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**A Summary of Pumpage from  
the Cambrian-Ordovician Aquifers  
of Northeastern Illinois, 2000-2004**

by  
**Stephen L. Burch and H. Allen Wehrmann**

**Illinois State Water Survey**  
A Division of the Illinois Department of Natural Resources  
and an affiliated agency of the University of Illinois

**2007**

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Illinois State Water Survey  
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## **Abstract**

Cambrian-Ordovician aquifers underlying the Chicago region at depths of 500 to 1,600 feet have been prolific sources of groundwater for more than 100 years. The Chicago region includes Cook, Kendall, DuPage, Lake, Grundy, McHenry, Kane, and Will Counties. Groundwater pumpage from the Cambrian-Ordovician aquifers (the St. Peter and Ironton-Galesville sandstones) has increased from about 200,000 gallons per day (gpd) in 1864 to a peak of 182.88 million gallons per day (mgd) in 1979. Pumpage from the Cambrian-Ordovician aquifers decreased rapidly to 63.3 mgd in 1993 as a result of expanded use of Lake Michigan water by Chicago collar communities. Deep aquifer withdrawals increased to 67.3 mgd by 1995 and to 71.9 mgd in 1999.

This report documents that deep aquifer withdrawals continue to increase steadily. The Illinois Water Inventory Program (IWIP) compiles responses to annual letters of inquiry sent to community, commercial, and industrial water-using facilities. The IWIP database was queried for pumpage from wells using the Cambrian-Ordovician aquifers during the study period of 2000-2004. A tally of the pumpages for the Chicago region determined that withdrawals had increased from 72.47 mgd in 2000 to 84.40 mgd in 2004. The largest community water supplies using the Cambrian-Ordovician aquifers continue to be Joliet and Aurora.

The last pumpage summary concluded with data through 1999. Since then, 38 new community supply wells were constructed, with the greatest number (11 wells) located in Kane County. Well development for community supplies is favoring use of the deeper Ironton-Galesville aquifer likely because of concerns over the long-term dependability of the shallower St. Peter sandstone. Thirty other large-diameter, high-capacity wells have been drilled for irrigation and industrial purposes. Ten of those wells were drilled in Lake County and accounted for more than half of the 19 irrigation wells constructed during the study period.

Increasing use of the Cambrian-Ordovician aquifers by domestic wells is apparent. Based on well records maintained by the Illinois State Water Survey, more than 1,000 domestic wells were drilled into these aquifers from 2000 to 2004, mostly in Kane and Kendall Counties. The total amount of water pumped by these wells is small in comparison to high-capacity and community uses tallied by the IWIP; however, the trend suggests an increasing use of the Cambrian-Ordovician aquifers for individual households.

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# **A Summary of Pumpage from the Cambrian-Ordovician Aquifers of Northeastern Illinois, 2000-2004**

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## **Introduction**

This report summarizes 2000-2004 pumpage by deep bedrock wells penetrating the Cambrian and Ordovician aquifers in the Chicago region. Pumpage data were compiled from the Illinois Water Inventory Program (IWIP) maintained by the Illinois State Water Survey (ISWS). The program annually gathers water-use information from community water-supply (CWS) operators and self-supplied, industrial-commercial facilities through voluntary questionnaires.

The Chicago region described in this report includes eight counties: Cook, DuPage, Grundy, Kane, Kendall, Lake, McHenry, and Will Counties (figure 1). This is consistent with previous reports (see Burch, 2002), but differs slightly from Suter et al. (1959), who initially limited the region to include six counties and only those parts of Grundy and Will Counties north of township T32N.

The Chicago region has been one of the most favored areas for groundwater development in Illinois because sandstone aquifers, at depths of 500-1,600 feet, have been prolific sources of water for more than 100 years. At shallower depths, underlying the glacial deposits is creviced dolomite, which often also serves as a source of groundwater. Less extensive sand-and-gravel deposits occur intermittently within the glacial deposits.

This report focuses only on the intervals of sandstone that underlie the eight northeastern counties of Illinois. Together, these intervals commonly are referred to as the Cambrian-Ordovician aquifers due to their geologic age. The upper water-bearing unit is the St. Peter sandstone, and the underlying unit is comprised of the Ironton and Galesville sandstones. Separating these two sandstone units are strata of low permeability comprised mainly of dolomite and shale that, collectively, are assigned to the Franconia Formation, Potosi Dolomite, Eminence Formation, and the Prairie du Chien group. The Cambrian-Ordovician aquifers discussed in this report do not include the Cambrian sandstones of the Eau Claire Formation or the Mt. Simon sandstone, both of which underlie the Ironton-Galesville sandstones. Throughout the Chicago region, both the Eau Claire and Mt. Simon Formations typically contain water too salty for most uses. The Cambrian-Ordovician aquifers commonly are referred to as the “deep bedrock aquifers” or “deep sandstones”.

Groundwater usage increased from about 200,000 gallons per day (gpd) in 1864 to a peak of 182.88 million gallons per day (mgd) in 1979. Since then, Lake Michigan water was extended to many groundwater users in the Chicago region principally to alleviate rapidly declining heads in the Cambrian-Ordovician aquifers. As a result, pumpage from the Cambrian-Ordovician aquifers rapidly declined in the 1980s to a minimum of 63.3 mgd in 1993 (Visocky, 1997).



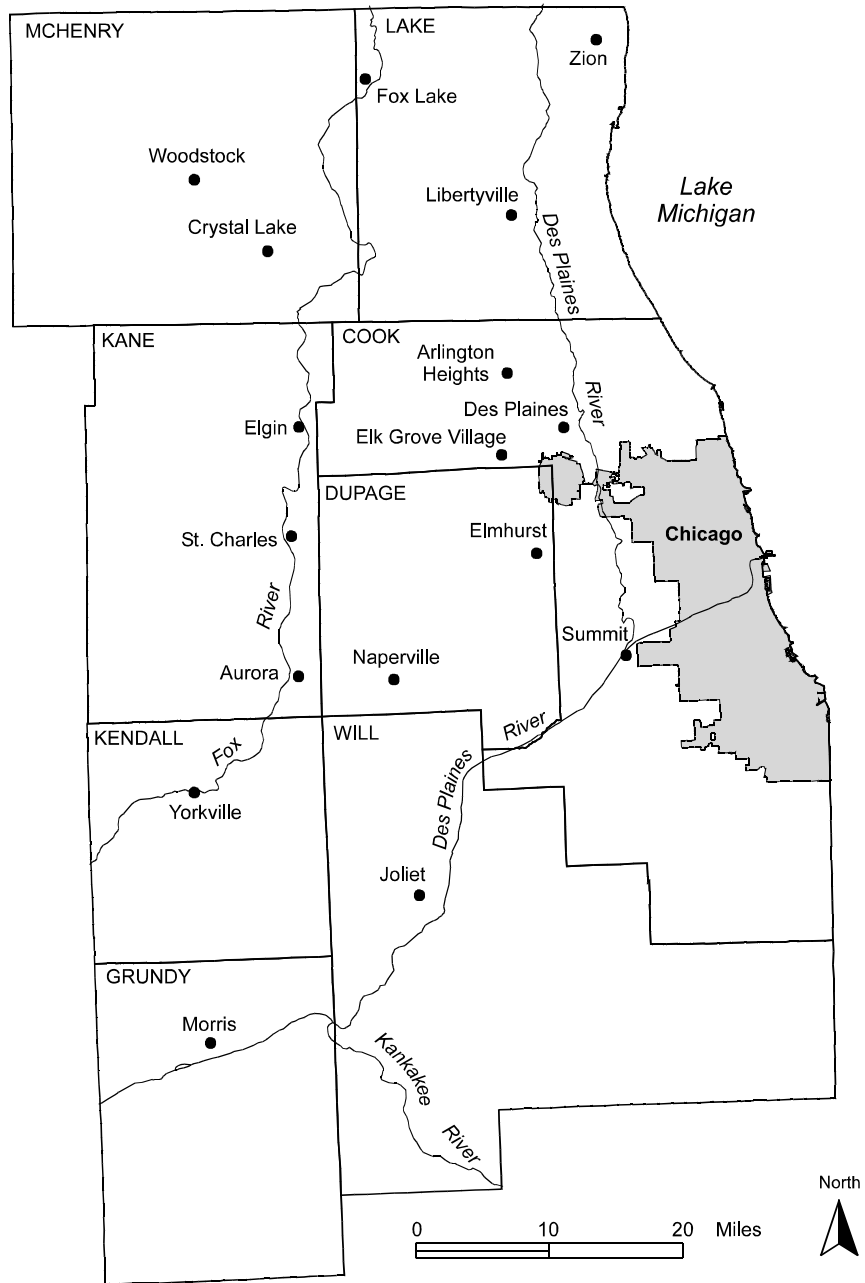


Figure 1. The eight-county Chicago region in northeastern Illinois

Pumpage from deep sandstone (Cambrian-Ordovician) wells, however, subsequently rose to 67.3 mgd by 1995 and continued to 71.9 mgd in 1999 (Burch, 2002).

This report documents continuing changes in the amount and spatial distribution of deep bedrock pumpage in the Chicago region. Evaluations of such data are necessary to understand the dynamics of the deep aquifers and as part of water-supply planning efforts in northeastern Illinois.

## **Acknowledgments**

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The authors processed raw pumpage data provided by Tim Bryant. Any errors are the responsibility of the authors. Pam Lovett and Patti Hill formatted the report and provided word processing support, Eva Kingston edited the report, and Linda Hascall improved and polished the graphics.



## Pumpage from Deep Bedrock Wells

The Illinois Water Inventory Program (IWIP) compiles responses from water-using facilities to annual letters of inquiry. The program relies on voluntary submission of a form tailored to each (known) major water user in the state. Information on the quantity of groundwater pumped by each well is categorized as: community water supply; self-supplied, industrial-commercial; or other. For this report, self-supplied, industrial-commercial pumpage and other (irrigation) withdrawals, such as those for country clubs, were combined and included under the industrial category. Pumpage from deep wells for individual domestic and rural residences or for farm supplies is not surveyed and is not included in the reported summary pumpage data. An assessment of domestic well drilling into the deep bedrock and the amount of water pumped by such wells is provided later in this report.

The IWIP database was queried to extract Cambrian-Ordovician groundwater pumpage data reported from the eight-county Chicago region during 2000-2004. Pumpage data for facilities that did not report in any given year were estimated from years when they did report. No known major water-using facility was left out of the compilation.

Of the 137 community water-supply (CWS) facilities recorded in this region, from 6-12% did not report in 2000-2004. Unfortunately, for four of those years, Joliet did not report annual water use, and it is the greatest user of deep bedrock water in the region. In 2000, the year in which Joliet reported 10.50 mgd deep bedrock use, the total estimated use by the nine nonreporting CWS facilities was 0.73 mgd, only 1% of the total CWS deep bedrock pumpage in 2000. For years when Joliet use was not reported and was estimated, approximately 24-31% of the CWS pumpage was estimated. Joliet's deep bedrock pumpage for 2003 and 2004 (14.34 mgd) was derived from a 2003 Illinois Environmental Protection Agency (IEPA) site visit report; pumpages for 2001 and 2002 were interpolated from the reported 10.50 mgd in 2000. Excluding Joliet's estimated pumpage, the total of all other CWS estimated uses was 1.4-2.1 mgd in 2001-2004.

For the facilities included under the industrial category, nonreporters included 18-30% of the 121 facilities in any year. Nonreported use, for which estimates had to be made, varied only from 6 to 12% of the total pumpage. In other words, the 22-36 nonreporting industrial facilities account for 1.2-2.4 mgd, or only about 0.03-0.07 mgd per facility.

A summary of pumpage from deep bedrock wells in the eight-county Chicago region is presented (table 1). The table is subdivided by usage type (community versus industrial) and by county. An examination of 2000-2004 community pumpage in Cook, DuPage, and Grundy Counties shows little change; modest increases in Kendall, Lake, and McHenry Counties; and increases of about 3-4 mgd in Kane and Will Counties.

Previous ISWS reports (Visocky, 1997; Burch, 2002) have listed CWS facilities using more than a million gallons per day (table 2). The number of large facilities changes slightly from year to year. For this report, Joliet and Aurora topped the list of large CWS facilities in the Chicago region. Composition of that group has changed since the last report (Burch, 2002) and no longer includes Geneva, St. Charles, and Plainfield, but does include Lake in the Hills, Huntley, Yorkville, and Bartlett.

**Table 1. Chicago Region Pumpage (mgd) from Deep Bedrock Wells by Use and County, 2000-2004**

<i>County</i>	<i>Community</i>	<i>Industrial</i>	<i>Total</i>
Cook	4.40	3.72	8.12
DuPage	1.81	0.21	2.02
Grundy	2.94	6.93	9.87
Kane	16.93	0.32	17.25
Kendall	2.17	0.56	2.73
Lake	3.29	0.89	4.18
McHenry	4.81	2.10	6.91
Will	16.23	5.16	21.39
<b>2000 Total</b>	<b>52.58</b>	<b>19.89</b>	<b>72.47</b>
Cook	4.64	4.56	9.20
DuPage	1.85	0.17	2.02
Grundy	3.13	5.80	8.93
Kane	17.71	0.57	18.28
Kendall	2.41	0.27	2.68
Lake	3.57	0.97	4.54
McHenry	5.22	1.92	7.14
Will	17.32	5.89	23.21
<b>2001 Total</b>	<b>55.85</b>	<b>20.15</b>	<b>76.00</b>
Cook	4.99	4.57	9.56
DuPage	1.68	0.23	1.91
Grundy	3.02	6.22	9.24
Kane	20.61	0.40	21.01
Kendall	2.89	0.30	3.19
Lake	3.79	1.04	4.83
McHenry	6.05	1.69	7.74
Will	18.70	5.65	24.35
<b>2002 Total</b>	<b>61.73</b>	<b>20.10</b>	<b>81.83</b>
Cook	4.56	5.01	9.57
DuPage	1.92	0.17	2.09
Grundy	2.98	5.80	8.78
Kane	18.22	0.45	18.67
Kendall	2.89	0.33	3.22
Lake	3.79	1.08	4.87
McHenry	6.63	1.46	8.09
Will	20.79	6.87	27.66
<b>2003 Total</b>	<b>61.78</b>	<b>21.17</b>	<b>82.95</b>
Cook	4.71	5.13	9.84
DuPage	2.12	0.17	2.29
Grundy	2.97	6.60	9.57
Kane	20.80	0.20	21.00
Kendall	3.34	0.31	3.65
Lake	3.85	1.10	4.95
McHenry	6.69	1.43	8.12
Will	18.68	6.30	24.98
<b>2004 Total</b>	<b>63.16</b>	<b>21.24</b>	<b>84.40</b>

**Table 2. Community Water-Supply Facilities in the Chicago Region Pumping More than 1.0 mgd from Deep Bedrock Aquifers, 2004**

<i>Community</i>	<i>Pumpage (mgd)</i>
Joliet	14.34*
Aurora	9.63
Crystal Lake	2.11
Oswego	2.02
Lake Zurich	2.00
Morris	1.93
Lemont	1.85
West Chicago	1.83
Lake in the Hills	1.76
Huntley	1.73
Romeoville	1.69
North Aurora	1.64
Batavia	1.46
Montgomery	1.33
Western Springs	1.23
Yorkville	1.07
Bartlett	1.03

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**Note:**

\*Estimate based on IEPA 2003 Joliet water system site visit report.

The Chicago region has 137 CWS facilities with wells drilled into the Cambrian-Ordovician aquifers, but only about 30 of those facilities pump more than 0.5 mgd. Likewise, about 120 industrial facilities pump from the deep bedrock, but fewer than 10 facilities withdraw more than 0.5 mgd. None of the 34 irrigation facilities (included within the industrial category for this report) were found to pump in excess of 0.5 mgd on a 365-day basis. Although the tallied irrigation use was predominantly for golf courses and none for row crops, an irrigation season does not span the entire year. Therefore, daily irrigation use during the irrigation season could be 3-4 times greater than the year-round average. For example, 0.93-1.44 mgd on a 365-day basis translates to 3.8-5.8 mgd on a 90-day basis or 2.8-4.4 mgd on a 120-day basis (e.g., mid-May to mid-September).

It is observed that groundwater withdrawals from the deep sandstones in the Chicago region are increasing. The amount of community and industrial pumpage rose from 72.47 mgd in 2000 to 84.40 mgd in 2004. These values were added to a previously published graph (Burch, 2002) of deep sandstone pumpage and illustrated in figure 2.

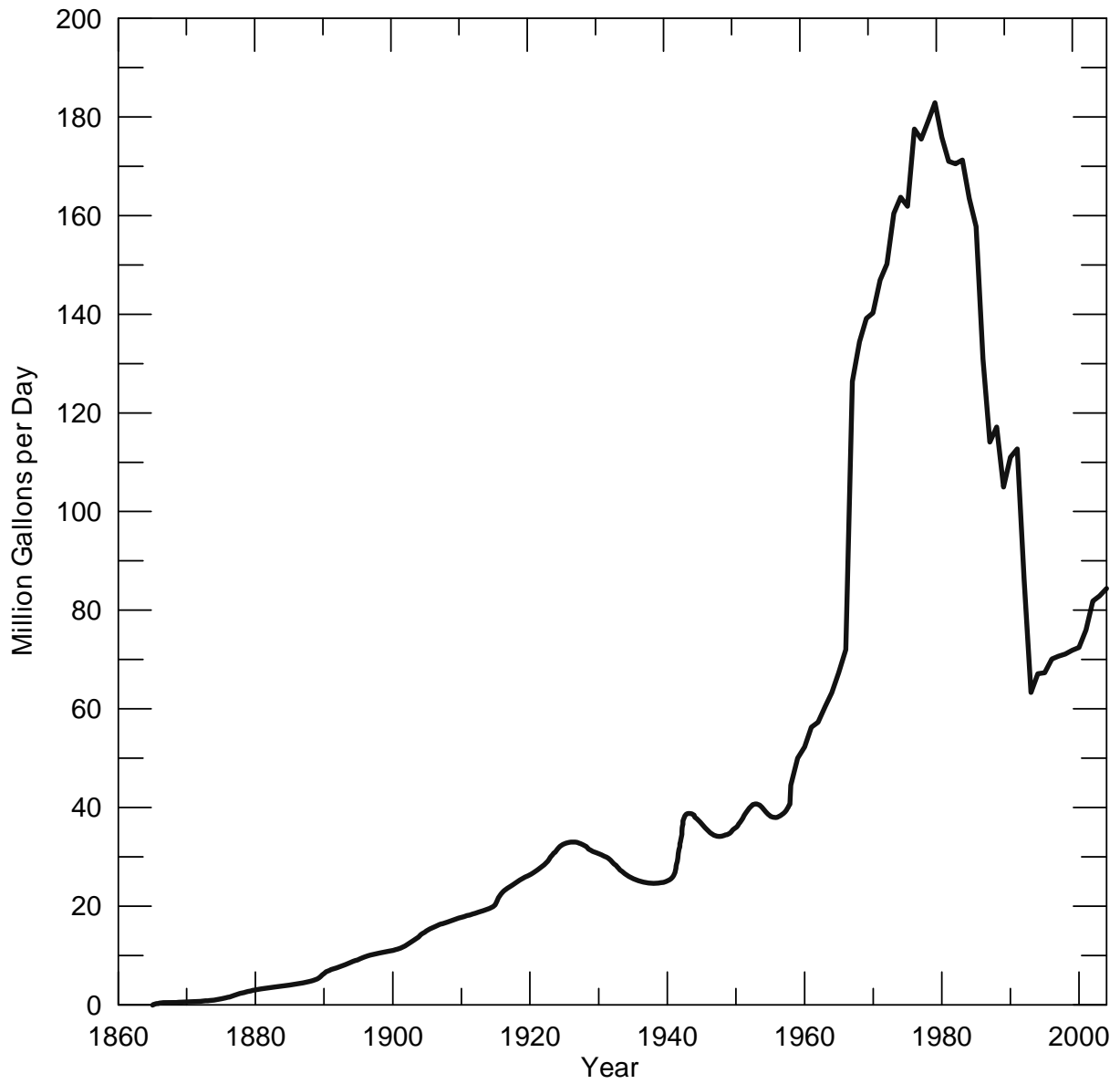


Figure 2. Estimated historical community and industrial pumpage from the Cambrian-Ordovician aquifers in the eight-county Chicago region, 1864-2004





## **New Deep Bedrock Wells, 2000-2004**

Since the last Chicago region pumpage summary (Burch, 2002), more than 1,000 new wells have been drilled into the Cambrian-Ordovician aquifers. Most of the new wells were constructed for private residences. The amount of their daily withdrawals of groundwater from the deep sandstones is judged to be small. Pumpage by larger wells, constructed for irrigation, self-supplied industry, or CWS accounts for far more water than that pumped by smaller capacity wells drilled for private residences. This section examines when and where wells of both types were constructed during 2000-2004.

### **Small-Capacity Domestic Wells**

Many privately owned wells are drilled for homeowners located beyond CWS service areas. Wells of this type are small in diameter (4-6 inches) and typically yield less than 20 gallons per minute. Table 3 summarizes the geographic distribution of domestic wells as determined from well-construction reports submitted by drillers through local county public health departments to the ISWS. More than 1,000 wells drilled between 2000 and 2004 include more than 800 wells located in Kane and Kendall Counties.

An examination of the well records on file at the ISWS found that since 1970, the number of domestic deep bedrock wells in the Chicago region has increased substantially. Only 21 construction reports were found for domestic wells greater in depth than 500 feet and built during 1970. The number of new domestic wells built each year fluctuated until the mid-1980s, but tended to be 25-50 wells/year. Then a steadily increasing trend began so that by 2000, 170 new domestic wells were reported deeper than 500 feet each year. The number increased to 219 new domestic deep bedrock wells in 2004.

If each new domestic deep bedrock well supplies an average of 3.2 persons per residence with 120 gallons of water per person per day, then the total new deep aquifer domestic pumpage in 2004 is an estimated 84,000 gpd or 0.08 mgd (3.2 people/residence x 120 gallons/person x 219 residences). Based on ISWS records, the total number of domestic wells drilled deeper than 500 feet since 1970 is about 3,000 wells. It is possible that many of these older wells have been sealed or abandoned as CWS service areas expanded. But even if all wells still were being used, the potential withdrawal from these domestic deep bedrock wells amounts to approximately 1.15 mgd using the assumptions described earlier. Compared to the amount of groundwater withdrawn by the large-capacity, community and industrial wells discussed in the previous section, and given the distribution of this domestic pumpage across all eight counties, this amount is small.

**Table 3. Construction Reports of Private Wells Deeper than 500 Feet,  
Drilled in 2000-2004**

<i>County</i>	<i>Number of wells</i>
Cook	15
DuPage	3
Grundy	61
Kane	525
Kendall	307
Lake	35
McHenry	9
Will	96

### **High-Capacity Wells**

Compared to the small-diameter domestic deep bedrock wells, construction of large-diameter, high-capacity wells is infrequent, according to the Public-Industrial-Commercial Survey (PICS) database at the ISWS, which contains site-specific information about active and inactive, high-capacity water withdrawals at facilities throughout Illinois. The PICS database indicates that unlike small-capacity, deep domestic wells (>500 feet), 68 new high-capacity wells were constructed in the Chicago region during 2000-2004.

Thirty-eight new, high-capacity wells were constructed for CWS use during the 5-year period (table 4). Eleven of these CWS wells were in Kane County within what Burch (2002) termed the Aurora-Oswego pumping center. Nearby development also occurred with six new wells in Kendall County and six others in Will County, primarily in Yorkville, Joliet, and Plainfield.

Thirty other PICS wells were constructed during 2000-2004 for irrigation and industrial uses. Ten of these wells were drilled in Lake County and accounted for more than half of the 19 irrigation wells constructed during the study period. Eleven other wells constructed for industrial users were scattered widely throughout the Chicago region.

The CWS wells primarily were finished in the Ironton-Galesville aquifer (58 percent), not the shallower St. Peter sandstone (21%). Only 5 of 38 CWS wells were open to both aquifers (13 percent), presumably to capture the greatest possible yield. Three other CWS wells (8 percent) are not easily classified because they are also open to the overlying Silurian-age bedrock and one or both of the Cambrian sandstones. It is apparent that during 2000-2004 more wells were finished in the deeper of the two Cambrian-Ordovician aquifers.

**Table 4. New Community Water-Supply Wells Drilled in 2000-2004, and Showing Deep Aquifer Preference**

<i>Community Supply Name</i>	<i>Well number</i>	<i>Depth (ft)</i>	<i>Year</i>	<i>County</i>	<i>Aquifer</i>
Aqua Illinois - Hawthorn Woods	1	1,320	2003	Lake	Sil-Ss
Holy Family Villa	1	700	2000	Cook	Sil-Ss
Holy Family Villa	2	670	2000	Cook	Sil-Ss
Braceville	4	875	2001	Grundy	StPtr
Diamond	3	875	2004	Will	StPtr
Prairie Trails of Long Grove	2	997	2003	Lake	StPtr
Providence at Painted Lakes	13	1,100	2002	Lake	StPtr
Providence at Painted Lakes	14	1,000	2003	Lake	StPtr
South Wilmington	5	970	2000	Grundy	StPtr
Volo	1	975	2000	Lake	StPtr
Volo	2	1,012	2000	Lake	StPtr
Aqua Illinois - Ravenna	1	1,280	2004	Lake	Both
Aurora	26	1,215	2003	Kane	Both
Aurora	27	1,460	2004	Kane	Both
North Aurora	6	1,335	2001	Kane	Both
Wynstone Water Company	5	1,332	2000	Lake	Both
Aurora	24	1,460	2000	Kane	IGal
Cary	13	1,304	2001	MCH	IGal
Gilberts	3	1,330	2000	Kane	IGal
Gilberts	4	1,330	2001	Kane	IGal
Hampshire	9	1,250	2004	Kane	IGal
Joliet	17	1,580	2000	Will	IGal
Joliet	18	1,580	2000	Will	IGal
Joliet	20	1,556	2003	Kendall	IGal
Joliet	21	1,555	2003	Kendall	IGal
Manhattan	7	1,770	2000	Will	IGal
Maple Park	5	1,300	2003	Kane	IGal
Montgomery	14	1,403	2002	Kane	IGal
Morris	7	1,449	2002	Grundy	IGal
Oswego	8	1,440	2001	Kendall	IGal
Pingree Grove	1	1,336	2004	Kane	IGal
Plainfield	6	1,490	2000	Will	IGal
Plainfield	7	1,500	2001	Will	IGal
Poor Clare Monastery	1	1,600	2002	Cook	IGal
Sugar Grove	8	1,465	2001	Kane	IGal
Yorkville	7	1,527	2004	Kendall	IGal
Yorkville	8	1,384	2004	Kendall	IGal
Yorkville	9	1,368	2004	Kendall	IGal

**Notes:**

Sil-Ss = Silurian to St. Peter sandstone; Both = St. Peter and Ironton-Galesville sandstones; StPr = St. Peter sandstone; and IGal = Ironton-Galesville sandstones.



## Summary and Conclusion

This report is an update of pumpage data for deep bedrock wells in the Chicago region. Pumpage figures for the 2000-2004 period used in this report are for large-capacity wells tracked by the IWIP maintained by the ISWS. The program annually gathers water-use information from community water-supply (CWS) operators and self-supplied, industrial-commercial facilities through voluntary questionnaires.

Sandstones underlying the Chicago region at depths of 500-1,600 feet have been prolific sources of groundwater for more than 100 years. The Chicago region includes Cook, Kendall, Du Page, Lake, Grundy, McHenry, Kane, and Will Counties. It is observed that withdrawals of groundwater from the deep sandstones in the Chicago region are increasing. The amount of pumpage rose from 72.47 mgd in 2000 to 84.40 mgd in 2004.

Since the last Chicago region pumpage summary (Burch, 2002), more than 1,000 new wells have been drilled into the deep sandstones. Most of the new wells were constructed for private residences located beyond CWS service areas. Wells of this type typically yield only 10-20 gallons per minute, and their pumpage is small in comparison to pumpage tracked by IWIP.

Large-diameter, high-capacity wells are much fewer in number according to the PICS database at the ISWS. Thirty-eight new, high-capacity wells were constructed for use as community supplies. Eleven of these CWS wells were in Kane County and within the Aurora-Montgomery pumping cone. Nearby development also occurred with six new wells in Kendall County and six others in Will County, primarily in Yorkville, Joliet, and Plainfield.

Thirty other PICS wells were constructed during 2000-2004 for irrigation and industrial uses. Ten wells drilled in Lake County accounted for more than half of the 19 irrigation wells constructed during the study period. Eleven other wells constructed for industrial users were widely scattered throughout the Chicago region.

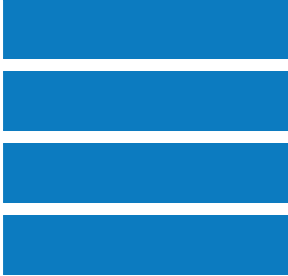
The areas most likely to have experienced deep bedrock aquifer groundwater-level (potentiometric surface) declines are Will and Kane Counties. Groundwater pumpage from the Cambrian-Ordovician aquifers in Will and Kane Counties rose by about 4 mgd each, while pumpage remained relatively steady in the other counties during 2000-2004. Correspondingly, it is expected that the potentiometric surface in the counties with steady pumpage has changed little since the last measurement in 2000 (Burch, 2002). It is concluded, however, that future efforts to quantify the potentiometric surface decline should emphasize Will and Kane Counties because of the magnitude of their pumpage increases. If expressed in terms of percentage growth, usage in Kendall County exceeded that in both Will and Kane Counties. Therefore, the next time the potentiometric surface is measured, the greatest decline should be expected in the southwestern portion of the Chicago region.



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