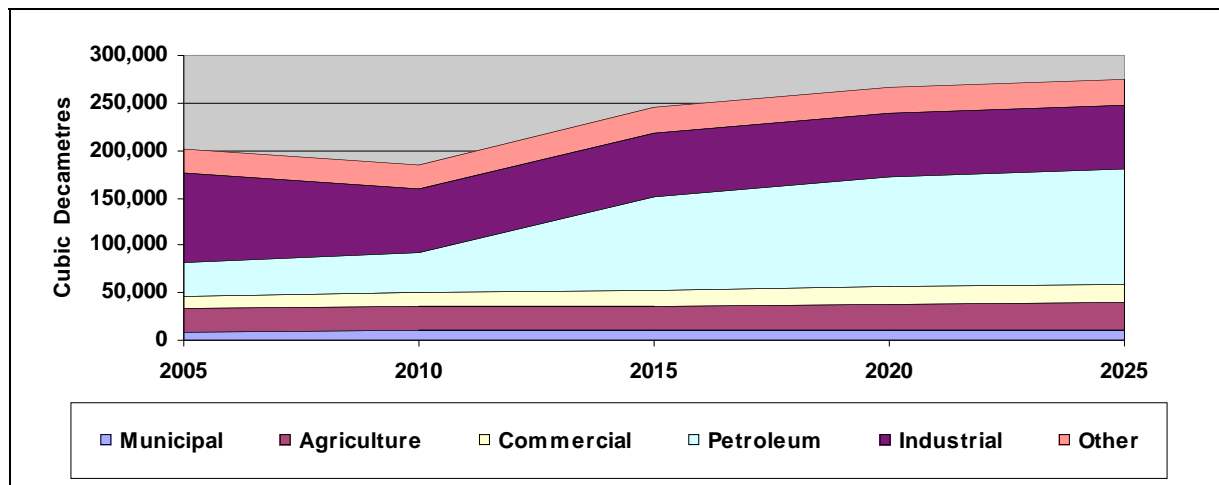
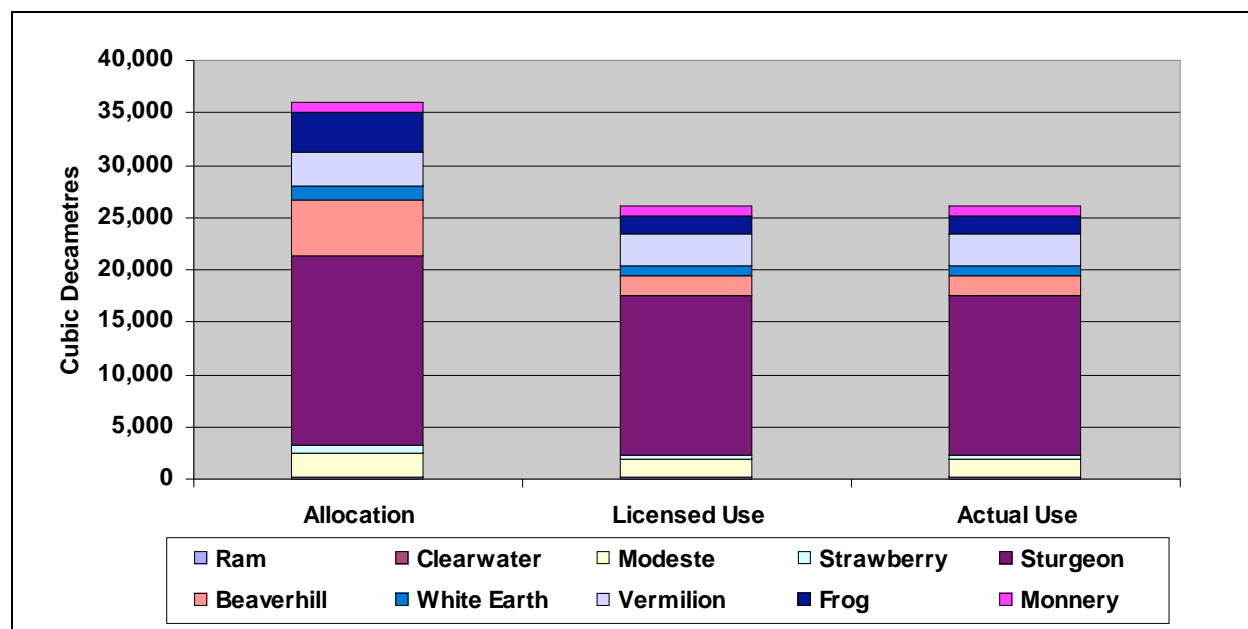


Table 15-15 shows the differences between water allocations, licensed water use and actual water use in 2005 for each of the sub-basins. It shows that the majority of allocations and licensed use occur in the Modeste, Beaverhill and Strawberry sub-basins while the majority of the actual use occurs in the Modeste, Sturgeon and Beaverhill sub-basins. These sub-basins include major industrial operations such as thermal power plants, petroleum operations such as upgraders and refineries and major population centres.

Table 15-15 Summary of Allocation and Use by Sub-basins in the NSRB

Sector	Allocation		Licensed Use		Return Flow dam ³	Actual Use		Licence Utilization
	dam ³	Percent	dam ³	Percent		dam ³	Percent	
Cline	60	0.0%	60	0.0%	0	196	0.1%	328.8%
Brazeau	207	0.0%	207	0.1%	0	498	0.2%	240.2%

Figure 15-24 Allocations, Licensed Use and Actual Use for the Other Sector, North Saskatchewan



15.6.3 Actual Water Use

There is no information on actual water diversions and consumption for any of the licences issued to the other sector. For purposes of this analysis, it is assumed that licensees are using their full entitlement.

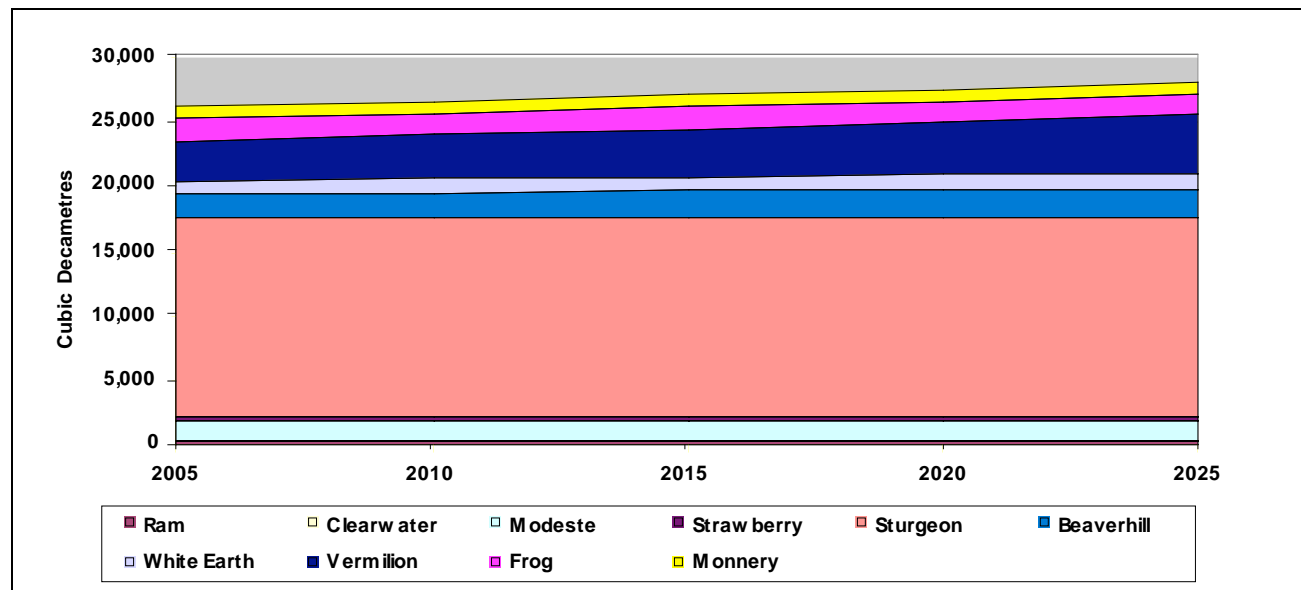
15.6.4 Forecasts of Future Water Use

Forecasts of future water use by the other sector are based on consultations with Ducks Unlimited and Alberta Environment. Neither organization has formal forecasts of their future water needs or for the counties. The number of projects that Ducks Unlimited will implement depends on a number of factors such as their budget, the state of the economy, and environment objectives. It is anticipated that there will be an increased emphasis on restoring drained wetlands to pre-drainage or natural conditions. These types of projects will not require new water licences. In terms of new water licences, Ducks Unlimited foresees an increase of about one or two new water licences per year (Randy Cummer, pers. comm. June 12, 2007). The emphasis will likely be on the Beaverhill, White Earth or Vermilion sub-basins. The forecasts assume that the current ratio of Ducks Unlimited Licences in each of these three basins for the distribution of new projects. Based on discussions with AENV, water use for projects licensed to AENV for other purposes is not expected to change over the forecast period.

Estimates of future water use by the other sector in Alberta are shown in Figure 15-25 for the Medium Growth Scenario. Estimated water use in 2025 is estimated to be 28,113 dam³; this is

an 8 percent increase from the current use. Most of the increase will occur in the Beaverhill, White Earth and Vermilion sub-basins where Ducks Unlimited is most interested in developing additional projects. Under the Low Growth and High Growth scenarios, water use for the other sector could remain constant or increase by 14 percent by 2025.

Figure 15-25 Projected Water Use for the Other Sector, Medium Scenario

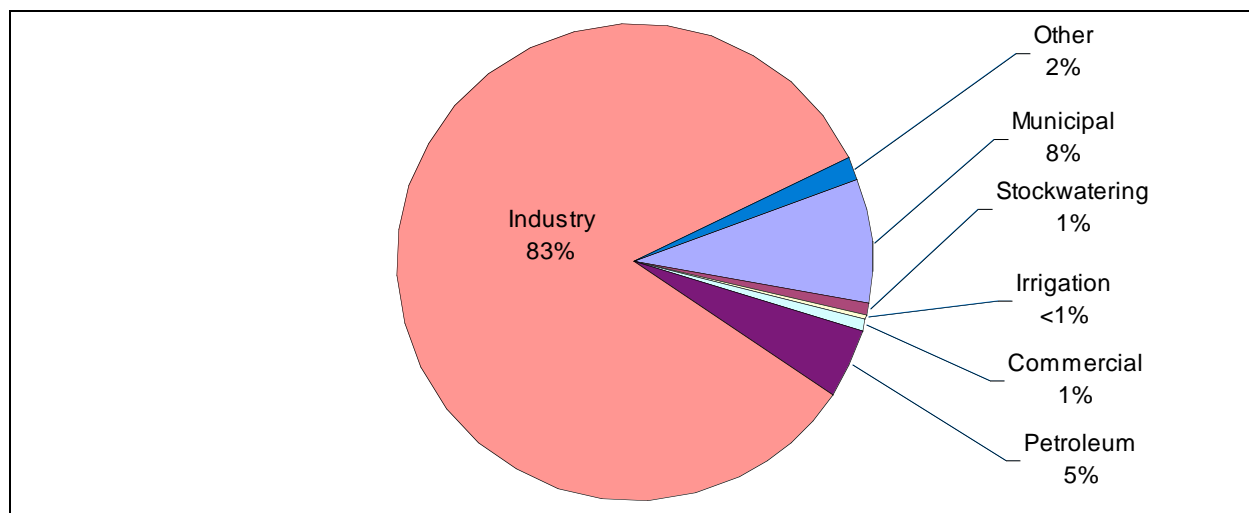


15.7 SUMMARY

As of 2005, total water allocations in the NSRB for all purposes amounted to 1.99 million dam³. As shown in Figure 15-26, the industrial sector has been allocated the most water (83 percent of the total). The municipal sector has the second highest allocations (8 percent), followed by the petroleum sector (5 percent), the other sector (2 percent), the commercial sector (1 percent), and the agricultural sector (stockwatering and irrigation) (1 percent).

While allocations are a measure of the amount of surface and groundwater that can be withdrawn, many licences, especially for surface water include an allowance for some water to be returned after use. Thus, expected use is less than the allocations, and this difference varies from activity to activity. As shown in Figure 15-27, the return flow allowance in licences issued for stockwatering, irrigation and the petroleum sector is very low, ranging from zero to 12 percent of the allocations. For these sectors, licensed use is equivalent to 96 percent, 96 percent and 77 percent, respectively. Licences issued for the commercial and other sectors assume that 79 and 70 percent of withdrawals will be consumed. The highest return flow allowances are in licences issued to the municipal and industrial sectors. On average, municipal licences expect that 27 percent of withdrawals will be consumed, and 73 percent will be returned. The highest return flow allowances are included in licences issued to the industrial sector where an average of 88 percent of withdrawals is expected to be returned. Overall, licences issued in the NSRB assume that about 20 percent of withdrawals will be used. Thus, current licences and registrations expectd that 400,534 dam³ of water will be used.

Figure 15-26 Summary of Water Allocations by Sector in the NSRB, 2005



In terms of water source, surface water accounts for most of the return flow however, groundwater withdrawals are typically returned to surface water sources with the municipal and the other sectors accounting for almost of this return. This groundwater return to surface water sources increases the availability of surface water in some sub-basins.

Figure 15-27 Licensed Allocation and Use and Actual Water by Activity

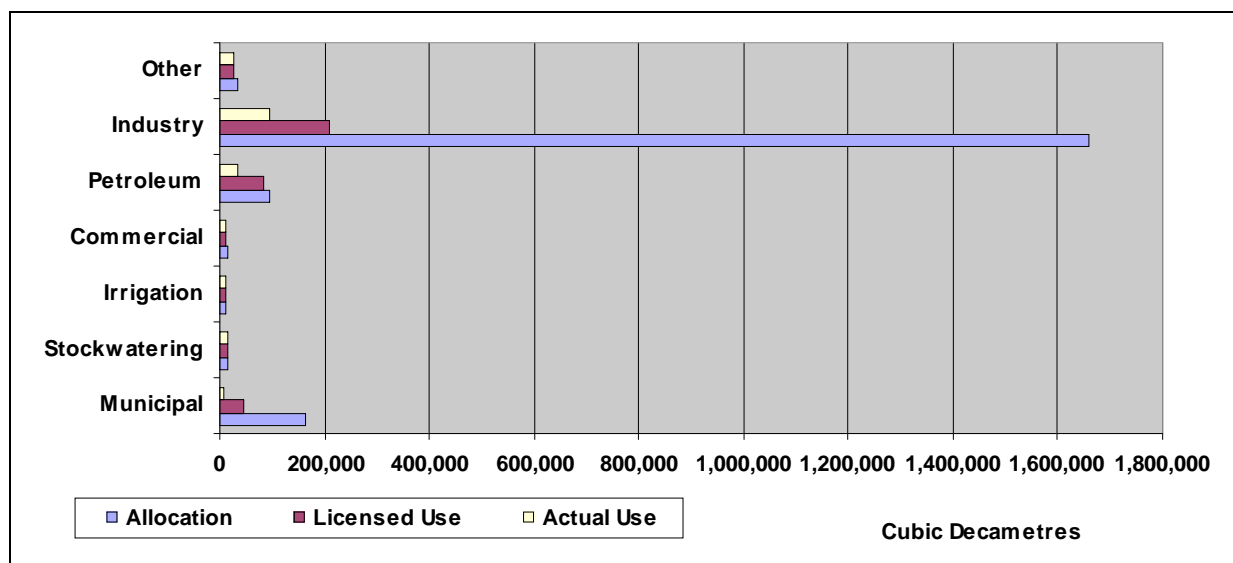


Table 15-14 shows the allocations and licensed use for each of the sectors. It shows that although the industrial sector accounted for 83 percent of allocations, this sector accounted for 52 percent of expected water consumption due to the very high return flow requirements. The petroleum sector accounted for 5 percent of allocations but more than 20 percent of expected

use while the municipal sector accounted for 8 percent of allocations but 12 percent of licensed use.

Table 15-14 Summary of Allocation and Use by Sector in the North Saskatchewan Basin

Sector	Allocation		Licensed Use		Return Flow dam ³	Estimated Actual Use		Licence Utilization
	dam ³	Percent	dam ³	Percent		dam ³	Percent	
Municipal	163,848	8.2%	45,956	11.5%	117,879	9,340	4.6%	20.3%
Stockwatering	16,698	0.8%	16,698	4.2%	0	15,018	7.4%	89.9%
Irrigation	9,712	0.5%	9,575	2.4%	137	9,575	4.7%	100.0%
Commercial	15,792	0.8%	12,562	3.1%	3,270	12,562	6.2%	100.0%
Petroleum	93,344	4.7%	82,085	20.5%	11,260	35,810	17.7%	43.6%
Industry	1,660,575	83.2%	207,594	51.8%	1,452,981	93,457	46.3%	45.0%
Other	36,010	1.8%	26,085	6.5%	9,925	26,085	12.9%	100.0%
Total	1,996,018	100.0%	400,534	100.0%	1,595,452	201,846	100.0%	50.4%

Based on available information on actual water use in 2005 and various assumptions about water use by licensees who did not report their use, it is estimated that licensees only used 50 percent of the amounts of water that they are expected to use. The actual water use is estimated to be 201,846 dam³. Table 15-14 also shows the licence utilization rates for each of the sectors. It shows that the highest utilization occurred in the commercial, other, and agricultural (irrigation and stockwatering) sectors, but this reflects the assumption that, in the absence of any actual information, licensees were using their full allocation. Better actual use data were available for some sectors and the estimates of license utilization ranged from 20 percent for the municipal sector, 44 percent for the petroleum sector, and 45 percent for the industrial sector. The difference between actual water use and licensed water use is also shown in Figure 15-27.

Actual water use over the next 20 years is predicted to increase by about 37 percent. The Medium Growth forecast is shown in Figure 15-28. There will be a significant increase in water use in the petroleum sector as additional upgraders begin operations after 2010. Industrial water use is expected to decline as the result of the closure of a couple of thermal power plants. By 2025 the proportion of water used by the industrial sector will decline by two percentage points relative to 2005 while the percentage of water use by the municipal, agriculture, commercial, and other sectors will remain the same as at present.

Figure 15-28 Projected Water Use by Sector

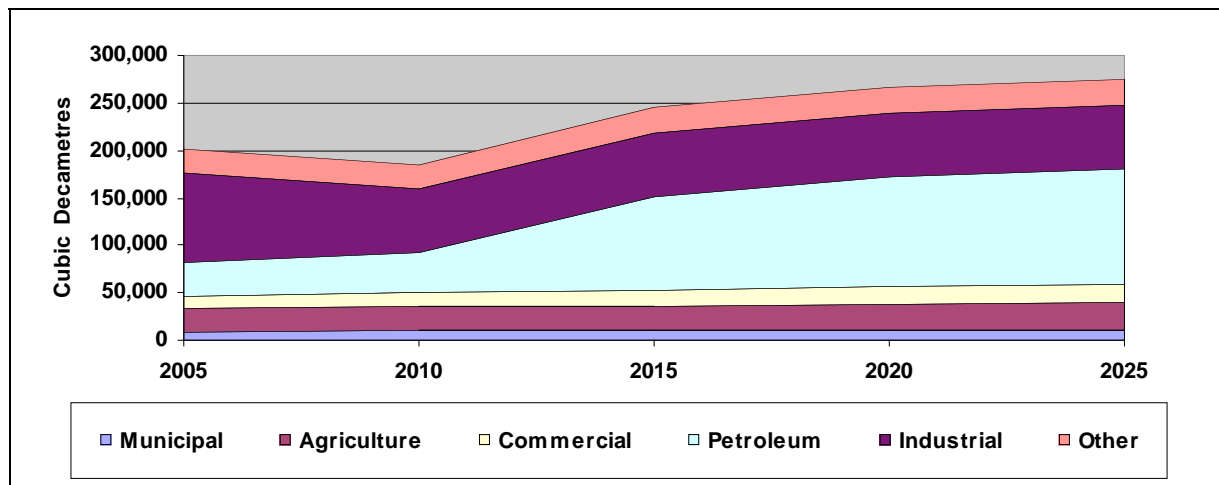


Table 15-15 shows the differences between water allocations, licensed water use and actual water use in 2005 for each of the sub-basins. It shows that the majority of allocations and licensed use occur in the Modeste, Beaverhill and Strawberry sub-basins while the majority of the actual use occurs in the Modeste, Sturgeon and Beaverhill sub-basins. These sub-basins include major industrial operations such as thermal power plants, petroleum operations such as upgraders and refineries and major population centres.

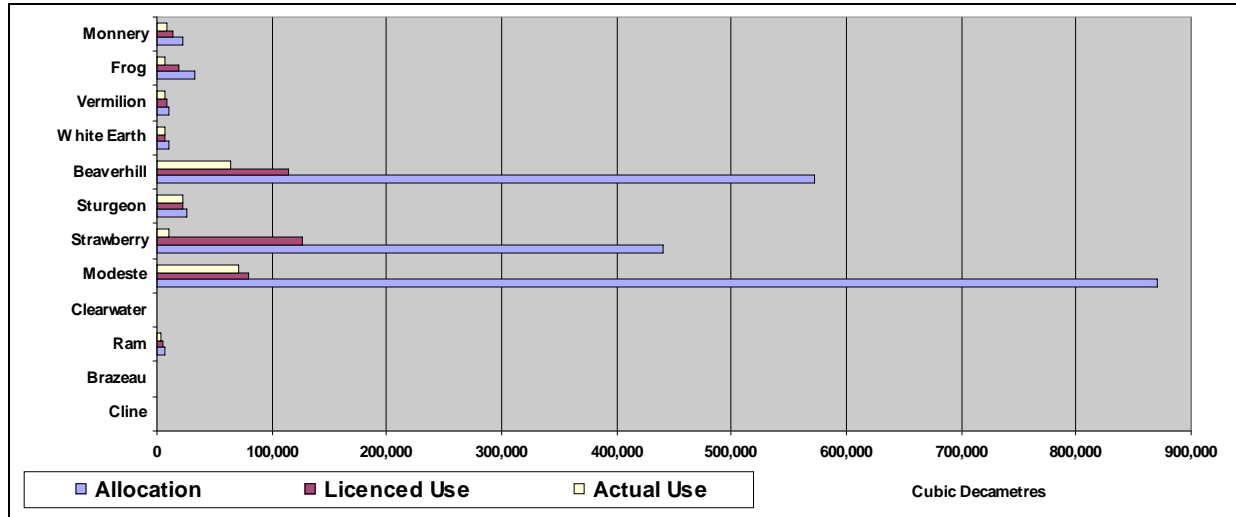
Table 15-15 Summary of Allocation and Use by Sub-basins in the NSRB

Sector	Allocation		Licensed Use		Return Flow dam ³	Actual Use		Licence Utilization
	dam ³	Percent	dam ³	Percent		dam ³	Percent	
Cline	60	0.0%	60	0.0%	0	196	0.1%	328.8%
Brazeau	207	0.0%	207	0.1%	0	498	0.2%	240.2%
Ram	7,632	0.4%	5,563	1.4%	2,070	3,420	1.7%	61.5%
Clearwater	2,356	0.1%	2,356	0.6%	0	818	0.4%	34.7%
Modeste	870,695	43.6%	79,809	19.9%	790,886	70,916	35.1%	88.9%
Strawberry	440,045	22.0%	127,219	31.8%	312,793	9,880	4.9%	7.8%
Sturgeon	26,183	1.3%	22,882	5.7%	3,301	22,272	11.0%	97.3%
Beaverhill	571,593	28.6%	114,504	28.6%	457,089	64,386	31.9%	56.2%
White Earth	10,808	0.5%	7,308	1.8%	3,500	6,176	3.1%	84.5%
Vermilion	10,390	0.5%	8,802	2.2%	1,588	6,799	3.4%	77.2%
Frog	32,914	1.6%	18,764	4.7%	14,150	7,626	3.8%	40.6%
Monnery	23,136	1.2%	13,061	3.3%	10,075	8,860	4.4%	67.8%
Total	1,996,018	100%	400,534	100%	1,595,452	201,846	100%	50.4%

Figure 15-29 shows the differences between allocations, licensed water use and actual water use for each of the sub-basins. The largest differences occur in the Modeste sub-basin where water allocations are currently dominated by thermal power plants which have large return flow allowances and actually account for very little actual water use. The Beaverhill and Strawberry sub-basins also have large return flow allowances tied to the municipal and industrial sectors.

Figure 15-29 also shows the importance of the Modeste, Strawberry and Beaverhill sub-basins in terms of allocations and water use in the NSRB.

Figure 15-29 Licensed Allocation and Use and Actual Water by Sub-basins



Projections of future water use in the NSRB under the Medium Growth scenario are provided in Figure 15-30 for each of the sub-basins. It shows that, in future, most of the increased use will occur in the Beaverhill and White Earth sub-basins as the seven proposed upgraders and the coal gasification plant commence operations. This increased use will more than offset the decline in water use from retiring or updating thermal power plants in the Modeste sub-basin. By 2010, water use is expected to drop by about 8 percent from 2005, levels, but this will increase so that by 2015, water use will be 22 percent higher than in 2005. Water use in 2025 will be 36 percent greater than in 2005. Using the low and high growth scenarios, actual water use is expected to be in the range of 24 to 45 percent higher by 2025.

Figure 15-30 Projected Water Use by River Basin

