FACT SHEET

OUR WATER SUPPLY AQUIFER PRODUCTIVITY & SUSTAINABLE USE

Key Facts

The City of Eau Claire derives its water supply from a glacial valley fill aquifer comprised of porous and permeable sand and gravel deposits that provide an abundant supply of water for the city and surrounding areas. The aquifer is continually and sustainably replenished from both upland areas and the Chippewa River, which lies both north and west of the City's wellfield. Both the eastern upland and river floodplain areas of the aquifer are replenished with a portion of precipitation events, and the aquifer underlying the river and floodplain are replenished by the river because of wellfield pumping. The wellfield itself makes the groundwater resource readily available for use by the citizens and businesses of Eau Claire. In configurations that have evolved with the City's needs, the wellfield and water supply system has been a reliable foundation for regional economic success.

Readily Available, Sustainably Replenished and with Demonstrated Reliability

The glaciated northern tier of the United States includes aquifers that comprise a significant natural resource from which many communities benefit. In particular, the northern tier Central Region of the US that includes Illinois, Indiana, Michigan, Ohio, Wisconsin, and portions of Minnesota, has both geologic and climatologic conditions that are supportive of very appreciable aquifer productivity across the multi-state area. According to recent studies by the United States Geological Survey (Reeves et al 2017, Scientific Investigations Report 2017–5015), the glacial aquifers of the Central Region strongly surpass the other glaciated portions of the country in supporting public water supply, irrigation, industrial, and domestic water supply needs. In 2010, the freshwater withdrawals from the region equaled about 2,400 million gallons per day (MGD). This abundance will drive economic activity long into the future.

Some factors relevant to Wisconsin include the following:

- Abundant annual precipitation in the range of 19 to 44 inches per year; and
- Appreciable estimated groundwater recharge rates ranging between 2 to 20 inches per year.

The geology of northwestern Wisconsin includes several west and southwestward draining valleys filled with glacial sediments that underlie the land surface and which comprise relatively thick water saturated deposits. Mapping completed by the Wisconsin Geological and Natural History Survey (WGNHS) shows that the Sand and Gravel aquifer in the Eau Claire area lies within a buried glacial valley that is occupied by the Chippewa River. These glacial deposits have made it possible for the City of Eau Claire to build and reliably use a wellfield comprised of wells that are themselves individually *highly productive.*

Based on wellfield geologic logs and reported well and water level depths, the aquifer's saturated thickness in the wellfield area ranges from about 40 to 90 feet and has a median thickness of about 71 feet. The 16 active City wells have depths that range from 80 to 110 feet and an average depth of 95 feet. The local glacial aquifer deposits near the Chippewa River, including those surrounding the current active wellfield, have been reliably used by the City of Eau Claire for about *140 years*.

The Aquifer

Wisconsin has both bedrock and unconsolidated deposits that can be classified as aquifers. These include Crystalline Bedrock; Sandstone and Dolomite; and the near surface Sand and Gravel, generally of glacial origin. The City of Eau Claire is underlain by all three, but the crystalline bedrock is rarely tapped for water supply purposes. Most commonly the near surface Sand and Gravel, and Sandstone aquifers are used for water supply with the preferred and most prolific being the Sand and Gravel Aquifer. Well yields from the Sandstone aquifer are reported to range up to 500 gallons per minute (gpm). In contrast, the preferred Sand and Gravel Aquifer has the following attributes:

- It is available near the ground surface and wells deeper than about 110 feet are not required to support pumping from individual wells easily exceeding 1,000 gpm,
- It has a reliable saturated thickness making well drilling success probable,
- It has favorable Hydraulic Conductivity in the range of 1 to 2000 feet per day,
- Upland Sand and Gravel deposits underlie appreciable portions of northern Wisconsin and within the 6590 square mile drainage basin of the Chippewa River, and these deposits discharge into the river which in turn replenishes the Sand and Gravel Aquifer above and in Eau Claire; and
- It can support relatively high groundwater withdrawal rates in areas near the Chippewa River due to sustainable aquifer recharge contributions from the river.

Groundwater modeling of the Eau Claire Municipal Wellfield (ECMWF) shows that the zone of wellfield influence creates a wellfield capture zone that extends to the Chippewa River and that saturated deposits beneath the river contribute very strongly to the wellfield itself. The following are based on simulations using the calibrated steady-state groundwater flow model developed for the ECMWF:

- When pumping all 16 of the ECMWF wells to withdraw a peak monthly demand rate of 14.2 MGD, a cone of depression results in the local aquifer that is centered around the wells.
- The aquifer flow budget for the calibrated groundwater flow model shows that because of wellfield pumping an appreciable amount of induced river water infiltration occurs along portions of the river boundary adjacent to the wellfield. Contrastingly, in portions of the river boundary that are not adjacent to the wellfield the flow budget shows aquifer flow into the river, which would be expected along the entire river boundary if the wellfield did not exist.
- The induced replenishment (rate and quantity) surpasses natural aquifer recharge that occurs from precipitation within the wellfield's groundwater contribution area. Induced infiltration is a documented phenomenon in river valley sediment aquifers such as the Eau Claire aquifer adjacent to and beneath the Chippewa River. The induced infiltration at this location acts to continuously replenish the wellfield, which has functioned unabated at its current location for many decades.
- Increasing the peak monthly demand rate by 0.850 MGD to meet a new water customer need results in less than 2 feet of additional drawdown in the local wellfield aquifer.
- A one-year groundwater flow tracking model simulation using the peak monthly demand rate of 14.2 MGD indicates most groundwater captured by the ECMWF is between the wellfield and the Chippewa River with much smaller groundwater contributions from upland areas.

Climatological Context

According to the Wisconsin Initiative on Climate Change Impacts 2021 Assessment Report:

> "Wisconsin's climate continues to change. In the ten years since the 2011 WICCI Assessment Report, new data show continued warming, increases in rain and snow, and more frequent extreme rainfall

events. Statewide temperatures have warmed by about three degrees Fahrenheit and precipitation has increased by nearly twenty percent since 1950." Key Points include:

- Wisconsin's average daily temperature has become three degrees Fahrenheit warmer since 1950. Warming is happening fastest in the winter and at night.
- The last two decades have been the warmest on record, and the past decade has been the wettest.
- Wisconsin has become wetter – average precipitation has increased 17 percent (about five inches) since 1950. Southern Wisconsin has experienced the highest increase in precipitation.
- Very extreme precipitation events will increase in the future.
- Extreme events are already causing immense impacts across the state, and the frequency of those events will generally increase.

Based on analyses of historical data, the University of Wisconsin – Madison, Nelson Institute, Center for Climatic (Center) Research broadly concludes the following related to precipitation and temperature patterns between 1950 and 2018:

- Annual Precipitation has increased 5 to 20 percent across Wisconsin and with significant upward trends notable across the southern part of the State
- Annual maximum temperatures have increased 2 to 3 degrees Fahrenheit across Wisconsin with significant upward trends noted statewide.

In addition, the Center has completed forecasts of future climate conditions using Representative Concentration Pathway (RCP) modeling. RCP 4.5 was selected for forecasting purposes and is one of four scenarios that scientists are using globally to study how the climate might respond to different increases of greenhouse gases and how much of the sun's energy they trap in the atmosphere. The scenarios can also be used to study possible ways to slow climate change and adapt to it. The RCP 4.5 scenario assumes that action will be taken to limit emissions. Without action, the emissions and the heat trapped in the atmosphere are expected to be higher, leading to more severe climate change. This scenario and the three others will provide a common thread for climate change research across many different science communities. As an example, significant attention is being paid to an extended duration drought that is occurring in the Southwestern United States. This drought has a severe Palmer Hydrological Drought Index (PHDI) currently ranging between -3 to -5. Long term, RCP 4.5 modeling for the SW US predicts appreciable baseflow reduction and decreased stream flows across the region by about 2080. By contrast the situation in Wisconsin, though also different than today, predicts precipitation increases that will tend to increase stream baseflow. These streamflow changes may be somewhat offset (incrementally reduced) by increased average and maximum temperatures that will influence evapotranspiration rates.

Based on Wisconsin modeling forecasts of the period between 2041 and 2060 that include the following:

- Annual Precipitation will increase Statewide.
- Annual maximum and average temperatures will increase Statewide.
- The frequency and severity of extreme rainfall events will increase by mid-century.

The historical trend data and forecasts are available for Wisconsin at the following location: https://wicci.wisc.edu/.