WATER SUPPLY SERVICE AREA PLAN

CITY OF NEW BERLIN
WAUKESHA COUNTY, WISCONSIN

FEBRUARY 11, 2009

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CHAPTER 1 - INTRODUCTION

I. GENERAL

The City of New Berlin is located in Waukesha County approximately 1-1/2 miles west of the western edge of the City of Milwaukee. The City of New Berlin occupies all lands in Town 6 North Range 20 East and land on the Northwest corner of Town 5 North, Range 20 East (Formerly Town of Muskego). The study area is the entire City which is comprised of primarily residential, commercial and industrial lands on the east and residential and agricultural on the west. Elevations in the study area range from a low of about 750 feet, National Geodetic Vertical Datum (NGVD) near 124th Street and Greenfield Avenue in the northeastern portion of the area, to a high of over 1070 feet NGVD on the western edge of the City, just south of Waukesha County's Minooka Park. The City is divided by the sub continental divide which runs north-south through the eastern part of the City. Roughly 27.0 square miles, or about 73 percent of the total area of the City are located in the Fox river watershed. This is the portion on the western side of the sub continental divide and is part of the Mississippi river watershed. The remaining area is tributary to the Great Lakes - St. Lawrence River drainage basin.

In April of 1990, Ruekert/Mielke, Inc. completed the <u>Report on Water Supply Facilities for the City of New Berlin, Wisconsin.</u>(1) The purpose of that study was to investigate the City's… "water supply, pumping and storage facilities and develop recommendations for needed improvements." The majority of the improvements recommended in that report were completed or reevaluated. The original report has periodically been reviewed, and minor revisions made, in the course of design projects since 1990. In April of 1999, the City of New Berlin was presented a report(2) summarizing the results of a study of the needs of the water supply system through the year 2010. The primary determination of that study was that the City should investigate the possibility of receiving water from a Lake Michigan water source. Based upon that recommendation, the City authorized a report(3) including an engineering and financial analysis of the issues related to a Lake Michigan water supply source. In 2001, the Lake Michigan Water Supply Study was completed and approved. Shortly thereafter, the radionuclides rule was promulgated by the EPA and became law. A study was conducted relative to methods of compliance with the radionuclides rule in 2003.(4) The Radionuclide Rule Compliance Master Plan was approved by the City at that time. The recommendations were to serve areas east of the sub continental divide with Lake Michigan water, and to seek approval to serve all areas of the City that had return flow to the great lakes basin via sanitary sewers with Lake Michigan water.

The City successfully negotiated a water service agreement with Milwaukee to provide Lake Michigan water to the water service area in New Berlin which lies within the Great Lakes Basin. The construction of, and service by, facilities in New Berlin to supply this water was approved by the State of Wisconsin Department of Natural Resources (DNR) and Lake Michigan water service to the area began in 2005.

Work began on a request to provide Lake Michigan water over the sub continental divide to areas west that also had return flow via Milwaukee Metropolitan Sewerage District (MMSD) sewers in 2006. That request was submitted to DNR in April, 2006(5). Subsequently, DNR opened a public comment period on the request. Following public comment, a letter requesting clarification and enhancement of twenty-seven items relating to efficient water use and environmental impacts was received by the City from DNR.(6)

On March 7, 2007, a 30 page amended sample application for Straddling Community Water Diversion was submitted to DNR, along with 2 volumes of supporting data.(7)

On July 13, 2007 the City received two letters from DNR.(8)(9) The first letter indicated a review of the information submitted was performed in comparison to the "… principles of the Great Lakes Compact and current State Administrative Rules". The letter further stated that a water loss approval under ch. NR 142 Wis. Administrative Code was not required and no additional information was needed at that time.

The second letter authorized the City of New Berlin to begin discussion with potential Lake Michigan water providers for the purposes of providing water to areas west of the sub continental divide and served by MMSD. The letter furthermore indicated that an additional review by DNR of any agreement reached with such a provider would be required.

On September 12, 2008 an agreement was signed with the City of Milwaukee to provide water to the entire MMSD water service area in New Berlin and some lands in the MMSD planning area, should MMSD service become available.(10) That agreement was forwarded to DNR on September 26, 2008 for review and comment.(11)

While these exchanges of information and requests were being made, the eight Great Lakes States were individually approving enabling legislation for the Great Lakes compact. Timing of state and federal approvals of the compact were up in the air. Wisconsin itself was working on legislation to approve the compact. The Wisconsin legislation that was ultimately approved in April, 2008(12) contained a two-pronged approach to approving the City of New Berlin's request. If federal ratification of the compact was delayed, an interim set of rules would be followed and New Berlin would need to meet that section of the law. After federal ratification, different and additional requirements would need to be met.

Following the ratification of the compact by the final State it appeared the federal government would need some time, even years to agree on their own ratification. Surprising, approval went quickly through congress and the compact was signed by the President on October 3, 2008 with implementation set for December 8, 2008. On December 31, 2008 a request for final diversion approval was submitted to DNR.(13) On January 7, 2009 DNR responded to the City that a much more in-depth study and a rerequest was required by the City and that the request include a document that meets the "… water supply service area plan requirements of 2007 Wisconsin Act 227.(14)

This document is intended to update and compliment these previously prepared documents and, along with sections of the Regional Water Supply Plan prepared by Southeastern Wisconsin Regional Planning Commission (SEWRPC),[(15)] serve as the Water Supply Service Area Plan required under Wis. Stat. §281.348.

II. PLAN DESIGN

To facilitate review of this plan by the public, by local and state governing bodies, and by others interested in the content herein, the plan is designed to address the requirements of Wis. Stat. §281.348(3)(c) which requires the plan to include all of the following:

1. Delineation of the area for which the plan is being prepared and proposed water supply service areas for each public water supply system making a withdrawal covered by the plan.

2. An inventory of the sources and quantities of the current water supplies in the area.

3. A forecast of the demand for water in the area over the period covered by the plan.

   Identification of the existing population and population density of the area for which the plan is prepared and forecasts of the expected population of the area during the period covered by the plan based on growth projections for the area and municipally planned population densities.

4. Identification of the options for supplying water in the area for the period covered by the plan that are approvable under other applicable statutes and rules and that are cost-effective based upon a cost-effectiveness analysis of regional and individual water supply and water conservation alternatives.

5. An assessment of the environmental and economic impacts of carrying out specific significant recommendations of the plan.

6. A demonstration that the plan will effectively utilize existing water supply storage and distribution facilities and wastewater infrastructure to the extent practicable.

7. Identification of the procedures for implementing and enforcing the plan and a commitment to using those procedures.

8. An analysis of how the plan supports and is consistent with any applicable comprehensive plans, as defined in s.66.1001 (1) (a), and applicable approved area-wide water quality management plans under s.283.83.

For this plan, some material that is copied in its entirety from other documents is presented in appendix material. Where larger sections of previous reports are used, and edited for current situation, for this plan, references appear in the text as superscripts linked to a reference list at the end of the report.

III. SUMMARY

The City of New Berlin has been working on a long-term solution to it's water supply needs and water quality issues since 1999. During the course of many City funded studies, temporary well projects, radium remediation projects, costly and time-consuming negotiations with lake water service providers, and discussions with regulatory agencies, it was determined Lake Michigan water was the most cost-effective and reliable long-term options for the water service needs of the City of New Berlin.

This plan, and it's review and approval, is one of the final implementation steps in implementing the selected solution.

The plan satisfies the requirements of S.283.83 where the rules are written and clear, and substantially addresses areas of the statutes where time has not allowed implementing agencies to establish clear delineation and explanation of the implementing rules. Furthermore, regional planning agency information referenced herein may be adopted by technical advisory committees and not yet by the approving commission as of the writing of this plan. This is noted in the text.

CHAPTER 2 – WATER SUPPLY SERVICE PLAN ELEMENTS

I. WATER SUPPLY SERVICE AREA DELINEATION

Figure 2-1 provides the information on the water supply service area. Four separate areas are shown on the Figure as follows:

- New Berlin's Corporate Boundary
- The SEWRPC Water Supply Service Area
- The current approved Lake Michigan Water Supply Service Area
- The Proposed expanded Lake Michigan Water Supply Service Area

This section provides a brief background and explanation of each of the four areas.

A. City of New Berlin Boundary

The City of New Berlin was incorporated in 1959 and includes all areas in the former Township of New Berlin and some larger parcels that contain land both in and out of the Township that were included in the incorporation. The City is surrounded on all sides by other incorporated areas, thereby limiting the potential for any change in size. Under the agreements between the City of Milwaukee and the City of New Berlin, New Berlin is not allowed to serve water outside it's corporate boundaries. New Berlin also cannot expand the service area if it expands by annexation, or provide water to annexed areas, without permission from Milwaukee. The fact that the corporate boundaries are basically set due to the institutional make-up of the area, makes the likelihood of any such expansion very low. The boundary is the outside border of the map in **Figure 2-1**.

B. The SEWRPC Water Supply Service Area

This is the area delineated by SEWRPC in the document Water Supply Service Area for the City of New Berlin.(16) This document was prepared at the request of New Berlin and satisfies requirements of the Great Lakes Compact (2007 Wisconsin Act 227) relating to area-wide water quality planning agencies delineation of proposed water supply service areas. The document containing the response is provided in **Appendix A**. The area is cross-hatched and within a dashed black line.

C. The Current Approved Lake Michigan Water Supply Area

This is the area that was initially and is currently approved by both DNR and the City of Milwaukee for Lake Michigan water service. It represents the areas within the New Berlin corporate boundary that lie east of the sub continental divide and within the Great Lakes Basin and is shown in blue shade. The sub continental divide is shown as a red line.

D. The Proposed Expanded Lake Michigan Water Supply Service Area

This is the area that lies within the SEWRPC water supply service area and is west (outside the basin) of the sub continental divide but within the MMSD sanitary sewer service area. The area is shown in yellow shade.

II. INVENTORY OF CURRENT WATER SUPPLIES

A. New Berlin Water System General Information[3]

The existing City of New Berlin water system consists of 9 wells, six ground level storage reservoirs, three elevated storage tanks, and two lake water booster stations. These facilities currently deliver an average of about 3.2 million gallons of water per day (MGD) to approximately 8,100 connected customers. To accommodate variations in ground surface elevations throughout the City, two separate water pressure zones have been established within the system. In addition, there are two localized areas where pressure boosting is required. **Figure 2-2** shows the location of the existing pressure zone boundaries.

The following sections provide a description of the facilities comprising the system and of relevant operational features.

B. Water Distribution System[3]

The purpose of the distribution system is to transport water from the sources of supply to customers. The distribution system must be capable of supplying water at needed rates and acceptable pressures throughout the service area. It must also be capable of providing acceptable supplies for fire protection.

As water flows from the source of supply to customers, the pressure in the mains drops. If the mains are large enough and are looped and well gridded, the pressure drop will not be excessive. Mains must be sized so that the pressure drop will be acceptable at the maximum anticipated flow rate. This rate would normally be equal to the peak day demand plus a fire flow allowance.

The water distribution system consists of mains ranging in size up to 16 inches in diameter. The 2007 system inventory is summarized in **Table 2-1.** The system consists of approximately 856,000 feet, or 162 miles of water mains. About 33 percent of these mains are 10 inches in diameter or larger and comprise the primary transmission mains for the system. About 67 percent of all mains are constructed of plastic material (PVC). The remaining 33 percent are constructed of ductile or cast iron.

C. Pressure Zones[3]

The New Berlin Water Utility operates its distribution system using two separate primary pressure zones. These zones have been established to accommodate variations in ground surface elevations throughout the City. The following is a description of each zone.

1. Primary Pressure Zone

The primary pressure zone encompasses the majority of the system. Current boundaries are roughly described as the City limits to the north, Calhoun Road to the west, the City limits to the south, and Sunny Slope Road to the east, and south of Howard Avenue to the east City limits. Eight of the wells are located in this zone. All three elevated tanks are located in this zone and are connected by the transmission main network. The maximum water elevation in these tanks is elevation 1027.5 feet, National Geodetic Vertical Datum of 1929 -- (NGVD) -- formerly known as Mean Sea Level Datum.

The highest ground surface elevation served in this area is about 925.0 NGVD and the lowest is about 840.0 NGVD. This results in normal operating pressures between 40 and 80 psi.

2. Reduced Pressure Zone

The reduced pressure zone encompasses that portion of the distribution system south of Greenfield Avenue, east of Sunny Slope Road, north of Howard Avenue and west of the City limits. This area is generally of elevations below 840.0 NGVD and range as low as 749.0 NGVD. In order to keep pressures within State requirements, the hydraulic grade in this area requires reduction. The zone is completely valved off from the remainder of the system with the exception of two connection points. At one connection is a pressure reducing valve (PRV) which is designed to hold a hydraulic grade of about 935 feet NGVD 1929. This corresponds to a pressure of 80 psi at the low elevation point and about 40 psi near the high elevation point. The valve is also designed to open fully to meet fire or other high use demands or close as demand decreases. The other connection is the Greenridge Lake water pumping station where a depicted pump provides water to the zone.

3. Pressure Boosting

Two areas are depicted on **Figure 2-2** which show those portions of the system requiring pressure boosting to meet code requirements. Those areas are located above elevation 925.0 NGVD and are considered hilltops. The first area is immediately east of the Sunny Slope Rd. Well No. 8 pump station. Booster pumps at the Sunny Slope Road station provide both domestic and fire flow to this residential area. The second area north of the National Avenue Well No. 7 pump station. This area is provided increased pressure from buried pumps at Well No. 7 for domestic service only. Fire protection can still be provided, through check valves, from the primary pressure zone for each of the boosted zones.

D. Existing Wells and Pump Stations

Many of the City well sources were originally constructed by private land developers to supply water to individual land subdivisions. These sources were acquired by the City when the water utility was formed. More recently, the City has constructed additional sources of supply to augment these facilities and meet increasing demands for water. The wells are numbered sequentially by date of construction. Well No. 6 was previously abandoned by the City and is no longer in service. **Table 2-2** provides summaries of pertinent data concerning the existing wells.

1. Pumping Stations/Reservoirs[(3)]

The City of New Berlin's water system consists of nine well pump stations, two Lake Michigan water pumping stations, six underground reservoirs, two elevated tanks, and approximately 162 miles of water main which serve approximately 9,268 customers with potable water.

a. **Pump Station No. 1** - (Forest View Pump Station) is located at the intersection of Sunny Slope Road and Crest View Drive. The 12 inch diameter well was drilled in 1965 to a total depth of 1,500 feet. The well is finished in sandstone. A 100 hp submersible pump is installed in the well, which currently discharges at the rate of about 500 gallons per minute (gpm) into an adjacent 62,000 gallon underground reservoir and clearwell. Two 30 Hp vertical turbine service pumps draw water from the reservoir and discharge to the distribution system. Each service pump has a capacity of 455 gpm.

b. **Pump Station No. 2** - (Glendale Park Pump Station) is located at 3615 South Cottonwood Road. The well at this pump station is 10 inches in diameter and 335 feet deep. It was drilled in 1965 and is finished in the limestone aquifer. A 25 Hp line shaft turbine pump is installed in the well, which currently discharges at the rate of about 310 gpm into an adjacent 150,000 gallon underground reservoir and 31,000 gallon clearwell. Three 25 Hp vertical turbine service pumps draw water from the reservoir and discharge to the distribution system. Each service pump has a rated capacity of 350 gpm and actual capacities of about 400 gpm.

An auxiliary powered engine to drive the well pump is installed at this station. There is also an auxiliary powered engine to run one service pump.

c. **Pump Station No. 3 -** (Rogers Drive Pump Station) is located at 16100 West Rogers Drive. The well at this pump station was drilled in 1965 to a total depth of 1,800 feet. The well is 16 inches in diameter, and is finished in sandstone. A 200 Hp submersible pump is installed in the well, which currently discharges at the rate of about 970 gpm into an adjacent 1,000,000 gallon underground reservoir and 84,000 gallon clearwell. Two 75 Hp vertical turbine service pumps draw water from the reservoir and discharge to the distribution system. Each of these service pumps has a rated capacity of 1,200 gpm. A third service pump (50 Hp) also draws water from the reservoir and discharges to the distribution system at the rate of 900 gpm. In addition, a fourth service pump, driven by a natural gas fueled auxiliary engine, is available to supply water to the distribution system in emergency situations (fires and power outages). The discharge rate of this service pump is approximately 1,500 gpm. The well and pump station is not currently in use.

d. **Pump Station No. 4** - (Green Ridge Pump Station) this well was abandoned and the station was converted to a Lake Michigan pumping station in 2005. See the description in subsequent sections of this report.

e. **Pump Station No. 5** - (Regal Manor Pump Station) is located at 3900 South Moorland Road. The well at this pump station was drilled in 1970 to a total depth of 1,700 feet. The well is 12 inches in diameter and is finished in sandstone. A 125 Hp submersible pump is installed in the well, which discharges at the rate of 550 gpm directly to the distribution system. There are also three service pumps and an underground reservoir at the station. However, the reservoir leaks and it is therefore not used. The service pumps have been removed.

f. **Pump Station No. 6 -** Abandoned.

g. **Pump Station No. 7** - (National Avenue Pump Station) is located at 16450 West National Avenue. The well at this station was drilled in 1976 to a depth of 2,018 feet. The well is 16 inches in diameter and is finished in sandstone. A 200 Hp submersible pump is installed in the well, which discharges at the rate of 1,080 gpm into an adjacent 550,000 gallon underground reservoir and clearwell. Two 75 Hp vertical turbine service pumps draw water from the reservoir and discharge to the distribution system. Each of the service pumps has a rated capacity of 1,600 gpm. Actual capacities vary between 1950 gpm and 1,885 gpm. A third 30 Hp service pump provides about 1000 gpm. A pair of buried turbine "can" style pumps on the site normally pump about 750 gpm to a boosted pressure area.

h. **Pump Station No. 8** - (Valley View East) is located at 5155 South Sunny Slope Road. The well at this location was drilled in 1984 to a total depth of 1,984 feet. The well is 15 inches in diameter and is finished in sandstone. A 300 Hp submersible pump is installed in the well which discharges at the rate of 1,375 gpm into an adjacent 580,000 gallon underground reservoir and clearwell. Two 50 Hp vertical turbine service pumps draw water from the reservoir and discharge into the distribution system. Each of the service pumps discharges at rates between 1,250 gpm and 1,500 gpm. The station can accommodate a future third service pump.

The station also provides service to a small boosted pressure zone from a 2 Hp pump and a 10 Hp pump which discharge 50 gpm and 550 gpm, respectively.

i. **Pump Station No. 9** - (Valley View West) is located at 5150 Small Road directly west of Pump Station No. 8. The well at this pump station was drilled in 1993 to a total depth of 343 feet. A 50 Hp open lineshaft pump is installed to 200 feet in the well and discharges about 690 gpm. The well pump discharges through a long raw water line to the reservoir at Pump Station No. 8. From there it discharges to the distribution system from service pumps mentioned previously.

j. **Well Pump Station No. 10** - (Westridge Pump Station) was completed in 1999. The pump station is located at 4990 S. Moorland Road in the Westridge Development. The 14-inch well was drilled in 1997 to depth of 321 feet and was finished in the limestone aquifer. The well pump is a 75 Hp open lineshaft pump discharging about 600 gpm to a 750,000 gallon composite water tower adjacent to the site. That tower was constructed about the same time as the well. The well pump can also pump directly to the distribution system by changing valve positions. The station is equipped with a 100 kw generator which can power the station and adjacent tower.

k. **Auxiliary Power Capability -** The Utility also maintains a 350 KW portable genset which can run the Forest View or Regal Manor pump station.

2. Lake Michigan Pumping Stations

The eastern portion of the utility was provided Lake Michigan water in 2005. Two pumping stations were constructed to supply Milwaukee water at adequate rates and pressures to the area east of the sub continental divide.

a. **Greenridge Pumping Station** - The Greenridge (Well 4) well pumping station was converted into one of two planned facilities that draw water from the Milwaukee distribution system and pump to New Berlin.

The Greenridge well pumping station is located at 12400 W. Crawford Dr.

The initial agreement between New Berlin and Milwaukee for wholesale water purchase and delivery to the eastern area includes two connection locations. These connection locations and the associated estimated maximum flow rates and minimum hydraulic grades are as shown below:

Connection Location	Estimated Maximum Flow Rate (MGD)	Minimum Hydraulic Grade
W. Howard Ave. & S. 124th St.	2.87	885.3
W. Grange Ave. & S. 124th St.	1.91	912.2
	4.78	

The total of 4.78 MGD is the estimated demand associated with full development of all land east of the sub continental divide.

The station is designed to discharge both to the main pressure zone and to the reduced pressure zone located in the northeast corner of the City. Supply is provided by Milwaukee's 12 inch water main on 124th St. at Morgan Oaks Dr. The supply available from Milwaukee at this location is sufficient to provide the agreement volume of 2.87 MGD.

The station is designed to discharge up to 2.87 MGD (1993 gpm). This is the estimated maximum flow rate contained in the agreement between New Berlin and Milwaukee. The station is designed as to allow for increasing the size of equipment to accommodate flow rates of up to 6.5 MGD (4514 gpm).

The existing 500 kW diesel fueled engine/generator was retained and is large enough to the power entire station including all pumps needed to supply the entire MMSD service area.

The existing chemical room was retained. Equipment was provided to allow sodium hypochlorite and phosphate solution feed rates to vary automatically based on the flow rate through the station.

The existing reservoir was reused. Approximate maximum volume is 300,000 gallons. The water in the reservoir is available to meet short duration peak demands or to shave the peak flow rate drawn from Milwaukee. A fill pipe conducts water from Milwaukee into the reservoir. The control system includes an automatic exerciser function so that the water in the reservoir is turned over regularly.

For improved reliability, two separate supply pipes conduct water from Milwaukee to the station. The supply pipes are 16 inch diameter. Either pipe alone has sufficient capacity for the agreement estimated maximum demand rate.

For improved reliability, two separate discharge pipes connect the station to the main pressure zone. The larger connection is a new 16 inch diameter pipe extending south on 124th St. from the station to Howard Ave. This pipe is capable of conducting the initial estimated peak flow rate of 2000 gpm. A separate connection was made to the existing 8 inch diameter pipe on 124th St.

While not capable of conveying the initial peak flow rate, this smaller diameter pipe is adequate as a backup for flow rates up to the average day rate.

There is a separate discharge connection to the existing main supplying the reduced pressure area. A single connection is sufficient because back up service to the reduced pressure zone is provided through a pressure reducing valve vault at another location.

A total of 5 pumps are housed in the station. All pumps are driven by variable speed motor controllers.

Three of the pumps are identical split-case units that discharge to the main pressure zone. The combined output of any 2 of these pumps are able to satisfy the peak day demand rate.

A single split-case pump discharges to the reduced pressure zone.

A single vertical turbine pump draws water from the on-site reservoir and discharges to the main pressure zone.

b. **Grange Avenue Pumping Station –** The second lake water pumping station is much less complicated in design and operation. A 16-inch water main approximately 900 feet in length connects the Milwaukee water system at 124th Street and Grange Avenue to the pumping station located at Frances Avenue and Grange Avenue. From the pumping station, water is boosted in pressure by three identical horizontal split case pumps driven by variable frequency drive units. Each motor is 30 hp and each pump is capable of delivering 700 GPM @ 120 feet total dynamic head. The station only pumps to the primary pressure zone. This facility is also designed to accommodate larger pumps when lake water becomes available to the entire service area.

3. Elevated Storage Facilities[(3)]

The City of New Berlin's water system also includes three elevated water storage tanks. One tank is located on Calhoun Road just north of Cleveland Avenue. It was constructed in 1967. The tank is a single pedestal style spheroid. It is about 138 feet tall and has a capacity of 500,000 gallons. The second tank is located at the Valley View pump station. It was constructed in 1983. It is also a single pedestal spheroid, and has a capacity of 500,000 gallons. The overflow elevation of both elevated tanks is 1027.5 feet above mean sea level, National Geodetic Vertical datum (NGVD).

A 750,000 gallon composite steel water tower is located immediately adjacent and to the east of Well No. 10. The tower is about 145 feet high and has an overflow elevation of 1027.5.

E. Chemical Addition[3]

The New Berlin Water Utility adds chemicals at all its active well pumping facilities. No chemical addition occurs at the lake water pumping stations but facilities are available for emergency chlorination.

Chlorination of the water supply is accomplished by adding gaseous chlorine. This is done for safety, disinfection, and to maintain bacteriological water quality in the distribution system. The chemical is added in dosages such that at least trace concentrations of residual chlorine are maintained in the distribution system.

A polyphosphate chemical is added at all active well sources. This is done to sequester iron concentrations in the well water, and to control corrosion. The chemical acts as a corrosion inhibitor by forming a protective film on pipe surfaces. The utility currently does not add fluoride to its water.

Table 2-3 presents pertinent data on the capacities of the existing City well water supply facilities. Descriptions of each column heading are as follows:

Well/Pump Station Facility - This is the well number and pump station identification used in the water utility records.

Well Pump Capacity - The measured pumping capacity in gallons per minute (gpm). All pumps are driven by electric motors.

Service Pump Capacity - Where pump stations are constructed with on-site storage, the well pump discharges into a reservoir. Service pumps draw water from the reservoir and boost it to system pressure. The capacity of each pump is listed in gallons per minute. The combined capacity of multiple service pumps at any single location is always less than the sum of the individual capacities. The total at the bottom of this column is the combined capacities of all service pump operating simultaneously and may not in all cases accurately reflect station capacities with all pumps running.

Auxiliary Power Well Pump Capacity - The pumping capacity of any well pump when driven by an emergency power source.

Auxiliary Power Service Pump Capacity - The pumping capacity of any service pump in gallons per minute when driven by an emergency power engine.

Total Source Capacity - The total volume that a pump station can supply at system pressure for a given period time. For a pump station with a single well that discharges directly into the distribution system, this volume is always equal to the well pump capacity available at system pressure, over the specified duration. For pump stations with on-site storage, this volume is equal to the combined service pump capacity over the specified duration of the reservoir volume plus well pump capacity over the specified duration, whichever is less. Usable reservoir volume is assumed to be 75 percent of the total volume to allow for some normal fluctuation in reservoir levels. It is assumed that the well pumps supplying the reservoir will be operating continuously.

Total 3 Hour Pump Capacity - This equals the maximum service pump output for a three hour period. Where service pump capacity exceeds reservoir capacity in a 3 hour period, the difference in time is rated using well pump capacity. For direct to system wells it equals the well pump capacity for three hours.

Total Auxiliary Power Pump Capacity - This is similar to the data provided in the previous column, except that only emergency engine driven pumps are assumed to be used. If the station was a reservoir, one reservoir volume plus well pump capacity was used if there is also a service pump with auxiliary power. A duration of 24 hours is used, representing a one day power outage. Service pump capacities may be limited by reservoir volume.

On-Site Storage - The total volume is gallons of any on-site reservoir and clearwell as reported on City records.

III. FORECAST OF DEMAND FOR PLANNING PERIOD

This plan is intended to cover a 20-year period or to year 2029. Previous planning efforts have looked at different terms and end planning horizons. For the purposes of this report we have taken the most recent forecasts of demands prepared by the regional planning commission, made straight line projections from the base year to the planning year (2035) and extracted 2029 data. This data is the most current data available from for the service area. This is further analyzed for the recommended Milwaukee water service area based upon current City planning data and results of the SEWRPC water supply service area determination.

A. SEWRPC Water Demand Projections[2]

As part of the ongoing regional water supply plan being prepared by SEWRPC, projections of water demand were made for individual communities. **Appendix B** contains Chapter IV from the regional plan which presents demographic and water demand data. Based upon that data, the graphs in **Figure 2-3** and **Figure 2-4** were prepared showing projected average and peak daily water pumpages for the planning period. The 20 year planning period water demand for this plan (2029) is also called out in the figures.

SEWRPC has projected a year 2035 population of 41,300 for the water service area. In the agreement with Milwaukee Water, the contractual service area is larger than the SEWRPC water service area. This means that areas shown on **Figure 2-1** in the far southwest portion of the City will be served by groundwater systems. This could be a stand alone system constructed by New Berlin or a purchased water system supplied by a neighboring community. In any case, no water service outside the contractual area for Milwaukee Water is contemplated now or in the foreseeable future. **Table 2-4** shows the 2035 and adjusted 2029 population, land use and water pumpage estimates based upon the evaluations performed as part of this study. 2029 population figures are based upon the January 19, 2009 Water Supply Service Area for the City of New Berlin report prepared by SEWRPC; 2029 land use figures are based upon a review of City of New Berlin planning staff projection of potential land development in the service area; 2035 population and land use projections are taken from the regional water supply study; and water pumpages are developed utilizing the methodology presented in the regional water supply study. **Figure 2-5** shows the SEWRPC 2035 forecast water pumpages and the adjusted forecast pumpages removing the area outside the contractual Milwaukee Water service area, and using population figures from the January 19, 2009 water supply service area for the City of New Berlin (SEWRPC, 2009 see **Appendix A**).

IV. POPULATION ESTIMATES, DENSITY AND FORECASTS FOR THE AREA

The projected water pumpages developed above were based upon a combination of land use data and population figures developed both locally and by the regional planning agency. **Table 2-5** shows this data in tabular form.

V. IDENTIFICATION OF WATER SUPPLY OPTIONS

In this section, a discussion of geology and groundwater will be provided. An analysis of groundwater quality and quantity trends will also be presented. The results of regional field investigations concerning water quality in the deep sandstone aquifer are also included.

A. Geology and Groundwater[3]

The current source of water supply for the City of New Berlin consists of 8 drilled wells. Three wells have been abandoned. The groundwater that is obtained from these wells is found in two distinct water bearing geologic formations or aquifers. A third aquifer also exists in the area but is not currently being used. A brief description of the groundwater geology of the City is provided below.

The first of the three aquifers consists of the unconsolidated sand and gravel layers of that lie on top of the bedrock. The extent and thickness of these layers do not provide significant groundwater yields in all areas. Sand and gravel deposits suitable for use as aquifers for municipal wells are difficult to locate. The thickness of the unconsolidated material underlying varies throughout the City. Wells finished in the sand and gravel formations have a wide range of capacity, from 10 to 1,500 gallons per minute or more. Since this aquifer is closest to the ground surface, it is most susceptible to contamination from surface sources. Proper well siting, and construction and wellhead protection can, however, minimize the potential for contamination. Currently, the City has no wells which obtain water from this aquifer. Well No. 11 was finished in this aquifer but has been abandoned due to microbiological clogging problems.

The next lowest aquifer consists of dolomitic bedrock known locally as the "Niagara Dolomite". The Niagara Dolomite is the aquifer from which most domestic wells in Waukesha County obtain water. This aquifer is also used as a source for some municipal wells in eastern Waukesha County.

The Niagara Dolomite contains numerous fractures, voids, and bedding plane enlargements that act as open conduits for groundwater migration. Groundwater can flow through these open conduits rapidly, both horizontally and vertically, without any significant filtration. As a result, any contamination that enters the aquifer can be transported hundreds to thousands of feet without attenuation.

The distribution of the fractures and voids is highly variable making it difficult to predict the primary pathways of groundwater migration. When viewed on large scale, the general pattern of groundwater flow resembles the typical uniform flow pattern of uniform porous aquifers. On a smaller scale, however, discrete flow paths exist which cause groundwater to flow at higher rates and in different directions. Therefore, while it is possible to describe the average groundwater flow pattern in this aquifer on a regional basis, it is usually not possible to describe the actual groundwater flow pattern to a particular well. Three of the City's eight wells obtain water from this aquifer. Abandoned Well No. 6 was also finished in this aquifer.

The next lowest aquifer is the sandstone aquifer. The sandstone aquifer of southeastern Wisconsin consists of interbedded sandstone, dolomite and shale units of Ordovician to Cambrian age. The aquifer is separated from the two shallower aquifers previously described by a regional confining unit that consists of the Maquoketa formation and the underlying Galena-Platteville dolomite. This confining unit restricts the vertical migration of water between the upper aquifers and the sandstone aquifer. The Maquoketa formation generally consists of a massive shale unit. The Wisconsin Department of Natural Resources is concerned about contaminant transport from the upper limestone to the sandstone aquifer. For this reason, it does not allow wells to be drilled which are open to both aquifers. The Maquoketa confining unit disappears approximately ten miles west of the City of Waukesha. The area where the confining unit is absent comprises the major recharge area for the sandstone aquifer. Precambrian granite and quartzite deposits lie immediately beneath the sandstone aquifer. These units are essentially impermeable and serve as the base of the sandstone aquifer.

This aquifer is the primary source for industrial and municipal wells in most of eastern Wisconsin. Approximately 50 municipal water systems and 200 industries obtain at least some of their water from wells in the sandstone aquifer in southeastern Wisconsin. In 1995 the sandstone aquifer supplied approximately 95 percent of municipal pumpage in Waukesha County. Five of the City's eight wells obtain water from this aquifer and one well has been abandoned. With the exception of a well documented zone of saline water located immediately adjacent to the Lake Michigan shoreline, the water in the aquifer has historically been fresh and suitable for most potable uses.

A large fault, known as the Waukesha fault, traverses the City of Waukesha and extends tens of miles to the northeast and southwest. On the northwestern side of the fault, the Precambrian surface is within approximately 1,200 feet of the ground surface. On the southeastern side of the fault the total thickness of the aquifer is unknown, but the Precambrian surface is estimated to be at least 3,000 feet deep. All of the City's sandstone wells are located on the southeast, or down side of the fault. No wells in Wisconsin are known to penetrate the full thickness of the aquifer on the down side of the Waukesha fault.

While the sandstone aquifer is the major source of groundwater for the region, it is not well understood. Most wells are drilled to a depth where adequate water quantity is obtained and terminated. As a result, few wells penetrate the full thickness of the aquifer, making the thickness of the aquifer poorly known in several areas. In some cases it is possible to estimate the elevation of the base of the aquifer by triangulation from surrounding wells. However, ridges of quartzite and mounds of granite are present that rise above the surrounding Precambrian surface. These features are poorly known or unmapped in many places and can cause the sandstone to be thinner than expected and the yield of a well to be less than projected.

Unknown mounds on the Precambrian surface have resulted in sandstone wells terminating shallower than expected in at least two cases in Waukesha County over the last few years. In 1996 the Village of Pewaukee drilled a sandstone well to the top of granite. The depth to the granite was estimated at 1,200 feet based on surrounding well logs. Unfortunately, the well encountered an unmapped quartzite ridge at 790 feet. Due to the reduced thickness of the Mount Simon sandstone, the well only produces about 600 gpm instead of the projected capacity of 1,000 to 1,200 gpm. In 1995, the Village of Delafield drilled a sandstone well. Quartzite was encountered at 1,225 feet instead of approximately 1,500 feet as projected from previously available regional data.

B. Drinking Water Quality[3]

1. Standards

Drinking water quality standards are established by the Wisconsin Administrative Code in Chapter NR 809, and are administered by the Wisconsin Department of Natural Resources. The standards are divided into two separate categories: primary, which are health related and secondary, which are related to aesthetics. The standards are further divided into the following categories: microbiological, inorganic, synthetic organic, volatile organic, physical, and radiological. The standards generally apply to samples collected at source locations. Also included in NR 809 are sampling frequency requirements for different parameters. **Table 2-6** summarizes the current standards set forth in NR 809.

2. Aesthetic Water Quality

Table 2-7 presents selected well water quality data obtain from sampling results for certain inorganic constituents. Customer perception of aesthetic water quality is largely influenced by concentrations of iron, manganese, hardness, total dissolved solids and sulfates. It can be seen from the tables that a significant percentage of City wells produce water with concentrations of total dissolved solids at or above the secondary standard of 500 mg/l. Most wells also produce water with iron concentrations above the secondary standard of 0.30 mg/l. Most City wells also produce water which is commonly considered very hard, with hardness concentrations exceeding 300 mg/l.

The City currently uses iron sequestration as a method to control the aesthetic impacts of iron without removing it. Total Dissolved Solids (TDS) levels increased dramatically in Well No. 8 before mitigation and appear to be increasing in other sandstone wells. This phenomenmon has been noticed elsewhere in the region and is probably due to overpumping of the aquifer. Prior to mitigation, water quality levels seen in Well No. 8, rendered the water unpalatable. The City blends water from Well No. 9, which has much lower TDS, to improve quality prior to delivery to customers.

3. Radionuclides

Current drinking water standards include maximum contaminant levels (MCLs) for naturally occurring radionuclide substances. Based on information contained in the rules the radionuclide drinking water standards may be summarized as follows:

- Radon – the radon. A standard is 200 picocuries per liter (200 pCi/l).

- Radium - the standard is 5 pCi/l for combined radium-226 and radium 228, measured separately.

- Gross Alpha Radiation - the standard is 15 pCi/l for contributions from all radionuclide isotopes exclusive of radon and uranium. All alpha particle emitters together contribute to the gross alpha level. These include isotopes of uranium, polonium, thorium, radium, radon, and bismuth.

- Uranium - the standard is 30 μ/L.

Results of radionuclide analyses for samples taken from the City system are presented in **Table 2-8**. The radionuclide standards are of concern to the City of New Berlin. This is because naturally occurring radionuclide elements are present in the aquifers from which the City wells obtain water. Routine sampling of all well sources has indicated that water from some wells contains radionuclides at levels which exceed current regulations.

Radon is easily removed from well water by simple aeration, which is exposure of the water to air. Radon gas dissipates into the air. Aeration occurs at facilities where ground level storage reservoirs are provided. Water pumped from the well is detained in the reservoir prior to repumping into the distribution system. Radon gas dissolved in well water dissipates during the time the water is detained. This aeration is provided at pump stations where reservoirs are provided. The extent to which radon is being removed by this process requires additional sampling.

Regional sampling experience has shown that radium and gross alpha concentrations are generally associated with water from the deep sandstone aquifer. Water obtained from the upper limestone aquifer usually contains negligible radium concentrations. At one location, the water utility is reducing radium concentrations in water from deep sandstone well by blending with water from a shallow limestone well located near the same site. That location is the Valley View facility. These facilities include a deep sandstone well and shallow limestone well. Both wells discharge to a common ground storage reservoir. Water from the two sources is blended in the reservoir. Radium concentrations in the sandstone water are diluted with water from the limestone well at this facility. Blending occurs prior to the water being pumped into the distribution system. At the facility, blending of water from Wells No. 8 and No. 9 reduces radium concentrations in Well 8 to an acceptable level.

Based on the results of the routine radionuclide sampling presented in **Table 2-8**, it can be seen that many of the existing wells sources are producing water which may exceed standards for combined radium, gross alpha particle activity, and/or radon concentrations. USEPA standards for these radionuclides were finalized in November 2000, and are applied to individual source entry points. The Federal rules required enforcement starting November 2003.

4. Inorganic and Organic Quality Parameters

Sampling for inorganic and volatile organic substances at all active sources was completed in 1999. Sampling included analyses for all regulated inorganic and volatile organic substances listed in **Table 2-7**. The sampling results indicate that the City water supply complies with all primary regulations associated with these substances. However, secondary aesthetic standards are exceeded in many instances as previously discussed. Secondary standards are standards for inorganic chemicals and physical properties and are set at levels at which consumption of water above these levels is not hazardous to health but may be objectionable to customers. If enough customers complain, the DNR can require remedial action.

5. Arsenic

Arsenic is a naturally occurring toxic metal that is soluble in ground water. Ingestion of arsenic has been linked to several forms of cancer, cardiovascular disease, skin diseases, neurological disorders, and diabetes. Elevated arsenic levels were first detected in ground water in Wisconsin about fifteen years ago. Since then, increased monitoring has discovered a large concentration of wells with elevated arsenic levels in east central Wisconsin and a smaller number of wells distributed throughout the State. In Wisconsin, the source of the arsenic is believed to be oxidation of sulfide minerals, such as pyrite, which are common trace constituents in most aquifers in the State. Upon exposure to air or other oxidizers during drilling or pumping a well, the sulfide minerals are oxidized to sulfates, and arsenic and other heavy metals can be released into the ground water. Several wells have been found in Winnebago and Calumet Counties that yield water with arsenic concentrations exceeding 1,000 parts per billion (1,000 ppb). Arsenic concentrations elsewhere in the State area are generally much lower. Arsenic levels appear to be rising in several areas in response to dewatering of different aquifers.

None of the wells supplying the City currently produce water exceeding the current drinking water standard of 10 ppb for arsenic.

C. Water Quality Trends[3]

Historic water quality data for the City wells were collated from the Wisconsin DNR data base. Selected water quality parameters were tabulated to illustrate current water quality and historic trends. The historic data base was limited for several wells. In some cases, several water samples were available from reservoirs supplied by two wells, with few samples available from the individual wells. This restricts the level of analysis that can be conducted. However, the available data were sufficient to permit identification of general trends in critical water quality parameters.

Tables 2-7 presents historic water quality data for chlorides, hardness, iron, manganese, sodium, total dissolved solids, and sulfates. These water quality indicators were selected based on the availability of data and the ability of the indicators to identify aesthetic problems and major changes in aquifer geochemistry. The water quality data can best be understood by examining data for the two major aquifers separately.

1. Water Quality in the Sandstone Aquifer Wells

The quality of water obtained from City wells finished in the sandstone aquifer is variable depending on location and generally poorer than several neighboring communities. Sulfate levels range from about 57 parts per million (57 ppm), to about 500 ppm. The limited historic data indicates that sulfate levels have been stable or rising over time. Some wells are producing water that exceeds the secondary standard for iron and manganese, which is not uncommon for sandstone wells in eastern Wisconsin. The water is hard, which is also common for the sandstone aquifer. The other water quality indicators are within acceptable limits.

Total dissolved solids (TDS) is a measure of mineral content or salinity of water, and is generally a good indicator of aesthetic water quality. TDS concentrations for the City sandstone aquifer wells are moderate to high in comparison to such levels in water obtained from sandstone wells in several surrounding utilities. Well 8, which had TDS levels of 1500 ppm in 1997, is high compared to other sandstone aquifer wells which produced water with TDS levels between 497 and 530 ppm. Following backfilling Well 8 dropped to a TDS level of approximately 500 ppm. Wells 2, 3, 4, 7 and 8 all have TDS levels above the secondary standard of 500 ppm.

TDS levels in the sandstone aquifer wells in New Berlin are relatively high, and apparently unstable. The recent experience of the Waukesha Water and the New Berlin water utilities indicate both systems have one or more wells that are experiencing rising TDS levels. In some wells, TDS levels have doubled or tripled over the last 10 to 15 years, rising from 300 to 400 ppm to over 1,000 ppm.

The cause of the rising TDS levels in new Berlin and Waukesha appears to be vertical migration of saline water from the lower part of the Mount Simon sandstone in response to heavy pumpage in the upper Mount Simon and overlying units of the sandstone aquifer. Several thin shale units are present in the upper Mount Simon aquifer which appear to provide a vertical permeability barrier inhibiting the upward migration of saline water. These shale units are not continuous and probably do not form a perfect barrier against migration. Several of the deeper sandstone wells penetrate several of the shale layers, reducing the effectiveness of the shale layers to act as a confining unit.

The wells that are experiencing rising TDS levels in Waukesha and New Berlin are all approximately 2,000 feet deep or deeper, and all penetrate one or more shale layers in the Mount Simon. In the Waukesha Water Utility wells, a strong correlation has been observed between TDS and well depth and between TDS and annual pumpage. By contrast, all of the City of Brookfield sandstone aquifer wells are 1,800 feet deep or less and penetrate relatively few shale layers. The improvement in water quality that occurred after filling the bottom of one Brookfield well is further evidence of the poor water quality at depth in the aquifer and the presence of a confining unit below the depth of the existing wells.

2. Water Quality in the Dolomite Aquifer Wells

A variety of data were reviewed regarding water quality in the dolomite wells. The DNR maintains a database of all samples required as part of routine sampling requirements. In addition, the utility has collected various samples since 1994 for inorganic and other chemical components. The **Table 2-7** results are the most current available as of the writing of this section.

The water quality from the dolomite aquifer is generally good with a few water quality indicators exceeding secondary drinking water standards. All dolomite wells produce water with iron levels above the secondary standard. Dolomite wells No. 9 and 10 exceed the recommended drinking water concentration for total dissolved solids with 671 gpm and 560 gpm respectively. Wells No. 9 and No. 10 also have relatively high levels of chlorides, although not approaching the standard. Well No. 9 also has higher sodium levels. This may indicate the presence of evaporative type minerals in the aquifer or road salt contamination.

The sulfate concentrations are well below the secondary drinking water standard, but are moderately elevated (up to 109 ppm), suggesting that a source of sulfur is present in the aquifer. A review of the geologic description of the well cuttings indicates that pyrite (iron sulfide) is present in small quantities throughout the aquifer. Sulfide minerals have been identified as a potential source of arsenic and other heavy metals in ground water in eastern Wisconsin. Well No. 2 has had a sample for arsenic as high as 9.3 ppb. This is only slightly lower than the standard and should be closely monitored.

The TDS levels in the dolomite aquifer are relatively normal compared to other municipal dolomite wells in Waukesha County. TDS levels for the dolomite wells range from 460 ppm to 800 ppm, with two wells producing water with levels exceeding the secondary drinking water standard.

3. Arsenic

Table 2-9 presents historic data on arsenic levels for City wells. Most of the wells were sampled in March of 2008. None of the wells are presently over the standard of 10 ppb. All wells presently produce water meeting the standard. Some variation in arsenic levels observed over time is generally noticed in this area and is at least partially due to differences in analytical methods. However, based on historic data from other areas, at least some of the change are probably related to changes in water chemistry, possibly due to the pumping history of the wells. The source of the arsenic appears to be pyrite deposits which are distributed throughout the aquifer as noted in the geologic descriptions of the well cuttings examined by the Wisconsin Geological and Natural History Survey. The cause of the apparent rise in concentrations has not been proven, but it may be related to oxygenation of the aquifer during pumping cycles.

None of the water samples from the sandstone aquifer wells has ever exceeded the arsenic standard. The highest measured arsenic level from a sandstone well was 9.3 ppb Well 2 in 1999. There does not appear to be a trend toward rising arsenic levels in any of the sandstone wells.

The low levels of arsenic in the sandstone aquifer wells is fortunate. The geologic description of well cuttings indicates that pyrite is widely distributed throughout the aquifer. In addition, several neighboring systems have sandstone wells that produce water exceeding the standard. Given the presence of pyrite in the formation and the regional decline in head in the aquifer, arsenic levels may increase over time, particularly if pumping levels decline to below the base of the Galena Platteville dolomite and air is injected into the aquifer.

4. Radionuclides

The radionuclide regulation has been previously described. Radionuclides are naturally occurring elements which are present in the aquifers in southeastern Wisconsin. Those of most concerns to the City are radium, radon, and gross alpha radiation. In general, radium is a naturally occurring radioactive element that occurs in two common isotopes, radium 226 and radium 228. Both originate from the decay of uranium and thorium which are common in the igneous rock that is the source material for the sandstone aquifer. Ingestion of radium has been linked to bone cancer. Gross alpha is a measure of all isotopes that emit alpha particles, which include radium 226 and several daughter products of radium 226 and 228. Ingestion of alpha particles has been linked to several forms of cancer. Radon is a daughter product of radium 226 and is primarily an inhalation risk linked to lung cancer.

Table 2-8 presents the historic radium, gross alpha, and radon sampling results for the City water system. The majority of samples were taken from the distribution system which provides a variable mixture of water from several wells, depending on where the sample was taken and which wells were pumping at the time of the sample. A few samples are available from individual wells. Of the five sandstone aquifer wells, the most recent radionuclide sampling was conducted in 2002 on Wells Nos. 1, 3, 5, 7 and entry point 200 (combined Wells 8 and 9). It is possible that changes in radionuclide concentrations have occurred in the time since these wells have been sampled.

While the lack of data from individual wells limits the interpretation, the data are sufficient to identify several major trends. All of the sandstone wells contain elevated levels of radium and gross alpha. The most recent data from all of the sandstone wells exceed the proposed standards for radium and all exceed gross alpha.

Gross alpha levels appear to be rising in the sandstone wells. However, no complete historic data on gross alpha levels are available for the Wells. Gross alpha levels increased in all wells during the 1980's while radium levels remained about the same. The data from the sandstone wells is too sparse to permit firm conclusions to be drawn, but most wells also show a rising trend in gross alpha levels. This trend is consistent with observations from several other water utilities with sandstone wells in Waukesha County and in a few other places around the

State. Gross alpha concentrations have doubled or tripled in these systems over the last 20 years with no apparent change in radium levels. The cause for the observed increase is unknown, but it could have significant implications for radium compliance strategies.

Gross alpha levels in the dolomite aquifer wells are much lower, with all measurements under the standard. No radium data are available from the dolomite aquifer wells except Well No. 10 at 2.6 pC/l. Based on the gross alpha data for the other wells, radium levels may be expected to be well below the proposed standard in water obtained from the dolomite aquifer. Radon sampling results are available for all of the wells. Only one of the wells have been sampled in the last ten years.

Radon levels are generally higher in the dolomite aquifer wells than in the sandstone wells. The average radon level for the dolomite wells for which data are available is 320 pCi/l as compared to an average of 143 pCi/l for the five sandstone wells. The latest data the dolomite wells shows radon levels to be over the standard of 200 pCi/l at Well No. 9 and abandoned Well No. 6. No sandstone wells are over the proposed standard.

5. Summary of Water Quality Data

The water quality produced by wells supplying the City of New Berlin is generally acceptable. The water is relatively hard and some wells exceed the secondary standards for iron and manganese, which is typical for eastern Wisconsin. Several water quality concerns exist, however. These concerns tend to be segregated by aquifer, with the water quality issues for sandstone aquifer wells being different than those for the dolomite aquifer wells.

TDS levels in water produced by the City sandstone aquifer wells are higher than for wells operated by several neighboring water utilities. From **Table 2-7**, Well No. 8 in particular has very high levels of TDS, sulfates, iron and hardness. In addition, the sandstone wells in New Berlin do show an apparent trend toward rising salinity at this time. This may be due to the fact that the New Berlin wells are deeper than the wells of neighboring utilities. The most recent radium and gross alpha measurements for most of the City sandstone wells, however, exceed the proposed standards. Radium levels appear to be stable, but gross alpha levels appear to be rising. This is consistent with trends observed in sandstone wells in several other water utilities.

The dolomite aquifer wells have TDS levels that are normal for Waukesha County. The dolomite aquifer wells tend to have elevated arsenic and radon concentrations. The latest data suggests that at least one City well exceeds the proposed arsenic standard.

The water quality data base for the City wells is limited and has some significant gaps. Most water quality data represent samples taken from the distribution system or from the ground level or reservoirs. This does not provide information on quality changes in individual wells. The water quality data available for individual wells is sparse. Additional sampling will be required to determine compliance with standards for water produced by many of the City wells. Collecting water quality data from individual wells on a regular basis is recommended. This would help detect long term trends in water quality before compliance issues arise.

In the future, radionuclide standards will continue to be of concern to the City if not mitigated. Potential increases in TDS levels in water from sandstone wells along with anticipated more stringent arsenic standards may also present challenges to the City in terms of meeting public drinking water quality standards. In general, quality standards are becoming more restrictive over time. These factors should be among those carefully evaluated by the City as part of any decision concerning long term water supply options.

D. Time Domain Electromagnetic Induction Survey

1. Background

In February of 2000, Aquifer Science and Technology (AST), a division of Ruekert/Mielke, conducted a Time Domain Electromagnetic Induction (TEM) survey in Waukesha County. The purpose of the study was to identify and delineate any zones of saline water in the deep sandstone aquifer in and around the area. The regional study was conducted by AST and the University of Wisconsin-Milwaukee and was funded by the Wisconsin Department of Natural Resources through the University of Wisconsin, Water Research Institute. The objective of the regional study was to determine the distribution of saline water in the sandstone aquifer over a broad area.

Pumpage from the sandstone aquifer has created a large cone of depression centered on eastern Waukesha County (SEWRPC 1976, and Jansen and Rau, 1998). In the 1970s, the regional cone of depression consisted of two adjacent cones, one centered in Milwaukee County and one centered on the City of Waukesha. Today, the centers of these cones have deepened and coalesced into a single larger cone of depression centered in New Berlin and Brookfield. By 1995, there had been over 500 feet of decline in static water levels within the aquifer compared to original conditions. From 1975 to 1995, static water levels in sandstone wells have declined by over 10 feet per year in several areas of Waukesha County. Water levels have been declining by approximately 5.0 to 6.5 feet in the Utility's wells over the same time period. This is a relatively rapid rate of decline which indicates that pumpage from the aquifer greatly exceeds the natural recharge. If this trend continues, the declining water levels will create difficulties in future pumping operations and can cause significant changes in the water quality in the aquifer over time.

Historically, water quality in the sandstone aquifer has been good and suitable for most potable uses. In general, water quality is best near the recharge area at the edge of the Maquoketa confining unit with total dissolved solids (TDS) levels rising gradually to the east. TDS levels in the sandstone aquifer are known to be well over 2,000 parts per million (ppm) along the Lake Michigan shoreline in portions of Ozaukee and Sheboygan Counties and over 1,000 ppm in extreme eastern Milwaukee County (Ryling 1961). Generally, TDS levels in sandstone wells located a few miles from the edge of the Maquoketa confining unit have been in the range of 300 to 450 ppm.

Over the last few years, TDS levels have risen in several wells in Waukesha County, including wells serving the cities of Waukesha and New Berlin. TDS levels in some of the deeper and heavier pumped wells have doubled or tripled over the last ten to fifteen years. In Brookfield, Well 29 encountered high TDS and sulfate concentrations when it was drilled to a total depth of 2,145 feet. Water quality improved when the well was back filled to 1,690 feet. Recent water quality data suggests that high TDS water may be migrating around or through the seal in the bottom of the well.

Similar increases in TDS and sulfates were experienced in the Kaukauna area from the 1930s to the 1980s. The change in water quality was correlated to increased pumpage and regional declines in static water levels. Similar positive correlation between pumpage, depth and elevated TDS levels have been noted in the Waukesha Water Utility wells. The apparent correlation between well depth and water quality is reinforced by the observation that TDS levels decreased by 25 percent and sulfate levels decreased by 52 percent in Waukesha Well 7 when the bottom 200 feet of the well was filled in 1991. In addition, a geophysical logging study conducted on Waukesha Well 5 by the USGS determined that the TDS level of the ground water increased from about 350 ppm at a depth of 1,000 feet to over 2,200 ppm at 1,600 feet.

These observations suggest that TDS levels increase with depth and that increasing well depth or increasing pumping will tend to draw more saline water into the wells. This is consistent with the findings of several new municipal wells and test wells in the Fox River valley area where TDS and sulfate levels were significantly reduced by filling the bottom portion of the borehole.

Zones of elevated TDS and sulfates have also been associated with ridges or mound on the Precambrian surface. The presence of the impermeable Precambrian rock creates a zone of stagnation around the mound. Ground water in the zone of stagnation is not flushed out by more recent recharge and can remain in the aquifer for much longer periods than the water around it. Because the water is older, it has more time to dissolve minerals from the formation and typically has a much higher TDS concentrations that the water in the flowing portion of the aquifer. As an example of this phenomenon, a new sandstone well drilled in Oakfield in 1998 encountered a stagnation zone down gradient from a quartzite ridge. The well produced water with over 1,000 ppm of sulfate and will be abandoned when a replacement site is found.

2. Discussion of Results

The data was modeled to produce one dimensional inversions of the change in resistivity with depth beneath each sounding. One dimensional modeling was appropriate for most soundings as the lateral changes in the area of measurement for most soundings were insignificant. However, several soundings were near the Waukesha fault. For these soundings, the fault may have introduced three dimensional effects into the data which cannot be addressed by the field methods used. For these soundings, some margin of additional uncertainty is present in the model results.

3. Conclusions

The TEM data appears to have indicated that the water quality in the sandstone aquifer is relatively fresh down to depths of about 1,000 feet over most of the City. This is in agreement with the TEM data collected in the Waukesha Water Utility well field. This data detected relatively high TDS water at depths of 1,000 to 1,500 feet under much of the well field. The difference in water quality in the upper portion of the sandstone aquifer is supported by the water quality data from the two well fields. The limited historic water quality data suggests that TDS levels have been generally rising over time. New Berlin's and Waukesha's largest producing wells have TDS levels in the range of 600 to 1,000 ppm, with a trend toward rising levels. Statistical analysis of the Waukesha data has shown a strong positive correlation between TDS levels and annual pumpage and total depth. Based on these observations, it appears that TDS levels in the City of New Berlin well field have risen because the wells are as deep and pumped as hard as the Waukesha wells.

The eastern portion of the City also appears to have elevated TDS levels in the upper sandstone aquifer. This appears to be related to an area of high TDS levels around Waukesha that was identified as part of the TEM survey for the Waukesha Water Utility. In some wells the TDS levels in Waukesha have risen 29 percent over the last 15 years (18 percent in just the last three years), indicating that high TDS water is migrating upward in response to heavy pumpage. There are no other sandstone wells in this area from which TDS water quality can be obtained.

While the results of the TEM soundings are compelling, some important limitation of the analysis should be noted. First of all, the modeled resistivities of the low resistivity portion of the aquifer are very low. If taken at face value, these results would suggest extremely high TDS levels (well over 10,000 ppm) at depth. While brines of this concentration are presumably possible, there is no direct indication that water of this level of salinity is present in Waukesha County. It may be more reasonable to assume that the modeled resistivity of the saline zone is limited by the sensitivity of the TEM method and site conditions. Given this assumption, the low resistivity values can be taken as indicators of high TDS water at depth, but the TDS levels may be closer to the range of a few thousand ppm to perhaps 10,000 ppm. The concentration of brine salinity is important for estimating future water quality trends in the Utility's sandstone wells.

Given this new information, it appears that the City of New Berlin sandstone wells have begun to experience the same deterioration in water quality in the sandstone aquifer as wells supplying some neighboring communities. This is probably due to the combination of deeper wells which penetrate many shale layers, and the higher pumping rates.

While salinity levels in the wells appear to be stable, static water levels are declining at between 5 and 10 feet per year. The current regional pumpage is clearly depleting the sandstone aquifer and may cause TDS levels to rise over time. Careful consideration of long term water levels and water quality should be given before any new sandstone wells are drilled. If any new sandstone wells are drilled, they should not be drilled any deeper than about 1600 feet nor should they pumped very hard.

E. Sustainability of Aquifers[3]

The water produced by the City's wells is part of a natural flow system. The flow system is governed by a water budget where the net recharge to the aquifers is balanced by discharge from the aquifers. The recharge areas are where surface precipitation is able to infiltrate into the aquifer, typically in topographically high areas where the aquifers are overlain by permeable soils. The discharge areas are normally streams, wetlands, or lakes in topographically low areas, or man-made features, such as wells.

The volume of ground water in an aquifer is controlled by the of recharge to the system, the rate of discharge, and the storage volume of the aquifer. Changes in recharge or discharge typically result in changes in the storage component of the aquifer which causes water levels to rise or fall. Typical suburban development can cause decreases in recharge to an aquifer due to a net increase in impermeable surfaces and an increase in discharge from the system due to pumpage from wells. These changes generally cause a net decrease in head as the aquifer readjusts the flow system to capture more recharge to offset the change. If sufficient additional recharge is captured, water levels stabilize in the aquifer and the aquifer achieves a new steady-state flow system. However, if the net discharge exceeds recharge, water levels continue to decline and the aquifer is slowly depleted. If pumpage from an aquifer is too high, the natural discharge to surface water is reduced or arrested. This can cause a substantial decrease in base flow to streams, reductions in lake levels, and deterioration in wetlands, particularly during dry times of the year.

The Southeastern Wisconsin Regional Planning Commission (SEWRPC) has conducted a ground water model of southeastern Wisconsin. The results of this model provide more quantified estimates of the recharge to the major aquifers and better predictions of future water levels in the aquifers.

1. The Sandstone Aquifer

   In eastern Waukesha County, the sandstone aquifer is covered by the Maquoketa shale. The Maquoketa shale is a low permeability unit which isolates the sandstone from the overlying Silurian dolomite and sand and gravel aquifers. The shale prevents any significant recharge from reaching the aquifer from local sources. While minor amounts of water may seep through the shale, the major recharge to the aquifer enters the sandstone in western Waukesha County where the Maquoketa shale is absent. The recharge to the sandstone aquifer does not significantly increase in response to pumpage and declining head because the recharge area is miles from the area of concentrated pumpage in eastern Wisconsin. As a result, the majority of the water produced by the wells in eastern Waukesha County comes from aquifer storage, causing the head in the aquifer to decline at a significant rate for the last several decades.

   Because the pumpage rate from the sandstone aquifer in eastern Waukesha County, and in much of southeastern Wisconsin, significantly exceeds the recharge to the aquifer, the head in the aquifer will continue to drop until it becomes uneconomical to continue to use the aquifer. Excessive pumpage has also caused water quality to deteriorate in several wells. In practical terms, water utilities are likely to develop alternate aquifers and gradually reduce their dependence on the sandstone aquifer. As a result, the pumpage from the aquifer will tend to be reduced for practical reasons until stable water levels and water quality are achieved. In the absence of regional cooperation and planning, declining water levels and water quality changes are likely to continue to the point where the only communities using the sandstone aquifer are those that have no attractive alternatives.

   Predicting the usable life of the sandstone aquifer as a water source for the City is difficult due to several factors that cannot be reliably predicted. These factors include the future regional demand from the aquifer and potential changes in water quality in the well field. Given the large degree of uncertainty, the most reasonable approach may be to examine current trends as an indication of future changes in the aquifer.

   The rate of water level decline in the City's sandstone wells ranges from 5 to 10 feet per year, with an average value of about 6 feet per year. At some time in the future, the pumping level in a sandstone well will reach a point where it will be uneconomical due to the pumping costs or due to restrictions in the well. This point is somewhat subjective and will vary from well to well. Assuming a pumping level of 1,000 feet as an arbitrary limit, the City's wells will reach usable limits in time spans of between about 20 to 80 years, with an average of about 50 years.

Other sandstone wells in Waukesha County are expected to exhaust their economic lives significantly sooner.

Sandstone wells serving the City will continue to be usable for a significant amount of time. The continued decline in water levels may cause other adverse conditions that will impact the viability of the aquifer. These factors include increased pumpage from other well fields, rising salinity levels, and changes in water quality due to aeration of the sandstone aquifer as the pumping level drops below the confining unit. Introducing oxygen into the aquifer could cause an increase in inorganic constituents, such as arsenic, or nuisance bacteria problems. In addition, the USEPA will be enforcing the radium and gross alpha regulations which may require significant investment for compliance.

2. The Sand and Gravel and Dolomite Aquifers

While the Silurian dolomite is locally confined in some areas, it is generally hydraulically connected to the sand and gravel aquifer. Typically, both aquifers are considered to be a single shallow aquifer. Although the storage volume of the shallow aquifer is much less than the sandstone aquifer, it receives direct recharge from local precipitation. As a result, the sustainable capacity of the shallow aquifer is higher than the sandstone aquifer.

The sustainable capacity of the shallow aquifer in the City of New Berlin has never been accurately determined. Unfortunately, the hydrogeologic data needed to perform this analysis has not been compiled. However, average recharge rates for Waukesha County have been estimated to be about 5 inches per year. If the ground water flow into and out of the City is ignored, and an area of about 25 square miles is assumed for the City, the recharge to the aquifer can be assumed to be about 6 million gallons per day. This indicates that the natural recharge to the shallow aquifers is sufficient to meet the current average daily pumpage with approximately 3 million gallons per day left for discharge to natural surface water bodies.

The pumpage from the shallow aquifer has increased over the last decade as the City has developed new dolomite wells to meet new demand. However, until recently the increased pumpage has not caused significant reduction in water levels in the aquifer. When recently pumped for longer durations a large increase in the cone of depression was noticed and the wells production needed to be cut back.

It is likely that additional development of the shallow aquifers will cause reduction in natural discharge compared to current conditions. The minimum discharge to surface water bodies needed to maintain minimum base flows is unknown. However, at some point increased pumpage or decreased recharge may create undesirable reductions in base flow conditions to surface water bodies. To prevent these changes, the City should include enhanced recharge in its storm water management process. By routing storm water into recharge structures or natural recharge areas, the recharge to the shallow aquifers can be significantly increased thereby offsetting the effects of increased pumpage or reduced natural recharge due to development.

3. Summary

The sandstone aquifer is being over-pumped in eastern Waukesha County and in southeastern Wisconsin as a whole. The decline in water levels in the aquifer is likely to continue until pumpage is reduced, either due to regional planning or due to undesirable changes in the economics of using the aquifer. If current trends continue, most of the City's sandstone wells will become uneconomical to pump within about 50 years in terms of pumping level. Other changes in the aquifer caused by the heavy pumpage may impact the economics of the wells significantly sooner.

Water levels in the sand and gravel and dolomite aquifers appear to be dropping at current pumping rates. At some point additional pumpage and reduction in the natural recharge to the aquifers may cause adverse impacts to surface water bodies. Methods to enhance the recharge to the aquifers should be considered to offset these changes as development in the aquifer and recharge area continues.

The City of New Berlin has been providing municipal water service since the 1960's when the City combined a number of private subdivision utilities into the current water system. As the City grew over the last 40 years, seven new wells were completed in the deep sandstone aquifer to provide the majority of the water to the City. Unfortunately, the deep sandstone aquifer in the Southeastern Wisconsin area has been found to have high levels of radionuclides, including combined radium 226 and 228, in excess of the Maximum Contaminant Levels (MCL) promulgated by the United States Environmental Protection Agency (EPA) and subsequently the Wisconsin Department of Natural Resources (DNR). Compliance with the rule was mandated for December 2006 by the DNR in a consent order signed by the City. Interim compliance methods have had some success but a permanent solution is needed. The City was facing an estimated Capital investment of approximately $4.0 Million and ongoing 20 year O & M costs of another $2.0 Million to gain compliance with the radionuclide rules using treatment. 20 years is most likely the time that the facilities to treat radium would be viable. The equipment will need replacement and declining water levels and rising saline levels in the deep aquifer could result in New Berlin having to find another source by that time.

In doing their due diligence, the City of New Berlin has been reviewing options for providing continued water service since the early 1990's.

The first studies of the potable (drinking) water resources of the area were performed in the early 1990's and centered on shifting reliance on the sandstone aquifer to shallower dolomite or sand and gravel aquifers. The work performed between 1990 and 2002 to locate alternative groundwater sources is listed below:

- Report on the Phase 1 Study of the Groundwater Exploration Program for the East Half of the City of New Berlin, Wisconsin, GeEx, August 1991

- Report on the Phase II, Sand and Gravel Well Exploration Studies at the High Point and Woodfield Sites in the East Half of the City of New Berlin, Wisconsin, GeEx, November 1991

- Report on the Phase II, Dolomite Well Exploration Studies at the Westridge and Valley View Park Sites in the East Half of the City of New Berlin, Wisconsin, GeEx, November 1991

- Geothermal Survey for Locating a Dolomite Well Site, Westridge Subdivision, New Berlin Wisconsin, Northern Environmental, June 1992

- Geothermal Survey for Locating a Dolomite Well Site, Valley View Park, New Berlin Wisconsin, Northern Environmental, July 1992

- Shallow Geothermal Survey for Valley View Park Test Well Site, New Berlin, Wisconsin, Northern Environmental, October 1992

- Report on the Geologic Reconnaissance Study for the Siting of Shallow Sand and Gravel Wells, Aquifer Science and Technology a Division of Ruekert & Mielke, August 2000

- Sand and Gravel Test Boring Results, City of New Berlin, Aquifer Science and Technology a Division of Ruekert & Mielke, April 2001

- Report on the Geophysical Logging Study on Well 8, City of New Berlin, Aquifer Science and Technology a Division of Ruekert & Mielke, July 2001

All of these studies were designed to identify areas of the City of New Berlin where non-radium water could be provided on a sustainable basis to meet the existing and future water demands. As a result of the study work, two new dolomite wells were completed in the 1990's and serve to supplement the sandstone wells. In 2003, as a result of the later studies, one site was identified as being geologically, environmentally and financial feasible to construct a high capacity sand and gravel well. That site was developed but due to microbiological problems has been abandoned.

As part of the later geological studies, a sand and gravel aquifer was also identified in the far southwestern corner of the City. This area is as far away from the existing water and sewer service areas as any area in the City. During the investigations, a contingent of local homeowners from New Berlin and other local communities organized to fight proposed wells in this area. These homeowners have private individual wells and were concerned that their wells were going to be affected by any high capacity well placed in this area. In addition, the cost to construct wells in this area and pipe the water back to the service area was not cost-effective when compared to other options. Under political pressure from these local homeowners and environmental groups, the City chose not to invest any more time and money in this area. This issue was later reviewed in the subsequent studies for future water service cited below.

As a result of the work cited above, the City successfully tapped all available areas that shallow water could be located that:

- Provided quantities of water sufficient for a municipal system
- Were radium free
- Met EPA and DNR Mandatory separation distances from potential contamination sources
- Were geologically acceptable
- Were politically and financially feasible.

In 1998, The City of New Berlin hired consultants to update a study of water supply facilities that was originally prepared in 1990 and served as the precursor to the search for shallow well sources cited above. That report recommended the City perform a further study of the possibility of obtaining lake Michigan Water as a supply source for the City, as well as exploring other options such as a new source of supply and/or treatment for radium.

The City of New Berlin then performed a study in 2000-2001 to evaluate how Lake Michigan could be used to serve potable water to the City. That study, after reviewing four separate Lake Michigan water service options, recommended that the City negotiate with a Lake Michigan water provider for service to the east side of the City. New Berlin, being located immediately adjacent and west of the City of Milwaukee Water service area, selected the City of Milwaukee as the logical provider and successfully negotiated a water service agreement with them. Pumping Stations and water mains were constructed to allow only those areas within the Great Lakes surface water basin to be served.

During these projects the new regulations relating to Radium were promulgated and the City once again did its due diligence and commissioned a Study of the best method to deal with Radionuclides in drinking water. That study took an in-depth look at the available methods to provide radium free water and the costs and environmental and other impacts related to compliance.

Based upon the results of that report, it was recommended that the City pursue Lake Michigan water for the entire proposed service area which coincides with the planned service area for MMSD sewers and therefore meets return flow requirements of the Compact. This recommendation was made after careful review of nine options for compliance and six evaluation criteria as well as present worth analysis. Options and Criteria reviewed were:

Options for Compliance	Review Criteria
Ion Exchange Softening	Reliability
Lime Softening	Regulations/Legal
Reverse Osmosis	Political/Public Acceptance/Environmental
Greensand Filtration	Operations and Maintenance
HMO Filtration	Schedule
Ion Selective Resins	Infrastructure
Surface Water	Cost-NPV
New Shallow Wells/Blending	
Reconstruct Deep Wells	

Figure 2-6 in shows the results of the analysis graphically and **Table 2-10** shows the numerical results. In the discussion related to this analysis, the option of reconstructing wells was the most attractive due to the low cost and chance for a "quick fix". The City pursued this option unsuccessfully. The next options, in order of preference were, Ion Exchange Softening, Reverse Osmosis, and Surface Water (Lake Michigan). These options ranked within a few percent of each other in this analysis. The present worth cost of all options was then reviewed in (**Table 2-11**) and it became apparent that Ion Exchange and Reverse Osmosis were cost prohibitive as well as having environmental impacts such as salt production and increased waste of water. The final recommendation was to pursue Lake Michigan water for the entire area because it was cost beneficial and the most environmentally friendly option. If that could not be accomplished for regulatory or other reasons, HMO filtration was the next choice. The reason for these recommendations were that under the Compact, the City of New Berlin is considered a "Straddling Community" as previously identified. If, however, the timing to gain approval for Lake Michigan supply could not coincide with the required timing by a radium consent order, it was realized that a less favorable option, from an environmental and cost standpoint, may need to be pursued.

The City then signed a consent order outlining the steps that would be taken to reach compliance with the radium rule. Included in this agreement was the fact that New Berlin would pursue Lake Michigan as an option for the entire MMSD service area.

The City also, in following the recommendations of the radium study and consent order, performed logging of two high radium wells to determine if the wells themselves could be rehabilitated to reduce the amount of radium entering the well bore. As a result of the geophysical logging, it was determined that the well construction did not allow for reconstruction at any cost effective level and that the likelihood of success with radium reduction was low. This was the first step in trying to solve the radium project.

Next, in compliance with the consent order, the City had a paper pilot study performed to determine the level of radium removal that could be expected from HMO filters at the three largest wells in the City. This study was successful and in 2006, three HMO plants were designed. These plant designs have been approved by DNR. Construction of the plants will solve the radium issue at a huge cost to the people of New Berlin and perpetuate environmental degradation from tens of thousands of tons of salts and other contaminants to the Great Lakes basin. Construction of these plants will also increase the amount of water removed from the Mississippi Basin and transmitted to the Great Lakes Basin due to backwash of the filters. These environmental impacts are discussed in depth in following sections.

IV. ASSESSMENT OF ENVIRONMENTAL AND ECONOMIC IMPACT OF PLAN

A. Water Supply Alternatives

A compilation of the work performed to identify options for water service was previously discussed. A summary of the information was provided in previous sections that showed the path leading to the Lake Michigan option recommendation.

B. Environmental Impacts[7]

Of primary importance to New Berlin are the positive environmental impacts that will result from the proposal. Specific environmental improvements that will result from approval of this application include:

- Transfer of water between basins will be minimized
- Water will be removed and returned to the Lake Michigan basin in nearly the same location
- The diversion of the wastewater generated with out-of-basin water will be minimized
- Iron and radium releases to Lake Michigan will be avoided
- Tens of thousands of tons of salt released to the lake will be significantly reduced
- Water use by regeneration of water softeners will be significantly reduced
- Groundwater levels in the deep sandstone aquifer that is hydraulically connected to Lake Michigan will begin to rebound
- Shallow groundwater sources outside the divide will no longer be tapped and not returned to their basin

- The area of New Berlin outside the MMSD service area will remain on private wells and septic

- Significant amounts of energy will be saved along with associated reductions in green house gas generation

- Groundwater chemistry changes in the deep sandstone aquifer will be reduced

These environmental improvements will be discussed in detail in the following section.

1. Transfer of Water Between Basins Will be Minimized

   The Compact and Agreement both cite the fact that not only is it desirable to minimize or eliminate the withdrawal of water from the Great Lakes Basin, but also that it is desirable to minimize the amount of water entering the Great Lakes Basin from outside the Basin. This is further supported by Wisconsin administrative code chapter NR 142 which has substantial review requirements for transfer of water either way across basin boundaries. It should be noted that the requirements of NR 142 provide DNR with authority to approve the types of transfers that currently occur and that are proposed if the transfers are consistent with the requirements of that chapter and certain state statutes.

   Presumably, the application, registration and review process established by NR 142 was set up to protect the two basins, Great Lakes and Mississippi, from any environmental issues that would arise out of a transfer of water. It can be inferred that if no transfer occurs, the concerns of this chapter would not apply. It can further be inferred that minimizing any such transfer would in turn minimize concerns with such transfer.

   Approval of this application will result in a more normal balance of water withdrawal and return to both basins. Water taken out of Lake Michigan will be returned to lake Michigan in quantities that much more closely match. Currently there is a net increase of out-of-basin water entering the Basin of about 1.056 billion gallons per year. This would be decreased at least to about 412 million gallons per year or, with continued I/I reform, even more. This is over a 60 percent reduction in out-of-basin water entering the basin.

   On the Mississippi basin side, the use of shallow and deep groundwater would cease. Concerns with over drafting aquifers in the City would be minimized and water tables would stabilize at levels where nearby private wells would not have issues resulting from City high capacity well influence.

2. Water Will be Removed and Returned in Close Proximity

   The City of New Berlin has two water treatment plants, Linwood and Howard. Either plant can serve as the source of supply for the locations that pump water to New Berlin. All of the sanitary return flow goes to the South Shore Wastewater Treatment Facility under normal conditions. This means that the point of withdrawal and the point of return to the lake is normally about 10 miles apart and a maximum of 15 miles apart, depending on which supply plant is being used. This close proximity replaces the water near where it is withdrawn following treatment.

3. Wastewater Generated Using Out-of-Basin Water will be Minimized

   The generation of wastewater will happen no matter where the source of supply is. The roughly 644 million gallons of water currently pumped from wells that flows into the MMSD system will be mostly eliminated under this proposal. That water has significant natural chemical difference from that of the Lake water. Hardness is more than double, iron, radium and many other metals are much higher, ph differs, water temperature differs and the total dissolved solids is much higher. These chemical differences would be minimized under this proposal.

4. Iron and Radium Releases to Lake Michigan will Cease

   If this proposal is not approved, the City has designed and is currently bidding the construction of three radium removal plants which will be constructed to gain compliance with the radium regulations. These treatment plants not only have a high cost economically but have a high environmental impact. The technology which was determined in aforementioned studies is Hydrous Manganese Oxide filtration. This process uses a normal iron filter retrofitted to add a chemical solution know as Hydrous Manganese Oxide (HMO). HMO is added to the water prior to filtration and the radium in the water adsorbs to the manganese component of the HMO solution. Once the adsorption occurs, the resultant particle size is large enough to be removed by the filter. The process also removes the majority of the iron and some other total dissolved solids in small quantities. It is estimated that the process, which has already received DNR construction approval, will result in a significant increase in iron and radium sent to the Milwaukee Wastewater treatment system. Some of this will end up in Lake Michigan and some in the sludge generated by the process and applied as fertilizer. Exact breakdowns would take a detailed study but conservative calculations show that the increased loadings to the treatment facilities will be about 2,200 pounds per year of iron and 822 million picocuries of radiation from radium. Much of this is currently being sent to MMSD via the sanitary sewers now, but if the treatments plants are constructed, the iron and radium would be concentrated in the removal process and more efficiently sent to the system. If Lake water is provided to these areas, the out of basin iron, radium and other constituents would not be transferred to the basin.

5. Salt Released to the Lake

The area of major concern is the amount of salts that are currently sent to the Lake. If the HMO facilities are installed, hardness will not be addressed. If lake water is provided, water hardness will drop from about 26 grains per gallon to about 8 grains per gallon according to DNR records. Experience with other communities such as Menomonee Falls shows that when the softer lake water is provided, households discontinue the use of the water softeners. This is evidenced by the fact that essentially no homes in Milwaukee or Milwaukee service areas have home water softeners. In order to estimate the aggregate water and salt savings from discontinuation of softening in New Berlin, the following assumptions were used:

- Currently there are 2650 residential customers in the area to be provided Lake Michigan water
- By 2020, there will be an additional 718 residential homes in the area
- Average residential water consumption is 220 gallons per day per customer. For homes having softeners, 180 gallons per day pass through the softener.
- Groundwater hardness averages 26 grains per gallon
- Average Lake water hardness is 8 grains per gallon
- If current and future customers are served with groundwater, 80 percent will use softeners
- If Future water supply is lake water, 10 percent will use softeners
- Softener capacity is 19,800 grains
- One pound of salt restores 3,350 grains of softener capacity
- Approximately 40 gallons of wastewater is produced during a softener regeneration

Based upon the above assumptions and projected water demands, the existing and future homes will generate an additional 1.8 million pounds of salts annually which will be sent to the lake. This would be reduced by an estimated 90 percent under the lake water proposal.

Water use by softeners will be reduced by about 9.4 million gallons per year based upon our calculations.

6. Groundwater Levels in the deep Sandstone will be Positively Affected

   Pre-development levels in the sandstone aquifer under New Berlin were over 500 feet higher than current levels. During that time, the normal flow of water in the sandstone was from about 30 miles west of the lake in the Mississippi basin to the east and into the Great Lakes basin. Decades of over pumping the aquifer have reversed the direction of the gradient and now water flows from the Great lakes basin towards the large pumping centers in and around New Berlin. Any proposal that stops the withdrawal of water from the sandstone is a step towards returning the flow to it's predevelopment condition.

7. Shallow Groundwater Sources Outside the Basin will no Longer be Affected

   Currently, New Berlin uses three shallow aquifer dolomite wells for about 25-30 percent of their supply. Even at the rates they are currently pumping these shallow wells, a cone of depression is occurring that affects local private wells. Any continued or expanded reliance on these shallow sources will have even greater, longer lasting effects on the groundwater and hydraulically connected surface waters in the area. If the deep wells are to be pumped because Lake water is not available, the decline in the level of the sandstone aquifer will continue and the well documented problems that exist with radium, saline water intrusion and prohibitive pump setting depths will continue to get worse. At some point it may become financially advantageous to find shallow resources further and further away from the City and the water service area. The City has already experienced vehement opposition to use of the available shallow aquifers and currently these options are cost prohibitive. Any increase in the use of the shallow aquifer will affect local wetlands and surface waters. As a region, any affect to surface waters or wetlands is negative. Flora and fauna in the region do not know that there is a basin divide and do not follow strict rules in staying on one side or the other of the divide. The provision of water and protection of regional resources is a regional issue. The proposal fits in well with the region.

8. Areas will Remain on Private Wells and Septic

   It is a common mistake to think that this proposal is designed to encourage "urban sprawl". Currently, the agreement New Berlin has with Milwaukee water for water service to in-basin areas limits the use of water to areas within the basin and within an even more restrictive area. The proposed amended service area would limit water service to the MMSD area as shown on **Figure 2-1**.

   This means the area shown in white on **Figure 2-1** would not be served by Lake Michigan or MMSD under this proposal. These homes and lots would continue to be served by private wells and septic or holding tanks. With most homes on septic, about 85 percent of the water used is returned to the ground this assists in the preservation of groundwater levels and wetlands and surface waters for the region.

In addition, The current agreement that New Berlin has with Milwaukee for water service clearly indicates that under no circumstances will New Berlin be allowed to transfer or sell water to any other community in the area.

Finally, as previously noted, there simply does not exist enough undeveloped area in the proposed new service area to support "urban sprawl". Only slightly over 1 percent of the total land area in the City and in the proposed service area is identified as unimproved.

9. Significant Amounts of Energy will be Saved and Green House Gas Generation Reduced

   New Berlin currently uses a tremendous amount of energy to pump water from the deep wells to the system. This will be greatly reduced if the Utility obtains all its water from Lake Michigan. Current estimates of energy use and the decrease in energy use under the proposed plan can be calculated by comparing the current total lift required to deliver water from the deep aquifers (average) to the total lift required for lake water. If we assume 70 percent efficient pumping systems under both scenarios and normal friction and other losses, there will be a savings of about 700,000 Kilowatt Hours of energy used annually by New Berlin to pump water. The Carbon Trust reports energy purchased off the grid uses an average of 0.43 $KgCO_2/KWh$ for a total reduction in carbon emissions of about 300,000 Kilograms annually.

10. Other Related Issues

   The primary related issue is development related. Many environmental entities have indicated that the continued development of areas in western New Berlin will pave over recharge areas, promote development away from urban centers, increase degradation of natural resources and other traditional arguments against development of suburban areas. New Berlin, through it's planning process, has developed very strict land development and zoning practices for areas not included in a designated sanitary sewer service area. For areas west of the MMSD area, minimum lot sizes of 5 acres are the standard and this level of development cannot support the provision of sanitary sewers or water facilities. These areas will remain on private systems and are not shown on any legal documents as being served. As previously mentioned, by current and proposed future agreements, these areas cannot be served.

   This water supply service area plan serves as a companion document to a request for the entire MMSD sewer service area in New Berlin to be included in the Lake Michigan Basin and therefore be allowed to receive it's water supply from the Basin. All concerns generated during the previous review process have been adequately addressed and based upon this document:

a. There is an overwhelming environmental benefit to the Great Lakes Basin and the Mississippi Basin in southeastern Wisconsin from approval of this proposal.

b. The cost to society, and in particular the citizens of New Berlin, is minimized if this proposal is approved.

c. New Berlin is a prime example of how zoning controls and community planning can limit and control any type of over development in areas of limited resources.

d. Water conservation has been a benefit to New Berlin and additional methods to promote conservation are underway on a local and regional basis.

VI. DEMONSTRATION THAT THE PLAN WILL EFFECTIVELY UTILIZE EXISTING FACILITIES

A. Storage and Distribution

No changes are proposed to the volume or location of existing storage. In order to avoid the high cost of water main improvements over and above those the Milwaukee Water Works is already committed to, an operations plan to make use of existing New Berlin storage facilities was developed. This plan has been contemplated since 2006 (see attached letter to DNR dated August 4, 2006).

As the City of Milwaukee and City of New Berlin contemplated the agreement to provide Milwaukee water to the entire water customer base in New Berlin, it was appropriate to revisit the operations plan and verify the ability of the two water systems to meet peak demands. That review was completed during the negotiation process with Milwaukee and is explained in detail herein.

The critical demands experienced by a water utility are generally classified into three industry accepted categories.

- Average Day Demand – Represents the annual pumpage divided by 365/366.
- Peak Day Demand – The maximum pumpage for a one calendar day period.
- Peak Hour Demand – The maximum rate of pumpage experienced on a peak day for a one hour period.

Average and peak day demands are measured by the SCADA (Supervisory Control and Data Acquisition) system. Peak hour demands are estimated at two times the peak day rate for a period of four hours on a peak day. There should also be an allowance for a fire flow event on a peak day. In New Berlin, a fire flow of 3,500 gallons per minute for 3 hours is the recommended rate by the insurance services office. This equates to a volume of 630,000 gallons.

B. Peak Day and Peak Hour Rate Calculation

Pumping Available = 6.5 MGD from Milwaukee

Usable Storage Available	=	Westridge	358,000	Gallons
		Sunnyslope	194,000	Gallons
		Industrial Park	194,000	Gallons
		Well No. 3	441,000	Gallons
		Well No. 7	412,000	Gallons
		Well No. 8	435,000	Gallons
		Total	2,034,000	Gallons
		Total Available	8,534,000	Gallons

Peak hour considered peak day times 1.75 for 4 hours = 6,500,00 x 1.75 = 13,000,000 x 4/24 = 1.896 MG

This means available usable storage exceeds peak demands by approximately 140,000 gallons.

Emergency supply can come from Milwaukee per the proposed agreement.

In addition, radium compliant wells will also be available while the system demands and water usage pattern are closely watched for the first few years of operation. If needed, the following wells can remain on-line and be used to supplement demands:

- Well No. 2 – Capacity of 446,000 GPD
- Wells No. 8 and No. 9 – Combined capacity of about 1,800,000 GPD
- Well No. 10 – Capacity of 864,000 GPD

The combined capacity of these compliant wells is about 2,160 GPM, or over 3.0 MGD. In a peak demand or emergency situation, these wells could be used but it is doubtful they would be needed.

In a non-emergency situation, peak day demands of about 8.5 MGD could be met using storage. The proposed agreement allows for emergency demands to come from Milwaukee. Another 3 MGD would also be available from wells if needed.

1. The plan, which is consistent with agreements already in place with the City of Milwaukee, will implement specific items of those agreements including:

    - Water supply will only be provided to areas served by MMSD and within the service boundary.

- Water will be supplied by Milwaukee at a rate no greater than 6.5 MGD, except in the case of an emergency or amended agreement.

- Water will not be provided to other communities except in emergencies.

- New Berlin will provide all required infrastructure within their boundaries.

2. Upon approval of this plan by the State of Wisconsin, New Berlin will discontinue all use of wells containing radium, as expeditiously as possible.

3. New Berlin will make improvements to existing pumping equipment and controls necessary to increase available supply to the 2029 peak daily demands within 6 months of approval of this plan.

4. New Berlin anticipates full service to the service area in mid-2009 from Lake Michigan. For the time between plan approval by the state and implementation of pumping station improvements, there is a possibility that non-radium wells may be used to supplement Lake Michigan supply. It is, however, doubtful this option will need to be exercised.

5. New customers covered under this plan will be required to:

   - Be within the service area established by both the Milwaukee agreements and the more restrictive water supply service area established by SEWRPC.

   - Have water service applications and new development plans reviewed for compliance with the area restrictions of this plan and the SEWRPC established service area.

   - Have any plan for service outside the established water supply service area review and approved, and the area amended by SEWRPC.

   The City of New Berlin is committed to implementation and enforcement of these procedures by adoption of this plan.

VII. CONSISTENCY WITH APPLICABLE COMPREHENSIVE AND AREA-WIDE WATER QUALITY MANAGEMENT PLANS

A. The City of New Berlin Comprehensive Plan

The City's Comprehensive Plan is being prepared under the authority of Wisconsin's Comprehensive Planning Law, Wis. Stats. §66.1001, more commonly referred to as "Smart Growth" Legislation. The 1999 Wisconsin Act 9, and subsequently 1999 Assembly Bill AB 872 and 2001 Wisconsin Act 16, revised planning legislation for all communities in the State. The Smart Growth legislation provides a framework for developing comprehensive plans, procedures for adopting such plans, and requires that any program or action of a community that affects land use must be consistent with the community's comprehensive plan. The principles of smart growth legislation are noted below.

The Comprehensive Plan definition breaks down the planning process into nine elements. Each of these elements will be addressed for the City, as well as the 10 Planning Neighborhoods.

1. Issues and Opportunities
2. Housing
3. Agriculture, Natural Resources, and Cultural Resources
4. Economic Development
5. Transportation
6. Land Use
7. Utilities and Community Facilities
8. Intergovernmental Cooperation
9. Implementation

Upon adoption, all land use decisions must be consistent with the goals, objectives and policies outlined in the Comprehensive Plan.

B. Principles of Smart Growth

1. Promotion of the redevelopment of lands with existing infrastructure and public services and the maintenance and rehabilitation of existing residential, commercial and industrial structures.
2. Encouragement of neighborhood designs that support a range of transportation choices.
3. Protection of natural areas, including wetlands, wildlife habitats, lakes, woodlands, open spaces and groundwater resources.
4. Protection of economically productive areas, including farmland and forests.
5. Encouragement of land uses, densities and regulations that promote efficient development patterns and relatively low municipal, state governmental and utility costs.
6. Preservation of cultural, historic and archaeological sites.

7. Encouragement of coordination and cooperation among nearby units of government.

8. Building of community identity by revitalizing main streets and enforcing design standards.

9. Providing an adequate supply of affordable housing for individuals of all income levels throughout each community.

10. Providing adequate infrastructure and public services and an adequate supply of developable land to meet existing and future market demand for residential, commercial and industrial uses.

11. Promoting the expansion or stabilization of the current economic base and the creation of a range of employment opportunities at the state, regional and local levels.

12. Balancing individual property rights with community interests and goals.

13. Planning and development of land uses that create or preserve varied and unique urban and rural communities.

14. Providing an integrated, efficient and economical transportation system that affords mobility, convenience and safety and that meets the needs of all citizens, including transit–dependent and disabled citizens.

The City of New Berlin has been divided into 10 Planning Areas for the purpose of the Comprehensive Plan. The planning process includes a Neighborhood Listening Session/Survey and Neighborhood Review Session for each of the 10 Planning Areas. In addition, a kick-off meeting to explain the process was held in March of 2008 and two City-wide open houses will be conducted in 1009 for the public to review the Draft Plan Recommendations. A final Public Hearing will be held in 2009 to approve the Comprehensive Plan. During the two year process there will be numerous Steering Committee meetings, Plan Commission update meetings, and Common Council meeting updates.

This plan, when adopted by the City, will be referenced in and become part of the comprehensive plan effort.

This plan must also support and be consistent with the approved area-wide water quality management plan. The following statement is made in the water supply service area for the City of New Berlin document in **Appendix B**:

> "Relationship to Regional Water Quality Management Plan/New Berlin Sewer Service Area Plan

The planned New Berlin water supply service area is considered to be fully consistent with the adopted New Berlin sewer service area, as documented in the sewer service area plan. One difference exists between the planned water service area and the planned sewer service area. That difference relates to a small, fully developed area in the northwest corner of the City which is currently served by private onsite sewage disposal systems. The area is part of the planned Brookfield sewer service area tributary to the Fox River Water Pollution Control Center sewage treatment plant, which discharges to the Fox River in the Mississippi River basin. The area is not being considered for a public water supply under the proposed New Berlin water supply service area set forth in this report. Individual onsite wells are expected to continue to be used in this area."

VIII. SUMMARY

This water supply service area plan for New Berlin satisfies the requirements listed in Wis. Stat. §281.348. The document must undergo public review and comment in the City of New Berlin, and be approved by the governing body of the City of New Berlin. The plan will then be submitted to WDNR for review.

It is understood that WDNR will likely conduct a department-sponsored public notice and comment period following receipt of the approved, properly noticed and publically reviewed plan.

IX. REFERENCES

1. Report on Water Supply Facilities for the City of New Berlin, Wisconsin, Ruekert & Mielke, Inc., 1990.

2. Report on Water Supply Facilities 1999 Update, City of New Berlin, Ruekert & Mielke, Inc., 1999.

3. Lake Michigan Water Supply Study, City of New Berlin, Ruekert & Mielke, Inc., 2001.

4. Radionuclide Rule Compliance Master Plan, City of New Berlin, Ruekert & Mielke, Inc., 2003.

5. City of New Berlin, Wisconsin Application for Water Diversion, Ruekert & Mielke, Inc., 2006.

6. Correspondence from Lee H. Boushon, P.E., Chief Public Water Supply Section Bureau of Drinking Water and Groundwater WDNR, dated January 23, 2007.

7. Amended Sample Application for Straddling Community Water Diversion, Ruekert & Mielke, Inc., 2007.

8. Correspondence from Todd Ambs, Administrator Division of Water WDNR, Dated July 13, 2007.

9. Correspondence from Scott Hassett, Secretary WDNR, dated July 13, 2007.

10. First Amendment to Agreement between the City of Milwaukee and the City of New Berlin for the Purchase of Water at Wholesale, September 12, 2008.

11. Correspondence to Mr. Todd Ambs, Division Administrator, Water WDNR, September 26, 2008.

12. 2007 Wisconsin Act 227, Published June 10, 2008.

13. Correspondence to Todd Ambs, Division Administrator Water Systems Section WDNR, dated December 31, 2008.

14. Correspondence from Eric Ebersberger, Water Use Section Chief WDNR, dated January 7, 2009.

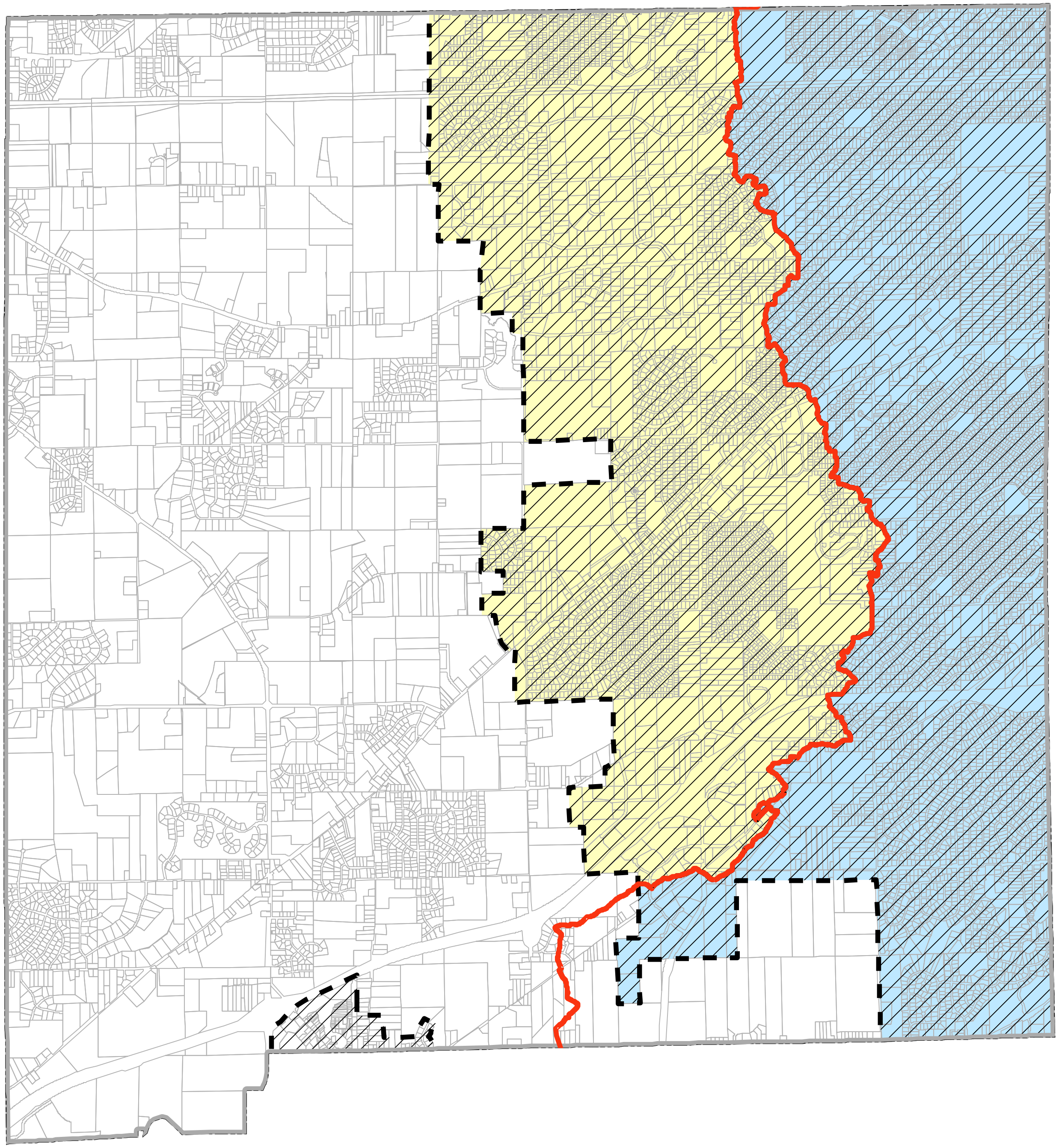
15. SEWRPC Planning Report No. 52, A Regional Water Supply Plan for Southeastern Wisconsin, Under Preparation.

Figures

FIGURE 2-1

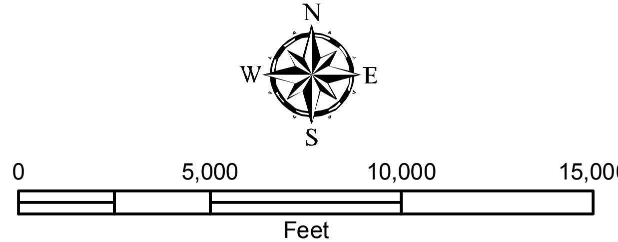
SEWRPC WATER SUPPLY SERVICE AREA

CITY OF NEW BERLIN, WAUKESHA COUNTY, WISCONSIN



Legend

- Sub-Continental Divide
- SEWRPC Water Supply Service Area
- Current Approved Lake Water Service Area
- Proposed Expanded Lake Water Service Area
- Areas Outside Current SEWRPC Water Supply Service Area



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Date: January, 2009

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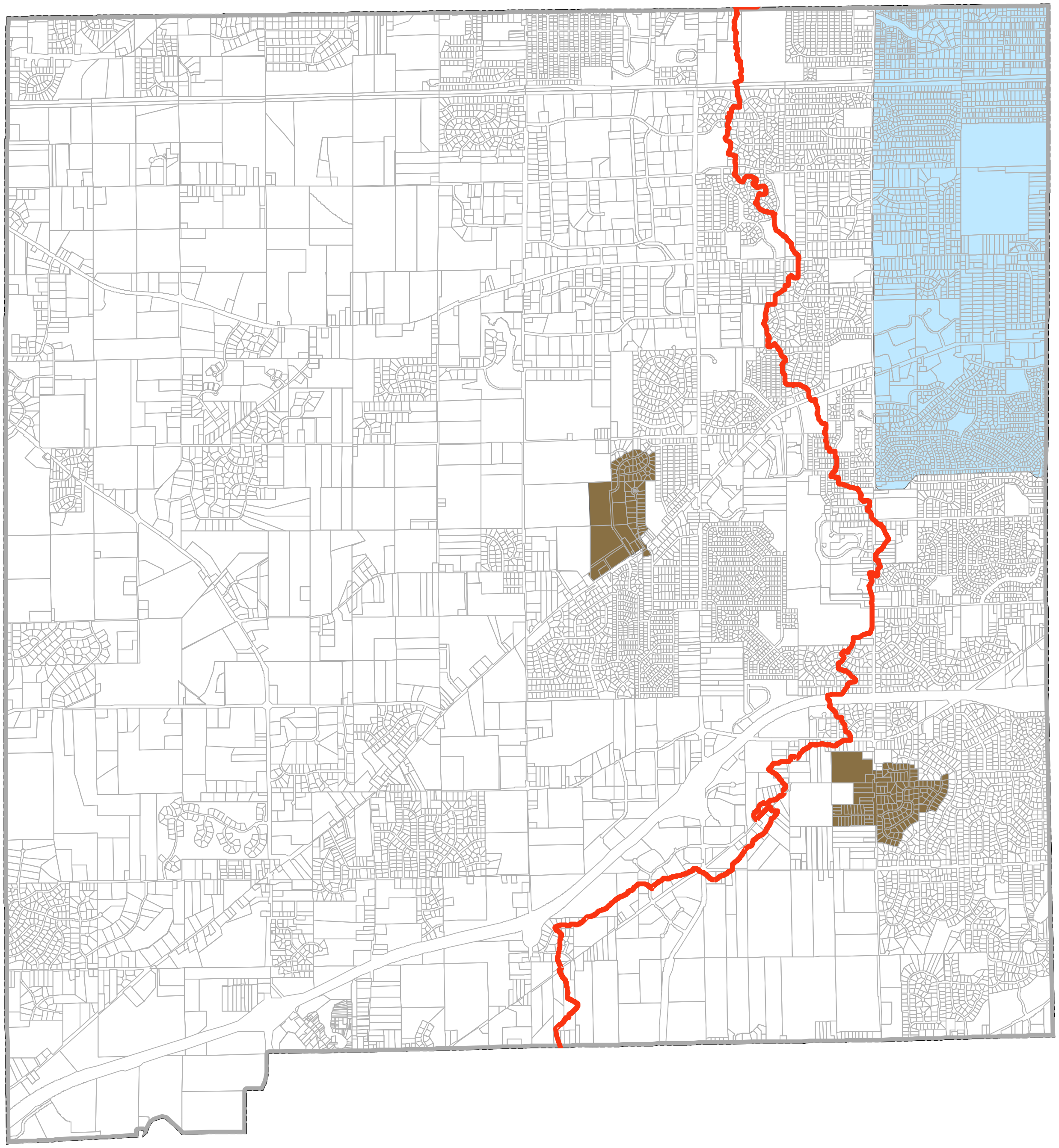


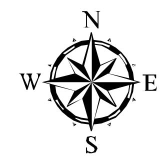
FIGURE 2-2

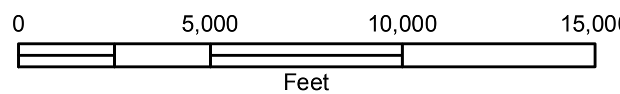
WATER PRESSURE
ZONE BOUNDARIES

CITY OF NEW BERLIN,
WAUKESHA COUNTY, WISCONSIN

Legend

Sub-Continental Divide
Boosted Pressure Areas
Reduced Pressure Zone





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Date: January, 2009

Figure 2-3

Proejcted Peak Daily Pumpages for East and West Water Service Areas: 2000 to 2035
as Taken From SEWRPC Regional Water Supply Study Draft Report
City of New Berlin, Wisconsin

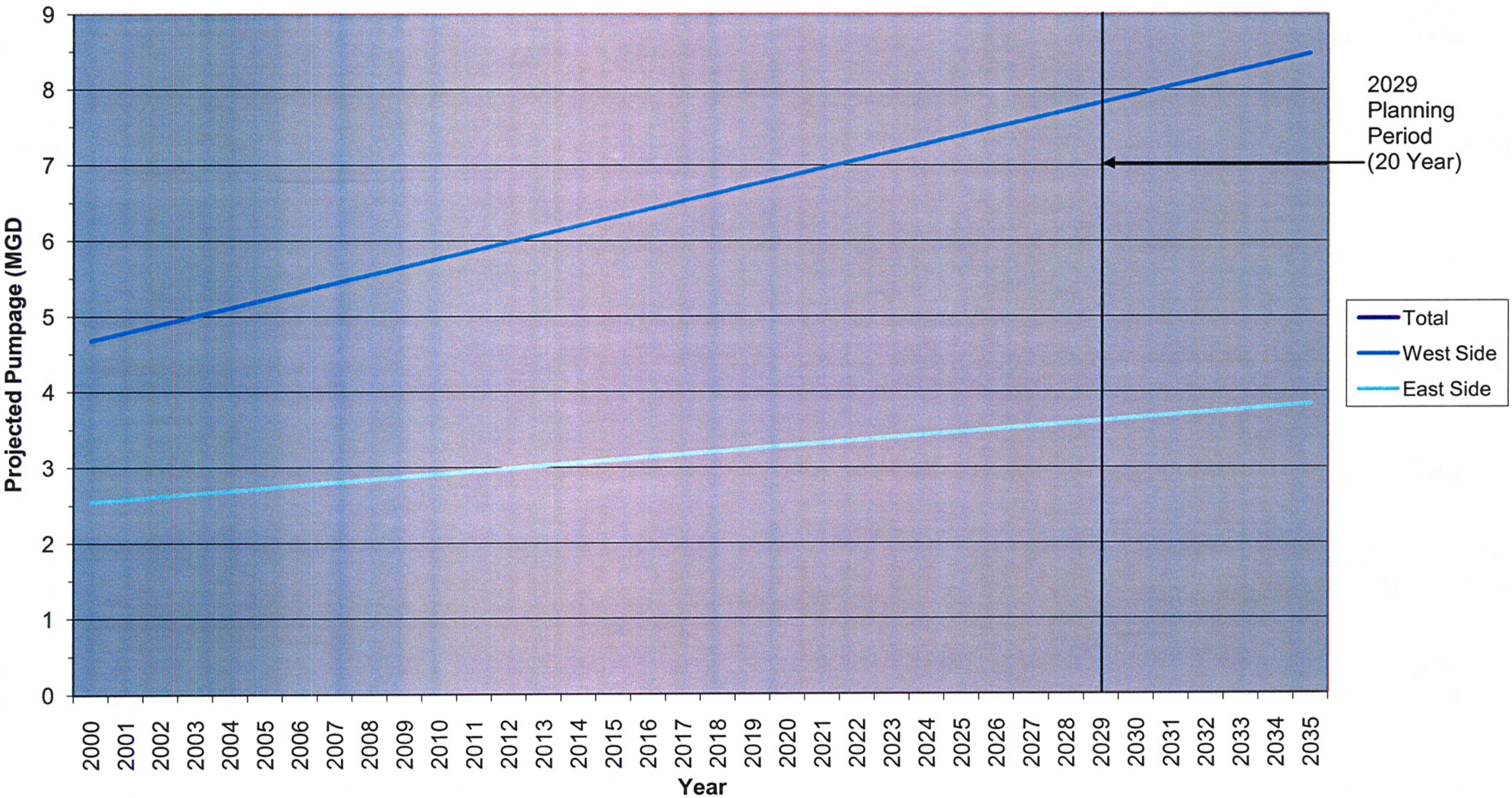


Figure 2-4

Proejcted Average Daily Pumpages for East and West Water Service Areas: 2000 to 2035
as Taken From SEWRPC Regional Water Supply Study Draft Report
City of New Berlin, Wisconsin

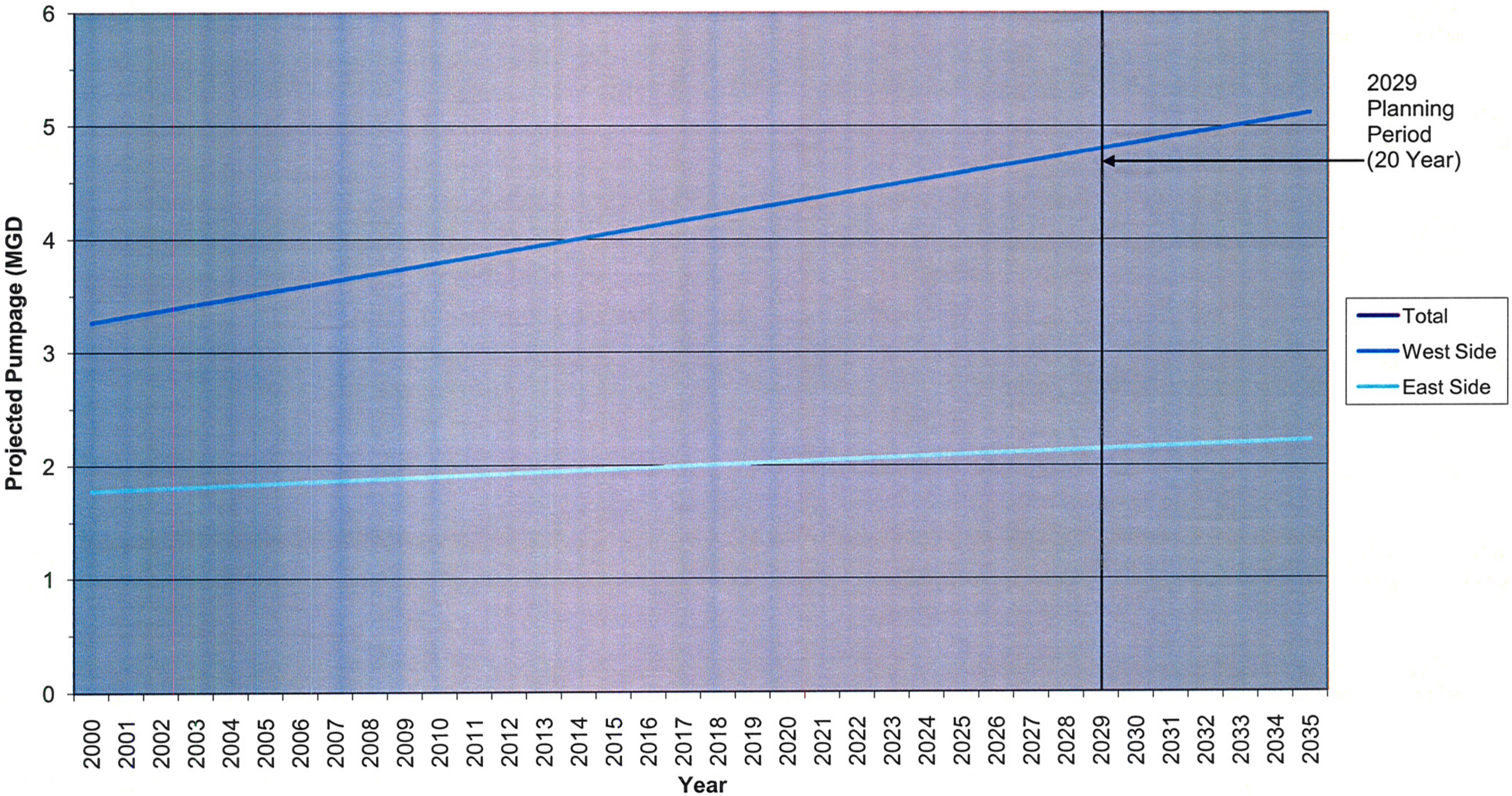


Figure 2-5
SEWRPC 2035 Water Pumpage Projections and Adjusted 2029 Service Area Pumpage Projections
Cityof New Berlin, Wisconsin

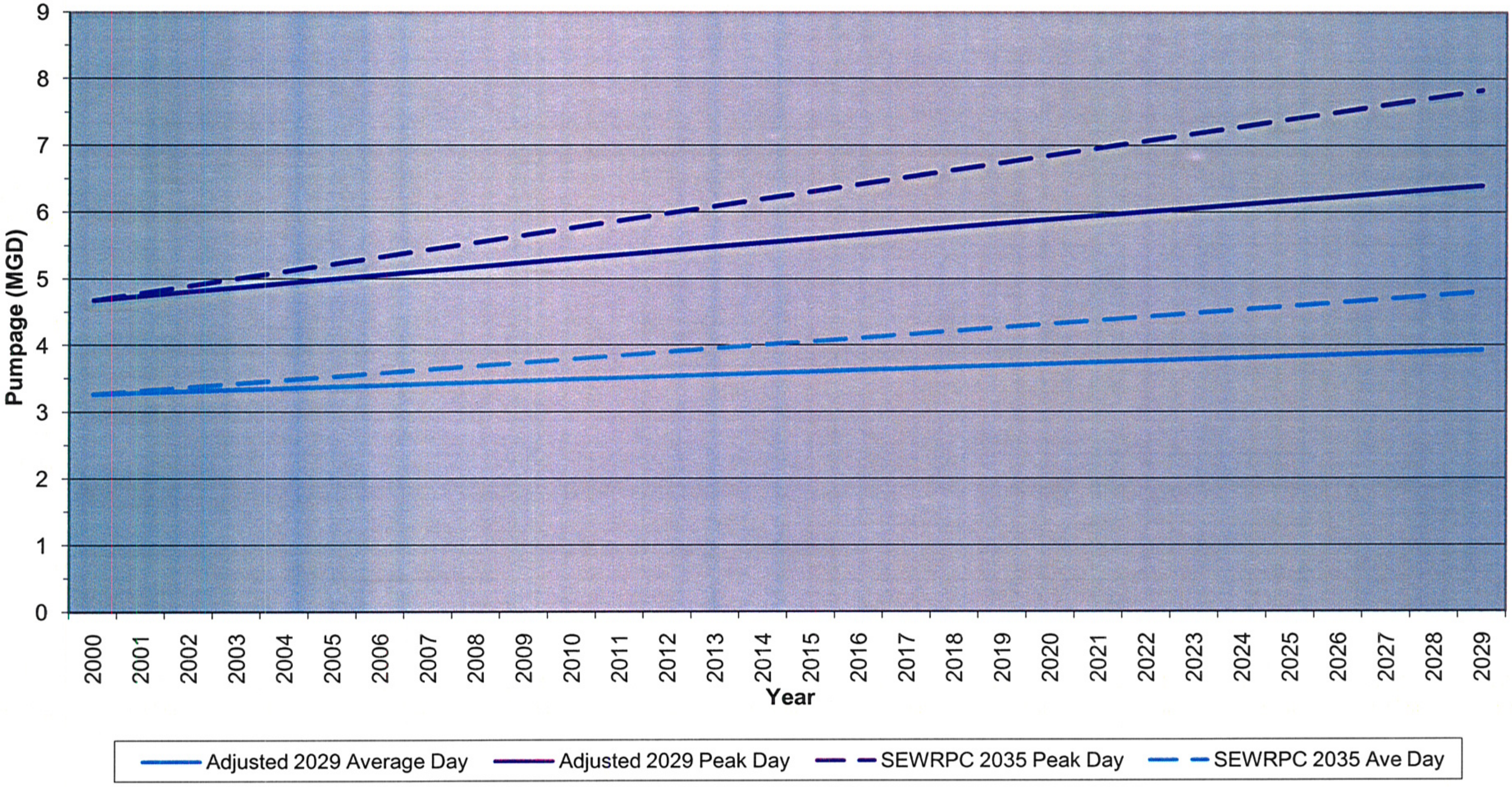
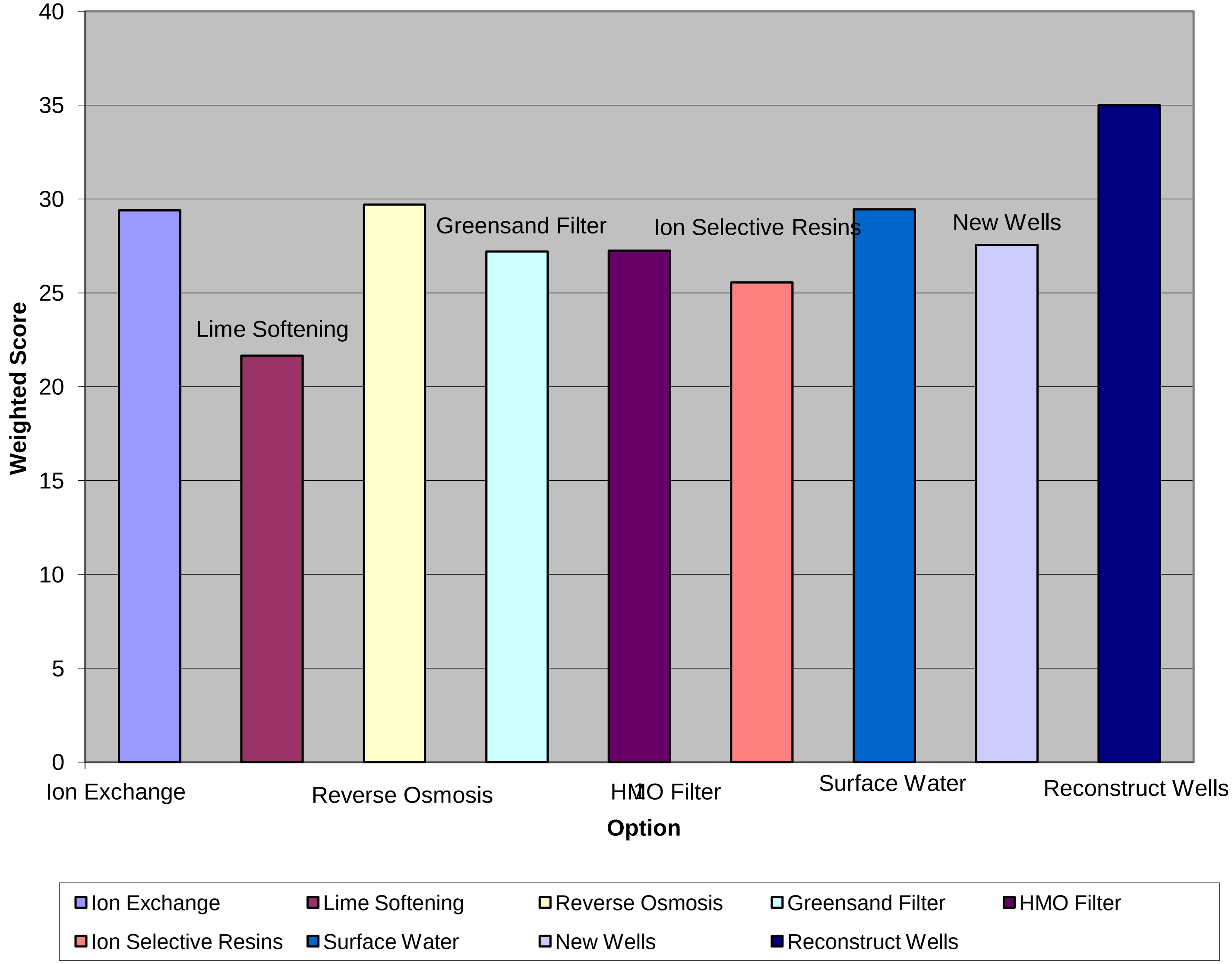


Figure 2-6
Radium Remediation Evaluation Results



Tables

Table 2-1

Water Main Inventory: 2007
New Berlin Water Utility
City of New Berlin, Wisconsin

Pipe Size	Pipe Material	No. of Feet	Equivalent Miles
4	Metal	600	0.11
4	Plastic	162	0.03
6	Metal	61,227	11.60
6	Plastic	157,153	29.76
8	Metal	49,835	9.44
8	Plastic	299,789	56.78
10	Metal	252	0.05
10	Plastic	16,297	3.09
12	Metal	32,331	6.14
12	Plastic	93,412	17.69
16	Metal	137,114	25.97
16	Plastic	7,189	1.36
	Totals	855,878	162.10

Source: PSC, R/M

Table 2-2

Existing Well Data: 2007

New Berlin Water Utility
City of New Berlin, Wisconsin

Source Designation	No. 1 Forest View	No. 2 Glendale Park	No. 3 Rogers Drive	No. 4 Green Ridge	No. 5 Regal Manor	No. 7 National Ave.	No. 8 Valley View	No. 9 Valley View	No. 10 Westridge
Year Constructed	1965	1965	1966	1966	1970	1976	1983	1993	1999
Nominal Open Hole Diameter (in.)	12	10	16	12	12	16	16	12	14
Constructed Depth (ft.)									
Well	1500	334	1800	1650	1700	2018	1983	342	345
Casing	552	154	543	523	540	566	580	70	14
Original Conditions									
Static Water Level (ft.)	333	43	350	298	403	500	505	8	32
Specific Capacity (gpm/ft.)	6.7	8.4	12.0	9.2	7.4	18.8	11.8	6.0	4.3
2000 Conditions (Estimated)									
Static Water Level (ft.)	500	67	567	501	599	593	584	53	49
Specific Capacity (gpm/ft.)	9.4	8.4	24.9	13.3	2.2	23.5	14.7	5.8	7.3
Average Static Water Level Decline (ft./yr.)	4.8	0.7	6.4	6.0	6.5	3.9	4.7	6.4	17.0
Aquifer	SS	D	SS	SS	SS	SS	SS	D	D
				Abandoned 2006					

NOTES:
SS = Sandstone
D = Dolomite

Source: R/M, DNR, New Berlin Water

Table 2-3

Well/Pump Station Capacities

New Berlin Water Utility

City of New Berlin, Wisconsin

Well/Pump Station Facility	Well Pump Capacity (GPM)	Service Pump Capacity (GPM)	Aux. Power Well Pump Capacity (GPM)	Aux. Power Service Pump Capacity (GPM)	Total Source Capacity (MGD) (1)	Total 3 HR Pump Capacity (MG)	Total Aux. Power Pump Capacity (24 Hr.) (MG)	On-Site Storage (Gal)
1) Forest View	500	455	500	775(6)	0.720	0.112(4)	0.782	62,000
		455						
2) Glendale Park	310	400	310	400(3)	0.446	0.190(5)	0.627	181,000
		400						
		400						
3) Rogers Drive	970	1,200		1,500	1.397	0.775(4)	2.160	1,084,000
		1,200						
		900						
		1,500						
4) Green Ridge (Reservoir Only)		1,000	N/A	1,000	N/A	0.180(4)	0.290	290,000
		600						
		350						
5) Regal Manor	550	--			0.792	0.099(5)		
6) Regal Manor Auxiliary	Abandoned							
7) National Avenue (Main System Only)	1,080	1,958			1.555	0.599(4)		550,000
		1,885						
		743						
8) Valley View East (Main System Only)	1,375	1,352			1.980	0.516(4)		580,000
		1,517						
9) Valley View West	690	--			0.994	0.124(5)		--
10) Westridge	600	--	600		0.864	0.108(5)	0.864	--
Total	6,075	13,815	1,360	3,675	8.748	2.703	4.723	2,747,000

Notes:

1) Equal to lessor of well pump output or total service pump output for a twenty four hour period.
2) Equal to lessor of 75% of reservoir volume plus three hours of well pump output or maximum service pump output for a three hour period.
3) This pump is controlled by an auxiliary engine and right angle gear drive. It is available for demands during power outages only.
4) Equal to estimated maximum service pump output for a three hour period.
5) Equal to 75% of reservoir volume plus three hours of well pump output.
6) Estimated output of service pumps with all pumps running.

Source: Ruekert/Mielke and New Berlin Water Utility

Table 2-4

2029 and 2035 Population, Land Use and Pumpage Projections

New Berlin Water Utility

City of New Berlin, Wisconsin

	Population		Increased Land Use (Acres)						Pumpage Projections (MGD)			
			Industrial		Commercial/Public		Other		Average Day		Peak Day	
	2029	2035	2029	2035	2029	2035	2029	2035	2029	2035	2029	2035
SEWRPC Regional Water Supply Study												
- East Side		22,800		48		168		486		2.218		3.829
- West Side		18,500		334		498		119		2.902		4.656
- Total		41,300		382		666		605		5.120		8.480
SEWRPC Water Supply Service Area												
- East Side	20,900											
- West Side	15,200											
- Total	36,100											
Water Supply Service Area Plan												
- East Side	20,900		48		168		486		2.142		3.605	
- West Side	15,200		0		249		119		1.778		2.786	
- Total	36,100		48		417		605		3.920		6.391	

Note: Aras not filled in were not determined under the referenced study.

Table 2-5

Existing and Forecast Population and Population Density Used for Water Pumpage Projections

New Berlin Water Utility

City of New Berlin, Wisconsin

	Year 2000			Year 2029		
	Population[3]	Area Served	Denisty (Pop./Sq. Mi.)	Population[3]	Area Served	Density (Pop./Sq. Mi.)
City of New Berlin Water Utility (East)[1]	18,900	8.0 Sq. Mi.	2362.5	20,900	8.0 Sq. Mi.	2612.5
City of New Berlin Water Utility (West)[2]	13,100	6.2 Sq. Mi.	2112.9	15,200	7.3 Sq. Mi.	2082.2
City of New Berlin Water Utility (Total)	32,000	14.2 Sq. Mi.	2253.5	36,100	15.3 Sq. Mi.	2359.5

1 - Area east of the sub continental divide within the planned Lake Michigan Water Service Area.
2 - Area west of the sub continental divide within the planned Lake Michigan Water Service Area.
3 - From SEWRPC January 19, 2009 water supply service area for the City of New Berlin (Appendix B).

Table 2-6

Drinking Water Standards - 2009

New Berlin Water Utility
City of New Berlin, Wisconsin

PRIMARY Inorganic Chemicals	Maximum Contaminant Level (Milligrams per Liter)
Arsenic	0.01
Asbestos	7 million fibers/liter
Barium	2
Cadmium	0.005
Chromium	0.1
Fluoride	4.0
Mercury	0.002
Nitrate	10 (as Nitrogen)
Nitrite	1 (as Nitrogen)
Total Nitrate/Nitrite	10 (as Nitrogen)
Selenium	0.05
Antimony	0.006
Beryllium	0.004
Cyanide (as free Cyanide)	0.2
Nickel	0.1
Thallium	0.002
Synthetic Organic Chemicals	**Maximum Contaminant Level (Milligrams per Liter)**
Anachlor	0.002
Atrazine	0.003
Benzo[a]pyrene	0.002
Carbofuran	0.04
Chlordane	0.002
Dalapon	0.2
Dibromochlonpropane	0.002
Di(2-ethylhexyl)adipate	0.4
Di(2-ethylhexyl)phthalate	0.006
2,4-D	0.07
Dinoseb	0.007
Diquat	0.02
Endrin	0.002
Endothall	0.1
Ethylene Dibromide	0.00005
Glyphosate	0.7
Heptachlor	0.004
Heptachlor epoxide	0.002
Hexachlorobenzene	0.001
Hexachloracyclopentadiene	0.05
Lindane	0.002
Methoxychlor	0.04
Oxamyl	0.2
Polychlorinated Biphenyls (PCBs)	0.005
Picloram	0.5
Pentachlorophenol	0.001
Simazine	0.004
Toxaphene	0.003
2,4,5-TP	0.05
2,3,7,8-TCDD (Dioxin)	$3x10^{-8}$

Table 2-6

Drinking Water Standards - 2009

New Berlin Water Utility

City of New Berlin, Wisconsin

Volatile Ograni c Chemicals	Maximum Contaminant Level (Milligrams per Liter)
Benzene	0.005
Vinyl Chloride	0.0002
Carbon tetrachloride	0.005
1,2-Dichloroethane	0.005
Trichloroethylene	0.005
1,1-Dichloroethylene	0.007
1,1,1-Trichloroethane	0.20
para-Dichlorobenzene	0.075
cis-1,2-Dichloroethylene	0.07
trans-1,2-Dichloroethylene	0.1
Dichloromethane	0.005
1,2-Dichloropropane	0.005
Ethylbenzene	0.7
Monochlorobenzene	0.1
o-Dichlorobenzene	0.6
Styrene	0.1
Tetrachloroethylene	0.005
Toluene	1
1,2,4-Trichlorobenzene	0.07
1,1,2-Trichloroethane	0.005
Xylenes (total)	10
OTHER	
Total Trihalomethanes	0.1
Lead and Copper	
as described in NR 809	
Microbiological	
as described in NR 809	
Turbidity	1-5 NTU
Radiological	
Combined Radium 226 and Radium 228	5 pCi/l
Gross Alpha Particle Activity	15 pCi/l
Tritium	20,000 pCi/l
Strontium-90	8 pCi/l
Gross Beta Particle Activity	50 pCi/l
SECONDARY	
Substance	**Milligrams per Liter except as noted**
Aluminum	0.05 to 0.2
Chloride	250
Color	15 units
Copper	1.0
Corrosivity	Noncorrosive
Fluoride	2.0
Foaming agents	0.5
MBAS (Methylene-Blue Active Substances)	
Hydrogen Sulfide	not detectable
Iron	0.3
Manganese	0.05
Odor	3 (Threshold No.)
Silver	0.1
Sulfate	250
Total Residue	500
Zinc	5

Source: Wisconsin Administrative Code, NR 809

Table 2-7

Selected Water Quality Data

New Berlin Water Utility

City of New Berlin, Wisconsin

Well No.	Aquifer	Year	Chloride	Hardness	Iron	Manganese	Sodium	TDS	Sulfate
1	SS	1999	5.0	350	0.43	0.02	17.3	552	177
2	D	2008	2.9	360	0.19	0.082	20	460	60
3	SS	2008	13	370	0.33	0.019	16	680	150
4	SS	2000	10.0	401	0.88	0.03	18.3	611	210
5	SS	1999	4.0	339	0.92	0.02	15.8	496	141
7	SS	2008	6.7	330	0.440	0.02	12.0	480	130
8	SS	1999	8.0	772	1.65	0.03	17.7	1160	564
9	D	1999	55.0	536	1.29	0.03	30.2	671	109
10	D	2008	220	510	0.16	0.04	77.0	800	65
Secondary Standard	--	--	250	N/A	0.30	0.05	N/A	500	250

N/A - No standards are in effect. Hardness above 300 is generally considered high and sodium is currently being studied.

D = Dolomite Aquifer
Ss = Sandstone Aquifer

Note: All units of measure are milligrams per liter (mg/l) ppm. Results from 2008 are from WDNR website. From 1999 samples collected by the City except Well 10 which is from DNR records.

Source: DNR, New Berlin, R/M

Table 2-8

Radium Analysis Results
New Berlin Water Utility
City of New Berlin

Sample Date	Sample Location	Radium-226	Radium-228	Gross Alpha	Gross Beta	Combined Radium	Radon
10/2/2002	Forestview #1	3.7	3	33.0	15.8	6.7	
10/2/2002	Glendale #2	0.47	0.9	3.0	2.1	1.37	
10/22/2002	Rogers Drive #3	3.8	3.8	33.0	19.0	7.6	
10/2/2002	Greenridge #4	3.9	3.8	27.0	14.0	7.7	
10/2/2002	Regal Main #5	4.5	3.7	31.0	17.0	8.2	
10/2/2002	National #7	3.9	4.2	24.0	18.0	8.1	
10/2/2002	Well No. 10	0.65	0.1	3.0	2.6	0.75	
10/2/2002	200 (Combined #8 and #9)	2.8	1.8	16.0	12.0	4.6	
11/1/2000	Distribution	3.5	3.4	30.0	15.0	6.9	
11/24/1998	Distribution	2.9	2.6	24.0		5.5	
11/19/1997	Distribution	2.6	2.2	19.0		3.8	
10/27/1997	Well No. 9	9.0					260
9/29/1997	Well No. 10	0.7	0.8	8.3	4.1	1.5	
12/17/1996	Distribution	3.0	3.2	44.0	13.0	6.2	
12/20/1995	Distribution	3.5	4.9	28.0	19.0	8.4	
11/30/1994	Distribution	3.2	3.3	29.0	16.0	6.5	
9/6/1994	Distribution	3.3	3.7	18.0	11.0	7.0	
6/8/1994	Distribution	3.1	3.0	22.0	15.0	6.1	
3/9/1994	Distribution					4.5	
12/10/1993	Distribution	3.3	2.4	20.0	12.0	5.7	
9/8/1993	Distribution	3.3	2.4	19.0	13.0	5.7	
5/25/1993	Distribution	3.2	2.7	24.0	14.0	5.9	
3/18/1993	Valley View #9			1.4			
3/18/1993	Distribution					4.3	
12/17/1992	Distribution	1.3	1.9			3.2	
12/14/1992	Distribution					4.9	
9/21/1992	Distribution	0.0	1.3	3.0		1.3	
6/16/1992	Distribution	3.6	2.7	25.1		6.3	
3/10/1992	Distribution	3.5	3.0	20.7		6.5	
12/9/1991	Distribution	3.3	2.2	21.8		5.5	
9/11/1991	Distribution	3.4	2.0			5.4	
6/18/1991	Distribution	3.4	2.3	16.5		5.7	
3/18/1991	Distribution	2.9	4.0	18.2		6.9	
12/17/1990	Distribution	3.3	3.0	15.9		6.3	
8/21/1990	Distribution	2.8	3.8	13.8		6.6	
6/11/1990	Distribution	4.3	3.6	22.1		7.9	
3/16/1990	Distribution	4.4	5.0	18.8		9.4	
12/4/1989	Distribution	3.6	2.2	15.0		5.8	
8/24/1989	Distribution	3.8	3.6	14.6		7.4	
6/13/1989	Distribution	3.3	3.6	11.5		6.9	
3/14/1989	Distribution	3.7	3.0	16.1		6.7	
9/27/1988	Distribution	2.4	1.9	7.7		4.3	
3/13/1987	Distribution	2.9	3.9	6.7		6.8	
11/12/1986	Distribution	3.0	3.0	9.7		6.0	
9/22/1986	Forest View #1			22.8			
9/17/1986	Rogers Dr. #3						152
9/17/1986	Forest View #1						180
9/17/1986	Glendale #2						245
9/17/1986	Greenridge #4						100
9/17/1986	Regal Main #5						156

Table 2-8

Radium Analysis Results
New Berlin Water Utility
City of New Berlin

Sample Date	Sample Location	Radium-226	Radium-228	Gross Alpha	Gross Beta	Combined Radium	Radon
9/17/1986	Regal Aux. #6						325
9/17/1986	National #7						141
6/9/1986	Valley View #8						129
3/27/1986	Distribution	3.6	4.2	23.2		7.8	
2/13/1986	Distribution	3.3	2.1	11.3		5.4	
2/13/1986	Forest View #1	4.8	2.7	28.9		7.7	
2/13/1986	Rogers Dr. #3	2.8	3.1	24.8		5.9	
2/13/1986	Greenridge #4	4.5	3.0	20.8		7.5	
2/13/1986	National Ave. #7	4.3	3.0	20.6		7.3	
9/23/1985	Valley View #8	5.7	8.6	25.7		14.3	
3/25/1985	Distribution	2.9	3.6	12.7		6.5	
12/17/1984	Distribution	4.6	3.9	20.6		8.5	
9/26/1984	Distribution	4.7	3.1	21.3		7.8	
6/13/1984	Distribution	5.0	3.4	23.7		8.4	
3/28/1984	Distribution	5.0	4.1	14.4		9.1	
12/21/1983	Distribution	5.3	3.0	15.5		8.3	
1/14/1983	Distribution	6.3	2.3	17.8		8.6	
10/12/1982	Valley View #8	6.3	13.0	22.8		19.3	
9/16/1982	Distribution	5.3	5.3			10.6	
7/7/1982	Well #8 Bailer	1.5	2.6	14.8		4.1	
7/7/1982	Forest View #1	4.3	3.0	14.7		7.3	
7/7/1982	Glendale #2			0.0			
7/7/1982	Rogers Dr. #3	2.4	3.8	13.2		6.2	
7/7/1982	Greenridge #4	4.9	4.2	16.6		9.1	
7/7/1982	Regal Aux. #6			62.6			
4/1/1982	National #7	0.0	4.7	17.0		4.7	
	Regal Main #5	3.8	2.2	12.4		6.0	

Table 2-9

Arsenic Project Sampling Data

New Berlin Water Utility

City of New Berlin, Wisconsin

Well No.	Date	Concentration (ppb)	Aquifer
1	4/29/2002	0.0	Sandstone
2	3/4/2008	4.0	Dolomite
3	3/4/2008	0.0	Sandstone
4	4/30/2002	0.0	Sandstone
5	8/9/2005	0.0	Sandstone
7	3/4/2008	0.0	Sandstone
8	6/29/2000	3.1	Sandstone
9	6/29/2000	2.4	Dolomite
10	3/4/2008	1.9	Dolomite
Proposed Standard		10.0	

Source: DNR, R/M

Table 2-10

Results of Alternate Evaluation

New Berlin Water Utility

City of New Berlin, Wisconsin

Alternative Description (Weight)	Reliability (100)	Infrastructure (95)	Regulations/ Legal (80)	Political/ Public (60)	O & M (45)	Schedule (35)	Weighted Score	Rank
Ion Exchange Softening	8	5	8	7	5	8	28.40	5
Lime Softening	4	3	6	9	3	7	20.85	9
Reverse Osmosis	9	5	7	9	3	8	28.90	3
Greensand Filter	6	7	6	6	6	7	26.20	7
HMO Filter	9	7	6	6	6	7	29.20	2
Ion Selective Resins	8	7	4	5	4	6	24.75	8
Surface Water	9	8	3	6	8	7	28.65	4
New Shallow Wells/Blending	8	5	7	6	7	8	27.90	6
Reconstruct Deep Wells	8	8	10	7	9	9	35.00	1

Ion Exchange	29.4
Lime Softening	21.65
Reverse Osmosis	29.7
Greensand Filter	27.2
HMO Filter	27.25
Ion Selective Resins	25.55
Surface Water	29.45
New Wells	27.55
Reconstruct Wells	35

Table 2-11

Summary of Capital and O & M Costs for Alternatives

New Berlin Water Utility

City of New Berlin, Wisconsin

Option		Well Reconstruction	Well Replacement	HMO Filtration	Ion-Exchange Softening	Reverse Osmosis	Ion-Selective Resins
Well							
No. 1	Capital	$427,900	$1,702,900	$998,400			
	O & M	$19,187	($119,941)	$335,836			
	Total	$447,087	$1,582,959	$1,334,236			
No. 3	Capital	$427,900	$2,373,900	$972,400	$783,250	$1,719,250	$455,650
	O & M	$46,553	($232,671)	$651,736	$3,072,468	$7,448,407	$3,724,204
	Total	$474,453	$2,141,229	$1,624,136	$3,855,718	$9,167,657	$4,179,854
No. 4	Capital		$1,799,100	$907,400			
	O & M	*	($143,948)	$403,054			
	Total		$1,655,152	$1,310,454			
No.5	Capital		$1,492,840	$919,100	$627,250		
	O & M	*	($88,724)	$248,426	$1,172,029		
	Total		$1,404,116	$1,167,526	$1,799,279		
No. 7	Capital	$427,900		$1,193,400	$939,250	$2,213,250	
	O & M	$51,810		$725,343		$8,290,004	
	Total	$480,310		$1,918,743		$10,503,254	
Nos. 5/7	Capital			$1,749,800		$2,850,900	
	O & M			$974,025		$11,128,797	
	Total			$2,723,825		$13,979,697	

* Option reviewed but not recommended.
Blank lines means the option was not reviewed further.

Appendix A

Water Supply Service Area for the City of New Berlin

WATER SUPPLY SERVICE AREA FOR THE CITY OF NEW BERLIN

WAUKESHA COUNTY WISCONSIN

SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION

WATER SUPPLY SERVICE AREA FOR THE CITY OF NEW BERLIN

WAUKESHA COUNTY, WISCONSIN

Prepared by the

Southeastern Wisconsin Regional Planning Commission
W239 N1812 Rockwood Drive
P.O. Box 1607
Waukesha, Wisconsin 53187-1607
www.sewrpc.org

January 2009

SEWRPC Staff Memorandum

RESPONSE TO REQUESTS BY THE CITY OF NEW BERLIN TO DELINEATE THE 20-YEAR PLANNED WATER SUPPLY SERVICE AREA FOR THE UTILITY

INTRODUCTION AND BACKGROUND

By letter of January 12, 2009, the City of New Berlin requested that the Southeastern Wisconsin Regional Planning Commission provide a delineation of the water supply service area potentially attendant to the City of New Berlin Water Utility. A copy of that letter request is attached hereto as Exhibit A. The request was made to support an application being considered by the Utility to expand the Lake Michigan water supply source to the central portion of the City. In its January 12th letter, the City indicated that the City of New Berlin and the Milwaukee Water Works have entered into an agreement to provide water to the area west of the subcontinental divide that also would have sewer service provided by the Milwaukee Metropolitan Sewerage District. This memorandum, including the attached Map 1, is intended to respond to the City's request.

Under the recently adopted Great Lakes Compact (2007 Wisconsin Act 227), any utility seeking a new or increased withdrawal of water from the Great Lakes basin and diverting the water to any place outside the Great Lakes basin must register with the State and provide information to the State regarding the proposed withdrawal. That information includes a water supply plan which is to be based upon a proposed water supply service area. The Act specifies that, for the purposes of the water supply plans, an areawide water quality planning agency designated by the Governor under the Wisconsin Department of Natural Resources areawide water quality management planning rule set forth in Chapter NR 121 of the *Wisconsin Administrative Code*, shall delineate the proposed water service supply areas for all of the public water supply systems in the planning area for which the agency is designated. The Southeastern Wisconsin Regional Planning Commission is such an agency. The Act also requires that the water supply service areas be consistent with the applicable approved areawide water quality management plan for the planning area. The regional agency may also provide regional needs assessments and other regional water supply planning information to parties preparing public water supply system plans.

The Southeastern Wisconsin Regional Planning Commission is currently preparing a regional water supply plan for the Southeastern Wisconsin Region.[1] That plan includes preliminary recommendations regarding planned water supply service areas. Those service areas were developed specifically taking into account consistency with the adopted regional water quality management plan.[2] In delineating the City of New Berlin Water Utility water supply service area included herein, the Commission drew upon the preliminary regional water supply plan and the adopted regional water quality management plan as last amended for the City of New Berlin in September 2008.

AREA DESCRIPTION

The 20-year water supply service area attendant to the City of New Berlin Water Utility is shown on Map 1. Also shown on Map 1 are the environmentally significant lands in the vicinity of the planned water supply service area.

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[1]*SEWRPC Planning Report No. 52,* A Regional Water Supply Plan for Southeastern Wisconsin, *under preparation.*

[2]*SEWRPC Planning Report No. 30,* A Regional Water Quality Management Plan for Southeastern Wisconsin: 2000*; Volume One,* Inventory Findings, *September 1978; Volume Two,* Alternative Plans, *February 1979; Volume Three,* Recommended Plan, *June 1979, as last amended for the City of Waukesha in December 2007.*

Those lands consist of environmental corridors, isolated natural resource areas, and small wetlands and surface waters. The adopted regional water quality management plan places great emphasis on protection of the environmentally sensitive lands. Details on the delineation process and protection recommendations for these environmentally sensitive areas can be found in the City of New Berlin sewer service area plan.[3]

The potential planned New Berlin water supply service area includes the portion of the City located east of the subcontinental divide, shown in blue on Map 1, and two separate portions of the central part of the City, shown in tan and yellow on Map 1. These three water supply areas of the City of New Berlin, as shown on Map 1 encompasses about 15.5 square miles.

The portion of the potential planned water supply service area located east of the subcontinental divide and currently approved for Lake Michigan supply (blue area on Map 1) encompasses about 8.0 square miles, the majority of which (90 percent) is currently developed and provided with public sewer and water supply systems. The year 2000 population residing in that portion of the water supply service area was about 18,900 persons. Under planned 2029 conditions, the resident population in the same area is expected to be about 20,900 persons, an increase of about 11 percent over the year 2000 population level. The wastewater generated in this area currently is conveyed to the Milwaukee Metropolitan Sewerage District system and thereby returned to Lake Michigan. This wastewater management strategy is expected to continue.

Also shown on Map 1 in tan color, are areas in the City of New Berlin which could potentially be provided with municipal water supply service using a Lake Michigan supply. That area encompasses about 7.3 square miles, of which about 6.2 square miles, or 85 percent, is currently developed. The remaining potential service area, comprising about 1.1 square miles, or 15 percent, is considered potentially developable land. This area has been included in the planned water supply service area because it is largely served with municipal water supply using groundwater as a source. That groundwater source does not meet current regulatory standards for radium. In addition, there are some portions of the area where there may be a need to support the resolution of potential water supply problems associated with existing development served by individual wells. Under the regional land use plan, a limited portion of this area is proposed to be developed to support the planned population level, as can be seen by the planned increase in resident population in the area. The year 2000 population residing in this area was about 13,100 persons. Under planned 2029 conditions, the resident population in the same area is expected to be about 15,200 persons, an increase of about 16 percent over the year 2000 population level.

Also shown on Map 1 in yellow color is a small area located south of IH 43 in the south-central portion of the City which is ultimately envisioned to be served by a municipal water supply system using groundwater as a source of supply. That area encompasses about 98 acres and is largely developed (85 percent).

RELATIONSHIP TO REGIONAL WATER QUALITY MANAGEMENT PLAN/NEW BERLIN SEWER SERVICE AREA PLAN

The planned New Berlin water supply service area is considered to be fully consistent with the adopted New Berlin sewer service area, as documented in the sewer service area plan.[4] One difference exists between the planned water service area and the planned sewer service area. That difference relates to a small, fully developed area in the northwest corner of the City which is currently served by private onsite sewage disposal systems. The

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[3]*SEWRPC Community Assistance Planning Report No. 157,* Sanitary Sewer Service Area for the City of New Berlin, Waukesha County, Wisconsin, *November 1987, as last amended in September 2008.*

[4]Ibid.

area is part of the planned Brookfield sewer service area tributary to the Fox River Water Pollution Control Center sewage treatment plant, which discharges to the Fox River in the Mississippi River basin. The area is not being considered for a public water supply under the proposed New Berlin water supply service area set forth in this report. Individual onsite wells are expected to continue to be used in this area.

RELATIONSHIP TO PRELIMINARY REGIONAL WATER SUPPLY PLAN

The planned New Berlin water supply service area is considered to be fully consistent with the preliminary regional water supply plan.[5] The 2035 water supply service area set forth in the preliminary regional water supply plan includes lands located south and southwest of the planned water supply service area set forth in this report, as well as a small strip of land along the western edge of the service area. These areas have been included to support the potential resolution of potential water supply problems associated with existing development currently served by individual private wells and, in some cases, to support development envisioned to occur in the longer-term future. Those areas are not included in the currently adopted sewer service area and are, therefore, not included in the water supply service area. These areas could be subject of future amendments to the planned sewer service and water supply service areas.

Given due consideration to the foregoing, it is concluded that the New Berlin planned water supply service area is consistent with the City of New Berlin sanitary sewer service area plan as incorporated in the adopted regional water quality management plan and the preliminary regional water supply plan.

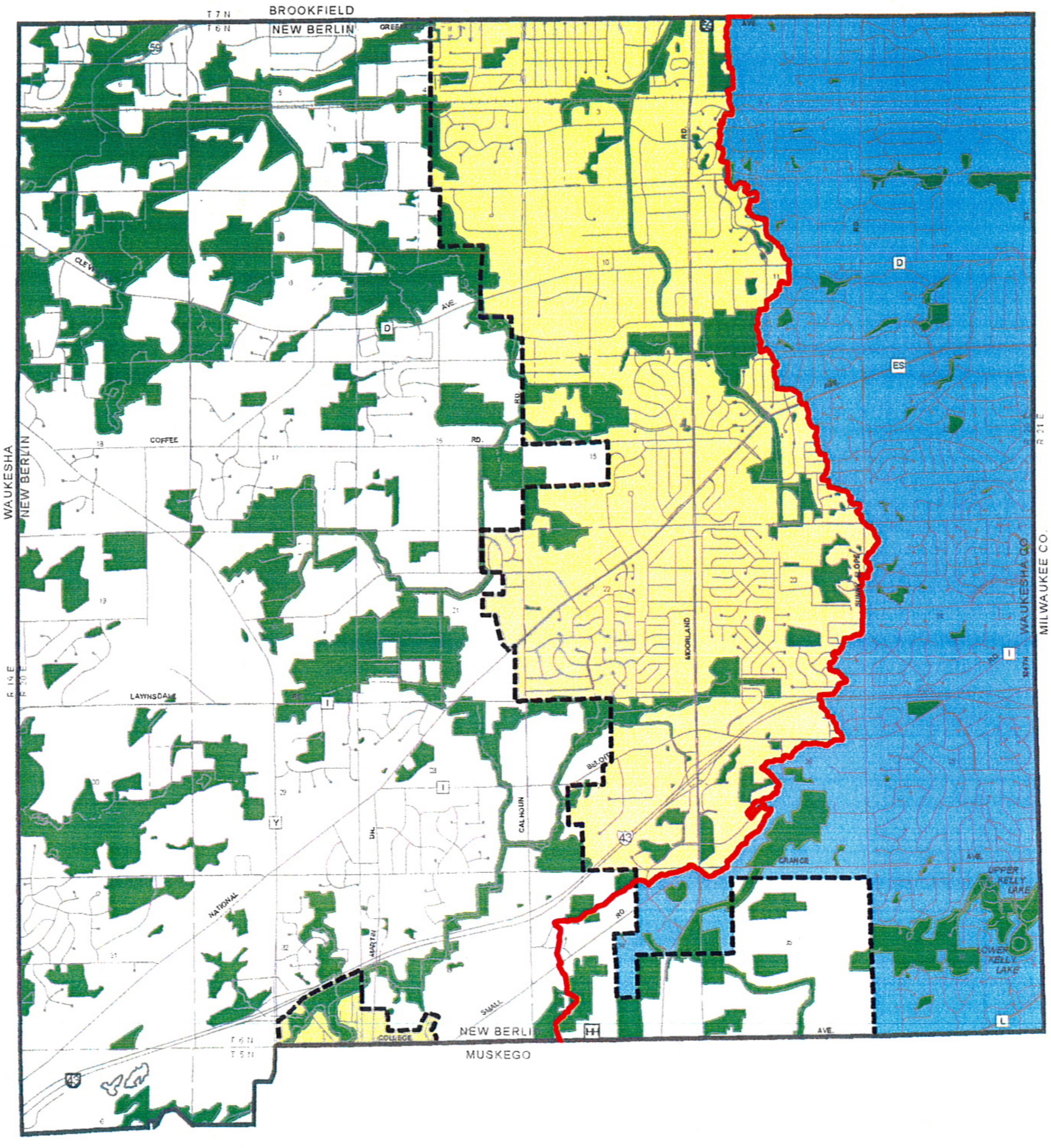
* * *

#142233 V1 - NEW BERLIN WATER SUPPLY STAFF MEMORANDUM
300-5000
RPB/pk
01/19/09

[5]*SEWRPC Planning Report No. 52,* A Regional Water Supply Plan for Southeastern Wisconsin, *under preparation.*

Map 1

City of New Berlin Utility Planned Water Supply Service Area: 2029



AREA CURRENTLY APPROVED FOR LAKE MICHIGAN WATER SUPPLY: JANUARY 2009

AREA TO BE POTENTIALLY SERVED BY LAKE MICHIGAN WATER SUPPLY (THIS AREA IS CURRENTLY PARTIALLY SERVED BY GROUNDWATER SUPPLY)

AREA THAT WILL CONTINUE TO BE SERVED BY GROUNDWATER SUPPLY

ENVIRONMENTALLY SENSITIVE AREA CONSISTING OF ENVIRONMENTAL CORRIDORS, ISOLATED NATURAL RESOURCE AREAS AND SMALL WETLANDS AND SURFACE WATERS

POTENTIAL PLANNED WATER SUPPLY SERVICE AREA BOUNDARY

2008 CITY BOUNDARY

SUBCONTINENTAL DIVIDE

N

0 0.5 1 Miles

0 1,500 3,000 Feet

Source: SEWRPC
October, 2008

Exhibit A

City of New Berlin
City Living with a Touch of Country

Mayor Jack F. Chiovatero
Mayor's Office
3805 South Casper Drive
P.O. Box 510921
New Berlin, Wisconsin 53151-0921

(262) 797-2441
Fax (262) 780-4601
www.newberlin.org

January 12, 2009

Mr. Kenneth R. Yunker
Executive Director
Southeastern Wisconsin Regional Planning Commission
P.O. Box 1607
Waukesha, WI 53187-1607

RE: Water Supply Service Area Delineation

Dear Mr. Yunker:

The City of New Berlin is in the process of preparing the final elements of the application for a diversion of Lake Michigan water. The City is seeking Lake Michigan water to serve the central portion of the City and eliminate the use of deep wells that contain levels of radium in excess of current standards. Lake Michigan water is currently supplied to the portion of the City east of the sub continental divide by the Milwaukee Waterworks. New Berlin and Milwaukee recently entered into an agreement for Milwaukee water to provide service to areas west of the sub continental divide that also have sanitary sewer service provided by the Milwaukee Metropolitan Sewerage District.

Under the recently adopted Great Lakes Compact (2007 Wisconsin Act 227), a utility seeking a new or increased withdrawal of water from the Great Lakes basin and diverting the water outside the basin must register with and provide certain information to the State. One of the elements to be provided is a Water Supply Service Area Plan, which is currently being prepared by the City. The Act specifies that as part of that plan, a proposed water supply service area shall be developed by an area wide water quality planning agency. For the City of New Berlin, the Southeastern Wisconsin Regional Planning Commission. is that agency.

These new rules took affect December 8, 2008. The city of New Berlin has been pursuing a solution to the radium exceedance for many years and has worked closely with local and State officials to get to the point where we have a solution and only need final State approval. At the same time, the State is aware of the radium exceedance and is evaluating referral of the City to the Department of Justice for potential penalties. With the unknowns related to the implementation period of the compact, the City has been placed in a position where we need to act swiftly with regard to the water supply service area plan.

The City of New Berlin respectfully requests that the Southeastern Wisconsin regional Planning Commission delineate a proposed water supply service area for the City. We furthermore request this delineation be performed as swiftly as possible to assist the city in their radium removal project and minimize any penalties. The City is planning on holding a public hearing on this issue on January 27, 2009 if at all possible and your assistance would be greatly appreciated.

Should you have questions or need information on previous planning efforts for the water system, please feel free to contact Mr. Steven Schultz, P.E. of Ruekert/Mielke at (262) 542-5733. Also, please feel free to contact me with any questions.

Very truly yours,

CITY OF NEW BERLIN

Jack F. Chiovatero

Mayor Jack F. Chiovatero

cc: File

Appendix B

SEWRPC Planning Report No. 5, Chapter IV, "Anticipated Growth and Change Affecting Water Supply in the Region (Preliminary Draft)"

Chapter IV

ANTICIPATED GROWTH AND CHANGE AFFECTING WATER SUPPLY IN THE REGION

INTRODUCTION

In any planning effort, forecasts are required of future conditions which may affect either the design of the plans or the implementation of the plans over time. The future demands for water supply are determined primarily by the size and spatial distribution of the future population, land use, and economic activity levels in the Region, and by the level of water use and water conservation expected to be associated with the economic activity, demographics, and land use patterns. In the preparation of the regional water supply plan, therefore, future employment, population, households, and land use levels had to be forecast. These forecasts could then be converted to future demands for land and water use within the Region. These land use and water demands, in turn, provided a basis for the preparation of a supporting land use and water supply plans. The design year 2035 regional land use plan[1] served as a basis for the forecast of employment, population, and land use and for the land use pattern envisioned in the regional water supply plan. However, it should be recognized that the regional water supply planning program may identify a need to refine or revise the design year 2035 land use plan owing to water supply considerations which were not known during development of the regional land use plan. The regional water supply plan, thus, includes recommendations for appropriate amendments to the regional land use plan. This iterative process has served well in the past for development of comprehensive integrated regional land use and water resources plans.

BASIS OF ECONOMIC ACTIVITY, POPULATION, HOUSEHOLD, AND LAND USE DEMAND FORECASTS

As already noted, employment, population, household, land use demand, and economic activity forecasts presented in this chapter are based upon forecasts prepared for, and used in other regional plan elements, including areawide land use, transportation, and sewerage system plans. This use of forecasts prepared for comprehensive, areawide planning purposes helps to assure consistency between the regional water supply plan and other long-range, areawide plan elements.

The employment, population, and household forecasts for the regional land use plan planning program were developed using an alternative futures approach. This approach projects a range of future employment, population, and household levels—high, intermediate, and low—for the Region, recognizing the uncertainty that surrounds any effort to predict future socioeconomic conditions. The intermediate projection is considered the

[1]*SEWRPC Planning Report No. 48,* A Regional Land Use Plan for Southeastern Wisconsin: 2035, *June 2006.*

most likely to be achieved for the Region overall, and, in this sense, constitutes the Commission forecasts to be used as a basis for the preparation of the regional water supply plan, as well as the regional land use and transportation system plans.[2] The high and low projections are intended to provide an indication of the range of employment, population, and household levels which could conceivably be achieved under significantly higher and lower, but nevertheless plausible, growth scenarios for the Region. While the intermediate projection is used for the preparation of the regional water supply plan, consideration may be given to the range of future conditions in local facility specific water supply facility planning and still be considered consistent with the regional plan framework.

PLANNED 2035 MUNICIPAL WATER SUPPLY SERVICE AREAS

Regional Land Use Plan Urban Service Areas

The initial basis for establishing planned municipal water supply service areas within the Region are the plan recommendations set forth in the design year 2035 regional land use plan.[3] That plan envisions that most new urban development within the Region will be served by municipal sanitary sewer and water supply facilities, and includes delineations of the areas of the Region within which municipal sanitary sewer and water facilities are to be provided. With respect to municipal utility service areas, the service area delineations contained in the adopted regional land use plan are generalized systems-level delineations that are intended to be refined and detailed in subregional and local land use utility planning efforts. The areas proposed for municipal water supply service as identified in the regional land use plan are shown on Map IV-1.

Municipal Water Supply Service Area Reevaluation

Under the regional water supply planning program, a reevaluation and refinement was made of the areas proposed to be served by municipal water supply facilities. That reevaluation and refinement was made considering land use development type and density, the relationship to existing water supply service areas, the shallow groundwater aquifer characteristics, the historical position toward water supply service, and known local plans.

Each of the planned municipal water supply service areas set forth in the adopted design year 2035 regional land use plan[4] was reviewed. Those areas are shown on Map IV-2. That plan identified new areas recommended to be served by municipal water service. These areas are largely comprised of expansions of the service areas of the 78 water utilities that provided municipal water supply services within the Region as of 2005. ~~An exception is the proposed service area of the~~ In addition, the expanded Village of North Prairie water system, currently categorized as a water trust, ~~but which~~ is being reported on as a municipal system, since it has characteristics similar to a municipal water utility. The planned municipal water supply service areas identified in the regional land use plan also include 34 new service areas, as highlighted on Map IV-2.

In the reevaluation, existing municipal utility water service areas were accepted, as were service areas represented by expansions to full service within municipal boundaries, or by expansion of existing contract services areas. Thirty-four new planned water service areas were reevaluated. These areas are shown on Map IV-2 and listed in Table IV-1.

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[2] *This usage is consistent with the generally accepted distinction between the terms "projection" and "forecast." A projection is an indication of the future value of a variable, such as population or employment levels, under a set of assumptions which affect that variable. Typically, more than one projection is developed, each with its own set of assumptions. A forecast, on the other hand, involves an element of judgment, it being the projection deemed most likely to occur.*

[3] *SEWRPC Planning Report No. 48,* op. cit.

[4] Ibid.

Pertinent information was developed for each of the 34 new planned water service areas. This information is summarized in Table IV-1. That information includes data on existing and proposed land use, existing residential housing units and densities, distance to the nearest existing municipal water supply service area, aquifer characteristics, and any known local initiative to develop municipal water supply systems.

Based upon a review of the characteristics of the 34 potential service areas, 23 of the areas are recommended to remain as planned municipal water service areas, while 11 are recommended to continue to rely on private water supply systems. The areas recommended to continue to rely on private individual water supply systems generally consisted of those areas of inland lake and Lake Michigan lake-oriented residential development, and some other residential areas with a gross density of less than 1.0 dwelling unit per acre. The latter equates to a density of less than approximately 640 housing units per square mile—or approximately 1,900 persons per square mile. Typically, all of these areas were located in parts of the Region where the sand and gravel aquifer yield is considered suitable to support private systems, and no major groundwater quality issues were known to exist. Such areas would continue to be considered in the regional land use plan as areas with the potential, over the long-term, municipal sanitary sewer service, but not for municipal water supply service.

Contaminated Groundwater Area Considerations

As reported in Chapter III, the Wisconsin Department of Natural Resources (WDNR) has established 35 areas within the Region where special well casing requirements apply because of the presence of, or potential for, groundwater contamination. Of those areas, there are 20 areas which are included within the planned water supply service areas or are not considered for inclusion in such areas due to the nature of the groundwater contamination, or of the distance of the area from the planned water supply service areas. However, there are 15 of the special well casing areas described in Chapter III for which the Wisconsin Department of Natural Resources staff recommends consideration be given to, including in the planned water supply service areas. In addition, there are two other areas for which new special well casing requirements are being developed and which are also recommended to be considered for addition to the public water supply service area. Accordingly, 17 special well casing areas have been considered for addition to the planned water supply service area. These areas are listed in Table IV-1a and are shown on Map IV-2a. More-detailed maps of each of the 17 areas arte included in Appendix H.

The recommendations for each of the 17 groundwater contamination areas considered with regard to municipal water service are summarized in Table IV-1a. Following review of the existing development, developable land, and extent of the groundwater contamination areas, all or portions of 12 of the 17 groundwater contamination areas were added to the municipal water supply service areas. As summarized in Table IV-1a, in the case of some areas, only the existing development and adjacent infill areas were added to the municipal water supply service areas. In other cases, the entire area was added. In the case of five of the areas, there was no significant development within the portion of the area of concern that was not included in the water supply service area. Given that these areas were beyond the urban services set forth in the regional land use plan, no changes were proposed to the water supply service areas in those five instances.

FORECAST EMPLOYMENT, POPULATION, AND HOUSEHOLD LEVELS

As already noted, the Southeastern Wisconsin Regional Planning Commission prepared a new set of employment, population, and household projections for the Region for the period 2000 to 2035. The Commission prepared a range of future employment, population, and household levels—high, intermediate, and low—for the Region. The intermediate projection is considered the most likely to be achieved for the Region overall, and, in this sense, constitutes the Commission "forecast." The intermediate projection was selected for use as the basis for the preparation of the design year 2035 regional land use plan and the regional water supply plan. The high and low projections are intended to provide an indication of the range of population, household, and employment levels which could conceivably be achieved under significantly higher and lower, but nevertheless plausible, growth scenarios for the Region.

Commission county-level projections envision that the historic trend in the decentralization of population, households, and employment relative to Milwaukee County within the Region would continue, but at a moderated rate in comparison to the historic trend. The intermediate population projection for Milwaukee County envisions that the recent decreases in population experienced by the County—a 0.6 percent loss during the of 1980s and a 2 percent loss during the 1990s—would be replaced by modest growth of 1.5 percent between 2000 and 2010, and growth of about 7 percent during the overall 35-year forecast period from 2000 to 2035. The projections envision growth in households in Milwaukee County at rates somewhat higher than occurred during the 1980s and 1990s. These relatively positive projections for Milwaukee County assume substantial growth in the remaining undeveloped areas of the County, and assume further that the City of Milwaukee and other communities in the County will continue to be proactive and successful in efforts to maintain, renew, and revitalize as appropriate their existing developed areas.

The Commission projections also envision the continuation of an "Illinois influence" on future population and household levels in Kenosha and Walworth Counties. One facet of the "Illinois influence" involves persons from northeastern Illinois seeking residences in Wisconsin. Available data indicate a significant net movement of individuals from residences in northeastern Illinois to residences in Kenosha and Walworth Counties during the 1990s. Commission projections anticipate a continuation of this trend.

Forecast Employment Levels

Future employment levels in the Region may be expected to be strongly influenced by the strength of the regional economy relative to the rest of the State and Nation. The Commission's recently completed economic study found no reason to conclude that the regional economy is likely to significantly increase or decrease in strength relative to the State or Nation over the course of the projection period. While there are some indications that the Region's economy has diminished marginally relative to the State and Nation over the past several decades—for example, a gradual decline in the Region's share of total State and national employment—a material change in the relative competitiveness of the regional economy is not expected.

The employment-level projections for each industry, presented in Table IV-2, were developed based upon a consideration of past industry trends, available indicators of future trends nationally and in the State and Region, and relative industry and sector strength in the Region as compared to State and national industries and sectors. Projections by State agencies and other recently published projections were also consulted. The projected employment levels take into account the employment declines of the 2001 recession and use 2003 data estimates as the last historical data points. Commission population projections indicate that a leveling-off in the regional labor force may be expected, particularly toward the middle of the projection period, as much of the baby-boom generation—those born from 1946 through 1964—reaches retirement age. This leveling-off in the labor force may be expected to moderate the number of jobs able to be accommodated in the Region. The sectoral changes—particularly, a shift from a goods producing economy to a services providing economy—that have occurred in the Region in recent decades are projected to continue.

Commission employment projections for the year 2035 are presented on a county basis in Table IV-3 and are shown graphically in Figure IV-1. The intermediate projection envisions total employment of 1,368,300 jobs in the Region in 2035, an increase of 145,500 jobs, or about 12 percent, over the 2000 level of 1,222,800 jobs.

Forecast Population Levels

As shown in Table IV-4, the total resident population of the Region increased from about 1.76 million persons in 1970 to about 1.93 million persons in 2000, an increase of 175,000 persons, or about 10 percent, over the 30-year period. As also presented in Table IV-4 and shown graphically in Figure IV-2, the population of the Region is expected to increase from the year 2000 level of 1.93 million persons to about 2.28 million persons by the plan design year 2035, an increase of about 345,000 persons, or about 18 percent, over the 35-year period.

As anticipated population growth occurs within the Region, population changes within municipal water service areas are also expected to occur. As summarized in Table IV-5, the population of the areas served by municipal water supply systems in the Region is expected to increase from the year 2000 level of about 1.56 million persons to about ~~2.09~~2.10 million persons in 2035, an increase of about ~~532,700~~536,000 persons, or about 34 percent. Thus, while the resident population within the Region is projected to increase by about ~~15~~18 percent, a decline in the total number of people that rely on private water systems is anticipated, from approximately 369,600 people in the year 2000 to about ~~181,800~~179,000 people in the year 2035. This anticipated decline in the population served by private water systems is primarily due to the anticipated expansion of existing municipal water service areas into areas currently served by private systems, and to the development of new municipal water services areas throughout the Region. Table IV-5 summarizes the data on forecast population changes within existing and anticipated 2035 municipal water supply service areas for each county and the Region.

Forecast Household Levels

Accompanying the changes in the size of the resident population of the Region are changes in the number and size of households. As shown in Table IV-6, the number of households in the Region is projected to increase from about 749,000 in 2000 to about 925,700 in 2035, an increase of 176,700, or about 24 percent, over the 35-year period. As also shown in Table IV-6, the average household size in the Region is expected to decrease from the 2000 level of 2.52 persons per household to 2.39 persons per household by the plan design year 2035, a decline of 0.13 persons per household, or about 5.2 percent, over the 35-year period.

As presented in Table IV-7 and shown graphically in Figure IV-3, the number of households served by municipal water supply systems in the Region is expected to increase from the year 2000 level of 610,100 to about ~~854,300~~855,300 households in 2035, an increase of about ~~244,200~~245,200 households, or about 40 percent. Although the number of households within the Region is projected to increase by 24 percent, a decline in the total number of households that rely on private water systems is forecast to be from about 139,000 households in the year 2000 to about ~~71,400~~70,400 households in the year 2035, a reduction of about ~~67,600~~68,600 households, or about 49 percent. This anticipated decline in the number of households on private water supply systems is primarily due to the anticipated expansion of existing municipal water service areas into areas of private service, and to the development of new municipal water services areas throughout the Region.

Table IV-7 indicates projected household changes within existing and anticipated 2035 municipal and private water supply service areas for each county and the Region. The projections envision a significant increase in the number of households in each county in the Region between 2000 and 2035. In each county, the relative increase in households is expected to exceed the relative increase in population, as household sizes continue to decline in each county.

PLANNED LAND USE

The design year 2035 land use plan serves, as already noted, as the basis for the preparation of the regional water supply plan. The regional land use plan was designed to accommodate the regional employment, population, and household forecasts previously described. The plan seeks to encourage infill development and redevelopment in existing urban centers, and new urban development adjacent to and outward from existing urban centers in areas which can be readily served by adopted sanitary sewage and water supply and by mass transit facilities; to preserve the environmental corridors[5] in the Region in essentially natural open uses; and to preserve the best remaining agricultural areas of the Region in agricultural uses. For purposes of the regional land use plan, "urban land" is defined as an area devoted to high-, medium-, and low-density residential use,[6] as well as to commercial,

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[5]*Environmental corridors are elongated areas in the landscape encompassing concentrations of the best remaining elements of the natural resource base, including the best remaining wetlands, woodlands, and wildlife habitat areas; surface water and associated shorelands and floodplains; and related features, such as existing park and open space sites, scenic views, and natural area sites.*

[6]*Residential densities are defined as follows: high-density—at least 7.0 dwelling units per net residential acre; medium-density—2.3 to 6.9 dwelling units per net residential acre; and low-density—0.7 to 2.2 dwelling units per net residential acre.*

industrial, governmental and institutional, recreational, and transportation, communication, and utility use. Under the regional land use plan, the combined area in these urban use categories would increase from about 732 square miles in 2000 to about 825 square miles in 2035, an increase of 93 square miles, or about 13 percent. Also under the 2035 regional land use plan, the urban land area of the Region would account for about 31 percent of the total area of the Region in 2035, compared to about 27 percent in 2000. Table IV-8 summarizes the existing year 2000 land use and the projected 2035 land use based on land use type.

Under the year 2035 regional land use plan, urban development would, as already noted, occur within delineated urban service areas—areas that are intended to accommodate urban development insofar as they are served by basic urban services and facilities, including public sanitary sewer service and typically also including public water supply service.[7] To the extent practicable, urban land would be accommodated within existing urban service areas as infill development and through redevelopment as appropriate. This is intended to maintain and enhance the viability of existing urban areas, maximize the use of existing public infrastructure and services, and moderate the amount of open land converted to urban use. Other urban development required to meet projected needs of the growing Region would be accommodated on lands proximate to existing urban service areas where basic urban services and facilities can be readily provided, resulting in the orderly expansion of existing urban service areas.

Map IV-3 provides an overview of the land use pattern for the Region in the year 2035 as envisioned under the 2035 regional land use plan. This map shows urban areas in the Region as envisioned under the plan; sub-urban areas, which are neither truly urban or rural in character; environmental corridors recommended for preservation in essentially natural open uses; and rural areas consisting of prime agricultural land, other agricultural land, rural-density residential land, and other open lands. In reviewing Map IV-3, it should be recognized that many communities in the Region have established sewer service areas that would accommodate high-growth projections of population, households, and employment. This approach provides some flexibility to communities in determining the spatial distribution of new urban development. As a result of this approach, however, some of the urban areas shown on Map IV-3 will probably not be fully developed by 2035.

As already noted, under the design year 2035 regional land use plan, most new urban development would be served with municipal sanitary sewer and water supply facilities. In addition, municipal sanitary sewer and water supply service would be extended to certain existing urban areas currently lacking these facilities. In this regard, the design year 2035 regional land use plan envisions that certain existing urban development which is served by onsite sewage treatment and disposal facilities and private water supply systems and located within planned urban service areas would eventually be connected to municipal sanitary sewer and water supply systems.

~~As summarized in Table IV-9, in the year 2000, about 390 square miles, or 14 percent of the total area of the Region, and about 1.56 million persons, or 82 percent of the regional population, were served by municipal water supply facilities. In 2035, under the regional land use plan, about 630 square miles, or 23 percent of the total area of the Region, and about 2.10 million persons, or 92 percent of the regional population, would be served by municipal water supply services.~~

Under the regional land use plan, development beyond planned sewer and water service areas would be discouraged in primary environmental corridors and other environmentally sensitive areas, and on prime farmland. The regional land use plan recommends that any development of nonprime farmland be limited to rural residential development in conservation subdivision designs at a density of no more than one unit per five acres. Low-density and sub-urban density development in rural areas of one unit per three-quarter acre to one unit

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[7] *Under the regional plan, urban development beyond planned urban service areas would be limited to low density residential development in areas already committed to such use, along with highway-oriented business uses, utility uses, and recreational uses that may, of necessity, have to be located beyond planned urban service areas.*

per five acres would be discouraged, and limited to that development already committed through approved subdivision plats and certified surveys.[8]

WATER DEMAND FORECAST PROCEDURES

The development of water supply systems requires the long term investment of large amounts of capital. The facilities concerned have relatively long physical, as well as economic, lives. Therefore, water supply systems and facilities must be planned and designed to meet future, as well as existing, needs. Accordingly, forecasts of the probable future demand for water must be prepared as a basis for sizing future water supply, storage, transmission and distribution facilities. The preparation of water demand forecasts typically includes consideration of historic trends in water use, projection of water demands associated with planned future land use patterns, and assumptions regarding the impacts on demand of probable future regulations, programs, policies, and other influencing factors, including water conservation programs.

Forecasting future water demand can be accomplished in a number of ways, including development and application of per capita unit water demand factors, extrapolation of historic trends, or water demand modeling. The use of unit water demand factors for the various user categories is an effective method in areas like south-eastern Wisconsin where good data bases on existing and historic water uses, on existing and historic land use patterns, and sound comprehensive land use planning are in place. That technique was, therefore, selected for use in the regional water supply planning program for southeastern Wisconsin. The process to be followed involves the preparation of alternative projections of future socioeconomic and land use conditions and the selection of a forecast from among the alternative projections of those conditions, followed by conversion of these projections to water demand by application of unit demand factors. The water demand projections and forecasts involve consideration of potential future resident population and household and employment levels, as well as future land use development patterns in the planning area. As previously noted, these socioeconomic projections and forecasts have been developed under the regional planning program to the plan design year of 2035.[9] These socioeconomic and land use forecasts were then converted to water demands utilizing the unit water demand coefficients set forth in this chapter.

In order to assess the variations in demands between municipal water systems due to differences in system age, service area demographics, and land use development patterns, a review of water use for the years 2000, 2004, and 2005 by utility was performed. Water use data are reported on an annual basis to the Wisconsin Public Service Commission (PSC) by each regulated utility. Other public utilities, such as unregulated water trusts, report water pumpage in accordance with State requirements and may or may not meter actual usage. Water use data were calculated for the years 2000, 2004, and 2005, with the year 2000 being the base year for the regional water supply planning program. Population, household, and land use data are available for that base year. In addition, the water use data were reviewed for the last two years for which the data were available, as of mid-2006, those years being 2004 and 2005. These two years presented a range of precipitation conditions, with 2004 having higher than average precipitation, and 2005 having lower than average precipitation, especially during the growing seasons, thus, placing the year 2000 data in a range, thus, existing demands for municipal utilities were

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[8]*In addition to the low and sub-urban density residential development outside planned sanitary sewer and water supply service areas indicated above, some residential development served by onsite sewage treatment and disposal systems and private wells may be expected within planned urban service areas, prior to the time that centralized utility services become available. The amount of such "premature" development will depend upon the demand for housing in such areas and community response to that demand, including the timing of utility extensions.*

[9]*SEWRPC Planning Report No. 48,* A Regional Land Use Plan for Southeastern Wisconsin: 2035, *June 2006; SEWRPC Technical Report No. 10, 4th Edition,* The Economy of Southeastern Wisconsin, *July 2004; and SEWRPC Technical Report No. 11, 4th Edition,* The Population of Southeastern Wisconsin, *July 2004.*

determined using recorded data for the base year—2000—and checked against available data for the two other years to identify possibly anomalous situations.

Once existing demand and pumpage patterns are established, unit demand factors were calculated and applied to expected future socioeconomic and land use conditions to obtain forecast future demand. Assumptions concerning potential reductions in demand due to conservation were then made and applied as the alternate analyses dictated. The unit demand factors applied in the forecast process were developed under the state-of-the-art water supply practices report prepared under the planning program, [10] and were as follows:

- Residential land use, average daily demand—70 gallons per capita per day.
- Commercial and Institutional land use, average daily demand—800 gallons per gross[11] acre per day.
- Industrial land use, average day demand—1,500 gallons per gross acre[12] per day.
- Miscellaneous municipal use, average day demand—100 gallons per gross acre[13] of urban service area per day.

The year 2035 average daily water use demand was initially calculated by using the year 2000 demand and the incremental demand between 2000 and 2035 estimated using the abovenoted factors. That demand was then reduced by from 4 to 10 percent to reflect the expected implementation of water conservation measures. The percent reduction was used and applied on a utility-specific basis to reflect the source of supply and existing infrastructure, as summarized in Table IV-9, which was developed and documented in the state-of-the-art water supply practices report.[14]

The initial water conservation levels selected are intended to be related to comprehensive water conservation programs, including both a supply side water supply system efficiency element and demand side water conservation measures. The selected levels are also intended to represent an increase in water conservation effectiveness over and above the current levels which are the result of a number of water efficiency and water conservation measures already in place at most municipal utilities in the Region. Thus, the selected levels are not as high as would be the case in an area where no water conservation measures are in place. These initial water conservation level assumption levels were reviewed and revised following the development and evaluation of the alternative plans if cost, environmental impact, or other factors relating to the achievement of plan objectives so dictated. Such revisions in water conservation levels were then incorporated into the recommended regional water supply plan.

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[10]*SEWRPC Technical Report No. 43,* State-of-the-Art of Water Supply Practices, *in preparation.*

[11]*Gross acre area is defined as the actual site area—consisting of the ground floor site area occupied by buildings, plus the required onsite yards and parking and loading areas, together with supporting land uses, such as streets, neighborhood parks and playgrounds, elementary schools and neighborhood institutional and commercial uses. Gross area is used in considering the density and intensity of development over relatively large areas, such as neighborhood units and U.S. Public Land Survey system sections. Gross densities are in contrast to net densities, the later being based upon the areas within the actual site boundaries of the various land uses concerned.*

[12]Ibid.

[13]Ibid.

[14]*SEWRPC Technical Report No. 43,* op. cit.

Average daily demand includes only those components which can be accounted for by metered billings and treatment plant records. Average day pumpage is the total amount of water which is pumped to the distribution system and water used in production. Projected average day pumpage is calculated by adding firefighting and other unaccountable water usage and losses to the average day demand. For purposes of the regional water supply planning program, average daily pumpage was calculated for 2035 by using the year 2000 ratio of average daily pumpage to average day demand, except where anomalies appeared to be involved. In such cases, other data from other years were considered. Maximum daily pumpage for the year 2035 was estimated using the three-year average (2000, 2001, and 2002) of the ratio of maximum daily pumpage to average daily pumpage. This three-year average was used rather than the year 2000 ratio alone, since the year 2000 had a high amount of precipitation during the growing season. However, the 2035 maximum daily pumpage was reduced by from 2 to 8 percent for water conservation measure effectiveness expected over and above that expected to impact the average daily demand, as shown in Table IV-10, which was developed for the state-of-the-art water supply practices report.[15]

The reduction in forecast maximum day water pumpage due to water conservation measures is intended to reflect the demand reduction due to the implementation of water conservation programs, including outdoor water use restrictions. This calculation is not intended to compromise fire-fighting capabilities. Fire-fighting design is typically established by pressure and flow requirements within the water supply distribution system. These requirements are typically designed to be met over and above the maximum day pumpage and are provided by system storage and pumping stations. As local utility water supply systems are developed, care should be taken to ensure that fire-fighting capability is not compromised by the assumptions on water conservation program effectiveness.

Additional detail in the calculation of water use demand and related pumpage for each municipal water utility are included in Appendix F.

Data are also presented in this chapter on the self-supplied water systems within the Region. The data presented include the location and selected information on residential, other than municipal, community systems and self-supplied industrial, commercial, institutional, recreational, agricultural, other irrigation, and water supply thermoelectric-power generation water supply systems. Information is also presented on private domestic wells. The information presented is based upon a review of the existing 2005 self-supplied system inventory documented in Chapter III. Assumptions were made that most systems, excepting large water users, such as used for irrigation, located within the planned 2035 municipal water supply service areas, would be connected to the municipal system. The data are obtained from the WDNR data base and it is recognized that some of the data on the self-supplied system lacks currency. The data for the residential other than municipal, community water supply system is kept relatively current. However, no periodic reporting is required for most of the self-supplied industrial, commercial, institutional, recreational, agricultural, and other irrigation self-supplied wells. As such, some of the self-supplied systems reported or may not be in service and there may be a limited number of new wells which are not included in the data abase. In cases where these situations were known to the Commission staff, based upon surveillance and land use inventories, the data reported was adjusted accordingly. The data on estimated pumpage is typically based upon very limited data—typically including normal and maximum approved daily pumpage. For groundwater modeling purposes under the regional water supply planning program, further investigations have to be made to develop estimates of self-supplied water system pumpage. As of 2007, the WDNR was in the process of updating the data base concerned. For future uses of the self-supplied water supply system data, it is recommended that updated information be obtained from the WDNR.

The data presented in this chapter report only on existing self-supplied water supply systems. No attempt was made to specifically identify new self-supplied water systems which may be developed. However, for purposes of groundwater modeling analyses used to define conditions associated with future conditions and alternative and

[15]Ibid.

recommended plans, as documented in Chapters VIII and IX, an allowance for such new systems was made. That allowance was made on a generalized basis by adjusting the per capita water use for new residential private wells from 65 gallons per day to 100 gallons per day and applying that allowance over the model cells based upon expected new private well development locations. Should new large-scale unplanned self-supplied water systems be proposed in the future, such systems would have to be considered on a case-by-case basis.

FORECAST OF WATER USE—KENOSHA COUNTY

Municipal Water Supply Systems

In 2005, there were six municipal water supply utility systems operating in Kenosha County, as shown on Map IV-4. By the year 2035, each of these municipal utility water service areas in Kenosha County is projected to experience an increase in water demand. In addition to the six existing municipal water utilities in Kenosha County, it is anticipated that four additional municipal water supply systems will be developed by 2035 to serve the Villages of Silver Lake and Twin Lakes, a portion of the Town of Salem, and the Powers-Benedict-Tombeau Lakes area in the Towns of Randall and Wheatland and partially located in the Town of Bloomfield in Walworth County. As presented in Table IV-10, the year 2000 total resident population served by municipal water utilities in Kenosha County was about 111,000, or about 74 percent of the 149,600 total population of the County. In 2035, the total population planned to be served by municipal water utilities is projected to increase by about 88,900 to just under 200,000 residents, or about 95 percent of the 2035 population of 210,100.

The area served by municipal water supply systems within Kenosha County is expected to increase by about 121 percent between 2000 and 2035, from about 29.8 square miles in 2000 to about 66.0 square miles in 2035. As noted in Chapter III, about 34.2 square miles were served by municipal water supply systems in 2005. Thus, the expected increase in area served between 2005 and 2035 is about 31.1 square miles, or an increase of about 91 percent. Just under 50 percent of the increase in water supply service area is due to the anticipated development of the four new utilities noted above which include areas that are currently largely developed. Another significant portion of the increase in urban land served is due to the expansion of existing municipal water service areas into developed areas currently served by self-supplied water systems. In total, the amount of urban land existing in 2000 included within the expansion or new municipal water service areas in Kenosha County comprises about 24.4 square miles, or about 67 percent of the increased service area. Thus, the amount of new urban land envisioned to be developed and served by municipal water systems between 2000 and 2035 is about 11.8 square miles, an increase of about 22 percent over the 54.2 square miles of urban land existing in 2000 within the planned 2035 municipal water service area. Table IV-10 provides forecast changes in population and urban area expected for the 10 existing and planned municipal water service areas in Kenosha County for the plan design year 2035.

Based upon the changes in population and land use within each of the municipal water service areas, estimates were made of the future water use demands and pumpage for each utility, as summarized in Table IV-11. More detailed information on the development of the forecast water uses and pumpage is included in Table F-1 in Appendix F. The total water use demand on an average daily basis for the 10 municipal water utilities in Kenosha County is estimated to increase from 11.0 mgd in 2000, to 21.1 mgd in 2035. The corresponding pumpage is estimated to increase from 14.9 mgd to 27.8 mgd on an average daily basis; and from 22.2 mgd to 42.6 mgd on a maximum daily basis. These pumpage estimates include water use demand based upon sales, water used for production and system maintenance, and unaccounted-for water. These estimates of water use and pumpage serve as the basis for the design of future 2035 municipal water supply systems under alternative plan conditions, as set forth in Chapter VIII of this report. It should be noted that about 50 percent of the projected increase in water use between 2000 and 2035 for municipal water supply systems in Kenosha County is due to the existing development not currently served, but within the planned 2035 service area described above. This portion of the increase in municipal water supply system water use represents a change from self-supplied system water use to municipally supplied water use.

Figure IV-4 illustrates the projected water use between 2000 and 2035 and, where applicable, the actual use between 1997 and 2005 for each municipal water supply system within Kenosha County and for the total municipal water use within the County. Review of Figure IV-4 indicates the comparison of the projected to actual municipal water uses appears to be consistent on a total County water use basis. Some variation is noted for selected water utilities. Where these variations occur, the primary reason appears to be reductions in industrial water use which were not offset by increases in residential water use. In the cases of the Village of Paddock Lake and the Town of Bristol Utility Districts, the actual water use appears to be lagging the projected use. This would be expected, given that these water supply systems are expected to be expanded substantially over the planning period.

The data set forth in Tables IV-10 and IV-11 are developed on an individual water utility basis. The Kenosha Water Utility provides water to multiple utilities, including the Village of Pleasant Prairie Water Utility, the Town of Bristol Utility District No. 1, and the Town of Somers Water Utility. Data on the population and area served, as well as water use and pumpage for the entire Kenosha utility service area is provided in Table IV-12.

Residential Other than Municipal, Community Systems

In 2035, it is expected that two of the privately owned, self-supplied, water systems operating in Kenosha County which provide water supply services to primarily residential land uses, would remain. These systems serve mobile home parks located beyond the municipal water supply service areas. The other self-supplied systems which existed in 2005 are expected to be connected to expanded municipal systems and no known new systems are currently planned. The remaining two systems utilize groundwater provided by six low-capacity wells as a source of supply. The location of these systems is shown on Map IV-4. Selected characteristics of these systems are presented in Table G-1 in Appendix G.

Industrial Water Supply Systems

In 2035, there are expected to be six privately owned, self-supplied, water systems in Kenosha County which provide water for industrial land uses. Of these, one system is currently classified as a low-capacity system and five are classified as high-capacity systems. These systems currently all utilize groundwater as a source of supply through three low-capacity and six high-capacity wells. The locations of these systems are shown on Map IV-5. Selected characteristics of each system are presented in Table G-2 in Appendix G.

Commercial Water Supply Systems

In 2035, there are expected to be 20 privately owned, self-supplied, water systems operating in Kenosha County which provide water for commercial land uses. Of these, three are currently classified as high-capacity systems and 17 are classified as low-capacity well systems. These systems all currently utilize groundwater as a source of supply through two high-capacity wells and 19 low-capacity wells. The locations of these systems are shown on Map IV-5. Selected characteristics of each system are presented in Table G-3 in Appendix G.

Institutional and Recreational Water Supply Systems

In 2035, there are expected to be 19 privately owned, self-supplied, water systems operating in Kenosha County which provide water for institutional and recreational land uses. Of these, six are currently classified as high-capacity systems and 13 are classified as low-capacity well systems. These systems all currently utilize ground-water as a source of supply through 32 low-capacity wells, and four high-capacity wells. The locations of these systems are shown on Map IV-5. Selected characteristics of each system are presented in Table G-4 in Appendix G.

Agricultural Water Supply Systems

In 2035, there are expected to be three privately owned, self-supplied, water systems operating in Kenosha County which provide water for irrigation and other purposes for agricultural land uses. All three systems are currently categorized as high-capacity and all utilize groundwater as a source of supply through six high-capacity wells. The locations of these systems are shown on Map IV-5. Selected characteristics of each system are presented in Table G-5 in Appendix G.

Irrigation Water Supply Systems

In 2035, there are expected to be six privately owned, self-supplied, water systems operating in Kenosha County which provide irrigation water for land uses other than agricultural uses, such as golf courses. All six systems are currently categorized as high-capacity systems and all utilize groundwater as a source of supply through 14 high-capacity wells. The locations of these systems are shown on Map IV-5. Selected characteristics of each system are presented in Table G-6 in Appendix G.

Thermoelectric-Power Generation Water Supply Systems

In 2035, there are expected to be two existing privately owned, self-supplied, water systems operating in Kenosha County which provided cooling water for thermoelectric-power-generation facilities. These facilities included the Pleasant Prairie Power Plant, a coal-based generating facility located in the Village of Pleasant Prairie, and the Paris Generating Station, a combustion turbine generating facility in the Town of Paris. Currently, the Pleasant Prairie Power Plant utilizes about 11 million gallons of water per day obtained from Lake Michigan. The majority of the water was used as make-up water for evaporation losses on the plant cooling tower system. The Paris Generating Station facility utilizes groundwater obtained through one well which has a maximum capacity of 600 gallons per minute. This well was finished in the sandstone aquifer. The amount of water used varies annually depending upon the need for the intermittent operation of the peaking facility. The water use estimated at the time of permitting was 36,000 gallons per day. There are two primary water uses at the Paris Generating Station: 1) water spray injection into the combustion turbines for nitrogen oxides control; and 2) an inlet air cooling system, used to enhance the combustion turbine generating capacity during warmer weather, cools the intake air by passing it over coils containing recirculating cold water produced in an on-site refrigeration system.

Self-Supplied Residential Water Systems

As of the year 2035, there are expected to be about 11,200 persons, or about 5 percent of the total resident year 2035 population of Kenosha County, served by private domestic wells. As summarized in Table IV-9 and shown on Map IV-4, areas totaling about 213 square miles exist outside of the planned 2035 municipal water utility service areas within Kenosha County. Assuming an average use of 65 gallons per capita per day, these private domestic wells would withdraw about 0.7 million gallons per day from the shallow groundwater aquifer. It is expected that the households served by private domestic wells will also be served by onsite sewage disposal systems. Thus, the majority (approximately 90 percent) of the water withdrawn by private wells, or about 0.6 million gallons per day, would be expected to be returned to the groundwater aquifer via onsite sewage disposal systems.

FORECAST OF WATER USE—MILWAUKEE COUNTY

Municipal Water Supply Systems

In 2005, there were 14 municipal water supply utility systems operating in Milwaukee County, as shown on Map IV-6. By the year 2035, each of these municipal utility water service areas in Milwaukee County is projected to either experience an increase in water demand, or to have a similar water demand to that currently being experienced. As presented in Table IV-13, the year 2000 total resident population served by municipal water utilities in Milwaukee County was about 917,000, or about 97 percent of the 940,200 total population of the County. In 2035, the total population planned to be served by municipal water utilities is projected to increase by about just over one million residents, or about 99 percent of the 2035 population of 1,007,000.

The area served by municipal water supply systems within Milwaukee County is expected to increase by about 12 percent between 2000 and 2035, from about 181 square miles in 2000 to about 202 square miles in 2035. About 85 percent of the increase in water supply service area is due to the expected expansion of the municipal water service areas in the City of Franklin and Oak Creek. Table IV-13 provides forecast changes in population and urban area expected for the 14 municipal water service areas in Milwaukee County for the plan design year 2035.

Based upon the changes in population and land use within each of the municipal water service areas, estimates were made of the future water use demands and pumpage for each utility, as summarized in Table IV-14. More detailed information on the development of the forecast water uses and pumpage is included in Table F-2 in Appendix F. The total water use demand on an average daily basis for the 14 municipal water utilities in Milwaukee County is estimated to increase from 124 mgd in 2000, to 132 mgd in 2035. The corresponding pumpage is estimated to increase from 137 mgd to 147 mgd on an average daily basis; and from 203 mgd to 241 mgd on a maximum daily basis. These pumpage estimates include water use demand based upon sales, water used for production and system maintenance, and unaccounted-for water. These estimates of water use and pumpage serve as the basis for the design of future 2035 municipal water supply systems under alternative plan conditions, as set forth in Chapter VIII of this report.

Figure IV-5 illustrates the projected water use between 2000 and 2035 and, where applicable, the actual use between 1997 and 2005 for each municipal water supply system within Milwaukee County and for the total municipal water use within the County. Review of Figure IV-5 indicates the actual water uses are lagging the projected water use municipal water uses appears on a total County water use basis and for several of the water utilities. The primary reason the variations have occurred appears to be reductions in industrial water use which were not offset by little change in residential and commercial water use. Some of this reduction for the City of Milwaukee Water Works has been offset by the addition of wholesale customers outside of Milwaukee County.

The data set forth in Tables IV-13 and IV-14 are developed on an individual water utility basis. The City of Milwaukee Water Works, City of Oak Creek Water and Sewer Utility, and the North Shore Water Commission provide water to multiple utilities. Data on the population and area served, as well as water use and pumpage for these three water providers is provided in Table IV-14a.

Residential and Other than Municipal, Community Systems
In 2035, it is expected that there will be one remaining privately owned, self-supplied, water system operating in Milwaukee County which provide water supply services to primarily residential land uses. The remaining self-supplied system which existed in 2005 provides service to a private residence and is classified as a high-capacity system with three wells.

Industrial Water Supply Systems
In 2035, there are expected to be five privately owned, self-supplied, water systems in Milwaukee County which provide water for industrial land uses. Of these, two systems are currently classified as low-capacity systems and three are classified as high-capacity systems. These systems currently all utilize groundwater as a source of supply through three low-capacity and three high-capacity wells. The locations of these systems are shown on Map IV-7. Selected characteristics of each system are presented in Table G-2 in Appendix G.

Commercial Water Supply Systems
In 2035, there are expected to be two remaining privately owned, self-supplied, water systems operating in Milwaukee County which provide water for commercial land uses. Both of these systems are classified as low-capacity systems. Both systems use groundwater as a source of supply through three low-capacity wells. The locations of these systems are shown on Map IV-7. Selected characteristics of these systems are presented in Table G-3 in Appendix G. The existing systems are all expected to be connected to the expanded municipal system.

Institutional and Recreational Water Supply Systems
In 2035, there are expected to be 15 privately owned, self-supplied, water systems operating in Milwaukee County which provide water for institutional and recreational land uses. Of these, six are currently classified as high-capacity systems and nine are classified as low-capacity well systems. These systems all currently utilize groundwater as a source of supply through 11 low-capacity wells, and eight high-capacity wells. The locations of these systems are shown on Map IV-7. Selected characteristics of each system are presented in Table G-4 in Appendix G.

Agricultural Water Supply Systems
In 2035, there are expected to be no privately owned, self-supplied, water systems operating in Milwaukee County which provide water for irrigation and other purposes for agricultural land uses. No such systems were in existence in 2005.

Irrigation Water Supply Systems
In 2035, there are expected to be 13 privately owned, self-supplied, water systems operating in Milwaukee County which provide irrigation water for land uses other than agricultural uses, such as golf courses. All 13 systems are currently categorized as high-capacity systems and all utilize groundwater as a source of supply through 21 high-capacity wells. The locations of these systems are shown on Map IV-7. Selected characteristics of each system are presented in Table G-6 in Appendix G.

Thermoelectric-Power Generation Water Supply Systems
In 2035, it is expected that the three facilities operating in Milwaukee County which utilize water for coal-based thermoelectric-power-generation will remain. These three facilities are the Valley Power Plant located in the City of Milwaukee, the Milwaukee County Power Plant located in on the Milwaukee County grounds in the City of Wauwatosa and the Oak Creek Power Plant. The Valley Power Plant is a co-generation facility, providing both electricity and steam for the City of Milwaukee's heating system. The Valley Power Plant circulates about 160 million gallons of water per day obtained from the Menomonee River and returned to the South Menomonee Canal. The Milwaukee County Power Plant is a co-generation facility, providing steam chilled water and some electricity to the Milwaukee Regional Medical Center. The Milwaukee County Power Plant obtains purchased surface water. The water use at the plant is relatively low due to its size and the use of closed loop cooling towers. The existing Oak Creek Power Plant draws cooling water from Lake Michigan and uses and open cycle cooling system which passes the water through heat exchangers and then returns the water to its source. The plant is authorized by WDNR permit to utilize 1.8 billion gallons per day of Lake water. The power plant is currently undergoing an expansion and is expected to use up to 2.2 billion gallons per day upon completion of that expansion. Nearly all the water withdrawn is returned to the Lake with a very small percentage being used for various power plant components other than heat exchanging, such as air emission reduction equipment.

Self-Supplied Residential Water Systems
As of the year 2035, there are expected to be about 3,000 persons, or less than 1 percent of the total resident year 2035 population of Milwaukee County, served by private domestic wells. As shown on Map IV-6, areas totaling about 40 square miles exist outside of the planned 2035 municipal water utility service areas within Milwaukee County. Assuming an average use of 65 gallons per capita per day, these private domestic wells would withdraw about 0.2 million gallons per day from the shallow groundwater aquifer. It is expected that the households served by private domestic wells will also be served by onsite sewage disposal systems. Thus, the majority (approximately 90 percent) of the water withdrawn by private wells, or about 0.18 million gallons per day, would be expected to be returned to the groundwater aquifer via onsite sewage disposal systems.

FORECAST OF WATER USE—OZAUKEE COUNTY

Municipal Water Supply Systems
In 2005, there were seven municipal water supply utility systems operating in Ozaukee County, as shown on Map IV-8. By the year 2035, each of these municipal utility water service areas in Ozaukee County is projected to experience an increase in water demand. In addition to the seven existing municipal water utilities in Ozaukee County, it is anticipated that one additional municipal water supply system will be developed by 2035 to serve the Town of Fredonia-Waubeka Area. In addition, a small portion of the planned Village of Newburg service area is located within Ozaukee County. As presented in Table IV-15, the year 2000 total resident population served by municipal water utilities in Ozaukee County was about 45,400, or about 55 percent of the 82,300 total population of the County. In 2035, the total population planned to be served by municipal water utilities is projected to increase by about 41,400 to about 86,800 residents, or about 86 percent of the 2035 population of 101,100.

The area served by municipal water supply systems within Ozaukee County is expected to increase by about 157 percent between 2000 and 2035, from about 15.7 square miles in 2000 to about 40.4 square miles in 2035. Just over 50 percent of the increase in water supply service area is due to the anticipated expansion of We Energies-Water Services system serving major portions of the City of Mequon. Another significant portion of the increase in urban land served is due to expansion of existing municipal water service into developed areas currently served by self-supplied water systems. As noted in Chapter III, in 2005, about 17.7 square miles were served by municipal water supply systems within Ozaukee County. Thus, the expected increase in area served between 2005 and 2035 is about 22.7 square miles, or an increase of about 128 percent. In total, the amount of urban land existing in 2000 included within the expansion or new municipal water service areas in Ozaukee County comprises about 18.3 square miles, or about 74 percent of the increased service area. Thus, the amount of new urban land envisioned to be developed and served by municipal water systems between 2000 and 2035 is about 6.4 square miles, an increase of about 19 percent over the 34.0 square miles of urban land existing in 2000 within the planned 2035 municipal water service area. Table IV-15 provides forecast changes in population and urban area expected for the nine existing and planned municipal water service areas in Ozaukee County for the plan design year 2035.

Based upon the changes in population and land use within each of the municipal water service areas, estimates were made of the future water use demands and pumpage for each utility, as summarized in Table IV-16. More detailed information on the development of the forecast water uses and pumpage is included in Table F-3 in Appendix F. The total water use demand on an average daily basis for the seven municipal water utilities in Ozaukee County is estimated to increase from 5.6 mgd in 2000, to 10.6 mgd in 2035. The corresponding pumpage is estimated to increase from 6.5 mgd to 13.2 mgd on an average daily basis; and from 10.4 mgd to 20.4 mgd on a maximum daily basis. These pumpage estimates include water use demand based upon sales, water used for production and system maintenance, and unaccounted-for water. These estimates of water use and pumpage serve as the basis for the design of future 2035 municipal water supply systems under alternative plan conditions, as set forth in Chapter VIII of this report. It should be noted that about 70 percent of the projected increase in water use between 2000 and 2035 for municipal water supply systems in Ozaukee County is due to the existing development not currently served, but within the planned 2035 service area described above. This portion of the increase in municipal water supply system water use represents a change from self-supplied system water use to municipally supplied water use.

Figure IV-6 illustrates the projected water use between 2000 and 2035 and, where applicable, the actual use between 1997 and 2005 for each municipal water supply system within Ozaukee County and for the total municipal water use within the County. Review of Figure IV-6 indicates that actual water use is lagging the projected water use by a small amount on a total County water use basis. This appears to be reasonable when considering that a large portion of the forecast increase in water use is attributable to existing urban land uses not yet incorporated into the municipal water service areas. Some variation is also noted for selected water utilities. Where these variations occur, the primary reason appears to be reductions in industrial water use which were not offset by smaller increases in residential water use.

Residential Other than Municipal, Community Systems

In 2035, it is expected that only one of the privately owned, self-supplied, water systems operating in Ozaukee County which provide water supply services to primarily residential land uses, would remain. That system serves an isolated residential land use located in the northwestern portion of the City of Mequon. The other self-supplied systems which existed in 2005 are expected to be connected to expanded municipal systems and no known new systems are currently planned. The remaining system utilizes groundwater provided by one high-capacity well as a source of supply. The location of this system is shown on Map IV-8. Selected characteristics of this system are presented in Table G-1 in Appendix G.

Industrial Water Supply Systems

In 2035, there are expected to be five privately owned, self-supplied, water systems remaining in Ozaukee County which provide water for industrial land uses. All of these systems are currently classified as high-capacity systems. These systems currently all utilize groundwater as a source of supply through two low-capacity and seven high-capacity wells. The locations of these systems are shown on Map IV-9. Selected characteristics of each system are presented in Table G-2 in Appendix G.

Commercial Water Supply Systems

In 2035, there are expected to be 20 privately owned, self-supplied, water systems operating in Ozaukee County which provide water for commercial land uses. Of these, one is currently classified as a high-capacity system and 19 are classified as low-capacity well systems. These systems all currently utilize groundwater as a source of supply through 24 low-capacity wells. The locations of these systems are shown on Map IV-9. Selected characteristics of each system are presented in Table G-3 in Appendix G.

Institutional and Recreational Water Supply Systems

In 2035, there are expected to be 35 privately owned, self-supplied, water systems remaining in Ozaukee County which provide water for institutional and recreational land uses. Of these, seven are currently classified as high-capacity systems and 28 are classified as low-capacity well systems. These systems all currently utilize groundwater as a source of supply through 43 low-capacity wells, and five high-capacity wells. The locations of these systems are shown on Map IV-9. Selected characteristics of each system are presented in Table G-4 in Appendix G.

Agricultural Water Supply Systems

In 2035, there are expected to be three privately owned, self-supplied, water systems operating in Ozaukee County which provide water for irrigation and other purposes for agricultural land uses. All three systems are currently categorized as high-capacity and all utilize groundwater as a source of supply through five high-capacity wells. The locations of these systems are shown on Map IV-9. Selected characteristics of each system are presented in Table G-5 in Appendix G.

Irrigation Water Supply Systems

In 2035, there are expected to be seven privately owned, self-supplied, water systems operating in Ozaukee County which provide irrigation water for land uses other than agricultural uses, such as golf courses. All seven systems are currently categorized as high-capacity systems and all utilize groundwater as a source of supply through 10 high-capacity wells. The locations of these systems are shown on Map IV-9. Selected characteristics of each system are presented in Table G-6 in Appendix G.

Thermoelectric-Power Generation Water Supply Systems

In 2035, the Port Washington Power Plant is expected to be the only privately owned, self-supplied system providing water for a thermoelectric-power-generation facility in Ozaukee County. During 2005, that system was being converted from a coal-fired power generation facility to an intermediate load natural gas-fired thermoelectric-power-generation facility. Based upon a Wisconsin Department of Natural Resources WPDES permit records, the average water withdrawal rate from the Lake for cooling the proposed facility is estimated to be 561,400 gpm. Of this total, approximately 508,000 gpm would be passed through the condensers and other heat exchange equipment. Another 34,400 gpm would be used to enhance the combustion turbine generating capacity during warmer weather by cooling the intake air by passing it over coils containing once-through circulating lake water. The remaining 19,000 gpm would be used in auxiliary cooling systems and the water supply for the spray backwash system for the intake traveling water screens.

The Port Washington power plant's existing water intake structure was designed with a capacity of 565,000 gpm, which is expected to be adequate for the proposed new plant configuration. Two new 150,000-gallon demineralized water storage tanks are proposed to be constructed to store water for use as steam-cycle makeup. The existing demineralizer plant, consisting of two trains, each with a capacity of 150 gpm, would be used to produce demineralized water for the new facility. The existing municipal water supply source would be used for potable uses, back-up fire protection, and for providing makeup to the demineralizer system.

Self-Supplied Residential Water Systems
As of the year 2035, there are expected to be about 14,300 persons, or about 14 percent of the total resident year 2035 population of Ozaukee County, served by private domestic wells. As shown on Map IV-8, areas totaling about 195 square miles exist outside of the planned 2035 municipal water utility service areas within Ozaukee County. Assuming an average use of 65 gallons per capita per day, these private domestic wells would withdraw about 0.9 million gallons per day from the shallow groundwater aquifer. It is expected that the households served by private domestic wells will also be served by onsite sewage disposal systems. Thus, the majority (approximately 90 percent) of the water withdrawn by private wells, or about 0.8 million gallons per day, would be expected to be returned to the groundwater aquifer via onsite sewage disposal systems.

FORECAST OF WATER USE—RACINE COUNTY

Municipal Water Supply Systems
In 2005, there were 12[16] municipal water supply utility systems operating in Racine County, as shown on Map IV-10. By the year 2035, each of these municipal utility water service areas in Racine County is projected to experience an increase in water demand. In addition to the 12[17] existing municipal water utilities in Racine County, it is anticipated that seven additional municipal water supply systems will be developed by 2035 to serve the areas which are currently largely developed in the Towns of Burlington, Dover, Norway, Rochester, and Waterford, and the Village of Rochester, as well as an undeveloped area in the Town of Caledonia. As presented in Table IV-17, the year 2000 total resident population served by municipal water utilities in Racine County was about 146,400, or about 78 percent of the 188,800 total population of the County. In 2035, the total population planned to be served by municipal water utilities is projected to increase by about 49,800 to about 196,200 residents, or about 92 percent of the 2035 population of 213,600.

The area served by municipal water supply systems within Racine County is expected to increase by about 70 percent between 2000 and 2035, from about 37.9 square miles in 2000 to about 64.5 square miles in 2035. About 40 percent of the increase in water service area is due to the anticipated development of the seven new utilities noted above which include areas that are largely developed. Another significant portion of the increase in urban area served is due to the expansion of existing municipal water service areas into developed areas currently served by self-supplied water systems. As noted in Chapter III, in 2005, about 38.3 square miles were served by municipal water supply systems within Racine County. Thus, the expected increase in area served between 2005 and 2035 is about 26.1 square miles, or an increase of about 68 percent. In total, the amount of urban land existing in 2000 included within the expansion or new municipal water service areas in Racine County comprises about 22.6 square miles, or about 85 percent of the increased service area. Thus, the amount of new urban land envisioned to be developed and served by municipal water systems between 2000 and 2035 is about 4.0 square miles, an increase of about 6.6 percent over the 60.5 square miles of urban land existing in 2000 within the planned 2035 municipal water service area. Table IV-17 provides forecast changes in population and urban area expected for the 19 existing and planned municipal water service areas in Racine County for the plan design year 2035.

Based upon the changes in population and land use within each of the municipal water service areas, estimates were made of the future water use demands and pumpage for each utility, as summarized in Table IV-18. More detailed information on the development of the forecast water uses and pumpage is included in Table F-4 in Appendix F. The total water use demand on an average daily basis for the 19[18] municipal water utilities in Racine

[16]*As of 2007, there has been consolidation of utilities within the Village of Caledonia and the Village of Sturtevant Water Utility has been purchased by the City of Racine. Thus, as of 2007, there were nine municipal water supply utilities in existence and there are expected to be 16 municipal water supply utilities in 2035.*

[17]Ibid.

[18]Ibid.

County is estimated to increase from 23.3 mgd in 2000, to 29.0 mgd in 2035. The corresponding pumpage is estimated to increase from 28.6 mgd to 36.8 mgd on an average daily basis; and from 46.0 mgd to 59.7 mgd on a maximum daily basis. These pumpage estimates include water use demand based upon sales, water used for production and system maintenance, and unaccounted-for water. These estimates of water use and pumpage serve as the basis for the design of future 2035 municipal water supply systems under alternative plan conditions, as set forth in Chapter VIII of this report. It should be noted that about 80 percent of the projected increase in water use between 2000 and 2035 for municipal water supply systems in Racine County is due to the existing development not currently served, but within the planned 2035 service area described above. This portion of the increase in municipal water supply system water use represents a change from self-supplied system water use to municipally supplied water use.

Figure IV-7 illustrates the projected water use between 2000 and 2035 and, where applicable, the actual use between 1997 and 2005 for each municipal water supply system within Racine County and for the total municipal water use within the County. Review of Figure IV-7 indicates that the actual water use lags the projected water use somewhat on a total County water use basis. This is primarily due to a similar lag in the City of Racine water use due to reduction in industrial water use which were not offset by increases in residential and commercial water uses. Some variation is also noted for selected water utilities. Where these variations occur, the primary reason appears to be reductions in industrial water use which were not offset by smaller increases in residential water use.

The data set forth in Tables IV-17 and IV-18 are developed on an individual water utility basis. The Racine Water and Wastewater Utility provides water to multiple utilities, including the Caledonia Utility District No. 1, the Village of Sturtevant Water and Sewer Utility, the Village of Wind Point Municipal Water Utility, and a portion of the North Park Sanitary District. Data on the population and area served, as well as water use and pumpage for the entire Racine utility service area is provided in Table IV-18a.

Residential Other than Municipal, Community Systems
In 2035, it is expected that two of the privately owned, self-supplied, water systems operating in Racine County which provide water supply services to primarily residential land uses, would remain. These systems serve mobile home parks located beyond the municipal water supply service areas. The other self-supplied systems which existed in 2005 are expected to be connected to expanded municipal systems and no known new systems are currently planned. The remaining two systems utilize groundwater provided by five low-capacity wells as a source of supply. The location of these systems is shown on Map IV-10. Selected characteristics of these systems are presented in Table G-1 in Appendix G.

Industrial Water Supply Systems
In 2035, there are expected to be nine privately owned, self-supplied, water systems in Racine County which provide water for industrial land uses. Of these, one system is currently classified as a low-capacity system and eight are classified ad high-capacity systems. These systems currently all utilize groundwater as a source of supply through 15 low-capacity and 11 high-capacity wells. The locations of these systems are shown on Map IV-11. Selected characteristics of each system are presented in Table G-2 in Appendix G.

Commercial Water Supply Systems
In 2035, there are expected to be 30 privately owned, self-supplied, water systems operating in Racine County which provide water for commercial land uses. Of these, two are currently classified as high-capacity systems and 28 are classified as low-capacity well systems. These systems all currently utilize groundwater as a source of supply through one high-capacity well and 41 low-capacity wells. The locations of these systems are shown on Map IV-11. Selected characteristics of each system are presented in Table G-3 in Appendix G.

Institutional and Recreational Water Supply Systems
In 2035, there are expected to be 23 privately owned, self-supplied, water systems operating in Racine County which provide water for institutional and recreational land uses. Of these, seven are currently classified as high-capacity systems and 16 are classified as low-capacity well systems. These systems all currently utilize ground-

water as a source of supply through 27 low-capacity wells, and one high-capacity well, and five wells of unknown capacity. The locations of these systems are shown on Map IV-11. Selected characteristics of each system are presented in Table G-4 in Appendix G.

Agricultural Water Supply Systems
In 2035, there are expected to be 15 privately owned, self-supplied, water systems operating in Racine County which provide water for irrigation and other purposes for agricultural land uses. All 15 systems are currently categorized as high-capacity and all utilize groundwater as a source of supply through three low-capacity wells and 26 high-capacity wells. The locations of these systems are shown on Map IV-11. Selected characteristics of each system are presented in Table G-5 in Appendix G.

Irrigation Water Supply Systems
In 2035, there are expected to be three privately owned, self-supplied, water systems operating in Racine County which provide irrigation water for land uses other than agricultural uses, such as golf courses. Two of these systems are categorized as high-capacity systems and one is classified as a low-capacity system. These systems all utilize groundwater as a source of supply through three low-capacity wells and two high-capacity wells. The locations of these systems are shown on Map IV-11. Selected characteristics of each system are presented in Table G-6 in Appendix G.

Self-Supplied Residential Water Systems
As of the year 2035, there are expected to be about 17,400 persons, or about 5 percent of the total resident year 2035 population of Racine County, served by private domestic wells. As shown on Map IV-10, areas totaling about 276 square miles exist outside of the planned 2035 municipal water utility service areas within Racine County. Assuming an average use of 65 gallons per capita per day, these private domestic wells would withdraw about 1.1 million gallons per day from the shallow groundwater aquifer. It is expected that the households served by private domestic wells will also be served by onsite sewage disposal systems. Thus, the majority (approximately 90 percent) of the water withdrawn by private wells, or about 1.0 million gallons per day, would be expected to be returned to the groundwater aquifer via onsite sewage disposal systems.

FORECAST OF WATER USE—WALWORTH COUNTY

Municipal Water Supply Systems
In 2005, there were 16 municipal water supply utility systems operating in Walworth County, as shown on Map IV-12. By the year 2035, all but one of these municipal utility water service areas in Walworth County is projected to experience an increase in water demand. In addition to the 16 existing municipal water utilities in Walworth County, it is anticipated that two additional municipal water supply systems will be developed by 2035 to serve the Town of Lyons and the Town of East Troy-Potter Lake Area. As presented in Table IV-19, the year 2000 total resident population served by municipal water utilities in Walworth County was about 56,200, or about 61 percent of the 92,000 total population of the County. In 2035, the total population planned to be served by municipal water utilities is projected to increase by about 55,900 to about 112,100 residents, or about 80 percent of the 2035 population of 140,000.

The area served by municipal water supply systems within Walworth County is expected to increase by about 113 percent between 2000 and 2035, from about 22.0 square miles in 2000 to about 46.7 square miles in 2035. The increase in area served is largely due to expansion of the municipal water service areas associated with the major existing urban centers in the County. A significant portion of the expanded service area includes existing developed areas currently served by self-supplied water systems. In total, the amount of urban land existing in 2000 included within the expansion or new municipal water service areas in Walworth County comprises about 6.2 square miles, or about 25 percent of the increased service area. Thus, the amount of new urban land envisioned to be developed and served by municipal water systems between 2000 and 2035 is about 18.5 square miles, an increase of about 66 percent over the 28.2 square miles of urban land existing in 2000 within the planned 2035 municipal water service area. Table IV-19 provides forecast changes in population and urban area expected for the 18 existing and planned municipal water service areas in Walworth County for the plan design year 2035.

Based upon the changes in population and land use within each of the municipal water service areas, estimates were made of the future water use demands and pumpage for each utility, as summarized in Table IV-20. More detailed information on the development of the forecast water uses and pumpage is included in Table F-5 in Appendix F. The total water use demand on an average daily basis for the 18 municipal water utilities in Walworth County is estimated to increase from 6.2 mgd in 2000, to 11.9 mgd in 2035. The corresponding pumpage is estimated to increase from 8.0 mgd to 15.6 mgd on an average daily basis; and from 13.8 mgd to 25.9 mgd on a maximum daily basis. These pumpage estimates include water use demand based upon sales, water used for production and system maintenance, and unaccounted-for water. These estimates of water use and pumpage serve as the basis for the design of future 2035 municipal water supply systems under alternative plan conditions, as set forth in Chapter VIII of this report. It should be noted that about 60 percent of the projected increase in water use between 2000 and 2035 for municipal water supply systems in Walworth County is due to the existing development not currently served, but within the planned 2035 service area described above. This portion of the increase in municipal water supply system water use represents a change from self-supplied system water use to municipally supplied water use.

Figure IV-8 illustrates the projected water use between 2000 and 2035 and, where applicable, the actual use between 1997 and 2005 for each municipal water supply system within Walworth County and for the total municipal water use within the County. Review of Figure IV-8 indicates that the actual water use lags the projected water use somewhat on a total County water use basis. Some variation is also noted for selected water utilities. Where these variations occur, the primary reason appears to be reductions in residential per capita water use and in commercial water use.

Residential Other than Municipal, Community Systems

In 2035, it is expected that seven of the privately owned, self-supplied, water systems operating in Walworth County which provide water supply services to primarily residential land uses, would remain. These systems serve residential development, such as mobile home parks and condominium complexes, located beyond the limits of the planned municipal water supply service areas. The other self-supplied systems which existed in 2005 are expected to be connected to expanded municipal systems and no known new systems are currently planned. The remaining seven systems utilize groundwater provided by one high-capacity and six low-capacity wells as a source of supply. The location of these systems is shown on Map IV-12. Selected characteristics of these systems are presented in Table G-1 in Appendix G.

Industrial Water Supply Systems

In 2035, there are expected to be 12 privately owned, self-supplied, water systems in Walworth County which provide water for industrial land uses. Of these, four systems are currently classified as low-capacity systems and eight are classified ad high-capacity systems. These systems currently all utilize groundwater as a source of supply through 10 low-capacity and 14 high-capacity wells, and one well of unknown capacity. The locations of these systems are shown on Map IV-13. Selected characteristics of each system are presented in Table G-2 in Appendix G.

Commercial Water Supply Systems

In 2035, there are expected to be 47 privately owned, self-supplied, water systems operating in Walworth County which provide water for commercial land uses. Of these, two are currently classified as high-capacity systems and 45 are classified as low-capacity well systems. These systems all currently utilize groundwater as a source of supply through six high-capacity wells and 48 low-capacity wells. The locations of these systems are shown on Map IV-13. Selected characteristics of each system are presented in Table G-3 in Appendix G.

Institutional and Recreational Water Supply Systems

In 2035, there are expected to be 46 privately owned, self-supplied, water systems operating in Walworth County which provide water for institutional and recreational land uses. Of these, 15 are currently classified as high-capacity systems and 31 are classified as low-capacity well systems. These systems all currently utilize groundwater as a source of supply through 97 low-capacity wells, and four high-capacity wells, and five wells of unknown capacity. The locations of these systems are shown on Map IV-13. Selected characteristics of each system are presented in Table G-4 in Appendix G.

Agricultural Water Supply Systems
In 2035, there are expected to be 16 privately owned, self-supplied, water systems operating in Walworth County which provide water for irrigation and other purposes for agricultural land uses. All 16 systems are currently categorized as high-capacity and all utilize groundwater as a source of supply through six low-capacity wells and 22 high-capacity wells. The locations of these systems are shown on Map IV-13. Selected characteristics of each system are presented in Table G-5 in Appendix G.

Irrigation Water Supply Systems
In 2035, there are expected to be 10 privately owned, self-supplied, water systems operating in Walworth County which provide irrigation water for land uses other than agricultural uses, such as golf courses. All 10 systems are categorized as high-capacity systems and all utilize groundwater as a source of supply through six low-capacity and 13 high-capacity wells, and one well with an unknown capacity. The locations of these systems are shown on Map IV-11. Selected characteristics of each system are presented in Table G-6 in Appendix G.

Self-Supplied Residential Water Systems
As of the year 2035, there are expected to be about 27,900 persons, or about 18 percent of the total resident year 2035 population of Walworth County, served by private domestic wells. As shown on Map IV-12, areas totaling about 530 square miles exist outside of the planned 2035 municipal water utility service areas within Walworth County. Assuming an average use of 65 gallons per capita per day, these private domestic wells would withdraw about 1.8 million gallons per day from the shallow groundwater aquifer. It is expected that the households served by private domestic wells will also be served by onsite sewage disposal systems. Thus, the majority (approximately 90 percent) of the water withdrawn by private wells, or about 1.6 million gallons per day, would be expected to be returned to the groundwater aquifer via onsite sewage disposal systems.

FORECAST OF WATER USE—WASHINGTON COUNTY

Municipal Water Supply Systems
In 2005, there were seven municipal water supply utility systems operating in Washington County, as shown on Map IV-14. By the year 2035, each of these municipal utility water service areas in Washington County is projected to experience an increase in water demand. In addition to the seven existing municipal water utilities in Washington County, it is anticipated that one additional municipal water supply system will be developed by 2035 to serve the Village of Newburg service area. As presented in Table IV-21, the year 2000 total resident population served by municipal water utilities in Washington County was about 66,800, or about 57 percent of the 1172,500 total population of the County. In 2035, the total population planned to be served by municipal water utilities is projected to increase by about 46,200 to about 113,000 residents, or about 72 percent of the 2035 population of 157,300.

The area served by municipal water supply systems within Washington County is expected to increase by about 94 percent between 2000 and 2035, from about 21.4 square miles in 2000 to about 40.5 square miles in 2035. About 65 percent of the increase in water supply service area is due to the anticipated expansion of water service areas in the Cities of Hartford and West Bend and the Village of Germantown. A significant portion of the expanded service area is existing development currently served by self-supplied water systems. In total, the amount of urban land existing in 2000 included within the expansion or new municipal water service areas in Washington County comprises about 12.3 square miles, or about 64 percent of the increased service area. Thus, the amount of new urban land envisioned to be developed and served by municipal water systems between 2000 and 2035 is about 6.8 square miles, an increase of about 20 percent over the 33.7 square miles of urban land existing in 2000 within the planned 2035 municipal water service area. Table IV-21 provides forecast changes in population and urban area expected for the eight existing and planned municipal water service areas in Washington County for the plan design year 2035.

Based upon the changes in population and land use within each of the municipal water service areas, estimates were made of the future water use demands and pumpage for each utility, as summarized in Table IV-22. More detailed information on the development of the forecast water uses and pumpage is included in Table F-6 in Appendix F. The total water use demand on an average daily basis for the eight municipal water utilities in Washington County is estimated to increase from 6.4 mgd in 2000, to 11.7 mgd in 2035. The corresponding pumpage is estimated to increase from 7.6 mgd to 13.8 mgd on an average daily basis; and from 12.1 mgd to 21.7 mgd on a maximum daily basis. These pumpage estimates include water use demand based upon sales, water used for production and system maintenance, and unaccounted-for water. These estimates of water use and pumpage serve as the basis for the design of future 2035 municipal water supply systems under alternative plan conditions, as set forth in Chapter VIII of this report. It should be noted that about 50 percent of the projected increase in water use between 2000 and 2035 for municipal water supply systems in Washington County is due to the existing development not currently served, but within the planned 2035 service area described above. This portion of the increase in municipal water supply system water use represents a change from self-supplied system water use to municipally supplied water use.

Figure IV-9 illustrates the projected water use between 2000 and 2035 and, where applicable, the actual use between 1997 and 2005 for each municipal water supply system within Washington County and for the total municipal water use within the County. Review of Figure IV-9 indicates the comparison of the projected to actual municipal water uses appears to be consistent on a total County water use basis, except for the less than projected water uses in 2004 and 2005. That difference appears to be largely due to the same trend for the City of West Bend Water Utility, which appears to be related to a reduction in per capita residential use in 2004 and 2005. Some other variations are noted for selected water utilities. Where these variations occur, the primary reason appears to be abrupt changes in industrial or commercial water use during 2004 and 2005.

Residential Other than Municipal, Community Systems
In 2035, it is expected that one of the privately owned, self-supplied, water system operating in Washington County which provide water supply services to primarily residential land uses, would remain. This system is classified as a high-capacity system using two wells as a source of supply.

Industrial Water Supply Systems
In 2035, there are expected to be 13 privately owned, self-supplied, water systems remaining in Washington County which provide water for industrial land uses. Of these systems, seven are currently classified as high-capacity systems and six are classified as low-capacity systems. These systems currently all utilize groundwater as a source of supply through 11 low-capacity and seven high-capacity wells. The locations of these systems are shown on Map IV-15. Selected characteristics of each system are presented in Table G-2 in Appendix G.

Commercial Water Supply Systems
In 2035, there are expected to be 82 privately owned, self-supplied, water systems operating in Washington County which provide water for commercial land uses. Of these, two are currently classified as a high-capacity system and 80 are classified as low-capacity well systems. These systems all currently utilize groundwater as a source of supply through 85 low-capacity wells. The locations of these systems are shown on Map IV-15. Selected characteristics of each system are presented in Table G-3 in Appendix G.

Institutional and Recreational Water Supply Systems
In 2035, there are expected to be 64 privately owned, self-supplied, water systems remaining in Washington County which provide water for institutional and recreational land uses. Of these, 19 are currently classified as high-capacity systems and 45 are classified as low-capacity well systems. These systems all currently utilize groundwater as a source of supply through 78 low-capacity wells, six high-capacity wells, and six wells with an unknown capacity. The locations of these systems are shown on Map IV-15. Selected characteristics of each system are presented in Table G-4 in Appendix G.

Agricultural Water Supply Systems
In 2035, there are expected to be four privately owned, self-supplied, water systems operating in Washington County which provide water for irrigation and other purposes for agricultural land uses. All four systems are currently categorized as high-capacity and all utilize groundwater as a source of supply through four high-capacity wells. The locations of these systems are shown on Map IV-15. Selected characteristics of each system are presented in Table G-5 in Appendix G.

Irrigation Water Supply Systems
In 2035, there are expected to be 10 privately owned, self-supplied, water systems operating in Washington County which provide irrigation water for land uses other than agricultural uses, such as golf courses. All 10 systems are currently categorized as high-capacity systems and all utilize groundwater as a source of supply through three low-capacity wells and 12 high-capacity wells. The locations of these systems are shown on Map IV-15. Selected characteristics of each system are presented in Table G-6 in Appendix G.

Thermoelectric-Power Generation Water Supply Systems
In 2035, the We Energies Germantown Power Plant is expected to be the only privately owned, self-supplied system providing water for a thermoelectric-power-generation facility in Washington County. This facility was a combustion turbine generating facility located in the Village of Germantown. The Germantown Power Plant was constructed in 1978 and expanded in 2000. The facility utilizes groundwater obtained through a well with an approved pump capacity of 500 gallons per minute, and an approved well capacity of 100,000 gallons per day. This well is finished in the deep sandstone aquifer. The amount of water used varies annually depending upon the need for the intermittent operation of the peaking facility. The water use for the only years reported, 1982 through 1989, averaged 220,000 gallons per year, or about 600 gallons per day. There are two primary water uses at the Germantown Power Plant: 1) water spray injection into the combustion turbines for nitrogen oxides control; and 2) an inlet air cooling system, used to enhance the combustion turbine generating capacity during warmer weather, cools the intake air by passing it over coils containing recirculating cold water produced in an on-site refrigeration system.

Self-Supplied Residential Water Systems
As of the year 2035, there are expected to be about 44,300 persons, or about 28 percent of the total resident year 2035 population of Washington County, served by private domestic wells. As shown on Map IV-14, areas totaling about 395 square miles exist outside of the planned 2035 municipal water utility service areas within Washington County. Assuming an average use of 65 gallons per capita per day, these private domestic wells would withdraw about 2.9 million gallons per day from the shallow groundwater aquifer. It is expected that the households served by private domestic wells will also be served by onsite sewage disposal systems. Thus, the majority (approximately 90 percent) of the water withdrawn by private wells, or about 2.6 million gallons per day, would be expected to be returned to the groundwater aquifer via onsite sewage disposal systems.

FORECAST OF WATER USE—WAUKESHA COUNTY

Municipal Water Supply Systems
In 2005, there were 16 municipal water supply utility systems operating in Waukesha County, as shown on Map IV-16. By the year 2035, most of these municipal utility water service areas in Waukesha County are projected to experience an increase in water demand. In addition to the 16 existing municipal water utilities in Waukesha County, it is anticipated that eight additional municipal water supply systems will be developed by 2035 to serve the areas which are currently largely developed in the Villages of Big Bend, Elm Grove, Lannon, and Wales and in the Towns of Eagle, Oconomowoc, and Ottawa. As presented in Table IV-23, the year 2000 total resident population served by municipal water utilities in Waukesha County was about 218,400, or about 61 percent of the 360,800 total population of the County. In 2035, the total population planned to be served by municipal water utilities is projected to increase by about 166,600 to about 385,000 residents, or about 86 percent of the 2035 population of 446,800.

The area served by municipal water supply systems within Waukesha County is expected to increase by about just over 100 percent between 2000 and 2035, from about 82 square miles in 2000 to about 171 square miles in 2035. About 15 percent of the increase in water service area is due to the anticipated development of the eight new utilities noted above which include areas that are largely developed. Another significant portion of the increase in urban area served is due to the expansion of existing municipal water service areas into existing developed areas currently served by self-supplied water systems. As noted in Chapter III, about 88 square miles were served by municipal water supply systems in 2005. Thus, the expected increase in area served between 2005 and 2035 is about 83.7 square miles, or an increase of about 95 percent. In total, the amount of urban land existing in 2000 included within the expansion or new municipal water service areas in Waukesha County comprises about 69.0 square miles, or about 79 percent of the increased service area. Thus, the amount of new urban land envisioned to be developed and served by municipal water systems between 2000 and 2035 is about 17.8 square miles, an increase of about 12 percent over the 151 square miles of urban land existing in 2000 within the planned 2035 municipal water service area. Table IV-23 provides forecast changes in population and urban area expected for the 24 existing and planned municipal water service areas in Waukesha County for the plan design year 2035.

Based upon the changes in population and land use within each of the municipal water service areas, estimates were made of the future water use demands and pumpage for each utility, as summarized in Table IV-24. More detailed information on the development of the forecast water uses and pumpage is included in Table F-7 in Appendix F. The total water use demand on an average daily basis for the 25 municipal water utilities in Waukesha County is estimated to increase from 23.1 mgd in 2000, to 41.6 mgd in 2035. The corresponding pumpage is estimated to increase from 27.0 mgd to 48.9 mgd on an average daily basis; and from 38.9 mgd to 80.5 mgd on a maximum daily basis. These pumpage estimates include water use demand based upon sales, water used for production and system maintenance, and unaccounted-for water. These estimates of water use and pumpage serve as the basis for the design of future 2035 municipal water supply systems under alternative plan conditions, as set forth in Chapter VIII of this report. It should be noted that about 70 percent of the projected increase in water use between 2000 and 2035 for municipal water supply systems in Waukesha County is due to the existing development not currently served, but within the planned 2035 service area described above. This portion of the increase in municipal water supply system water use represents a change from self-supplied system water use to municipally supplied water use.

Figure IV-10 illustrates the projected water use between 2000 and 2035 and, where applicable, the actual use between 1997 and 2005 for each municipal water supply system within Waukesha County and for the total municipal water use within the County. Review of Figure IV-10 indicates the comparison of the projected to actual municipal water uses appears to be consistent on a total County water use basis. Some variation is noted for selected water utilities. Where these variations occur, the primary reason appears to be reductions in industrial and/or commercial water use which were not offset by smaller increases in residential water use.

Residential Other than Municipal, Community Systems

In 2035, it is expected that 10 of the privately owned, self-supplied, water systems operating in Waukesha County which provide water supply services to primarily residential land uses, would remain. These systems serve mobile home parks, condominiums, and residential developments located beyond the municipal water supply service areas. The other self-supplied systems which existed in 2005 are expected to be connected to expanded municipal systems and no known new systems are currently planned. The remaining 10 systems utilize groundwater provided by nine low-capacity wells, six high-capacity wells, and four wells of unknown capacity as a source of supply. The location of these systems is shown on Map IV-16. Selected characteristics of these systems are presented in Table G-1 in Appendix G.

Industrial Water Supply Systems

In 2035, there are expected to be 13 privately owned, self-supplied, water systems in Waukesha County which provide water for industrial land uses. Of these, two systems are currently classified as low-capacity systems and 11 are classified ad high-capacity systems. These systems currently all utilize groundwater as a source of supply through 18 low-capacity and 15 high-capacity wells, and one well with unknown capacity. The locations of these systems are shown on Map IV-17. Selected characteristics of each system are presented in Table G-2 in Appendix G.

Commercial Water Supply Systems
In 2035, there are expected to be 55 privately owned, self-supplied, water systems operating in Waukesha County which provide water for commercial land uses. Of these, four are currently classified as high-capacity systems and 51 are classified as low-capacity well systems. These systems all currently utilize groundwater as a source of supply through 60 low-capacity wells and one high-capacity well. The locations of these systems are shown on Map IV-17. Selected characteristics of each system are presented in Table G-3 in Appendix G.

Institutional and Recreational Water Supply Systems
In 2035, there are expected to be 79 privately owned, self-supplied, water systems operating in Waukesha County which provide water for institutional and recreational land uses. Of these, 19 are currently classified as high-capacity systems and 60 are classified as low-capacity well systems. These systems all currently utilize groundwater as a source of supply through 142 low-capacity wells, and 10 high-capacity wells, and 10 wells of unknown capacity. The locations of these systems are shown on Map IV-17. Selected characteristics of each system are presented in Table G-4 in Appendix G.

Agricultural Water Supply Systems
In 2035, there are expected to be 11 privately owned, self-supplied, water systems operating in Waukesha County which provide water for irrigation and other purposes for agricultural land uses. All 11 systems are currently categorized as high-capacity and all utilize groundwater as a source of supply through eight low-capacity wells and 15 high-capacity wells. The locations of these systems are shown on Map IV-11. Selected characteristics of each system are presented in Table G-5 in Appendix G.

Irrigation Water Supply Systems
In 2035, there are expected to be 30 privately owned, self-supplied, water systems operating in Waukesha County which provide irrigation water for land uses other than agricultural uses, such as golf courses. All of these systems are categorized as high-capacity systems. These systems all utilize groundwater as a source of supply through 21 low-capacity wells, 31 high-capacity wells, and six wells of unknown capacity. The locations of these systems are shown on Map IV-17. Selected characteristics of each system are presented in Table G-6 in Appendix G.

Self-Supplied Residential Water Systems
As of the year 2035, there are expected to be about 61,800 persons, or about 14 percent of the total resident year 2035 population of Waukesha County, served by private domestic wells. As shown on Map IV-16, areas totaling about 410 square miles exist outside of the planned 2035 municipal water utility service areas within Waukesha County. Assuming an average use of 65 gallons per capita per day, these private domestic wells would withdraw about 4.0 million gallons per day from the shallow groundwater aquifer. It is expected that most of the households served by private domestic wells will also be served by onsite sewage disposal systems. Thus, the majority (approximately 90 percent) of the water withdrawn by private wells, or about 3.6 million gallons per day, would be expected to be returned to the groundwater aquifer via onsite sewage disposal systems.

SUMMARY

One of the elements of the regional water supply plan consisted of the forecast of future employment, population, and household levels within the Region for the design year 2035. These forecasts are then converted to future demands for land use and water demand. The chapter documents the 2035 forecasts made and the procedures used in developing the forecasts.

Municipal Water Supply System Forecasts
In 2005, there were 78 municipal water supply utility systems operating in the Region. Due to consolidation there were three less, or a total of 75, utilities in existence in 2007. By the year 2035, it is anticipated that 24 additional municipal water supply systems will be developed to serve existing urban areas currently not served by municipal

water supply. As presented in Table IV-25, the year 2000 total resident population served by municipal water utilities in the Region was about 1,562,000, or about 81 percent of the 1,931,000 total population of the Region. In 2035, the total population planned to be served by municipal water utilities is projected to increase by about 536,000 to just under 2.1 million residents, or about 92 percent of the 2035 population of 2.3 million.

The area served by municipal water supply systems within the Region is expected to increase by about 62 percent between 2000 and 2035, from about 390 square miles in 2000 to about 631 square miles in 2035, as summarized in Table IV-25. As noted in Chapter III, about 418 square miles were served by municipal water supply systems in 2005. Thus, the expected increase in area served between 2005 and 2035 is about 213 square miles, or an increase of about 51 percent. A significant portion of the increase in urban land served is due to the expansion of existing municipal water service areas into developed areas currently served by self-supplied water systems, and the development of new utilities to serve existing areas that are largely developed, but served by private water supply systems. In total, the amount of urban land existing in 2000 included within the expansion or new municipal water service areas in the Region comprises about 178 square miles, or about 74 percent of the increased service area. Thus, the amount of new urban land envisioned to be developed and served by municipal water systems between 2000 and 2035 is about 63 square miles, an increase of about 11 percent over the 568 square miles of urban land existing in 2000 within the planned 2035 municipal water service area. Table IV-25 summarizes forecast changes, on a county basis, for the population and urban area expected for the existing and planned municipal water service areas in the Region for the plan design year 2035.

Based upon the changes in population and land use within each of the municipal water service areas, estimates were made of the future water use demands and pumpage for each utility, as summarized by county in Table IV-26. The total water use demand on an average daily basis for the municipal water utilities in the Region is estimated to increase from 200 mgd in 2000, to 258 mgd in 2035. The corresponding pumpage is estimated to increase from 231 mgd to 303 mgd on an average daily basis; and from 347 mgd to 492 mgd on a maximum daily basis. These pumpage estimates include water use demand based upon sales, water used for production and system maintenance, and unaccounted-for water. These estimates of water use and pumpage serve as the basis for the design of future 2035 municipal water supply systems under alternative plan conditions, as set forth in Chapter VIII of this report. It should be noted that about 60 percent of the projected increase in water use between 2000 and 2035 for municipal water supply systems in the Region is due to the existing development not currently served, but within the planned 2035 service area described above. This portion of the increase in municipal water supply system water use represents a change from self-supplied system water use to municipally supplied water use.

Residential Other than Municipal, Community Systems

In 2035, it is expected that 24 of the privately owned, self-supplied, water systems operating in the Region which provide water supply services to primarily residential land uses, would remain. These systems serve residential development, such as mobile home parks, condominium complexes, and other residential groupings located beyond the municipal water supply service areas. The other self-supplied systems which existed in 2005 are expected to be connected to expanded municipal systems and no known new systems are currently planned. The remaining 24 systems utilize groundwater provided by 26 low-capacity and 13 high-capacity wells as a source of supply. Selected characteristics of these systems are presented in Table G-1 in Appendix G.

Industrial Water Supply Systems

In 2035, there are expected to be 63 privately owned, self-supplied, water systems in the Region which provide water for industrial land uses. Of these, 23 systems are currently classified as a low-capacity system and 40 are classified as high-capacity systems. These systems currently all utilize groundwater as a source of supply through 62 low-capacity and 63 high-capacity wells. Selected characteristics of each system are presented in Table G-2 in Appendix G.

Commercial Water Supply Systems

In 2035, there are expected to be 256 privately owned, self-supplied, water systems operating in the Region which provide water for commercial land uses. Of these, 14 are currently classified as high-capacity systems and 242 are classified as low-capacity well systems. These systems all currently utilize groundwater as a source of supply through 10 high-capacity wells and 280 low-capacity wells. Selected characteristics of each system are presented in Table G-3 in Appendix G.

Institutional and Recreational Water Supply Systems

In 2035, there are expected to be 28 privately owned, self-supplied, water systems operating in the Region which provide water for institutional and recreational land uses. Of these, 79 are currently classified as high-capacity systems and 202 are classified as low-capacity well systems. These systems all currently utilize groundwater as a source of supply through 430 low-capacity wells, 34 high-capacity wells, and 15 wells of unknown capacity. Selected characteristics of each system are presented in Table G-4 in Appendix G.

Agricultural Water Supply Systems

In 2035, there are expected to be 52 privately owned, self-supplied, water systems operating in the Region which provide water for irrigation and other purposes for agricultural land uses. Of these systems, all are currently categorized as high-capacity systems. These systems all utilize groundwater as a source of supply through 86 high-capacity and 14 low-capacity wells. Selected characteristics of each system are presented in Table G-5 in Appendix G.

Irrigation Water Supply Systems

In 2035, there are expected to be 70 privately owned, self-supplied, water systems operating in the Region which provide irrigation water for land uses other than agricultural uses, such as golf courses. One of these systems is currently categorized as low-capacity and 78 are categorized as high-capacity systems. All of these systems utilize groundwater as a source of supply through 103 high-capacity and 10 low-capacity wells. Selected characteristics of each system are presented in Table G-6 in Appendix G.

Thermoelectric-Power Generation Water Supply Systems

In 2035, there are expected to be six existing privately owned, self-supplied, water systems operating in the Region which provided cooling water for thermoelectric-power-generation facilities. These facilities included the Pleasant Prairie Power Plant, a coal-based generating facility, and the Paris Generating Station facility, both in Kenosha County; the coal-based Valley Power Plant and the Oak Creek Power Plant, both in Milwaukee County; the Port Washington Power Plant, a facility being converted, in 2006, from coal to and intermediate-load, natural gas facility in Ozaukee County; and the Germantown Power Plant, a combustion turbine gas-fired, intermittent-use facility in Washington County. Combined, these facilities are reported to use nearly two billion gallons of water per day in 2000. Most of that water is utilized by the Valley Power Plant, the Oak Creek Power Plant, and the Port Washington Power Plant, all of which utilize Lake Michigan water for once-through cooling systems. These systems typically return over 99 percent of the cooling water used back to the Lake. The Pleasant Prairie Power Plant is located five miles away from Lake Michigan, where a closed-loop system with large cooling towers is used. The amount of water used is reported to be about 11 million gallons per day, the majority which is make-up water for the plant cooling towers. We Energies reports that nearly 75 percent of the water used at that plant is evaporated to the atmosphere. The two small peaking combustion turbine power plants in the Village of Germantown and the Town of Paris use limited amounts of well water for cooling and for nitrogen oxide control on an intermittent-use basis.

Self-Supplied Residential Water Systems

As of the year 2035, there are expected to be about 180,000 persons, or about 8 percent of the total resident year 2035 population of the Region, served by private domestic wells. As summarized in Table IV-25, areas totaling about 2,060 square miles exist outside of the planned 2035 municipal water utility service areas within the Region. Assuming an average use of 65 gallons per capita per day, these private domestic wells would withdraw about 12.0 million gallons per day from the shallow groundwater aquifer. It is expected that the households served by private domestic wells will also be served by onsite sewage disposal systems. Thus, the majority (approximately 90 percent) of the water withdrawn by private wells, or about 10.0 million gallons per day, would be expected to be returned to the groundwater aquifer via onsite sewage disposal systems.

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Chapter IV

ANTICIPATED GROWTH AND CHANGE AFFECTING WATER SUPPLY IN THE REGION

TABLES

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Table IV-1

SELECTED CHARACTERISTICS OF POTENTIAL MUNICIPAL WATER SUPPLY SERVICE AREAS IN THE SOUTHEASTERN WISCONSIN REGION

Potential Water Service Area	Predominant Land Use	Residential Land Use Data		Existing Density		Distance to Nearest Existing 2000 Water Service Area (miles)[a]	Shallow Aquifer Private Well Suitability[b]	Comments	Conclusion Regarding Assumptions Water Supply Service Area
		Total Housing Units	Residential Acreage	Housing Units per Net Residential Acre	Approximate Housing Units per Gross Residential Acre				
Ashippun Lake	Residential	125	108	1.2	0.9	<0.5	High	Lake-oriented development	Private water systems[c]
Beaver Lake	Residential	646	738	0.9	0.7	<0.5	High	Lake-oriented development	Private water systems[c]
Big Bend	Residential	636	442	1.4	1.1	0.6	Medium	Many lots less than 0.5 acre	Municipal water service area
Bohner Lake	Residential	911	456	2.0	1.5	0.6	Medium	Lake-oriented development. Previous local initiative for public water was not supported	Municipal water service area
Eagle Lake	Residential	735	285	2.6	2.0	0.4	High	Lake-oriented development	Municipal water service area
Eagle Springs Lake	Residential	237	166	1.4	1.1	1.2	Medium	Lake-oriented development	Municipal water service area
Elm Grove	Residential	2,155	1,204	1.8	1.4	<0.5	High	Local initiative for public water to serve portion of area is underway	Municipal water service area
Golden Lake	Residential	104	63	1.7	1.3	1.8	High	Lake-oriented development	Municipal water service area
Lake Church	Residential	319	325	1.0	0.8	1.7	Medium	Shallow bedrock in vicinity	Private water systems[c]
Lake Keesus	Residential	365	320	1.1	0.9	2.3	Medium	60 percent of lots are less than 1.0 acre	Private water systems[c]
Lannon	Residential	535	298	1.8	1.4	<0.5	Medium	Local initiative for public water underway	Municipal water service area
Lyons	Residential	323	163	2.0	1.5	1.2	Medium	Municipal water service area	Municipal water service area
Merton	Residential	596	556	1.1	0.8	0.5	High	- -	Private water systems[e]
Newburg	Residential	557	364	1.5	1.1	1.5	Medium	- -	Municipal water service area
North Lake	Residential	296	233	1.3	1.0	2.1	Medium	Lake-oriented development	Private water systems[c]
Northwest Caledonia	Residential	50	37	1.3	1.0	0.5	High	Undeveloped nonresidential land	Municipal water service area
Norway	Residential	2,420	1,177	2.1	1.6	0.5	Medium	Lake-oriented development	Municipal water service area
Oconomowoc Lake	Residential	188	259	0.7	0.5	<0.5	High	Lake-oriented development	Private water systems[c]
Okauchee Lake	Residential	2,550	1,680	1.5	1.0	<0.5	Medium	Lake-oriented development	Municipal water service area
Powers-Benedict-Tombeau Lakes	Residential	989	543	1.8	1.4	0.8	High	Lake-oriented development	Municipal water service area
Pewaukee Lake West	Residential	1,871	1,596	1.2	0.9	<0.5	High	Lake-oriented development	Private water systems[c]
Pine Lake	Residential	287	427	0.7	0.5	<0.5	High	Lake-oriented development	Private water systems[c]
Potter Lake	Residential	518	357	1.5	1.0	<0.5	Medium	Lake-oriented development	Municipal water service area

Table IV-1 (continued)

Potential Water Service Area	Predominant Land Use	Residential Land Use Data				Distance to Nearest Existing 2000 Water Service Area (miles)[a]	Shallow Aquifer Private Well Suitability[b]	Comments	Conclusion Regarding Assumptions Water Supply Service Area
				Existing Density					
		Total Housing Units	Residential Acreage	Housing Units per Net Residential Acre	Approximate Housing Units per Gross Residential Acre				
Pretty Lake	Residential	126	100	1.3	1.0	1.3	Medium	Lake-oriented development	Municipal water service area
Rainbow Springs	Residential	1	1	0.8	0.6	2.2	High	Development density limitations due to wetlands and environmental corridors	Private water systems[d]
River Hills	Residential	567	1,354	0.4	0.3	<0.5	High	- -	Private water systems[e]
Salem	Residential	3,889	1,946	2.0	1.5	<0.5	High	Local initiative for part of area underway	Municipal water service area
Silver Lake	Residential	1,217	390	3.1	2.3	0.5	High	- -	Municipal water service area
Town of Fredonia-Waubeka Area	Residential	183	150	1.2	0.9	0.5	Medium	- -	Municipal water service area
Town of Rochester	Residential	275	165	1.7	1.3	<0.5	High	- -	Municipal water service area
Town of Waterford	Residential	1,797	978	1.8	1.4	<0.5	High	Lake-oriented development	Municipal water service area
Twin Lakes	Residential	2,905	1,062	2.7	2.0	0.5	High	Mixed-use community	Municipal water service area
Village of Rochester	Residential	453	156	2.9	2.2	0.1	High	Mixed-use community	Municipal water service area
Wales	Residential	299	158	1.9	1.4	<0.5	High	Mixed-use community	Municipal water service area

[a]Distance was measured to the nearest planned 2035 boundary of the existing municipal water utility service area.

[b]*High:*
- *Sand and gravel deposits with expected aquifer well yield of over 15 gallons per minute*
- *No known quality problems*

Medium:
- *Sand and gravel aquifer depth and capacity is limited*
- *No known quality problems*

Or
- *Sand and gravel deposits with expected aquifer well yield of over 15 gallons per minute*
- *Limited known quality problems*

Low:
- *Known significant quality problems*

[c]*Conclusion based upon relatively low-density trends in similar lake-oriented developments and adequate aquifer capacity.*

[d]*Conclusion based upon natural sources of the area and limited development potential.*

[e]*Conclusion based upon very low-density development and adequate aquifer capacity.*

Source: SEWRPC.

PRELIMINARY DRAFT

Table IV-1a

ANALYSIS SUMMARY OF SPECIAL WELL CASING AREAS CONSIDERED FOR ADDITION TO MUNICIPAL WATER SUPPLY SERVICE AREAS

Identification Number[a]	WDNR Identification Number	Location	Contaminant Found	Casing Recommendation	Comments	Water Service Area Recommendation
Washington County						
1	40	Town of Barton Section 27 and 34	VOC	60 feet into bedrock	Area includes existing industrial development	Add to water supply service area
2	41a and b	Town of Barton, Town of West Bend Sections 3, 4, 9, 10, 15, and 16	VOC, vinyl chloride	To base of Maquoketa shale	Portion of well casing area is in service area. Includes existing residential devel-opment and environ-mentally sensitive areas	Include existing residential development and adjacent potential infill development areas
3	47	Town of Polk Section 20	VOC	210 feet	Aesthetically poor ground-water quality. Local resident complaints	Add to water supply service area
4	46a, b, and c	Town of Jackson Sections 21, 27, and 28	Bacteria, nitrate, gasoline	220 feet	Includes a high school, otherwise mostly rural	Extend service area eat to include high school site. Do not add include most of the rural lands
5	45	Town of Richfield Sections 12 and 13	Gasoline and VOC	100 feet into bedrock	Includes existing mixed-use development	Include older "village area" along STH 175. Categorized as new or expanded system
6	42a and b	Village of Germantown Sections 9 and 10	Gasoline, bacteria, and nitrate	80-100 feet	Includes existing mixed-use development. Contamina-tion from onsite sewage disposal system and spills	Add to water supply service area
7	43	Village of Germantown Section 32	Gasoline	150 feet	Most of area of concern is in service area, small portion is not	Add to water supply service area
8	44/55	Village of Germantown Section 31	Gasoline	220 feet	Includes existing residential development and intervening developable lands	Add to water supply service area
Ozaukee County						
9	27	City and Town of Cedarburg Section 21	VOC	Special sampling	Most of area of concern is in service area, small portion is not	Include only existing development
10	28	Village and Town of Grafton Section 25	VOC	Special sampling	Aesthetically poor water quality; portion of well casing area is in service area; most of area not included is not developable at urban-density	Maintain initial service area boundary
11	- -	Village of Thiensville Section 15	Aesthetics	Special casing	No significant development in area. Some of area is undevelopable at urban-density	Maintain initial service area boundary

Table IV-1a (continued)

Identification Number[a]	WDNR Identification Number	Location	Contaminant Found	Casing Recommendation	Comments	Water Service Area Recommendation
				Waukesha County		
12	53a and b, 54/44	Town of Lisbon and Village of Sussex Sections 22, 24, 25, 28, 33, 34, 35, and 36	Bacteria, turbidity	100-200 feet or special approval	Portion of well casing area is in service area; shallow bedrock	Include existing residential development and adjacent potential infill development areas
13	52a and b	Town of Genesee Sections 23, 24, 25, and 26	Bacteria	200 feet	Includes existing residential development and one large industry	Include existing development as new or expanded area
14	67a and b	City of Muskego Sections 17, 18, 19, and 20	VOCs and leachate	Special sampling and site-specific casing requirements	Portion of well casing area is in service area; no significant development in area not included in service are	Maintain initial service area boundary
				Walworth County		
15	39	Town of East Troy Sections 15, 21, and 22	Leachate	To top of bedrock	Portion of well casing area is in service area; no significant development in area. Some of area is undevelopable at urban-density	Maintain initial service area boundary
16	- -	Town of Lyons	Bacteria, nitrates	Under development	Nearly all of the "Village of Lyons" area is included as a new service area	Include all of the "Village of Lyons" area
17	- -	City of Lake Geneva and Town of Lyons	Salt	Under development	No significant development in area. Some of area is undevelopable at urban-density	Maintain initial service area boundary

NOTE: VOC = Volatile Organic Compound.

[a]*See Map IV-2a. Identification numbers are the same as used in Chapter III.*

Source: Wisconsin Department of Natural Resources and SEWRPC.

Table IV-2

PROJECTED EMPLOYMENT BY INDUSTRY GROUP IN THE SOUTHEASTERN WISCONSIN REGION: 2035

Industry	2000 Employment		Projected 2035 Employment	
	Number of Jobs	Percent of Total	Number of Jobs	Percent of Total
Manufacturing				
Printing and Publishing	24,500	2.0	24,700	1.8
Fabricated Metal Products	25,600	2.1	11,600	0.9
Industrial Machinery and Equipment	48,000	3.9	24,900	1.8
Electrical and Other Electrical Equipment	27,000	2.2	15,300	1.1
All Other Manufacturing	99,200	8.1	83,900	6.1
Subtotal	224,300	18.3	160,400	11.7
Construction	53,800	4.4	57,100	4.2
Retail Trade	193,700	15.8	205,400	15.0
Wholesale Trade	64,400	5.3	64,400	4.7
Transportation, Communication, and Utilities	54,800	4.5	51,100	3.7
Services				
Business Services	102,800	8.4	164,600	12.0
Health Services	97,700	8.0	132,000	9.7
Social Services	34,300	2.8	62,100	4.5
All Other Services	171,200	14.0	231,300	16.9
Subtotal	406,000	33.2	590,000	43.1
Finance, Insurance, and Real Estate	93,700	7.7	103,600	7.6
Government and Government Enterprises[a]	114,400	9.3	115,300	8.4
Agriculture	6,000	0.5	4,800	0.4
Other[b]	11,700	1.0	16,200	1.2
Total	1,222,800	100.0	1,368,300	100.0

[a]*Includes all nonmilitary government agencies and enterprises, regardless of SIC code.*

[b]*Includes agricultural services, forestry, commercial fishing, mining, and unclassified jobs.*

Source: U.S. Bureau of Economic Analysis and SEWRPC.

Table IV-3

ACTUAL AND PROJECTED EMPLOYMENT IN THE SOUTHEASTERN WISCONSIN REGION BY COUNTY: 2000-2035

County	Year 2000		Year 2035		2000-2035 Increment	
	Total Employment	Percent of Region	Total Employment	Percent of Region	Total Employment	Percent
Kenosha	68,700	5.6	88,500	6.5	19,800	28.8
Milwaukee	624,600	51.1	628,900	45.9	4,300	1.8
Ozaukee	50,800	4.2	62,300	4.5	11,500	22.6
Racine	94,400	7.7	106,600	7.8	12,200	12.9
Walworth	51,800	4.2	69,400	5.1	17,600	33.9
Washington	61,700	5.0	78,900	5.8	17,200	28.5
Waukesha	270,800	22.2	333,700	24.4	62,900	23.2
Region	1,222,800	100.0	1,368,300	100.0	145,500	11.9

Source: U.S. Bureau of Economic Analysis and SEWRPC.

Table IV-4

ACTUAL AND PROJECTED POPULATION CHANGES IN THE SOUTHEASTERN WISCONSIN REGION: 1970, 2000, AND 2035

County	1970 Population	2000 Population	1970-2000 Increment		2035 Projected Population	2000-2035 Increment	
			Number	Percent		Number	Percent
Kenosha	117,900	149,600	31,700	27	210,100	60,500	40
Milwaukee	1,054,200	940,200	-114,000	-11	1,007,100	66,900	7
Ozaukee	54,500	82,300	27,800	51	101,100	18,800	23
Racine	170,800	188,800	18,000	11	213,600	24,800	13
Walworth	63,400	92,000	28,600	45	140,000	48,000	52
Washington	63,800	117,500	53,700	84	157,300	39,800	34
Waukesha	231,300	360,800	129,500	56	446,800	86,000	24
Region	1,756,100	1,931,200	175,100	10	2,276,000	344,800	18

Source: U.S. Bureau of the Census and SEWRPC.

Table IV-5

ACTUAL AND PROJECTED POPULATION CHANGES IN MUNICIPAL AND PRIVATE WATER SUPPLY SERVICE AREAS WITHIN THE SOUTHEASTERN WISCONSIN REGION: 2000 AND 2035

County	Municipal Water Service Area				Private Water			
	2000 Population	2035 Projected Population	2000-2035 Municipal Water Increment		2000 Population	2035 Projected Population	2000-2035 Private Water Increment	
			Number	Percent			Number	Percent
Kenosha	111,000	199,900	88,900	80	38,600	10,200	-28,400	-74
Milwaukee	917,300	1,004,200	86,900	9	22,900	2,900	-20,000	-87
Ozaukee	45,400	86,800	41,400	91	36,900	14,300	-22,600	-61
Racine	146,400	196,200	49,800	34	42,400	17,400	-25,000	-59
Walworth	56,200	112,100	55,900	99	35,800	27,900	-7,900	-22
Washington	66,800	113,000	46,200	69	50,700	44,300	-6,400	-13
Waukesha	218,400	385,000	166,600	76	142,400	61,800	-80,600	-56
Region	1,561,600	2,097,200	535,700	34	369,600	178,800	-190,900	-52

Source: U.S. Bureau of the Census and SEWRPC.

Table IV-6

ACTUAL AND PROJECTED HOUSEHOLDS AND HOUSEHOLD SIZES IN THE SOUTHEASTERN WISCONSIN REGION BY COUNTY: 2000-2035

	Year 2000			Year 2035			Projected Change		
County	Total Households	Percent of Region	Average Household Size	Total Households	Percent of Region	Average Household Size	Total Households	Percent of Region	Percent Change Average Household Size
Kenosha	56,100	7.5	2.60	82,900	8.9	2.46	26,800	47.8	-5.4
Milwaukee.........	377,700	50.4	2.43	427,500	46.2	2.29	49,800	13.2	-5.8
Ozaukee	30,900	4.1	2.61	40,000	4.3	2.45	9,100	29.4	-6.1
Racine	70,800	9.5	2.59	84,000	9.1	2.46	13,200	18.6	-5.0
Walworth..........	34,500	4.6	2.57	54,400	5.9	2.47	19,900	57.7	-3.9
Washington.......	43,800	5.8	2.65	62,800	6.8	2.45	19,000	43.4	-7.5
Waukesha.........	135,200	18.1	2.63	174,100	28.8	2.50	38,900	28.8	-4.9
Region	749,000	100.0	2.52	925,700	100.0	2.39	176,700	23.6	-5.2

Source: U.S. Bureau of the Census and SEWRPC.

Table IV-7

ACTUAL AND PROJECTED HOUSEHOLD CHANGES IN MUNICIPAL WATER AND PRIVATE WATER SUPPLY SERVICE AREAS IN THE SOUTHEASTERN WISCONSIN REGION: 2000 AND 2035

	Municipal Service Area				Private Water			
			2000-2035 Municipal Water Increment				2000-2035 Private Water Increment	
County	2000 Households	2035 Projected Households	Number	Percent	2000 Households	2035 Projected Households	Number	Percent
Kenosha	41,600	78,900	37,300	90	14,500	4,000	-10,500	-72
Milwaukee..........	368,700	426,300	57,600	16	9,100	1,200	-7,900	-87
Ozaukee	17,000	34,300	17,300	102	13,800	5,700	-8,100	-59
Racine	54,900	77,200	22,300	41	15,900	6,800	-9,100	-57
Walworth............	21,100	43,600	22,500	107	13,400	10,800	-2,600	-19
Washington........	24,900	45,100	20,200	81	18,900	17,700	-1,200	-6
Waukesha..........	81,900	149,900	68,000	83	53,400	24,200	-29,200	-55
Region	610,100	855,300	245,200	40	139,000	70,400	-68,600	-49

Source: U.S. Bureau of the Census and SEWRPC.

Table IV-8

EXISTING AND PROPOSED LAND USE IN THE SOUTHEASTERN WISCONSIN REGION: 2000 AND 2035

Land Use Category	Existing 2000		Planned Increment 2000-2035		Planned 2035	
	Square Miles	Percent of Total	Square Miles	Percent	Square Miles	Percent of Total
Urban						
Residential						
High-Density[a]	46.0	1.7	3.8	8.3	49.8	1.9
Medium-Density[b]	109.0	4.1	52.8	48.4	161.8	6.0
Low-Density[c]	178.0	6.6	12.0	6.7	190.0	7.1
Subtotal	333.0	12.4	68.6	20.6	401.6	15.0
Commercial	30.3	1.1	12.8	42.2	43.1	1.6
Industrial	32.9	1.2	5.3	16.1	38.2	1.4
Transportation, Communication, and Utilities	200.9	7.5	19.5	9.7	220.4	8.2
Governmental and Institutional[d]	33.7	1.2	2.2	6.5	35.9	1.3
Recreational[e]	50.4	1.9	7.7	15.3	58.1	2.2
Unused Urban	50.9	1.9	-23.4	-46.0	27.5	1.0
Subtotal	732.1	27.2	92.7	12.7	824.8	30.7
Nonurban						
Sub-Urban-Density Residential[f]	29.1	1.1	9.0	30.9	38.1	1.4
Rural-Density Residential[g]	- -	- -	5.9	- -	5.9	0.2
Agricultural	1,259.4	46.8	-103.9	-8.2	1,155.5	43.0
Other Open Land[h]	669.3	24.9	-3.7	-0.6	665.6	24.7
Subtotal	1,957.8	72.8	-92.7	-4.7	1,865.1	69.3
Total	2,689.9	100.0	- -	- -	2,689.9	100.0

NOTE: Offstreet parking area is included with the associated land use.

[a] *7.0 or more dwelling units per net residential acre.*

[b] *2.3-6.9 dwelling units per net residential acre.*

[c] *0.7-2.2 dwelling units per net residential acre.*

[d] *Increment consists, for the most part, of the increase at public sites.*

[e] *Includes only that land that is intensively used for recreational purposes. Increment consists, for the most part, of the increase at public sites.*

[f] *0.2-0.6 dwelling unit per net residential acre.*

[g] *No more than 0.2 dwelling unit per acre. Only the planned incremental rural residential area is indicated on this table; the area associated with existing (2000) rural residential development is included in the urban and sub-urban residential land categories. The planned incremental rural residential area assumes that there would be one acre of developed homesite area per dwelling, the remainder of the required area being retained in open space use.*

[h] *Includes woodlands, water, wetlands, landfill sites, quarries, and unused rural lands.*

Source: SEWRPC.

Table IV-9

PLANNED INITIAL ASSUMPTIONS CONCERNING EFFECTIVENESS OF WATER CONSERVATION PROGRAM LEVELS FOR USE IN ALTERNATIVE PLAN DEVELOPMENT FOR THE REGIONAL WATER SUPPLY SYSTEM PLANNING PROGRAM FOR SOUTHEASTERN WISCONSIN

Water Utility Category	Future Water Conservation Assumption Over and Above the Current Level[a]		Comments
	Average Day Demand Reduction (percent)	Maximum Day Demand Reduction (percent)	
• Lake Michigan Supply with Return of Spent Water • Adequate Water Supply Infrastructure in Place for 10 or More Years	4	6	• Assuming a current level of water conservation effectiveness of 4 percent, these values would equate to total reduction level of 8 and 12 percent • Total reduction levels of 8 percent • Cost of water conservation program may be offset by savings in operational cost • Cost savings associated with infrastructure avoidance is not a major consideration
• Lake Michigan Supply with Return of Spent Water • Some Water Supply Infrastructure Needs Expected During the Next 10 Years	4	10	• Assuming a current level of 4 percent, these values would equate to total reduction levels of 10 and 14 percent • Cost of water conservation program may exceed savings in operating costs • Cost savings associated with infrastructure avoidance is an important consideration
• Groundwater Supply • Adequate Water Supply Infrastructure for 10 or More Years • No Major Aquifer Quality or Quantity Issues	6	12	• Assuming a current level of 4 percent, these values would equate to total reduction levels of 10 to 16 percent • Cost of water conservation program is expected to exceed savings in operating costs • Cost savings associated with infrastructure avoidance is not a major consideration
• Groundwater Supply • Major Infrastructure Needs Expected During the Next 10 Years • No Major Aquifer Quantity or Quality Problems	8	16	• Assuming a current level of water conservation effectiveness of 4 percent, these values would equate to total reduction levels of 12 to 18 percent • Cost of the water conservation program will likely exceed the associated reduction in operational costs • Cost savings associated with infrastructure avoidance is an important consideration
• Groundwater Supply • Major Infrastructure Needs Expected During the Next 10 Years • Aquifer Quantity or Quality Problems	10	18	• Assuming a current level of water conservation effectiveness of 4 percent, these values would equate to total reduction levels of 14 to 22 percent • Cost of the water conservation program will likely exceed the associated reduction in operational costs • Cost savings associated with infrastructure avoidance is an important consideration • Aquifer considerations may be the driving factor

[a]*Initial assumptions which may be revised following development and evaluation of water supply alternative plans, if demonstrated as needed by cost, environmental impacts, or other factors related to the plan objectives.*

Source: SEWRPC.

Table IV-10

MUNICIPAL WATER SUPPLY SERVICE POPULATION AND AREA COMPARISON FOR KENOSHA COUNTY: 2000-2035

Utility	Population				Area Served			
		2000-2035 Increment				2000-2035 Increment		
	2000 Population	Change in Population	Percent Change	2035 Population	2000 Area Served (square miles)	Change in Area (square miles)	Percent Change	2035 Area Served (square miles)
Kenosha Water Utility	98,700	11,200	11	109,900	20.2	2.6	13	22.8
Paddock Lake Water Utility	1,000	4,000	400	5,000	0.2	1.3	650	1.5
Pleasant Prairie Water Utility	7,900	22,650	287	30,550	6.5	7.9	122	14.4
Town of Bristol Utility District No. 1	1,100	3,800	355	4,900	0.7	1.5	214	2.2
Town of Bristol Utility District No. 3	200	0	0	200	0.1	1.5	1,500	1.6
Town of Somers Water Utility	2,100	13,250	631	15,350	2.1	5.4	249	7.5
Powers-Benedict-Tombeau Lakes Area[a]	- -	1,800	- -	1,800	- -	1.5	- -	1.5
Village of Silver Lake	- -	4,900	- -	4,900	- -	2.2	- -	2.2
Village of Twin Lakes	- -	9,400	- -	9,400	- -	3.9	- -	3.9
Town of Salem	- -	17,900	- -	17,900	- -	8.5	- -	8.5
Total	111,000	88,900	80	199,900	29.8	36.2	122	66.0

[a]*Limited to the portion of proposed Powers-Benedict-Tombeau Lakes service area within Kenosha County.*

Source: SEWRPC.

Table IV-11

MUNICIPAL WATER SUPPLY SERVICE AREA DEMAND AND PUMPAGE IN KENOSHA COUNTY: 2000 AND 2035

Utility	Year 2000			Year 2035		
	Average Water Use Demand (gallons per day X 1,000)[a]	Average Daily Pumpage (gallons per day X 1,000)[a]	Maximum Daily Pumpage (gallons per day X 1,000)[a]	Average Water Use Demand[b] (gallons per day X 1,000)	Average Daily Pumpage[b] (gallons per day X 1,000)	Maximum Daily Pumpage[b] (gallons per day X 1,000)
Kenosha Water Utility[c]	9,071	12,460	19,188[c]	10,228	14,050	21,186
Paddock Lake Water Utility	57	72	181	421	535	1,458
Pleasant Prairie Water Utility	1,382	1,703	1,822	4,142	5,104	6,947
Town of Bristol Utility District No. 1	193	226	346	573	672	1,239
Town of Bristol Utility District No. 3	13	15	26	815	940	1,814
Town of Somers Water Utility	295	371	608	1,697	2,135	3,428
Powers-Benedict-Tombeau Lakes Area[d]	- -	- -	- -	261	352	527
Village of Silver Lake[d]	- -	- -	- -	483	652	976
Village of Twin Lakes[d]	- -	- -	- -	828	1,117	1,673
Town of Salem[d]	- -	- -	- -	1,654	2,233	3,344
Total	11,011	14,847	22,171	21,102	27,786	42,591

[a]*Data based upon year 2000 Public Service Commission Reports data for water sales with the exception of Paddock Lake Water Utility and Town of Bristol Utility District Nos. 1 and 3 for which data were based upon year 2005 reports.*

[b]*See Appendix F for additional detail.*

[c]*City of Kenosha Water Utility data includes estimates for the Utility's retail service area.*

[d]*Relationship of average day and maximum day pumpage for the Powers-Benedict-Tombeau Lakes Area, Town of Salem, Village of Silver Lake, and Village of Twin Lakes is based upon the average of the other Kenosha County utilities for the three year (2000, 2001, and 2002) average ratio of maximum day pumpage to average day pumpage for each utilities' total pumpage values.*

Source: SEWRPC.

Table IV-12

MUNICIPAL WATER SUPPLY SERVICE POPULATION, AREA, WATER DEMAND AND PUMPAGE DATA FOR UTILITIES PROVIDING WATER TO MULTIPLE SYSTEMS IN KENOSHA COUNTY: 2000-2035

					Water Demand					
					Year 2000			Year 2035		
Utility	2000 Population	2035 Population	2000 Area Served (square miles)	2035 Area Served (square miles)	Average Water Use Demand (gallons per day X 1,000)	Average Daily Pumpage (gallons per day X 1,000)	Maximum Daily Pumpage (gallons per day X 1,000)	Average Water Use Demand (gallons per day X 1,000)	Average Daily Pumpage[b] (gallons per day X 1,000)	Maximum Daily Pumpage (gallons per day X 1,000)
Kenosha Water Utility Service Area[a]	108,900	156,000	28.9	46.3	10,761	14,549	21,644	16,822	22,229	33,375

[a]*Includes City of Kenosha Water Utility, Village of Pleasant Prairie Water Utility, Town of Bristol Utility District No. 3, and Town of Somers Water Utility.*

Source: SEWRPC.

Table IV-13

MUNICIPAL WATER SUPPLY SERVICE POPULATION AND AREA COMPARISON FOR MILWAUKEE COUNTY: 2000-2035

Utility	Population				Area Served			
		2000-20335 Increment				2000-20335 Increment		
	2000 Population	Change in Population	Percent Change	2035 Population	2000 Area Served (square miles)	Change in Area (square miles)	Percent Change	2035 Area Served (square miles)
City of Cudahy Water Utility............	18,450	400	2	18,850	4.7	0.0	0	4.7
City of Franklin Water Utility	16,900	33,250	197	50,150	7.7	10.8	140	18.5
City of Glendale Water Utility..........	13,350	4,000	30	17,350	5.8	0.0	0	5.8
City of Milwaukee Water Works.......	650,750	13,800	2	664,550	107.7	2.3	2	110.0
City of Oak Creek Water and Sewer Utility..........................	26,000	24,850	96	50,850	11.2	7.4	66	18.6
City of South Milwaukee Water Utility	21,250	600	3	21,850	4.2	0.0	0	4.2
City of Wauwatosa Water Utility	47,300	3,450	7	50,750	12.8	0.0	0	12.8
City of West Allis Water Utility	61,250	3,400	6	64,650	11.3	0.0	0	11.3
We Energies-Water Services	550	3,650	664	4,200	0.3	1.5	575	1.8
Village of Brown Deer Public Water Utility.......................	12,200	-400	-3	11,800	4.4	0.0	0	4.4
Village of Fox Point Water Utility	7,000	-900	-13	6,100	2.8	0.0	0	2.8
Village of Greendale Water Utility....	14,400	-900	-6	13,500	4.2	<0.1	<1	4.3
Village of Shorewood Municipal Water Utility	13,750	1,100	8	14,850	1.6	0.0	0	1.6
Village of Whitefish Bay Water Utility	14,150	600	4	14,750	2.2	<0.1	1	2.2
Total	917,300	86,900	9	1,004,200	180.9	21.4	12	202.3

Source: SEWRPC.

Table IV-14

MUNICIPAL WATER SUPPLY SERVICE AREA DEMAND AND PUMPAGE IN MILWAUKEE COUNTY: 2000 AND 2035

Utility	Year 2000			Year 2035		
	Average Water Use Demand (gallons per day X 1,000)[a]	Average Daily Pumpage (gallons per day X 1,000)[a]	Maximum Daily Pumpage (gallons per day X 1,000)[a]	Average Water Use Demand[b] (gallons per day X 1,000)	Average Daily Pumpage[b] (gallons per day X 1,000)	Maximum Daily Pumpage[b] (gallons per day X 1,000)
City of Cudahy Water Utility............	4,416	4,800	6,565	4,394	4,777	6,010
City of Franklin Water Utility	1,618	1,797	4,686	5,294	5,947	12,795
City of Glendale Water Utility..........	2,013	2,092	3,860	2,262	2,350	4,725
City of Milwaukee Water Works[c].....	92,916	103,023	147,014	93,561	103,738	163,539[c]
City of Oak Creek Water and Sewer Utility[d]......................	3,969	4,755	9,510[b]	6,382	7,646	14,973[b]
City of South Milwaukee Water Utility	2,003	2,666	3,635	1,963	2,613	4,251
City of Wauwatosa Water Utility	5,699	6,243[c]	8,148	5,984	6,556	10,997[c]
City of West Allis Water Utility	6,307	6,948[c]	9,082	6,264	6,900	10,009[c]
We Energies-Water Services	46	67	171	335	488	793
Village of Brown Deer Public Water Utility......................	1,417	1,545	2,561[c]	1,463	1,595	2,979[c]
Village of Fox Point Water Utility	753	764	1,680	686	697	1,117
Village of Greendale Water Utility....	1,265	1,338	2,550[c]	1,247	1,319	3,527[c]
Village of Shorewood Municipal Water Utility	1,116	1,253	2,080[c]	1,156	1,298	2,110[c]
Village of Whitefish Bay Water Utility	1,294	1,321	2,280	1,326	1,353	3,012
Total	124,832	138,612	203,822	132,317	147,277	240,836

[a]*Data based upon year 2000 Public Service Commission Reports data for water sales with the exception of City of Glendale Water Utility and Village of Fox Point Water Utility for which data were based upon year 1999 reports.*

[b]*See Appendix F for more detail.*

[c]*City of Milwaukee Water Works data include estimate for the Utility's retail service area.*

[d]*City of Oak Creek Water and Sewer Utility data include estimate for the Utility's retail service area.*

Source: SEWRPC.

Table IV-14a

MUNICIPAL WATER SUPPLY SERVICE POPULATION, AREA, WATER DEMAND AND PUMPAGE DATA FOR UTILITIES PROVIDING WATER TO MULTIPLE SYSTEMS IN MILWAUKEE COUNTY: 2000-2035

Utility	2000 Population	2035 Population	2000 Area Served (square miles)	2035 Area Served (square miles)	Water Demand					
					Year 2000			Year 2035		
					Average Water Use Demand (gallons per day X 1,000)[a]	Average Daily Pumpage[a] (gallons per day X 1,000)	Maximum Daily Pumpage[b] (gallons per day X 1,000)	Average Water Use Demand[b] (gallons per day X 1,000)	Average Daily Pumpage[b] (gallons per day X 1,000)	Maximum Daily Pumpage[b] (gallons per day X 1,000)
City of Milwaukee Water Works[a]	834,900	906,300	158.9	186.1	112,326	124,991	176,575	119,253	132,884	212,297
City of Oak Creek Water and Sewer Utility[b]	48,100	107,200	20.5	38.6	5,996	7,049	15,521	12,208	14,235	29,223
North Shore Water Commission[c]	35,050	42,400	11.1	12.6	4,106	4,244	8,091	4,609	4,888	9,647

[a]*Includes City of Milwaukee Water Works retail service area, Village of West Milwaukee, City of West Allis Water Utility, City of Wauwatosa Water Utility, Village of Greendale Water Utility, Village of Shorewood Municipal Water Utility, a portion of the City of New Berlin Water Utility, the Village of Butler, a portion of the Village of Menomonee Falls, and a portion of the City of Mequon and Village of Thiensville provided by We Energies-Water Services.*

[b]*Includes the City of Oak Creek Water Utility retail service area, the City of Franklin Water Utility, the Caddy Vista Sanitary District, the Crestview Sanitary District, and a portion of the North Park Sanitary District No. 1.*

[c]*Includes the City of Glendale Water Utility, the Village of Fox Point Water Utility, the Village of Whitefish Bay Water Utility, and a portion of the Village of Bayside provided by the We Energies-Water Services.*

Source: SEWRPC.

Table IV-15

MUNICIPAL WATER SUPPLY SERVICE POPULATION AND AREA COMPARISON FOR OZAUKEE COUNTY: 2000-2035

Utility	Population				Area Served			
		2000-2035 Increment				2000-2035 Increment		
	2000 Population	Change in Population	Percent Change	2035 Population	2000 Area Served (square miles)	Change in Area (square miles)	Percent Change	2035 Area Served (square miles)
City of Cedarburg Light and Water Commission	11,250	3,650	33	14,900	3.1	2.9	91	6.0
We Energies-Water Services[a]	5,300	23,500	434	28,800	4.5	13.0	291	17.5
City of Port Washington Water Utility	10,600	4,400	41	15,000	2.8	1.9	68	4.7
Village of Belgium Water Utility........	1,700	600	37	2,300	0.6	0.4	78	1.0
Village of Fredonia Municipal Water Utility	1,900	1,100	53	3,000	0.7	0.6	95	1.3
Village of Grafton Water and Wastewater Commission	10,500	5,950	58	16,450	3.0	3.3	111	6.3
Village of Saukville Municipal Water Utility	4,150	1,500	37	5,650	1.2	1.8	148	3.0
Village of Newburg Area[b]	- -	250	- -	250	- -	0.4	- -	0.4
Town of Fredonia-Waubeka Area....	- -	500	- -	500	- -	0.5	- -	0.5
Total	45,400	41,450	93	86,850	15.7	24.7	157	40.4

[a]*Provides service to portions of the City of Mequon and the Village of Thiensville.*

[b]*Limited to the portion of proposed Village of Newburg service area within Ozaukee County.*

Source: SEWRPC.

Table IV-16

MUNICIPAL WATER SUPPLY SERVICE AREA DEMAND AND PUMPAGE IN OZAUKEE COUNTY: 2000 AND 2035

Utility	Year 2000			Year 2035		
	Average Water Use Demand[a] (gallons per day X 1,000)	Average Daily Pumpage[a] (gallons per day X 1,000)	Maximum Daily Pumpage[a] (gallons per day X 1,000)	Average Water Use Demand[b] (gallons per day X 1,000)	Average Daily Pumpage[b] (gallons per day X 1,000)	Maximum Daily Pumpage[b] (gallons per day X 1,000)
City of Cedarburg Light and Water Commission	1,256	1,418	2,150	1,694	1,913	2,937
We Energies-Water Services[c].........	464	672	1,727	3,140	4,547	6,352
City of Port Washington Water Utility	1,151	1,334	1,702	1,681	1,947	3,127
Village of Belgium Water Utility........	221	267	605	325	393	1,107
Village of Fredonia Municipal Water Utility	144	171	398	326	388	825
Village of Grafton Water and Wastewater Commission	1,130	1,420	2,043	1,884	2,366	3,833
Village of Saukville Municipal Water Utility	1,207	1,261	1,737	1,513	1,580	2,071
Town of Fredonia-Waubeka Area....	- -	- -	- -	65	76	104
Total	5,573	6,542	10,362	10,629	13,212	20,356

[a]*Data based upon year 2000 Public Service Commission Reports.*

[b]*See Appendix F for more detail.*

[c]*Provides service to portions of the City of Mequon and the Village of Thiensville.*

Source: SEWRPC.

Table IV-17

MUNICIPAL WATER SUPPLY SERVICE POPULATION AND AREA COMPARISON FOR RACINE COUNTY: 2000-2035

Utility	Population				Area Served			
		2000-2035 Increment				2000-2035 Increment		
	2000 Population	Change in Population	Percent Change	2035 Population	2000 Area Served (square miles)	Change in Area (square miles)	Percent Change	2035 Area Served (square miles)
City of Burlington Water Utility.........	9,950	5,350	54	15,300	3.8	2.3	61	6.2
City of Racine Water and Wastewater Utility........................	103,800	9,700	9	113,500	22.3	5.4	24	27.7
Caddy Vista Sanitary District[a].........	800	450	60	1,250	0.2	0.3	173	0.4
Village of Caledonia Utility District No. 1[a].............................	3,550	8,250	231	11,800	2.0	4.8	239	6.8
Crestview Sanitary District[b]............	3,800	450	12	4,250	1.0	0.6	60	1.7
North Park Sanitary District (Oak Creek)[b].............................	600	100	16	700	0.4	0.0	0	0.4
North Park Sanitary District (Racine).......................................	8,300	900	11	9,200	3.0	<0.1	1	3.1
Village of Sturtevant Water and Sewer Utility[c].............................	5,300	1,250	23	6,550	1.5	0.6	42	2.1
Village of Union Grove Municipal Water Utility................................	4,300	1,600	37	5,900	1.2	0.7	59	1.9
Village of Waterford Water Utility.....	4,050	1,350	33	5,400	1.2	1.1	94	2.3
Village of Wind Point Municipal Water Utility................................	1,850	500	26	2,350	1.1	0.0	1	1.1
North Cape Sanitary District............	100	50	27	150	0.1	<0.1	6	0.1
Yorkville Utility District No. 1............	<50	350	1,411	400	0.1	0.8	704	0.9
Town of Burlington-Bohner Lake Area...................................	- -	2,200	- -	2,200	- -	1.1	- -	1.1
Town of Dover-Eagle Lake Area......	- -	2,000	- -	2,000	- -	1.0	- -	1.0
Northwest Caledonia Area...............	- -	200	- -	200	- -	0.3	- -	0.3
Town of Norway Area[d]....................	- -	5,800	- -	5,800	- -	2.6	- -	2.6
Village of Rochester Area................	- -	1,250	- -	1,250	- -	0.4	- -	0.4
Town of Rochester Area..................	- -	1,300	- -	1,300	- -	0.8	- -	0.8
Town of Waterford Area..................	- -	6,700	- -	6,700	- -	3.6	- -	3.6
Total	146,400	49,750	34	196,200	37.9	26.4	70	64.5

[a]*As of 2006, the Caddy Vista Sanitary District and the Village of Caledonia Utility District No. 1 have been combined into the Caledonia West Utility District.*

[b]*As of 2007, the Crestview Sanitary District and the North Park Sanitary District have been combined into the Caledonia East Utility District.*

[c]*As of 2007, the Village of Sturtevant Water Utility was purchased by the City of Racine Water and Wastewater Utility and is served by the City Utility on a retail basis. The Village of Sturtevant continues to own and operate its sewer utility facilities.*

[d]*Limited to the portion of proposed Norway refined service area within Racine County.*

Source: SEWRPC.

Table IV-18

MUNICIPAL WATER SUPPLY SERVICE AREA DEMAND AND PUMPAGE IN RACINE COUNTY: 2000 AND 2035

Utility	Year 2000			Year 2035		
	Average Water Use Demand[a] (gallons per day X 1,000)	Average Daily Pumpage[a] (gallons per day X 1,000)	Maximum Daily Pumpage[a] (gallons per day X 1,000)	Average Water Use Demand[b] (gallons per day X 1,000)	Average Daily Pumpage[b] (gallons per day X 1,000)	Maximum Daily Pumpage[b] (gallons per day X 1,000)
City of Burlington Water Utility	1,576	1,884	2,892	2,129	2,545	4,508
City of Racine Water and Wastewater Utility[c]	18,513	22,763	35,510[a]	19,470	23,940	36,568
Caddy Vista Sanitary District[d]	42	50	199[b]	88	105	317[b]
Caledonia Utility District No. 1[d]	276	613	698[a]	1,444	3,208	4,366[a]
Crestview Sanitary District[e]	233	270	836[a]	300	348	835[a]
North Park Sanitary District (Oak Creek)[e]	135	177	290[b]	144	189	303
North Park Sanitary District (Racine)[f]	601	789	1,294[a]	641	842	1,352
Sturtevant Water and Sewer Utility	580	595	1,103[a]	906	930	1,493[a]
Village of Union Grove Municipal Water Utility	678	716	1,359	1,000	1,056	1,841
Village of Waterford Water Utility	320	391	698	507	620	1,228
Village of Wind Point Municipal Water Utility	231	254	417[a]	262	288	462[a]
North Cape Sanitary District	10	11	15	19	21	26
Yorkville Utility District No. 1	57	71	683	267	332	2,799
Town of Burlington-Bohner Lake Area	- -	- -	- -	177	237	355
Town of Dover-Eagle Lake Area	- -	- -	- -	212	285	426
Northwest Caledonia Area	- -	- -	- -	71	95	143
Town of Norway Area	- -	- -	- -	553	741	1,110
Village of Rochester Area	- -	- -	- -	98	132	197
Town of Rochester Area	- -	- -	- -	118	158	237
Town of Waterford Area	- -	- -	- -	549	736	1,102
Total	23,252	28,584	45,994[c]	28,958	36,808	59,669[c]

[a]*Data based upon year 2000 Public Service Commission Reports.*

[b]*See Appendix F for more detail.*

[c]*Data presented were estimates for the City of Racine Water and Wastewater Utility retail service area.*

[d]*As of 2006, the Caddy Vista Sanitary District and the Village of Caledonia Utility District No. 1 have been combined into the Caledonia West Utility District.*

[e]*As of 2007, the Crestview Sanitary District and the North Park Sanitary District have been combined into the Caledonia East Utility District.*

[f]*As of 2007, the Village of Sturtevant Water Utility was purchased by the City of Racine Water and Wastewater Utility and is served by the City Utility on a retail basis. The Village of Sturtevant continues to own and operate its sewer utility facilities.*

Source: SEWRPC.

Table IV-18a

MUNICIPAL WATER SUPPLY SERVICE POPULATION, AREA, WATER DEMAND AND PUMPAGE DATA FOR UTILITIES PROVIDING WATER TO MULTIPLE SYSTEMS IN RACINE COUNTY: 2000-2035

Utility	2000 Population	2035 Population	2000 Area Served (square miles)	2035 Area Served (square miles)	Water Demand					
					Year 2000			Year 2035		
					Average Water Use Demand (gallons per day X 1,000)[a]	Average Daily Pumpage (gallons per day X 1,000)[a]	Maximum Daily Pumpage (gallons per day X 1,000)[a]	Average Water Use Demand[b] (gallons per day X 1,000)	Average Daily Pumpage (gallons per day X 1,000)[b]	Maximum Daily Pumpage (gallons per day X 1,000)
City of Racine Water and Wastewater Utility Service Area[b]	122,800	143,400	29.9	40.8	20,201	25,014	39,022	22,723	29,208	44,241

[a]*Includes the City of Racine Water and Wastewater Utility, the Village of Sturtevant Water and Sewer Utility, the Village of Wind Point Municipal Water Utility, the Village of Caledonia Utility District No. 1, and a portion of the North Park Sanitary District.*

[b]*Data based upon year 2000 Public Service Commission Reports data for water sales, with the exception of the Town of Bristol District No. 3<<??Kenosha County?>> for which date were based upon year 2005 reports*

Source: SEWRPC.

Table IV-19

MUNICIPAL WATER SUPPLY SERVICE POPULATION AND AREA COMPARISON FOR WALWORTH COUNTY: 2000-2035

Utility	Population				Area Served			
		2000-2035 Increment				2000-2035 Increment		
	2000 Population	Change in Population	Percent Change	2035 Population	2000 Area Served (square miles)	Change in Area (square miles)	Percent Change	2035 Area Served (square miles)
Delavan Water and Sewerage Commission	8,350	11,700	140	20,050	2.8	5.6	203	8.4
Elkhorn Light and Water	7,650	7,300	95	14,950	3.0	2.8	100	5.8
Lake Geneva Municipal Water Utility	8,100	6,400	79	14,500	3.0	3.5	124	6.5
Whitewater Municipal Water Utility	11,350	4,750	42	16,100	2.8	0.8	30	3.6
Darien Water Works and Sewer System	1,650	1,150	70	2,800	0.7	0.5	77	1.2
Village of East Troy Municipal Water Utility	3,750	5,700	152	9,450	1.4	2.6	179	4.0
Fontana Municipal Water Utility	1,850	300	16	2,150	1.8	0.4	20	2.2
Village of Genoa City Municipal Water Utility	1,900	2,400	126	4,300	0.7	1.0	133	1.7
Sharon Waterworks and Sewer System	1,650	950	58	2,600	0.7	0.1	20	0.8
Walworth Municipal Water and Sewer Utility	2,400	2,350	98	4,750	0.9	1.0	118	1.9
Williams Bay Municipal Water Utility	2,550	3,400	133	5,950	1.5	2.4	170	3.9
Pell Lake Sanitary District No. 1	2,450	2,250	92	4,700	1.4	0.5	43	1.9
Town of East Troy Sanitary District No. 3	50	50	100	100	<0.1	<0.1	43	0.1
Lake Como Sanitary District No. 1	1,900	1,050	55	2,950	1.1	0.4	37	1.6
Country Estates Sanitary District	450	650	144	1,100	0.1	0.3	296	0.3
Town of Troy Sanitary District No. 1	150	0	0	150	0.1	<0.1	45	0.1
Town of Lyons Area	- -	1,700	- -	1,700	- -	0.7	- -	0.7
Mukwonago Municipal Water Utility[a]		1,450	- -	1,450	- -	0.6	- -	0.6
Town of East Troy-Potter Lake Area		1,200	- -	1,200	- -	0.9	- -	0.9
Powers-Benedict-Tombeau Lakes Area[b]	- -	1,150	- -	1,150	- -	0.5	- -	0.5
Total	56,200	55,900	99	112,100	22.0	24.7	113	46.7

[a]*Limited to the portion of Mukwonago Municipal Water Utility within Walworth County.*

[b]*Limited to the portion of proposed Powers-Benedict-Tombeau Lakes area within Walworth County.*

Source: SEWRPC.

Table IV-20

MUNICIPAL WATER SUPPLY SERVICE AREA DEMAND AND PUMPAGE IN WALWORTH COUNTY: 2000 AND 2035

Utility	Year 2000			Year 2035		
	Average Water Use Demand[a] (gallons per day X 1,000)	Average Daily Pumpage[a] (gallons per day X 1,000)	Maximum Daily Pumpage[a] (gallons per day X 1,000)	Average Water Use Demand[b] (gallons per day X 1,000)	Average Daily Pumpage[b] (gallons per day X 1,000)	Maximum Daily Pumpage[b] (gallons per day X 1,000)
Delavan Water and Sewerage Commission	808	898	1,552	2,052	2,280	4,019
Elkhorn Light and Water	838	1,208	1,714	1,754	2,528	3,324
Lake Geneva Municipal Water Utility	1,049	1,289	1,965	1,648	2,025	3,587
Whitewater Municipal Water Utility	1,567	1,888	3,276	1,987	2,394	3,979
Darien Water Works and Sewer System	96	110	281	303	347	789
Village of East Troy Municipal Water Utility	510	569	904	1,101	1,229	2,030
Fontana Municipal Water Utility	388	513	1,090	409	541	716
Village of Genoa City Municipal Water Utility	144	280	485	483	938	1,414
Sharon Waterworks and Sewer System	102	132	727	173	224	682
Walworth Municipal Water and Sewer Utility	320	489	655	603	921	1,253
Williams Bay Municipal Water Utility	220	320	728	590	858	1,762
Pell Lake Sanitary District No. 1	93	183	467	262	516	956
Town of East Troy Sanitary District No. 3	4	4	13	8	9	22
Lake Como Sanitary District No. 1	86	131	294	187	285	568
Country Estates Sanitary District	20	23	42	77	89	152
Town of Troy Sanitary District No. 1	4	4	40	4	5	16
Town of Lyons Area	- -	- -	- -	167	215	351
Town of East Troy-Potter Lake Area	- -	- -	- -	139	179	293
Total	6,249	8,042	13,766	11,948	15,585	25,914

[a]*Data based upon year 2000 Public Service Commission Reports.*

[b]*See Appendix F for more detail.*

Source: Public Service Commission of Wisconsin and SEWRPC.

Table IV-21

MUNICIPAL WATER SUPPLY SERVICE POPULATION AND AREA COMPARISON FOR WASHINGTON COUNTY: 2000-2035

Utility	Population				Area Served			
	2000 Population	2000-2035 Increment: Change in Population	2000-2035 Increment: Percent Change	2035 Population	2000 Area Served (square miles)	2000-2035 Increment: Change in Area (square miles)	2000-2035 Increment: Percent Change	2035 Area Served (square miles)
City of Hartford Water Utilities	10,850	7,300	67	18,150	3.4	3.1	94	6.5
City of West Bend Water Utility.............	28,200	16,350	58	44,550	8.0	5.5	72	13.5
Village of Germantown Water Utility.....	15,050	8,400	56	23,450	5.7	4.5	83	10.2
Village of Jackson Water Utility	4,900	5,050	103	9,950	1.6	1.9	123	3.5
Village of Kewaskum Municipal Water Utility	3,350	2,150	64	5,500	1.0	0.8	84	1.8
Slinger Utilities	3,700	4,450	120	8,150	1.3	2.1	165	3.4
Allenton Sanitary District	750	800	107	1,550	0.3	0.4	119	0.7
Village of Newburg Area[a].....................	- -	1,700	- -	1,700	- -	0.9	- -	0.9
Total	66,800	46,200	69	113,000	21.4	19.3	94	40.5

[a]*Limited to the portion of the proposed Village of Newburg service area within Washington County.*

Source: SEWRPC.

Table IV-22

MUNICIPAL WATER SUPPLY SERVICE AREA DEMAND AND PUMPAGE IN WASHINGTON COUNTY: 2000 AND 2035

Utility	Year 2000			Year 2035		
	Average Water Use Demand (gallons per day X 1,000)[a]	Average Daily Pumpage (gallons per day X 1,000)[a]	Maximum Daily Pumpage (gallons per day X 1,000)[a]	Average Water Use Demand (gallons per day X 1,000)	Average Daily Pumpage (gallons per day X 1,000)	Maximum Daily Pumpage (gallons per day X 1,000)
City of Hartford Water Utilities	1,204	1,497	2,424	1,981	2,463	3,703
City of West Bend Water Utility.............	2,665	2,908	4,070	4,405	4,807	6,470
Village of Germantown Water Utility.....	1,363	1,786	2,924	2,523	3,305	5,452
Village of Jackson Water Utility	467	494	986	1,097	1,161	2,096
Village of Kewaskum Municipal Water Utility	377	473	907	597	749	1,358
Slinger Utilities	283	327	604	742	857	1,598
Allenton Sanitary District	67	92	159	147	202	677
Village of Newburg Area.......................	- -	- -	- -	189	223	345
Total	6,426	7,577	12,074	11,682	13,768	21,699

[a]*Data based upon year 2000 Public Service Commission Reports data for water sales, with the exception of Slinger Utilities and Allenton Sanitary District for which data were based upon year 2001 reports.*

Source: SEWRPC.

Table IV-23

MUNICIPAL WATER SUPPLY SERVICE POPULATION AND AREA COMPARISON FOR WAUKESHA COUNTY: 2000-2035

	Population				Area Served			
		2000-2035 Increment				2000-2035 Increment		
Utility	2000 Population	Change in Population	Percent Change	2035 Population	2000 Area Served (square miles)	Change in Area (square miles)	Percent Change	2035 Area Served (square miles)
City of Brookfield Municipal Water Utility	24,000	20,950	87	44,950	13.7	7.6	57	21.3
Delafield Municipal Water Utility	400	12,300	3,075	12,700	0.3	8.6	2,906	8.9
City of Muskego Public Water Utility	7,800	20,850	267	28,650	2.6	8.3	317	10.9
City of New Berlin Water Utility (east)	19,900	2,900	15	22,800	5.9	2.7	45	8.6
City of New Berlin Water Utility (west)	10,200	8,300	81	18,500	5.6	4.5	59	10.1
City of Oconomowoc Utilities	12,500	9,800	78	22,300	3.9	6.7	171	10.6
City of Pewaukee Water and Sewer Utility	6,850	8,150	119	15,000	4.3	3.9	90	8.2
City of Waukesha Water Utility	65,000	23,500	36	88,500	17.7	11.9	69	29.6
Village of Butler Public Water Utility	1,900	0	0	1,900	0.8	<0.1	1	0.8
Dousman Water Utility	1,600	3,150	197	4,750	0.5	2.2	455	2.7
Village of Eagle Municipal Water Utility	1,700	200	12	1,900	0.8	<0.1	13	0.8
Hartland Municipal Water Utility	7,900	3,650	46	11,550	3.1	2.8	93	5.9
Village of Menomonee Falls Water Utility (east)	28,050	4,650	17	32,700	11.6	3.2	27	14.8
Village of Menomonee Falls Water Utility (west)	1,550	6,650	429	8,200	0.5	3.3	594	3.8
Mukwonago Municipal Water Utility	6,150	5,350	87	11,500	2.2	3.1	142	5.3
Village of Pewaukee Water Utility	8,150	3,450	42	11,600	2.3	1.7	73	4.0
Village of Sussex Water Utility	8,850	7,950	90	16,800	3.4	4.0	123	7.4
Brookfield Sanitary District No. 4	5,900	200	3	6,100	3.0	<0.1	2	3.0
Village of Big Bend	--	2,200	--	2,200	--	1.8	--	1.8
Village of Elm Grove	--	6,650	--	6,650	--	3.1	--	3.1
Village of Lannon	--	1,700	--	1,700	--	1.2	--	1.2
Village of North Prairie	--	2,900	--	2,900	--	2.3	--	2.3
Village of Wales	--	1,600	--	1,600	--	0.7	--	0.7
Town of Eagle-Eagle Spring Lake Area	--	450	--	450	--	0.3	--	0.3
Town of Norway-Wind Lake Area[a]	--	1,350	--	1,350	--	0.8	--	0.8
Town of Oconomowoc-Okauchee Lake Area-	--	7,250	--	7,250	--	4.5	--	4.5
Town of Ottawa-Golden Lake Area	--	200	--	200	--	0.2	--	0.2
Town of Ottawa-Pretty Lake Area	--	250	--	250	--	0.1	--	0.1
Total	218,400	166,550	75	384,950	82.3	89.1	105	171.4

[a] *Limited to the portion of the proposed Town of Norway-Wind Lake service area within Waukesha County.*

Source: SEWRPC.

Table IV-24

MUNICIPAL WATER SUPPLY SERVICE AREA WATER AND PUMPAGE IN WAUKESHA COUNTY: 2000 AND 2035

Utility	Year 2000			Year 2035		
	Average Water Use Demand (gallons per day X 1,000)[a]	Average Daily Pumpage (gallons per day X 1,000)[a]	Maximum Daily Pumpage (gallons per day X 1,000)[a]	Average Water Use Demand[b] (gallons per day X 1,000)	Average Daily Pumpage[b] (gallons per day X 1,000)	Maximum Daily Pumpage[b] (gallons per day X 1,000)
City of Brookfield Municipal Water Utility	2,971	3,659	4,545	4,908	6,045	9,374
Delafield Municipal Water Utility	85	95	218	1,344	1,503	2,982
City of Muskego Public Water Utility	525	586	1,075	2,276	2,540	5,400
City of New Berlin Water Utility (east)	1,527	1,777	2,547	1,906	2,218	3,824
City of New Berlin Water Utility (west)	1,279	1,488	2,133	2,494	2,902	4,656
City of Oconomowoc Utilities	1,296	1,562	2,609	2,785	3,356	5,790
City of Pewaukee Water and Sewer Utility	889	1,150	1,793	1,938	2,507	4,935
City of Waukesha Water Utility	7,356	7,770	10,147	9,296	9,819	13,437
Village of Butler Public Water Utility	363	404	670	437	487	782
Dousman Water Utility	133	148	234	430	479	811
Village of Eagle Municipal Water Utility	130	145	566	230	257	775
Hartland Municipal Water Utility	801	923	1,472	1,237	1,426	2,617
Village of Menomonee Falls Water Utility (east)	2,779	3,565	5,293	4,095	5,253	8,935
Village of Menomonee Falls Water Utility (west)	140	180	267	787	1,011	1,604
Mukwonago Municipal Water Utility	520	636	896	1,232	1,506	2,217
Village of Pewaukee Water Utility	655	849	1,220	1,003	1,300	1,977
Village of Sussex Water Utility	836	996	1,812	1,694	2,018	3,692
Brookfield Sanitary District No. 4	819	1,029	1,392	970	1,219	1,689
Village of Big Bend	--	--	--	438	512	807
Village of Elm Grove	--	--	--	657	769	1,299
Village of Lannon	--	--	--	321	375	591
Village of North Prairie	--	--	--	361	422	665
Village of Wales	--	--	--	205	240	378
Town of Eagle-Eagle Spring Lake Area	--	--	--	36	42	67
Town of Oconomowoc-Okauchee Lake Area-	--	--	--	641	750	1,182
Town of Ottawa-Golden Lake Area	--	--	--	14	17	26
Town of Ottawa-Pretty Lake Area	--	--	--	20	24	38
Total	23,104	26,962	38,889	41,756	48,996	80,551

[a] *Data based upon year 2000 Public Service Commission Reports data for water sales, except for the City of New Berlin data which was based upon estimated year 2006 data provided by the City of New Berlin Water Utility.*

[b] *See Appendix F for more detail.*

Source: SEWRPC.

Table IV-25

PROJECTED CHANGES IN MUNICIPAL WATER SUPPLY SERVICE AREAS IN THE SOUTHEASTERN WISCONSIN REGION: 2000 AND 2035

	Municipal Water Service Area							Population Served By Municipal Water Systems							
		Year 2000		Year 2035		2000-2035 Increment		Year 2000			Year 2035			2000-2035 Increment	
County	Total Area (square miles)	Area Served (square miles)	Percent of County	Area Served (square miles)	Percent of County	Number	Percent	Total County Population	Population Served 2000	Percent Served	Projected County Population	Population Served 2035	Percent Served	Number	Percent
Kenosha	278.4	29.8	11	66.0	24	36.2	121	149,600	111,000	74	210,100	199,900	95	88,900	80
Milwaukee	242.7	180.9	75	202.3	83	21.4	12	940,200	917,300	98	1,007,100	1,004,200	100	86,900	9
Ozaukee	235.5	15.7	7	40.4	17	24.7	157	82,300	45,400	55	101,100	86,800	86	41,400	91
Racine	340.6	37.9	11	64.4	19	26.5	70	188,800	146,400	78	213,600	196,200	92	49,800	34
Walworth	576.5	22.0	4	46.7	8	24.7	112	92,000	56,200	61	140,000	112,100	80	55,900	99
Washington	435.6	21.4	5	40.5	9	19.2	89	117,500	66,800	57	157,300	113,000	72	46,200	69
Waukesha	580.5	82.3	14	170.6	29	88.3	107	360,800	218,400	61	446,800	385,000	86	166,600	76
Region	2,689.9	390.0	14	630.9	23	240.7	62	1,931,200	1,561,600	81	2,276,000	2,097,200	92	535,700	34

Source: U.S. Bureau of the Census and SEWRPC.

Table IV-26

MUNICIPAL WATER SUPPLY SERVICE AREA DEMAND AND PUMPAGE BY COUNTY IN THE SOUTHEASTERN WISCONSIN REGION : 2000 AND 2035

County	Year 2000			Year 2035		
	Average Water Use Demand (gallons per day X 1,000)	Average Daily Pumpage (gallons per day X 1,000)	Maximum Daily Pumpage (gallons per day X 1,000)	Average Water Use Demand (gallons per day X 1,000)	Average Daily Pumpage (gallons per day X 1,000)	Maximum Daily Pumpage (gallons per day X 1,000)
Kenosha	11,011	14,847	22,171	21,102	27,786	42,591
Milwaukee	124,832	138,612	203,822	132,317	147,277	240,836
Ozaukee	5,573	6,542	10,362	10,629	13,212	20,356
Racine	23,252	28,584	45,994	28,958	36,808	59,669
Walworth	6,249	8,042	13,766	11,948	15,585	25,914
Washington	6,426	7,577	12,074	11,682	13,768	21,699
Waukesha	23,104	26,962	38,889	41,756	48,996	80,551
Region	200,447	231,166	347,078	258,392	303,432	491,616

Source: SEWRPC.

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Chapter IV

ANTICIPATED GROWTH AND CHANGE AFFECTING WATER SUPPLY IN THE REGION

FIGURES

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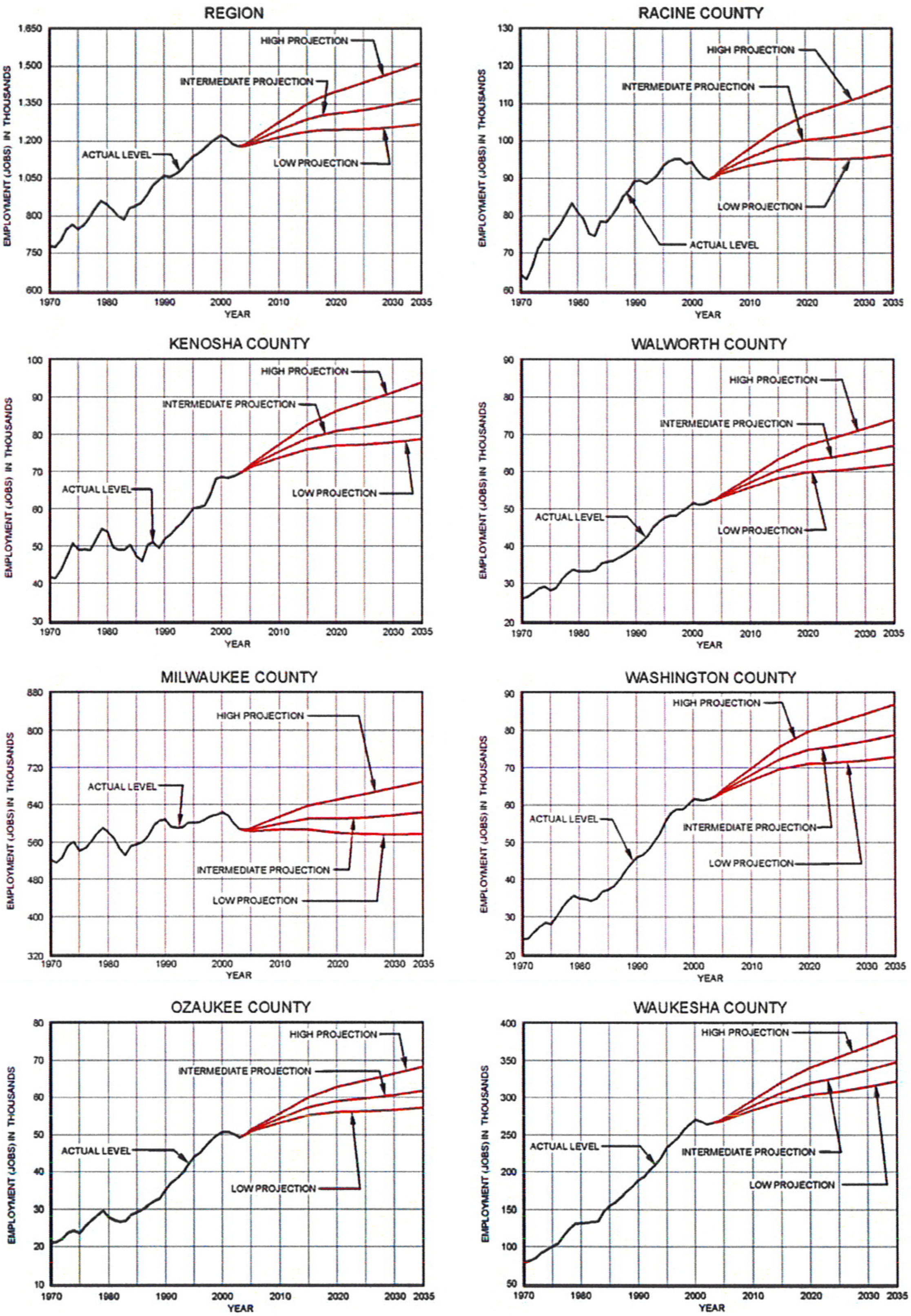
Figure IV-1

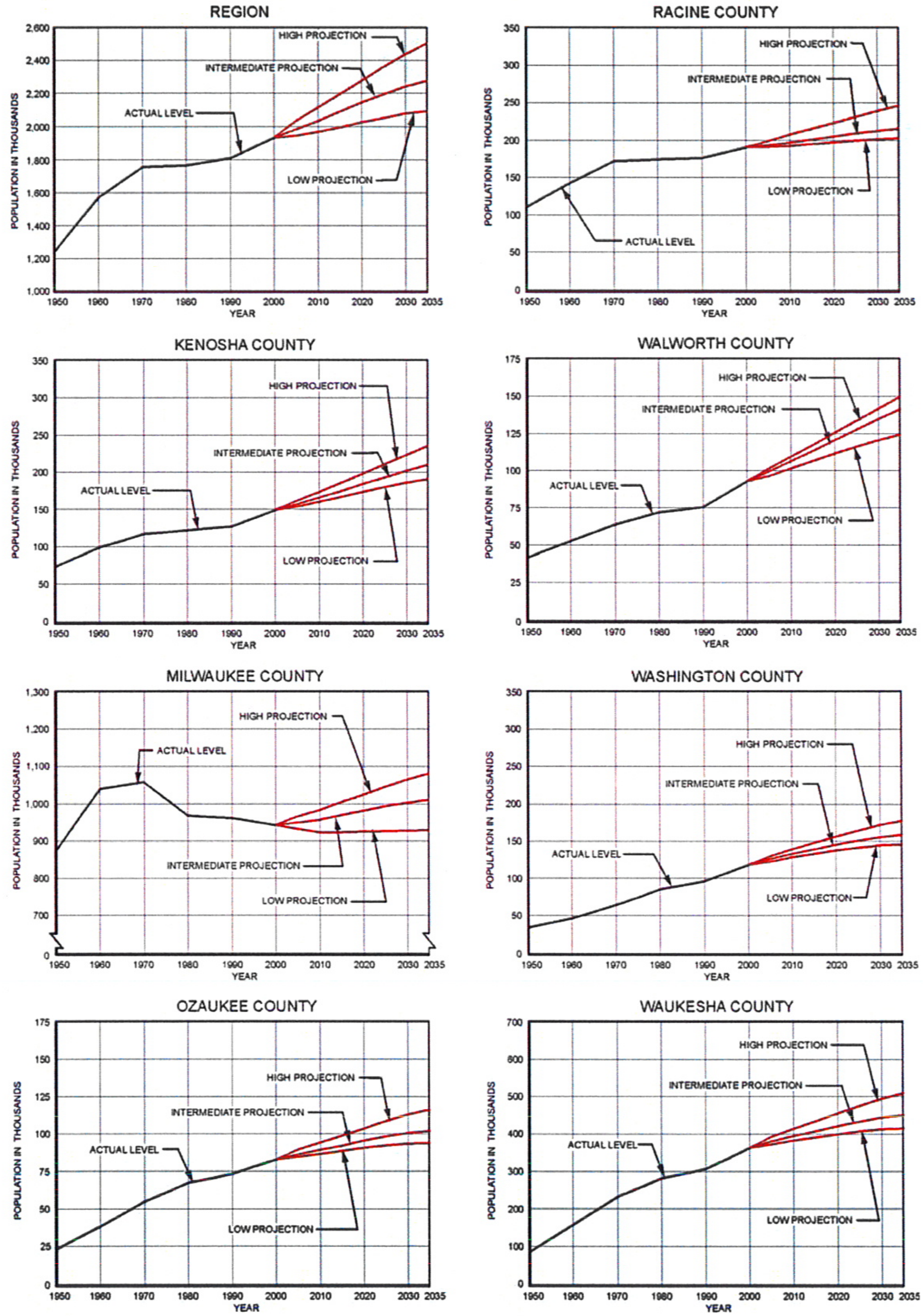
ACTUAL AND PROJECTED REGIONAL AND COUNTY EMPLOYMENT LEVELS: 1970-2035



Source: U.S. Bureau of Economic Analysis; Wisconsin Department of Workforce Development; and SEWRPC.

Figure IV-2

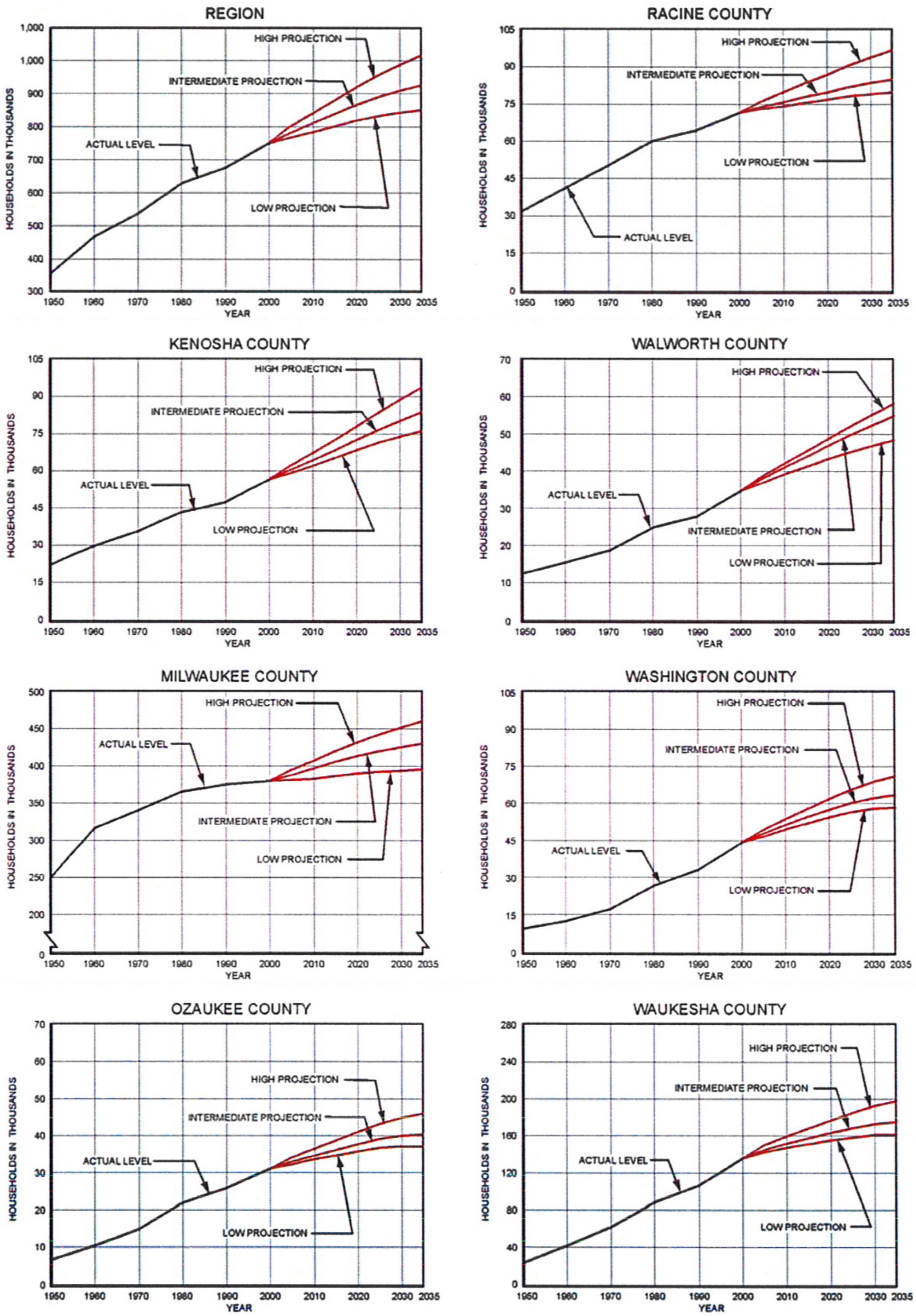
ACTUAL AND PROJECTED REGIONAL AND COUNTY POPULATION LEVELS: 1950-2035



Source: U.S. Bureau of the Census; Wisconsin Department of Administration; and SEWRPC.

Figure IV-3

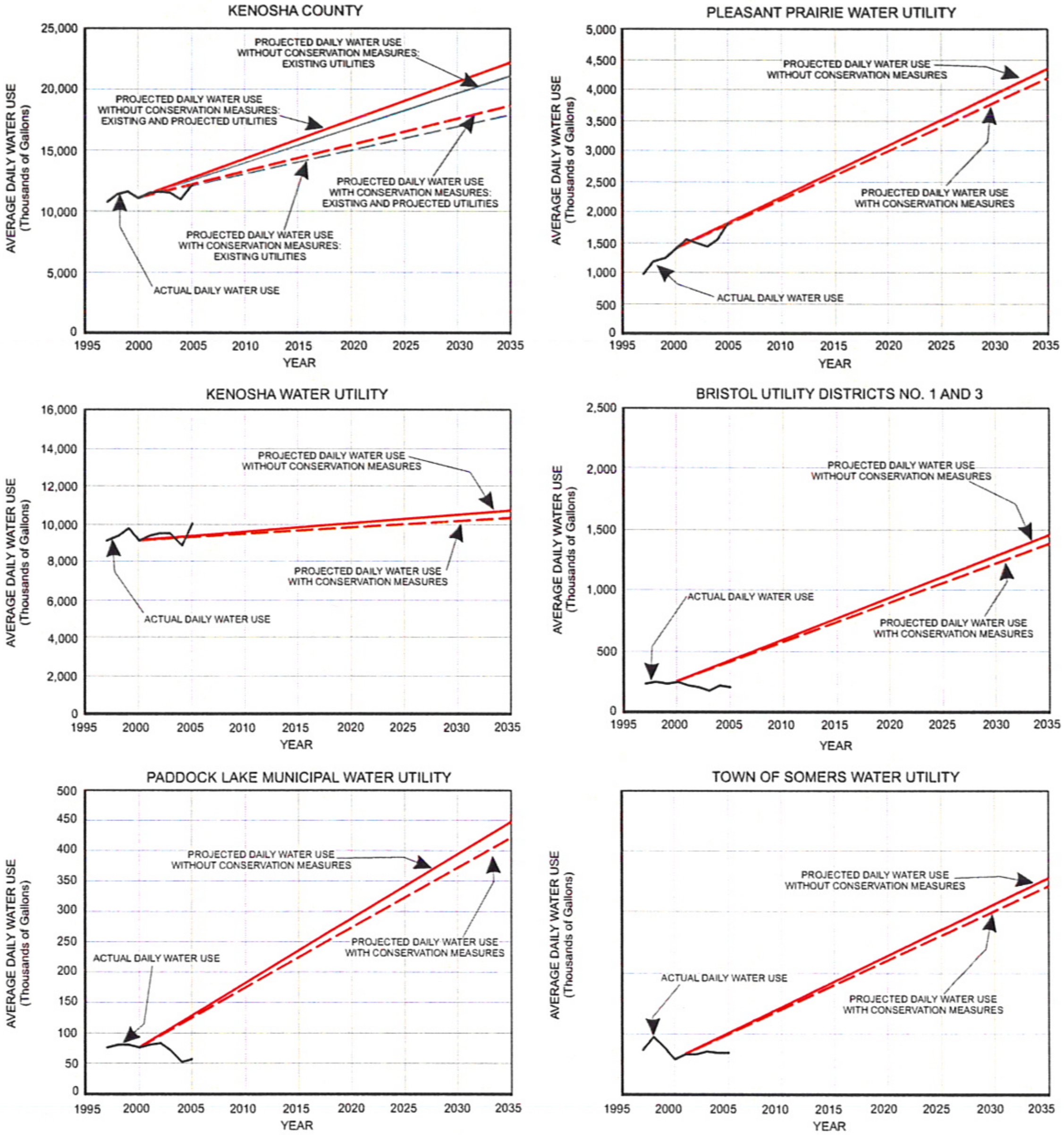
ACTUAL AND PROJECTED REGIONAL AND COUNTY HOUSEHOLD LEVELS: 1950-2035



Source: U.S. Bureau of the Census; Wisconsin Department of Administration; and SEWRPC.

Figure IV-4

ACTUAL AND PROJECTED AVERAGE DAILY WATER USE: KENOSHA COUNTY



Source: Public Service Commission and SEWRPC.

Figure IV-5

ACTUAL AND PROJECTED AVERAGE DAILY WATER USE: MILWAUKEE COUNTY

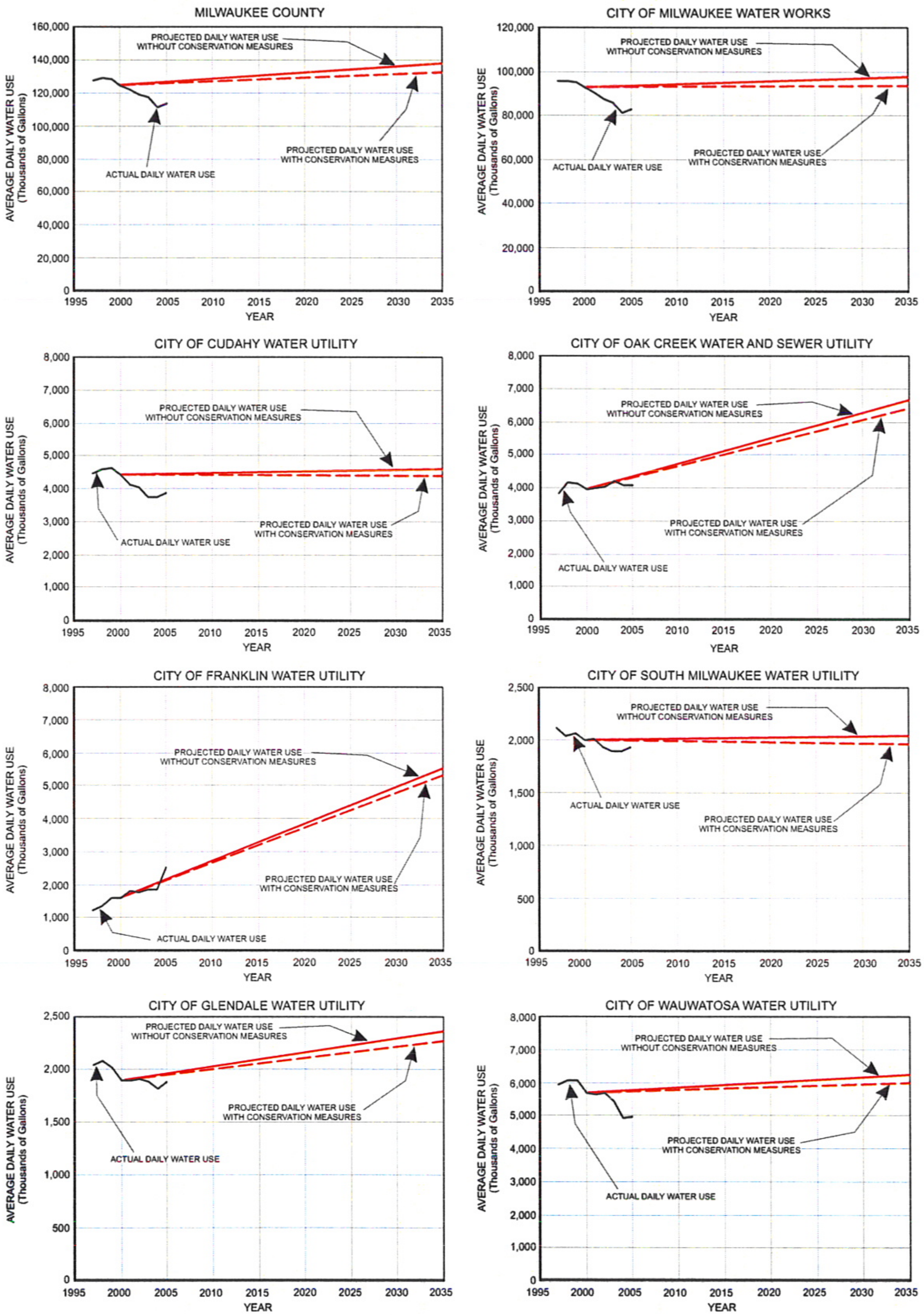
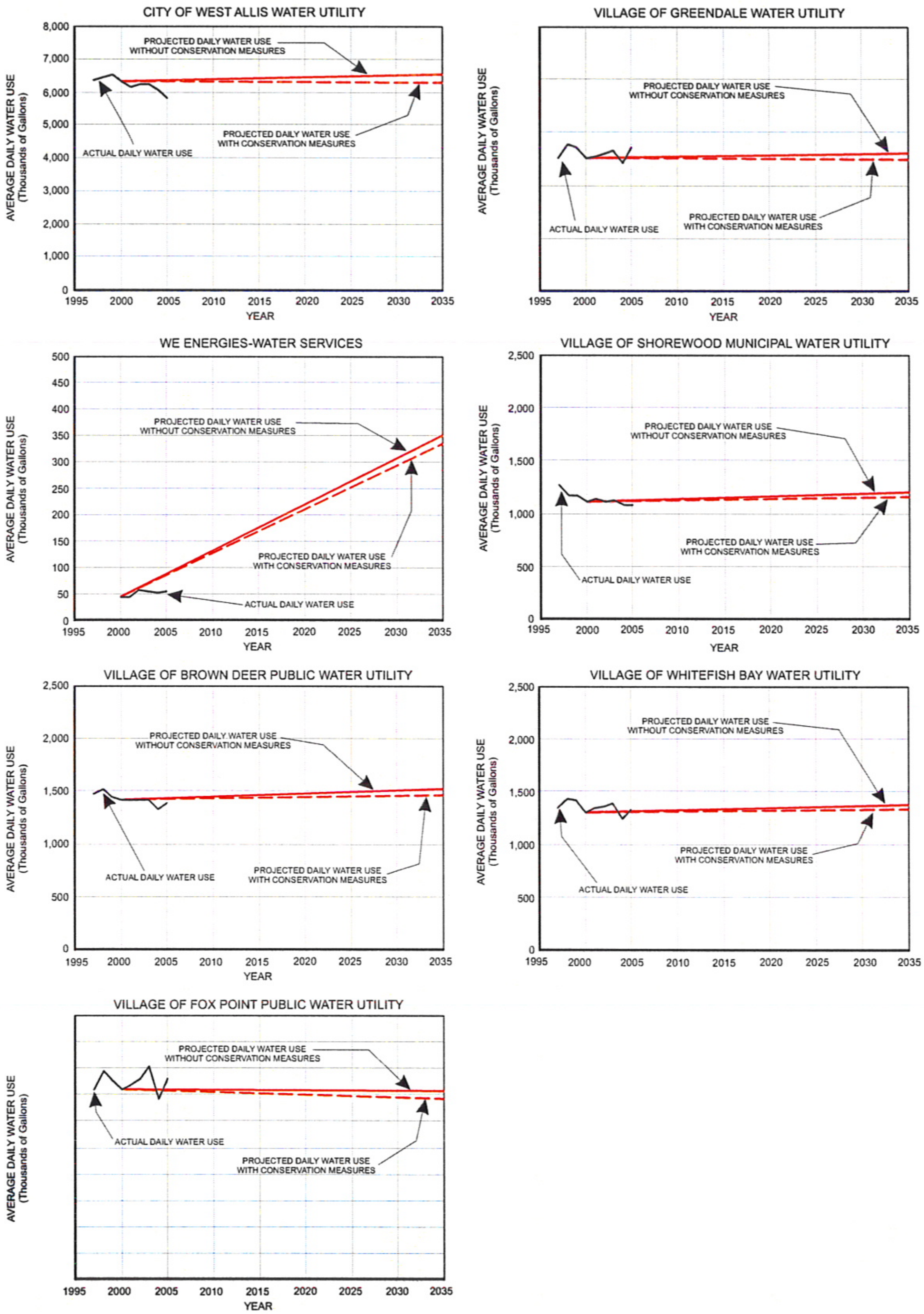


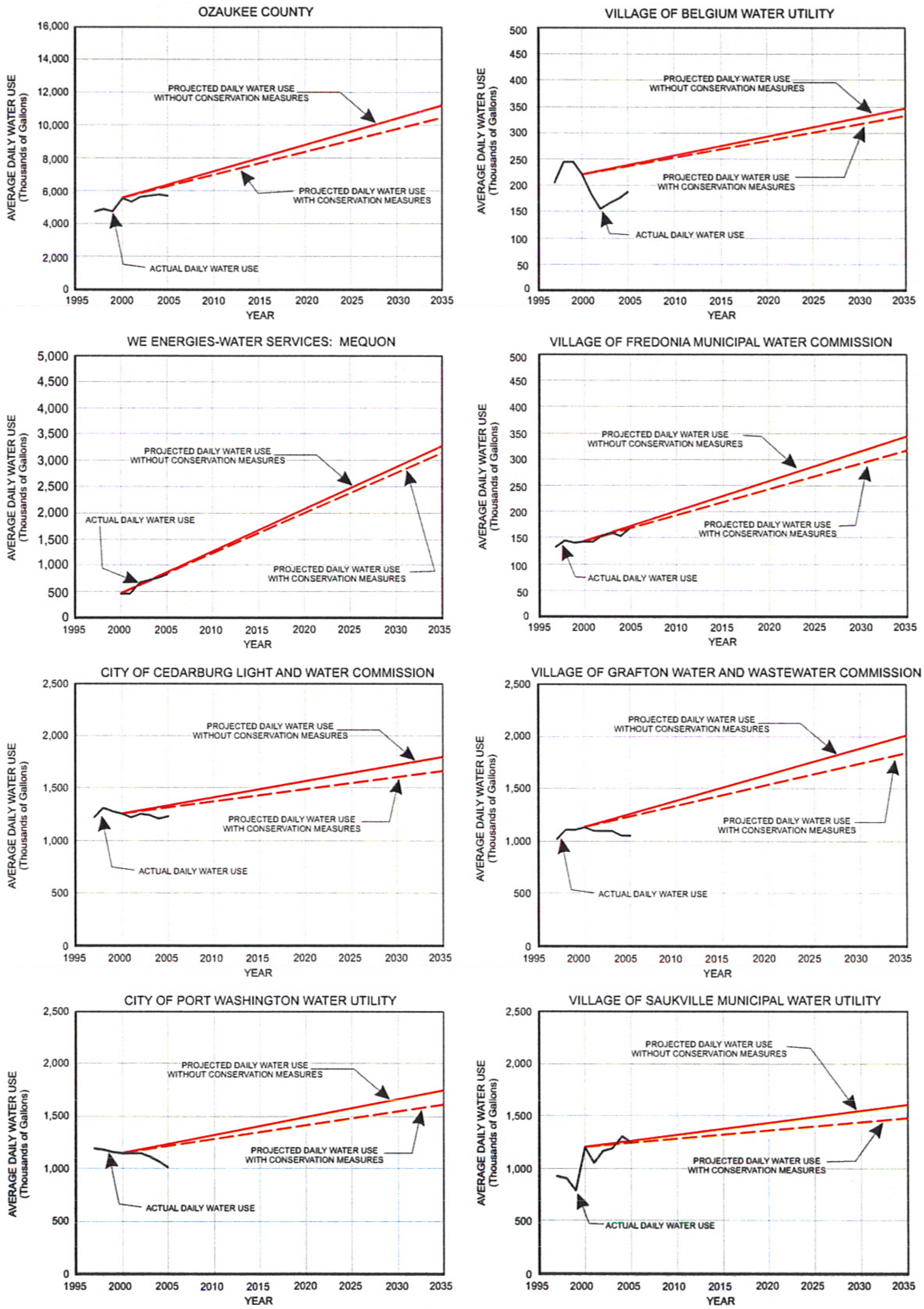
Figure IV-5 (continued)



Source: Public Service Commission and SEWRPC.

Figure IV-6

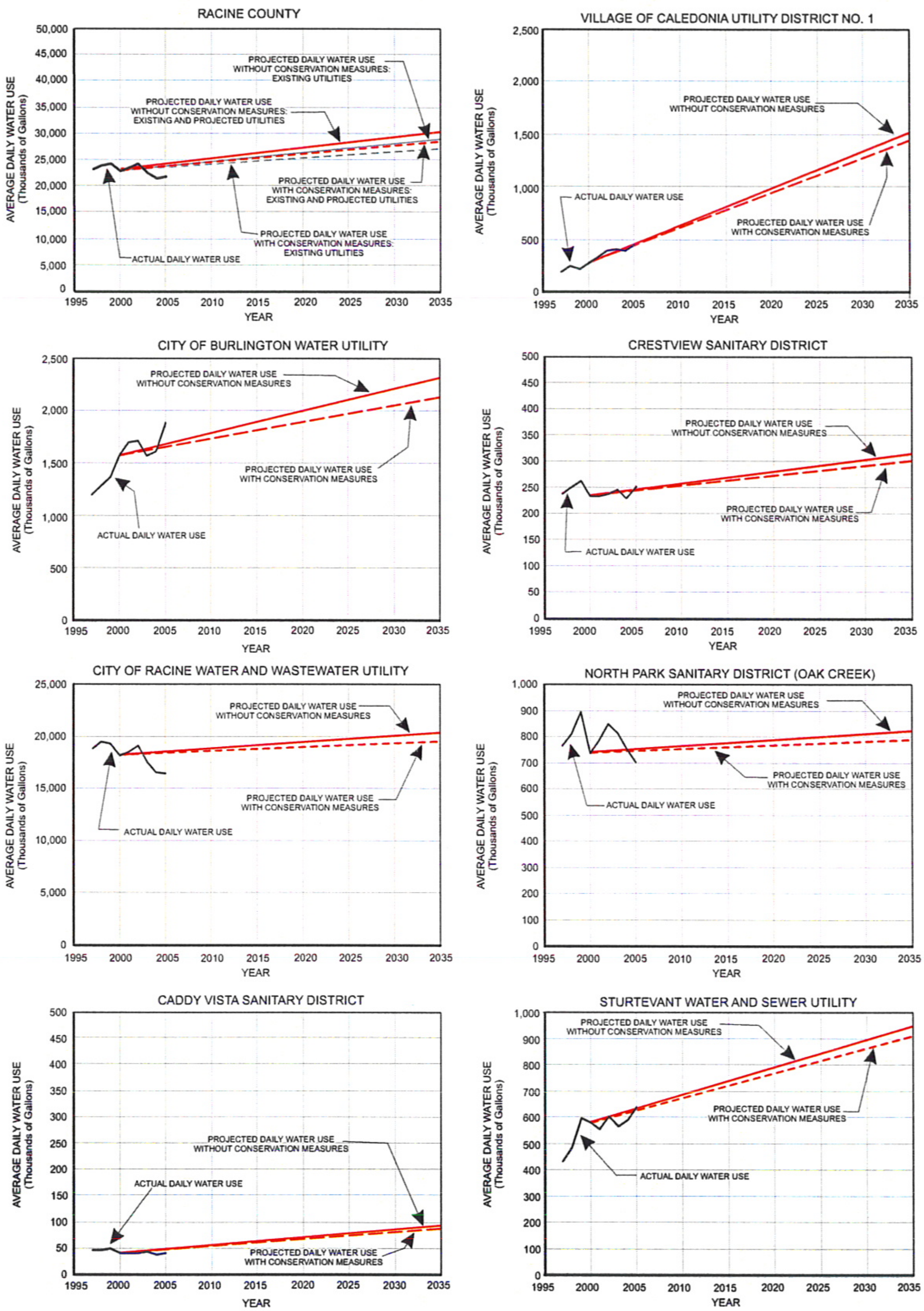
ACTUAL AND PROJECTED AVERAGE DAILY WATER USE: OZAUKEE COUNTY



Source: Public Service Commission and SEWRPC.

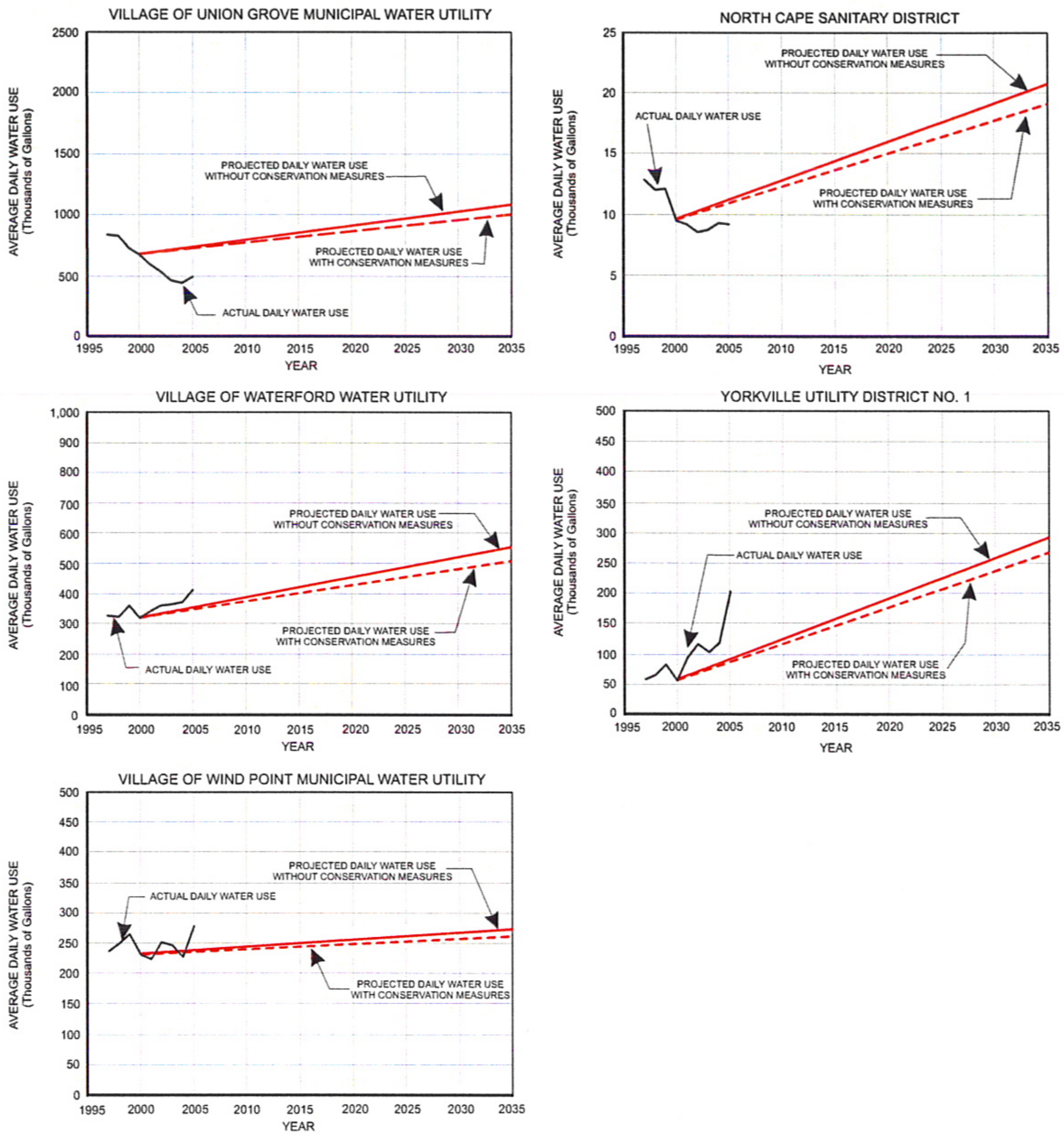
Figure IV-7

ACTUAL AND PROJECTED AVERAGE DAILY WATER USE: RACINE COUNTY



PRELIMINARY DRAFT

Figure IV-7 (continued)



Source: Public Service Commission and SEWRPC.

Figure IV-8

ACTUAL AND PROJECTED AVERAGE DAILY WATER USE: WALWORTH COUNTY

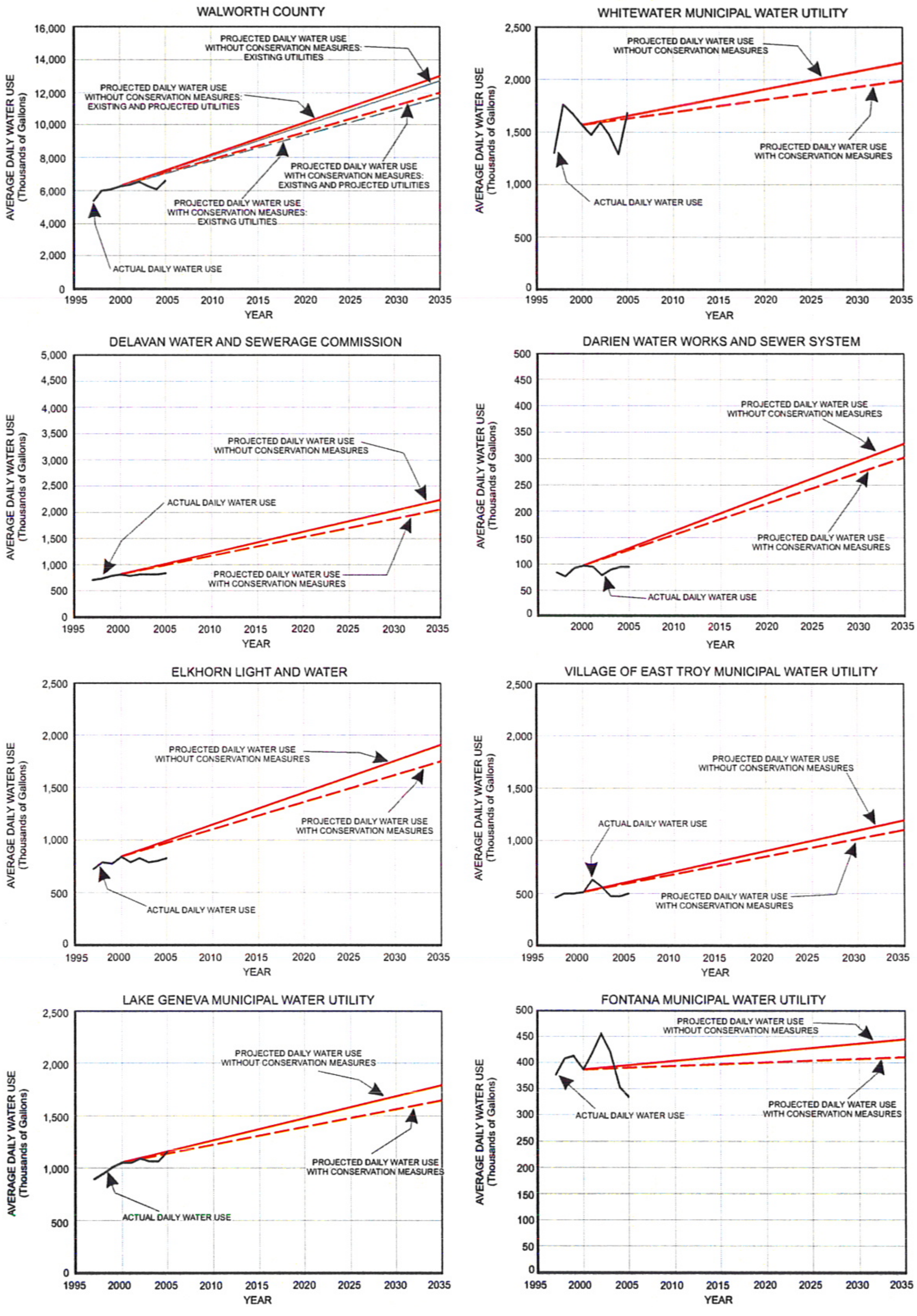
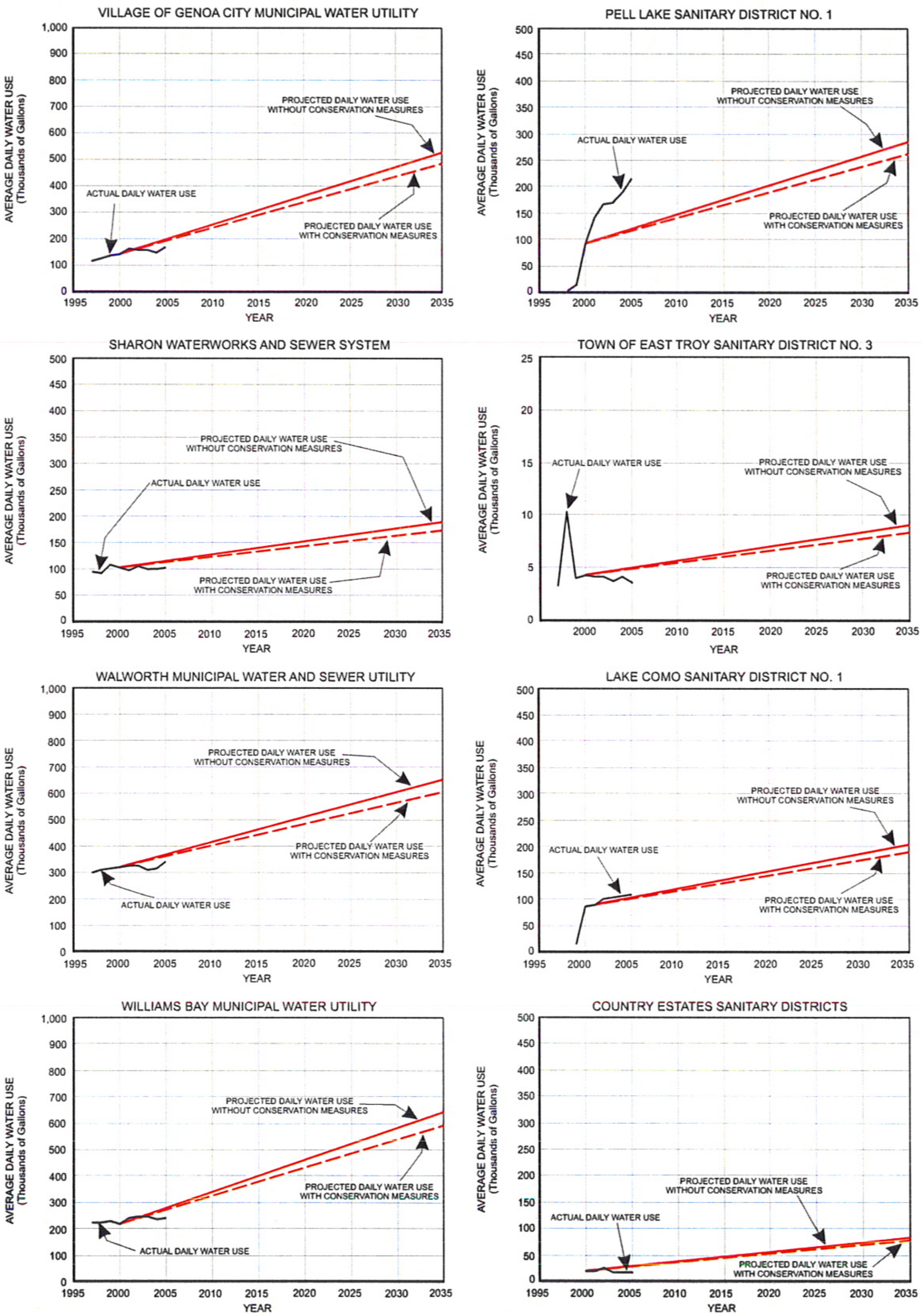
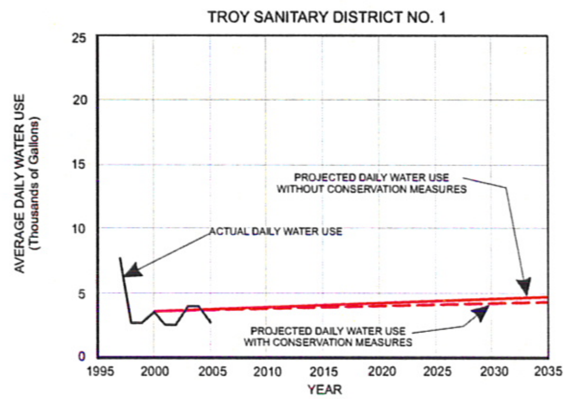


Figure IV-8 (continued)



PRELIMINARY DRAFT

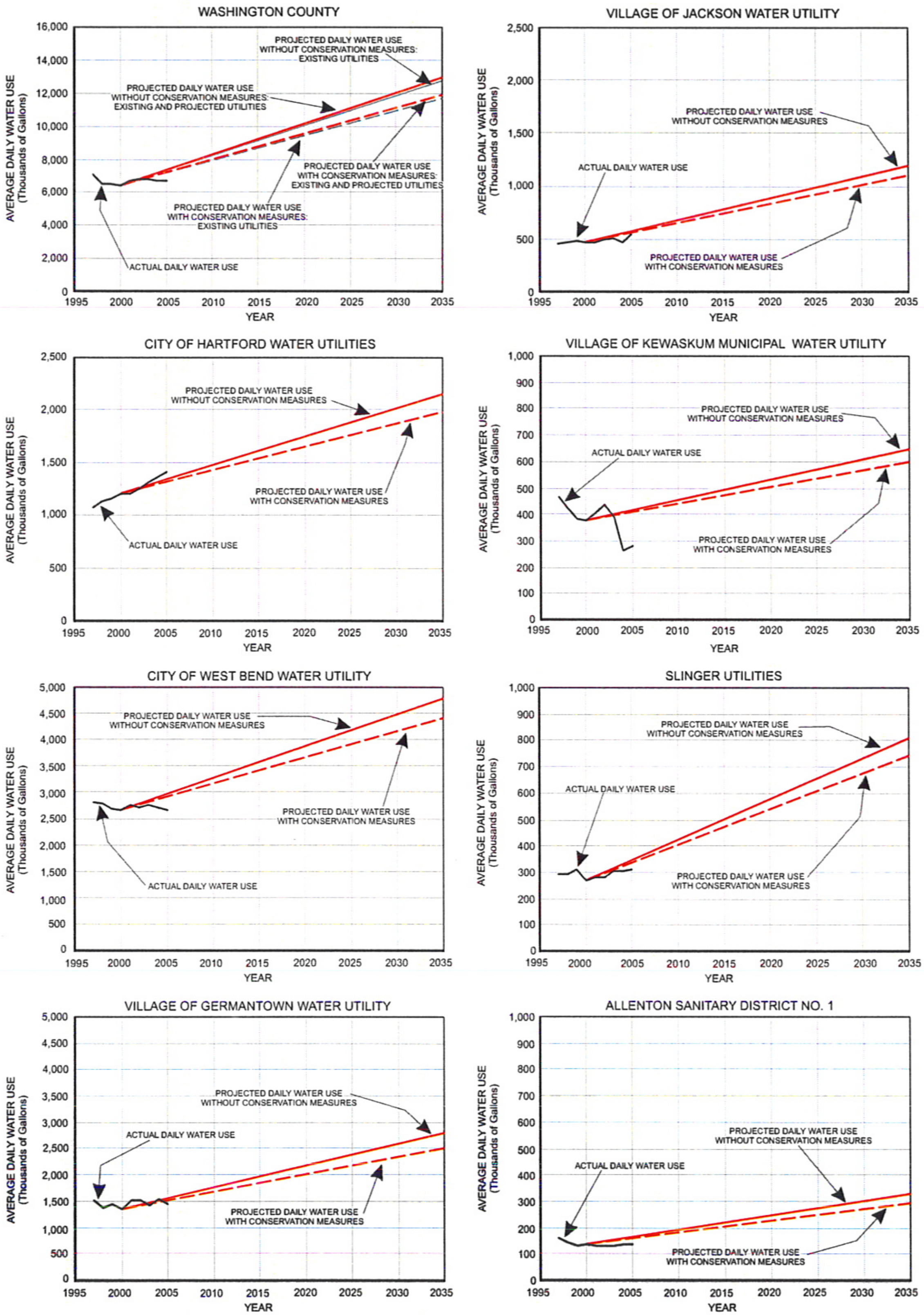
Figure IV-8 (continued)



Source: Public Service Commission and SEWRPC.

Figure IV-9

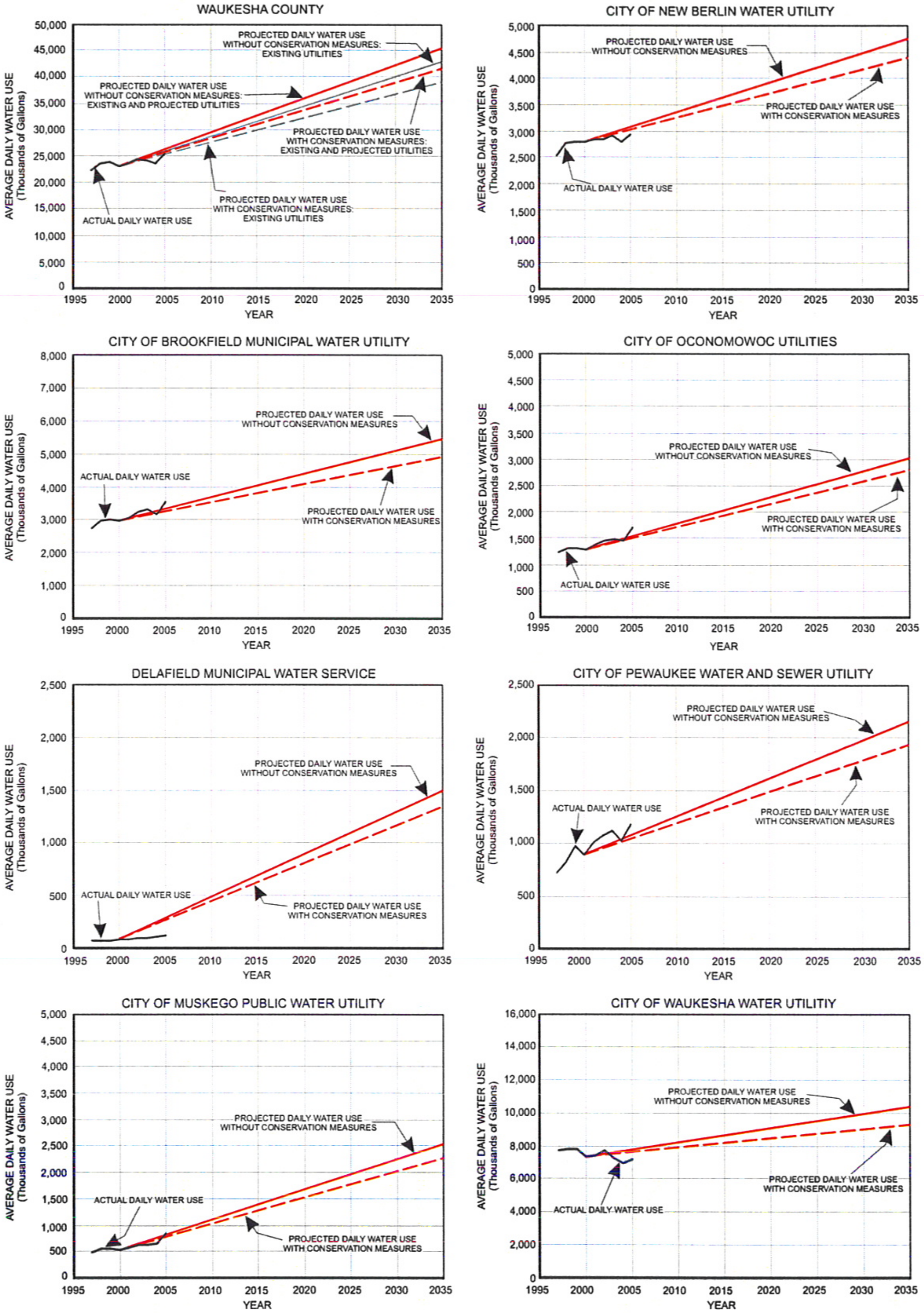
ACTUAL AND PROJECTED AVERAGE DAILY WATER USE: WASHINGTON COUNTY



Source: Public Service Commission and SEWRPC.

Figure IV-10

ACTUAL AND PROJECTED AVERAGE DAILY WATER USE: WAUKESHA COUNTY



PRELIMINARY DRAFT

Figure IV-10 (continued)

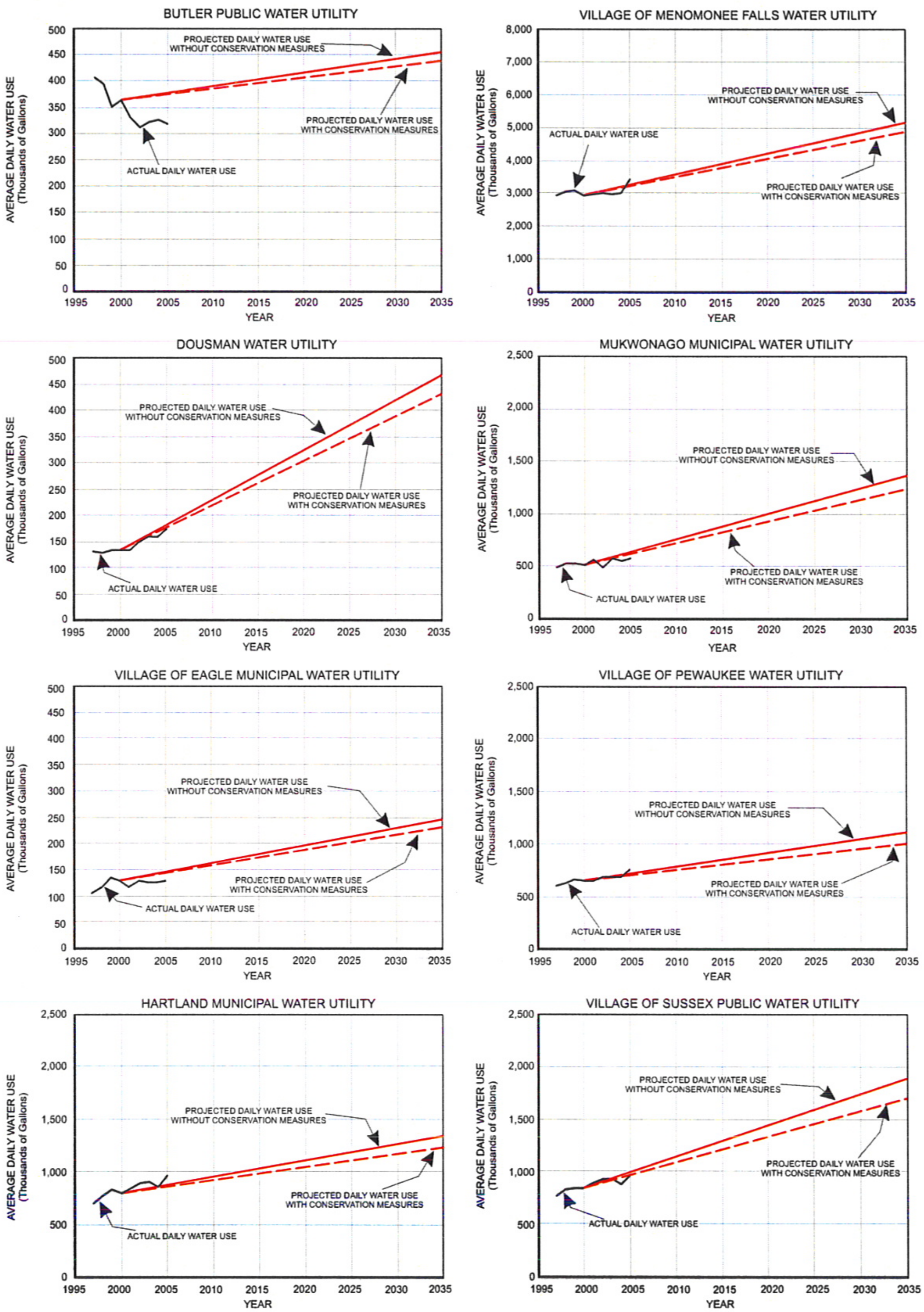
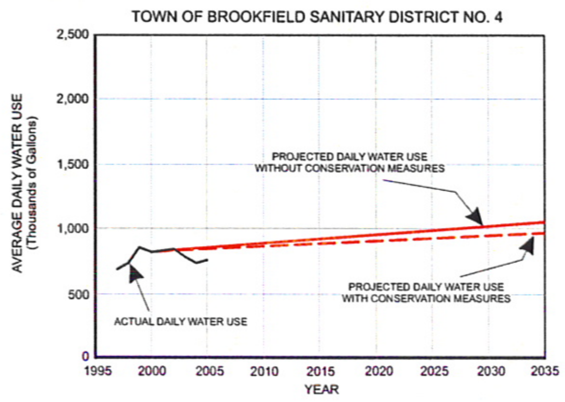


Figure IV-10 (continued)



Source: Public Service Commission and SEWRPC.

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Chapter IV

ANTICIPATED GROWTH AND CHANGE AFFECTING WATER SUPPLY IN THE REGION

MAPS

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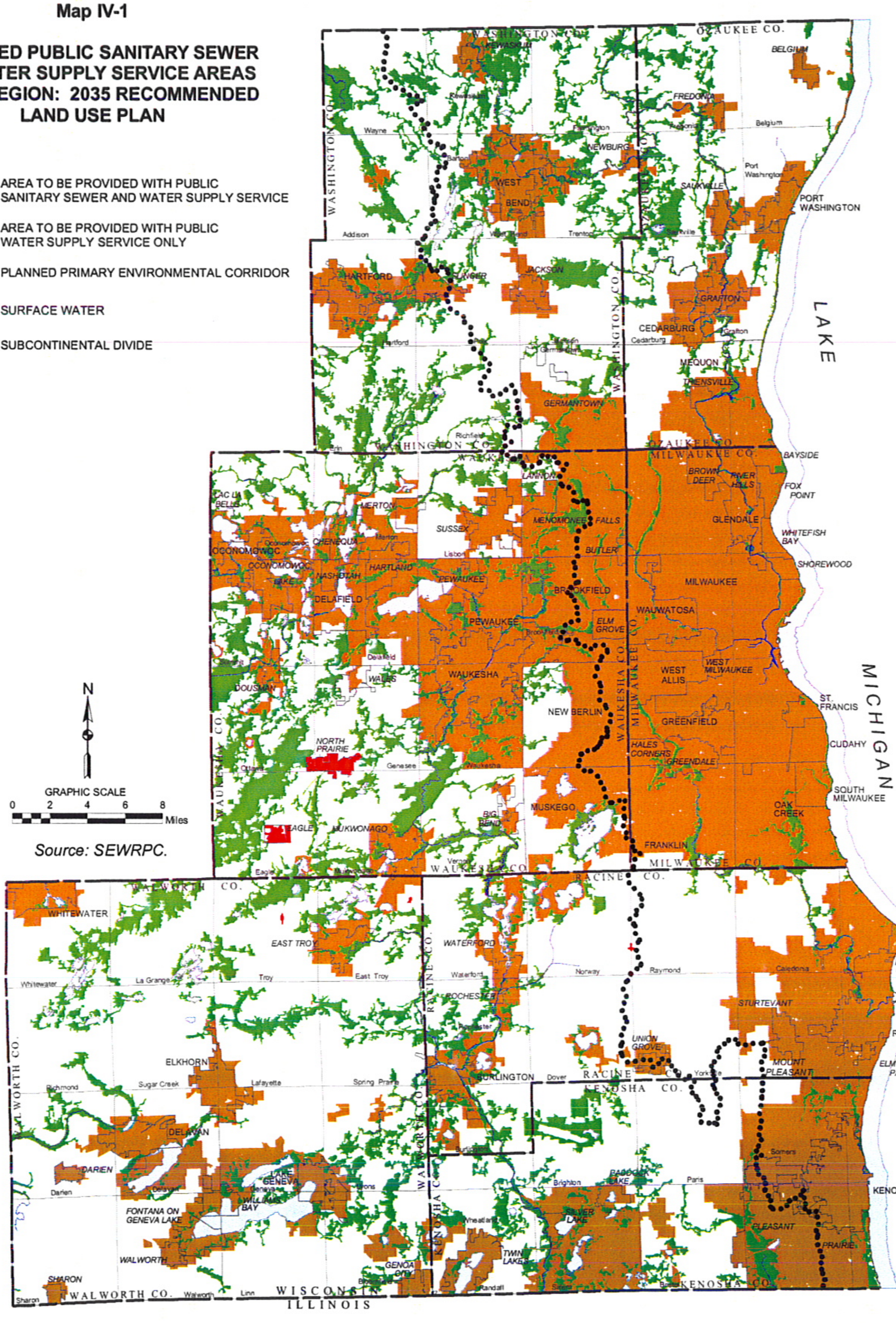
Map IV-1

PROPOSED PUBLIC SANITARY SEWER AND WATER SUPPLY SERVICE AREAS IN THE REGION: 2035 RECOMMENDED LAND USE PLAN

- AREA TO BE PROVIDED WITH PUBLIC SANITARY SEWER AND WATER SUPPLY SERVICE
- AREA TO BE PROVIDED WITH PUBLIC WATER SUPPLY SERVICE ONLY
- PLANNED PRIMARY ENVIRONMENTAL CORRIDOR
- SURFACE WATER
- ••••• SUBCONTINENTAL DIVIDE



GRAPHIC SCALE

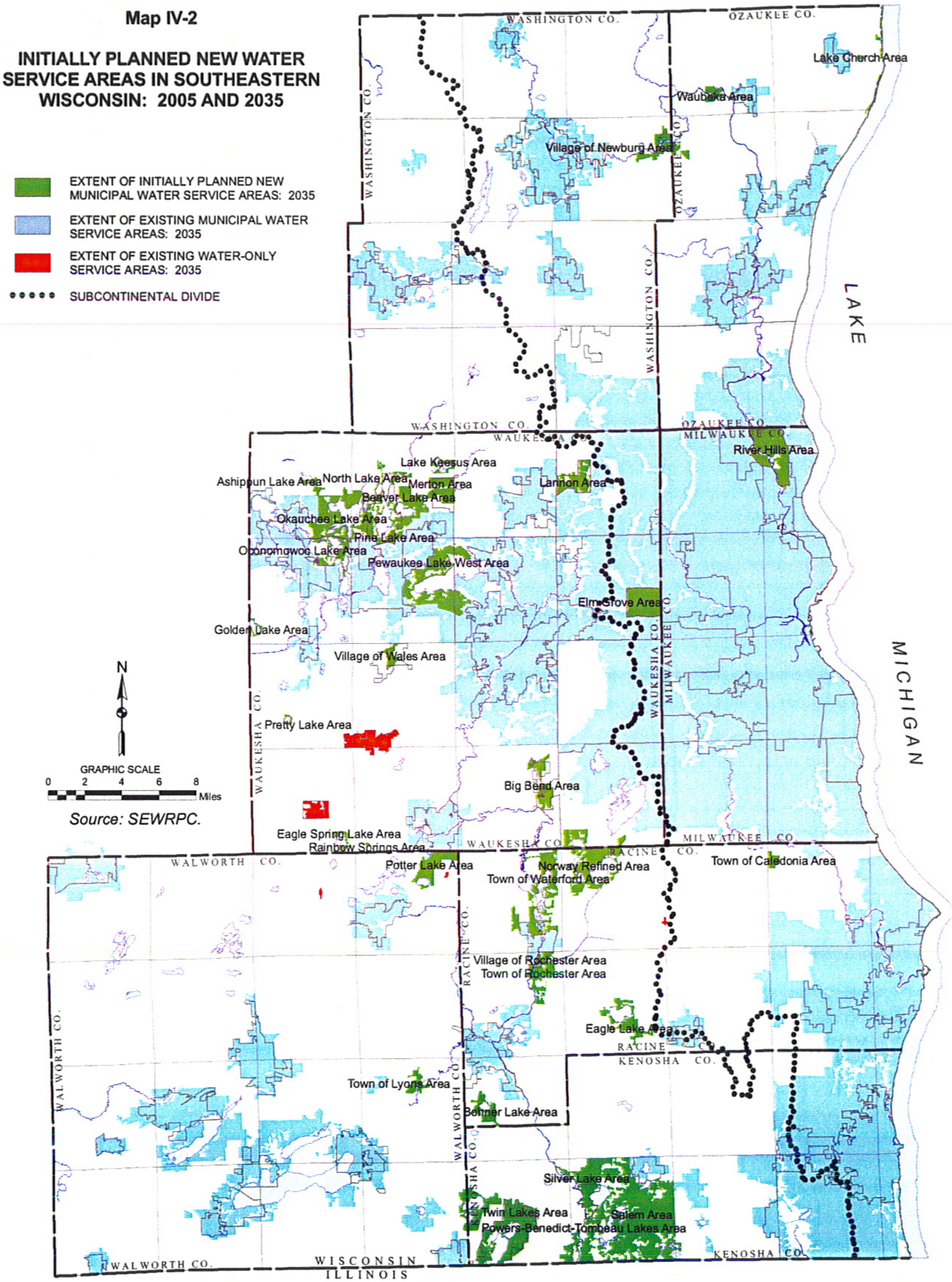
0 2 4 6 8 Miles

Source: SEWRPC.

PRELIMINARY DRAFT

Map IV-2

INITIALLY PLANNED NEW WATER SERVICE AREAS IN SOUTHEASTERN WISCONSIN: 2005 AND 2035

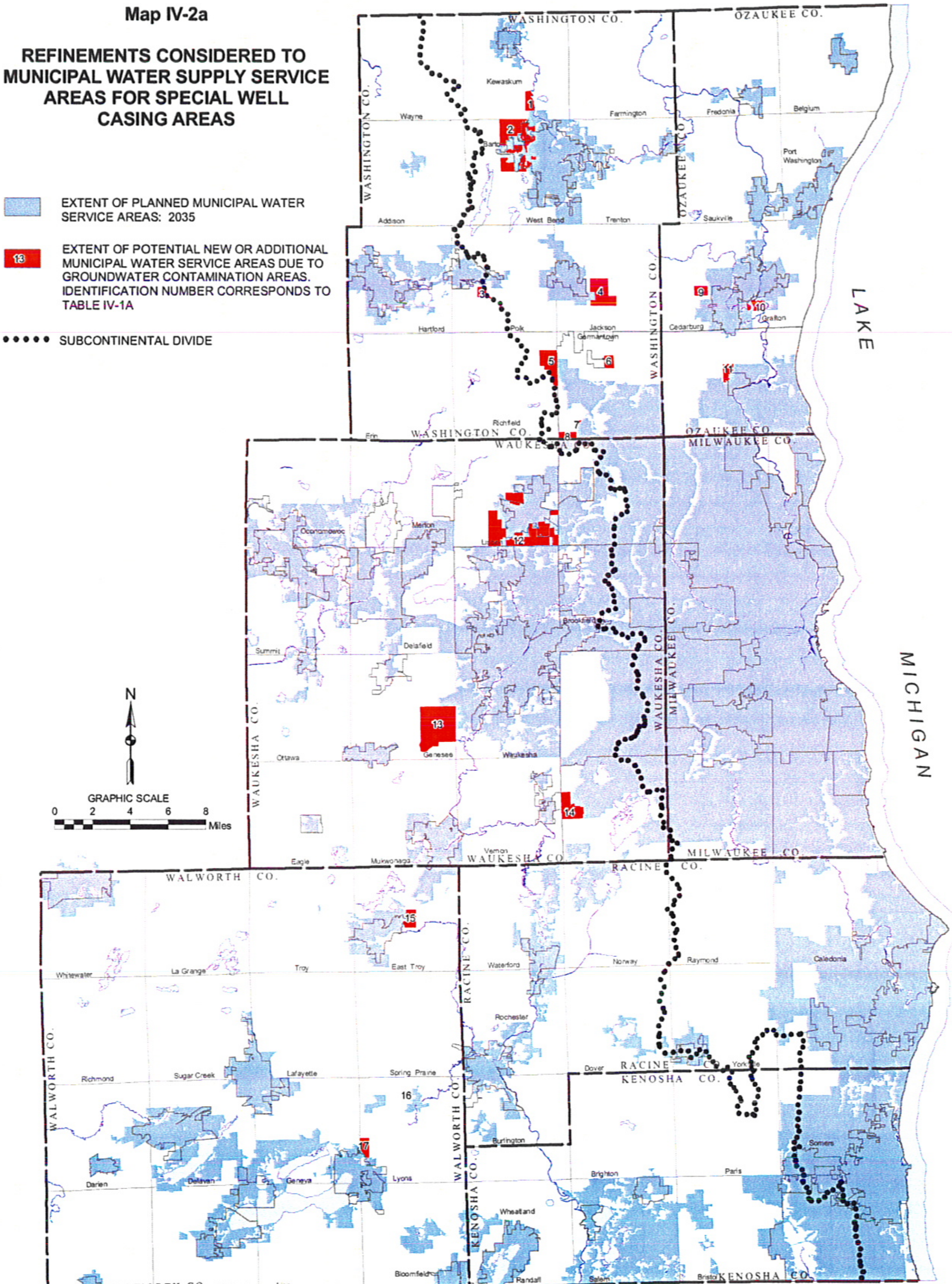


Source: SEWRPC.

PRELIMINARY DRAFT

Map IV-2a

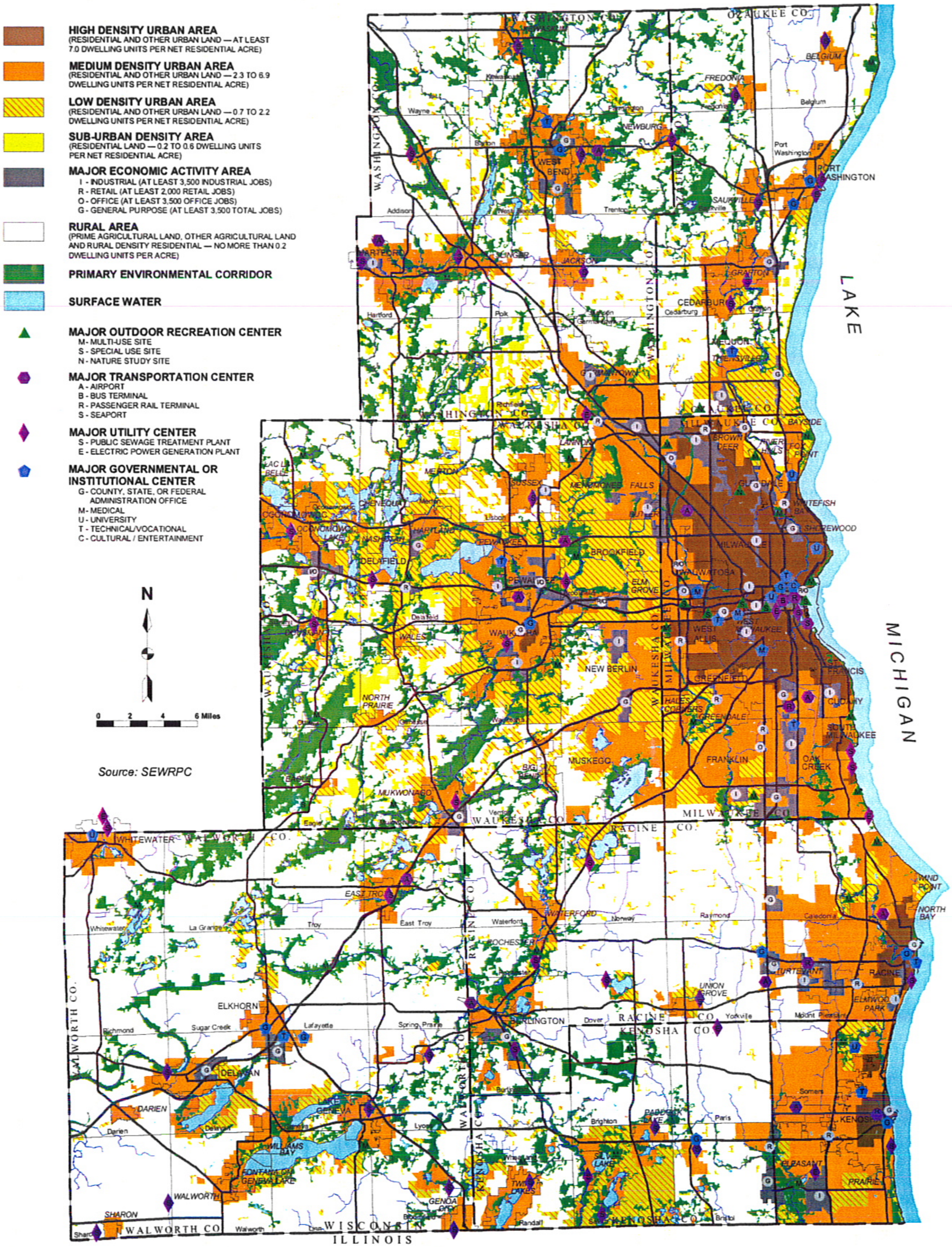
REFINEMENTS CONSIDERED TO MUNICIPAL WATER SUPPLY SERVICE AREAS FOR SPECIAL WELL CASING AREAS



Source: Wisconsin Department of Natural Resources and SEWRPC.

Map IV-3

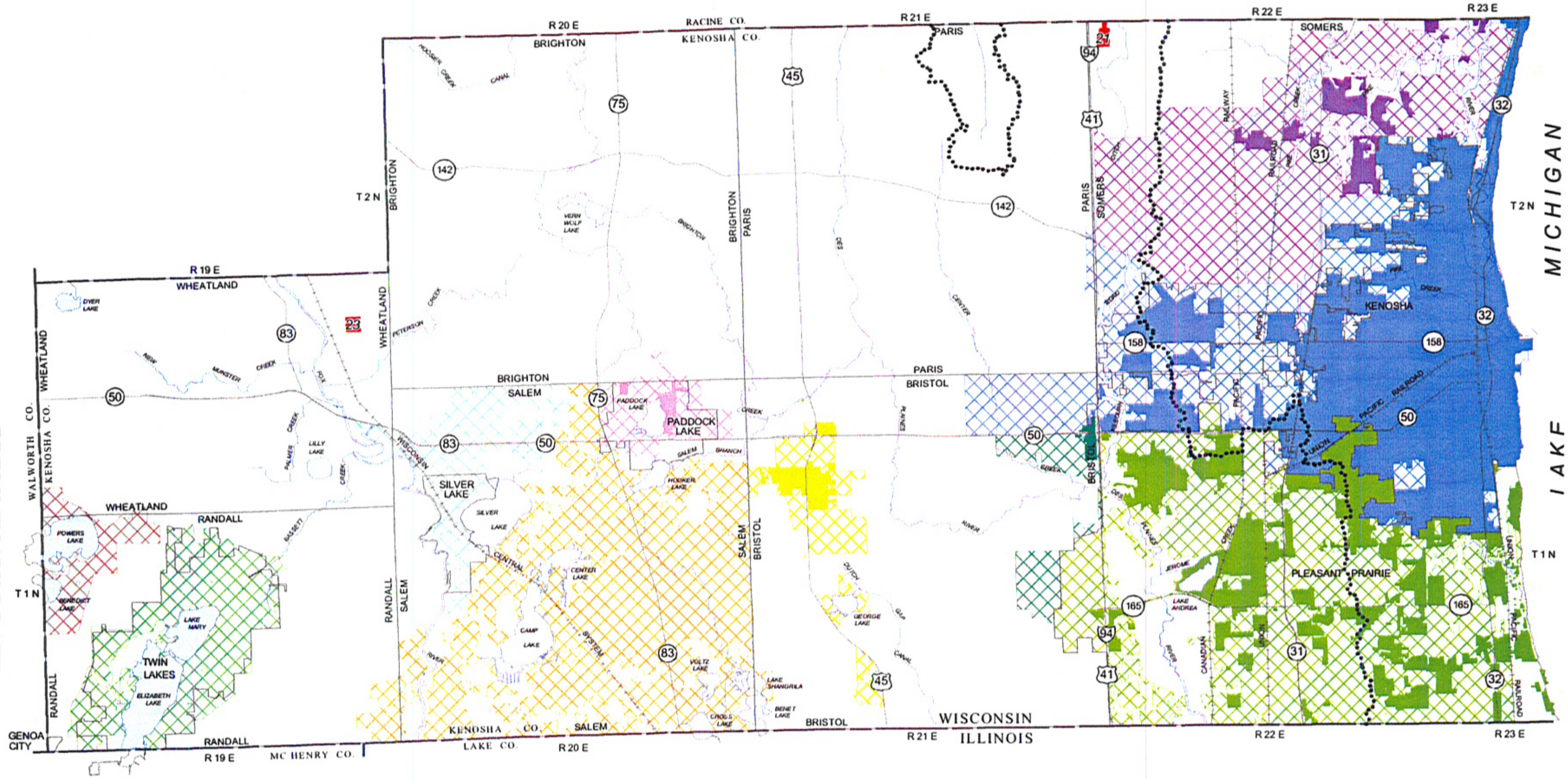
REGIONAL LAND USE PLAN FOR THE SOUTHEASTERN WISCONSIN REGION: 2035



PRELIMINARY DRAFT

Map IV-4

PROJECTED AREAS SERVED BY MUNICIPAL AND OTHER THAN MUNICIPAL, COMMUNITY WATER SUPPLY SYSTEMS IN KENOSHA COUNTY: 2035



SURFACE WATER-SUPPLIED SYSTEMS IN 2005

2005	2035	
		KENOSHA WATER UTILITY SERVICE AREA
		PLEASANT PRAIRIE WATER UTILITY SERVICE AREA
		TOWN OF SOMERS WATER UTILITY SERVICE AREA
		TOWN OF BRISTOL UTILITY DISTRICT 3

•••••••• SUBCONTINENTAL DIVIDE

GROUNDWATER-SUPPLIED SYSTEMS IN 2005

2005	2035	
		PADDOCK LAKE MUNICIPAL WATER UTILITY SERVICE AREA
		TOWN OF BRISTOL UTILITY DISTRICT 1

NEW SYSTEMS

2035	
	POWERS-BENEDICT-TOMBEAU LAKES AREA
	TOWN OF SALEM
	VILLAGE OF SILVER LAKE
	VILLAGE OF TWIN LAKES

23 AREA SERVED BY OTHER THAN MUNICIPAL, COMMUNITY WATER SYSTEMS USING GROUNDWATER. IDENTIFICATION NUMBER CORRESPONDS WITH APPENDIX G

NOTE: RECOMMENDED SOURCES OF SUPPLY FOR AREAS ADDED TO EXISTING MUNICIPAL WATER SUPPLY SERVICE AREAS ARE NOT YET ESTABLISHED .

N

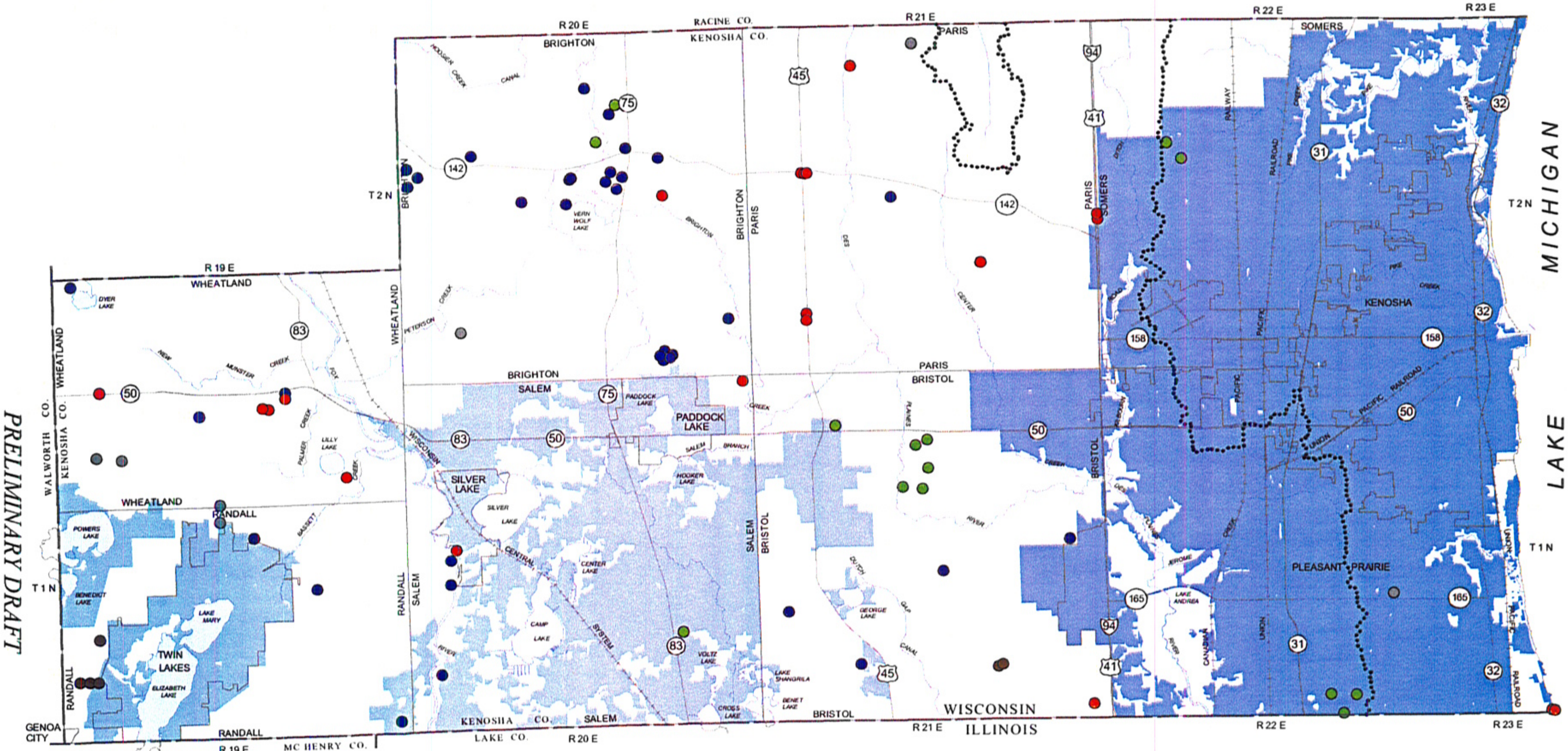
GRAPHIC SCALE
0 0.75 1.5 2.25 3 Miles
0 5,000 10,000 15,000 20,000 Feet

Source: Water utilities and SEWRPC.

PRELIMINARY DRAFT

Map IV-5

SELF-SUPPLIED INDUSTRIAL, COMMERCIAL, INSTITUTIONAL AND RECREATIONAL, AGRICULTURAL, AND IRRIGATION WATER SUPPLY SYSTEMS IN KENOSHA COUNTY: 2035



SELF-SUPPLIED WATER SYSTEM WELLS

- INDUSTRIAL
- COMMERCIAL
- INSTITUTIONAL AND RECREATIONAL
- IRRIGATION
- AGRICULTURAL

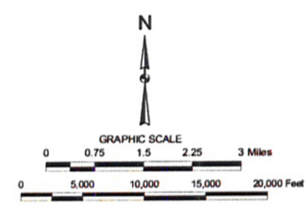
AREA SERVED BY PUBLIC WATER UTILITY WHICH USED SURFACE WATER IN 2005

AREA SERVED BY PUBLIC WATER UTILITY WHICH USED GROUNDWATER IN 2005

SUBCONTINENTAL DIVIDE

NOTES: 1. THE SELF-SUPPLIED WATER SYSTEMS INDICATED ON THIS MAP INCLUDE ALL KNOWN WELLS DEFINED AS NON-COMMUNITY TRANSIENT AND NON-TRANSIENT, AND ALL NON-COMMUNITY HIGH-CAPACITY WELLS. THE WELL LOCATIONS SHOWN ON THIS MAP ARE APPROXIMATE. MORE SPECIFIC INFORMATION ON THE NUMBER AND LOCATION OF SELF-SUPPLIED WATER SYSTEMS IS AVAILABLE FROM THE WISCONSIN DEPARTMENT OF NATURAL RESOURCES.

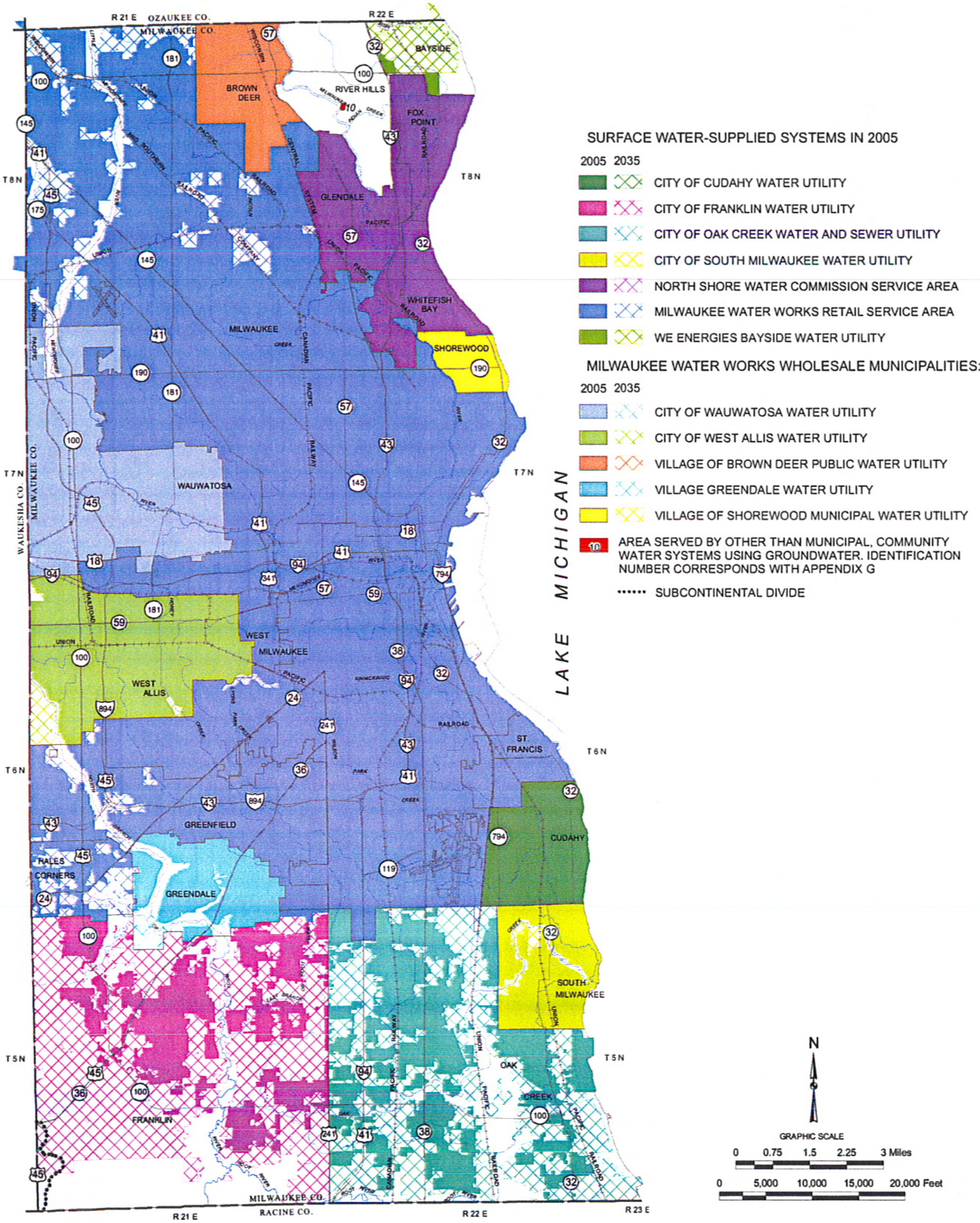
2. RECOMMENDED SOURCES OF SUPPLY FOR AREAS ADDED TO EXISTING WATER SUPPLY SERVICE AREAS ARE NOT YET ESTABLISHED.



Source: Wisconsin Department of Natural Resources and SEWRPC.

Map IV-6

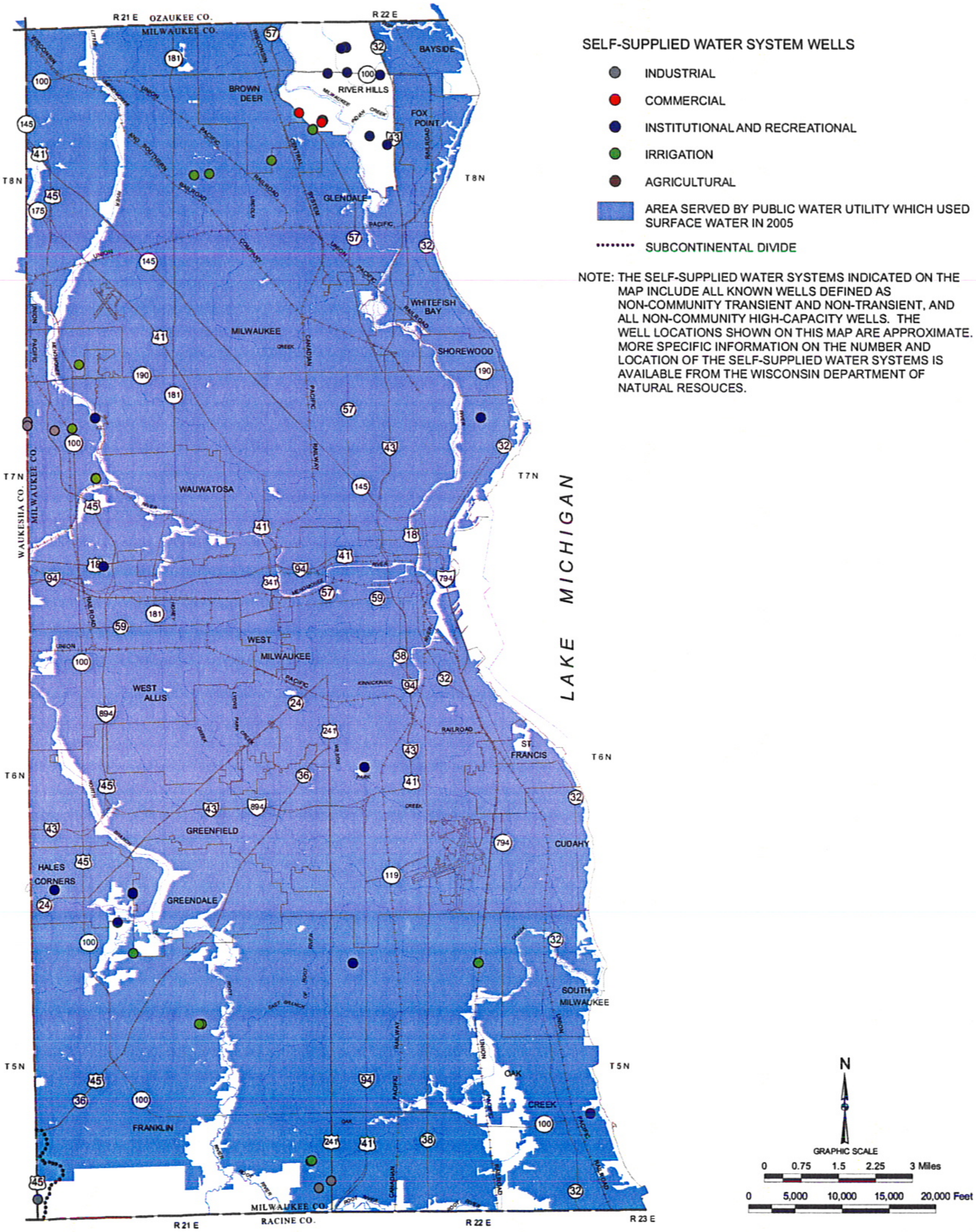
PROJECTED AREAS SERVED BY MUNICIPAL AND OTHER THAN MUNICIPAL, COMMUNITY WATER SUPPLY SYSTEMS IN MILWAUKEE COUNTY: 2035



Source: Water utilities and SEWRPC.

Map IV-7

SELF-SUPPLIED INDUSTRIAL, COMMERCIAL, INSTITUTIONAL AND RECREATIONAL, AGRICULTURAL, AND IRRIGATION WATER SUPPLY SYSTEMS IN MILWAUKEE COUNTY: 2035

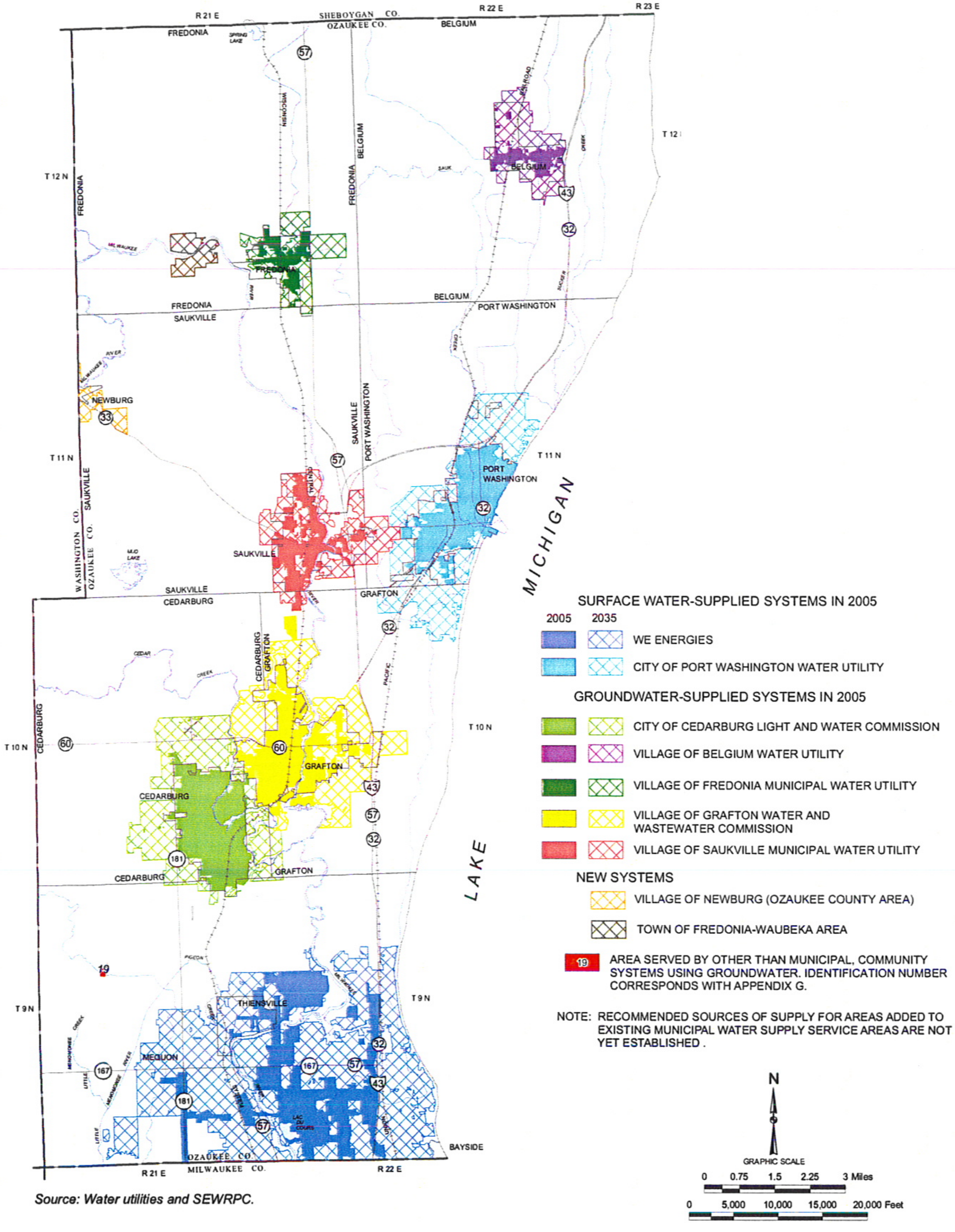


Source: Wisconsin Department of Natural Resources and SEWRPC.

PRELIMINARY DRAFT

Map IV-8

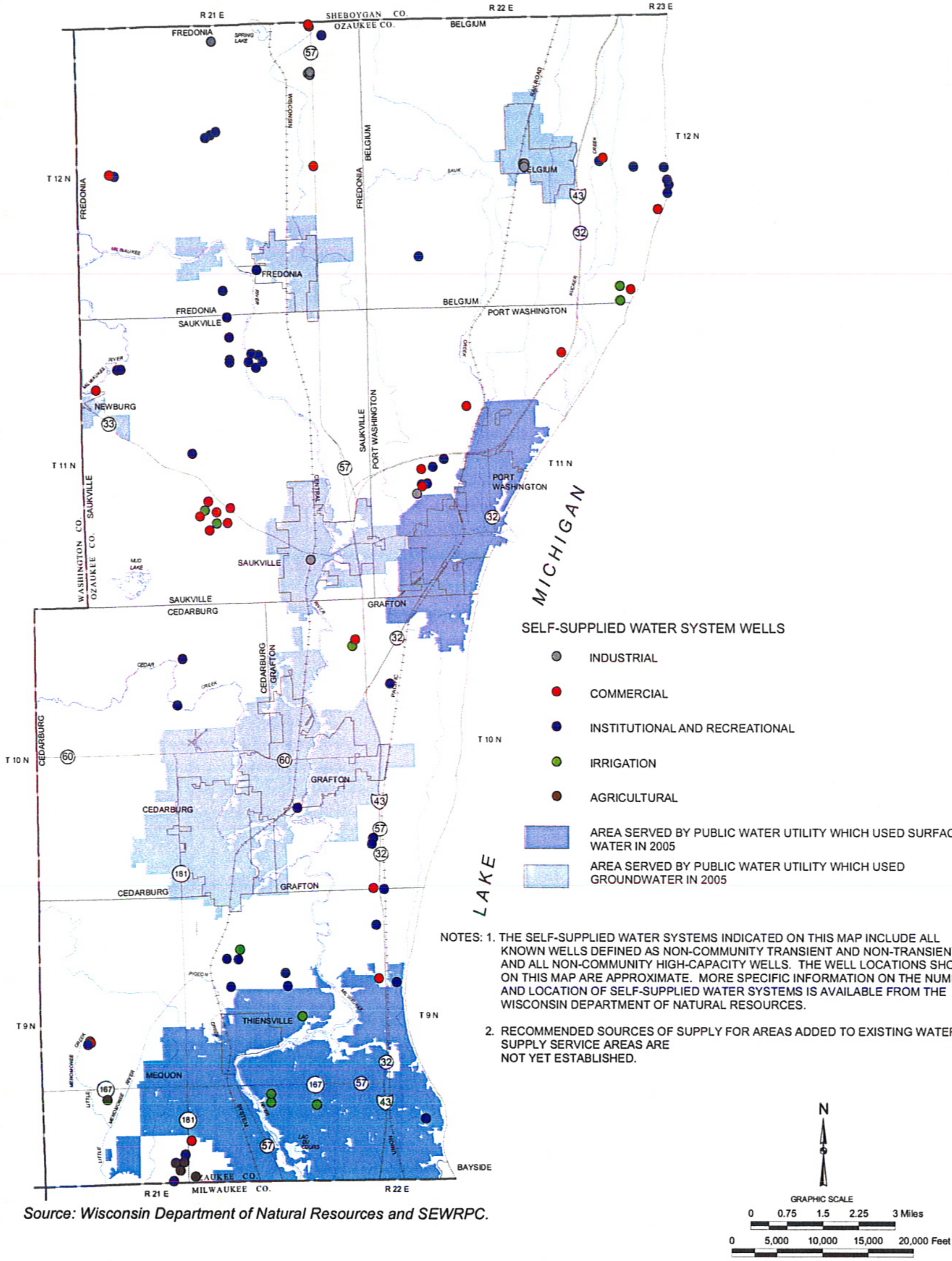
PROJECTED AREAS SERVED BY MUNICIPAL AND OTHER THAN MUNICIPAL, COMMUNITY WATER SUPPLY SYSTEMS IN OZAUKEE COUNTY: 2035



Source: Water utilities and SEWRPC.

Map IV-9

SELF-SUPPLIED INDUSTRIAL, COMMERCIAL, INSTITUTIONAL AND RECREATIONAL, AGRICULTURAL, AND IRRIGATION WATER SUPPLY SYSTEMS IN OZAUKEE COUNTY: 2035



SELF-SUPPLIED WATER SYSTEM WELLS

- INDUSTRIAL
- COMMERCIAL
- INSTITUTIONAL AND RECREATIONAL
- IRRIGATION
- AGRICULTURAL
- AREA SERVED BY PUBLIC WATER UTILITY WHICH USED SURFACE WATER IN 2005
- AREA SERVED BY PUBLIC WATER UTILITY WHICH USED GROUNDWATER IN 2005

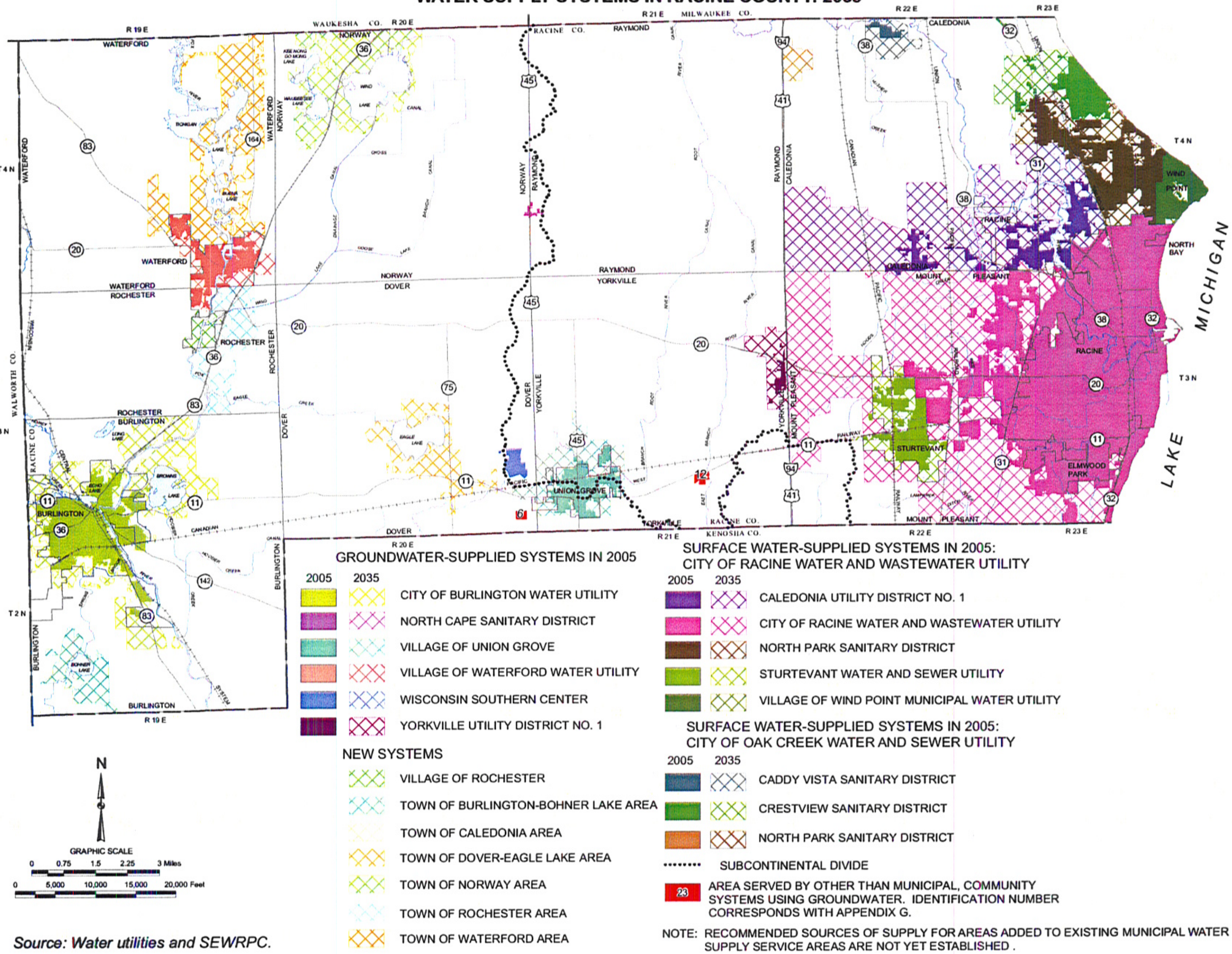
NOTES: 1. THE SELF-SUPPLIED WATER SYSTEMS INDICATED ON THIS MAP INCLUDE ALL KNOWN WELLS DEFINED AS NON-COMMUNITY TRANSIENT AND NON-TRANSIENT, AND ALL NON-COMMUNITY HIGH-CAPACITY WELLS. THE WELL LOCATIONS SHOWN ON THIS MAP ARE APPROXIMATE. MORE SPECIFIC INFORMATION ON THE NUMBER AND LOCATION OF SELF-SUPPLIED WATER SYSTEMS IS AVAILABLE FROM THE WISCONSIN DEPARTMENT OF NATURAL RESOURCES.

2. RECOMMENDED SOURCES OF SUPPLY FOR AREAS ADDED TO EXISTING WATER SUPPLY SERVICE AREAS ARE NOT YET ESTABLISHED.

Source: Wisconsin Department of Natural Resources and SEWRPC.

Map IV-10

PROJECTED AREAS SERVED BY MUNICIPAL AND OTHER THAN MUNICIPAL, COMMUNITY WATER SUPPLY SYSTEMS IN RACINE COUNTY: 2035

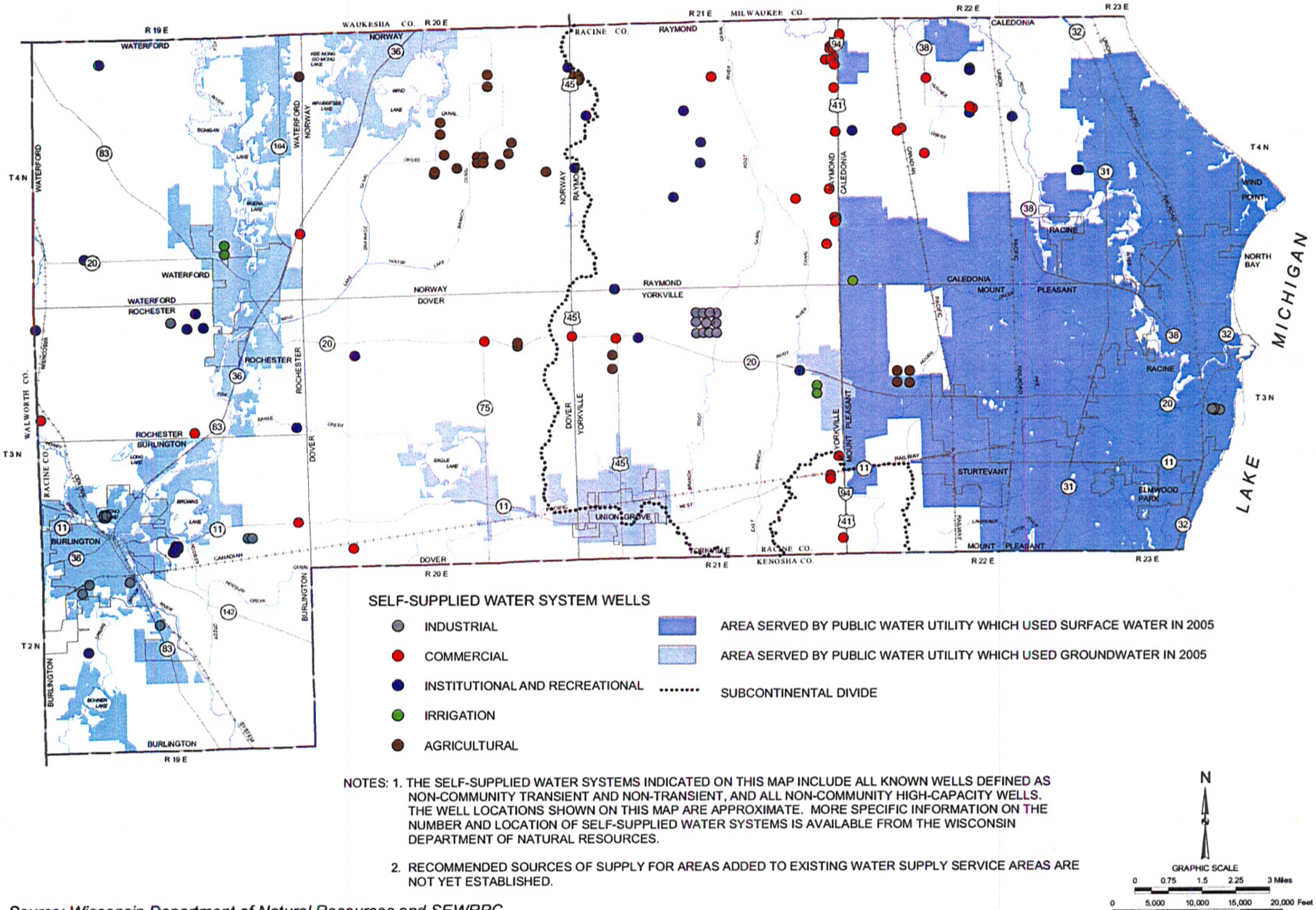


Source: Water utilities and SEWRPC.

PRELIMINARY DRAFT

Map IV-11

SELF-SUPPLIED INDUSTRIAL, COMMERCIAL, INSTITUTIONAL AND RECREATIONAL, AGRICULTURAL, AND IRRIGATION WATER SUPPLY SYSTEMS IN RACINE COUNTY: 2035



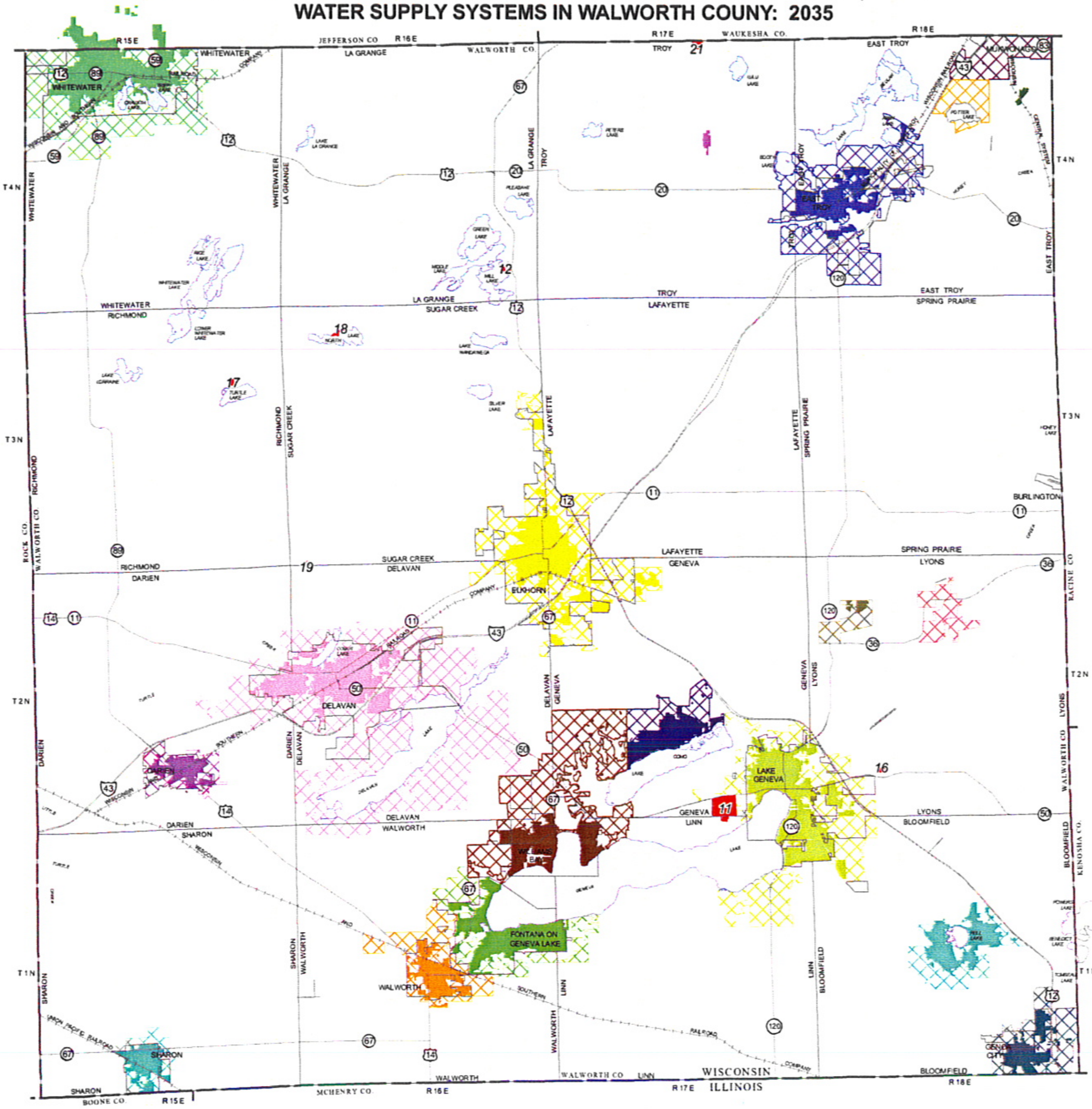
NOTES: 1. THE SELF-SUPPLIED WATER SYSTEMS INDICATED ON THIS MAP INCLUDE ALL KNOWN WELLS DEFINED AS NON-COMMUNITY TRANSIENT AND NON-TRANSIENT, AND ALL NON-COMMUNITY HIGH-CAPACITY WELLS. THE WELL LOCATIONS SHOWN ON THIS MAP ARE APPROXIMATE. MORE SPECIFIC INFORMATION ON THE NUMBER AND LOCATION OF SELF-SUPPLIED WATER SYSTEMS IS AVAILABLE FROM THE WISCONSIN DEPARTMENT OF NATURAL RESOURCES.

2. RECOMMENDED SOURCES OF SUPPLY FOR AREAS ADDED TO EXISTING WATER SUPPLY SERVICE AREAS ARE NOT YET ESTABLISHED.

Source: Wisconsin Department of Natural Resources and SEWRPC.

Map IV-12

PROJECTED AREAS SERVED BY MUNICIPAL AND OTHER THAN MUNICIPAL, COMMUNITY WATER SUPPLY SYSTEMS IN WALWORTH COUNY: 2035



GROUNDWATER-SUPPLIED SYSTEMS IN 2005

2005	2035		2005	2035	
		COUNTRY ESTATES SANITARY DISTRICT			TROY SANITARY DISTRICT NO. 1
		DARIEN WATER WORKS AND SEWER SYSTEM			VILLAGE OF EAST TROY MUNICIPAL WATER UTILITY
		DELAVAN WATER AND SEWERAGE COMMISSION			VILLAGE OF GENOA CITY MUNICIPAL WATER UTILITY
		ELKHORN LIGHT AND WATER			WALWORTH MUNICIPAL WATER AND SEWER UTILITY
		FONTANA MUNICIPAL WATER UTILITY			WHITEWATER MUNICIPAL WATER UTILITY
		LAKE COMO SANITARY DISTRICT NO. 1			WILLIAMS BAY MUNICIPAL WATER UTILITY
		LAKE GENEVA MUNICIPAL WATER UTILITY			MUKWONAGO MUNICIPAL WATER UTILITY
		PELL LAKE SANITARY DISTRICT NO. 1	NEW SYSTEMS		
		SHARON WATERWORKS AND SEWER SYSTEM			TOWN OF LYONS AREA
		TOWN OF EAST TROY SANITARY DISTRICT NO. 3			TOWN OF EAST TROY, POTTER LAKE AREA

23 AREA SERVED BY OTHER THAN MUNICIPAL, COMMUNITY WATER SYSTEMS USING GROUNDWATER. IDENTIFICATION NUMBER CORRESPONDS WITH APPENDIX G.

N

GRAPHIC SCALE

0 0.75 1.5 2.25 3 Miles

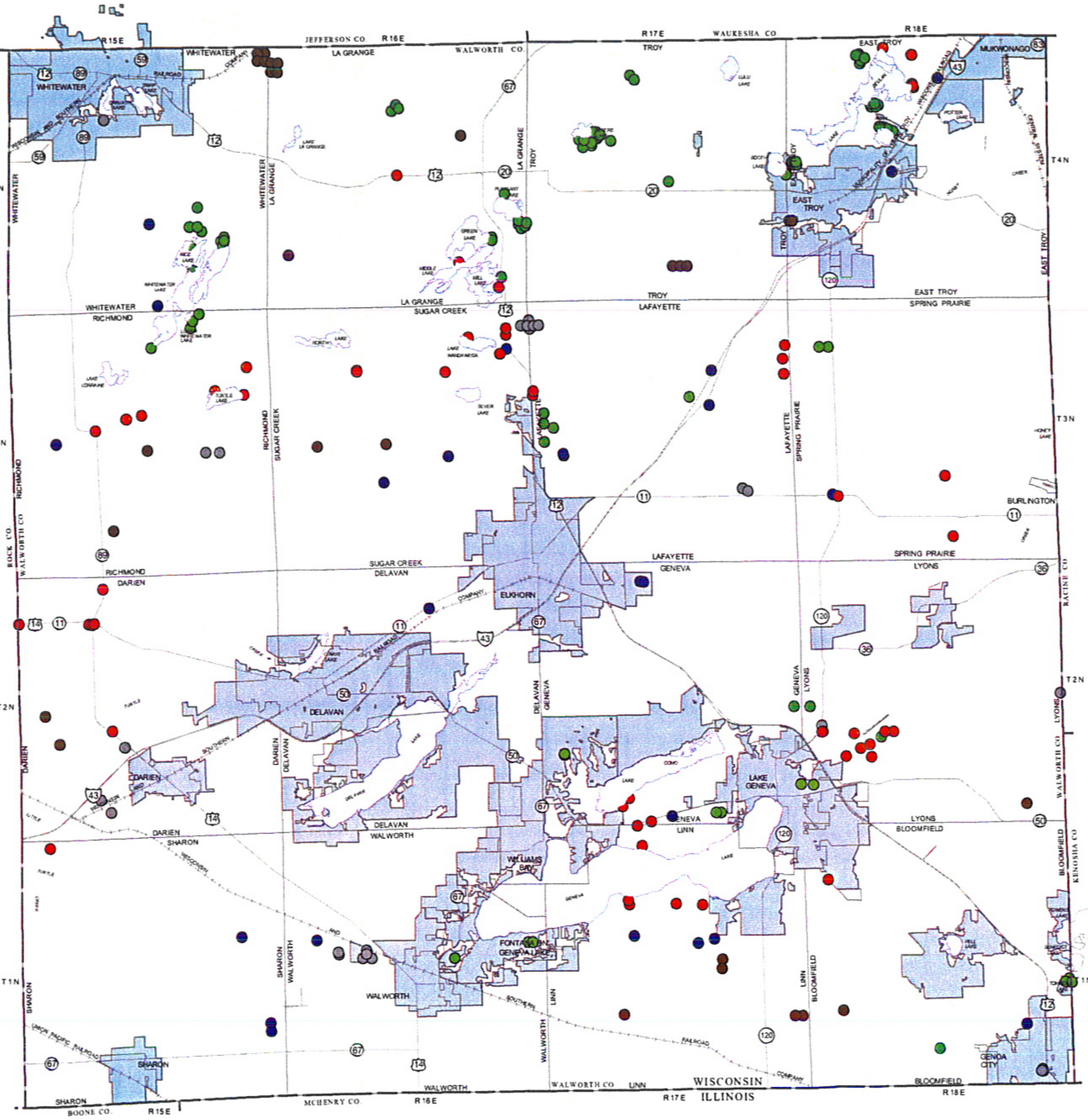
0 5,000 10,000 15,000 20,000 Feet

Source: Water utilities and SEWRPC.

PRELIMINARY DRAFT

Map IV-13

SELF-SUPPLIED INDUSTRIAL, COMMERCIAL, INSTITUTIONAL AND RECREATIONAL, AGRICULTURAL, AND IRRIGATION WATER SUPPLY SYSTEMS IN WALWORTH COUNTY: 2035



SELF-SUPPLIED WATER SYSTEM WELLS

- INDUSTRIAL
- COMMERCIAL
- INSTITUTIONAL AND RECREATIONAL
- IRRIGATION
- AGRICULTURAL

AREA SERVED BY PUBLIC WATER UTILITY WHICH USED GROUNDWATER IN 2005

N

GRAPHIC SCALE

0 0.75 1.5 2.25 3 Miles

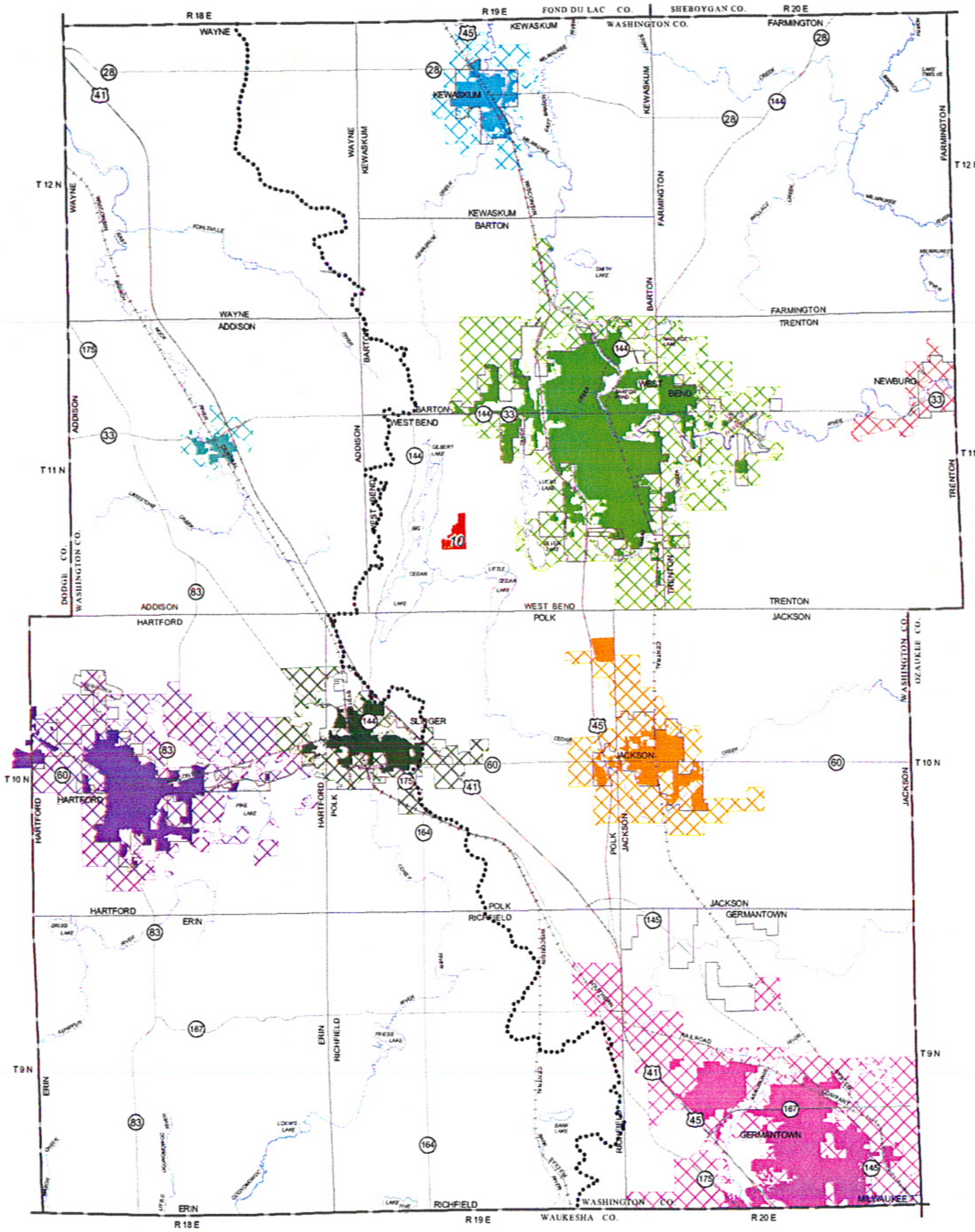
0 5,000 10,000 15,000 20,000 Feet

NOTE: THE SELF-SUPPLIED WATER SYSTEMS INDICATED ON THIS MAP INCLUDE ALL ACTIVE WELLS DEFINED AS NON-COMMUNITY TRANSIENT AND NON-TRANSIENT, AND ALL NON-COMMUNITY HIGH-CAPACITY WELLS. THE WELL LOCATIONS SHOWN ON THIS MAP ARE APPROXIMATE. MORE SPECIFIC INFORMATION ON THE NUMBER AND LOCATION OF SELF-SUPPLIED WATER SYSTEMS IS AVAILABLE FROM THE WISCONSIN DEPARTMENT OF NATURAL RESOURCES.

Source: Wisconsin Department of Natural Resources and SEWRPC.

Map IV-14

PROJECTED AREAS SERVED BY MUNICIPAL AND OTHER THAN MUNICIPAL, COMMUNITY WATER SUPPLY SYSTEMS IN WASHINGTON COUNTY: 2035



GROUNDWATER-SUPPLIED SYSTEMS IN 2005

2005	2035	
		ALLENTON SANITARY DISTRICT
		CITY OF HARTFORD WATER UTILITIES
		CITY OF WEST BEND WATER UTILITY
		KEWASKUM WATER UTILITY
		SLINGER UTILITIES
		VILLAGE OF GERMANTOWN WATER UTILITY (PORTION OF NEW AREA IN THE TOWN OF RICHFIELD COULD BE A SEPARATE NEW TOWN UTILITY)
		VILLAGE OF JACKSON WATER UTILITY

NEW SYSTEM

2035

VILLAGE OF NEWBURG AREA

SUBCONTINENTAL DIVIDE

23 AREA SERVED BY OTHER THAN MUNICIPAL, COMMUNITY WATER SYSTEMS USING GROUNDWATER. IDENTIFICATION NUMBER CORRESPONDS WITH APPENDIX G.

NOTE: RECOMMENDED SOURCES OF SUPPLY FOR AREAS ADDED TO EXISTING MUNICIPAL WATER SUPPLY SERVICE AREAS ARE NOT YET ESTABLISHED.

N

GRAPHIC SCALE

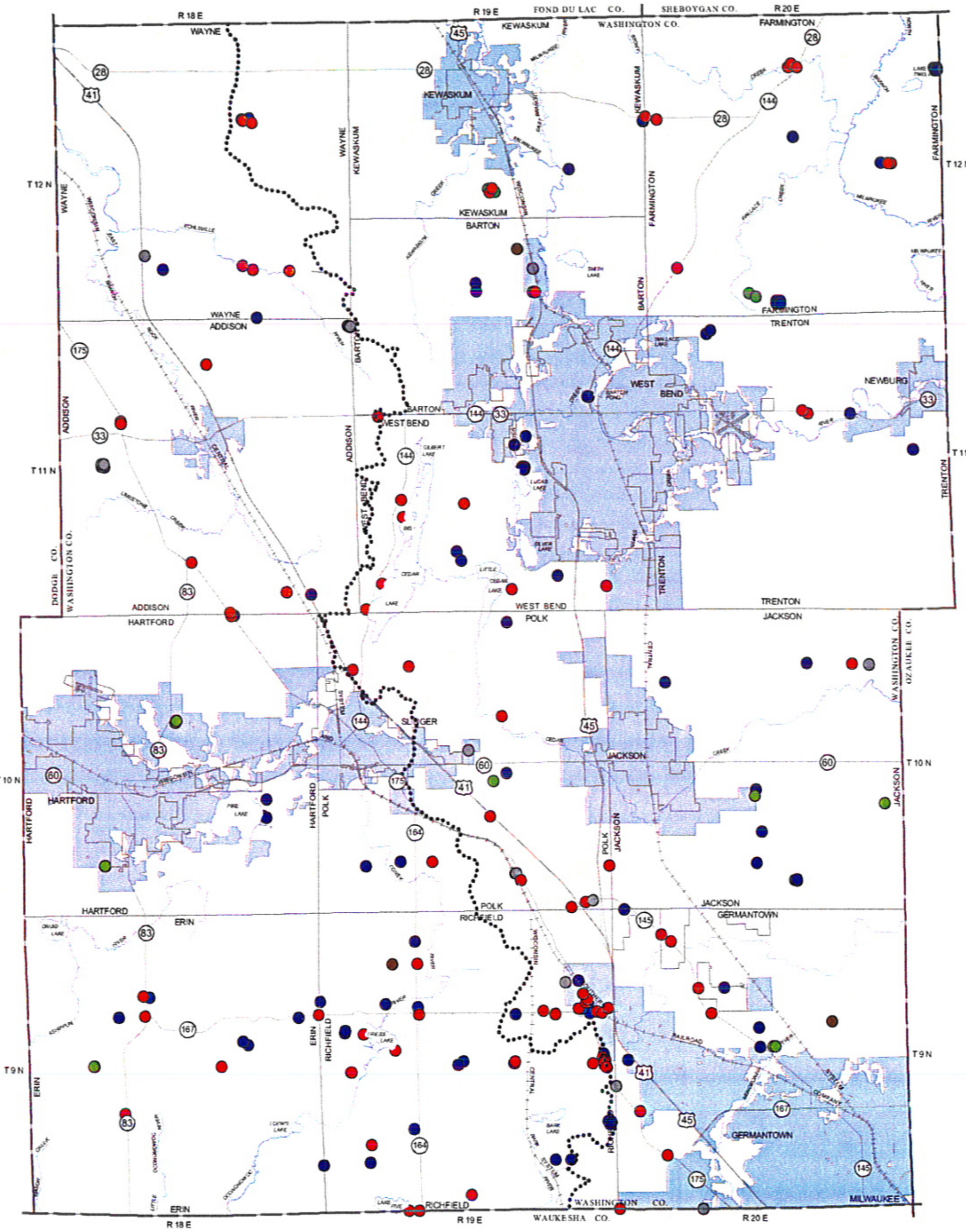
0 0.75 1.5 2.25 3 Miles

0 5,000 10,000 15,000 20,000 Feet

Source: Water utilities and SEWRPC.

Map IV-15

SELF-SUPPLIED INDUSTRIAL, COMMERCIAL, INSTITUTIONAL AND RECREATIONAL, AGRICULTURAL, AND IRRIGATION WATER SUPPLY SYSTEMS IN WASHINGTON COUNTY: 2035



SELF-SUPPLIED WATER SYSTEM WELLS

- INDUSTRIAL
- COMMERCIAL
- AGRICULTURAL
- IRRIGATION
- INSTITUTIONAL AND RECREATIONAL

AREA SERVED BY PUBLIC WATER UTILITY WHICH USED GROUNDWATER IN 2005

SUBCONTINENTAL DIVIDE

NOTES: 1. THE SELF-SUPPLIED WATER SYSTEMS INDICATED ON THIS MAP INCLUDE ALL KNOWN WELLS DEFINED AS NON-COMMUNITY TRANSIENT AND NON-TRANSIENT, AND ALL NON-COMMUNITY HIGH-CAPACITY WELLS. THE WELL LOCATIONS SHOWN ON THIS MAP ARE APPROXIMATE. MORE SPECIFIC INFORMATION ON THE NUMBER AND LOCATION OF SELF-SUPPLIED WATER SYSTEMS IS AVAILABLE FROM THE WISCONSIN DEPARTMENT OF NATURAL RESOURCES.

2. RECOMMENDED SOURCES OF SUPPLY FOR AREAS ADDED TO EXISTING WATER SUPPLY SERVICE AREAS NOT YET ESTABLISHED.

N

GRAPHIC SCALE

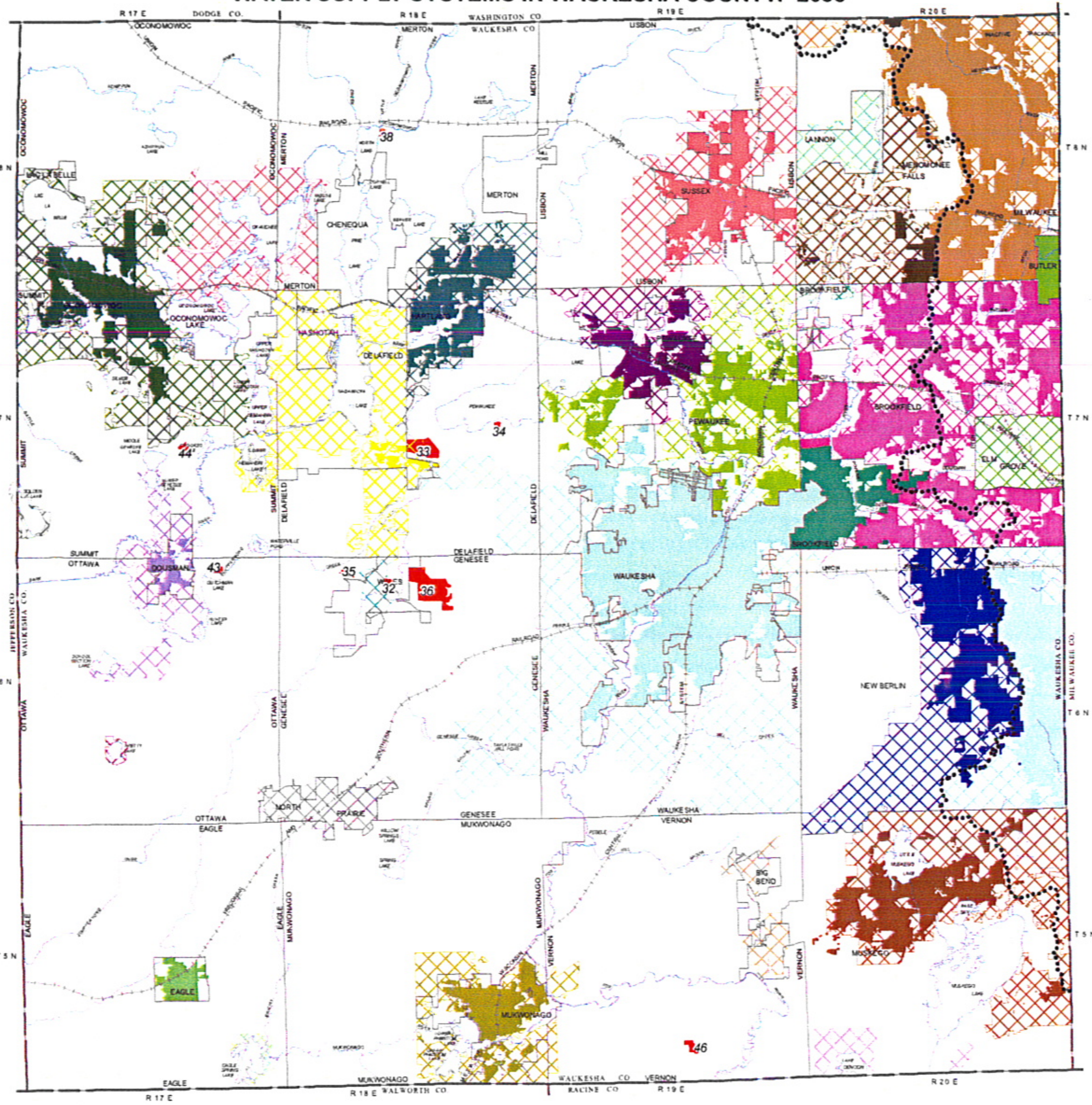
0 0.75 1.5 2.25 3 Miles

0 5,000 10,000 15,000 20,000 Feet

Source: Wisconsin Department of Natural Resources and SEWRPC.

Map IV-16

PROJECTED AREAS SERVED BY MUNICIPAL AND OTHER THAN MUNICIPAL, COMMUNITY WATER SUPPLY SYSTEMS IN WAUKESHA COUNTY: 2035



GROUNDWATER-SUPPLIED SYSTEMS IN 2005

2005	2035	
		CITY OF BROOKFIELD MUNICIPAL WATER UTILITY
		DELAFIELD MUNICIPAL WATER UTILITY
		CITY OF MUSKEGO PUBLIC WATER UTILITY
		CITY OF NEW BERLIN WATER UTILITY
		CITY OF OCONOMOWOC UTILITIES
		CITY OF PEWAUKEE WATER UTILITY
		CITY OF WAUKESHA WATER UTILITY (PORTION OF NEW AREA IN TOWN OF GENESSEE COULD BE A NEW TOWN UTILITY DISTRICT)
		VILLAGE OF EAGLE MUNICIPAL WATER UTILITY
		DOUSMAN WATER UTILITY
		HARTLAND MUNICIPAL WATER UTILITY
		VILLAGE OF MENOMONEE FALLS WATER UTILITY
		MUKWONAGO MUNICIPAL WATER UTILITY
		PRAIRIE VILLAGE WATER TRUST
		VILLAGE OF PEWAUKEE WATER UTILITY
		SUSSEX VILLAGE HALL AND WATER UTILITY
		BROOKFIELD SANITARY DISTRICT NO. 4

NOTE: RECOMMENDED SOURCES OF SUPPLY FOR AREAS ADDED TO EXISTING MUNICIPAL WATER SUPPLY SERVICE AREAS ARE NOT YET ESTABLISHED.

NEW GROUNDWATER-SUPPLIED SYSTEMS

2035	
	VILLAGE OF BIG BEND
	VILLAGE OF LANNON AREA
	VILLAGE OF WALES AREA
	TOWN OF EAGLE-EAGLE SPRING LAKE AREA
	TOWN OF MUKWONAGO-RAINBOW SPRINGS AREA
	TOWN OF NORWAY-WIND LAKE AREA
	TOWN OF OCONOMOWOC-OKAUCHEE LAKE AREA
	TOWN OF OTTOWA-PRETTY LAKE AREA
	TOWN OF SUMMIT-GOLDEN LAKE AREA

SURFACE WATER-SUPPLIED SYSTEMS IN 2005

2005	2035	
		VILLAGE OF BUTLER PUBLIC WATER UTILITY
		VILLAGE OF MENOMONEE FALLS WATER UTILITY
		CITY OF NEW BERLIN WATER UTILITY

NEW SURFACE WATER-SUPPLIED SYSTEMS

VILLAGE OF ELM GROVE

••••• SUBCONTINENTAL DIVIDE

93 AREA SERVED BY OTHER THAN MUNICIPAL, COMMUNITY SYSTEMS USING GROUNDWATER. IDENTIFICATION NUMBER CORRESPONDS WITH APPENDIX G.

N

GRAPHIC SCALE

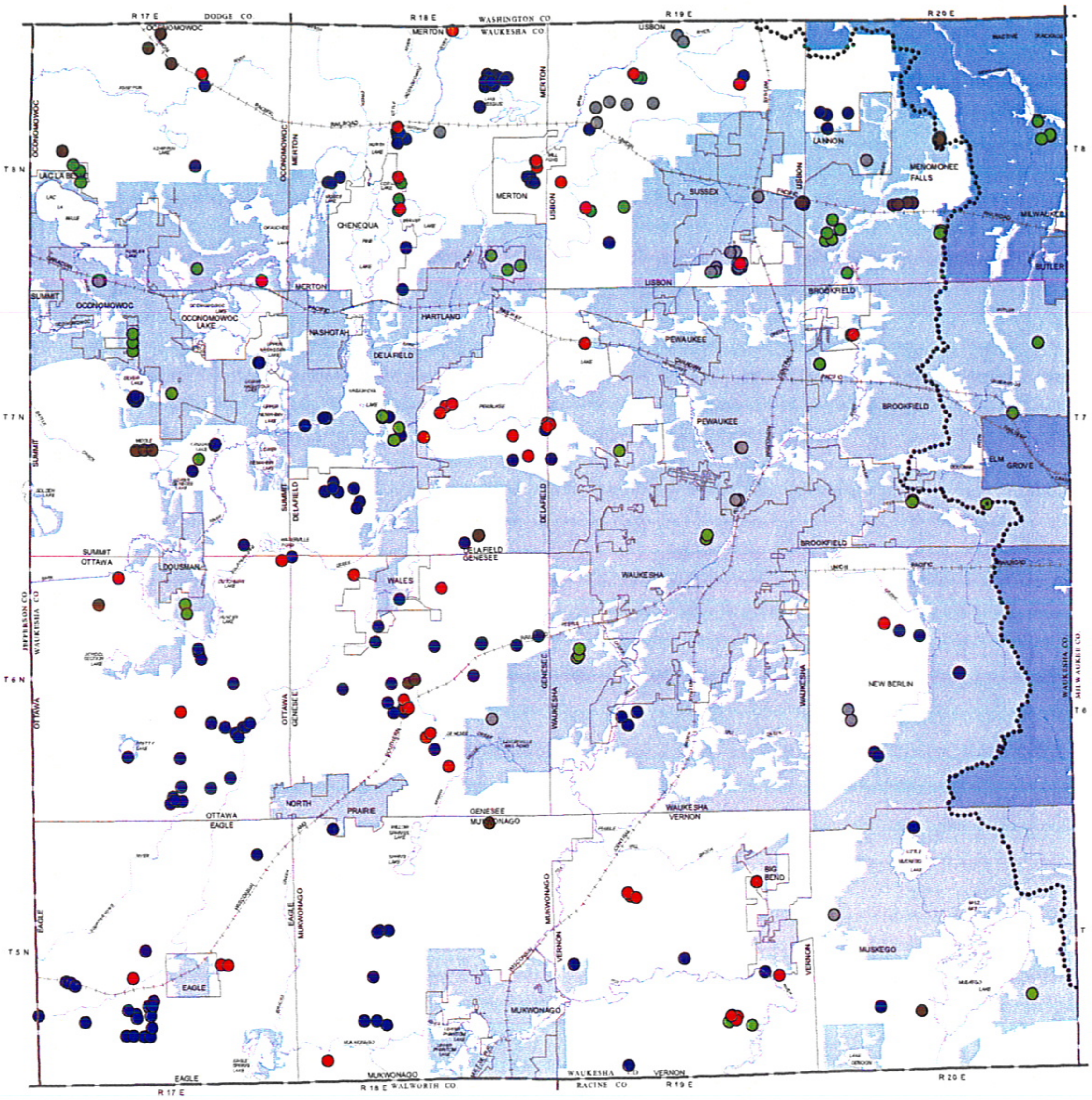
0 0.75 1.5 2.25 3 Miles

0 5,000 10,000 15,000 20,000 Feet

Source: Water utilities and SEWRPC.

Map IV-17

SELF-SUPPLIED INDUSTRIAL, COMMERCIAL, INSTITUTIONAL AND RECREATIONAL, AGRICULTURAL, AND IRRIGATION WATER SUPPLY SYSTEMS IN WAUKESHA COUNTY: 2035



SELF-SUPPLIED WATER SYSTEM WELLS

- INDUSTRIAL
- COMMERCIAL
- INSTITUTIONAL AND RECREATIONAL
- IRRIGATION
- AGRICULTURAL

- AREA SERVED BY PUBLIC WATER UTILITY WHICH USED SURFACE WATER IN 2005
- AREA SERVED BY PUBLIC WATER WHICH USED GROUNDWATER IN 2005
- SUBCONTINENTAL DIVIDE

NOTES: 1. THE SELF-SUPPLIED WATER SYSTEMS INDICATED ON THIS MAP INCLUDE ALL KNOWN WELLS DEFINED AS NON-COMMUNITY TRANSIENT AND NON-TRANSIENT, AND ALL NON-COMMUNITY HIGH-CAPACITY WELLS. THE WELL LOCATIONS SHOWN ON THIS MAP ARE APPROXIMATE. MORE SPECIFIC INFORMATION ON THE NUMBER AND LOCATION OF SELF-SUPPLIED WATER SYSTEMS IS AVAILABLE FROM THE WISCONSIN DEPARTMENT OF NATURAL RESOURCES.

2. RECOMMENDED SOURCES OF SUPPLY FOR AREAS ADDED TO EXISTING WATER SUPPLY SERVICE AREAS ARE NOT YET ESTABLISHED.

N

GRAPHIC SCALE

0 0.75 1.5 2.25 3 Miles

0 5,000 10,000 15,000 20,000 Feet

Source: Wisconsin Department of Natural Resources and SEWRPC.

 PRELIMINARY DRAFT