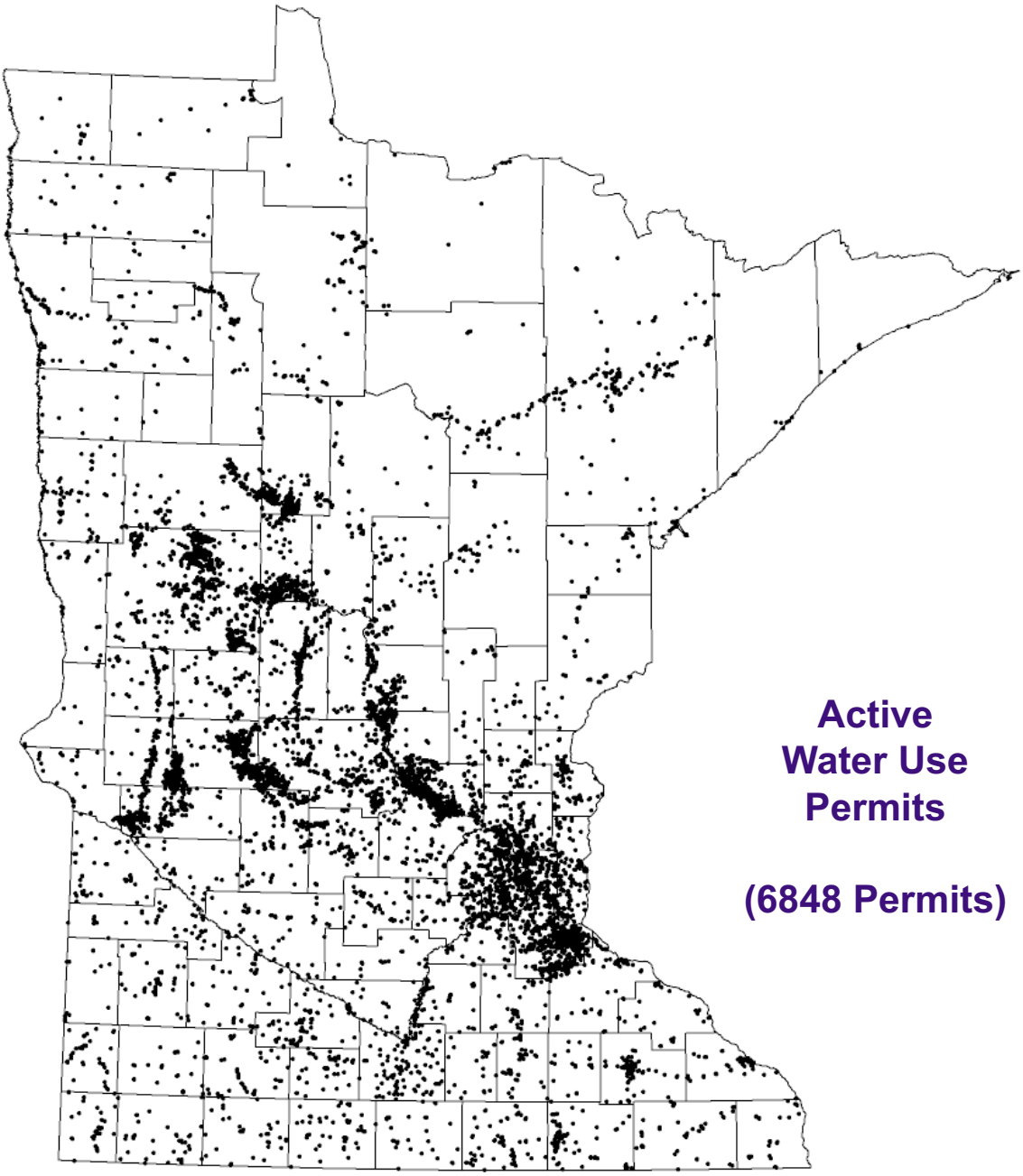
Chapter Four

Water Use



Active Water Use Permits

(6848 Permits)

Introduction

DNR water appropriations permits are required for all users withdrawing more than ten thousand gallons of water per day or one million gallons per year. Appropriations lower than these thresholds, such as for rural domestic use, do not require a permit from the DNR and therefore are not included in this chapter.

As a condition of each permit, the holder must report the volume of water withdrawn for the previous year within an accuracy of 10%. The data collected is used for many purposes, such as documenting water conflicts, understanding the hydrology of aquifers from which water is withdrawn and evaluating existing water supplies by monitoring use and the impact of that use. The data are reported on a calendar year basis. This chapter summarizes the reported water use data for calendar years 1998 and 1999.

MAJOR WATER USE CATEGORIES

THERMOELECTRIC POWER GENERATION - water used to cool power generating plants. This is historically the largest volume use and relies almost entirely on surface water sources. Thermoelectric power generation is primarily a nonconsumptive* use in that most of the water withdrawn is returned to its source.

PUBLIC WATER SUPPLY - water distributed by community suppliers for domestic, commercial, industrial and public users. This category relies on both surface water and ground water sources.

INDUSTRIAL PROCESSING - water used in mining activities, paper mill operations, food processing, etc. Three-fourths or more of withdrawals are from surface water sources. Consumptive use varies depending on the type of industrial process.

IRRIGATION - water withdrawn from both surface water and ground water sources for major crop and noncrop uses. Nearly all irrigation is considered to be consumptive use.

OTHER - large volumes of water withdrawn for activities including air conditioning, construction dewatering, water level maintenance and pollution confinement.

*Consumptive use is defined as water that is withdrawn from its source and is not directly returned to the source (M.S. 103G.005, Subd.8). Under this definition, all ground water withdrawals are consumptive unless the water is returned to the same aquifer. Surface water withdrawals are considered consumptive if the water is not directly returned to the source so that it is available for immediate further use.

Statewide Water Use Comparison for 1998 and 1999

Total water use for calendar years 1998 and 1999 remained relatively stable. However, the totals for these two years average about 10% higher than the previous two-year period. The reported water use in 1999 was nearly 1300 billion gallons (BG), up from 1281 BG in 1998. Figure 1 is a comparison of the two years showing use by major category and the volume and percent change between the years. The largest increase in use was for power generation which changed by 27 BG or 3%. The largest decrease in use was for irrigation which changed by 5 BG or 4%.

Figure 2 graphically shows the changes in use patterns for four main use categories (excluding power generation) from 1986 to 1999. Note the low irrigation use in 1986 and 1993, the peak of irrigation use in 1988 and the overall increase in industrial processing use since 1986. The pattern seen in irrigation reflects low use in times of high precipitation and high use in times of drought. The changes in industrial processing appear to be due to local economic factors.

Figure 1

Water Use Comparison by Major Category: 1998 & 1999
(Billions of Gallons)

	1998		1999			
Use Category	**BG**	**% of Total**	**BG**	**% of Total**	**BG Change**	**% Change**
Power Generation	785.3	61%	811.8	62%	27	3%
Public Supply	191.8	15%	184.4	14%	-7	-4%
Industrial Processing	168.9	13%	166.2	13%	-3	-2%
Irrigation	77.1	6%	71.9	6%	-5	-7%
Other	58.2	5%	65.3	5%	7	12%
Totals	**1,281.3**	**100%**	**1,299.6**	**100%**	**18 ***	**1.4% ***

* change in totals from 1998 to 1999

Water Use by Major Category: 1986 to 1999
(Billions of Gallons)

	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Power Generation	539	637	663	664	698	694	679	722	765	748	710	701	785	812
Public Supply	170	192	203	174	164	170	175	164	178	180	189	185	192	184
Industrial Processing	76	69	94	120	102	115	158	127	120	160	147	159	169	166
Irrigation	30	67	103	86	71	60	63	30	56	62	80	58	77	72
Other	42	38	42	48	53	52	58	63	64	60	57	63	58	65
Total	**857**	**1003**	**1105**	**1092**	**1088**	**1091**	**1133**	**1106**	**1183**	**1210**	**1183**	**1166**	**1281**	**1299**

Note: column totals may not sum due to independent rounding

A comparison of surface water versus ground water use for 1999 (Figure 3) shows that the majority of appropriations are from surface water sources. In 1999, 83% of withdrawals in Minnesota were from surface water sources, which compares closely with the national average of 80% (USGS data). However, if the non-consumptive use for most power generation is removed, use of ground water and surface water are more even (non-consumptive means water that is immediately returned to its source after use). 60 to 65 percent of water use in Minnesota is for power plant cooling, a relatively non-consumptive use.

Surface water use increased slightly from 1998 to 1999, primarily due to increased appropriation for power generation and uses described in "other uses". Ground water use decreased slightly from 1998 to 1999 primarily due to decreased demand for irrigation and public supply.

Figure 2

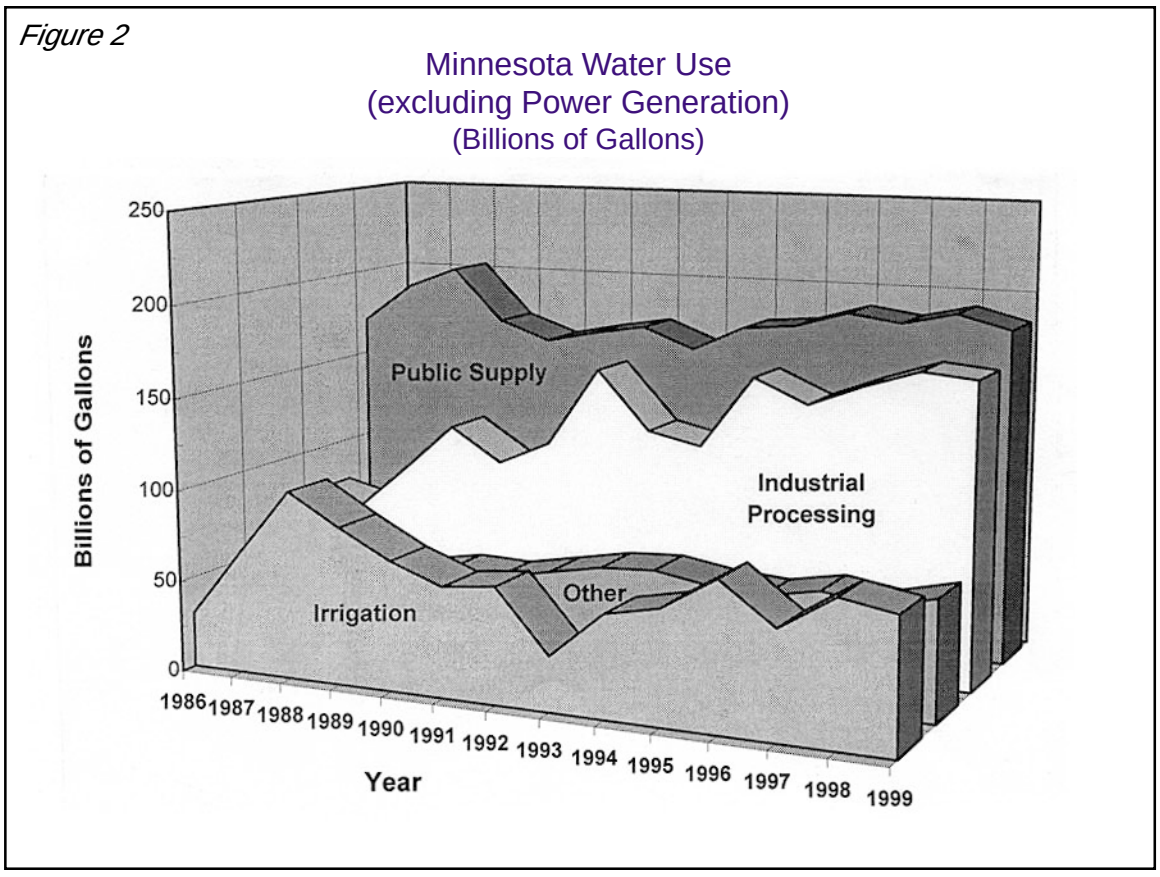
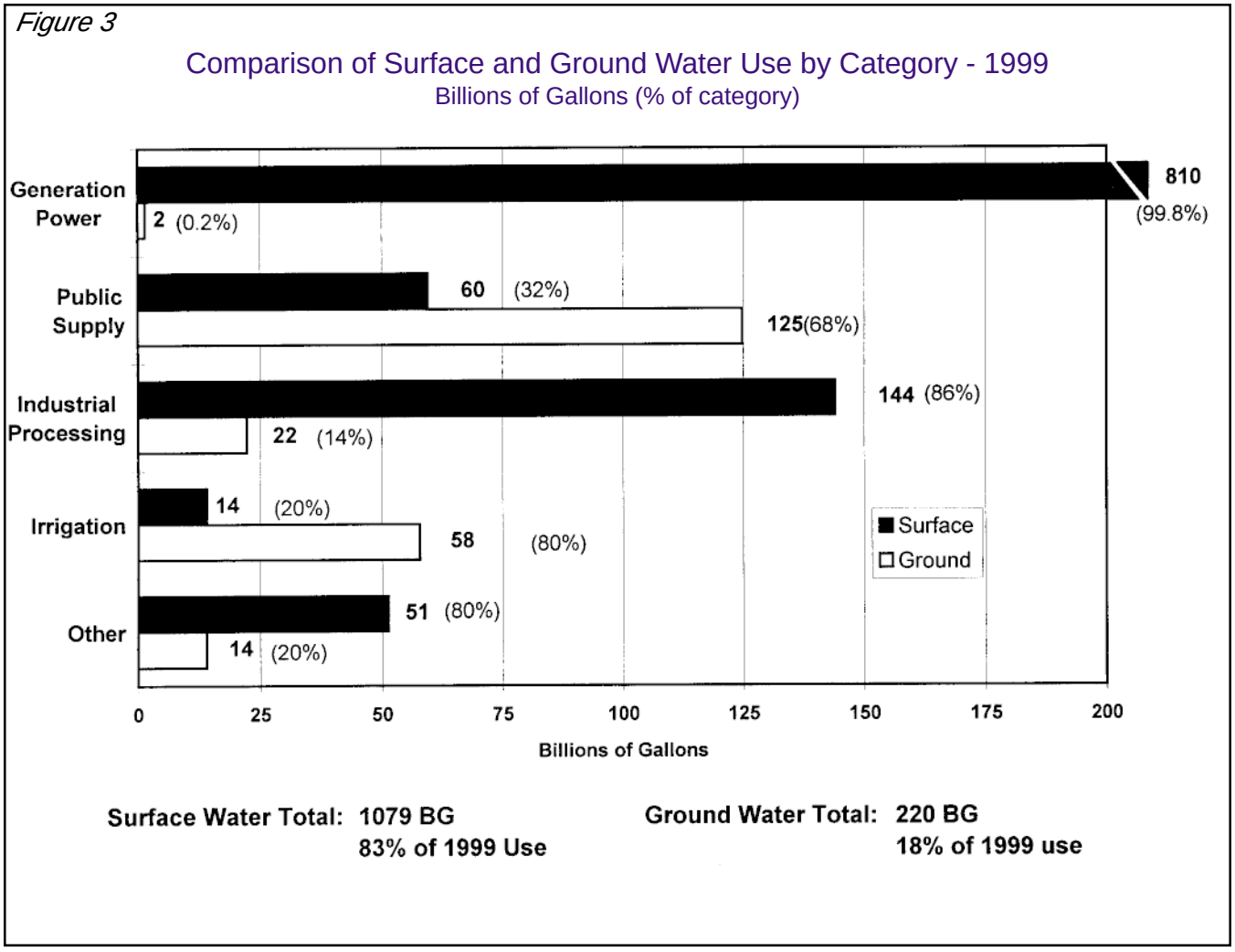


Figure 3



Power Generation

Power generation (nuclear power cooling and steam power cooling) was the primary use in 8 of the 11 counties reporting the highest totals in 1999 (Figure 4). Power generation accounted for 62% of all use in Minnesota for the year. The combination of power generation use for 1998 and 1999 is 13% more than the combination during the 1996-1997 period. Power generation in Goodhue and Wright Counties accounted for 27% of all reported use in 1999, largely due to nuclear power plant cooling. Surface water sources supply nearly all of the water used for power generation. Most of the water is for cooling purposes and is returned to the surface water source after use.

Public Water Supply

Water use for public supply remained fairly constant from 1989 to 1999 (Figure 2), dipping slightly in 1990 and 1993. Reported use for 1998 and 1999 was 192 BG and 184 BG respectively. Public supply has slowly increased from 1990 to 1998 due to population increases and industrial demands. 1998 use approached the high level associated with the spike in 1988 due to drought conditions. 68% of public water supply in Minnesota comes from ground water sources, compared to 39% nationally (USGS data, 1986-1990).

Local water conservation programs that implement measures to improve water use efficiencies and promote the wise use of water can help communities reduce the need for expensive new municipal wells and water/wastewater treatment plants. Public water suppliers that serve more than 1,000 people are required to develop water emergency and conservation plans and also to implement demand management measures before requesting approval for new municipal wells. These efforts can help water customers and communities save money while helping to protect Minnesota's valuable water resources for future domestic and economic uses.

Figure 4

Appropriations by the Counties with the Greatest Use in CY 1999

	County	Surface Water	Ground Water	Total	Primary Use
1)	Goodhue	222.9	2.4	225.3	Nuclear Power Cooling
2)	Wright	126.9	2.7	129.6	Nuclear Power Cooling
3)	Washington	99.9	11.3	111.2	Steam Power Cooling
4)	St Louis	109.1	2.1	111.2	Steam Power Cooling
5)	Hennepin	73.4	35.1	108.5	Steam Power Cooling
6)	Dakota	66.7	22.3	89.0	Steam Power Cooling
7)	Itasca	70.9	1.2	72.2	Steam Power Cooling
8)	Ramsey	44.5	14.5	59.0	Steam Power Cooling
9)	Cook	49.1	< 1	49.1	Mine Processing
10)	Lake	48.7	< 1	48.7	Mine Processing
11)	Anoka	38.1	10.1	48.2	Municipal Waterworks
	Total	**950.2**	**101.7**	**1052.0**	
millions of gallons		*88% of* SW Use	*46% of* GW Use	*81% of* Total Use	

Irrigation

Water use for irrigation has dropped considerably since the peak usage of 103 BG in 1988. Yearly variation in the amount and distribution of rainfall greatly affects the demand for irrigation water. The combined irrigation use for 1998-99 was 8% higher compared to the previous two-year period.

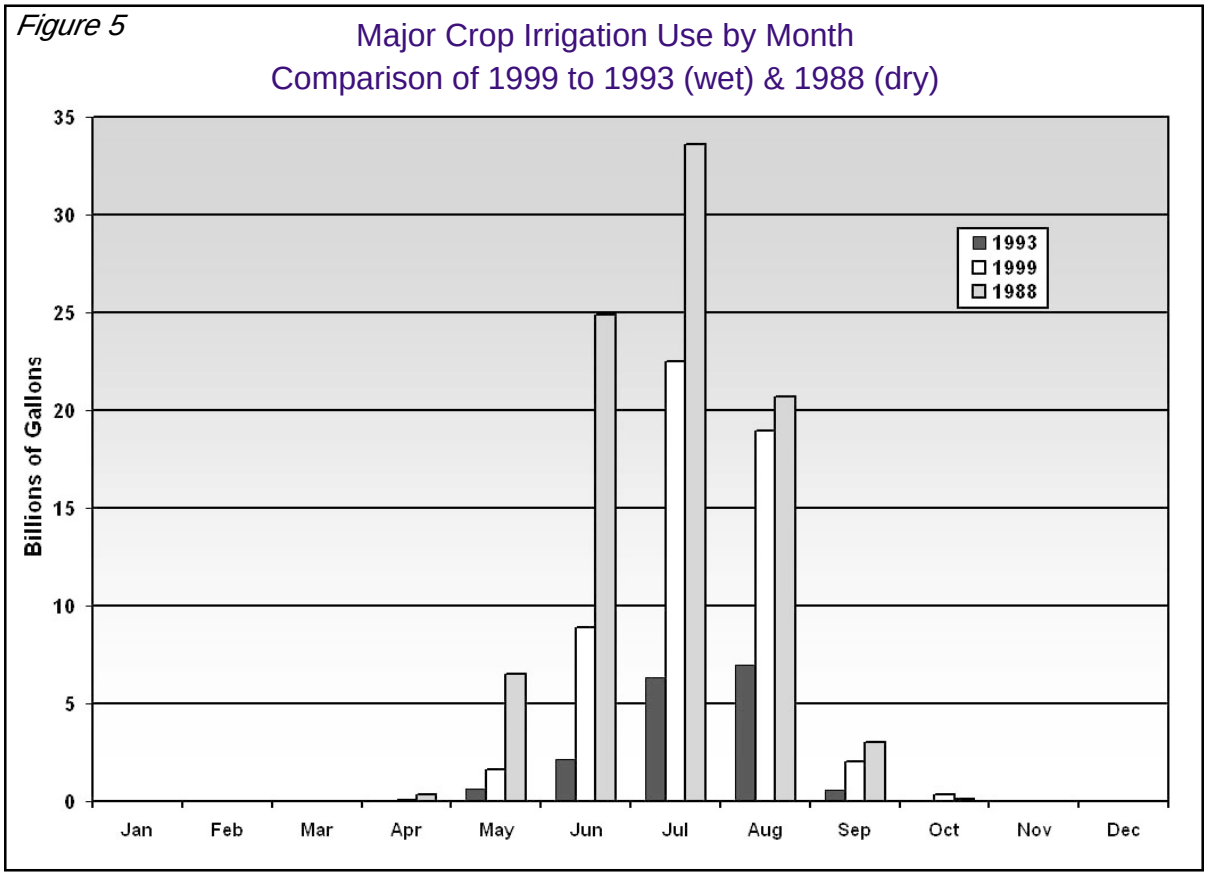
Irrigation accounts for only a small amount (6%) of total water use in Minnesota. However, this use is significant because it is almost entirely consumptive and the majority is from ground water sources (80%). The timing of irrigation can be significant when evaluating regional water supplies and the potential for well interferences. Nearly all major crop irrigation use is compacted into the five-month period from May to September of each year (Figure 5).

Otter Tail and Sherburne Counties reported the highest amounts for irrigation in 1999, using 8.4 BG and 7.1 BG respectively. Roseau and Mahnomen were the only counties that reported no use for irrigation in 1999. Carlton, Lake and Traverse Counties reported less than 4 million gallons used for irrigation in 1999.

Industrial Processing

Industrial processing use decreased 2% from 1998 to 1999. However, the combination of industrial processing use for 1998 and 1999 is 10% more than the 1996-1997 period. Mine processing accounted for 65% of the reported industrial process total, while pulp and paper processing and agricultural processing accounted for 17% and 6% respectively.

Figure 5



Other Uses

Other uses include air conditioning, water level maintenance, fisheries, temporary construction dewatering, pollution confinement and other specialty uses that represent about 5% of Minnesota's total.

Once-Through Systems

In 1988, approximately 100 active appropriation permits existed for office buildings and other types of structures that used ground water for heating and air-conditioning purposes. These "once-through systems" pump water through heating, ventilation or air conditioning systems, then discharge the water without recirculating or reusing it for another purpose. This is not the best or most efficient use of Minnesota's high quality ground water resources.

Once-through systems reached a peak use of 11 BG in 1989 and accounted for approximately 19% of the total ground water use in the Twin Cities Metropolitan Area. 1990 legislation requires once-through systems to be phased out at the end of the design life of the equipment, but no later than the year 2010. Through the conversion of once-through systems to water efficient alternatives, ground water withdrawals for this purpose have dropped from 11 BG to just over 4 BG per year by the end of 1999 (Figure 6).

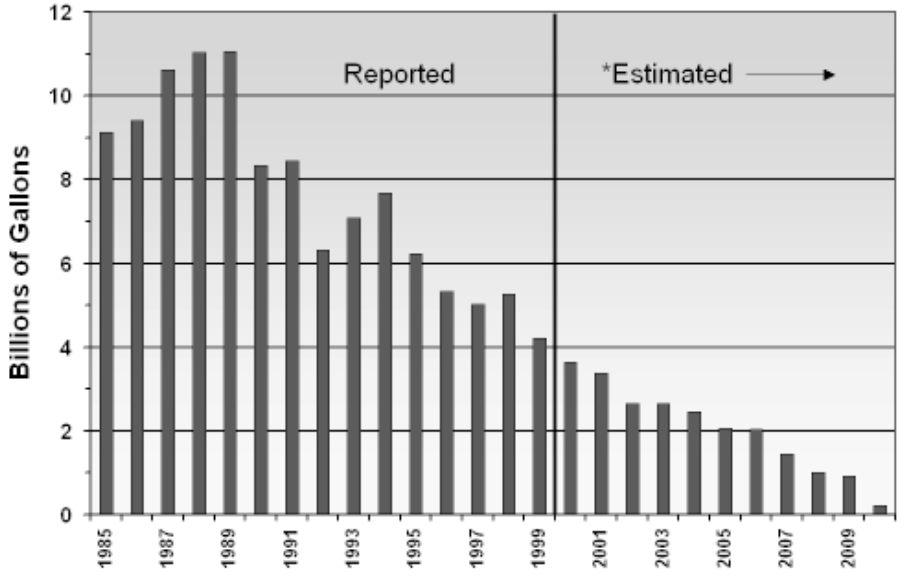
Summary

Total water use from 1998 to 1999 remained relatively constant, increasing by about 1% overall. Power generation continues to account for the majority of use totaling 812 BG of the 1300 BG reported for 1999 (63%). Surface water accounts for 82% of all appropriations.

Figure 6

Once-Through Systems Use

(2000-2010 values are estimates based on existing permits)



Reported Water Use by County
1998 - 1999 (Millions of Gallons)
Reported Water Use

	County	1998 Surface	1998 Ground	1998 Total	1999 Surface	1999 Ground	1999 Total	Primary Use	Percent of 1999 Total
1	Aitkin	2,115.7	91.0	2,206.7	1,732.2	91.2	1,823.4	Wild Rice Irrigation	93
2	Anoka	40,387.4	11,661.9	52,049.3	38,063.1	10,056.1	48,119.2	Municipal Waterworks	96
3	Becker	23.5	2,079.2	2,102.7	8.2	1,982.2	1,990.4	Major Crop Irrigation	53
4	Beltrami	1,557.0	760.7	2,317.7	1,691.0	629.4	2,320.4	Wild Rice Irrigation	71
5	Benton	3,367.7	3,449.2	6,816.9	3,492.7	3,142.5	6,635.2	Industrial Processing	52
6	Big Stone	40.1	413.9	454.0	12.2	412.7	424.9	Major Crop Irrigation	49
7	Blue Earth	7,775.0	3,683.8	11,458.8	7,847.5	3,714.9	11,562.4	Steam Power Cooling	67
8	Brown	100.8	829.3	930.1	125.8	930.0	1,055.8	Municipal Waterworks	46
9	Carlton	1,235.0	696.2	1,931.2	2,225.0	640.8	2,865.8	Pulp/Paper Processing	63
10	Carver	20.7	2,666.7	2,687.4	28.1	2,338.6	2,366.7	Municipal Waterworks	82
11	Cass	40.6	1,078.9	1,119.5	20.4	889.0	909.4	Hatcheries & Fisheries	25
12	Chippewa	362.6	467.4	830.0	303.0	491.2	794.2	Municipal Waterworks	55
13	Chisago	266.1	1,005.6	1,271.7	127.4	866.9	994.3	Municipal Waterworks	61
14	Clay	1,544.9	944.0	2,488.9	1,717.3	877.4	2,594.7	Municipal Waterworks	73
15	Clearwater	5,206.9	126.6	5,333.5	4,200.9	115.0	4,315.9	Wild Rice Irrigation	96
16	Cook	54,025.3	12.5	54,037.8	49,062.9	13.2	49,076.1	Mine Processing	99.7
17	Cottonwood	192.2	952.2	1,144.4	202.8	1,011.1	1,213.9	Municipal Waterworks	35
18	Crow Wing	1,566.3	1,833.7	3,400.0	1,554.7	1,811.6	3,366.3	Pulp/Paper Processing	41
19	Dakota	67,279.2	21,183.9	88,463.1	66,742.2	22,255.6	88,997.8	Steam Power Cooling	70
20	Dodge	61.8	429.2	491.0	13.0	421.0	434.0	Municipal Waterworks	75
21	Douglas	121.4	1,417.2	1,538.6	132.6	1,377.4	1,510.0	Municipal Waterworks	41
22	Faribault	0.0	738.4	738.4	0.0	721.8	721.8	Municipal Waterworks	69
23	Fillmore	3,729.6	580.6	4,310.2	3,854.8	673.3	4,528.1	Hatcheries & Fisheries	85
24	Freeborn	17.4	1,692.0	1,709.4	4.0	1,706.6	1,710.6	Municipal Waterworks	94
25	Goodhue	200,492.4	2,495.8	202,988.2	222,940.3	2,390.1	225,330.4	Nuclear Power Cooling	92
26	Grant	0.0	743.7	743.7	0.0	623.1	623.1	Major Crop Irrigation	68
27	Hennepin	76,965.3	38,190.3	115,155.6	73,414.9	35,123.0	108,537.9	Steam Power Cooling	67
28	Houston	4.8	518.2	523.0	6.8	528.0	534.8	Municipal Waterworks	76
29	Hubbard	19.5	4,431.4	4,450.9	17.4	3,673.9	3,691.3	Major Crop Irrigation	72
30	Isanti	0.0	604.4	604.4	0.8	560.1	560.9	Municipal Waterworks	57
31	Itasca	70,254.8	1,197.5	71,452.3	70,937.0	1,222.8	72,159.8	Steam Power Cooling	85
32	Jackson	164.1	284.1	448.2	50.9	274.5	325.4	Municipal Waterworks	74
33	Kanabec	11.9	227.1	239.0	27.6	159.3	186.9	Municipal Waterworks	77
34	Kandiyohi	600.1	2,621.5	3,221.6	644.8	3,037.8	3,682.6	Municipal Waterworks	44
35	Kittson	28.5	348.0	376.5	24.3	269.7	294.0	Rural Waterworks	58
36	Koochiching	17,540.0	42.0	17,582.0	18,130.2	42.1	18,172.3	Pulp/Paper Processing	97
37	Lac Qui Parle	48.9	1,349.7	1,398.6	37.2	1,303.7	1,340.9	Agricultural Processing	49
38	Lake	49,184.8	0.1	49,184.9	48,701.1	0.1	48,701.2	Mine Processing	99
39	Lake of the Woods	268.0	68.5	336.5	251.2	70.0	321.2	Wild Rice Irrigation	76
40	Le Sueur	2,342.6	1,053.2	3,395.8	2,319.3	978.9	3,298.2	Quarry/Mine Dewatering	70
41	Lincoln	5.1	544.0	549.1	6.1	551.3	557.4	Rural Waterworks	76
42	Lyon	196.4	1,677.2	1,873.6	170.9	1,541.7	1,712.6	Municipal Waterworks	67
43	McLeod	302.5	2,082.1	2,384.6	289.2	1,964.9	2,254.1	Municipal Waterworks	54
44	Mahnomen	0.0	78.0	78.0	0.0	85.0	85.0	Municipal Waterworks	100

Reported Water Use by County
1998 - 1999 (Millions of Gallons)

Reported Water Use

County	1998 Surface	1998 Ground	1998 Total	1999 Surface	1999 Ground	1999 Total	Primary Use	Percent of 1999 Total
45 Marshall	148.5	304.5	453.0	83.2	220.6	303.8	Municipal Waterworks	34
46 Martin	7,556.6	259.9	7,816.5	7,550.5	356.5	7,907.0	Steam Power Cooling	89
47 Meeker	16.9	1,268.2	1,285.1	15.2	1,461.8	1,477.0	Major Crop Irrigation	53
48 Mille Lacs	39.8	512.1	551.9	55.2	458.7	513.9	Municipal Waterworks	67
49 Morrison	103.5	3,862.3	3,965.8	53.5	3,494.7	3,548.2	Major Crop Irrigation	76
50 Mower	176.3	2,567.1	2,743.4	186.8	2,426.6	2,613.4	Municipal Waterworks	47
51 Murray	49.0	224.0	273.0	60.2	216.1	276.3	Municipal Waterworks	77
52 Nicollet	40.9	1,854.2	1,895.1	27.2	1,884.1	1,911.3	Municipal Waterworks	83
53 Nobles	50.7	1,104.6	1,155.3	63.6	1,167.8	1,231.4	Municipal Waterworks	94
54 Norman	0.0	163.0	163.0	0.0	146.2	146.2	Municipal Waterworks	95
55 Olmsted	5,533.3	6,072.9	11,606.2	5,868.2	5,998.0	11,866.2	Steam Power Cooling	48
56 Ottertail	24,696.0	11,696.6	36,392.6	24,167.7	9,538.5	33,706.2	Steam Power Cooling	68
57 Pennington	588.7	25.8	614.5	808.4	25.1	833.5	Wild Rice Irrigation	46
58 Pine	16.1	570.9	587.0	17.2	483.7	500.9	Municipal Waterworks	63
59 Pipestone	44.5	857.1	901.6	29.6	906.2	935.8	Rural Waterworks	43
60 Polk	5,089.9	376.4	5,466.3	5,195.0	409.7	5,604.7	Municipal Waterworks	56
61 Pope	71.9	4,931.8	5,003.7	112.0	5,782.6	5,894.6	Major Crop Irrigation	93
62 Ramsey	54,179.3	13,462.3	67,641.6	44,545.8	14,488.3	59,034.1	Steam Power Cooling	75
63 Red Lake	270.9	399.3	670.2	256.8	375.4	632.2	Municipal Waterworks	59
64 Redwood	120.4	436.6	557.0	38.8	474.5	513.3	Municipal Waterworks	79
65 Renville	86.7	872.6	959.3	106.4	899.6	1,006.0	Municipal Waterworks	46
66 Rice	65.2	2,495.0	2,560.2	74.5	2,465.0	2,539.5	Municipal Waterworks	79
67 Rock	39.4	510.6	550.0	52.0	604.3	656.3	Municipal Waterworks	48
68 Roseau	0.0	341.1	341.1	0.0	335.0	335.0	Municipal Waterworks	92
69 St. Louis	100,173.3	2,097.0	102,270.3	109,102.6	2,086.8	111,189.4	Steam Power Cooling	52
70 Scott	2,273.5	3,650.8	5,924.3	2,454.6	3,785.7	6,240.3	Municipal Waterworks	43
71 Sherburne	22,515.6	8,804.2	31,319.8	24,471.0	8,599.6	33,070.6	Steam Power Cooling	63
72 Sibley	7.5	653.9	661.4	11.5	665.8	677.3	Municipal Waterworks	82
73 Stearns	3,518.6	7,566.4	11,085.0	2,980.7	7,930.7	10,911.4	Major Crop Irrigation	46
74 Steele	425.3	1,707.8	2,133.1	949.0	1,643.4	2,592.4	Municipal Waterworks	60
75 Stevens	90.9	1,410.7	1,501.6	80.2	1,436.5	1,516.7	Major Crop Irrigation	65
76 Swift	31.9	3,563.8	3,595.7	40.7	3,216.6	3,257.3	Major Crop Irrigation	86
77 Todd	161.0	2,587.0	2,748.1	175.6	2,308.1	2,483.7	Major Crop Irrigation	70
78 Traverse	2.7	131.6	134.3	1.6	114.2	115.8	Municipal Waterworks	99
79 Wabasha	0.4	1,094.8	1,095.2	0.2	1,121.0	1,121.2	Municipal Waterworks	78
80 Wadena	444.0	2,999.8	3,443.8	393.2	2,190.8	2,584.0	Major Crop Irrigation	87
81 Waseca	30.5	849.6	880.1	29.8	726.5	756.3	Municipal Waterworks	91
82 Washington	91,016.3	11,407.0	102,423.3	99,911.0	11,336.8	111,247.8	Steam Power Cooling	88
83 Watonwan	10.9	905.6	916.5	6.1	902.4	908.5	Municipal Waterworks	72
84 Wilkin	92.1	245.5	337.6	17.2	180.4	197.6	Municipal Waterworks	72
85 Winona	1,049.0	2,666.4	3,715.4	1,087.1	2,598.5	3,685.6	Municipal Waterworks	42
86 Wright	122,950.4	2,364.1	125,314.5	126,872.1	2,696.3	129,568.4	Nuclear Power Cooling	98
87 Yellow Medicine	89.7	748.1	837.8	82.8	716.6	799.4	Rural Waterworks	50
Total			**1,281,308**			**1,299,611**		

Minnesota Reported Water Use

Category	1998	1999
Power Generation		(Millions of Gallons)
Nuclear Power		
surface	305,432.4	333,578.8
ground	0.0	0.0
Steam Power Cooling		
surface	390,044.8	378,796.7
ground	636.9	764.4
Other Power		
surface	88,460.6	97,900.2
ground	740.9	760.3
Subtotal	**785,315.6**	**811,800.4**
Percent of Total	**61%**	**62%**
surface	783,937.8	810,275.7
ground	1,377.8	1,524.7
Public Supply		
Municipal Water Works		
surface	64,396.0	59,546.0
ground	123,325.0	120,523.2
Private Water Works		
surface	8.6	9.6
ground	779.2	800.2
Comercial & Institutional		
surface	0.0	0.0
ground	1,448.0	1,595.6
Cooperative Water Works		
surface	0.0	0.0
ground	1.9	1.9
Fire Protection		
surface	0.0	0.0
ground	23.9	23.4
State Parks, Waysides, Rest Areas		
surface	0.0	0.0
ground	29.0	22.4
Rural Water Districts		
surface	0.0	0.0
ground	1,830.0	1,848.8
Subtotal	**191,841.6**	**184,371.1**
Percent of Total	**15%**	**14%**
surface	64,404.6	59,555.6
ground	127,437.0	124,815.5

	1998	1999
Irrigation		
Golf Course		
surface	1,221.6	1,193.2
ground	4,607.9	4,343.7
Cemetary		
surface	0.0	0.0
ground	54.6	42.9
Landscaping		
surface	58.3	41.0
ground	570.4	454.1
Sod		
surface	152.7	66.2
ground	272.5	119.4
Nursery		
surface	18.2	117.5
ground	471.6	339.9
Orchard		
surface	0.0	0.0
ground	4.5	3.1
Non Crop		
surface	19.6	18.9
ground	29.5	12.9
Temporary		
surface	0.0	0.0
ground	0.0	16.3
Major Crop		
surface	2,230.9	1,897.8
ground	56,036.2	52,480.9
Wild Rice		
surface	11,304.9	10,743.9
ground	17.5	0.0
Subtotal	**77,070.9**	**71,891.7**
Percent of Total	**6%**	**6%**
surface	15,006.2	14,078.5
ground	62,064.7	57,813.2

	1998	1999
Industrial Processing		
Agricultural		
surface	391.0	328.8
ground	9,406.0	9,753.3
Pulp and Paper		
surface	27,394.8	28,701.6
ground	695.5	725.2
Mine		
surface	112,246.3	108,268.9
ground	25.5	30.1
Sand and Gravel Washing		
surface	2,288.5	2,119.7
ground	1,134.1	1,367.9
Sewage Treatment		
surface	1.8	2.5
ground	985.7	898.0
Petroleum or Chemical		
surface	257.2	257.2
ground	3,456.8	3,177.8
Metal		
surface	0.0	0.0
ground	1,086.8	1,192.9
Non-Metal		
surface	0.9	1.1
ground	1,747.6	1,892.0
Other		
surface	4,229.0	4,285.1
ground	3,547.4	3,246.9
Subtotal	**168,894.9**	**166,249.0**
Percent of Total	**13%**	**13%**
surface	146,809.5	143,964.9
ground	22,085.4	22,284.1
Other		
Air Conditioning		
Commercial & Institutional Building AC		
surface	7.8	8.0
ground	189.6	205.3

	1998	1999
Heat Pumps & Coolant Pumps		
surface	728.9	402.9
ground	0.0	0.0
District Heating		
surface	0.0	0.0
ground	0.0	0.0
Once Through Heating or AC		
surface	0.0	0.0
ground	5,273.3	4,221.9
Other AC		
surface	70.9	55.6
ground	0.0	0.0
Temporary		
Temporary Construction Non-Dewatering		
surface	18.6	4.9
ground	0.0	0.2
Temporary Construction Dewatering		
surface	24.1	50.6
ground	2,035.9	1,395.8
Temporary Pipeline and Tank Testing		
surface	21.8	56.5
ground	0.0	0.0
Other Temporary		
surface	278.1	312.9
ground	32.2	2.5
Water Level Maintenance		
Basin (Lake) Level Maintenance		
surface	1,004.2	4,109.4
ground	207.3	147.3
Mine Dewatering		
surface	23,551.3	28,813.4
ground	13.0	12.6
Quarry Dewatering		
surface	11,000.5	10,574.5
ground	0.0	0.0
Sand/Gravel Pit Dewatering		
surface	570.0	759.2
ground	0.0	0.0

	1998	1999
Tile Drainage & Pumped Sumps		
surface	29.4	21.0
ground	9.3	9.5
Other Water Level Maintenance		
surface	35.3	35.1
ground	560.8	1,002.1
Special Categories		
Pollution Confinement		
surface	0.1	5.0
ground	5,056.1	5,258.5
Hatcheries & Fisheries		
surface	5,721.9	5,955.2
ground	751.0	711.0
Snow Making		
surface	112.8	113.0
ground	292.5	306.1
Peat Fire Control		
surface	0.0	0.0
ground	1.1	0.3
Livestock Watering		
surface	0.0	0.0
ground	536.8	685.2
Other Special Categories		
surface	1.2	14.2
ground	49.8	49.6
Subtotal	**58,185.6**	**65,299.3**
Percent of Total	**5%**	**5%**
surface	43,176.9	51,291.4
ground	15,008.7	14,007.9
Grand Total (Millions of Gallons)	**1,281,308**	**1,299,611**
surface	**1,053,335**	**1,079,166**
ground	**227,973**	**220,445**

This document is also available on our web site at www.dnr.state.mn.us/waters