Appendix XX – Methodology for projecting a range of water demand

This memorandum provides a summary of the method to project total water demand for the Twin Cities Metropolitan Area for municipal groundwater and surface water systems and private high-capacity wells that are permitted with the Minnesota Department of Natural Resources and produce more than 10,000 gallons per day on average or more than 1 million gallons per year. This work is being done in support of the regional Metro Area Water Supply Plan update. The memorandum describes the use of region-wide water demand projections and details of the proposed approach.

Use of region-wide water demand projections

The Metropolitan Council estimated a likely range of future water demand to support the update of the Metro Area Water Supply Plan. This information helps planners better understand the general magnitude and distribution of future water use in the region. These projections can also serve as an input to the Metropolitan Council's groundwater modeling efforts and water supply analyses to predict resource constraints and evaluate approaches under future scenarios.

The water demand projections are intended to:

1. Assist Met Council planners and policy makers, state agencies, and community planners to plan for future growth and address regional issues. These projections can help us understand where future water demand might bump up against or exceed capacity, or where there is sufficient capacity to support growth.
2. Provide subregional and regional water demand data for Met Council's groundwater modeling projects, surface water analyses, and other studies.
3. Provide guidance for communities as they develop content for the water supply section of their comprehensive plan updates, to project water utility revenue, plan for water infrastructure improvements, and request Minnesota Department of Natural Resources water appropriation permits and permit amendments as needed to serve growth.

Overview of the projection method

The metro region's total water demand is the sum of the demands from municipal water use (surface water and groundwater systems) and private high-capacity well use. The demand projections based on this approach represent a scenario of future water use in the years 2030, 2040, and 2050. Projecting water demand for these years helps connect regional water use planning to the broader regional development guide, Imagine 2050, using population forecasts to be adopted for 2030, 2040, and 2050. The approach assumes that the water use that occurred between 2013 and 2022 in the metro region is representative of how water will continue to be used in the future.

The Technical Advisory Committee (TAC) advised not including demand projections for low capacity residential private wells that are not permitted by the DNR since this category uses less than 5 percent of the total water use in the metro region and the vast majority of this water is returned to the groundwater from septic drain fields and does not leave the metro region unlike the majority of municipal and industrial water that eventually leaves the metro region via wastewater treatment facilities that discharge to the Mississippi River.

The total metro region water demand includes the following basic equation:

> ***Total Metro Region Water Demand = Projected Municipal Water Use + Projected Private High Capacity Well Use (permitted wells)***

The projection method for each type of water demand is described as follows:

Projecting municipal water use

The method used for projecting municipal water demand uses a total per capita unit use coefficient approach for each of the municipal water utilities in the seven-county metropolitan area. The total per capita unit use coefficient is the total gallons per capita per day water usage (TGPCD) from all water uses in a community including residential, commercial, governmental, and institutional water uses, and unaccounted for water (water leaks, unmetered uses, etc.). This approach calculates a total per capita water use for each community based on the average TGPCD that occurred from 2013-2022 and assumes that the average per capita use will remain constant over the planning horizon of the Metro Area Water Supply Plan. A variable range is applied to reflect uncertainty in demand from year to year.

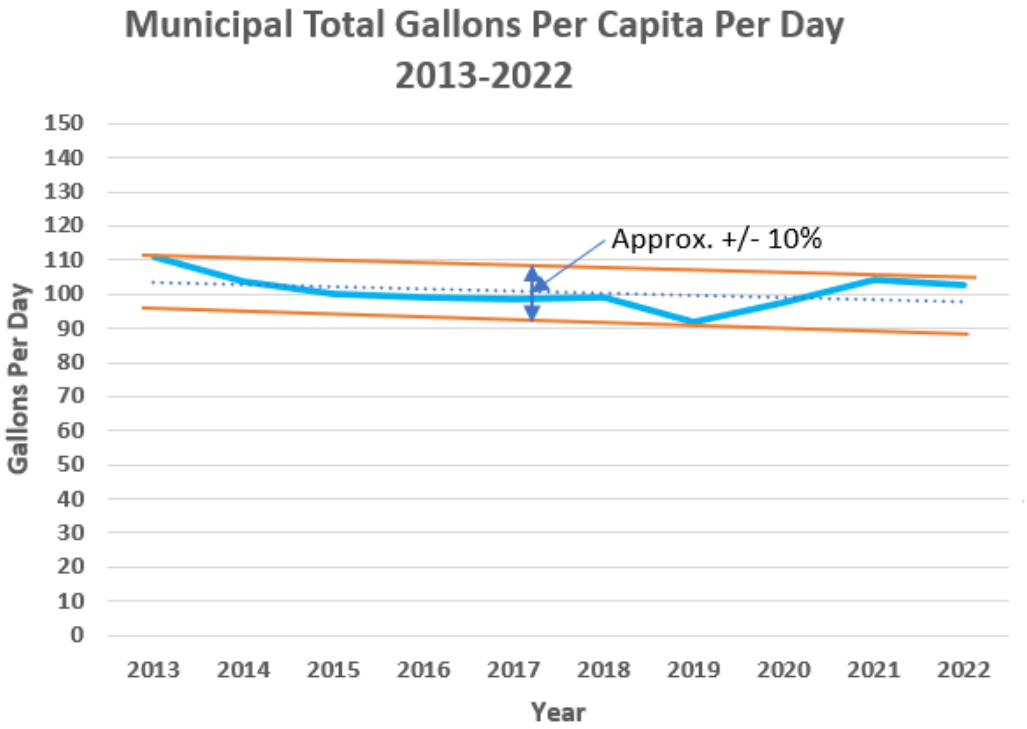
Future water demand projections for municipal water systems will be obtained by multiplying future water service population projections by the average annual TGPCD water demand that occurred from 2013-2022 with a variable range factor (+/-) to account for variations in the TGPCD that occurred from 2013-2022. Data used in this analysis is from the MN Department of Natural Resources Permitting and Reporting System (MPARS).

The average annual TGPCD demand across the entire metro region for municipal water systems was 100.81 TGPCD from 2013-2022, based on preliminary calculations using MPARS data (see Table 1 and Figure 1 below). It is important to note that 100.81 TGPCD was the average water usage that occurred during this timeframe, and it is essential to plan for a variable range of future water demands to account for changes in TGPCD demands that occurred from 2013-2022, additional population and industrial growth beyond growth projections, changes in water efficiency, extreme weather patterns (wet and dry), and other variable conditions that could affect future water demands.

Table 1. Average 2013-2022 total gallons per capita per day across the entire metro region for municipal water systems.

Year	Total Gallons per Capita per Day (Total Usage/Service Population)
2013	111.03
2014	103.55
2015	100.34
2016	99.27
2017	98.53
2018	99.22
2019	91.90
2020	97.34
2021	104.36
2022	102.58
Range	91.90-111.03
Average (2013-2022)	100.81
% Above Average	10.13
% Below Average	-8.84

Figure 1. Average annual total gallons per capita per day (TGPCD) across the entire metro region for municipal water systems for the years 2013-2022 (blue line). The average annual TGPCD ranged by approximately +/-10% above and below the trend line (dotted blue line).



The highest annual TGPCD demand, 111.03 GPCD, occurred in 2013. This demand is 10.13% above the average annual TGPCD (100.81) that occurred from 2013-2022 (see Table 1 and Figure 1 above). Therefore, it is recommended to use 10% for the variable upper range for calculating the total metro region water demand as a whole to account for additional population and industrial growth beyond growth projections, changes in water efficiency, extreme weather patterns (wet and dry), and other variable conditions that could affect future water demands. The lowest annual TGPCD demand, 91.90 GPCD, occurred in 2019. This demand is 8.84% below the average annual TGPCD (100.81) that occurred from 2013-2022 (see Table 1 and Figure 1 above). Therefore, it is recommended to also use 10% for the variable lower range for calculating the total metro region water demand as a whole to provide consistency (same as upper range). A minimum variable range of +/-10% is recommended to project future annual water demands for the entire metro region as a whole through 2050. This variable range reflects the historical variable range that occurred from 2013-2022 in the metro region.

Individual communities should consider using a **higher variable range of +/-20% when planning for water system infrastructure improvements and adjusting water utility billing rates** to account for additional population and industrial growth beyond growth projections, changes in water efficiency, extreme weather patterns (wet and dry), and other variable conditions that could affect future water demands. This recommendation is supported by the fact that a number of communities in the metro region experienced water demands that fluctuated greater than +/-10% and closer to +/-20% from 2013-2022. These communities experienced higher variable water demands mainly due to significant changes in their industrial water use and rapid and unforeseen residential growth. The projected municipal water use includes the following equation:

Projected Municipal Water Use = [Projected Water Service Population] X [2013-2022 Average Municipal Total Per Capita Water Use] X 365 Days with a Variable Range (+/-10% for entire metro region water demand as a whole and +/-20% for individual communities)

Projecting private high-capacity well use

Water demands from private high-capacity wells that produce more than 10,000 gallons per day or more than one million gallons per year will also be projected for the metro region for 2030, 2040, and 2050. These wells require a permit from the MN Department of Natural Resources, and annual pumping is reported in MPARS. The growth rate for this type of water use will be the average annual growth rate that occurred from the permittee's total private high capacity well use from 2013-2022.

Similar to the assumptions made for the future municipal water demand projections, a variable range of +/-10 to 20% is also recommended to project future water demands from private high-capacity wells in each community. This will provide a reasonable planning approach to account for additional industrial growth beyond growth projections, changes in water efficiency, extreme weather patterns (wet and dry), and other variable conditions that could affect future water demands for private high capacity well owners. The projected private high capacity well use includes the following equation:

Projected Private High-Capacity Wells Water Use = [Current Total Annual High-Capacity Wells Demand] X [2013-2022 Average Annual Increase Percentage in Demand] with a Variable Range (+/-10% for entire metro region water demand as a whole and +/-20% for individual private high capacity well owners)

Total metro region water demand: municipal and private high-capacity well demand

In summary, the Total Metro Region Water Demand was calculated according to the following combined equation that accounts for each type of water use:

Total Metro Region Water Demand =

Projected Municipal Water Use = [Projected Water Service Population] X [2012-2021 Average Municipal Total Per Capita Water Use] X 365 Days with a Variable Range (+/-10% for entire metro region water demand as a whole and +/-20% for individual communities)

+

Projected Private High-Capacity Wells Water Use = [Current Total Annual High-Capacity Wells Demand] X [2013-2022 Average Annual Increase Percentage in Demand] with a Variable Range *(+/-10% for entire metro region water demand as a whole and +/-20% for individual private high capacity well owners)*

Data used to project water demand

Data used to support this analysis are from multiple sources to help consider some of the uncertainties related to projecting water demands.

- Forecasted population from Metropolitan Council data. The forecasted population data was taken from the Metropolitan Council's website for the years 2030, 2040 and 2050: https://metrocouncil.org/Data-and-Maps/Research-and-Data/Thrive-2040-Forecasts.aspx
- Historical annual water use data was obtained from the Minnesota Department of Natural Resources Permitting and Reporting System (MPARS). The annual use data was taken from data published on the Minnesota Department of Natural Resources website for each year

between 2013 and 2022:
http://www.dnr.state.mn.us/waters/watermgmt_section/appropriations/wateruse.html

Municipal water service population data

In many communities, there is a difference between total population and population served by the public water system. Data on population served by the public water system in each community was obtained from Water Supply Plans submitted to the DNR by each community and from the Minnesota Department of Health's Water Quary website. The population not served by the water system was calculated as the difference between the reported total population and population served. This unserved population was averaged over the number of years with complete data.

Future municipal water service population calculations

Future water service populations for each community that is served by a municipal water system were calculated by adding Met Council's projected population increases for 2030, 2040, and 2050 to the Minnesota Department of Health's 2020 water service population data.

Water Service Population = MDH 2020 Water Service Population + Projected Population Increases from 2020 to 2050

Per capita water use calculations

Total per capita water use was calculated for each community for each year between 2013 and 2022 by dividing the reported water use by the estimated water service population. The per capita water use was then averaged over this ten-year period. The average per capita water use based on population served is reported in this way for each community.

Total Per Capita Water Use = (Total Municipal Water Use) / (Water Service Population)

This value represents the total municipal water use per capita for each community. This includes all water use in the community, including commercial, governmental, industrial, and institutional uses, and unaccounted for water.