City of Manitowoc, Wisconsin

Central Brown County Water Authority Communities

NR 854 – Water Supply Service Area Plan

MPU
MANITOWOC
PUBLIC UTILITIES

CENTRAL BROWN COUNTY
WATER AUTHORITY

DATE ADOPTED: December 2025

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1. INTRODUCTION

1.1 Background on the City of Manitowoc and the CBCWA

The Manitowoc Public Utilities (MPU) water treatment plant (WTP), located at 1323 South 7th Street in the City of Manitowoc, Wisconsin (Manitowoc), was originally constructed in 1935 and was commissioned as a conventional WTP in 1970. The original WTP treated groundwater from collector wells near Lake Michigan before being converted to a surface water source using conventional treatment. The conventional WTP treated Lake Michigan water using flocculation, sedimentation, filtration, and disinfection to provide drinking water to Manitowoc. One raw water pumping station (RWPS) pulled lake water through a 48-inch-diameter, 9,000-foot-long intake to serve the WTP. Two collector wells (Collector A and C) near the lakeshore provide a back-up water supply and pump directly to the Manitowoc distribution system.

In 1999, the conventional WTP was decommissioned and replaced with a continuous microfiltration (CMF) treatment system sized to treat 11 million gallons per day (MGD). The flocculation and settling basins were converted to clear well storage, now referred to as the North Clearwell. The original clear well, now the South Clearwell, remained in service for a time but is currently empty because of a potential cross-connection issue and hydraulic limitations.

In 2005-2006, MPU demolished select portions of the conventional side of the WTP and installed membrane treatment using a submerged membrane filtration (SMF) system with a treatment capacity of 20 MGD. The gravity filters were decommissioned and some of the filter basins were converted to SMF basins.

A second lake water intake and RWPS was also constructed in 2005-2006. The second raw water intake is a 60-inch-diameter pipe extending 4,000 feet into the lake. RWPS No. 2 includes two pumps, each sized to pump 28 MGD, and both can deliver water to the MPU Power Plant and WTP.

Construction of the SMF plant coincided with MPU agreeing to supply treated drinking water to the newly formed Central Brown County Water Authority (CBCWA), which (at the time) was made up of six communities outside of the City of Green Bay (Allouez, Bellevue, Howard, De Pere, Ledgeview, Lawrence). The 2006 project included construction of a 3-million-gallon (MG) finished water reservoir and finished water pumping station (FWPS) that pumps water to the CBCWA communities.

CBCWA contributed toward the construction of the 2006 improvements. MPU owns and operates the WTP and pumping stations. An agreement between MPU and the CBCWA allocates up to 20 MGD of water treatment capacity to CBCWA from the SMF plant. In

2009, an amendment to the water supply agreement allocated the remaining space in the SMF plant (remaining gravity filter basins) to CBCWA for future expansion of treatment capacity by another 20 MGD.

In 2013, MPU placed the CMF system in long-term storage due to recurring treatment capacity issues with the CMF system. The combined demands of Manitowoc and CBCWA have allowed for both systems to be supplied by the SMF plant; however, this is not a viable long-term solution. After the completion of a Master Plan study by Strand Associates in 2024, the CMF plant is being considered for upgrades, retrofit or replacement with a new membrane technology due to the considerable sum of O&M expenses needed to bring this treatment system back online and functional.

In May of 2022, the Village of Denmark joined the CBCWA as a Customer Member. After construction of its pumping station and connection to the CBCWA transmission main, service to the Village began in March of 2024.

MPU and the CBCWA, are jointly undertaking this Water Supply Service Area Plan to comply with applicable planning requirements for consecutive systems. Since CBCWA is a wholesale customer of MPU, and the CBCWA member communities are wholesale customers of CBCWA, it is necessary to plan cooperatively for the related water service areas.

1.2 Requirements and Purpose of this Plan

As part of NR 854 and Wis. Stat. s. 281.348, public water supply systems serving a population of 10,000 or more and that own and utilize their own surface water or groundwater intakes must create a water supply area plan. The purpose of this plan is to illustrate compliance with the NR 854 requirements as follows:

- Identify both existing and future population and population density within the service area.
- Identify the City of Manitowoc and CBCWA Service Area(s).
- Inventory existing sources of water supply.
- Estimate water demand forecasts over the study period.
- Identify options for alternate water supply.
- Assess the environmental and economic impacts of implementing the proposed diversion.
- Demonstrate the plan effectively utilizes existing infrastructure.
- Identify procedures for implementing and enforcing the plan.
- Illustrate that the plan supports and is consistent with comprehensive plans for the service area.

This Water Supply Service Area Plan will not require oversight, review or approval by the department and is intended for utility use only.

1.3 Establishment of Planning Period

As referenced in NR 854.05(1), the Water Supply Service Area Plan shall identify the planning period covered by this plan. The planning period of this plan will be set equal to 15 years and will expire at the end of the planning period in 2040.

1.4 Jurisdictions Included in this Plan

Jurisdictions included in this plan include the following public water supply systems:

a. The City of Manitowoc and Manitowoc Public Utilities (PWSID#43603648)
b. The Village of Allouez and the Village of Allouez Water Department (PWSID#40504552)
c. The Village of Bellevue and the Bellevue Water Utility (PWSID#40504596)
d. The City of De Pere and the De Pere Water Department (PWSID#40504530)
e. The Village of Denmark and the Denmark Municipal Water Utility (PWSID# 40503518)
f. The Village of Howard and the Village of Howard Water and Sewer Department (PWSID# 40504684)
g. The Town of Lawrence and the Town of Lawrence Water Utility (PWSID# 40516256)
h. The Town of Ledgeview and the Ledgeview Sanitary District #2 (PWSID# 40514188)
i. The Central Brown County Water Authority (PWSID#43602878)

Further explanation follows regarding the role of water service area planning for each identified jurisdiction. MPU owns and operates a public water supply system that serves a population of 10,000 or more, and withdraws water from the waters of the state, and therefore must prepare a water supply service area plan.

The CBCWA is a consecutive system to, and a wholesale customer of, MPU. CBCWA does not withdraw water from the waters of the state but receives all of its water from MPU. CBCWA is not required to prepare a water supply service area plan but will be included in the planning required of MPU.

Allouez, Bellevue, De Pere, Denmark, Howard, Lawrence, and Ledgeview are each consecutive systems to, and wholesale customers of, CBCWA. Each of these communities rely on CBCWA, and in turn MPU, for their primary supply of water. Each of these communities also owns and operates one or more groundwater wells that are capable of withdrawing water from waters of the state, but these wells are under

WDNR-approved Extended Well Abandonment Agreements. Thus, these wells are used only for emergency back-up supply. Additionally, the Village of Denmark and the Towns of Lawrence and Ledgeview currently have a population of less than 10,000. Allouez, Bellevue, De Pere, Denmark, Howard, Lawrence, and Ledgeview are not required to prepare water supply service area plans but will be included along with CBCWA in the planning required of MPU.

1.5 Delineation of Water Supply Area(s)

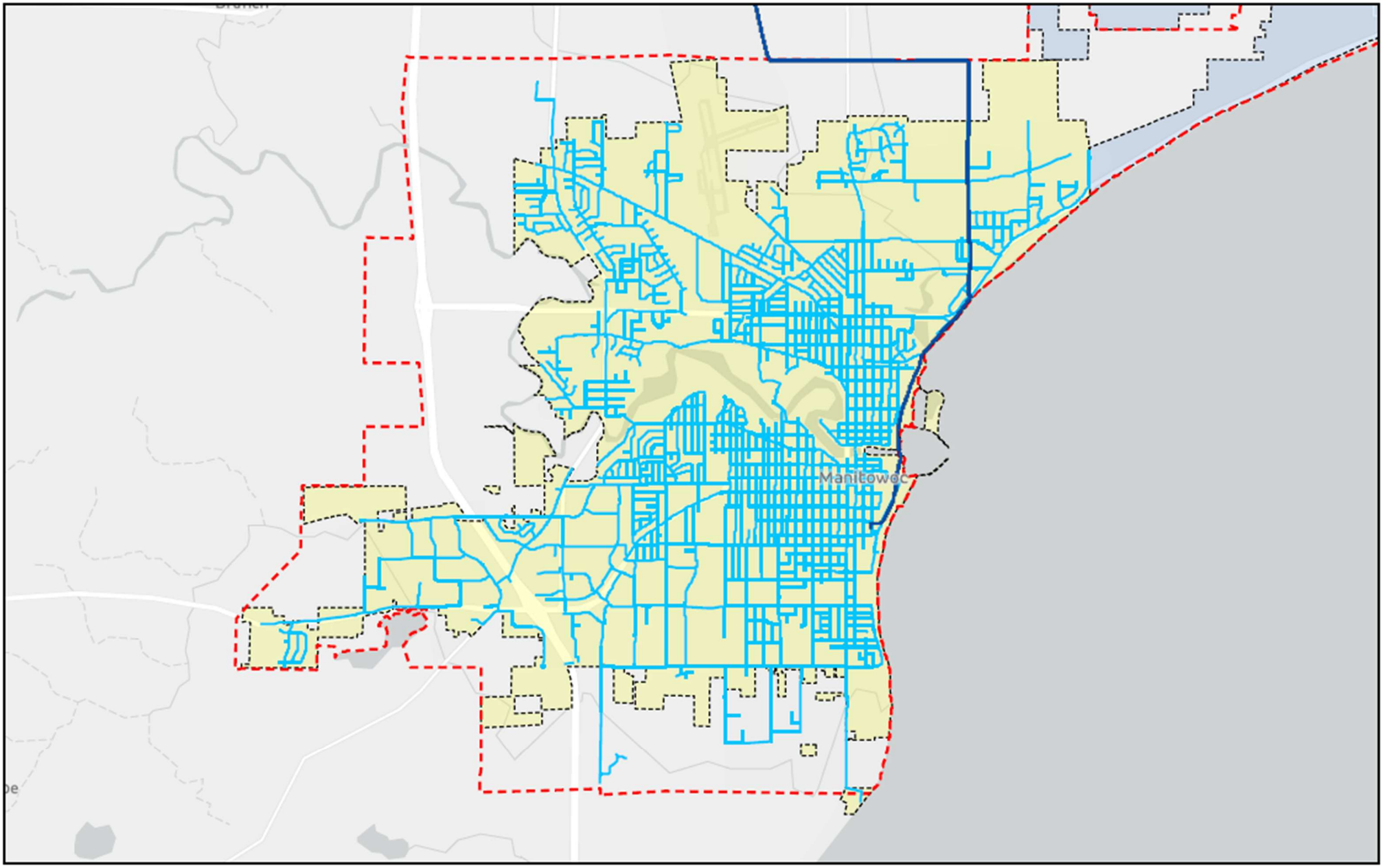
Per requirements listed in NR 854.05(2)(a), the water supply service area plan shall delineate the area for which the plan is being prepared, including all areas to which the public water supply system currently serves retail customers and the projected growth area for the system within the planning period.

Figure 1 depicts the existing water supply area as well as the projected growth area of the City of Manitowoc. The projected growth area is based on the Manitowoc-Two Rivers-Mishicot Sewer Service Area (SSA) developed in part with the Bay-Lake Regional Planning Commission. Per Manitowoc's 2023 Comprehensive Plan: "*This boundary, which includes the City and portions of adjacent towns, depicts the area planned for urban development with a full range of services including public water and sewer.*"

Additionally, Figure 2 depicts the existing water supply areas of the CBCWA communities which follow their respective municipal boundaries.

MANITOWOC PUBLIC UTILITIES

Figure 1: City of Manitowoc Water Service Area



CBCWA Transmission Main

Water Mains

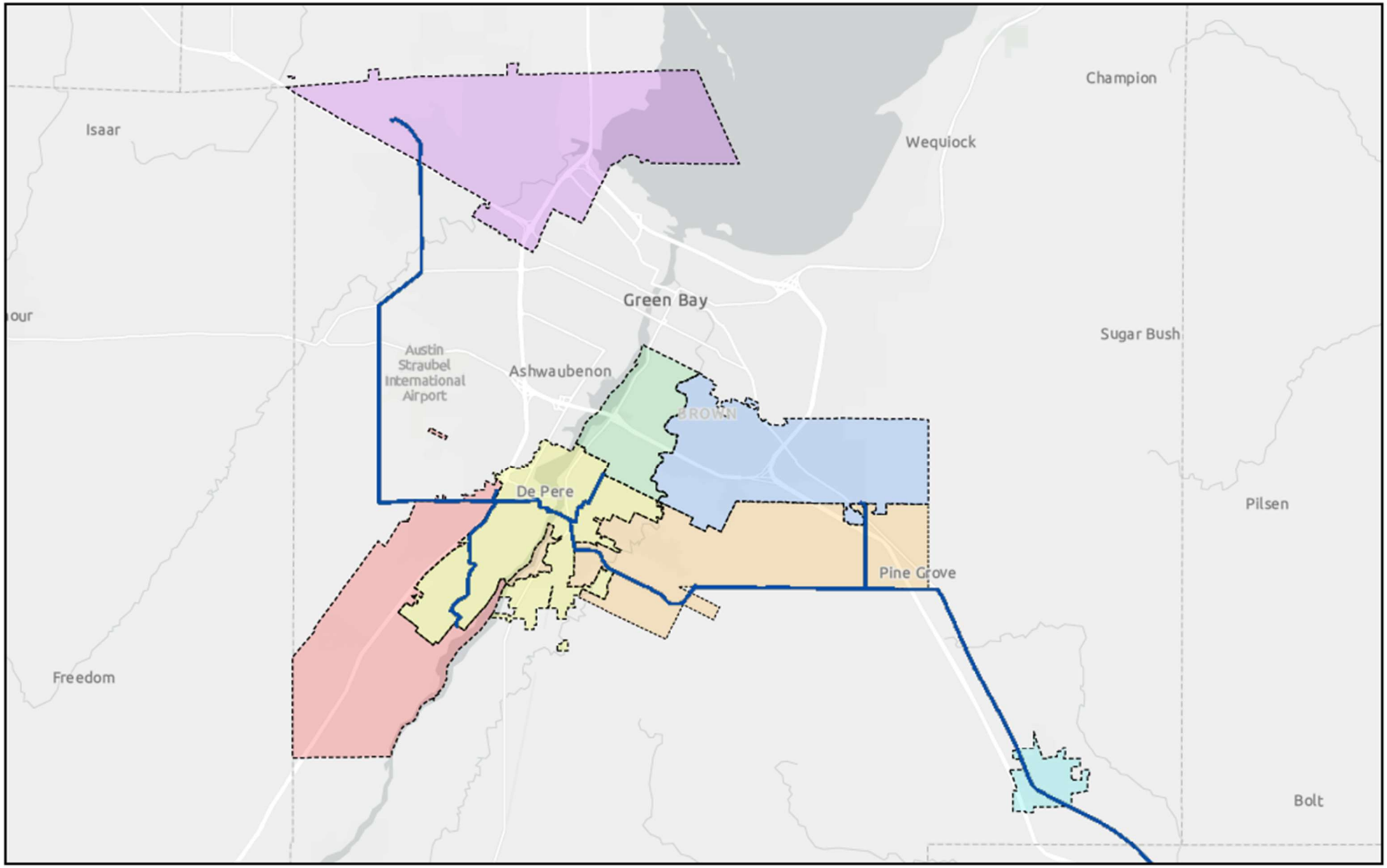
Manitowoc SSA Boundary

Manitowoc boundary

Two Rivers boundary

Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, (c) OpenStreetMap contributors, and the GIS User Community, Sources: Esri, TomTom, Garmin,

Figure 2: CBCWA Water Service Areas



Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, (c) OpenStreetMap contributors, and the GIS User Community, Sources: Esri, TomTom, Garmin,

2. EXISTING WATER SUPPLY

2.1 Water Supply System

2.1.1 Existing Sources Serving the System

Manitowoc and the CBCWA communities obtain source water from Lake Michigan primarily using two intake pipes and two Raw Water Pump Stations (RWPS). There is a 48-inch-diameter intake pipe that extends approximately 9,000 feet from shore and delivers water to RWPS No. 1. This intake and pumping station were constructed in 1970. The second intake includes a 60-inch-diameter pipe that extends approximately 4,000 feet from the shore and connects RWPS No. 2, which was constructed in 2006.

A. RWPS No. 1

The RWPS No. 1 building includes a main operating floor, lower level, and below grade shore well. The main floor includes the pump motors, traveling screen head, and electrical gear. The lower level includes the pump discharge piping, chemical feed system, and access to the shore well.

The 48-inch intake pipe connects to a 32-foot-diameter cylindrical shore well beneath RWPS No. 1. The bottom of the shore well is approximately 50 feet below the main floor of the pumping station. Water enters the shore well where a travelling screen removes large debris. Five vertical turbine pumps extend into the shore well downstream of the travelling screen and pump water through the discharge piping to the raw water header outside the pumping station. The wet well is split into two separate halves: Pump Nos. 1, 2, and 3 are on one side, and Pump Nos. 4 and 5 are on the other side. A sluice gate allows water to flow between the halves.

Typically, Pump Nos. 1, 2, and 3 can only feed water to the CMF plant, which operates at a higher head than the other pumps; however, a normally closed isolation valve in the yard piping could be opened to allow these pumps to provide water to the power plant and SMF plant. The CMF plant is currently out of service, so these three pumps are inactive. Pump Nos. 4 and 5 are primarily controlled by the MPU power plant for cooling water supply, but the pumps also feed the SMF plant using the same header.

Table 1: RWPS No. 1 Pump Capacities

Pump No.	Capacity (gpm)	Capacity (MGD)	Horsepower (hp)
1	5,000	7.2	300
2	7,200	10.4	300
3	7,200	10.4	300
4	15,000	21.6	300
5	15,000	21.6	300

Piping in the lower level of the pumping station includes an auxiliary warm water feed line coming from the power plant that can be used to mix noncontact cooling water from the power plant with lake water. MPU uses this connection during cold weather months to maintain a water temperature of approximately 40 degrees Fahrenheit (°F) to the WTP. Plant operators control the mixing valve manual via the SCADA system to achieve the desired temperature.

B. RWPS No. 2

RWPS No. 2 includes a main operating floor constructed above a cylindrical shore well. The pump motors, discharge piping, and electrical gear are accessed from the main floor. There is no lower level.

RWPS No. 2 includes a 35-foot-diameter shore well that extends to a depth of 46 feet below the main floor of the pumping station. There is no travelling screen in this pumping station. There is a Johnson Wedgewire intake screen on the end of the intake pipe that block large debris from entering the intake pipe and shore well.

Two vertical turbine pumps draw water from the shore well and pump to the raw water header outside the pumping station. The piping allows this pumping station to pump to the MPU Power Plant and the Submerged Microfiltration Plant at the WTP. The pumps are numbered as Nos. 6 and 7 to be sequential with the pumps in RWPS No. 1. The station has space for two additional future pumps. At maximum capacity, RWPS No. 2 was designed to deliver 92 MGD if all four pumps were installed. There are intake barrels surrounding the pump bowls on each pump that reduce vortexing in the wet well.

The RWPS No. 2 also has warm water capabilities, but is only used to address frazil icing at the Johnson Wedgewire intake screens

Table 2: RWPS No. 2 Pump Capacities

Pump No.	Capacity (gpm)	Capacity (MGD)	Horsepower (hp)
6	19,444	28.0	400
7	19,444	28.0	400

C. RWPS No. 3

RWPS No. 3, primarily maintained and operated by the MPU Power Plant, has hydraulic capabilities of supplying raw water to the Water Plant in extreme emergencies when RWPS No. 1 and No. 2 are limited or not functional. RWPS No. 3 possesses two rock crib intakes that feed three power plant wet wells. Four vertical turbine pumps draw water from the wet well(s) to a raw water header

outside of the pumping station. This header pipe has a valve connection to the raw water piping exiting RWPS No. 1 and RWPS No. 2.

Table 3: RWPS No. 3 Pump Capacities

Pump No.	Capacity (gpm)	Capacity (MGD)	Horsepower (hp)
10	15,000	21.6	300
11	15,000	21.6	300
12	8,000	11.5	150
13	8,000	11.5	150

Additionally, there are two groundwater wells in operation that provide a backup source water to the Manitowoc distribution system. The wells are Ranney Collector Wells that have a combined capacity of 14 MGD. The wells are designed to feed the Manitowoc distribution system via a 24" pipe that directly feeds the New York Reservoir.

D. Collector A

Collector A was constructed in 1944 by the Ranney Water Collector Corporation. The well is constructed with a 13-foot-diameter caisson to a depth of 66 feet. There are two tiers of collector laterals extending radially out from the caisson. The laterals vary in length. Tier A laterals are at a height of approximately 2 feet above the caisson floor and the total length of Tier A laterals is 271 feet. Tier B is at a height of approximately 7 feet above the caisson floor and the total length of Tier A laterals is 270 feet.

There are two pumps installed in Collector A. The pumps are denoted as Pumps A1 and A2. Pump A1 has a rated capacity of 2,800 gpm at a TDH of 283 feet and is driven by a 250-hp motor. Pump A2 has a rated capacity of 1,200 gpm at a TDH of 283 feet and is driven by a 125-hp motor.

The Collector A well house includes a pump room with electrical gear, well pumps, and discharge piping. Pump-to-waste piping and valves allow the pumps to discharge out the east wall toward the lake. A separate room houses a chlorine gas disinfection system. Chlorine gas is pulled into a feed water line by a vacuum ejector and fed directly to the well. Collector A provides safe drinking water, but is seldom used due to relatively high hardness when compared to the WTP and Collector C.

E. Collector C

Collector C was constructed in 1958. The collector includes a 13-foot-diameter caisson well constructed to a depth of 85 feet below the pump room floor. There

are two tiers of collector laterals extending radially out from the caisson. The laterals vary in length. Tier A laterals are at a height of approximately 2 feet above the caisson floor, and total length of Tier A laterals is 708 feet. Tier B is at a height of approximately 7 feet above the caisson floor and the total length of Tier A laterals is 328 feet.

There are two pumps installed in Collector C. The pumps are denoted as Pumps C4 and C5. Both pumps have a rated capacity of 2,800 gpm at a TDH of 290 feet and are driven by 250-hp motors.

The structure includes two operating floors above the caisson. The lower floor contains the well pumps and discharge piping. The upper floor is the primary access point from the exterior and includes a prepackaged chemical feed system for addition of a blended phosphate corrosion inhibitor. There are two sets of chemical tanks and feed pumps, one dedicated to each well pump. The lower level is accessed through a floor opening and steel ladder. The well pumps can be accessed through a roof hatch and upper floor grating, and a mandoor.

There is a separate building near the collector that includes an electrical room and a chlorine gas feed room. The primary electrical service is fed from the MPU electrical distribution system and has a back-up service supplied by Wisconsin Public Service (WPS).

The chlorine gas feed system includes two 150-pound cylinders, scales, a carrier water pump, and ejectors set to feed either directly to the well or to the discharge piping in a buried vault north of the collector structure. The system includes a Hydro Instruments Omni-Valve Series 110 control and was installed in 2017.

Collector C also provides safe drinking water, and would act as the preferred backup should the WTP be unavailable or additional water supply is needed.

2.1.2 Existing Source Water Quality Issues

Lake Michigan source water pumped from the RWPS's can experience seasonal and weather-related water quality issues. Typically, after storm events that involve high winds or exceptional rainfall events, influent Lake Michigan source water can have conductivity levels that spike above normal conditions. Analyzers measuring conductivity at the WTP read normal conductivity levels around 290 µs (micro-siemens). Conductivity during the weather events described above have the potential to exceed 340 µs. Conductivity, a measure of the ability of water to pass an electric current is a relatively reliable parameter when it comes to determining changes in water quality and overall understanding of the influent level of dissolved solids.

During events of high conductivity, operations staff are required to increase the levels of chlorine dosage due to the increase in chlorine demand from the poor water quality entering the WTP. Similar events occur when lake temperatures increase during warm summer months. The warm lake water is also inducive to water quality related issues. The combination of poor influent water quality and increased chlorine demand can have aesthetic taste and odor changes that are noticed by more-sensitive residents across the City of Manitowoc and CBCWA communities.

During these events, the WTP microfiltration membranes continue to act as a barrier to pathogenic organisms found in Lake Michigan, such as Cryptosporidium and Giardia. Water that passes through the microfiltration process undergoes up to 30 tests each day in the WTP Laboratory. MPU has not had any violations for detections of contaminants that exceed Health Advisory Levels.

Although not a water quality issue, a reoccurring threat that temporarily disables the usage of RWPS #2 is the build-up of frazil ice on the cylindrical Johnson Wedgewire screen during frigid winter days and nights. MPU Operations are able to eliminate frazil ice by redirecting discharge water from WDNR permitted outfalls back to the RWPS #2 wet well. At the same time, the RWPS #2 pumps are turned off. Hydraulically, the level within the wet well is able to reverse the direction of flow in RWPS #2 and in result is able to dislodge the frazil ice, allowing the pump station to be brought back online.

Additionally, in the occasion when Collector A or C are used to supply water to the City of Manitowoc distribution system, industries that may have specialized processes and equipment are prone to notice and are sensitive to the differing quality of potable water. Specifically, groundwater pumped from the two Collector wells have hardness levels two to three times the level of treated Lake Michigan source water. For reference in recent tests conducted in 2019, water samples tested for Tap 81 (SMF treated Lake Michigan source water) found that hardness levels were approximately 140 mg/L. Past water samples collected and tested from Collector C discharge consistently find that hardness levels are approximately 330 mg/L. Hardness, a measured concentration of dissolved minerals such as calcium and magnesium, is known to cause buildup in plumbing and fixtures and could potentially affect the efficiency of equipment at industries across the City of Manitowoc. Upon MPU Water Department initiative, when Collector A or C are called to run operators are tasked to call a list of commercial and industrial customers that should be notified of change in water quality to help mitigate any challenges they may endure during Collector well operation.

2.1.3 Relationship to Consecutive Systems

On July 20th, 2004, a water purchase and sale agreement was established between the CBCWA and MPU. Beginning December 1st, 2006, MPU has been obliged to continuously supply the CBCWA with up to 20 million gallons per day of potable water. The demand of 20 MGD is representative of the rated capacity of the Submerged Microfiltration (SMF) Plant built in relation to the water purchase and sale agreement. The CBCWA has the exclusive right to 100% of the SMF plants capacity. As permitted in the agreement, MPU actively utilizes the excess capacity not used by CBCWA throughout the year.

MPU owns, operates and maintains all MPU water supply facilities necessary to deliver potable water to the CBCWA point of purchase. The MPU water supply facilities built as part of the water purchase and sale agreement include but are not limited to the Raw Water Pump Station #2, the Submerged Microfiltration Plant, and the Finished Water Pump Station. The CBCWA paid for the capital cost of these MPU water supply facility assets.

Allouez, Bellevue, De Pere, Denmark, Howard, Lawrence, and Ledgeview are each consecutive systems to, and wholesale customers of, CBCWA. Each of these communities rely on CBCWA, and in turn MPU, for their primary supply of water.

On May 29th, 2014, a water supply service agreement was established between MPU and Two Rivers. Two Rivers, a neighboring community to Manitowoc is allowed to purchase water from MPU as may be needed up to a maximum rate of 2,000,000 gallons per day. Only in the event of an emergency, may MPU temporarily reduce the volume of water provided to Two Rivers, or temporarily cease providing water. Emergency occurrences are defined as “an act of god, an equipment or water main failure and a consequential interruption of water available for distribution” to Two Rivers.

2.2 Existing Water Sources Withdrawals

2.2.1 Water Supply to City of Manitowoc and CBCWA Communities

As part of Wisconsin DNR requirements, MPU is subject to a Water Use permit issued on a 10-year cycle due to withdrawing over 100,000 gallons per day in any 30-day period from the Great Lakes Basin. Issued last on November 16, 2021, Manitowoc Public Utilities Water Use Individual Permit (Property #266) allows the utility to withdraw up to 208,100,000 gallons per day. This quantity includes withdraws necessary for both water treatment and distribution to the City of Manitowoc and CBCWA communities but also cooling water applications at the neighboring MPU-owned electric and steam generating power plant. Annually, MPU is required to report

to the WDNR the total Water Withdrawal in gallons from each water source, and pay the annual water withdrawal fee to the WDNR.

Water supply sources, RWPS #1, #2 and #3 directly withdraw water from Lake Michigan. Collector A and C withdraws groundwater that is directly sourced from Lake Michigan. All sources being a part of the Great Lakes Basin.

2.2.2 Maximum Withdrawal Capacity for Each Source

Below in Table 4, is a documentation of the existing maximum pumping capacity of the existing water sources serving the City of Manitowoc and CBCWA communities.

Table 4: Water Source Maximum Capacities

Water Source	Existing Maximum Capacity
RWPS #1	70 MGD
RWPS #2	56 MGD[1]
RWPS #3	68 MGD
Collector A	6 MGD
Collector C	8 MGD
CBCWA Water Supply Capacity Total	**194 MGD**
Manitowoc Water Supply Capacity Total	**208 MGD**

2.2.3 10-Year History of Total Water Use for Each Source

During normal operations, RWPS #1 and #2 work in tandem to supply raw water to the SMF water treatment plant and MPU power plant. Hydraulically RWPS #1 is the primary pumping station that actively feeds raw water to the SMF plant. Only when RWPS #1 is offline due to emergency, maintenance and cleaning occurrences will RWPS #2 flow be used to actively feed raw water to the SMF plant. As previously discussed, Collector A and C act as a backup water supply source and for even further emergency water supply, RWPS #3 can be used. Table 5 below summarizes the average daily flow from each water supply source and also the flow split amongst the City of Manitowoc and CBCWA communities.

Table 5: Average Daily Flow (ADF) from Water Supply Sources

Year	ADF RWPS1, MGD	ADF RWPS2, MGD	ADF Collector A, MGD	ADF Collector C, MGD	ADF Manitowoc, MGD	ADF CBCWA[2], MGD	ADF Backwash, MGD
2024	14.39	0.23	0.00	0.02	5.56	7.68[3]	1.47
2023	14.05	0.16	0.00	0.00	6.09	7.11	1.45
2022	13.67	0.07	0.00	0.00	5.80	6.93	1.43

[1] As previously noted, RWPS #2 was designed to deliver 94 MGD in the circumstances that all four raw water pumps were installed. As of 2025, pumps No. 5 and No. 6 have the capacity to supply 56 MGD.
[2] Breakdown by individual CBCWA communities listed in Table 6 below.
[3] Includes increase in flow supplied to Denmark upon connection to CBCWA transmission line.

2021	13.62	0.14	0.00	0.00	5.99	6.80	1.39
2020	13.44	0.00	0.00	0.00	5.66	6.70	1.35
2019	12.31	0.82	0.00	0.00	5.39	6.72	1.34
2018	13.43	0.00	0.00	0.00	5.41	6.76	1.42
2017	12.73	0.34	0.00	0.01	5.24	6.22	1.31
2016	13.09	0.00	0.01	0.13	5.41	6.38	1.44
2015	13.10	0.27	0.00	0.02	5.33	6.61	1.55

2.3 Description of Existing Water Use

2.3.1 Population and Population Density of the Existing Service Area(s)

The population of the City of Manitowoc is approximately 34,626 based on the U.S. Census Bureau's most recent estimates completed in 2020. Per the 2024 Annual Public Service Commission report, there are 14,001 metered customers. Additionally, there are 110 metered customers located outside of city limits in the Town of Manitowoc and Town of Newton.

The existing population density of the City of Manitowoc has been grossly estimated based on land area and overall population of the City of Manitowoc. Manitowoc possesses a land area of approximately 12,475.9 acres (19.5 square miles). The average population density of the City of Manitowoc is approximately 2.8 persons per acre (or 1,776 persons per square mile).

2.3.2 City of Manitowoc 10 Largest Retail Customers

As per requirements in NR 854.05(5)(d), listed below in Table 6 are the City of Manitowoc's 10 largest retail water customers.

Table 6: City of Manitowoc Top 10 Largest Retail Customers

Customer Name	Total Gallons Sold Last 10 Years	Equivalent Water Demand (gal/day)
Briess Malt & Ingredients Company	1,977,335,756	541,365
Lakeside Foods Inc.[4]	1,261,932,100	345,498
Federal Mogul Powertrain	1,149,091,064	314,604
Jagemann Plating	507,907,708	139,058
Parker Hannifin Corporation	443,331,372	121,378
Northern Laboratories	347,143,808	95,043
MPU Power Plant	296,058,400	81,056
Kerry Inc.	279,291,232	76,466
Holy Family Memorial Hospital	278,970,340	76,378
International Paper Company	240,856,000	65,943

[4] As of 2025, a major cleaning and canning operating facility owned by Lakeside Foods has shut down. It is expected that approximately 500,000 gallons per day typical of summer demand for the facility will no longer be sold.

2.3.3 10-Year History of Water Purchases by Customers

By requirement, each water utility is required to submit financial and utility data annually to the Public Service Commission (PSC) of Wisconsin. The PSC collects this information to post for public access. The data found in Table 7 below was taken from page W-02 (Water Operating Revenues – Sales of Water) of Manitowoc's annual PSC reports. Additionally, Table 6 below lists the water purchases by each CBCWA consecutive water system customer as reported on page W-14 of respective annual PSC reports.

Table 6: Water Sales to CBCWA Customers

Year	Allouez		Bellevue		De Pere		Howard		Lawrence		Ledgeview		Denmark	
	Gallons Sold	MGD	Gallons Sold	MGD	Gallons Sold	MGD	Gallons Sold	MGD	Gallons Sold	MGD	Gallons Sold	MGD	Gallons Sold	MGD
2024	374,476,000	1.03	473,919,000	1.30	758,422,000	2.08	698,442,000	1.91	140,718,000	0.39	228,018,000	0.62	150,521,000	0.41
2023	368,654,000	1.01	476,559,000	1.31	756,502,000	2.07	671,630,000	1.84	116,830,000	0.32	227,024,000	0.62	-	-
2022	358,256,000	0.98	419,301,000	1.15	738,138,000	2.02	656,082,000	1.80	105,086,000	0.29	227,880,000	0.62	-	-
2021	376,839,000	1.03	451,459,000	1.24	715,996,000	1.96	596,792,000	1.64	99,308,000	0.27	218,481,000	0.60	-	-
2020	399,596,000	1.09	446,642,000	1.22	706,622,000	1.94	578,442,000	1.58	98,133,000	0.27	223,491,000	0.61	-	-
2019	398,950,000	1.09	407,138,000	1.12	744,395,000	2.04	587,371,000	1.61	88,050,000	0.24	212,413,000	0.58	-	-
2018	402,567,000	1.10	384,389,000	1.05	796,583,000	2.18	623,689,000	1.71	90,598,000	0.25	192,810,000	0.53	-	-
2017	380,464,000	1.04	380,775,000	1.04	767,069,000	2.10	572,804,000	1.57	86,870,000	0.24	167,992,000	0.46	-	-
2016	389,759,000	1.07	396,384,000	1.09	770,468,000	2.11	578,710,000	1.59	86,667,000	0.24	169,951,000	0.47	-	-
2015	417,362,000	1.14	447,477,000	1.23	754,607,000	2.07	598,115,000	1.64	87,048,000	0.24	173,653,000	0.48	-	-

Table 7: City of Manitowoc Summary of Water Sales to Customers

Year	Retail			Commercial			Industrial			Public Authority			Multifamily Residential		
	# of Meters	Gallons Sold	MGD	# of Meters	Gallons Sold	MGD	# of Meters	Gallons Sold	MGD	# of Meters	Gallons Sold	MGD	# of Meters	Gallons Sold	MGD
2024	12,689	531,732,000	1.46	925	170,187,000	0.47	139	775,645,000	2.13	90	44,559,000	0.12	268	88,156,000	0.24
2023	12,638	559,455,000	1.53	922	164,757,000	0.45	141	813,929,000	2.23	90	40,034,000	0.11	272	89,970,000	0.25
2022	12,554	533,942,000	1.46	920	172,228,000	0.47	138	788,177,000	2.16	91	31,019,000	0.08	272	91,943,000	0.25
2021	12,508	544,639,000	1.49	905	179,537,000	0.49	134	834,756,000	2.29	67	34,801,000	0.10	267	84,242,000	0.23
2020	12,486	550,613,000	1.51	898	164,897,000	0.45	136	785,685,000	2.15	66	34,282,000	0.09	259	84,144,000	0.23
2019	12,454	516,373,000	1.41	895	175,761,000	0.48	138	777,613,000	2.13	66	43,247,000	0.12	261	80,674,000	0.22
2018	12,429	545,643,000	1.49	889	185,632,000	0.51	132	742,761,000	2.03	67	45,589,000	0.12	256	80,862,000	0.22
2017	12,400	526,012,000	1.44	885	186,391,000	0.51	132	797,205,000	2.18	66	47,527,000	0.13	256	81,206,000	0.22
2016	12,383	540,840,000	1.48	880	185,829,000	0.51	131	788,438,000	2.16	67	42,880,000	0.12	254	86,253,000	0.24
2015	12,345	555,402,000	1.52	878	177,551,000	0.49	132	759,143,000	2.08	68	51,676,000	0.14	245	83,424,000	0.23

3. Future Water Demand

3.1 City of Manitowoc Projected Total Water Demand

Four variables were considered in the estimation of the City of Manitowoc's projected total water demand through the year 2040:

1. Population
2. Historical Per Capita Sales
3. Water Loss
4. Maximum Day Peaking Factor

Results indicate that total water demand projections reflect similar water demands seen today due to Manitowoc's overall stagnant population growth. Table 8 below summarizes the estimated total water demands for year 2030 and 2040.

Table 8: City of Manitowoc Future Water Demands

Year	Projected Average Daily Water Demand (gal/day)	Projected Max Daily Water Demand (gal/day)
2030	5,295,000	7,625,000
2040	5,340,000	7,689,000

The following sections detail the four variables and provide rationale for their significance to water demand projections.

3.1.1 Population Projection

Overall, the City of Manitowoc has experienced relatively modest population changes the past 50 years. With this, water demands have remained stagnant with average daily demands (ADD) roaming around 5.4 MGD for the past 10 years. This population trend is expected to continue over the next 15 years. Population projections developed as part of Manitowoc's latest Comprehensive Plan and Wisconsin Department of Administration (WDOA) annual analysis, show that populations will remain constant and may actually decrease. A comparison of the two population projections through 2040 are listed below in Table 9.

Table 9: City of Manitowoc Population Projections through 2040

Year	WDOA Population Projection	Comprehensive Plan Population Projection
2020	34,626 (census data)	
2030	33,529	34,889
2040	31,856	35,184

These population projections likely take into consideration that Manitowoc's population is getting older and is notably older than the state average. The City's median age is 45 and percent of the population over the age of 65 is 22%, while the state median age is 40 and the state percent of the population over the age of 65 is 17%. Additional population growth limitations include existing barriers to housing development and the lack of space for new business park development as detailed in Manitowoc's comprehensive plan. For a conservative estimate, the comprehensive plan population projections were used in the estimation of the City of Manitowoc's total water demand for years 2030 and 2040 listed in Table 9 above.

3.1.2 Per Capita Sales

To estimate future water demand projections, data presented in Table 8 above was used to calculate per capita sales by customer types. Manitowoc, a community that possesses a well dispersed blend of residential, commercial, and industrial customers has a sale of 129 gallons per capita per day. This average was derived based on the previous 15-years per capita sales as shown in Table 10 below. Industrial customers have a large impact on the fluctuation of per capita sales. For instance, industries employ large portions of the population of Manitowoc but also account for majority of water sales in the community. To emphasize the impact of the industrial sector of Manitowoc, in 2015 the opening of a new industry to the City, Briess Malt & Ingredients Company, noticeably increased the water consumption by roughly 13 gallons per capita per day. Taking into consideration the restricted growth opportunity of Manitowoc's industrial park, it is expected that per capita sales shall remain consistent throughout the Water Supply Service Area planning period.

Table 10: Sales for the City of Manitowoc (gallons/capita/day)

Year	Residential	Commercial	Industrial	Public Authority	Multi-Family Residential	Total
2010	48	22	54	5	-	129
2011	49	22	48	5	-	124
2012	51	21	49	5	-	126
2013	47	18	49	5	3	122
2014	45	14	49	5	7	120
2015	45	14	62	4	7	132
2016	44	15	64	3	7	133
2017	43	15	65	4	7	134
2018	44	15	60	4	7	130
2019	42	14	63	4	7	129
2020	44	13	62	3	7	128
2021	43	14	66	3	7	133
2022	42	14	62	2	7	128
2023	44	13	64	3	7	132
2024	42	13	61	4	7	127

Average	**43**	**13**	**63**	**3**	**7**	**129**

3.1.3 Water Loss

A significant contributor to meeting water demands is the hidden impact of uncontrolled water loss. An indication of a water systems aging infrastructure, water loss is typically random year-to-year, but can be estimated when looking at historical data. The last 10-years' worth of water loss is documented below in Table 11. As shown, on average 20% of water pumped into the distribution system is lost to unknown leaks and/or unmetered water customers. With increased efforts to replace old segments of water infrastructure and detect hidden leaks in the system, a 15% water loss will be utilized for future water demand projections.

Table 11: City of Manitowoc Historical Water Loss

Year	Water Sales (gal/day)	Water Pumped (gal/day)	Percent Loss
2015	4,455,020	5,351,860	17%
2016	4,501,684	5,380,886	16%
2017	4,485,533	5,400,142	17%
2018	4,381,895	5,422,068	19%
2019	4,363,225	5,340,688	18%
2020	4,434,281	5,622,795	21%
2021	4,594,045	5,871,518	22%
2022	4,427,951	5,674,408	22%
2023	4,664,164	6,090,918	23%
2024	4,490,305	5,557,752	19%
Average			**20%**

3.1.4 Maximum Day Peaking Factor

Typically contributed to the hottest and driest periods of summer, the maximum water demand day is an important variable when determining whether the water supply intake(s) can meet the spike in demand. This factor was calculated based on a ratio of the maximum water purchased in one day from each of the last 5 years (2020-2024) versus the average water purchased per day as reported via annual PSC reports. A summary of the calculated maximum day peaking factors is listed below in Table 12.

Table 12: City of Manitowoc Maximum Day Peaking Factor

Year	Maximum Day Peaking Factor
2020	1.43
2021	1.31
2022	1.50
2023	1.50

2024	1.46
Average	**1.44**

3.2 Projected Total Water Demand for CBCWA Members

The four variables considered in the projection of Manitowoc's water demand were also used to estimate water demand projections for the various CBCWA communities:

1. Population
2. Historical Per Capita Sales
3. Water Loss
4. Maximum Day Peaking Factor

Results indicate that total water demand projections will continue to grow steadily due to the CBCWA's overall natural population growth. Table 13 below summarizes the estimated total water demands for year 2030 and 2040.

Table 13: Projected Water Demands of CBCWA Communities

Year	Projected Average Daily Water Demand (gal/day)	Projected Max Daily Water Demand (gal/day)
2030	7,941,000	12,725,000
2040	8,688,000	13,983,000

The following sections detail the four variables and provide rational for their significance to water demand projections.

3.2.1 Population Projection

As a whole, CBCWA community populations are expected to steadily increase over the span of the water supply planning period. A common theme laid out in each community's comprehensive plan emphasizes the need to plan affordable housing developments for the expected increase in population. Development sparked by the new "Southern Bridge" corridor is also expected to drive significant future growth, especially for the communities located along the new transportation corridor (i.e., De Pere, Lawrence, Ledgeview, and Bellevue). Currently, cumulative water demands for the seven CBCWA communities' averages around 7.3 MGD ADD. Population projections developed as part of CBCWA communities latest Comprehensive Plans and Wisconsin Department of Administration (WDOA) annual analysis, show that populations will steadily increase for the majority of the communities. A comparison of the two population projections through 2040 are listed below in Table 14.

Table 14: CBCWA Communities Population Projections through 2040

City	2020 (census)	Comprehensive		WDOA	
		2030	2040	2030	2040
Allouez	14,156	14,355	14,554	13,508	12,895
Bellevue	15,935	19,140	20,780	17,828	19,663
De Pere	25,410	29,550	31,280	25,264	25,145
Howard	19,950	26,110	29,370	23,676	27,277
Lawrence	6,306	9,696	13,086	8,100	9,831
Ledgeview	8,820	10,810	12,480	10,957	13,022
Denmark	2,408	2,490	2,565	2,545	2,679
CBCWA Totals	92,985	112,151	124,115	101,878	110,512

For a conservative estimate, the comprehensive plan population projections were used in the estimation of the CBCWA's total water demand for years 2030 and 2040 listed in Table 14 above.

3.2.2 Per Capita Sales

Customer water sales for each CBCWA community present a different demographic to what is experienced in Manitowoc. Predominantly, the CBCWA communities act as bedroom communities to Green Bay with limited industrial water demand. Due to the dominant residential demographic, with the exception of Denmark, per capita water sales are significantly lower than a community like Manitowoc as shown in Table 15 below.

Table 15: CBCWA Water Demand (gallons/capita/day)

Year	Allouez	Bellevue	De Pere	Howard	Lawrence	Ledgeview	Denmark
2020	69	59	62	68	39	28	143
2021	63	61	66	67	39	28	142
2022	57	58	64	68	38	27	149
2023	57	60	66	73	42	30	159
2024	57	59	63	68	38	27	181
Average	**60**	**59**	**64**	**69**	**39**	**28**	**155**

In contrast, Denmark has experienced a significant surge in water demand in the industrial sector of their community in recent years as displayed in Table 15. In result, Denmark has a much higher gallons per capita albeit the smallest of the CBCWA communities. Without knowing what the future entails, if one or more CBCWA communities begin to expand with the introduction of new industrial customers, water demands may begin to drastically increase. For now, the 5-year average(s) calculated in Table 15 above will be used to project future water demands in years 2030 and 2040 for each community.

3.2.3 Water Loss

Similar to Manitowoc, a significant contributor to meeting water demands is the hidden impact of uncontrolled water loss. An indication of a water systems aging infrastructure, water loss is typically random year-to-year, but can be estimated when looking at historical data. The last 5-years' worth of water loss is documented below in Table 16. As shown, on average 9-19% of water pumped into the distribution system is lost to unknown leaks and/or unmetered water customers dependent on the community. It is assumed that the range varies amongst communities due to the age of the existing water infrastructure. A blanket 15% water loss will be utilized for future water demand projections.

Table 16: CBCWA Communities Water Loss Percentage

Year	Allouez	Bellevue	De Pere	Howard	Lawrence	Ledgeview	Denmark
2020	10%	20%	16%	14%	7%	13%	2%
2021	17%	15%	13%	13%	9%	13%	7%
2022	19%	13%	17%	21%	11%	16%	15%
2023	20%	23%	17%	18%	10%	12%	11%
2024	22%	23%	19%	21%	31%	17%	10%
Average	**18%**	**19%**	**16%**	**17%**	**14%**	**14%**	**9%**

3.2.4 Maximum Day Peaking Factor

Typically contributed to the hottest and driest periods of summer, the maximum water demand day is an important variable when determining whether the water supply intake(s) can meet the spike in demand. Considering each CBCWA community is a little bit different in their makeup, whether that be the size, customer demographic, age of water infrastructure, availability of water storage, etc., a maximum day peaking factor was calculated for each community. This factor was calculated based on a ratio of the maximum water purchased in one day from each of the last 5 years (2020-2024) versus the average water purchased per day as reported via annual PSC reports. A summary of the calculated maximum day peaking factors is listed below in Table 17.

Table 17: CBCWA Communities Maximum Day Peaking Factor

Year	Allouez	Bellevue	De Pere	Howard	Lawrence	Ledgeview	Denmark
2020	1.72	1.87	1.37	2.01	1.95	1.47	1.51
2021	1.51	2.33	1.51	1.51	2.56	2.19	1.42
2022	1.23	2.06	1.60	1.43	1.04	2.12	1.47
2023	1.37	1.85	1.29	1.56	2.24	2.08	1.64
2024	1.26	1.22	1.58	1.29	1.71	1.68	1.73
Average	**1.42**	**1.87**	**1.47**	**1.56**	**1.90**	**1.91**	**1.55**

3.3 City of Manitowoc and CBCWA Total Combined Projected Water Demand

Based on the results documented and discussed in Sections 3.1 and 3.2, the total combined projected total water demand is shown below in Table 18. Based on these projections, the existing water supply sources discussed in Section 2.2 will be able to meet water demands over the duration of the planning period.

Table 18: City of Manitowoc and CBCWA Total Combined Projected Water Demand

Year	Projected Average Daily Water Demand (gal/day)	Projected Max Daily Water Demand (gal/day)
2030	13,236,000	20,350,000
2040	14,028,000	21,672,000

4. Water Supply Alternatives in the Region

4.1 Inventory of Existing Alternate Water Sources

Alternative existing groundwater sources available in the region include the emergency backup supply wells owned and maintained by the CBCWA Member communities. The following Table 19 identifies key characteristics of these wells.

Table 19: CBCWA Water Supply Alternate Sources

Community	Well No.	Capacity GPM	Capacity MGD
Village of Allouez	#4	1,000	1.44
	#7	925	1.33
Village of Bellevue	#2	1,000	1.44
	#4	1,000	1.44
City of De Pere	#5	1,150	1.66
	#4	950	1.37
	#3	975	1.40
	#6	800	1.15
Village of Denmark	#3	600	0.86
Village of Howard	#2	1,500	2.16
	#3	1,500	2.23
Town of Lawrence	#1	850	1.22
Town of Ledgeview	#1	600	0.86
Total			**18.56 MGD**

While these wells are capable of withdrawing water from waters of the state, note that they are under WDNR-approved Extended Well Abandonment Agreements. These Agreements are necessary as the water quality available from these wells is substantially different than that supplied by MPU. Due to water quality standard exceedances for combined Radium and any other water quality standards, these wells

are used only for emergency back-up supply. Public notice must be issued within one week whenever these wells are pumped to distribution. The combined total pumping capacity of these groundwater wells is sufficient to meet current and projected future combined total maximum day demand.

The Village of Howard is an exception in that it is additionally authorized for limited blending of water from Well #2 with CBCWA water to pump to distribution. The Village of Denmark is another exception in that its groundwater wells have not exceeded any primary water quality standards at this time. Public notice is not required for the emergency use of Denmark's wells. However, Denmark's wells do not have sufficient pumping capacity to meet current and projected future maximum day demands for the Village.

5. Recommendations

5.1 Analysis of Sources for Meeting Existing and Projected Demand

As listed in Table 4 in Section 2.2.2, the capacity of raw water sources that can be treated and distributed to both the City of Manitowoc and CBCWA communities is 194 MGD. As previously mentioned in Sections 1 and 2, the Manitowoc Public Utilities Power Plant is another significant user of the RWPS's. The Power Plant uses Lake Michigan water pumped from the RWPS's to cool and condense steam generated from the operation of two circulating fluidized bed boilers. To understand the distribution of the raw water pumping capacity, Table 20 listed below breaks down the percent capacity used by each user or operation. As projected through 2040, the existing RWPS's have the capability to meet all future water use demands.

Table 20: RWPS Percent Capacity used by Active Users

	Power Plant	Manitowoc Water	CBCWA Water	SMF Backwash	Excess Capacity
2024 Average	21.6%	2.8%	3.9%	0.7%	71.0%
2030 Average	26.5%	2.7%	4.0%	0.7%	66.0%
2040 Average	26.5%	2.7%	4.4%	0.7%	65.6%
2024 Max	42.2%	4.1%	6.0%	0.9%	46.7%
2030 Max	45.9%	3.9%	6.4%	0.9%	42.9%
2040 Max	45.9%	3.9%	7.1%	0.9%	42.3%

5.2 Analysis of Effective Utilization of Existing Water Supply and Distribution Facilities

Based on the findings presented in this NR 854 Water Supply Service Area Plan, no changes to the City of Manitowoc distribution facilities or CBCWA transmission facilities are necessary at this time. However, it is worth noting the contractual stipulations that dictate the usage of the SMF plant. As previously mentioned in

Section 2.1.3, the CBCWA has the exclusive right to 100% of the SMF plants capacity. As permitted in the agreement, MPU actively utilizes the excess capacity not used by CBCWA throughout the year. Exact contractual language are as follows:

"*The Authority has the exclusive right to 100% of the capacity allocated to it… The Authority consents to MPU's use of capacity allocated to the Authority provided that under no condition shall MPU's use prevent the Authority from being able to make 100% of the capacity allocated to the Authority when if the Authority needs it.*"

The rated capacity of the SMF plant is 20 MGD. As this plan suggests, max daily water demands combined for both Manitowoc and the CBCWA communities are projected to exceed the 20 MGD threshold by 2030. As part of a multi-year capital project beginning in 2026, a water treatment plant expansion dedicated to meet the City of Manitowoc's water demand will commence. Considering that the project scope is unknown at this time, no further details can be provided. Updates shall be added in future revisions of this plan.

6. References/Consistency Analysis

Throughout the creation of this NR 854 Water Supply Service Area Plan, the following resources were referenced:

- City of Manitowoc 2043 Comprehensive Plan (adopted April 2023)
- Village of Allouez 2044 Comprehensive Plan (adopted July 2024)
- Village of Bellevue 2043 Comprehensive Plan (adopted January 2023)
- City of De Pere 2030 Comprehensive Plan (adopted July 2010)
- Town of Lawrence 2044 Comprehensive Plan (updated September 2024)
- Village of Howard 2042 Comprehensive Plan (adopted November 2022)
- Village of Denmark 2040 Comprehensive Plan (adopted June 2021)
- Town of Ledgeview 2035 Comprehensive Plan (adopted February 2019)
- Manitowoc-Two Rivers-Mishicot Sewer Service Area Plan, 2040 Water Quality Management Plan (approved July 2016)
- 2040 Brown County Urban Service Area Water Quality Plan (approved February 2023)
- Public Service Commission Annual Reports 2015-2024 for each community mentioned in this report
- Wisconsin Department of Administration, Population Projections 2020-2050 for each community mentioned in this report

This Water Supply Service Area Plan is generally consistent with and not in conflict with any of the referenced plans listed above.

7. Procedures for Implementing and Updating the Plan

Internally, once every five years this plan shall be updated to reflect new populations and population projections provided by the US Census Bureau and DOA, along with new historical data retrieved from community PSC annual reports. Considering most of the CBCWA communities at this point in time are projected to steadily increase in population over the next 15 years, it will be crucial to maintain a routine observation on the ever-changing water demands. The next update to this plan will be completed by December 31, 2030. Updates shall include:

- Re-delineation of service areas (if necessary)
- Update to Water Supply Sources and their respective capacities (if necessary)
- Population and Population Projections of respective communities
- Recalculation of future water demands for respective communities
- Public participation opportunity and/or notice provided for the CBCWA communities, as applicable

8. Public Participation

Given its communities' reliance on MPU for their primary supply of water, this plan was developed in cooperation with CBCWA. CBCWA was afforded the opportunity to review the plan in draft form and to provide comments for MPU consideration. Additionally, the final draft of the plan was also made available to the CBCWA Technical Committee and Board prior to adoption by MPU in November 2025.The CBCWA Technical Committee provided the following feedback that resulted in changes to the previous version of this plan:

1. Clarified and removed any confusion between the Brown County Sanitary Service Area (SSA) plan and this Water Supply Area Plan that was previously written and delineated in Figure 2. The CBCWA delineation reflects the current municipal boundaries for each community.
2. Revised Section 6 to include language referencing the consistency analysis that was completed during the writing of this Water Supply Area Plan.

MPU also presented the Water Supply Service Area Plan to the MPU Commission which also serves as a public hearing on November 10th, 2025. At the time of finalizing this Water Supply Service Area Plan, no comments were received from the public for consideration and entry. The plan is posted to the MPU website (mpu.org) for members of the public to read and provide comment. Any future comments received will be integrated into the plan at the next revision prior to December 31, 2030.