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Regional Water Demand Forecast for Northeastern Illinois

2020 - 2050

Chicago Metropolitan Agency for Planning

Sea Grant ILLINOIS–INDIANA

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- Daniel Abrams, groundwater flow modeler, Illinois State Water Survey
- Steve Altman, manager, division of resource management, Illinois Department of Natural Resources Office of Water Resources
- Wes Cattoor, chief of engineering studies, Illinois Department of Natural Resources Office of Water Resources
- Veronica Fall, climate extension specialist, Illinois-Indiana Sea Grant, Prairie Research Institute
- Russ Flinchum, section chief, Lake Michigan programs, Illinois Department of Natural Resources Office of Water Resources
- Jeff Freeman, chief executive officer, Engineering Enterprises, Inc.
- Wei Han, water supply program manager, Illinois Department of Natural Resources Office of Water Resources
- Vlad Iordache, hydrogeologist, groundwater science section, Illinois State Water Survey
- Don Jensen, superintendent water production, City of Highland Park
- Joe Johnson, vice president, Stantec
- Walt Kelly, affiliate scientist, Illinois State Water Survey
- Paul May, general manager, DuPage Water Commission
- Laura Medwid, post-doctoral research associate, Government Finance Research Center, University of Illinois Chicago
- Pete Wallers, chairman, president and CEO emeritus, Engineering Enterprises, Inc. and chair of the Northwest Water Planning Alliance's Technical Advisory Committee
- Steve Wilson, program director, PrivateWellClass.org and WaterOperator.org, Illinois Water Resources Center
- Ryan Wilson, director, Metropolitan Planning Council
- Zhenxing Zhang, water supply hydrologist, Illinois State Water Survey

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Introduction

Clean, reliable, and affordable water is vital for the health and prosperity of our region. Around the world, communities are grappling with growing water resource challenges and northeastern Illinois is no exception. Many areas of the region, especially those dependent on groundwater, are already encountering issues with water supply and quality.

Understanding future water demand is key to managing these resources sustainably. To support this effort, the Chicago Metropolitan Agency for Planning (CMAP), Illinois-Indiana Sea Grant (IISG), and University of Illinois Extension have updated the region's water demand forecast using CMAP's 2022 Socioeconomic Forecast. This analysis projects water demand through 2050 at county and regional levels, broken down by water source and sector across Cook, DuPage, Kane, Kendall, Lake, McHenry, and Will counties.

The forecast reveals an encouraging trend: overall water use is expected to decline due to continued advancements in conservation and efficiency, which are outpacing population and employment growth. However, in some areas, projected demand is expected to surpass available groundwater supplies. These findings highlight the importance of proactive planning to conserve water, protect supplies, and evaluate alternative drinking water sources — key strategies also emphasized in ON TO 2050, the region's comprehensive plan.

This report summarizes the key findings of the forecast, outlining the methodologies, data sources, and sector-specific approaches used. It concludes with an overview of existing limitations encountered during the process. The report is intended to inform planners, policymakers, and stakeholders while guiding future forecasting efforts.

Advisory committee

A technical advisory committee provided critical feedback along the way by reviewing and confirming the forecast purpose and goals, methodology, and forecast results. The technical advisory committee was composed of representatives from a variety of organizations with a range of backgrounds — including those with forecasting experience at different scales as well as stakeholders who can use the results to inform their work. In 2022, the advisory committee met twice to confirm goals and methodological approaches. In 2024, the advisory committee regrouped to review results and confirm necessary methodology changes.

Advisory committee members

- Daniel Abrams, groundwater flow modeler, Illinois State Water Survey
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Forecast overview

This forecast builds upon previous regional water demand forecasts completed in 2008 and 2018. The 2008 forecast, *Regional Water Demand Scenarios for Northeastern Illinois: 2005-50*, informed the development of *Water 2050: Northeastern Illinois Regional Water Supply/ Demand Plan*.[1] This foundational effort provided a comprehensive assessment of water demand for the 11-county region and highlighted key water supply and demand challenges.[2]

In 2018, CMAP and IISG updated the regional water demand forecast for the seven-county CMAP region with *ON TO 2050 Regional Water Demand Forecast for Northeastern Illinois, 2015-2050*.[3] Like the 2008 effort, this forecast was a long-range forecast and focused on supporting regional planning. It advanced forecasting efforts by providing datasets on all key inputs and results online for stakeholders to access and explore.

Starting in 2022, CMAP and IISG partnered again to refine the forecasting methodology, building on CMAP's Socioeconomic Forecast and land use model. The primary innovation of this latest forecast is an improved understanding of the location and service areas of water facilities, which in turn improves the assignment of demand drivers in the forecasting method.

Forecast scope and data inputs

The 2024 forecast spans 30 years (2020-2050) with projections at five-year intervals, aligning with CMAP's 2022 Socioeconomic Forecast. The forecast incorporates population and employment trends, factoring in birth, death, and migration data from county health departments and the U.S. Census Bureau. Employment trends are derived from Moody's Analytics. The forecast includes policy impacts from ON TO 2050 recommendations.

The forecast relies on annual water withdrawal data from two primary sources: The Illinois Water Inventory Program, managed by the Illinois State Water Survey, and the Lake Michigan Allocation Program, a division of the Illinois Department of Natural Resources. The datasets include annual withdrawals from 2007 to 2018 and corresponding information of public water supply and self-supplied facilities in industrial, institutional, irrigation, and commercial sectors. All data is self-reported by facility operator and is required for:

- Public water supply systems;
- Permittees of the Lake Michigan Allocation Program; and/or
- Facilities operating high-capacity wells and intakes capable of withdrawing at least 100,000 gallons of water per day.

Water use sectors

The configuration of the water use sectors has varied across forecasts, reflecting improvements in data availability and understanding of service areas. For this effort, the following sectors are included:

- **Municipal public water supply** (Municipal PWS): Public or private water systems serving most of a municipality.
- **Municipal domestic self-supply** (Municipal DSS): Municipalities without centralized water systems, where residents and businesses use lower capacity wells not subject to annual reporting requirements.
- **Industrial, institutional, and commercial self-supply** (II&C self-supply): Private high-capacity wells or intakes for industrial, institutional, and commercial uses.
- **Smaller-scale public water supply** (Smaller-scale PWS): Private water systems that serve at least 25 people or 15 connections.
- **Agriculture and irrigation self-supply**: Private high-capacity wells or intakes for agriculture and irrigation purposes.

Methodology

Water demand is influenced by key factors including population and employment. Like previous efforts, this forecast uses the unit use method, which estimates current per-capita, per-employee, or per-acre water consumption (depending on the sector) and multiplies these values by projected population, employment, and land use conditions.

Two forecast methods were used for each sector forecast, with variations to reflect each sector's unique characteristics:

- **Reference forecast:** Assumes base-year unit use (measured either in gallons per capita, employee, or acre per day) remains constant over time. Changes in water demand are driven solely by shifts in population, employment, or acreage.
- **Conservation forecast:** Incorporates an annual percentage reduction in unit use to reflect conservation and historic trends. This method explored two scenarios:
    - **Current conservation:** Reflects ongoing conservation and efficiency trends.
    - **High conservation:** Models more aggressive conservation measures.

The current conservation forecast was selected as the basis for the regional water demand forecast and is reflected in all regional totals.

For the municipal sectors, 2018 was chosen as the base year, because it represented the most recent weather-normal year.[4] For all other sectors, 2010 was used as the base year to align with CMAP's UrbanSim model, which provides facility level employment and population data. The municipal focused sectors are calculated for each municipality; the other three sectors are calculated at the county level. Table 1 provides a summary the forecast method for each sector, which are discussed in more detail in subsequent sections of this report.

Table 1. Summary of forecast characteristics by sector

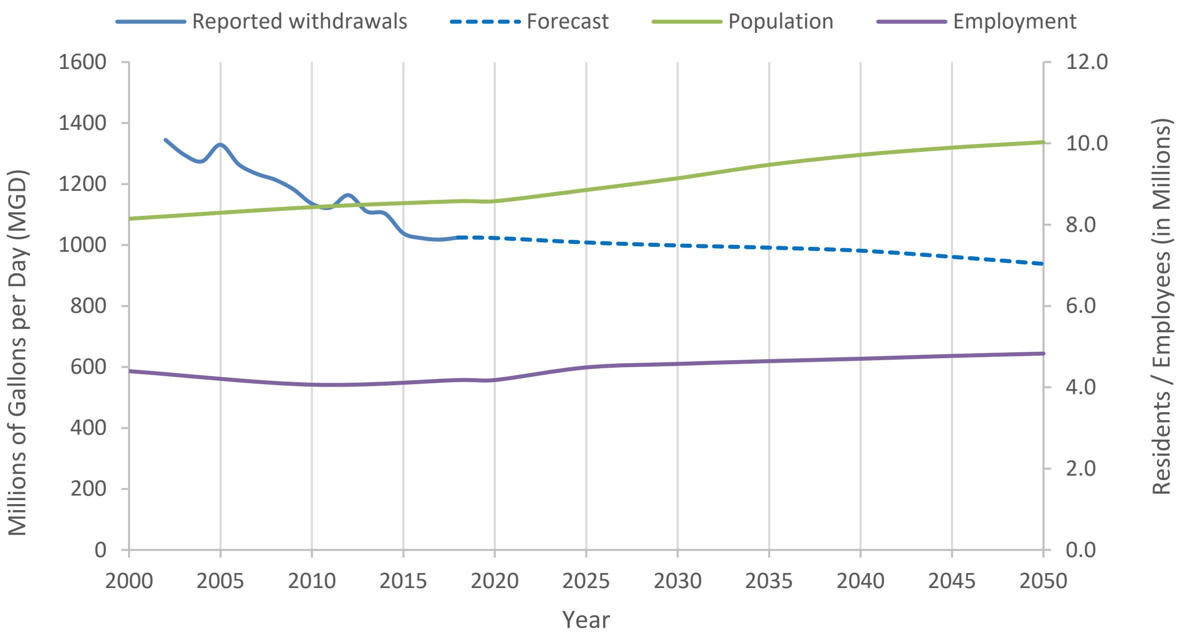
Sector	Total Number	Forecasted Number	Base year	Forecast geography	Unit use
Municipal PWS	253 municipalities	243 municipalities	2018	Municipality	Gallons per capita per day
Municipal DSS	31 municipalities	31 municipalities	2018	Municipality	Gallons per capita per day
Smaller-scale PWS	174 facilities	160 facilities	2010	County	Gallons per capita per day
Agriculture & irrigation self-supply	424 facilities	125 facilities	2010	County	Gallons per acre per day
II&C self-supply		111 facilities	2010	County	Gallons per employee per day

Source: CMAP and IISG, 2024.

Water demand forecast results

By 2050, total water withdrawals are estimated to reach 938 million gallons per day (MGD), an 8 percent decrease from 2018 levels (Figure 1). During this same period, the region is projected to add more than 1.4 million residents and nearly 300,000 jobs. Overall water use is estimated to decline due to steady advances in water conservation and efficiency that are outpacing population and employment growth.

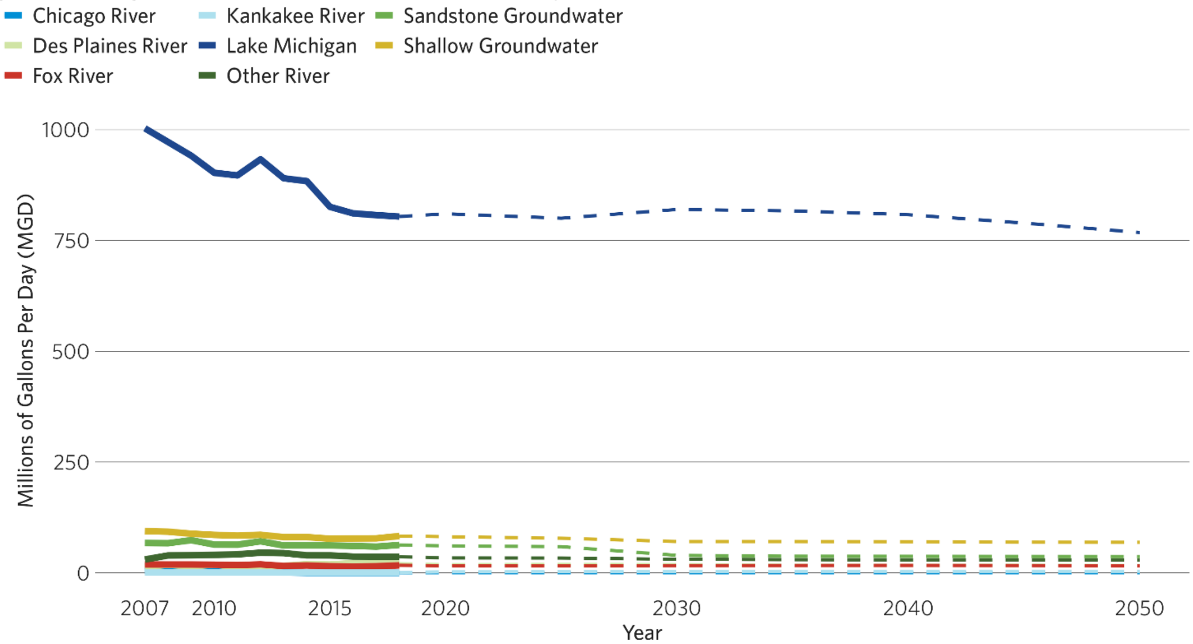
Figure 1. 2024 regional water demand forecast and 2022 socioeconomic forecast



Source: CMAP and IISG, 2024 and CMAP 2022 Socioeconomic Forecast.

Water withdrawals from Lake Michigan are forecasted to decline by 36 MGD or 4 percent by 2050; all other water sources are projected to experience a decrease in withdrawals, except for the Kankakee River which is projected to increase by 2.3 MGD primarily due to communities switching to this resource early in the forecast period (Figure 2 and Table 2).

Figure 2. Regional water demand forecast by source, (2018-50), MGD



Source: CMAP and IISG, 2024.

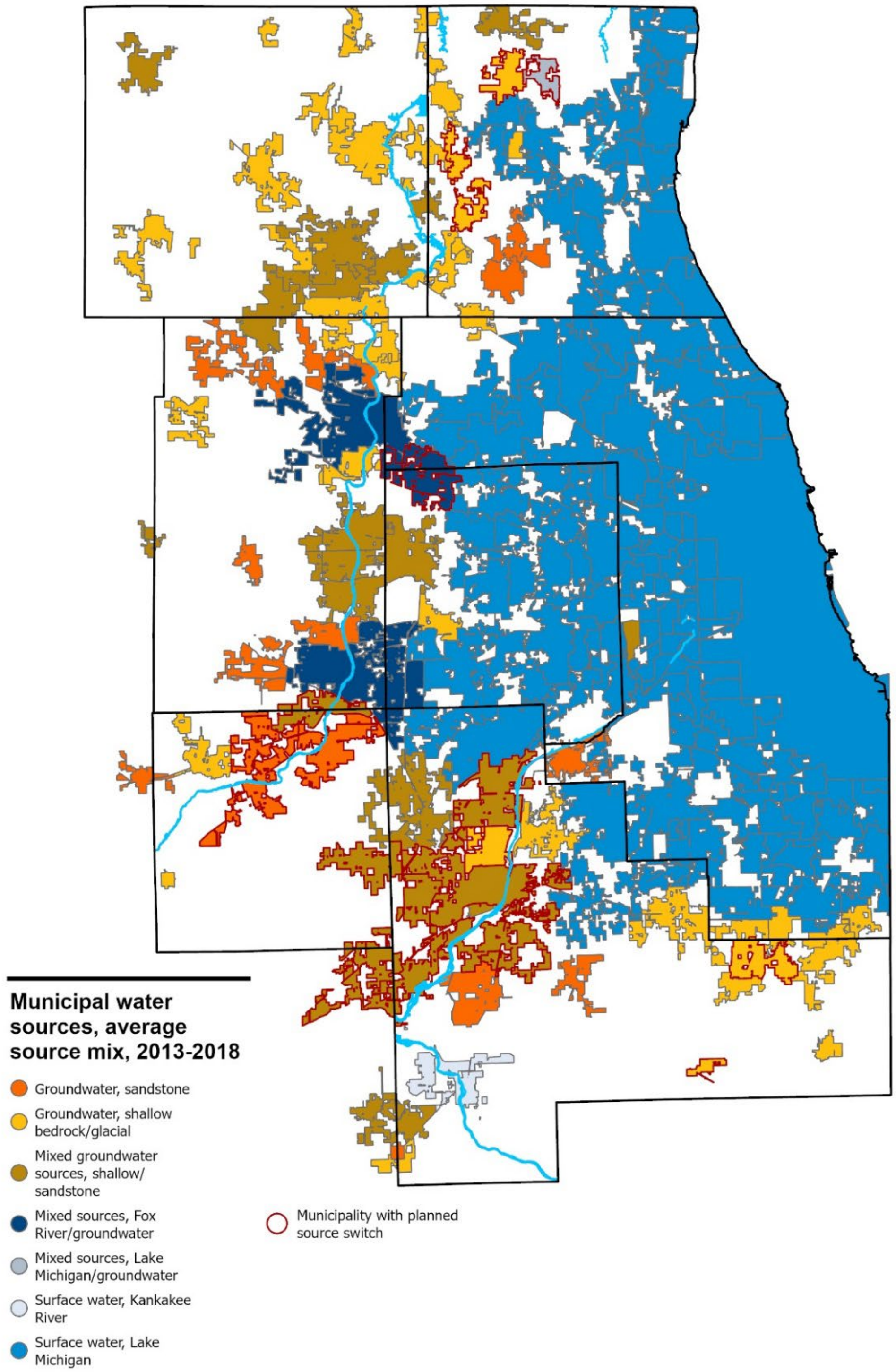
Table 2. Percent change in withdrawals by source, 2018 and 2050

Water source	Total use, MGD		Percent change
	2018	2050	
Des Plaines River	21	17	-20%
Fox River	17	16	-5%
Kankakee River	0.7	3	353%
Lake Michigan	804	768	-4%
Sandstone aquifer	63	37	-42%
Shallow aquifer	83	69	-17%
Other river	36	29	-21%

Source: CMAP and IISG, 2024.

Individual water facilities may switch water sources in the coming years. The forecast accounts for these planned source switches by municipalities that have made official plans. Otherwise, the forecast assumes that communities and facilities will continue to rely on their current source.

Figure 3. Water source by forecasted municipality, based on average source mix 2013-2018



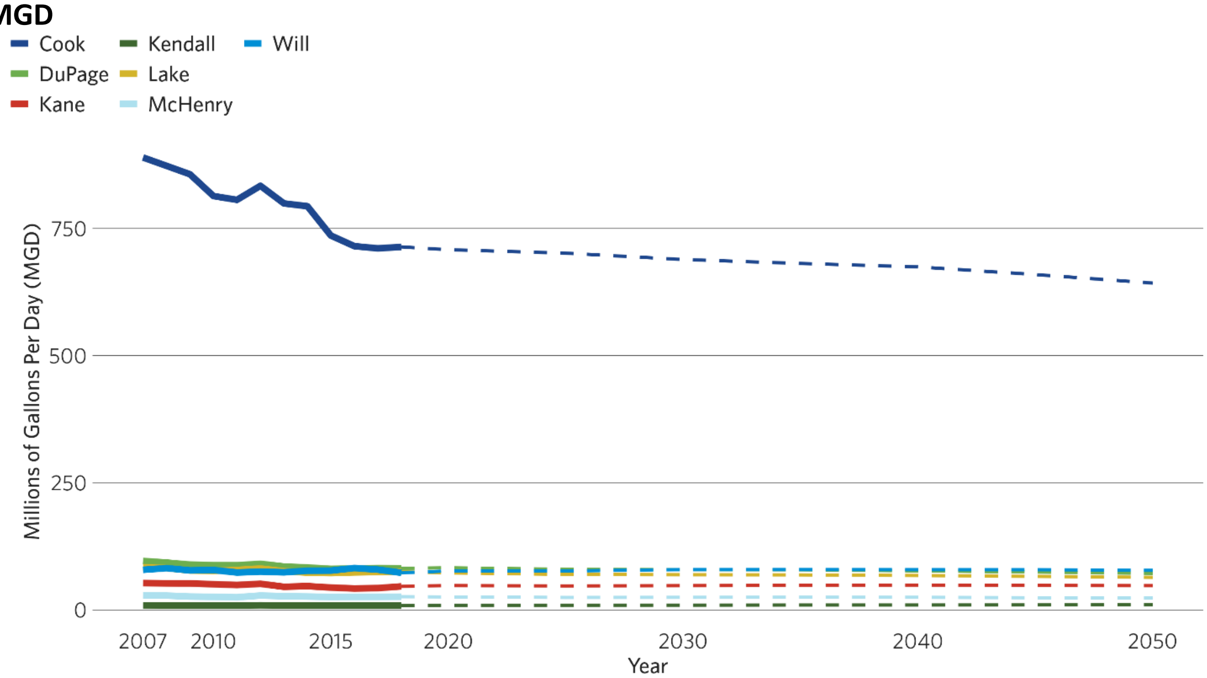
Note: Municipalities with one source of water listed may rely on additional sources, but those sources account for 10 percent or less of their total withdrawals. Municipalities with an official decision to change water sources during the forecast period are accounted for in the forecast (see Table 10).

Source: CMAP and IISG, 2024.

Figure 3 above spatially illustrates water source by forecasted municipality and outlines municipalities that are switching sources during the forecast period. Of note, and discussed in more depth later, there are several municipalities that rely on groundwater that will be switching sources in the forecast period—primarily to Lake Michigan, but also to the Kankakee River. Overall, most municipalities in the eastern portion of our region rely on Lake Michigan water, and further west, south, and northwest, the more groundwater sources come into play.

Most projected withdrawals are attributed to water use within Cook County (Figure 4 and Table 3). While water demand within Cook County is anticipated to decline in the future, other counties — most notably Kendall, Kane, McHenry, and Will — are projected to see increases in water demand.

Figure 4. Regional water demand forecast by county, reported withdrawals and forecast, MGD



Source: CMAP and IISG, 2024.

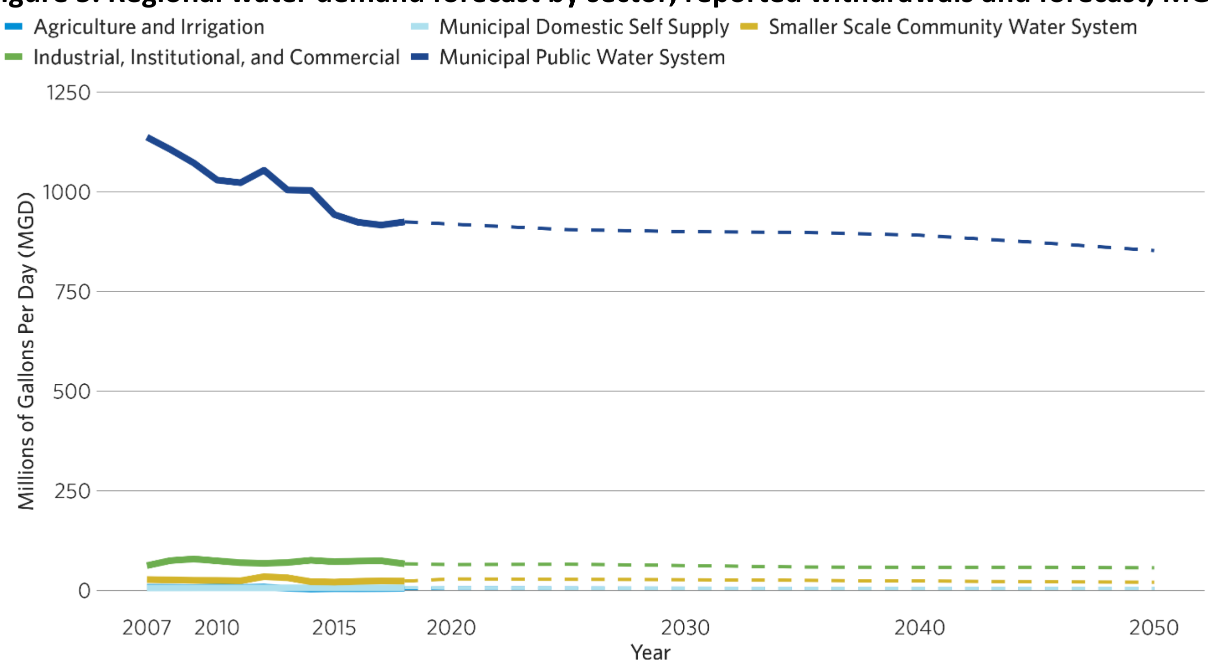
Table 3. Percent change in water demand by county, 2018 and 2050

County	Total use, MGD		Percent change
	2018	2050	
Cook	714	642	-10%
DuPage	82	72	-12%
Kane	46	48	4%
Kendall	9	10	11%
Lake	75	64	-15%
McHenry	26	24	-8%
Will	73	78	7%

Source: CMAP and IISG, 2024.

Municipal PWS systems are the largest users of water, withdrawing 90 percent (852 MGD) of all water in the seven-county region to serve 7.89 million people and corresponding businesses and institutions. The remaining four sectors use under 60 MGD by 2050. The agriculture and irrigation sector requires the least amount of water, which in part is a reflection the urbanized landscape of our region. By 2050, the municipal DSS sector is expected to have the largest proportional decrease in water use, and this is predominantly driven by larger reductions in population relative to the other sectors. Conversely, the industrial, institutional, and commercial sector is expected to increase its water demand by 2050, reflecting substantial growth in the employment served by this sector (Figure 5 and Table 4).

Figure 5. Regional water demand forecast by sector, reported withdrawals and forecast, MGD



Source: CMAP and IISG, 2024.

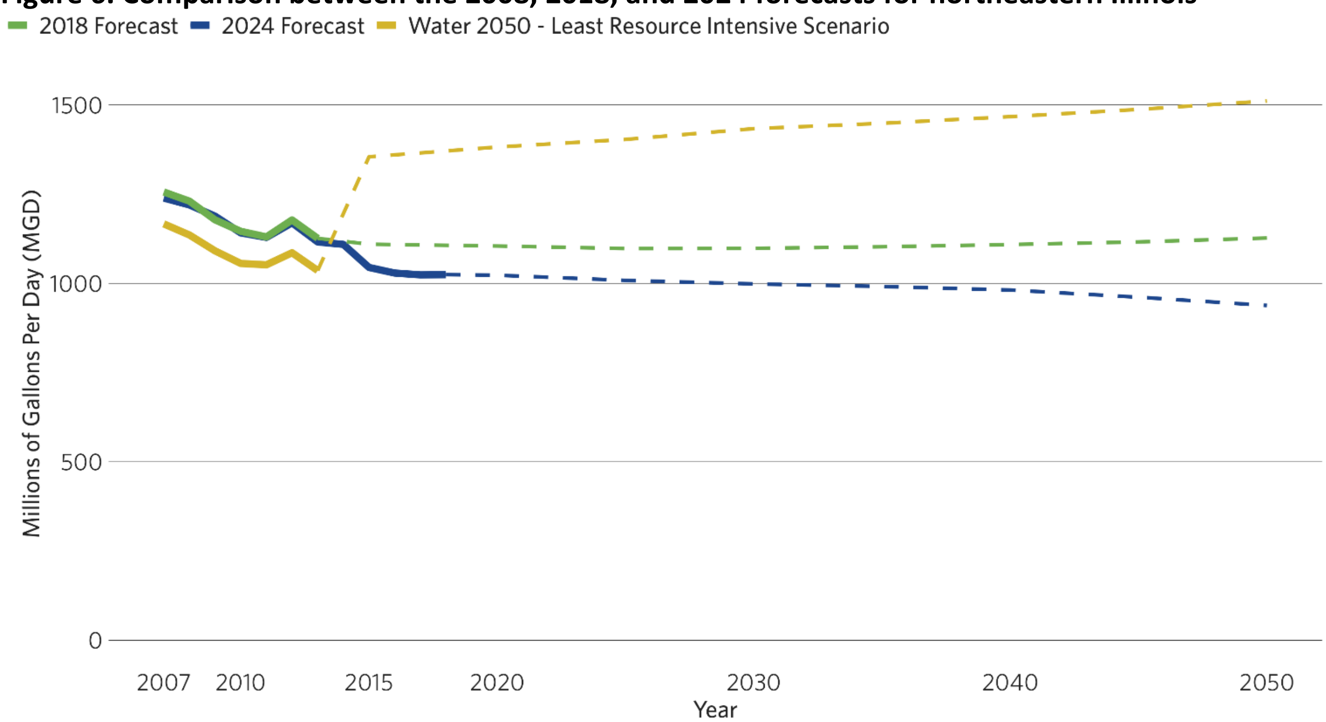
Table 4. Percent change in water demand by sector, 2018 and 2050

Sector	Total use, MGD		Percent change
	2018	2050	
Municipal PWS	924	852	-7.8%
Municipal DSS	6.2	4.7	-24.2%
II&C self-supply	55.7	56.4	1.25%
Smaller-scale PWS	23	20.2	-12.2%
Agriculture & irrigation self-supply	4	4.7	15.9%

Source: CMAP and IISG, 2024.

Figure 6 compares forecast results with past forecasting efforts in 2008 and 2018. Presented together, the forecasts reveal a common phenomenon in water demand forecasting where projections commonly anticipate higher demands than what is born out in reported withdrawal data. This indicates higher water conservation and efficiency trends or other factors that reduce demand at work that are not being captured by the forecast methodology. Differences in reported water withdrawals between the 2008 forecast and those more recently completed in 2018 and 2024 can be attributed to improvements in water data reporting and data processing differences. For example, the 2008 forecast did not include each municipal system.

Figure 6. Comparison between the 2008, 2018, and 2024 forecasts for northeastern Illinois



Note: The 2008 forecast represents the Least Resource Intensive scenario and only presents values for the 7-county region.

Source: Dziegielewski and Chowdhury, 2008; CMAP and IISG, 2018; CMAP and IISG, 2024.

Comparing demand to sustainable supply

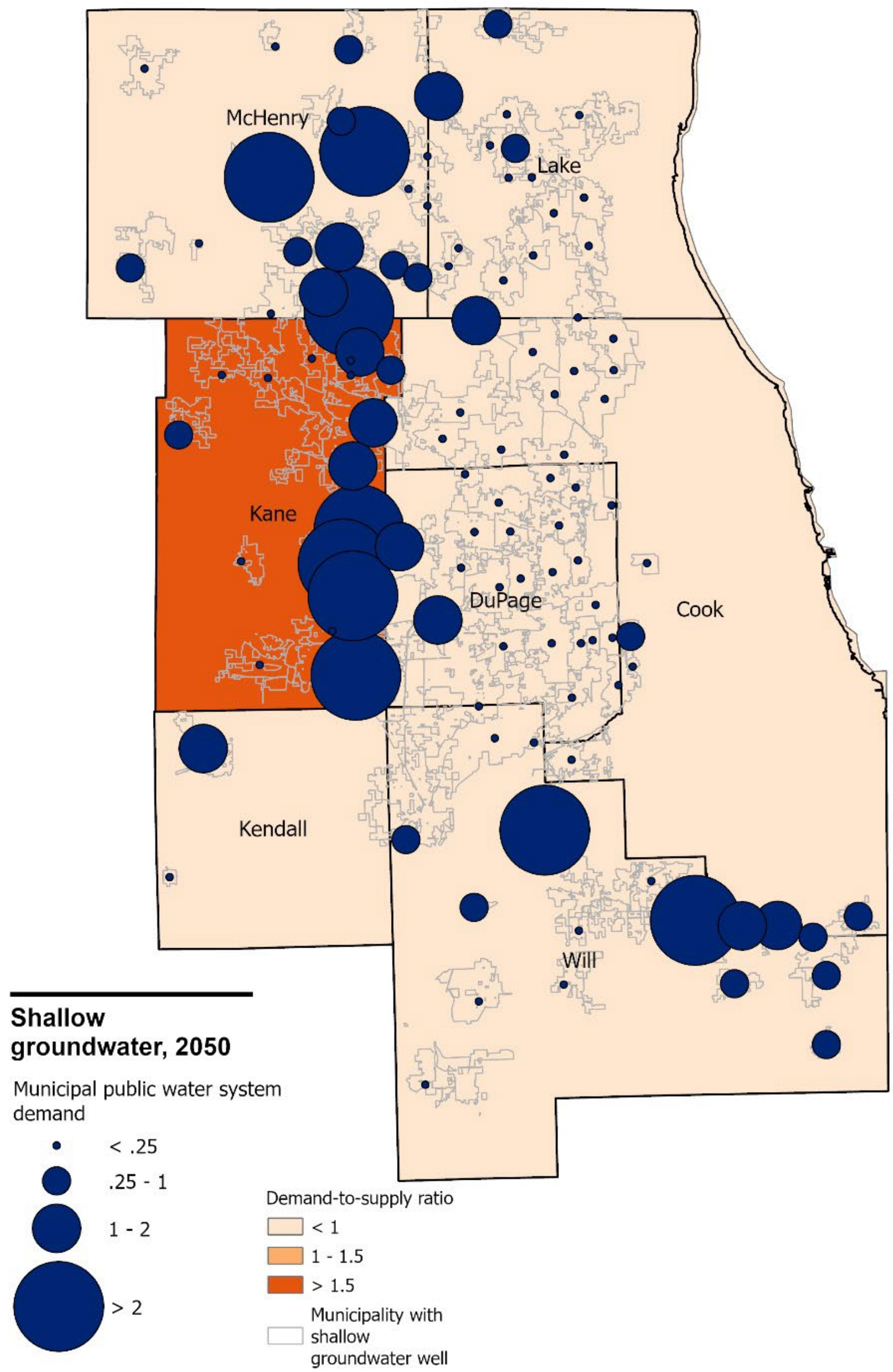
The Illinois State Water Survey has developed sustainable supply values for each water source in the state. For groundwater, these values estimate the annual amount of water that can be pumped without causing further desaturation of sandstone aquifers or harming aquatic ecosystems due to reduced shallow groundwater discharges to streams. Provided at the county level, this data allows the regional water demand forecast to identify areas where water demand is expected to exceed available sustainable supplies of water over the long term.

CMAP calculated demand-to-sustainable supply ratios for shallow and sandstone groundwater sources (Figures 7 and 8), and the extent to which county water demand is expected to exceed available supply by 2050 (Table 5). Ratios greater than one mean that demand surpasses the sustainable yield estimates. While the sustainable supply estimates will continue to advance and incorporate water quality, drought, and other seasonality issues, the demand-to-sustainable supply ratios give the region insights into the scale of action needed to maintain a long-term supply. Table 5 provides estimates of how much demand should be reduced within each county so that total demands remain within sustainable supply estimates. Further study could help illuminate where reductions are needed most within a county and identify water quality or seasonality constraints that could further refine these values.

Table 5. Demand exceedances in shallow and sandstone sources by county, 2050

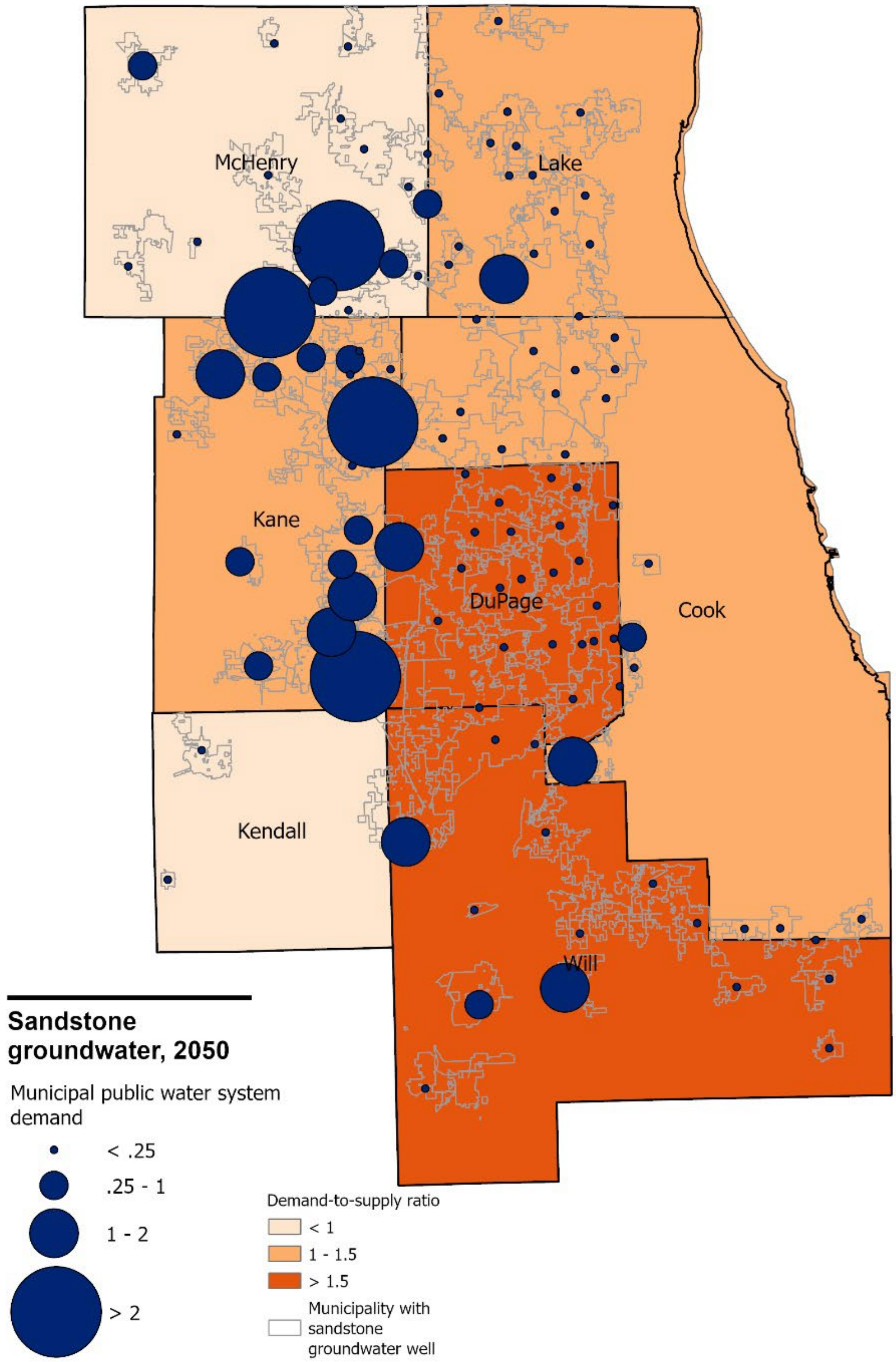
County	Reduction needed (MGD)
Cook	0.54
DuPage	2.44
Kane	12.59
Kendall	-
Lake	0.11
McHenry	-
Will	4.02
Total	**19.71**

Figure 7. Demand-to-sustainable supply ratio for shallow groundwater, 2050



Source: CMAP and IISG, 2024.

Figure 8. Demand-to-sustainable supply ratio for sandstone groundwater, 2050



Source: CMAP and IISG, 2024.

Methodology

Developing a regional water demand forecast requires organizing and preparing data on water withdrawals, population, employment, and a variety of independent variables. This section describes the forecast type, the data collection and preparation process for the inputs into the forecasts, and the forecasts for each of the sectors.

Forecast type

Two forecast methods were used for each of the sector forecasts, with variations to reflect unique characteristics of each sector. This section describes how the reference and conservation forecasts are derived. The horizon for all forecasts is a 30-year projection (every 5 years from 2020-50), which aligns with the 2022 Socioeconomic Forecast for 2050.

Reference forecast

The reference forecast assumes that base year unit use — measured in gallons per capita per day (GPCD), gallons per employee per day (GPED), or gallons per acre per day (GPAD) — remains constant over time. As a result, changes in water demand are driven solely by shifts in population, employment, or acreage. This approach isolates the effects of these factors and incorporates the assumptions contained in the 2022 Socioeconomic Forecast.

By holding unit water use constant, this forecast provides a reference for comparing scenarios that include additional demand drivers beyond population and employment. It assumes no future gains in water conservation or efficiency.

The method applies fixed unit use rates, as shown in Table 6, where *t* is the forecasting year.

Table 6. Reference forecast equations by sector

Sector	MGD, year *t*
Municipal PWS	Population served_t* GPCD_{2018}
Municipal DSS	Population served_t* $\text{GPCD}_{2018\ \text{estimate}}$
Smaller-scale PWS	Population served_t* GPCD_{2010}
II&C self-supply	Employment served_t* GPED_{2010}
Agriculture and irrigation self-supply	Acreage served_t* GPAD_{2010}

Source: CMAP and IISG, 2024.

Conservation forecast

In addition to the reference forecast, a conservation-based model was developed to account for overarching trends in water conservation and efficiency. Unlike the reference forecast, this model relaxes the assumption of fixed unit use and incorporates an annual percentage reduction in unit use to reflect conservation trends.

Determining the existing and potential future conservation rates for each sector is complicated by a lack of recent, regionally-focused research; data limitations; and variation in water use within each sector. The project team relied on previous research that informed the 2018 regional water demand forecast, which resulted in the selection of a trend that reduced unit use by approximately 0.7 percent annually. That work was informed by a 2009 study, *Residential Water Use in Northeastern Illinois, Estimating Water-use Effects of In-fill Growth versus Exurban Expansion*, which found that average residential water use (measured in GPCD) declined by approximately 0.7 percent annually from 1990 to 2005.[5] This historical rate captures the combined effects of all factors influencing residential water use. National initiatives such as the Energy Policy Act of 1992 and the U.S. EPA's WaterSense program have significantly contributed to these declines.[6]

According to the Water Resource Foundation's Residential End Uses of Water Study V2 (REU2016), average residential indoor water use dropped from 69.3 GPCD in 1999 to 58.6 GPCD in 2016 — a 15 percent reduction — primarily due to more efficient fixtures and appliances. As noted in the 2018 demand forecast, achieving full adoption of currently available water-efficient technologies could reduce indoor residential water use to between 30 and 40 GPCD.[7]

The advisory committee discussed how to account for conservation trends, acknowledging the many factors that could influence the rate of water use reduction in the future. A key consideration was the significant differences between residential and non-residential water use. Non-residential sectors encompass a range of activities including manufacturing, office operations, entertainment, hospitality, healthcare, park districts, golf courses, and agricultural irrigation. Each sector is influenced by unique economic, technological, and behavioral forces.

Several trends could shape future conservation rates, including:

- **Technological advancements**: The pace and adoption of water-saving technologies, which vary significantly across sectors and subsectors.
- **National water scarcity:** Growing awareness and market shifts driven by water scarcity may accelerate the availability and adoption of efficient fixtures and practices.
- **Climate change:** More frequent and severe droughts, increased precipitation, and extreme heat could increase water demand and potentially necessitate greater conservation efforts.
- **Industrial growth or decline:** Fluctuations in high-water-use industries, like data centers, could significantly impact overall demand.
- **Lead service line replacement:** Large-scale infrastructure upgrades could reduce water loss by replacing outdated pipes. Water cost increases, either through water or energy pricing.
- **Rising costs:** Increases in water or energy pricing may drive greater conservation efforts across all sectors.

- **Water reuse policy changes**: Regulatory or incentive-based policies could increase the adoption of water reuse, which will likely vary significantly across sectors and subsectors.

To reflect the variation and uncertainty in water conservation and efficiency trends, two conservation forecasts were developed and applied to each sector. The method applies unit use rates in the forecasting equations, as shown in Table 7, where *t* and *n* represent years. The conservation rates appear in Table 8.

- **Current conservation forecast:** Assumes the historic 0.7 percent annual reduction in unit use continues unchanged through 2050
- **High conservation forecast:** Assumes conservation efforts intensify, increasing the annual reduction rate by 50 percent linearly to 1.05 percent by 2050

Table 7. Conservation forecast equations by sector

Sector	MGD, year *t*	Adjusted unit use, from year *t* to year *n*
Municipal PWS	Population served$_t$* Adjusted GPCD$_t$	Adjusted GPCD$_t$ = GPCD$_{(n)}$* (1 - Annual Conservation Rate)^(*t*-*n*)
Municipal DSS	Population served$_t$* Adjusted GPCD$_t$	Adjusted GPCD$_t$ = GPCD$_{(n)}$* (1 - Annual Conservation Rate)^(*t*-*n*)
Smaller-scale PWS	Population served$_t$* Adjusted GPCD$_t$	Adjusted GPCD$_t$ = GPCD$_{(n)}$* (1 - Annual Conservation Rate)^(t-n)
II&C self-supply	Employment served$_t$*Adjusted GPED$_t$	Adjusted GPED$_t$ = GPED$_{(n)}$* (1 - Annual Conservation Rate)^(*t*-*n*)
Agriculture and irrigation self-supply	Acreage served$_t$*Adjusted GPAD$_t$	Adjusted GPAD$_t$ = GPAD$_{(n)}$* (1 - Annual Conservation Rate)^(*t*-*n*)

Source: CMAP and IISG, 2024.

Table 8. Annual conservation rates by forecast type

Year	Reference	Current conservation	High conservation	
			Base year 2010	Base year 2018
2010	0%	-0.7%	-0.7%	*n/a*
2018		-0.7%	-0.77%	-0.7%
2020		-0.7%	-0.78%	-0.74%
2035		-0.7%	-0.93%	-0.88%
2050		-0.7%	-1.05%	-1.05%

Source: CMAP and IISG, 2024.

Water withdrawal data collection and processing

This section provides details on data sources, sector and spatial assignment, water data processing, and municipal source switching.

Data sources

The forecast is based on annual water withdrawal data associated with the PWS and industrial, institutional, irrigation, and commercial self-supply available through the Illinois Water Inventory Program (IWIP) of the Illinois State Water Survey and the Lake Michigan Allocation program, a division of Illinois Department of Natural Resources (IDNR). All IWIP and IDNR data is self-reported by the facility operator.

For the PWS, the IWIP annual data on water withdrawals, well type, [8] aquifer codes[9] for groundwater withdrawals, purchase network for wholesale distribution, and the name, address, and identification number of facilities and associated wells and intakes (points) with coordinates[10] and identification number. The IDNR's Lake Michigan Allocation Program collects annual data on water withdrawals for the PWS and other permittees via the annual water use audit form, called the LMO-2 collected through the Lake Michigan Allocation Program. The LMO-2 data includes annual data on water withdrawals, water source, purchase network for wholesale distribution, permittee names, and service population. The ISWS also reviews IWIP data against data collected through the Lake Michigan Allocation Program; some, but not all Lake Michigan permittees also report annual data to the IWIP.

Industrial, institutional, irrigation and commercial self-supply facilities that can withdraw at least 100,000 gallons per day are required to report annual water withdrawals to the IWIP. The IWIP collects annual volumes, well type, aquifer codes for groundwater withdrawals, and the name, address, and identification number of facilities and associated wells and intakes (points) with coordinates and identification number. In addition, the ISWS removes extreme outliers and conducts other interpretations in the self-reported data through a variety of steps.[11]

Sector assignment

The project team used a variety of methods to assign facilities to one of the five sectors of the forecast (Table 9). The PWS are facilities that are publicly- or privately-owned that serve at least 25 people or maintain 15 residential service connections and are identified in IWIP data by well type.[12] The PWS serves municipalities as well as smaller-scale private entities, like individual subdivisions and mobile home parks. Two distinct sectors are needed as these systems are managed differently.

Service area boundaries are not collected by any state entity currently, which makes it difficult to distinguish between municipal and smaller-scale PWS. In the absence of service area boundaries, the project team identified municipalities where most of the population is likely being served by a single public water system. The project team relied on data from the previous forecast in 2018,[13] public and private water utility service boundaries,[14] municipal, commission, or wholesaler websites, IEPA's Drinking Water Watch, and other sources to determine whether a given facility was a municipal-scale or a smaller-scale public water system. Smaller-scale PWS are facilities that typically serve subdivisions, mobile home parks, schools, and other mostly residential areas.

Table 9. Sector description and data used to categorize facilities by sector

Sector	Description	Categorization data sources
Municipal PWS	Public or private water systems serving most of a municipality	IWIP well type code, IEPA Drinking Water Watch, 2018 Regional Water Demand Forecast, private water utility service boundaries, and municipal, commission, or wholesaler websites
Municipal DSS	Municipalities without centralized water systems, where residents and businesses use lower capacity wells not subject to annual reporting requirements	Remaining 31 municipalities without a public water supply
II&C self-supply	Private high-capacity wells or intakes for industrial, institutional, and commercial uses	IWIP well type code, plus CMAP inferred designation by facility name for purchase network only facilities. The IWIP power generation code and EIA data on electricity generators were used to remove facilities associated with power generation from this sector.
Smaller-scale PWS	Private water systems that serve at least 25 people or 15 connections	IWIP well type code, IWIP well type code, private water utility service boundaries, and municipal, commission, or wholesaler websites
Agriculture & irrigation self-supply	Private high-capacity wells or intakes for agriculture and irrigation purposes	IWIP well type code flagging irrigation, UrbanSim building type

Source: CMAP and IISG, 2024.

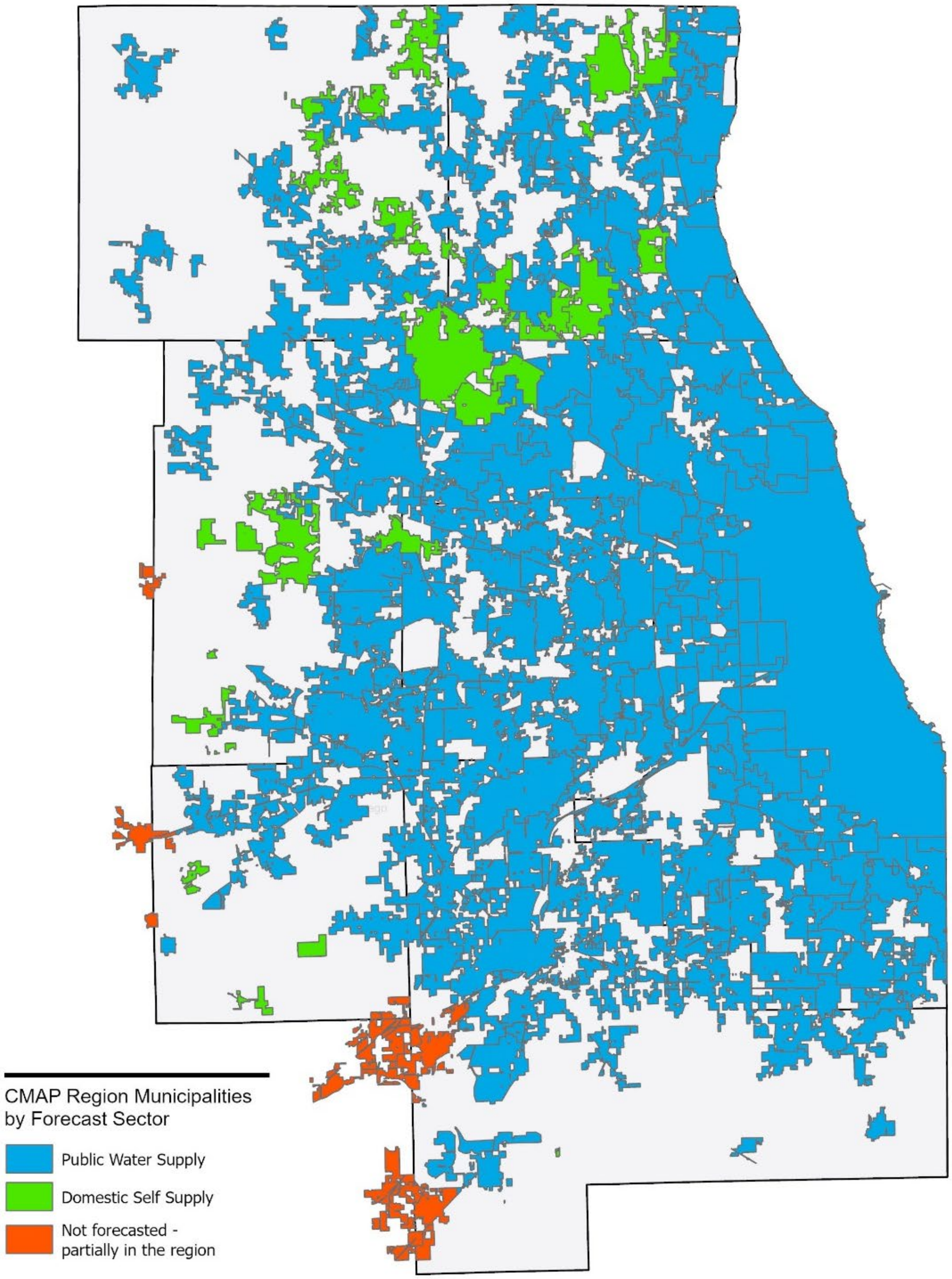
The CMAP region has 284 municipalities. In the end, 243 municipalities were identified as having a municipal-scale PWS system and were included in the municipal PWS sector, and 31 municipalities were identified as relying on private residential wells and were included in the municipal DSS sector.[15] The remaining 10 municipalities are on known water systems, but due to data limitations, they are unable to be forecasted (Figure 9). An additional 174 facilities were identified for the smaller-scale PWS sector.

Industrial, institutional, and commercial self-supply are identified in IWIP data by well type and the project team used this designation to assign facilities to this II&C sector.[16] IWIP data provides an irrigation flag that was used to filter out agriculture and irrigation facilities.

Additional facilities were added to this sector using land use information — agriculture or other civic/cultural/recreation — derived from the UrbanSim model. Additional facilities relying only on purchased water were also identified for this sector by inferring their sector by name.

To separate facilities either generating electricity for their own internal processes or distributing it to the electric grid, the project team reviewed IWIP data[17] and data from the U.S. Energy Information Administration on electricity generators to categorize this sector.[18] Eighteen facilities were identified for the power generation sector, with 12 facilities involved in direct power distribution, two facilities involved in large scale cooling systems, and four facilities in the III&C sector with surface water withdrawals identified.[19] These facilities were removed from the II&C sector, see limitations section below. In the end, 424 facilities were identified for the II&C and agriculture and irrigation sector, however, not all are used to derive unit use calculations.

Figure 9. Municipalities by water system type



Source: CMAP and IISG, 2024.

Spatial assignment

With the facilities categorized by sector, the project team worked to locate the facilities geographically to better understand their service areas. In order to connect II&C and agriculture and irrigation facilities to parcels in CMAP's land use model, the project team performed a series of spatial overlay processes using the facility address, well and intake coordinates, and proximity analyses to identify parcels with similar land owner names and land use types and then manually reviewed to confirm.[20] Smaller-scale PWS systems were located in a similar fashion, however, these facilities are more likely to serve a larger number of parcels and additional datasets were needed, including private utility and county water system service areas, the Northeastern Illinois Development Database, and individual county subdivision files.[21] Municipal PWS systems were primarily located via facility name matching with some exceptions.[22]

The project team used the base year (2010) parcel file for the UrbanSim land use model to assign each of the over 2 million parcels in the region to a facility. This was done using 2021 municipal boundaries, which were assigned to either the municipal PWS or municipal DSS, and the parcel assignments for the II&C self-supply, smaller-scale public water supply, and agriculture and irrigation self-supply.[23] All remaining parcels are assumed to be on their own private wells and are associated with the broader domestic self-supply sector that is not incorporated in the forecast.

The output of the spatial assignment is a sector geography geodatabase that contains feature classes for each sector. Every parcel in the region is assigned a sector, and where appropriate, a specific facility.

Purchase network

The project team then used the IWIP purchase network data to connect purchased water to facility geographies. Most of the facilities in this dataset consist of municipal PWS systems or water commissions that supply water to multiple municipal PWS. The purchase network data required interpretations by the project team.[24] Where available, Lake Michigan data was used instead of relying on the purchase network for transactions between two permittees or a permittee and its water commission or joint action water authority. All other transactions from the purchase network were added or subtracted from the data to arrive at a final volume per facility.

Annual water withdrawals

Using IWIP staff guidance, the project team made informed assumptions on when a facility might have opened or closed during the study period and interpolated and forward and backward filled to develop a more complete dataset.[25] With LMO-2 data, the project team used the same IWIP assumptions on when a facility might have opened or closed during the study period and interpolated and forward and backward filled to develop a more complete dataset.

Understanding future water demand by county is an important output of the regional water demand forecast. The II&C, smaller-scale PWS, and agriculture and irrigation self-supply sector withdrawals were assigned a county geography based on the location signified by the facility identification number.[26] While most municipalities in the region exist entirely within one county, several communities straddle more than one county with significant demands on either side of the county line. To assign water withdrawals to a county for these municipalities, a proportion of the use was assigned to the respective county based on the location of population within each municipality.

Water sources

Understanding water demand by source is a critical element of the regional water demand forecast. Water source information is provided in the IWIP point data via a well type code and an aquifer code.[27,28] Lake Michigan permittees are generally on Lake Michigan, though some permittees who are in the process of transitioning to lake water support their withdrawals from other sources. IWIP data does not contain the name of the source waters; therefore, CMAP assigned surface water sources based on proximity-based GIS analysis.[29] Surface water-based facilities that lacked coordinate data were manually assigned based on internet research to identify the location. For groundwater-based facilities composed of multiple wells and where some wells lacked source information, CMAP assigned the dominant aquifer code of the known wells to the missing data. For groundwater-based facilities composed of a single well with no aquifer code, these sources were manually assigned based on the dominant water source of nearby, unrelated wells.

The forecast relies on withdrawal totals at the facility level, not the well/intake data, because the facility data has undergone more extensive ISWS review. Therefore, the proportion of use by water source was derived from the point data and then the percentage was applied to facility level withdrawal totals. Some facilities rely on more than one water source and the proportion coming from each source can vary over time due to a variety of factors, including weather and infrastructure maintenance. To account for these variations, an average source mix from five years of data (2013-18) was generated to project out future water demand by source.[30] Municipal PWS were reviewed for any dramatic proportional changes within annual data (2013-18). Permanent source switching in smaller-scale PWS or industrial and commercial self-supply is not accounted for in this methodology.

For the municipal DSS sector, with no reported water withdrawals, average source mix ratios of sandstone and shallow groundwater sources were determined in a two-step process. First, supplemental data from the ISWS[31] was used to determine the presence of sources within a municipality. If a municipality uses both sandstone aquifers and shallow groundwater sources, a ratio was assigned based on the average source mix of nearby municipalities. If no municipality on a known system is near the domestic self-supply municipality, a county average was assigned.

The forecast assumes that communities and facilities will continue to rely on their current source (Figure 3), unless they have taken official actions to change supplies. With the help of the advisory committee, 16 forecasted municipalities were identified with plans to switch sources during the forecast period. For these communities, the average source mix from 2013-2018 is not used after the source change is project to have occurred and it is replaced with an assumption that they are entirely on their new source. Table 10 provides a list of communities and when they are switching sources, either to Lake Michigan or the Kankakee River. Once the source mix was derived, it was applied to forecasted volumes to generate water demand by source.

Table 10. Municipal PWS water source changes anticipated during forecast period

Future Source	Year	Municipalities
Lake Michigan	2020	Bartlett, Lake Villa, Lindenhurst, Volo, Wauconda
	2030	Channahon, Crest Hill, Joliet, Minooka, Oswego, Romeoville, Shorewood, Yorkville
	2035	Montgomery
Kankakee River	2020	University Park, Peotone

Note: Lake Zurich is also projected to switch to Lake Michigan by 2028. However, this source switch was discovered by the project team late in the process and is not yet accounted for in the forecast.

Source: CMAP and IISG, 2024.

Demand factor data collection and processing

This section steps through the data collection and processing methods to prepare the input data for forecasting. To calculate historical and future unit use of water for each sector, historical population, employment, and acreage data is needed for each facility in our region for the forecast base year and all future years. The majority of our input data is derived from the Census or CMAP's forecasting efforts.

Past population and employment data

CMAP's 2022 Socioeconomic Forecast provides 2010 population and employment at the facility level for all facilities. To supplement this data, the U.S. Census and American Community Survey were used to provide population served values for each municipality.[32] Municipal population came from the U.S. Census for 2007 and 2010 and the American Community Survey 5-year estimates for 2005-09 through 2012-18. The Census data were adjusted to account for the population serviced by non-municipal sectors within the municipal boundaries, based on the UrbanSim facility level data.[33]

Future population and employment data

Projected population, employment, and land use information from CMAP's Socioeconomic Forecast released with the 2022 ON TO 2050 plan update is a core data input. The U.S. Census data used for the past population and employment data is the same source used by the forecast for input demographic data to generate their future population and employment values. By using the same input data source for both past and future data, the historical population and employment used in this forecast is well calibrated to the future demographic data.

CMAP's Socioeconomic Forecast estimates the characteristics of the seven-county Chicago metropolitan region's population and employment in 2050.[34] The forecast estimates the age distribution, race/ethnicity, household size, and similar factors for residents, as well projecting employment by sector in five-year intervals (2015-50). Overall, the forecast projects that the region will continue to grow, despite slow growth. By 2050, the region will have just over 10 million residents compared with 8.6 million in 2020. Employment will be about 4.8 million, growing from 4.18 million in 2020. More information on the methodology can be found in the Socioeconomic Forecast Appendix.[35]

CMAP's land use microsimulation model, UrbanSim, provides population and employment data at the parcel level for each of the forecast years. Using the sector geography and UrbanSim population estimates by parcel for each year of the forecast (2020, 2025, 2030, 2035, 2040, 2045, and 2050), the population of parcels served by each sector was generated.

The projected population and employment were then assigned to one of sectors. A number of assumptions were made based on which facility was likely to service this new growth (Table 11). All existing municipal PWS were assumed to continue to provide service in the future and that they would serve any population and employment change that occurred within their 2021 municipal boundary in future forecast years.[36] All municipalities without an existing public water system were assumed to continue with the use of private wells during the forecast period and no new municipal PWS were added. Similarly, all existing smaller-scale PWS were assumed to continue to provide service during the forecast period. New residential development, and corresponding population, that occurs outside of the existing 2021 municipal boundaries is assumed to be served by a new, smaller-scale PWS systems, versus domestic self-supply.[37] The II&C sector is assumed to be composed of the existing facilities, with no closures. New employment that is added outside of the 2021 municipal boundaries is added to this sector. Finally, CMAP's UrbanSim land use model does not project new development in the land use categories associated with the agriculture and irrigation sector: agriculture and other civic/cultural/recreation. Therefore, this sector is assumed to be composed of the existing facilities, with no closures and no new facilities constructed.

Table 11. Socioeconomic forecast assignments by sector

Sector	Socioeconomic forecast assignment assumptions
Municipal PWS Municipal DSS	All existing facilities are assumed to continue in the future. Any population or employment change within the 2021 municipal PWS or DSS boundary.
Smaller-scale PWS	All existing facilities are assumed to continue in the future. Any population change outside of 2021 municipal PWS or DSS boundary.
II&C self-supply	All existing facilities are assumed to continue in the future. Any employment change outside of 2021 municipal PWS or DSS boundary.
Agriculture and irrigation	All existing facilities are assumed to continue in the future. No new facilities are assumed to be created with new development.

Source: CMAP and IISG, 2024.

Base year selection

The base year for unit use forecasts varies by water sector, depending on the quality of available input data and the weather conditions in a given year. For municipal PWS and municipal DSS sectors, 2018 was selected as the base year because it represents the most recent water withdrawal data available from the IWIP and the Lake Michigan Allocation Office, and population values can be obtained for all historical data years. In contrast, 2010 was used as the base year for other sectors, aligning with CMAP's UrbanSim model, which provides facility level employment and population data. CMAP staff reviewed historical climate data from the ISWS's Climatologist Office to confirm that both 2010 and 2018 represent weather-normal years.

Sector forecasts

This section details the unique assumptions and methodological steps taken to analyze historic and future water use for each sector. These reported and forecasted results apply to a subset of municipalities or facilities in the region (Table 1).

Municipal public water supply

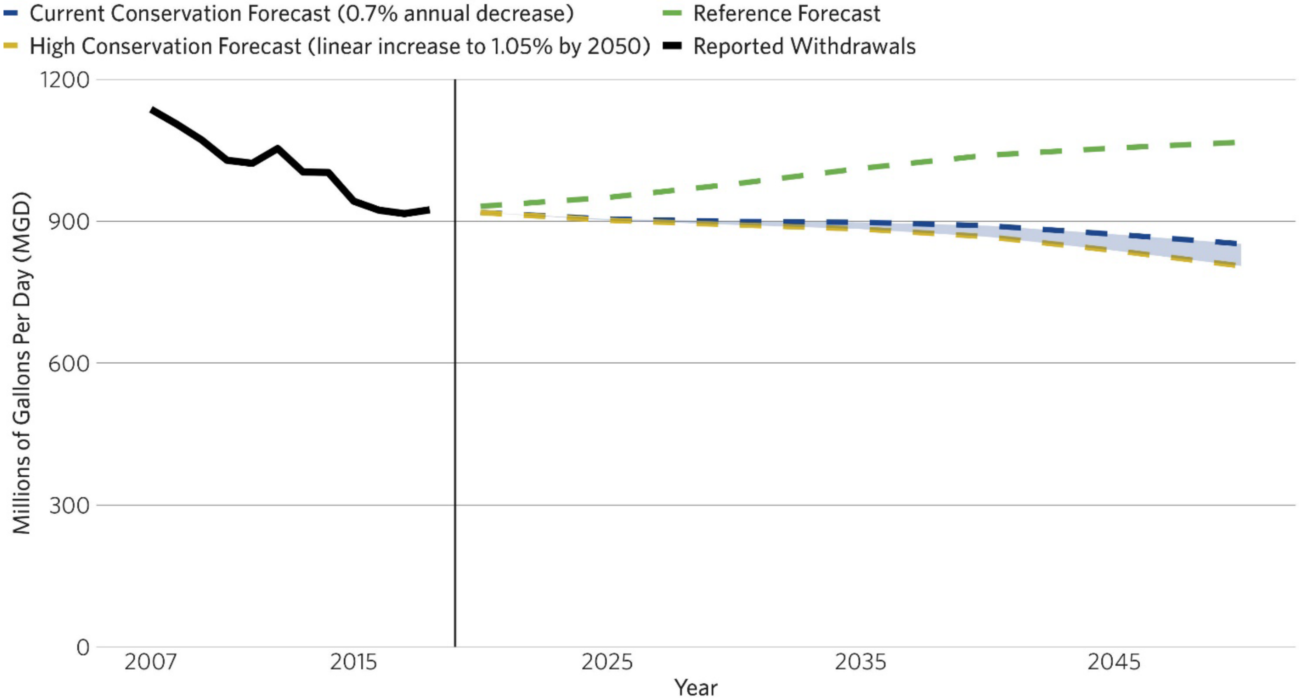
For this sector, water unit use is calculated as gallons per capita per day (GPCD) with a base year of 2018. GPCD is calculated at the municipal level by dividing the total reported water withdrawals for the sector in 2018 by the total employment of the facilities within each county.

The reference and conservation forecasts were applied to future municipal population for this sector. All existing municipal boundaries are assumed to remain the same. In addition, any new population that occurs outside of municipal service areas is assigned to the smaller-scale PWS sector. The future municipal population estimates are derived using the CMAP UrbanSim model. Water use associated with employment within municipal PWS systems is embedded in these results.

Municipal population is expected to increase by approximately 1 million residents between 2018 and 2050, which would lead to an increase of water use in our region under the reference forecast; however, with anticipated conservation and efficiency trends continuing in the future, municipal water use is expected to decrease by about 7.8 percent by 2050 based on the current conservation forecast (Figure 10). This water reduction occurs despite an increase in regional population because the conservation rate reduces unit use by about 23 GPCD by 2050 (Table 12).

The GPCD is forecasted at the municipal PWS geography, so the conservation rate decreases the GPCD at the same rate over time for all municipalities. Despite this, counties that experience more than 15 percent growth in population are expected to have increased total water use in the future. Kane, Kendall, McHenry, and Will counties are expected to increase total water use 2-20 percent by 2050. Cook, DuPage, and Lake counties are expected to decrease water use 9-13 percent by 2050.

Figure 10. Municipal public water supply by forecast type



Source: CMAP and IISG, 2024.

Table 12. Municipal public water supply summary

	GPCD		MGD			Population		
County	2018	2050 current conservation	2018	2050 current conservation	Change	2018	2050	Change
Cook	129.5	105.2	665.0	604.0	-9.2%	5,138,756	5,743,408	+11.2%
DuPage	93.2	74.5	77.0	66.4	-13.8%	825,865	891,354	+7.9%
Kane	94.7	77.9	42.6	43.8	+2.8%	449,651	562,322	+25.1%
Kendall	84.6	66.7	8.2	9.7	+18.3%	96,359	145,122	+50.6%
Lake	92.9	74.8	54.6	49.1	-10.1%	588,368	656,892	+11.6%
McHenry	83.5	67.0	19.0	19.3	+1.6%	227,084	288,258	+26.9%
Will	100.6	80.3	57.2	59.9	+4.7%	568,844	746,203	+31.2%
Region	117.0	94.3	924.0	852.2	-7.8%	7,894,926	9,033,559	+14.4%

Source: CMAP and IISG, 2024.

Municipal domestic self-supply

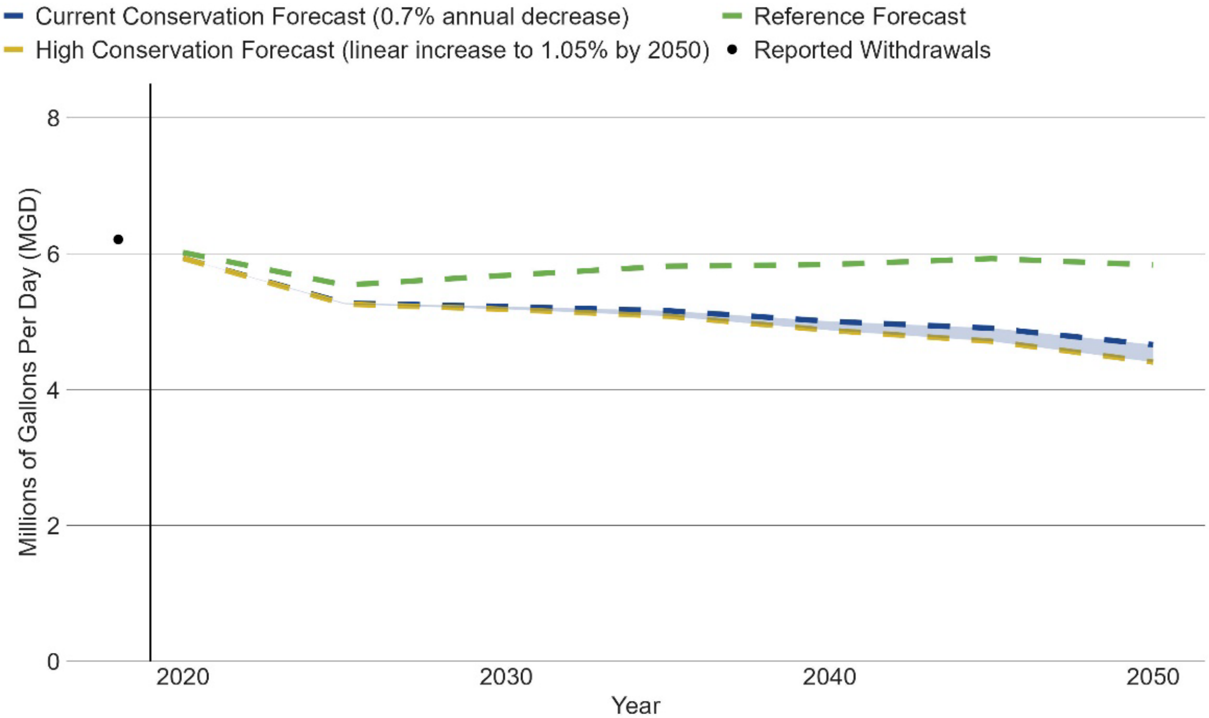
For this sector, water unit use is calculated as gallons per capita per day (GPCD) with a base year of 2018. The GPCD is estimated at the municipal level based on nearby municipalities on known PWS systems.[38] If no municipality with a PWS is near the domestic self-supply municipality, then the county average GPCD from the municipal sector, excluding extreme values, was assigned for 2018 GPCD.

The reference and conservation forecasts were applied to future municipal population for this sector. All 2021 municipal boundaries are assumed to remain the same. In addition, any new population that occurs outside of municipal service areas is assigned to the smaller-scale PWS sector. The future municipal population estimates are derived using the CMAP UrbanSim model. Water use associated with employment within municipal PWS systems is embedded in these results.

The population of municipalities on domestic self-supply wells is expected to decrease by about 4,000 residents between 2018 and 2050. Coupled with the conservation that is occurring in the region, municipal DSS water use is expected to decrease by approximately 25 percent by 2050 in the current conservation forecast (Figure 11). This reduction in 1.5 MGD by 2050 reflects a reduction in unit use over time from 93.1 to 73.6 GPCD (Table 13).

Water use decreases across all counties, but the magnitude of the reduction in water use by county is dependent on the changes in population at the municipal level. DuPage, Kane, Kendall, and McHenry counties are anticipated to increase in population by 2050, while Cook, Lake, and Will counties decrease. DuPage County experiences the smallest proportional decrease in water use, 8.1 percent, which reflects that this county has the highest proportional change in population, a 15.2 percent increase. Conversely, Cook County has the highest proportional decrease in water use, 42.8 percent, which reflects that this county has the smallest proportional change in population, a 26.5 percent decrease.

Figure 11. Municipal DSS by forecast type



Source: CMAP and IISG, 2024.

Table 13. Municipal DSS summary, where *i* is the number of full municipalities in the county and *j* is the number of municipalities partially in the county

County *(i,j)*	GPCD		MGD			Population		
	2018	2050 current conservation	2018	2050 current conservation	Change	2018	2050	Change
Cook *(2,2)*	96.7	76.3	1.4	0.8	-42.8%	14,079	10,350	-26.5%
DuPage *(1,0)*	98.6	78.8	0.1	0.1	-8.1%	948	1,092	+15.2%
Kane *(5,2)*	86.2	69.0	1.2	1.0	-18.0%	13,903	14,228	+2.3%
Kendall *(3,0)*	86.3	68.9	0.1	0.1	-15.7%	794	838	+5.5%
Lake *(8,3)*	91.6	72.9	2.1	1.6	-21.8%	22,441	22,050	-1.7%
McHenry *(8,2)*	98.5	77.3	1.4	1.1	-26.0%	14,425	14,604	+1.2%
Will *(1,0)*	93.5	74.7	<0.01	<0.01	-25.4%	121	113	-6.6%
Region *(31,0)*	93.1	73.6	6.21	4.66	-25.0%	66,712	63,274	-5.1%

Source: CMAP and IISG, 2024.

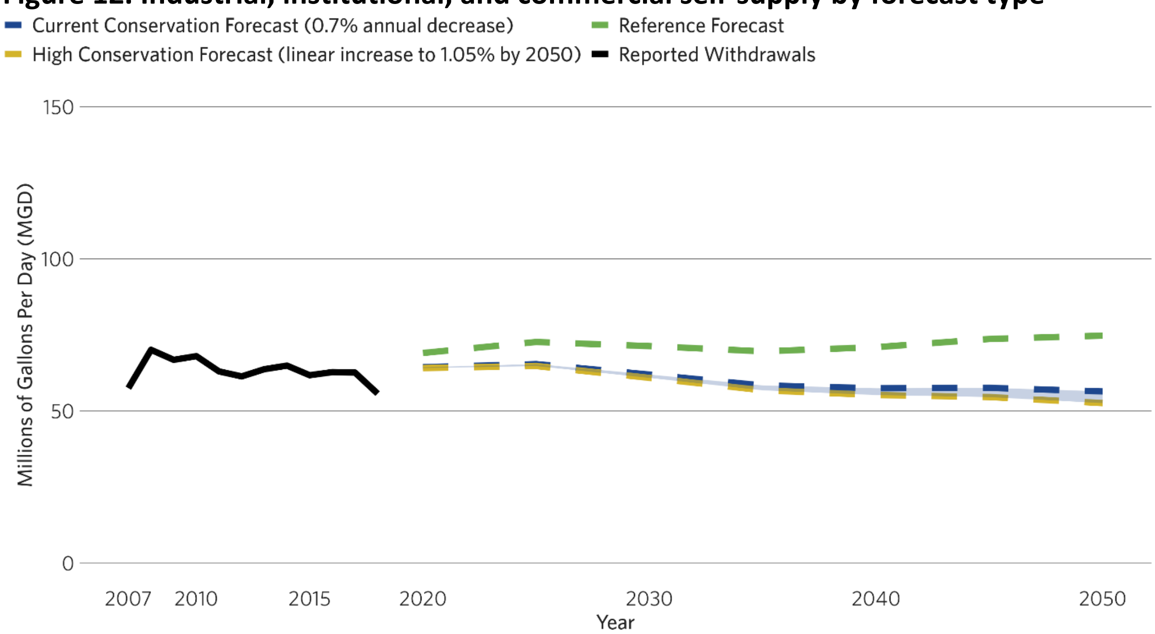
Industrial, institutional, and commercial

For this sector, water unit use is calculated as gallons per employee per day (GPED) with a base year of 2010. The GPED is calculated at the county level by dividing the total reported water withdrawals for the sector in 2010 by the total employment of the facilities within each county. The facilities that were used in the GPED calculation had to be active in the 2010 base year *and* had to be active at least one year from 2013 to 2018 to be included in the source mix.

The reference and conservation forecasts were applied to future county employment for this sector. All existing facilities are assumed to remain operational with no closures. In addition, any new employment that occurs outside of municipal service areas is assigned to this sector, representing new facilities. Using the UrbanSim model, the future county employment estimates are derived from projections for each existing facility and from employment projected *outside* of municipal service areas. As a result, total employment for this sector grows by 15 percent or 8,400 people from 2010 to 2050. Water use associated with employment within municipal PWS systems is covered in that sector's forecast.

Figure 12 illustrates reported water withdrawals alongside the reference and conservation forecasts, including the current and high conservation scenarios. Under the current conservation forecast, water use in this sector is projected to decrease by 17.4 percent between 2010 and 2050, equivalent to a reduction of 11.8 MGD. All counties are projected to experience a decline during this period, except for Will County. Will County's water demand is expected to increase by 1 percent or 0.2 MGD, due to a 45 percent increase in employment between 2010 and 2050 (Table 14).

Figure 12. Industrial, institutional, and commercial self-supply by forecast type



Source: CMAP and IISG, 2024.

Table 14. Industrial, institutional, and commercial self-supply summary

County	GPED		MGD			Employment		
	2010	2050 current conservation	2010	2050 current conservation	Change	2010	2050	Change
Cook	2398	1811	36	28	-22%	13,248	15,617	+18%
DuPage	148	112	2	1.9	-5%	13,814	16,908	+22%
Kane	362	273	1.6	1.3	-19%	4,148	4,846	+17%
Kendall	147	111	0.3	0.2	-50%	1,935	1,949	+0.7%
Lake	762	575	10.2	7.1	-30%	12,637	12,289	-3%
McHenry	555	419	2	1.6	-20%	3,513	3,781	+8%
Will	2878	2173	15.8	16	+1%	5,090	7,399	+45%
Total	N/A	N/A	67.9	56.1	-17.4%	54,385	62,789	+15%

Source: CMAP and IISG, 2024.

Smaller-scale public water supply

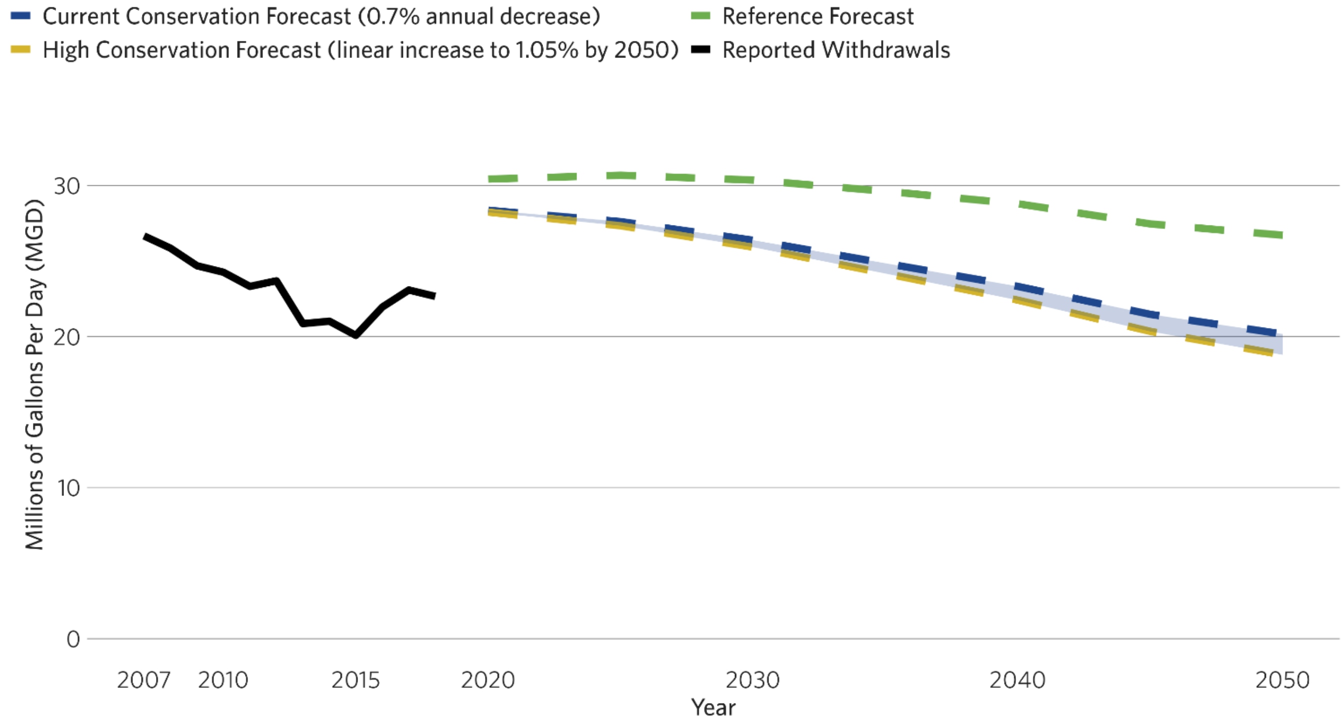
For this sector, water unit use is calculated as gallons per capita per day (GPCD) with a base year of 2010. The GPCD is calculated at the county level by dividing the total reported water withdrawals for the sector in 2010 by the total population served by these facilities within each county. The facilities that were used in the GPCD calculation had to be active in the 2010 base year *and* had to be active at least one year from 2013 to 2018 to be included in the source mix.

The reference and conservation forecasts were applied to future county populations for this sector. All existing facilities are assumed to remain operational with no closures. In addition, any new residential development that occurs outside of municipal service areas is assigned to this sector, representing new facilities. Using the UrbanSim model, the future county populations are therefore derived from population projections for each existing facility and from all residential developments projected *outside* of municipal service areas. As a result, total population for this sector grows by 12 percent or 30,000 people from 2010 to 2050.

Figure 13 illustrates reported water withdrawals alongside the reference and conservation forecasts, including the current and high conservation scenarios. Starting in the first year of the forecast (2020), forecasted values dramatically increase by about 4 MGD when compared to reported withdrawals. This is due to the new population assumed to join this sector based on projected development outside of municipal jurisdictions. While a significant portion of this population may in fact be served by domestic self-supply wells, not have enough information is available to comfortably apply the population elsewhere.

Under the current conservation forecast, water use in this sector is projected to decrease by 17 percent between 2010 and 2050, equivalent to a reduction of 4 MGD. All counties are projected to experience a decline during this period, except for McHenry County. McHenry County's water demand is expected to increase by 10 percent or 0.1 MGD, due to a 52 percent increase in population between 2010 and 2050. All counties project increases in population except for Kane County, which is projected to decrease by 1,035 people. The decrease in population in Kane County may be due to how the model reallocates households and redevelops properties. Households might move based on factors like tenure, household size, or regional opportunities, and the model may shift residential space to commercial use, reducing population while potentially increasing jobs (Table 15).

Figure 13. Smaller-scale public water supply by forecast type



Source: CMAP and IISG, 2024.

Table 15. Smaller-scale public water supply summary

County	GPCD		MGD			Population		
	2010	2050 current conservation	2010	2050 current conservation	Change	2010	2050	Change
Cook	118	89	10.0	8.3	-17%	83,929	92,585	+10%
DuPage	57	43	2.9	2.6	-10%	50,018	59,269	+18%
Kane	91	68	1.5	1.1	-27%	17,085	16,050	-6%
Kendall	66	50	0.18	0.16	-12%	2,718	3,277	+20%
Lake	132	100	6.8	5.4	-20%	50,671	53,940	+6%
McHenry	61	46	1.0	1.1	+10%	16,364	24,820	+52%
Will	83	62	2.0	1.5	-25%	24,011	24,486	+2%
Total	N/A	N/A	24.3	20.2	-17%	244,796	274,427	+12%

Source: CMAP and IISG, 2024.

Agriculture and irrigation

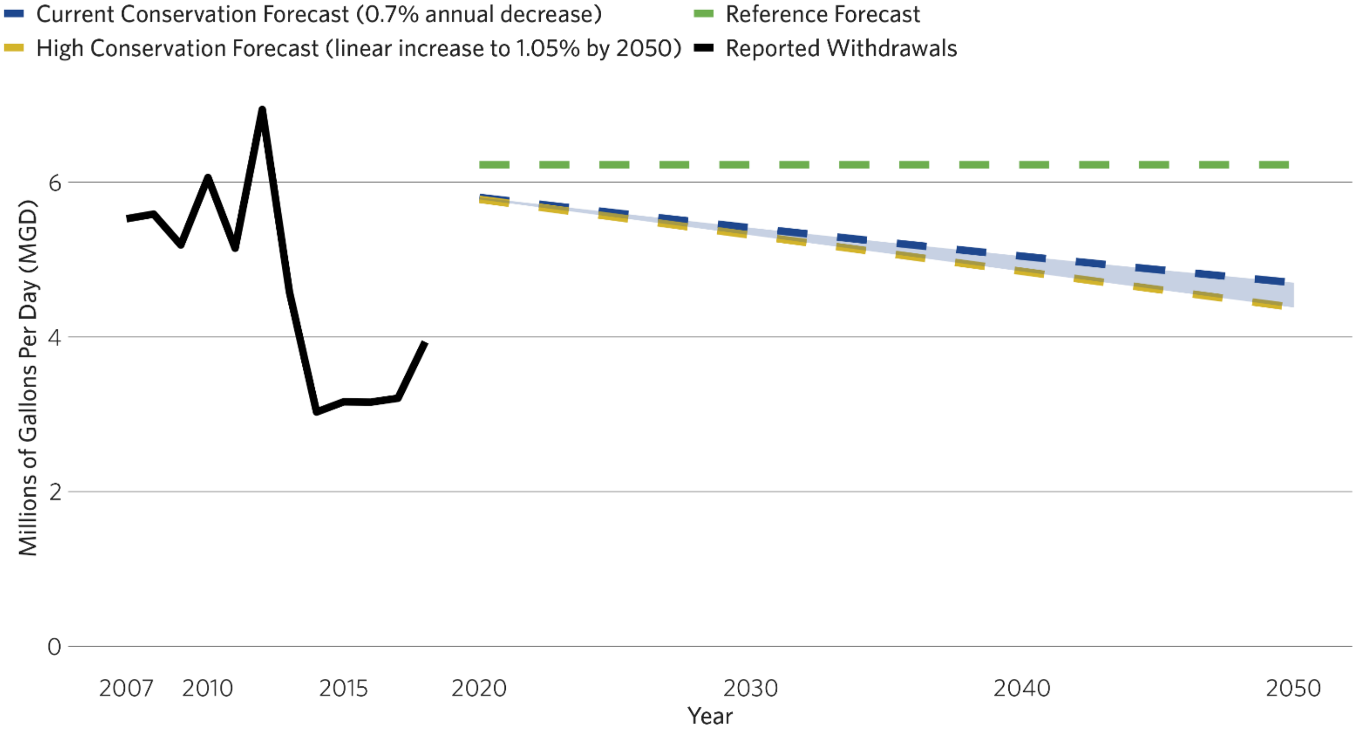
For this sector, water unit use is calculated as gallons per acre per day (GPAD) with a base year of 2010. The GPAD is calculated at the county level by dividing the total reported water withdrawals for the sector in 2010 by the total parcel acreage of facilities within each county. The facilities that were used in the GPAD calculation had to be active in the 2010 base year *and* had to be active at least one year from 2013 to 2018 to be included in the source mix.

The reference and conservation forecasts were applied to 2010 county acreages for this sector, assuming all existing facilities remain operational with no closures or new developments during the forecast period. As a result, total acreage for this sector remains constant throughout the forecast period.

Figure 14 illustrates reported water withdrawals alongside the reference and conservation forecasts, including the current and high conservation scenarios. Reported withdrawals show a sharp decline in water use starting in 2012. The exact cause of this drop is unclear but may be linked to the 2009-2010 housing recession, which slowed new development and reduced demand for sod farms and nursery production. Changes in golf course landscaping and the adoption of water conservation and efficiency measures may also have contributed to the drop. The variation in 2010 GPAD across counties may be due to the prevalence of higher water use subsectors in Cook, Kane, and McHenry counties.

Under the current conservation forecast, water use in this sector is projected to decrease by 23 percent between 2010 and 2050, equivalent to a reduction of 1.3 MGD. All counties are projected to experience a decline during this period (Table 16).

Figure 14. Agriculture and irrigation self-supply by forecast type



Source: CMAP and IISG, 2024.

Table 16. Agriculture and irrigation self-supply summary

County	GPAD		MGD			Acreage
	2010	2050 current conservation	2010	2050 current conservation	Change	2010
Cook	432	327	1.7	1.3	-24%	3,877
DuPage	146	113	1.0	0.8	-25%	6,874
Kane	269	220	.8	0.7	-13%	3,090
Kendall	22	25	0.1	0.08	-20%	3,258
Lake	158	120	1.1	0.8	-27%	7,135
McHenry	315	238	1.1	0.8	-27%	3,356
Will	30	24	0.3	0.2	-33%	9,552
Total	N/A	N/A	6	4.7	-22%	37,142

Source: CMAP and IISG, 2024.

Demand-to-sustainable supply comparisons

In 2024, ISWS has developed county-level sustainable water supply estimates which identify the volume of water that can be withdrawn from each source without impacting the long-term viability of that source to provide water for future generations.[39,40] Estimates are provided at the county level and are intended to guide statewide planning, particularly targeting state resources to the areas of greatest need, and inform regional planning efforts. These estimates do not account for water quality, seasonality, or drought conditions, which influence water availability. The following methodologies and assumptions are used to calculate sustainable water supply for each water source (Table 17).[41]

- **Deep sandstone groundwater supply** focuses on limiting desaturation, which may be challenging to achieve in areas of heavy water use. It is calculated as the theoretical maximum water that can enter the aquifer via vertical leakage (recharge).[42] It is important to note that wells may not be positioned to access this full amount. Within a county, there may be wells in areas with large volumes of water, while other areas may face a lack of supply and, potentially, water quality issues associated with dewatering. Additionally, for some counties in northern Illinois — including Kane, Kendall, and DeKalb counties, where the sandstone aquifer is near the land surface and shares the same recharge as nearby shallow aquifers — the estimates for deep groundwater supply in these counties are based on the same methodologies and assumptions used for shallow groundwater supply.
- **Shallow groundwater supply** focuses on reducing impacts to aquatic ecology. Estimates are based on a 15 percent reduction in recharge as a proxy for a 15 percent reduction in natural groundwater discharge to streams based on observational research by Zorn et al. (2012).[43] Additional research is needed to understand impacts specific to Illinois streams as well as localized impacts to aquifers that might occur using this threshold.
- **River supply** currently reflects the maximum existing demand from public rivers over the past five years based on existing users and infrastructure. The approach does not yet consider limitations during drought, water quality issues, or navigation concerns. As of 2024, the ISWS acknowledged additional research is needed to evaluate impacts to streamflow and aquatic ecology; for unregulated rivers, stakeholder feedback will be needed to evaluate acceptable thresholds.
- **Lake Michigan supply** is calculated based on existing infrastructure and Lake Michigan allocations permitted by the state in 2017.[44]

Given that the river and Lake Michigan estimates simply reflect existing demand, infrastructure, and/or permits, the shallow and deep groundwater sustainable supply estimates can be used to investigate how demand compares to sustainable supplies. At the county level, however, it is important to note that these estimates do not necessarily line up with where the wells and corresponding demand are located, and the water supplies may not be accessible to those who need it. Similarly, water quality, drought, and other seasonal variations that could influence water availability are not included in these quantity-focused estimates.

Table 17. Tier 1 sustainable supply estimates by water source and county, MGD

County	Shallow groundwater	Sandstone groundwater	Rivers	Lake Michigan	Total
Cook	19.27	3.03	n/a	789.8	812.1
DuPage	4.45	0.49	n/a	237.68	242.62
Kane	11.33	11.33	14.79	2.33	39.78
Kendall	5.07	5.07	n/a	2.6	12.74
Lake	8.11	2.28	n/a	73.5	83.89
McHenry	26.89	17.77	0.14	n/a	44.8
Will	17.4	2.5	0.84	52.07	72.81
Total	92.52	42.47	15.77	1157.98	1308.74

Note: Lake Michigan values reflect existing allocations as of 2017 and do not include planned source switches and do not reflect the purchasing or selling of water by municipal PWS systems or water commissions that supply water to multiple municipal PWS systems. The deep groundwater values for Kane, Kendall, and DeKalb counties are the same as the shallow supply values because the sandstone aquifer in these counties is near the land surface and shares the same recharge as nearby shallow aquifers. As a result, the estimates are based on the same methodologies and assumptions used for shallow groundwater supply. ISWS plans to revise this approach as they make improvements to the groundwater models used to generate these estimates.

Source: ISWS, Water Budget Vista, 2024.

For each county, sustainable supply estimates were then compared to projected demand estimates for the year 2050 for shallow and sandstone groundwater sources. A ratio was generated by dividing demand by sustainable supply estimates, where ratios greater than one indicate that demand surpasses the county's estimated sustainable supply for that source (Table 18). The volume of demand exceedances was calculated as the sum of the deficits; surpluses in the other groundwater source were not used in the exceedance calculation because those sources may not be accessible to address the deficits.

Table 18. 2050 Demand-to-sustainable supply ratios by groundwater source and county, MGD

	Sandstone				Shallow				Total
	Supply	Demand	Ratio	Diff.	Supply	Demand	Ratio	Diff.	Demand exceedance
Cook	3.03	3.57	1.18	0.54	19.27	7.64	0.40	-11.63	0.54
DuPage	0.49	2.93	5.99	2.44	4.45	3.97	0.89	-0.48	2.44
Kane	11.33	14.84	1.31	3.51	11.33	20.41	1.80	9.08	12.59
Kendall	5.07	0.58	0.11	-4.49	5.07	1.54	0.30	-3.53	n/a
Lake	2.28	2.39	1.05	0.11	8.11	7.80	0.96	-0.31	0.11
McHenry	17.77	5.84	0.33	-11.93	26.89	16.99	0.63	-9.90	n/a
Will	2.5	6.52	2.61	4.02	17.4	10.55	0.61	-6.85	4.02
Total									19.71

Source: CMAP and IISG, 2024.

Limitations and future refinements

Estimating future water demand is a complex process and encounters several challenges and limitations. This section identifies those challenges, to be transparent about what the forecast does and does not include. In some cases, this section identifies areas for further improvements in the next regional water demand forecasting process.

Water data

Data from the IWIP and Lake Michigan Allocation Program are critical to the regional water demand forecasting effort. Data availability and processing challenges limit the methodological design of the forecast, including the following issues:

- **Available years of water data:** While greatly improved compared to previous forecasts, the most recent available water data year was 2018, limiting the forecast's ability to reflect current conditions.
- **Annual versus monthly data:** Limits the incorporation of demand factors accounting for seasonal variation, weather, and climate.
- **Lack of reported data:** Extensive interpolation as well as generous assumptions about whether a facility is open or closed likely leads to higher reported withdrawal volumes and less variability in the data.
- **Lack of facility service areas:** Requires assumptions of the corresponding population, employment, and land uses to obtain unit use.
- **Lack of confirmed purchase network:** Data required high levels of processing that would benefit from facility review.
- **Lack of customer and water loss data:** The drivers of residential and non-residential water use are distinct and would ideally be modeled separately for PWS systems. In addition, water loss data is not available across the geography; therefore, water loss values are embedded in unit use calculations.
- **Administrative issues:** Lack of common set of facility identification numbers across the IWIP and IDNR Lake Michigan Allocation Office adds steps to combine datasets and introduces opportunities for error.

In addition to these issues, there are several other water data limitations that require additional coverage.

Domestic self-supply

In general, the domestic self-supply sector, which includes private residential wells, is not required to report annual water use. This forecast is focused on the domestic self-supply sector that exists within municipalities where there is no public water supply. This leaves out an unknown, yet potentially sizeable, portion of water demand associated with residents of unincorporated areas and areas within municipalities that have PWS systems. The decision to craft the DSS sector in this manner was made due to several reasons:

- **No reported volumes:** Given that these wells pump smaller volumes of water, self-supplied domestic withdrawals are not required to report withdrawals to the IWIP or the county departments of public health, which are the agencies involved in initial permitting.
- **Unknown locations and populations:** Inconsistencies in well closure logs as well as a lack of data on public water supply system service areas make it difficult to assess where active private residential wells are located and who they serve.
- **Municipalities with no PWS are served by private wells:** Given the uncertainties outlined above, the forecast could confidently estimate the population served by private wells by focusing on municipalities with no systems.

To better understand the extent to which this forecast method could be undercounting the DSS sector, USGS National Water Use Information Program data estimating the population, GPCD, and total volumes for the year 2015 was compared to the municipal DSS sector estimates for 2018. The USGS National Water Use Information Program compiles and publishes national water use data, including data on the domestic self-supply sector, with 2015 as the most recent year available. The USGS estimates usage by multiplying an estimate of the population *not served* by public supply by an estimate for the GPCD, which for 2015 was 80 GPCD.[45] Note, reported population served values by PWS systems have been shown to contain issues, where reported values are often simply U.S. Census values for the municipality and may not reflect the actual customer base.[46]

Table 19 compares municipal DSS sector population and demand estimates for 2018 with the USGS estimates for the larger DSS sector in 2015. The 2018 municipal DSS population represents only about 15 percent of the total DSS population estimated by the USGS in 2015, while its demand accounts for 13 percent of the USGS demand estimate. This effort assumes a slightly higher base year GPCD (93.1 GPCD) compared to USGS’s 80 GPCD, as employment-related water use is embedded in the 2018 estimate.

A key contribution of the municipal DSS sector analysis is its refined population estimates. In two instances, the county population of municipalities without public water supplies exceeds USGS county-level estimates for DSS populations. The USGS appears to undercount the DSS population in Cook and Kane counties. This discrepancy highlights the importance of municipal-level data in accurately characterizing the DSS sector.

It is important to note that the municipal PWS sector forecast assumes that all population in the geography are being served by the PWS systems, despite the known prevalence of private residential wells. This results in lower GPCD values for those municipal PWS systems.

Table 19. Comparison of USGS 2015 DSS estimates with 2018 municipal DSS estimates

County	USGS 2015 estimates			CMAP municipal DSS 2018 estimates		
	Population	GPCD	MGD	Population	GPCD	MGD
Cook	5,239	80.0	0.42	14,079	96.7	0.8
DuPage	72,636	80.0	5.81	948	98.6	0.1
Kane	5,449[a]	80.0	0.44[b]	13,903	86.2	1.2
Kendall	23,274	80.0	1.86	794	86.3	0.1
Lake	86,970	80.0	6.96	22,441	91.6	2.1
McHenry	65,640	80.0	5.25	14,425	98.5	1.4
Will	140,315	80.0	11.23	121	93.5	<0.01
Total	**448,572**	80.0	**35.89**	**66,712**	93.1	4.66

[a] Original value was 54,498, updated to remove the last digit which was likely in error when compared with population values from 2000-2010.[b] Original value was 4.36, adjusted based on population updates.

Source: USGS National Water Use Information Program.

Data centers

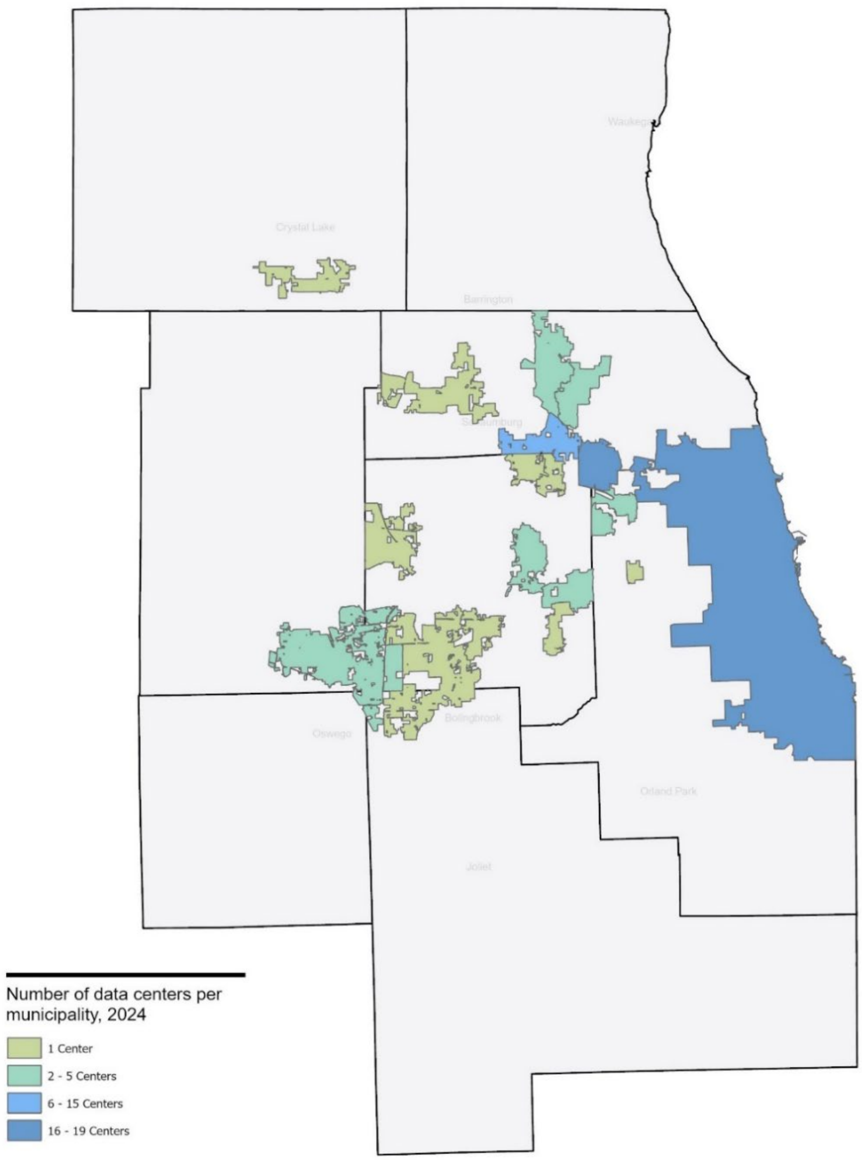
Data centers represent a new and uncertain factor in the regional water demand forecast due to the rapid growth of this industry in recent years. These facilities house computing infrastructure and equipment to process, manage, and store data — making them highly energy-intensive. A typical data center uses 10 to 50 times more energy per square foot than a standard commercial office building. [47] It also consumes significant amounts of water; onsite water use is primarily for cooling and humidification systems, using water indirectly through the water required to generate the electricity date centers consume. However, estimating onsite water use is challenging due to a lack of publicly available data. For reference, a 2021 study found that a small 1-megawatt data center using traditional cooling systems can consume approximately 6.7 million gallons of water a year.[48]

The data center industry is projected to grow rapidly, driven by the increasing demand for artificial intelligence, search engines, e-commerce, cryptocurrency, and other data-heavy sectors. Nationwide, annual growth expectations are high, ranging from 10 to 23 percent.[49,50] In Illinois, state incentives are further accelerating this expansion. The Data Center Investment Program, established in 2019 under Public Act 101-31, provides tax exemptions and credits to encourage development.[51] By the end of 2023, 21 data centers participating in this program had collectively invested over $11 billion.[52]

As of 2024, there are 66 operational data centers in the region (Figure 15), with a median construction year of 2020, and 13 additional data centers in the planning stages.[53,54] Cook County hosts the majority, with 55 facilities — 19 in Chicago and 17 in Elk Grove Village — followed by DuPage County. Data centers are known to purchase water from municipal PWS systems, though an unknown portion may be relying on their own supply. The largest planned facility is the T5 Data Center in Grayslake, projected to have a capacity of 480 megawatts when it comes online in 2027.

Data centers may purchase water from municipal PWS systems or rely on their own private wells or intakes. Despite efforts to analyze historical water withdrawal data in municipalities with data centers, no clear patterns emerged, suggesting that some facilities may not use municipal water or other changes in municipal use mask the addition of the data center. The absence of water use data, coupled with the potential for technological advancements and the rapid growth of this industry, introduces significant uncertainty into water demand forecasting. This uncertainty could lead to underestimating future water demand if the water needs of data centers are not accurate captured.

Figure 15. Number of data centers per municipality, 2024



Source: CMAP and IISG, 2024.

Power supply sector

The amount of water used in power generation is dependent on electricity demand and the type of power generation. Electric power production through thermoelectric generation — using coal, petroleum, natural gas, or nuclear fission — requires significant volumes of water for cooling. The amount of water used depends on the type of cooling system employed:

- **Once-through cooling systems:** These withdraw large volumes of water, which is then returned to the source at elevated temperatures with minimal evapotranspiration. This process is classified as non-consumptive water use.
- **Closed-loop (recirculating) systems:** These withdraw significantly less water but lose a substantial portion to evapotranspiration, making them a consumptive use of water.

For a more detailed discussion on water use in power generation, please refer to the 2008 forecast method. According to that report, closed-loop systems accounted for 4 percent of total water use in 2005, or approximately 52 MGD. [55] In comparison, once-through cooling systems withdrew a much larger volume, totaling 4,207 MGD in the same year.

The electric power sector is undergoing significant transformation as efforts to reduce greenhouse gas emissions accelerate. Illinois' Climate and Equitable Jobs Act mandates phasing out fossil fuel plants and promotes the development of clean energy facilities.[56] The state's renewable portfolio standard requires 50 percent of electricity to come from renewable sources by 2040 and 100 percent by 2050.

These changes introduce a major uncertainty to the regional water demand forecast, given the rapid evolution anticipated during the forecast period. Estimating the timeline for phasing out thermoelectric power plants and their associated cooling systems falls outside the scope of this forecast. As a result, water facilities tied to power generation — including wells and intakes associated with II&C self-supply facilities — were excluded. If Illinois' decarbonization goals are achieved, this sector will likely see a significant decline in water use.

Population and employment data

Historic and future population and employment are key inputs into the forecasting model. Data quality and availability varies geographically and temporally. This section addresses the known concerns with the historic and future demographic data and describes potential future resolutions.

Historic data

Historic population and employment data is derived from multiple sources depending on the facility geography. For non-municipal facilities, historic population and employment are derived from CMAP's 2022 Socioeconomic Forecast and the UrbanSim land use model. For municipal geographies, historic population is collected from the U.S. Census American Community Survey.

- **Base year selection:** The spatial assignment of facilities to parcels matching CMAP's UrbanSim model allows for increased geographic precision of historic population and employment to the facilities water use; however, the base year for this model is 2010. This means that the latest known demographic data available is from 2010. Facility level data for non-municipal facilities in other years with the same geographic precision is not available currently, therefore the non-municipal facilities forecasts have a base year of 2010. Municipal facility geographies predominantly match the geography of the full municipality, so Census derived estimates are appropriate to use. The latest year of reported water use data is 2018, so this is the base year for the municipal geography's forecasts. Future updates to the UrbanSim model will provide the opportunity to have a more recent base year for non-municipal facilities.
- **Census undercounting:** The U.S. Census produces annual population estimates at the municipal level which were used to determine municipal population. Every 10 years, the Census produces intercensal estimates that use new information to revise previous population estimates. This water forecast analysis was performed prior to the publication of the 2010-2020 Intercensal estimates. The intercensal estimates suggest that the 2018 municipal population used in this study is undercounting by about 1.8 percent, or 150,000 residents. Future forecasting efforts will use this most recent data available, which will yield more precise results.

Future data

- **CMAP's 2022 Socioeconomic Forecast under/over counting:** Provides estimates on the abundance and distribution of population and employment in the region. CMAP is confident in the updated regional-level population projections; however, the projections for township and municipal level populations appear less reflective of current trends in near-term population growth. CMAP is currently developing a new local forecast that will be adopted in late 2026. For this reason, forecasted results are not presented at the municipal or facility geography.
- **Partially in the region municipalities:** The CMAP region consists of 284 incorporated municipalities, 274 of which are fully in the 7-county region. The remaining 10 municipalities lie on the border of a CMAP region county and an external county, such as DeKalb or Grundy. CMAP's UrbanSim model only forecasts population and employment for the portions of these municipalities in the CMAP region. This would result in a disconnect between the demand driving the historical water use and the future water use within these 10 municipalities, so for this study they were not forecasted. Work to estimate the population and employment in the non-CMAP portions of these municipalities would allow for their inclusion in future forecasts.

Appendix: Data sources

The table below provides a full list of the data used in the forecast, including the source, geography, and time series.

Table A.1. Characteristics of data used in the forecast

Data	Source	Geography	Time series
Water data			
Facility and well/intake usage	Illinois Water Inventory Program	Facility and Intakes/Wells	Annual, 2007-2020
Purchase network transactions	Illinois Water Inventory Program	Facility purchases and sales records	Annual, 2007-2020
Public water supply withdrawals	Illinois Department of Natural Resources Office of Water Resources, Lake Michigan Allocation Program	Public water supplier and other facilities	Annual, 2007-2018
Hydrography	U.S. Census Bureau Area Hydrography shapefile	County	2022
Facility and other data related to geographic assignments			
Municipal boundaries	U.S. Census Bureau TIGER/Line Shapefiles	Municipality	2021
Service area boundaries	Individual PWS	PWS	Various
Cook County subdivision files	Cook County, Illinois 1:1200-Scale Subdivision Digital Data Set	Subdivisions	2011
Kane County subdivisions	Kane County, GIS-Technologies	Subdivisions	2022
Will County subdivisions	Will County	Subdivisions	2014
Northeastern Illinois Development Database	CMAP	Parcels	Various
Cook County Sanitary Districts	Cook County	Taxing districts	2020
Power generation	Illinois State Water Survey	Intakes/Wells	Various
Inventory of electricity generators (EIA-860)	U.S. Energy Information Administration	Business	Various
Dependent variables data			
Population	U.S. Census; American Community Survey (ACS)	Municipality	Annual, 2007-2020
	CMAP 2022 Socioeconomic forecast	Parcels/ Municipality	2010; 5-year increments, 2020-2050
Employment	CMAP 2022 Socioeconomic forecast	Parcels	2010; 5-year increments, 2020-2050

Source: CMAP and IISG, 2024.

Endnotes

[1] CMAP, *Water 2050: Northeastern Illinois Regional Water Supply/Demand Plan*, CMAP, 2010.
[2] Previous water demand forecasts include the Northeastern Illinois Planning Commission's 2002 Strategic Plan for Water Resource Management as well as the 1976 Estimated Future Water Supply Demands for Northeastern Illinois report.
[3] CMAP and IISG, *ON TO 2050 Regional Water Demand Forecast for Northeastern Illinois, 2015-50* (2018), https://www.cmap.illinois.gov/programs/water/supply-planning/resources/2050-water-demand.
[4] Given that the forecast requires selecting one year of unit use for each municipality to project out into the future, the weather of that selected year could lead to distortion in the overall forecast. The most dramatic impact could occur if drought conditions lead PWS systems to change the proportion of withdrawals by source
[5] Dziegielewski, Benedykt, "Residential Water Use in Northeastern Illinois, Estimating Water-Use Effects of In-fill Growth versus Exurban Expansion," Memorandum prepared for CMAP, Southern Illinois University Carbondale, 2009.
[6] The EPAct established the first uniform plumbing standards that became mandatory nationwide in 1994. As technology has evolved, the EPAct standards continue to be revised accordingly. The U.S. EPA launched the voluntary WaterSense partnership in 2006, a program that provides nationally recognized water efficiency product branding, and also works with partners to implement water conservation programming.
[7] CMAP and IISG, *ON TO 2050 Regional Water Demand Forecast for Northeastern Illinois, 2015-50* (2018), https://www.cmap.illinois.gov/programs/water/supply-planning/resources/2050-water-demand.
[8] Well types include public supply groundwater, public supply surface water, individual self-supply groundwater, individual self-supply surface water, irrigation groundwater, and irrigation surface water.
[9] Groundwater wells can be categorized using the last two digits of the aquifer code. If the last two digits are equal to 60 or greater than 66 and less than 97, the source is sandstone groundwater, otherwise it is shallow groundwater.
[10] Where a lambert x/y is not available, township/range/section/plot information is provided.
[11] Abrams, Daniel, "Illinois State Water Survey," personal communication, January 2018. This process primarily includes flagging and removing order of magnitude discrepancies in reporting. In some cases, modification of the self-reported purchase distribution network was made to coincide with IEPA data records, which was essential in converting water withdrawals to water usage data.
[12] There are six well/intake types: public supply groundwater (33), public supply surface water (34), Individual self-supply groundwater (35), individual self-supply surface water (36), irrigation groundwater (37), irrigation surface water (38). The PWS are identified as public supply in IWIP data (codes 33 or 34).
[13] CMAP and IISG, *ON TO 2050 Regional Water Demand Forecast for Northeastern Illinois,* https://www.cmap.illinois.gov/programs/water/supply-planning/resources/2050-water-demand *2015-50* (2018).
[14] The project team received service area boundaries from several large private PWS, including Aqua Illinois, Utilities Inc, and Illinois American, as well as county PWS, including Lake County Public Works and DuPage County Public Works departments.
[15] Residential properties with private domestic wells as well as smaller facilities associated with industrial, institutional, irrigation, and commercial businesses that do not withdraw enough water to be required to report to the IWIP exist within municipal boundaries, but their location, number, and water withdrawals are not known.
[16] Well types used include individual self-supply surface water (36), irrigation groundwater (37), and irrigation surface water (38).
[17] The ISWS provided two key datasets to identify withdrawals associated with power generation: self-reported data to IWIP on whether or not a given facility is used for power generation and a separate list of self-supply points with Standard Industrial Classification or SIC codes indicating power generation. All facilities reporting power generation to the IWIP were reviewed and those points reporting surface water withdrawals over 10 MGD were removed. An additional four facilities with SIC codes indicating power generation were identified to have significant power generation and the corresponding surface water withdrawals from specific intakes were also removed. In addition, two surface water intakes reporting water for cooling were removed.

[18] The IWIP data flagged facilities associated with power generation. These facilities were reviewed for large volume water withdrawals and in concert with U.S. Energy Information Administration data on electricity generators to confirm facilities producing power for distribution. These facilities include Northwestern University – Evanston campus, Midwest generation (Joliet 9, 29, Romeoville, Fisk, Crawford (retired), Waukegan), Nicor Gas, Aurora Generation, Dynegy Kendall, Exelon Braidwood, and MWRDGC-Lockport. Additional facilities are involved with large scale cooling systems and were removed for similar reasons, including MDE Thermal Technologies and the Civic Opera House. In addition, III&C self-supply facilities were reviewed to estimate if they are using water to produce power for their own internal processes. For these facilities, point level data was reviewed for surface water withdrawals with annual amounts over 2.6 billion, which would be at least an annual daily pumping value of 10 million gallons minus weekends. These facilities include Ingredion, Exxon Mobil Joliet, Zion Solutions, LLC, and Calumet Transfer.

[19] Any water withdrawals associated with groundwater wells were retained as this water was likely used for other purposes, not once-through cooling.

[20] Spatial overlay processes identified the parcels within which facility (addresses) and intakes (points) were located and manually confirming association based on facility name and well/intake type relative to the owner's name and land use of each parcel. Proximity analyses included an evaluation of parcels within a 500-foot buffer (for facilities that did not get matched to facilities in the overlay analysis) and within 1,000-foot buffer (as a final check for additional parcels for facilities that were matched to parcels through the overlay or 500-foot buffer proximity analysis).

[21] Parcels were assigned to smaller-scale PWS systems based on 1) performing a spatial overlay of known boundaries, including private utility and county public water system service areas; 2) matching the facility names to the service area/development name and verifying with a spatial overlay (Northeastern Illinois Development Database outline only) and location of facility well(s)/intake(s); 3) internet search for any information that can result in a service area boundary (e.g., real estate maps, plans, studies, etc.); and 4) parcel-owner name and/or underlying land use. Facilities that had no usage reported for 2000-2010 were not initially located, however, a portion of these facilities were later found to be active via the purchase network analysis. To streamline the geographical assignment of those facilities, municipal-scale facilities and facilities with large, reported purchases were prioritized.

[22] Some municipal PWS systems have multiple facilities that were assumed to be managed collectively: Beach Park, Bolingbrook, Burbank, Channahon, Fox Lake, and Johnsburg. Hawthorn Woods and Wonder Lake had multiple facilities under separate management that served most of the municipal boundary but their precise service areas could not be identified. As a result, their combined withdrawals were assumed to cover the majority of the municipal area. The facilities serving Orland Hills and University Park also serve substantial areas outside of their municipal boundaries. The reported IWIP water withdrawals for Justice and Willow Springs are combined under the Justice Willow Springs Water Commission; for this effort, these withdrawal totals were split based on their proportion of use in IDNR Lake Michigan Allocation Program annual reports to preserve separate municipal calculations. Additionally, some facility names, especially those run by private entities, do not necessarily match the municipal name and further investigation was required.

[23] The 2021 municipal boundaries that define the municipal-scale public water sector are from the U.S. Census Bureau. The Bureau's 2021 boundaries reflect what is reported as of January 1, 2021, which makes the 2021 boundaries the most accurate representation of 2020 municipal boundaries.

[24] CMAP manipulated the purchase network data in the following ways: compiled the four datasets into one using a process of comparing annual values to the overall average of all transactions between buyer-seller pairs to avoid mass balance issues; reviewed established buyer-seller pairs for anomalies and made corrections to account for physically impossible sales, buyer-seller reversed, etc.; reviewed water volumes to address unusually small reported values that were likely an order of magnitude issue; and interpolation and forward and back fill steps. It was assumed that permittees who buy and sell water are exchanging Lake Michigan water. A permittee may have other wells that withdraw water from other sources, but those wells are assumed to not be a part of the purchase network. However, exceptions to this rule were made for permittees selling water who have not yet gained access to Lake Michigan water.

[25] Abrams, Daniel, et al., "Illinois State Water Survey," personal communication, March 2022. Any non-municipal facilities failing to submit annual reports are assumed to have closed only after five years of missing entries. For this effort, this translates into extending the last data point up to five years at the end of the data period. For a facility with their last report in 2015, this results in extending that data for 2016-2020. Facilities serving municipalities were forward filled regardless of the final reporting year. For new facilities, it is assumed that it can take up to three years to submit their first annual report. This translates into backfilling the first data point up to three years at the beginning of the data period.

[26] The first three digits of the facility identification number is the county code.

[27] Aquifer codes consist of four digits, with the first two digits indicating the uppermost aquifer the well is open to while the last two digits signifying the lowermost aquifer the well is open to. For this forecast, any code where the last two digits signified the sandstone aquifer — either 60 or any number between 66-97 — were attributed to the sandstone aquifer. All others were designated as a shallow aquifer well.

[28] The USGS reports that all domestic self-supply relies on groundwater sources, but information on withdrawals by aquifer type are not known. Therefore, the information on water withdrawals by source does not include withdrawals from the domestic self-supply sector.

[29] A buffer of one mile was placed around the intake to see if it intersected a major body of water. If it did, it was assigned that water body as a source, if it didn't, it was assigned to Other River.

[30] Abrams, Daniel, et al., "Changing Groundwater Levels in Sandstone Aquifers of Northern Illinois and Southern Wisconsin: Impacts on Available Water Supply," Illinois State Water Survey, Contract Report 2015-02, 2015.

[31] Iordache, Vlad, "Illinois State Water Survey," personal communication, November 2024.

[32] Past population data is collected with PWS withdrawal data. IEPA's SDWIS collects population served data on a rolling basis while the Lake Michigan Water Allocation Program collects population served data on an annual basis. However, conversations with the technical advisory committee and other stakeholders (NWPA Technical Advisory Committee) indicate that the PWS operators generally track the number of service connections via billing systems, not the population served. Therefore, when asked to report on population served, municipal-scale PWS operators are thought to commonly rely on U.S. Census population data for the municipality

[33] The 2010 non-municipal employment and population from UrbanSim was assumed to remain constant through 2018. Therefore, 2010 employment and population associated with non-municipal facilities within municipal boundaries were removed from the 2018 municipal populations derived from the Census ACS. Forecasted values are generated at the parcel level by UrbanSim, which directly aligns with our sector geography.

[34] The Federal Highway Administration requires metropolitan planning organizations, such as CMAP, to include a socioeconomic forecast in long-range plans. CMAP revisits its population and employment forecasts every four years in conjunction with the long-range plan schedule.

[35] CMAP, "Socioeconomic Forecast Data 2022 and 2018 Series," 2022, https://datahub.cmap.illinois.gov/datasets/01b2e734f2dd48009fe85e6d907b33a6/about.

[36] The expansion of municipal boundaries will likely occur in the forecast period but how they could expand is unknown and not covered in this forecast.

[37] As a result, the population served by private residential wells is anticipated to decrease over time.

[38] Municipal DSS boundaries were buffered by 3000ft. Any domestic self-supply municipality that has at least three municipalities on a known public water supply within this buffer was assigned a 2018 GPCD based on the average of the 2018 GPCDs of these nearby municipalities.

[39] Illinois State Water Survey, "Illinois Water Budget Vista (IWBV)," 2024, https://experience.arcgis.com/experience/6a481d66193640ccaf1d0f1194d3813e.

[40] As the first of its kind, this data will continue to be refined as more information is gathered about both water supply and demand.

[41] Illinois State Water Survey, "Illinois Water Budget Vista (IWBV): User's Guide," 2024, https://experience.arcgis.com/experience/6a481d66193640ccaf1d0f1194d3813e/page/Page/?views=User%27s-Guide.

[42] As natural recharge is limited in deep aquifers, unmanaged recharge through wells open to multiple formations can exaggerate inflow. However, unmanaged recharge requires local scale investigations to understand associated uncertainty and is excluded from Tier 1 deep groundwater supply.
[43] T.G. Zorn, P.W. Seelbach, and E.S. Rutherford, "A Regional-Scale Habitat Suitability Model to Assess the Effects of Flow Reduction on Fish Assemblages in Michigan Streams," *Journal of the American Water Resources Association* 48 (2012): 871–895.
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[46] CMAP and IISG, *ON TO 2050 Regional Water Demand Forecast for Northeastern Illinois, 2015-50* (2018), https://www.cmap.illinois.gov/programs/water/supply-planning/resources/2050-water-demand.
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[48] Siddik, Md Abu Bakar, Shehabi, Arman, and Marston, Landon, "The Environmental Footprint of Data Centers in the United States," *Environmental Research Letters* 16, no. 6 (2021): Abstract, https://doi.org/10.1088/1748-9326/abfba1.
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[51] Illinois Department of Commerce & Economic Opportunity, "Data Center Investment Tax Exemptions and Credits - Incentives," accessed July 9, 2024, https://dceo.illinois.gov/expandrelocate/incentives/datacenters.html.
[52] Illinois Department of Commerce and Economic Opportunity, *"Data Center Investment Program 2023 Annual Report,"* p. 17.
[53] CMAP, 2024. This is an internal dataset compiled from publicly available sources.
[54] Additional facilities may be planned beyond the 13 facilities with known location information. "Growth of Chicago-Area Data Centers Taking Off, No Signs of Slowdown," *WBEZ,* December 17, 2024, https://www.wbez.org/business/2024/12/17/growth-chicago-area-data-centers-taking-off-no-signs-slowdown.
[55] Dziegielewski, Benedykt and Chowdhury, F.J., "Regional Water Demand Scenario for Northeastern Illinois: 2005-2050" (Southern Illinois University Carbondale, 2008).
[56] Illinois Environmental Protection Agency, "Climate and Equitable Jobs Act," 2023, https://epa.illinois.gov/topics/ceja.html.

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The Chicago Metropolitan Agency for Planning (CMAP) is our region's comprehensive planning organization. The agency and its partners developed and are now implementing ON TO 2050, a new long-range plan to help the seven counties and 284 communities of northeastern Illinois implement strategies that address transportation, housing, economic development, open space, the environment, and other quality-of-life issues.

See cmap.illinois.gov for more information.

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