VOLUME 1 OF 5

Application Summary, City of Waukesha Application for a Lake Michigan Diversion with Return Flow

OCTOBER 2013

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CH2MHILL®
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Preface: Overview of Changes Since May 2010

The City of Waukesha (City) submitted its *Application for Lake Michigan Supply* to the Wisconsin Department of Natural Resources (WDNR) in May 2010, in accordance with the Great Lakes–St. Lawrence River Basin Water Resources Compact (Compact) and Wisconsin Statutes section 281.346. Since then, there has been subsequent technical evaluation, extensive review of the materials, and requests from the WDNR for additional analyses. This revised *Application for a Lake Michigan Diversion with Return Flow* (Application) contains the technical information originally provided in May 2010 and discussion of the additional review and updated analysis that occurred after May 2010.

The Application has not changed materially. As described below, most of the technical and substantive information remains the same; however, some changes were made to reflect subsequent evaluations made in response to WDNR requests, post–May 2010 administrative rules, and new data.

Water Conservation Plan and Water Supply Service Area Plan

The City revised its water conservation plan to conform to the Wisconsin Water Conservation and Water Use Efficiency administrative rule (Wisconsin Administrative Code chapter NR 852) that was adopted by the State in 2010 to comply with the Compact (Volume 3, City of Waukesha Water Conservation Plan). Compliance with this rule is mandatory for new or increased Great Lakes diversions. The revised water conservation plan establishes for the City a program to achieve the measurable water savings goal of a 10 percent reduction in water use as required by chapter NR 852. Further, it documents the process the City is using to develop, implement, and monitor its portfolio of environmentally sound and economically feasible water conservation measures that meet the standards of the Compact.

The City also revised its Water Supply Service Area Plan to conform to Wisconsin's draft Water Supply Service Area Plans administrative rule (Wisconsin Administrative Code chapter NR 854). (Volume 2, City of Waukesha Water Supply Service Area Plan) The administrative rule administers the State's water supply plan statute (Wis. Stat. § 281.348), which was enacted as part of the 2008 Wisconsin law that adopted the Compact. The City's water supply planning analyses and documentation were updated to include the revised water conservation plan, 2010 U.S. Census Bureau data, updated water demand forecasts, broader evaluation of the environmental impacts of water supply alternatives, consideration of new Wisconsin administrative rules pertaining to return flow phosphorus and thermal discharge limits, and updated cost estimates. Significantly, the City's requested diversion volume of 10.1 million gallons per day is less than the 2010 requested volume of 10.9 million gallons per day.

Preferred Water Supplier

The 2010 application included three potential Lake Michigan water suppliers: the City of Milwaukee, the City of Oak Creek, and the City of Racine. In 2010, Waukesha indicated that the City of Milwaukee was the preferred water supplier. Following discussions with these three previously identified potential suppliers, Waukesha signed a letter of intent with the City of Oak Creek in 2012. This revised Application now identifies the City of Oak Creek as the preferred supplier and provides related details.

Preferred Return Flow Discharge Location

The City previously selected Underwood Creek, a tributary to Lake Michigan, as the return flow discharge location. The Underwood Creek option is not being considered at this time as it is currently not implementable due to issues associated with the total maximum daily load (TMDL) being prepared by the Milwaukee Metropolitan Sewerage District (MMSD). Also, the City conducted additional analysis of the Root River. Based on that analysis, it was determined that the return flow to the Root River provides environmental benefits to the Root River and enhances Great Lakes fisheries.

Water Supply Alternatives

The revised Application provides additional details and information pertaining to the comparison of water supply alternatives. These were generated at the request of the WDNR to allow reviewers to more fully understand the City's basis for the selecting the preferred alternative.

Application Organization

The Application comprises five volumes:

Volume 1, *Application Summary, City of Waukesha Lake Michigan Diversion with Return Flow* provides an overview of the entire Application and summarizes how the Application satisfies the requirements of the Compact and Wisconsin Statute chapter 281.

Volume 2, *City of Waukesha Water Supply Service Area Plan* documents a water supply planning process required of the City. The purpose of the water supply service area plan is to systematically evaluate alternative means of supplying water to the delineated water supply service area and to identify a cost-effective water supply alternative for a 20-year planning period.

Volume 3, *City of Waukesha Water Conservation Plan* documents the City's program of cost-effective, environmentally sound, and economically feasible water conservation and water use efficiency measures. The plan focuses on conservation activities over the next 5 years and includes recommendations for the next 20 years in support of the City's long-term water-saving goals.

Volume 4, *City of Waukesha Return Flow Plan* documents the City's evaluation of alternatives for returning the withdrawn water to the Lake Michigan source watershed. The evaluation includes technical and cost-effectiveness analyses.

Volume 5, *City of Waukesha Environmental Report for Water Supply Alternatives* documents the City's assessment of the environmental impacts of the water supply alternatives evaluated as part of its water supply planning process.

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Acronyms and Abbreviations

ADD	average day demand
Application	City of Waukesha Application for a Lake Michigan Diversion with Return Flow
AWWA	American Water Works Association
City	City of Waukesha
Compact	Great Lakes – St. Lawrence River Basin Water Resources Compact
County	Waukesha County
ERP	Environmental Repair Program
ft	feet
gal/day	gallons per day
gpcd	gallons per capita day
HMO	hydrous manganese oxide
MDD	maximum day demand
MCL	maximum contaminant level
MG	million gallons
mgd	million gallons per day
mg/L	milligram per liter
MMSD	Milwaukee Metropolitan Sewerage District
NR 852	Wisconsin Administrative Code Chapter NR 852 Water Conservation and Water Use Efficiency
NR 854	Wisconsin Administrative Code Chapter NR 854 Water Supply Service Area Plans
piC/L	picocurie per liter
PSC	Public Service Commission of Wisconsin
psi	pounds per square inch
SEWRPC	Southeastern Wisconsin Regional Planning Commission
SOC	synthetic organic compound
TDS	total dissolved solids
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound
WDNR	Wisconsin Department of Natural Resources
WSSA	Water Supply Service Area
WWU	Waukesha Water Utility

1. Introduction

The City has prepared and submitted this *Application for a Lake Michigan Diversion with Return Flow* in accordance with the Great Lakes–St. Lawrence River Basin Water Resources Compact and Wisconsin's Compact implementing legislation: 2007 Wisconsin Act 227 and Wisconsin Statutes chapter 281; recently published Wisconsin Administrative Code chapters NR 850, NR 852, and NR 856; and draft Wisconsin Administrative Code chapter NR 854.

The Application documents that the City's proposal to divert Lake Michigan water to the City satisfies the decision-making standard criteria for communities within a straddling county, which provide an exception from the prohibition against diversion of Great Lakes water out of the Great Lakes basin. It provides historic evidence, water conservation information, and analyses of water resources that support the conclusion that a Lake Michigan diversion with return flow is the only reasonable and environmentally sustainable water supply for the City. Compared to other alternatives, the City's switch from the deep St. Peter sandstone aquifer and the shallow Troy Bedrock Valley aquifer to a Lake Michigan water supply with return flow is most protective of the environment—particularly regional ground and surface waters—and of public health.

The proposed volume of water withdrawn and returned is the volume needed to serve the City's public water system at the ultimate buildout, or full development, condition of the City water supply service area (WSSA). The buildout condition exists when all the land available for development in the WSSA has been developed in a manner consistent with the southeastern Wisconsin regional water quality, water supply, and land use plans. Buildout may be more than 40 years in the future, but it is a key consideration now because extensive infrastructure needs to be constructed to provide a sustainable long-term water supply. Under Wisconsin's water supply planning and approval process, the WDNR may approve water supply plans for a planning period of 20 years (Wis. Stat. ch. 281). Consequently, while the City is submitting an application for a Lake Michigan diversion with return flow for the buildout condition of its service area, WDNR may approve the interim volume needed to meet the demands through 2030.

1.1 Eligibility to Apply

A proposal by a Community within a Straddling County to divert Great Lakes water is excepted from the prohibition against Diversions, provided that the Proposal satisfies all of the requirements of the Compact and Wisconsin Statutes section 281.346(4). Compact section 4.9.3; Wis. Stat. § 281.346(4).

"*Community within a Straddling County means any incorporated city, town or the equivalent thereof, that is located outside the Basin but wholly within a County that lies partly within the Basin and that is not a Straddling Community." Compact section 1.2. See also Wis. Stat. § 281.346(1)(d). A "'[s]traddling county' means a county that lies partly within the Great Lakes basin." Wis. Stat. § 281.346(1)(tm). See also Wis. Stat. § 281.348(3).*

The City is a historic community in southeastern Wisconsin located in Waukesha County about 17 miles west of Lake Michigan and 1.5 miles west of the Great Lakes watershed surface water divide. Thus, the City's water supply service area lies within the Mississippi River basin. Waukesha County is a straddling county because it lies partly within the Great Lakes basin (Exhibit 1-1).

EXHIBIT 1-1
Wisconsin Counties within Great Lakes Basin

"A person who proposes to begin a diversion or to increase the amount of a diversion under par. (c), (d), or (e) shall apply to the [Wisconsin Department of Natural Resources] for approval." Wis. Stat. § 281.346(4)(b)1.

"A person may apply under subd. 1. For approval of a new or increased diversion under par. (c) or (e) only if the person operates a public water supply system that receives or would receive water from the new or increased diversion." Wis. Stat. § 281.346(4)(b)2.

As a qualifying applicant, the City is solely responsible for providing information that demonstrates that the applicant meets the Compact standards for a diversion. *See* Wis. Stat. § 281.346(4)(b)2.

The department may not approve a proposal unless "[t]he proposal is consistent with an approved water supply service area plan under s. 281.348 that covers the public water supply system." § 281.346(4)(e)1.em.

The applicant for the diversion is the City, whose planned water supply service area includes the City and parts of neighboring communities as determined under the planning requirements in Wisconsin Statutes chapter 281. The City operates a public water supply system through its Waukesha Water Utility, a public water supplier governed by Wisconsin Statutes chapter 196 and regulated by the WDNR and the Wisconsin Public Service Commission (PSC).

The City's application is excepted from the Compact's prohibition against diversion provided that the application satisfies the requirements of the Compact and Wisconsin Statutes chapter 281, including the following:

- The City does not have a reasonable water supply alternative within the Mississippi River basin, including conservation of existing supplies.
- The diverted water will be used solely for public water supply purposes.
- The diversion with return flow will not endanger the integrity of the Great Lakes basin ecosystem.
- The portion of diverted water returned to the Great Lakes basin will be maximized, and the portion of returned water that is from the Mississippi River basin will be minimized.

The Application presents technical information and analyses that demonstrate that:

- The City is eligible to apply for a Lake Michigan supply with return flow.
- The population projections and water demand forecasts for the City's water supply service area are reasonable and incorporate significant water conservation measures.
- The City needs a new water supply because current deep aquifer and shallow aquifer groundwater sources are not sustainable.
- The City cannot avoid water supply issues merely with water conservation measures.
- Compared to other water supply sources, and combinations of sources in the Mississippi River basin, a Lake Michigan supply with return flow is a sustainable water supply that is most protective of the environment and public health.

Section 5 details why the application satisfies the Compact and Wisconsin Statutes chapter 281 requirements. Exhibit 1-2 provides references for Compact and Wisconsin Statutes provisions that govern the City's Application.

EXHIBIT 1-2
Compact and Wisconsin Statute Compliance Summary

Compact	State Statute	Resources
Water Use and Adequate Supply Section 4.9.3.a.	Water Use and Adequate Supply Wis. Stat. § 281.346(4)(b)2. Wis. Stat. § 281.346(4)(e)1. Wis. Stat. § 281.346(4)(e)1.a.	Volume 1, City of Waukesha Application Summary, Sections 1.1 Eligibility to Apply and Section 2.1 Public Water System Volume 2, City of Waukesha Water Supply Service Area Plan, Sections 3 and 11
	Supporting Letters/Resolution Wis. Stat. § 281.346(4)(b)4m	Volume 2, City of Waukesha Water Supply Service Area, Section 12
Return of Water Less Consumptive Use; Maximizing Return of Water and Minimizing Water from Outside Basin Section 4.9.3.b. Section 4.9.4.c. Section 4.11.1.	Return of Water Less Consumptive Use; Maximizing Return of Water and Minimizing Water from Outside Basin Wis. Stat. § 281.346(4)(e)1.b. Wis. Stat. § 281.346(4)(e)1.c. Wis. Stat. § 281.346(4)(f)4. Wis. Stat. § 281.346(4)(f)3. Wis. Stat. §§ 281.346(6)(a).	Volume 1, City of Waukesha Application Summary, Section 4 Volume 4, City of Waukesha Return Flow Plan, Section 2
No Reasonable Alternative, Including Conservation Section 4.9.3.d. Section 4.9.4.a.	No Reasonable Alternative, Including Conservation Wis. Stat. § 281.346(4)(e)1.d. Wis. Stat. § 281.346(4)(f)1. Wis. Stat. § 281.346(5m)(c).	Volume 1, City of Waukesha Application Summary, Sections 3 and 4 Volume 2, City of Waukesha Water Supply Service Area Plan, Section 7
No Endangerment to Basin Ecosystem Integrity, No Significant or Cumulative Adverse Impacts to Quantity or Quality of Waters/Water Dependent Natural Resources. Section 4.9.3.e Section 4.9.4.d. Section 4.11.2.	No Endangerment to Basin Ecosystem Integrity, No Significant or Cumulative Adverse Impacts to Quantity or Quality of Waters/Water Dependent Natural Resources Wis. Stat. § 281.346(4)(e)1.e. Wis. Stat. § 281.346(4)(f)5. Wis. Stat. § 281.346(5m)(e). Wis. Stat. § 281.346(6)(b). Provision of Information/Assessment of Potential Impacts Wis. Stat. § 281.346(4)(b)4. Wis. Stat. § 281.346(4)(b)5. Wis. Stat. § 281.346(4)(b)4s. Protection of Integrity of Receiving Water Wis. Stat. § 281.346(4)(f)4m. Return Location Wis. Stat. § 281.346(4)(f)3m.	Volume 1, City of Waukesha Application Summary, Section 4 Volume 2, City of Waukesha Water Supply Service Area Plan, Section 11 Volume 4, City of Waukesha Return Flow Plan, Section 3 Volume 5, City of Waukesha Environmental Report on Water Supply Alternatives, Sections 5 and 6
Existing Water Supply Interconnected to Waters of Basin Section 4.9.3.	Existing Water Supply Interconnected to Waters of Basin Wis. Stat. § 281.346(4)(e)2.	Volume 1 City of Waukesha Application Summary, Section 2.2.1 Deep Confined Aquifer Volume 2, City of Waukesha Water Supply Service Area Plan, Section 7
Reasonable Quantity, Use of Water, and Minimization of Waste Section 4.9.4.b. Section 4.11.5.a.	Reasonable Quantity, Use of Water, and Minimization of Waste Wis. Stat. § 281.346(4)(f)2. Wis. Stat. § 281.346(4)(i). Wis. Stat. § 281.346(6)(e)1. Wis. Stat. § 281.346(5m)(a).	Volume 1, City of Waukesha Application Summary, Section 3 Volume 2, City of Waukesha Water Supply Service Area Plan, Section 6
Reasonable Use Based on Supply Potential Section 4.11.5.d.	Reasonable Use Based on Supply Potential Wis. Stat. § 281.346(6)(e)4.	Volume 1, City of Waukesha Application Summary, Section 3 Volume 2, City of Waukesha Water Supply Service Area Plan, Section 6

EXHIBIT 1-2
Compact and Wisconsin Statute Compliance Summary

Compact	State Statute	Resources
Reasonable Use Based on Restoration of Source Watershed Section 4.11.5.f.	Reasonable Use Based on Restoration of Source Watershed Wis. Stat. § 281.346(6)(e)6.	Volume 5, City of Waukesha Environmental Report on Water Supply Alternatives, Section 5
Reasonable Use Based on Adverse Impacts Section 4.11.5.e.	Reasonable Use Based on Adverse Impacts Wis. Stat. § 281.346(6)(e)5.	Volume 1, City of Waukesha Application Summary, Section 4 Volume 5, City of Waukesha Environmental Report on Water Supply Alternatives, Section 5
Environmentally Sound and Economically Feasible Water Conservation Measures Section 4.9.4.e. Section 4.11.3.	Environmentally Sound and Economically Feasible Water Conservation Measures Wis. Stat. § 281.346(4)(f)6. Wis. Stat. § 281.346(8)(d). Wis. Stat. § 281.346(6)(c). Efficient Use/Conservation of Existing Water Supplies Wis. Stat. § 281.346(4)(g). Wis. Stat. § 281.346(6)(e)2. Cost−Effective Conservation Practices Wis. Stat. § 281.346(5m)(d)	Volume 1, City of Waukesha Application Summary, Section 3 Volume 3, City of Waukesha Water Conservation Plan
Compliance with Other Laws Section 4.9.4.f Section 4.11.4.	Compliance with Other Laws Wis. Stat. § 281.346(4)(f)7. Wis. Stat. § 281.346(6)(d).	Volume 2, City of Waukesha Water Supply Service Area Plan, Section 8
Reasonable Use Based on Balancing Section 4.11.5.c.	Reasonable Use Based on Balancing Wis. Stat. § 281.346(6)(e)3.	Volume 1, City of Waukesha Application Summary, Section 4 Volume 2, City of Waukesha Water Supply Service Area Plan, Section 11
	Water Supply Service Area Plan Wis. Stat. § 281.346(4)(e)1.em. Wis. Stat. § 281.346(4)(bg)2.	Volume 1, City of Waukesha Application Summary, Section 4 Volume 2, City of Waukesha Water Supply Service Area Plan, Section 11

See Section 5 for expanded table and narrative.

2. City of Waukesha Background

The City of Waukesha (pop. 70,818) is the largest city in Waukesha County, and the seventh largest in Wisconsin. Incorporated as a village in 1846 and as a city in 1896, it is well established. The City is a vibrant community that provides a high quality of life at a reasonable cost. It supports its diverse population with a wide variety of educational, social, and community services that are adapted to meet citizens' needs (Exhibit 2-1).

Through active strategic planning and landmark preservation, the City has revitalized its central downtown area to support a thriving commercial and arts district. The City is the birthplace of Les Paul, the inventor of the electric guitar, and it is the first small city "GuitarTown" in the country.

Because the City is more than 100 years old, community development is primarily in the form of in-fill or redevelopment. To establish a benchmark for sustainable buildings, development, and redevelopment, the City developed and adopted green and sustainable building guidelines to enhance building and site development to reduce energy use, landfill waste, greenhouse gas emissions while creating healthy indoor and outdoor environments, conserving building resources and promoting water efficiency (City of Waukesha, 2009).

EXHIBIT 2-1
City of Waukesha Facts

City Facts:

- Home of oldest university in Wisconsin, Carroll University
- Central transfer station for Waukesha Metro Transit, serving Waukesha County
- Minority population growth of 4,770 between 2000 and 2010, accounts for 80 percent of the City's total growth
- Home ownership rate is 60 percent
- Youngest median age in Waukesha County

Statistic	2000	2010
Population	64,825	70,718
Demographics		
White	91%	88%
Non-white	9%	12%
Median Household Income	$50,085	$57,001
Population below poverty level	5.9%	10.6%

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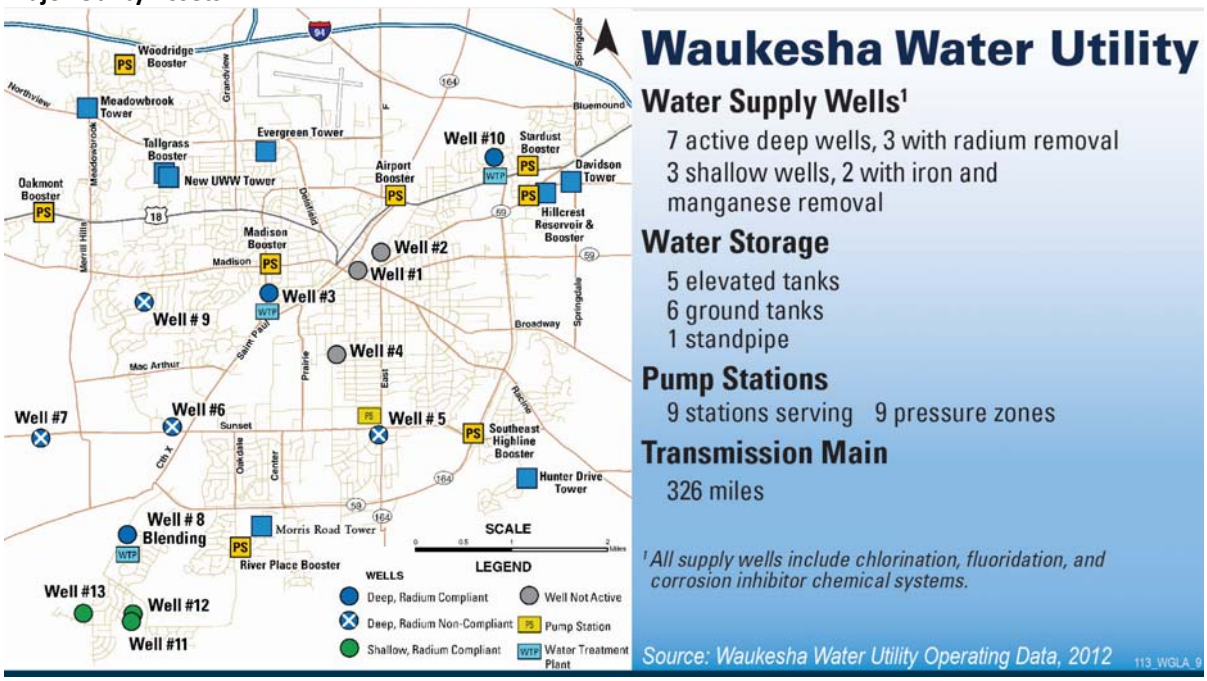
2.1 City Public Water System

"The Water shall be used solely for the Public Water Supply Purposes of the Community within a Straddling County. . . ." Compact section 4.9.3.a.; Wis. Stat. § 281.346(4)(e)1. A person may apply for approval of a new or increased diversion only if the person operates a public water supply system that receives or would receive water from the new or increased diversion. Wis. Stat. § 281.346(4)(b)2.

"Public Water Supply Purposes" means water distributed to the public through a physically connected system of treatment, storage, and distribution facilities serving a group of largely residential customers that may also serve industrial, commercial, and other institutional customers. Compact section 1.2; Wis. Stat. § 281.346(1)(pm) (defining "Public water supply").

The City's public water system comprises groundwater supply, treatment, storage, and conveyance assets and serves residential, industrial, commercial, and public customers (Exhibit 2-2). The City maintains a water utility administration building with offices for customer service, billing, supervisory control and data acquisition system control, meter testing, fleet storage, and equipment storage. Volume 2, City of Waukesha Water Supply Service Area Plan, Section 3 contains additional information on the City's water infrastructure and service area. The proposed new diversion will serve only the public water supply system needs of the City's water supply service area.

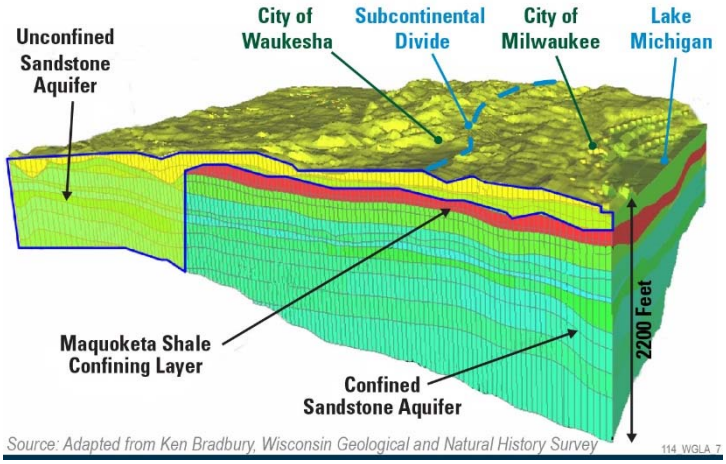
EXHIBIT 2-2
Major Utility Assets



2.2 Current City Water Supply Sources

For decades, the City's sole water supply source was the deep confined St. Peter sandstone aquifer. Currently, the City obtains about 85 percent of its water supply from this deep aquifer and about 15 percent from the shallow Troy Bedrock Valley aquifer (Waukesha Water Utility, 2005–2012). The deep aquifer wells are constructed to depths greater than 2,100 feet and withdraw water from 800 to 1,000 feet below ground. Some wells are more than 75 years old. The shallow wells are less than 200 feet deep and have been in service less than 10 years.

EXHIBIT 2-3
Deep Confined Aquifer



2.2.1 Deep Confined Aquifer

The deep aquifer under the City and extending about 12 miles west is confined by a geological feature—the Maquoketa shale layer—that limits the amount of water that can recharge or replenish the aquifer (Exhibit 2-3).

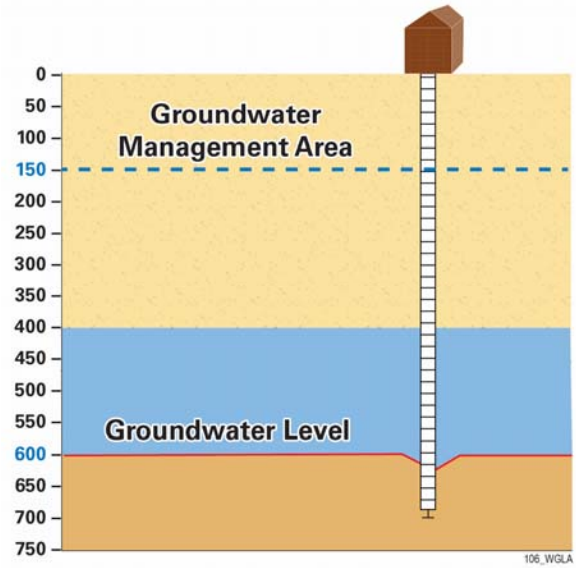
Decades of overpumping by communities in southeastern Wisconsin and northeastern Illinois has created a large cone of depression in the deep confined aquifer with local groundwater levels 400 to over 600 feet below ground (Exhibit 2-4). Pursuant to WDNR's groundwater protection law (Wisconsin Statutes section 281.34), groundwater

drawdown of 150 feet or more warrants concern. Consequently, the WDNR placed Waukesha County in a Groundwater Management Area pursuant to Wisconsin Administrative Code chapter NR 820.

The reduced groundwater levels in southeastern Wisconsin have in turn affected regional surface waters, which now receive about 12 percent less groundwater contribution as water is drawn toward the deep aquifer wells (USGS, 3/2007).

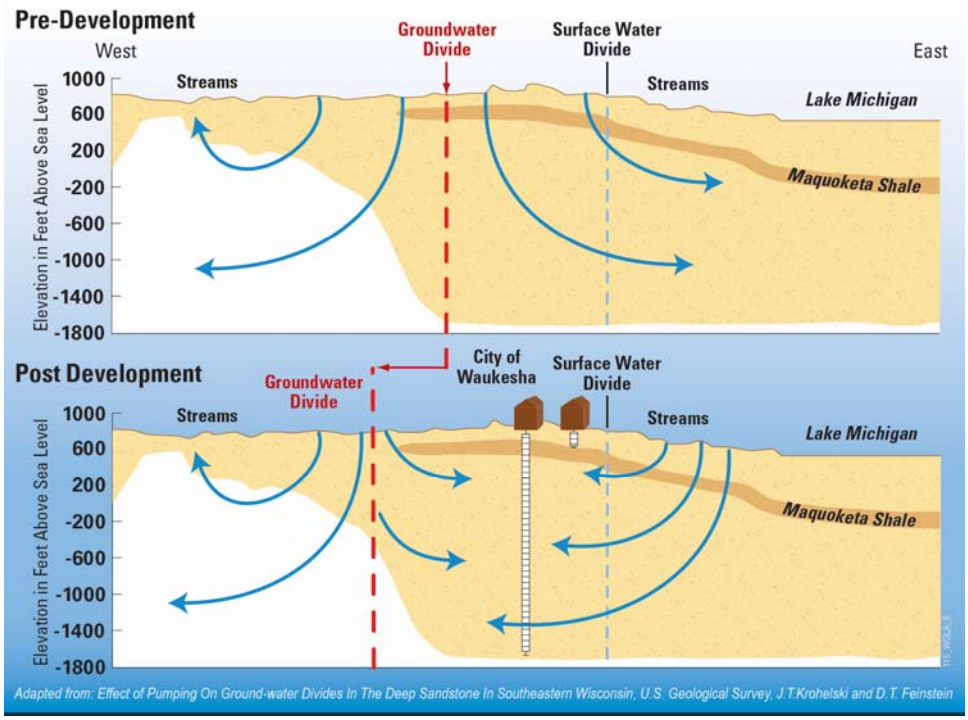
"Further, substantive consideration will also be given to whether or not the Proposal can provide sufficient scientifically based evidence that the existing water supply is derived from groundwater that is hydrologically interconnected to Waters of the Basin." Compact section 4.9.3. See also Wis. Stat. 281.346(4)(e)2 ("The department may not use a lack of hydrological connection to the waters of the Great Lakes basin as a reason to disapprove a proposal.").

EXHIBIT 2-4
Local Deep Aquifer Groundwater Levels



The deep aquifer is hydrologically interconnected to the waters of the Great Lakes basin (USGS, 03/2007). Although water in the deep confined sandstone aquifer once flowed toward the Great Lakes basin, overpumping has altered the natural hydrogeology and reversed the flow of groundwater, so that it now flows *away* from the Great Lakes basin and toward wells in Waukesha County (Exhibit 2-5).The Wisconsin Geological and Natural History Survey (WGNHS) and the United States Geological Survey (USGS) estimates that about 30 percent of the groundwater pumped by wells penetrating the deep aquifer in southeast Wisconsin originates from inside the Lake Michigan basin (WGNHS and USGS, 10/2006).

EXHIBIT 2-5
Impact of Deep Aquifer Pumping on Groundwater Flow Direction



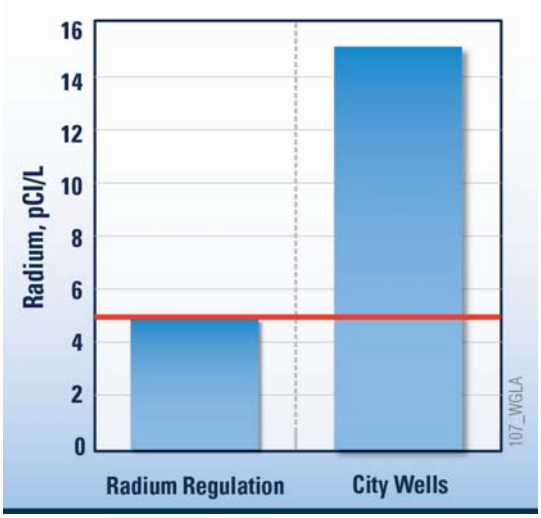
In addition to greatly depressed groundwater levels, the deep confined aquifer contains radionuclides at concentrations exceeding federal and state drinking water standards (Waukesha Water Utility, 2001–2012). Radionuclides (radium-226, radium-228, and gross alpha) are naturally occurring elements that pose increased risk of cancer if ingested through potable water supplies. Radium is present in the City's deep aquifer supply at levels up to 3 times greater than the drinking water standard of 5 picocurries per liter (piC/L) (Exhibit 2-6).

To provide water that complies with the radium standards (USEPA, 12/2000) the City treats the groundwater it pumps from the deep aquifer to remove radium, blends water obtained from the deep and shallow aquifers, and reduces its peak water demands through demand side water conservation measures. Even with these efforts, the City does not

continually meet the radium standards. Under a stipulated court order, the City must continuously provide radium-compliant water throughout its public water system by June 30, 2018 (*State of Wisconsin v. City of Waukesha,* Waukesha County Case Number 2009CX000004).

In addition to radium, declining groundwater levels have resulted in other water quality problems which will increase with groundwater level decline. Concentrations of total dissolved solids (TDS), specifically salts, have increased in one of the City's wells (Well No. 9, in 1999) to levels greater than twice the secondary drinking water standard. Part of the well was sealed off to reduce the salt content, but doing so significantly reduced water supply. The well can only be used infrequently and is an example of the future water quality problems that accompany continued use of the groundwater in the deep confined aquifer.

EXHIBIT 2-6
Radium Level in City Wells



Other communities using the deep confined aquifer have had similar radium and water quality concerns. Many communities within the Great Lakes basin have switched to Great Lakes water to comply with radium regulations and avoid a depleted groundwater supply source. Communities that have reduced pumping of the deep aquifer have observed partial recovery of groundwater levels. However, in places like northeastern Illinois, where the center of deep aquifer pumping has moved farther west with population growth, deep aquifer levels are declining again and severe drawdown is projected in future decades (Chicago Metropolitan Agency for Planning, 03/2010).

In recent years, across the nation and in Wisconsin, municipal water use has declined despite increasing population. Correspondingly, local pumping of the deep aquifer has decreased, slowing the rate of groundwater level decline. However, levels in the deep aquifer remain more than 400 to 600 feet below ground (SEWRPC, 12/2010). Treating water to remove contaminants like radium and TDS increases the rate of drawdown because more water is withdrawn from the aquifer to make up for the production of wastewater from the treatment process. Therefore, continued use of the deep aquifer is not sustainable.

2.2.2 Troy Bedrock Valley Shallow Aquifer

When the City determined that continued pumping of the deep aquifer was unsustainable, the City investigated and developed a small shallow aquifer water supply to reduce radium levels by blending with deep aquifer water. However, the City still does not meet radium regulations at all times. Moreover, the City found naturally occurring arsenic at levels that exceed the drinking water standard in shallow aquifer test wells near the City.

Pumping the shallow aquifer withdraws groundwater baseflows that otherwise would naturally feed local streams and wetlands (SEWRPC, 12/2010). Increased pumping of the shallow aquifer would dramatically reduce or eliminate groundwater flow to surface waters and water-dependent resources (RJN Environmental Services LLC, 04/2010; RJN Environmental Services, 08/2013). Drawdown at that scale would reduce the availability of water for private wells and could draw contaminants from private septic systems into the public water supply.

Contamination poses a greater risk to shallow aquifers than to the deep aquifer because contaminants can pass relatively quickly through the sand and gravel and enter the water. Potential sources of contamination include agricultural runoff, septic systems, and urban runoff. Also, there are more than 200 registered contamination sites (leaking underground storage tanks, landfills, waste disposal sites) within a 1-mile radius of the deep and shallow aquifer wells (WDNR Bureau for Remediation and Redevelopment, 07/2012). The proximity of these contamination sources poses a health risk to public groundwater supplies.

Every gallon of water withdrawn from the shallow aquifer comes at the expense of surface water flows (lakes, streams, wetlands). Groundwater modeling indicates that with increased pumping of the shallow aquifer, thousands of acres of wetlands could be adversely affected, along with lakes, natural springs, and streams.

Withdrawing water for public supply at the cost of significant adverse environmental impacts is another unstainable water supply strategy (RJN Environmental Services LLC, 04/2010; RJN Environmental Services, 08/2013).

In addition, a recent Wisconsin Supreme Court decision (*Lake Beulah Management District v. State of Wisconsin Department of Natural Resources,* 2011 WI 54 (July 6, 2011) determined that any party can challenge a new well permit if there is a credible case that groundwater withdrawal will adversely affect surface water held in public trust. This makes the development and long-range operation of new groundwater wells uncertain.

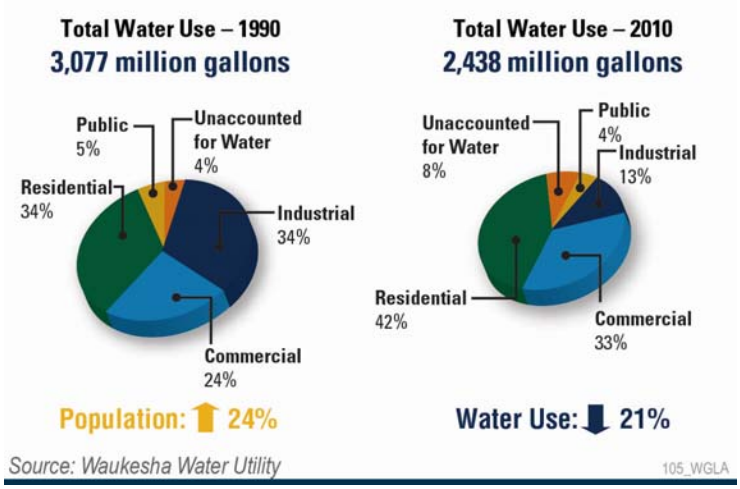
The shallow and deep aquifers both have hard water with high levels of calcium and magnesium. Most residents soften their water. Water softening produces more than seven million pounds of salt that is discharged into the environment each year, primarily through the City's wastewater treatment plant discharge to the Fox River. Pending changes to the treatment plant's discharge permit include a lower chloride limit that the City cannot meet at this time (Volume 4, City of Waukesha Return Flow Plan, Appendix A-4). Continued use of a very hard water supply and subsequent softening by customers may require additional treatment processes for permit compliance.

2.3 Water Conservation and Efficiency

There is no reasonable water supply alternative within the basin/watershed in which the community is located, including conservation of existing water supplies. Compact section 4.9.3.d.; Wis. Stat. § 281.346(4)(e)1.d.

The need for the diversion cannot be reasonably avoided through the efficient use and conservation of existing water supplies. Compact section 4.9.4.a.; Wis. Stat. § 281.346(4)(f)1.

EXHIBIT 2-7
City of Waukesha Population and Water Use 1990–2010



In 2006, the City of Waukesha launched an aggressive water conservation plan. In 2012, the City updated its conservation plan to conform with Wisconsin's Compact implementing rule, Wis. Admin. Code ch. NR 852 (Volume 3, City of Waukesha Water Conservation Plan). Over the past 7 years, the City has reduced water usage through a ban on daytime water sprinkling, rate structures that promote water conservation, a high efficiency toilet rebate program, and educational outreach. Water conservation is a factor in reduced customer demand, which in turn has reduced the number of days each year the City provides non-radium-compliant drinking water. Water conservation, loss of local industry, and commercial decline during the extended economic recession contributed to the City's recent water use trend. Between 1990 and 2010, water use decreased 21 percent, despite a corresponding 24 percent increase in population during the same period (Exhibits 2-7 and 2-8).

The City has implemented environmentally sound and economically feasible water conservation measures. It will continue to maintain and adapt its water conservation program because there are opportunities to use water more efficiently. Though reducing water use and water waste through conservation and efficiency measures contributes to the source of supply, water conservation alone is not a water supply alternative. It is only a partial solution to the City's water supply needs and cannot save enough water to avoid the need for a sustainable water supply to meet the projected future water demand.

2.4 Need for a Sustainable Water Supply

The diverted water shall be used solely for public water supply purposes of a community within a straddling county that is without adequate supplies of potable water. Compact section 4.9.3.a.; Wis. Stat. §§ 281.346(4)(e)1., 281.346(4)(e)1.a.

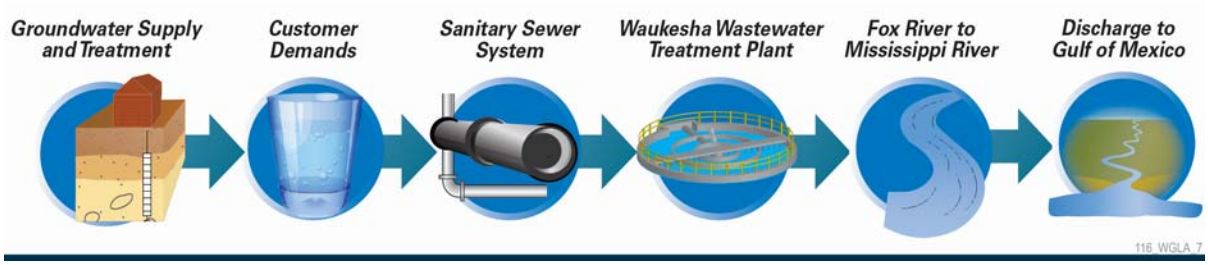
EXHIBIT 2-8
Water Use Before and After Water Conservation Measures

"'Without adequate supplies of potable water' means lacking a water supply that is economically and environmentally sustainable in the long term to meet reasonable demands for a water supply in the quantity and quality that complies with applicable drinking water standards, is protective of public health, is available at a reasonable cost, and does not have adverse environmental impacts greater than those likely to result from the proposed new or increased diversion." Wis. Stat. § 281.346(1)(zm).

There is no reasonable water supply alternative within the basin/watershed in which the community is located, including conservation of existing water supplies. Compact section 4.9.3.d.; Wis. Stat. §§ 281.346(4)(e)1.d. See also Wis. Stat. § 281.346(5m)(c)("The applicant has assessed other potential water sources for cost−effectiveness and environmental effects.").

"'Reasonable water supply alternative' means a water supply alternative that is similar in cost to, and as environmentally sustainable and protective of public health as, the proposed new or increased diversion and that does not have greater adverse environmental impacts than the proposed new or increased diversion." Wis. Stat. § 281.346(1)(ps).

EXHIBIT 2-9
City of Waukesha Water Supply Strategy



Although the City's water conservation efforts have been effective, the City concluded that its current water supply strategy—in which water is withdrawn from local aquifers at rates exceeding natural recharge and affecting water-dependent resources, is used, treated, and ultimately discharged to the Gulf of Mexico—is unsustainable (Exhibit 2-9). This conclusion is based on groundwater modeling, planning studies, and physical evidence and is supported in the independent Southeastern Wisconsin Regional Planning Commission (SEWRPC) comprehensive water supply plan which recommended that the City connect to a Lake Michigan supply and provide return flow in order to reduce existing and probable future water supply problems and to preserve and protect sources of supply (SEWRPC, 12/2010). Volume 2, Water Supply Service Area Plan, Section 7 contains additional details on the City's need for a sustainable water supply. See also Volume 1, City of Waukesha Application Summary, sections 4.4.2 and 4.4.3.

3. Water Supply Planning

Given the need for a sustainable water supply, the City undertook comprehensive water supply planning that included evaluation of a wide range of water sources and combinations of water sources to reliably meet its long-term water needs and to conserve environmental resources. In order to analyze the environmental impacts, costs, and implementation constraints associated with alternative water supplies, conceptual designs of the infrastructure needed to support each alternative were developed. Conceptual design concepts (e.g., number and capacity of wells, size and type of treatment plants, size of pipelines) were based largely on how much water the City needs to meet its long-term water demands.

The City forecast its long-term water needs in a manner consistent with adopted county, regional and state plans (Volume 2, City of Waukesha Water Supply Service Area Plan, Section 8). The City's water supply planning process, described in this section and in Section 4, Water Supply Alternatives Evaluation, conforms to Wisconsin Statutes chapter 281 and Wisconsin's draft administrative rule on Water Supply Service Area Plans (draft Wisconsin Administrative Code chapter NR 854). Chapter NR 854 implements the State's water supply plan statute, which was enacted as part of the 2008 Wisconsin law that adopted the Compact. Water demand forecasts were developed considering the following:

- Delineation of the City of Waukesha water supply service area (WSSA) by regional planners
- Development of population projections and future land use
- Establishment of water volume savings goals through water conservation and water use efficiency

In accordance with Wisconsin regulations, water demand forecasts were developed for a 20-year planning period and the ultimate buildout, or full development condition, of the WSSA. Buildout condition exists when all the land available for development in the WSSA has been developed in a manner consistent with the southeastern Wisconsin regional water quality, water supply, and land use plans. Buildout condition may be more than 40 years in the future but is a key consideration now because construction of extensive infrastructure is needed to provide a sustainable long-term water supply.

3.1 Water Supply Service Area

For the purposes of applying the application requirements [to a community within a straddling county], "the [Wisconsin Department of Natural Resources] shall use, as appropriate, the current or planned service area of the public water supply system receiving water under the proposal. The planned service area is the service area of the system at the end of any planning period authorized by the [Wisconsin Department of Natural Resources] in the approved water supply service area plan under s. 281.348 that covers the public water supply system." Wis. Stat. § 281.346(4)(bg)2. See also Wis. Stat. § 281.346(4)(e)1.em (to be approved, a proposal must be consistent with an approved water supply service area plan under Wisconsin Statute section 281.348 that covers the public water supply system).

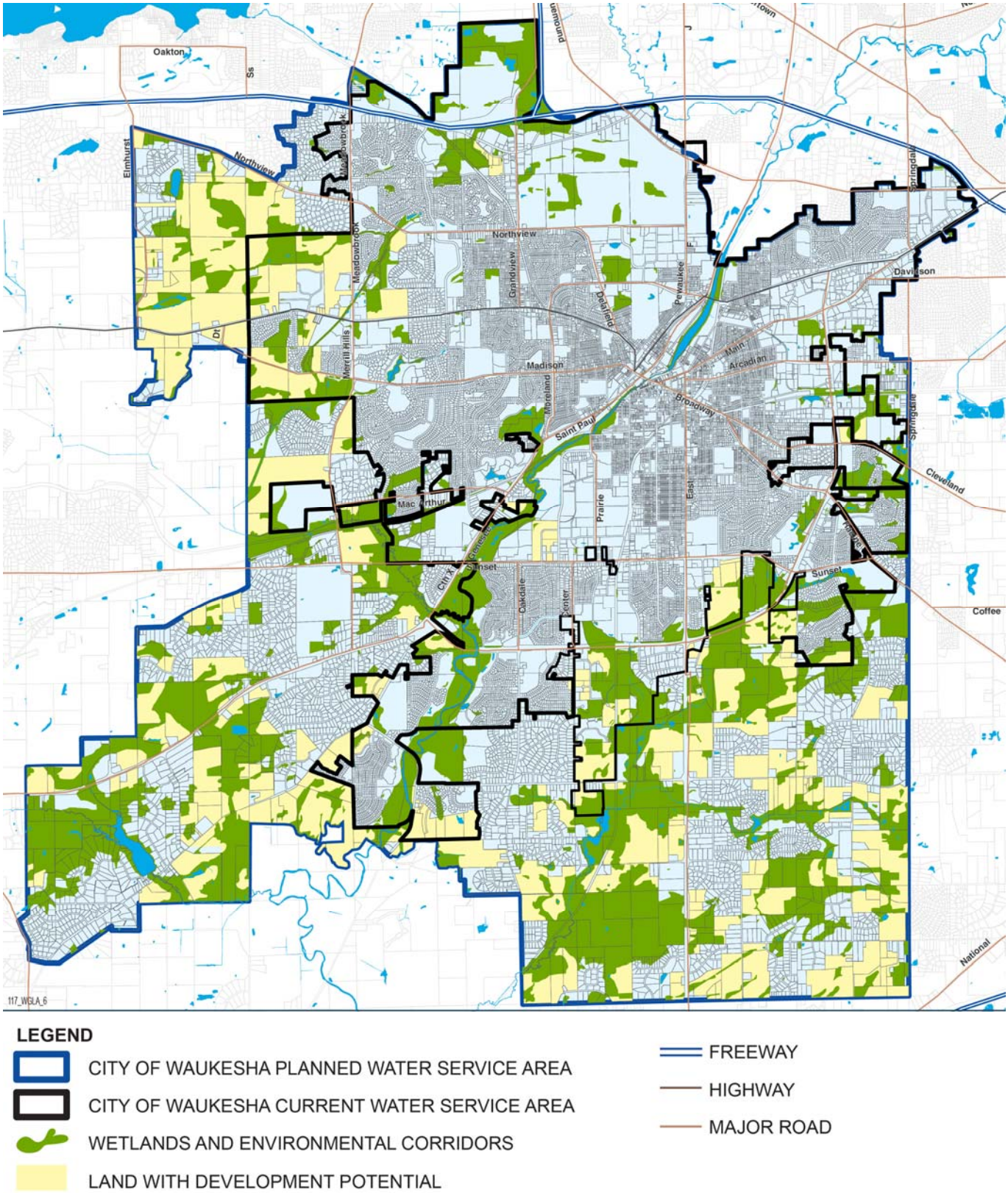
The WDNR may not limit water supply service areas based on jurisdictional boundaries, except as necessary to prevent waters of the Great Lakes basin from being transferred from a county that lies completely or partly within the Great Lakes basin into a county that lies entirely outside the Great Lakes basin. *See* Wis. Stat. § 281.348(3)(e).

"The [Wisconsin Department of Natural Resources] shall specify in a plan under this section a water supply service area for each public water supply system making a withdrawal covered by the plan. The [Wisconsin Department of Natural Resources] may not limit water supply service area based on jurisdictional boundaries, except as necessary to prevent waters of the Great Lakes basin from being transferred from a county that lies completely or partly within the Great Lakes basin into a county that lies entirely outside the Great Lakes basin." Wis. Stat. § 281.348(3)(e)

Under Wisconsin Statutes chapter 281 and Wisconsin Administrative Code chapter NR 121, SEWRPC is authorized to delineate the City's water supply service area. The WSSA, as prepared by SEWRPC, is designed to meet the requirements of the Compact and Wisconsin Statutes enacted to implement the Compact. The factors that are considered in the service area delineation include urban development densities, distance to the nearest existing

water supply service area, aquifer characteristics, and potential for groundwater contamination. The planned 20-year (through 2030) and ultimate buildout (fully developed) service areas are identical (Exhibit 3-1).

EXHIBIT 3-1
Current and Planned WSSA



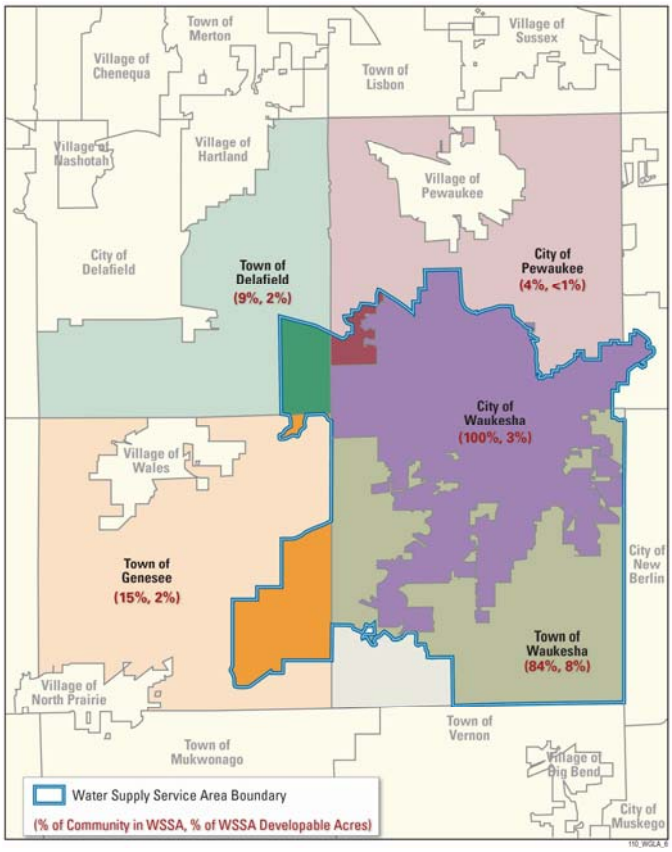
"Community within a Straddling County means any incorporated city, town or the equivalent thereof, that is located outside the Basin but wholly with a County that lies partly within the Basin and that is not a Straddling Community". Compact section 1.2. See also Wis. Stat. § 281.346(1)(d)("Community within a straddling county" is defined as "any city, village or town that is not a straddling community and that is located outside the Great Lakes basin but wholly within a county that lies partly within the Great Lakes "). A "'[s]traddling county' means a county that lies partly within the Great Lakes basin." Wis. Stat. § 281.346(1)(tm). See also Wis. Stat. § 281.348(3).

The WDNR interprets the WSSA to be a community in a straddling county under the Compact (WNDR, 8/2012).

"A person who proposes to begin a diversion or to increase the amount of a diversion under par. (c), (d), or (e) shall apply to the [Wisconsin Department of Natural Resources] for approval." Wis. Stat. § 281.346(4)(b)1.

"A person may apply under subd. 1. For approval of a new or increased diversion under par. (c) or (e) only if the person operates a public water supply system that receives or would receive water from the new or increased diversion." Wis. Stat. § 281.346(4)(b)2.

EXHIBIT 3-2
Civil Divisions within City of Waukesha WSSA



It is the responsibility of the applicant, as a person operating a public water supply system, to provide information satisfying the criteria under sec. 281.348(3)(c)1. *See also* Wis. Stat. § 281.346(4)(b).

The City currently serves the City of Waukesha and limited areas in the Town of Waukesha and the City of Pewaukee. The delineated service area includes parts of neighboring communities (Exhibit 3-2).

The communities outside the City's municipal borders are largely developed and served by private wells and septic systems, some of which have been contaminated by pathogens, pollution, and naturally occurring elements in the groundwater. In accordance with regional planning practices (SEWRPC, 12/2010), Wisconsin Statutes chapter 281, and draft Wisconsin Administrative Code chapter NR 854, the City's WSSA Plan includes provisions to allow the City to serve those areas for public health reasons. For planning purposes, it is assumed that the City will be prepared to serve the entire WSSA by 2030 (Volume 2, City of Waukesha Water Supply Service Area Plan, Section 2).

3.2 Land Use in the Water Supply Service Area

The planned WSSA covers 32,209 acres. The 2000 land use inventory and 2035 land use plan information summarized in Exhibit 3-3 demonstrate there is limited growth potential in the WSSA. Only 15 percent of the land is available for new development, because roughly 70 percent of the land is already developed and 15 percent of the land is designated as environmentally protected. In keeping with recommended land use plans, only 0.5 percent of the land outside city limits is undeveloped industrial land, and only 0.2 percent is undeveloped commercial land.

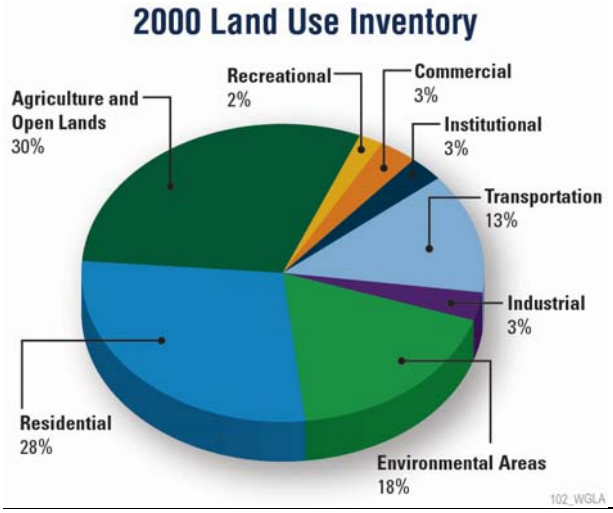
Between 2000 and 2035, little change is projected in WSSA land designated for recreational, commercial, institutional, transportation, and environmental use. The greatest anticipated changes in land use are the 19 percent increase in residential land use, 3 percent increase in industrial land use, and 26 percent decrease in agricultural and open lands. To estimate the change in residential and industrial land use between the 2000 inventory and 2010, the City used 2010 digital aerial photography, polygon land use boundaries, and parcel information from Waukesha County. The City determined that roughly 50 percent of the residential and 20 percent of the industrial projected land use changes have already occurred (Exhibit 3-4).

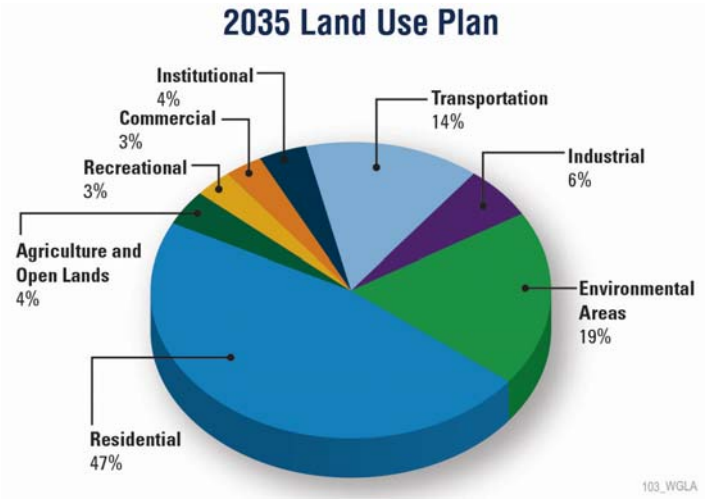
EXHIBIT 3-3

WSSA Land Use Comparison by Civil Division—2000 Inventory versus 2035 Plan

Land Use Categories	City of Pewaukee	City of Waukesha	Town of Delafield	Town of Genesee	Town of Waukesha	Grand Total
2000 LAND USE INVENTORY (acres)						
Agricultural and Other Open Lands	175	3,460	836	1,086	4,202	9,760
Commercial	0	816		9	64	889
Environmental Areas and Wetlands	53	1,670	195	932	2,711	5,562
Extractive	0	75		10	0	85
Governmental and Institutional		802	8	2	54	866
Industrial	0	987		23	38	1,048
Multi-family Residential		919		1	1	921
Recreational	13	500		26	260	800
Single-Family Residential	208	3,756	103	643	3,267	7,978
Surface Water	1	126	14	51	33	226
Transportation, Communication, and Utilities	60	2,904	43	165	904	4,075
Total	**511**	**16,014**	**1,200**	**2,949**	**11,534**	**32,209**
2035 LAND USE PLAN (acres)						
Agricultural and Other Open Lands	3	182		292	808	1,285
Commercial	0	879		26	118	1,023
Environmental Areas and Wetlands	54	1,800	214	976	2,868	5,913
Extractive						
Governmental and Institutional	15	964	43	2	162	1,186
Industrial	0	1,639		37	151	1,827
Multi-family Residential		583			0	583
Recreational	17	641	12	0	491	1,161
Single-Family Residential	366	5,999	879	1,389	5,956	14,589
Surface Water	1	114		52	33	200
Transportation, Communication, and Utilities	55	3,214	52	174	946	4,441
Total	**511**	**16,014**	**1,200**	**2,949**	**11,534**	**32,209**

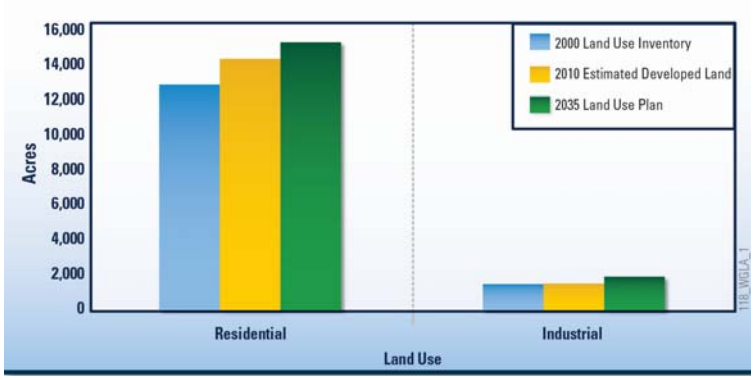
Sources: SEWRPC. 2000. *Regional Land Use Inventory*. Waukesha County. 2009. *2035 Recommended Land Use Plan.*





"Residential" is the combination of single- and multi-family residential land use acres.
"Environmental Areas" is the combination of environmental areas, wetlands, and surface waters.

EXHIBIT 3-4
WSSA Residential and Industrial Land Use



3.3 Population Projections

The diversion shall be limited to quantities that are reasonable for the purposes for which it is proposed. Compact section 4.9.4.b; Wis. Stat. § 281.346(4)(f)2.

The Wisconsin Department of Natural Resources shall specify a diversion amount equal to the quantity of water that is reasonable for the purposes for which the diversion is proposed when granting an approval for a diversion. Wis. Stat. § 281.346(4)(i).

Population growth in the WSSA is expected to occur at an annual rate of 0.5 percent through buildout. SEWRPC prepared population projections for 2035 for the City's WSSA using 2000 census information from the U.S. Census Bureau and population projections from the State of Wisconsin Department of Administration (Exhibit 3-5). In addition to the WSSA population projections, SEWRPC estimated the buildout population within each civil division (SEWRPC, 02/2012); see Exhibit 3-6 and Volume 2, City of Waukesha Water Supply Service Area Plan, Section 6.

EXHIBIT 3-5
WSSA Population Projections

Year	Population	Citation Source
2000	75,500	SEWRPC email to City, January 25, 2012
2028	85,800	SEWRPC letter to City, December 23, 2008
2035	88,500	SEWRPC *A Regional Water Supply Plan For Southeastern Wisconsin*, December, 2010
Buildout	97,400	SEWRPC letter to City, March 17, 2009

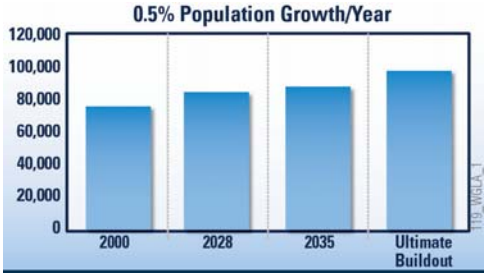


EXHIBIT 3-6
WSSA Population Projections by Civil Division in WSSA

Civil Division within WSSA	Year 2000 Population	Year 2030 Population[a]	Buildout Population
City of Waukesha (includes parts of the Town of Waukesha already served by the City)	65,700	71,105	76,330
City of Pewaukee	900	1,042–1,139	1,180–1,370
Town of Genesee	1,250	1,514–1,555	1,770–1,850
Town of Waukesha	7,410	9,485–10,552	11,490–13,590
Town of Delafield	240	535–2,284	820–4,260
Total	**75,500**	**83,681–86,636**	**91,590–97,400**

[a] Interpolated from available SEWRPC estimates.

3.4 Water Conservation Planning

The need for the diversion cannot be reasonably avoided through the efficient use and conservation of existing water supplies. Compact section 4.9.4.a.; Wis. Stat. §§ 281.346(4)(f)1.

The proposal will be implemented so as to incorporate environmentally sound and economically feasible water conservation measures to minimize water withdrawals and consumptive use. Compact section 4.9.4.e.; see also Wis. Stat. § 281.346(4)(f)6.

"Environmentally Sound and Economically Feasible Water Conservation Measures" mean those measures, methods, technologies or practices for efficient water use and for reduction of water loss and waste or for reducing a Withdrawal, Consumptive Use or Diversion that i) are environmentally sound, ii) reflect best practices applicable to the water use sector, iii) are technically feasible and available, iv) are economically feasible and cost effective based on an analysis that considers direct and avoided economic and environmental costs and v) consider the particular facilities and processes involved, taking into account the environmental impact, age of equipment and facilities involved, the processes employed, energy impacts and other appropriate factors. Compact section 1.2. See also Wis. Stat. § 281.346(1)(i).

An applicant shall document the water conservation planning and analysis used to identify the water conservation and efficiency measures that the applicant determined were feasible. Wis. Stat. § 281.346(4)(g).

The City implemented water conservation measures to effectively and efficiently conserve water resources and to help meet the goal of providing radium-compliant water at all times. The City's initial 2006 water conservation plan set short-, mid-, and long-term conservation goals, and the City successfully implemented the following:

- Wisconsin's first inclining block water rate structure, to encourage conservation
- Wisconsin's first ordinance to ban daytime sprinkling
- Wisconsin's first rebates for high-efficiency toilets
- School and general public information and education campaigns

Annual water main replacement projects and flow meter maintenance are other examples of other City investments to minimize water loss and use water efficiently.

In addition to operational savings (reduced energy and treatment costs), water conservation and water use efficiency reduce the volume of water needed from the City's sources of supply. For these reasons, water conservation measures will remain in place and continue to expand, regardless of source of supply.

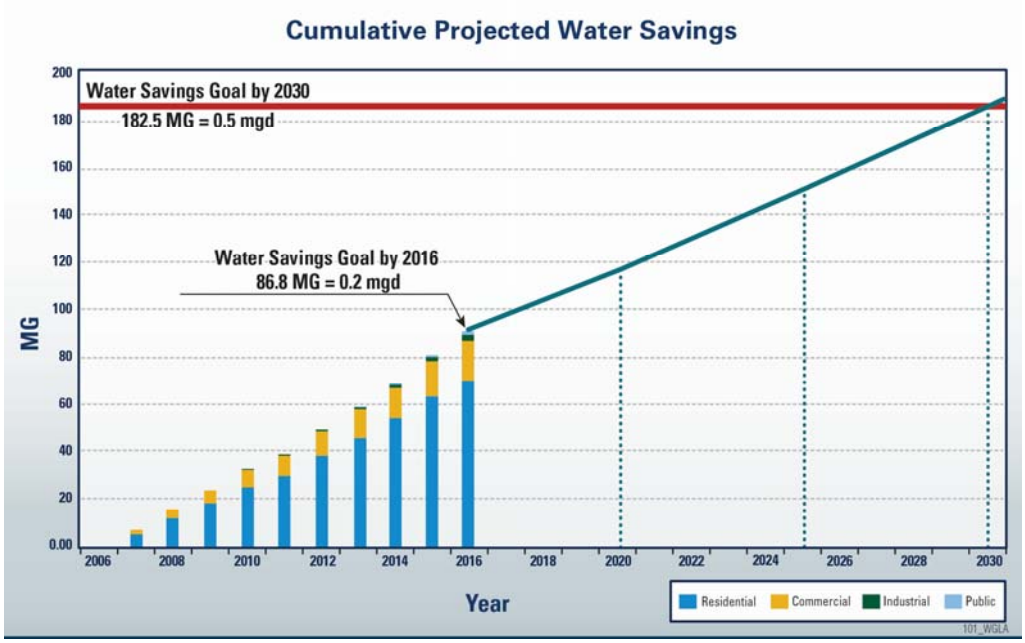
In 2012, the City revised its water conservation plan to conform to the Wisconsin Water Conservation and Water Use Efficiency administrative rule set forth in Wisconsin Administrative Code chapter NR 852, adopted by the State in 2010 to comply with the Compact. Compliance with the rule is mandatory for new or increased Great Lakes diversions (Volume 3, City of Waukesha Water Conservation Plan).

In accordance with chapter NR 852, the City evaluated, prioritized, and scheduled for implementation a wide range of supply- and demand-side water conservation and efficiency measures. Further, the revised plan documents the process the City is using to develop, implement and monitor its portfolio of environmentally sound and economically feasible water conservation measures.

The City's present and future actions target an overall 10 percent reduction in water use, or an increase in water efficiency. A 10 percent reduction in water use is equivalent to roughly 1 million gallons per day (mgd) for ultimate buildout of the City's water supply service area. Exhibit 3-7 shows near- and long-term target water savings from conservation (CH2M HILL, Vickers, and Foy, 05/2012).

Implementation of the conservation program involves continuous monitoring of program effectiveness, annual reporting to the PSC, and investigation of state-of-the-art conservation technologies. Comprehensive documentation of the City's water conservation planning process, analysis of water use by its customers, evaluation of potential conservation measures, and development of implementation schedules and budgets are presented in Volume 3, The City of Waukesha Water Conservation Plan.

EXHIBIT 3-7
Water Savings Goal and Projected Water Savings



3.5 Water Demand Forecasts

The diversion shall be limited to quantities that are reasonable for the purposes for which it is proposed. Compact section 4.9.4.b.; Wis. Stat. § 281.346(4)(f)2. See also Wis. Stat. § 281.346(4)(i).

Developing reliable water demand forecasts involves analysis of wide-ranging historical data and consideration of variable factors that affect water use, such as climate change and the economy. The City's water demand forecasts are based on analysis of water use data, land use plans, water conservation practices, and economic conditions. The City's water demand forecasts are conservative. They include a margin of safety to avoid under-predicting future needs because of the uncertainties inherent to long-term projections. The forecasts (Exhibit 3-8) are also based on reasonable assumptions that reflect conditions within the service area and are consistent with regional water use projections.

EXHIBIT 3-8
Water Demand Forecast Summary

	Average Day Demand	Maximum Day Demand
2030	9.7 mgd	16.1 mgd
Buildout	10.1 mgd	16.7 mgd

The water demand forecasts were prepared following two common approaches:

- Regional planning water use coefficients calibrated to land use and refined to service area conditions
- Water use coefficients for customers by categories (residential, commercial, industrial, and public) based on historic City water use and water system performance

Since the early 1990s, the City has prepared water demand forecasts every 5 years as part of its master planning process. Water demand forecasts prepared for the 2006 water system master plan were updated in 2009 to reflect WSSA population projections and implementation the City's water conservation plan. The 2009 projections were updated in 2013 to reflect updates to the water conservation plan and to provide supplemental projections calibrated to land use plans. Volume 2, Water Supply Service Area Plan, Appendix C contains the detailed development of the water demand forecasts. The key criteria and factors that form the basis of the City's current water demand forecasts include the following:

- Historically, per-capita water use factors have been useful tools in projecting near- and long-term City water use, which is important for assessing financial and facility needs. The City will continue to monitor per-capita water use as part of its water conservation program and in its annual budget-setting process.

- Land within the WSSA is approximately 70 percent developed, 15 percent undeveloped, and 15 percent designated as "environmental areas." There are no significant changes in planned land use between current conditions and the 2035 recommended land use plan or the plan at buildout.
- With the availability of more water-efficient fixtures, appliances, and equipment, water use has declined. But given the age of the City's housing stock, there are still fixtures that can be retrofit with water-efficient devices.
- The City's water conservation program applies to all public water system customers in the WSSA. The program will continue to be implemented, monitored, and adapted as needed to cost-effectively meet the City's water savings goals of 0.5 mgd by 2030 and 1 mgd, or 10 percent, at ultimate buildout.
- Water use over the last 10 years reflects the influences of water efficiency in the marketplace, the City's water conservation program, and weak economic conditions occurring after the terrorist attacks on September 11, 2001, and the start of the recession in 2008, which resulted in loss of local industry and reduced industrial water use. The average water use factors for this 10-year period are used in the water demand forecasts: 44 gallons per capita day (gpcd) for residential customers; 33 gpcd for commercial customers; and 4 gpcd for public uses.
- To develop a range of water demand projections for industrial customers, two intensity factors were used:
  - 642 gallons/acre/day, which is equivalent to the current water use and which is the lowest historic level.
  - 1,297 gallons/acre/day, which is equivalent to industrial water use intensity in 2000. *Note:* This value is a modest representation of industrial water use prior to September 11, 2001, and is a value less than SEWRPC's planning factor of 1,500 gallons/acre/day.
- The maximum day demand (MDD) is 1.66 times greater than average day demand (ADD).
- Unaccounted-for water was projected at 8 percent of total water pumpage, which is less than the American Water Work Association recommended target of 10 percent and less than the state average of 17 percent.
- There is risk associated with using historic water use, water system performance, and population projections to forecast future water requirements. Uncertainties in planning factors increase as planning horizons extend farther into the future. Some contingency is required in long-term water supply planning to account for drought, changes in customer class (particularly the number and type of commercial and industrial users), and prevailing economic conditions.

Applying these criteria and factors, the ranges of forecast ADD and MDD are depicted in Exhibit 3-9. Exhibit 3-10 presents the projected ADD by customer class for the planning period in 5-year increments. Exhibit 3-11 lists the estimated ADD and MDD requirement for the 20-year planning period and ultimate buildout by civil division. The population projections and water demand forecasts support the reasonableness of the City's diversion request. SEWRPC projections strongly support these numbers as well (SEWRPC, 12/2012).

FIGURE 3-9
Water Demand Forecasts

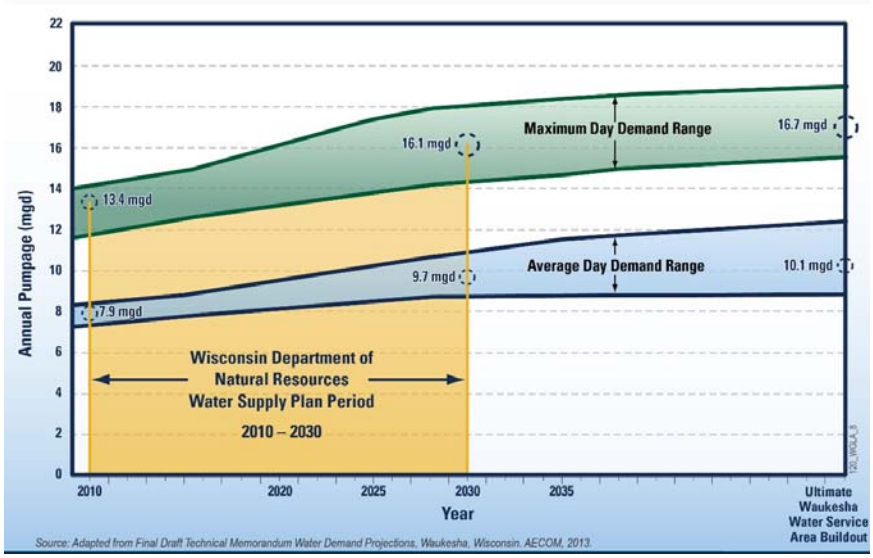


EXHIBIT 3-10
Five-Year Period Water Demand Projections for WSSA

Description	Actual 2012	Projected Water Demands (mgd)							
		2015	2020	2025	2030	2035	2040	2045	Buildout
Population	71,697	74,187	78,337	82,486	86,636	89,327	92,018	94,7099	97,400
Residential sales (44 gpcd)	2.9	3.1	3.2	3.3	3.4	3.4	3.4	3.5	3.5
Public sales (4 gpcd)	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4
Commercial sales (33 gpcd)	2.3	2.4	2.5	2.7	2.8	2.8	2.9	3.0	3.1
Industrial sales (1,297 gal./acre/day)	0.9	2.0	2.1	2.2	2.4	2.4	2.4	2.4	2.4
Commercial sales	6.4	7.8	8.2	8.5	8.9	9.0	9.1	9.2	9.3
Industrial sales	0.6	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8
Average day	**7.0**	**8.5**	**8.9**	**9.3**	**9.7**	**9.8**	**9.9**	**10.0**	**10.1**
Maximum day	**10.8**	**14.1**	**14.8**	**15.4**	**16.1**	**16.2**	**16.4**	**16.6**	**16.7**

EXHIBIT 3-11
Year 2030 and Ultimate Buildout Water Average Demand Forecasts by Customer Class and Civil Division

Civil Division	Population	Residential (mgd)	Commercial (mgd)	Public (mgd)	Industrial (mgd)	UFW (mgd)	Total (mgd)
Year 2030							
City of Waukesha	71,105	2.80	2.28	0.28	2.12	0.65	8.1
City of Pewaukee	1,139	0.04	0.04	0.00	0.00	0.01	0.1
Town of Genesee	1,555	0.06	0.05	0.01	0.05	0.01	0.2
Town of Waukesha	10,522	0.41	0.34	0.04	0.20	0.09	1.1
Town of Delafield	2,284	0.09	0.07	0.01	0.00	0.01	0.2
Total	**86,636**	**3.41**	**2.78**	**0.34**	**2.37**	**0.77**	**9.7**
Ultimate Buildout							
City of Waukesha	76,330	2.72	2.39	0.30	2.12	0.65	8.2
City of Pewaukee	1,370	0.05	0.04	0.01	0.00	0.01	0.1
Town of Genesee	1,850	0.07	0.06	0.01	0.05	0.02	0.2
Town of Waukesha	13,590	0.48	0.43	0.05	0.20	0.10	1.3
Town of Delafield	4,260	0.15	0.13	0.02	0.00	0.03	0.3
Total	**97,400**	**3.47**	**3.06**	**0.38**	**2.37**	**0.81**	**10.1**

4. Water Supply Alternatives Evaluations

4.1 Background

The need for a sustainable water supply for the City is discussed in Section 2. This section 4 summarizes the available water supply alternatives for the City and provides a comparative analysis to determine reasonable water supply alternatives. Details of the water supply alternatives and comparative analyses can be found in Volume 2, City of Waukesha Water Supply Service Area Plan, Section 11 and Volume 5, City of Waukesha Environmental Report for Water Supply Alternatives.

A proposal to transfer water to a community within a straddling county is excepted from the prohibition against diversions, provided that it satisfies several conditions, including "[t]here is no reasonable water supply alternative within the basin in which the community is located, including conservation of existing water supplies." Compact section 4.9.3.d. See also Wis. Stat. § 281.346(4)(e)1.d. ("There is no reasonable water supply alternative within the watershed in which the community is located, including conservation of existing water supplies . . ."). "'Reasonable water supply alternative' means a water supply alternative that is similar in cost to, and as environmentally sustainable and protective of public health as, the proposed new or increased diversion and that does not have greater adverse environmental impacts than the proposed new or increased diversion." Wis. Stat. § 281.346(1)(ps).

Recognizing that the City's current water supply sources—the deep confined aquifer and shallow aquifer—are unsustainable, the City extensively investigated alternative water supplies. Fourteen water supply sources, and combinations of sources, were evaluated. Six water supply alternatives based on these water sources are analyzed in detail. The technical studies of water supply alternatives all included analysis of environmental impacts, public health protection, and environmental sustainability.

This Application also uses information from previous studies of water supplies in Southeastern Wisconsin (SEWRPC, 2010; Cherkauer, 02/2010; Reeves, 2010; USGS, 03/2007; Feinstein, 10/2006; CH2M HILL, 2002). The studies and evaluations are found in Volume 2, City of Waukesha Water Supply Service Area Plan, Section 11, and Volume 5, City of Waukesha Environmental Report for Water Supply Alternatives.

SEWRPC is charged by law with making and adopting a comprehensive plan for the physical development of the seven county region, including Waukesha. In 2010, SEWRPC completed an extensive water supply study (SEWRPC, 12/2010). This study included SEWRPC conducting extensive groundwater and surface water modeling to evaluate water supply alternatives. SEWRPC also completed a socioeconomic study on water supply alternatives (University of Wisconsin–Milwaukee, Center for Economic Development, 07/2010).

SEWRPC compared a Waukesha Lake Michigan water supply with return flow alternative to alternatives using current or new groundwater supplies (deep and shallow aquifers) with water return to the Fox River. SEWRPC recommended a Lake Michigan water supply for Waukesha based on long-term sustainability, environmental and water quality benefits (SEWRPC, 12/2010). SEWRPC noted other advantages of Waukesha switching from a ground water supply to a Lake Michigan supply, including:

- Greater groundwater level recovery in the deep aquifer, improving sustainability and water quality
- Using Lake Michigan water production capacity, with potential cost advantages to both the supplier and supplied utilities

On that basis, SEWRPC recommended that the City change from a groundwater supply to a Lake Michigan water supply. Thirty-two experts with varied interests and perspectives in the region concurred with this recommendation. Some of the experts included representatives from WDNR, USGS, Wisconsin Geological and Natural History Survey, and the University of Wisconsin–Milwaukee.

4.2 Evaluation Criteria

The City's evaluation criteria for water supply alternatives were developed applying the standards and conditions of the Compact. The overarching principle is protection of the integrity of the Great Lakes–St. Lawrence River Basin Ecosystem. The evaluation criteria recognize uncertainties with respect to demands that may be placed on Basin Water, including groundwater, levels and flows of the Great Lakes and the St. Lawrence River, future changes in environmental conditions, the reliability of existing data and the extent to which Diversions may harm the integrity of the Basin Ecosystem. (Compact section 4.5.1.d.) The City also prepared an environmental report detailing the environmental impacts of water supply alternatives. Volume 5, City of Waukesha Environmental Report for Water Supply Alternatives.

In addition, the City used proven principles of sound water supply planning, such as protection of public health, long-term sustainability, and reliability. Finally, the City used practical aspects of implementing a public water supply system, such as impacts on land owners and other water users.

The following water supply alternative evaluation criteria were developed with input from WDNR:

- Environmental Impacts
  - Impact on groundwater resources
  - Impact on wetlands and surface water ecosystem aquatic habitats
- Long-Term Sustainability
  - Amount of water returned to the original source
  - Reliability during droughts to provide adequate water
- Public Health
  - Potential for contamination
  - Quality of the water and treatment required to protect public health
  - Number of different water qualities to be blended to create a consistent water quality to customers
- Implementability
  - Operation and maintenance requirements
  - Infrastructure and land requirements
  - Coordination with other government entities (county, city, town, state)
  - Impact on other wells

Specific metrics for each criteria are set forth in Volume 2, City of Waukesha Water Supply Service Area Plan, Exhibit 11-5. Based on these evaluation criteria, each water supply alternative was categorized as follows:

- ○ No adverse impact or risk
- ⦿ Minor adverse impact or risk
- ◉ Moderate adverse impact or risk
- ● Significant adverse impact or risk

The environmental impact criteria summarized in this Application Summary are those with significant adverse impacts for some water supply alternatives. Environmental criteria that do not have significant adverse impacts for some water supply alternatives are not summarized here, but are included in the Environmental Report. Additional criteria with no or only minor adverse impacts include such environmental categories as flooding, water quality, soils, and land use (see Volume 5, Environmental Report for Water Supply Alternatives, Section 1 for a summary of impacts and Section 6 for a comprehensive comparison of alternatives).

4.3 Water Supply Alternatives

The City and others have extensively studied the water resources in the Waukesha area (SEWRPC, 12/2010; Cherkauer, 02/2010; Reeves, 2010; USGS, 03/2007; WGNHS and USGS, 10/2006). The City evaluated the 14 water supply sources listed in Exhibit 4-1 for this Application (CH2M HILL and Reukert-Mielke, 2002). Only one water supply source—the deep confined aquifer—is within the City's borders.

Ten of the 14 sources were not selected for further evaluation as the sole water supply because of inadequate quantity, major environmental or regulatory issues and other factors shown in Exhibit 4-2 (CH2M HILL and Reukert-Mielke, 2002; Volume 2, City of Waukesha Water Supply Service Area Plan, Exhibit 11-1). However, some of the water supply sources were used as a portion of a water supply alternative that was evaluated further.

Six water supply alternatives, including four using a combination of water sources, were selected for detailed evaluation in this Application (see also Exhibit 4-1).

1. Deep confined aquifer and shallow aquifer
2. Lake Michigan
3. Shallow aquifer and Fox River alluvium
4. Lake Michigan and shallow aquifer
5. Deep unconfined aquifer
6. Multiple source waters (deep aquifers, shallow aquifers, surface waters)

EXHIBIT 4-1
Water Supply Sources Evaluated

Conceptual designs of the infrastructure needed to implement each alternative were prepared to support technical analysis of each option and the preparation of cost estimates. Design concepts were based on compliance with applicable municipal, state and federal laws. Groundwater modeling, streamflow analysis, and other technical studies were conducted on the water supply alternatives. Details of these analyses are in Volume 2, City of Waukesha Water Supply Service Area Plan (Section 11) and Volume 5, City of Waukesha Environmental Report for Water Supply Alternatives.

EXHIBIT 4-2
Water Supply Sources Not Selected

Potential Water Supply Source	Primary Reason for Not Being a Primary Water Supply Source
Dolomite Aquifer	Insufficient water in the aquifer to meet the needs of the City of Waukesha.
Fox River	Inability to provide a reliable supply during dry periods, when public water supply is most needed.
Rock River	Inability to provide a reliable supply during dry periods, when public water supply is most needed.
Dam on the Fox or Rock River	Environmental impacts, regulatory issues, and public/property concerns.
Waukesha Quarry	Inadequate supply, water quality contamination potential, used for other purposes.
Waukesha Springs	Insufficient water in the aquifer to meet the needs of the City of Waukesha.
Pewaukee Lake	Insufficient water to meet the needs of the City of Waukesha, adverse environmental impacts, property owner concerns.
Milwaukee River	Poor quality, environmental impacts.
Wastewater Reuse	Public health and perception, water quality concerns, treatment requirements, limited supply, seasonal demand, regulatory issues.

A general description of the six water supply alternatives follows. More detailed descriptions of the alternatives can be found in Volume 2, City of Waukesha Water Supply Service Area Plan, Exhibit 11-4.

4.3.1 Alternative 1—Deep Confined Aquifer and Shallow Aquifer

Alternative 1 consists of continued use of some of the deep wells in the confined aquifer (St. Peter through Mt. Simon sandstone) and additional wells in the shallow aquifer south of Waukesha (Troy Bedrock Valley). To meet a future maximum day demand of 16.7 mgd, infrastructure would be in place for 7.6 mgd firm capacity from the existing deep wells and 9.1 mgd from shallow wells. After treatment, water from the wells would be blended in a pipeline to the Hillcrest reservoir and then distributed throughout the City. Exhibit 4-3 shows the facilities associated with Alternative 1.

A summary of the Alternative 1 evaluation based on the water supply alternative evaluation criteria follows. Detailed evaluations and analysis are in Volume 2, City of Waukesha Water Supply Service area Plan, Section 11.4.1 and Volume 5, City of Waukesha Environmental Report for Water Supply Alternatives, Sections 2 and 6.

Environmental Impacts

- Groundwater levels in the deep confined aquifer are significantly depressed (400 to 600 feet below ground). Excessive groundwater drawdown below the confining unit can expose sulfide minerals to oxygen and increase levels of toxic metals, such as arsenic. This could create a regional contamination issue and either limit the availability of this groundwater resource or require additional treatment before use. Exposure to oxygen can also provide conditions for growth of pathogenic microorganisms in wells, which has occurred in a number of deep wells (CH2M HILL and Ruekert-Mielke, 03/2002). Changing the physical and biological nature of the aquifer creates adverse environmental impacts and is not environmentally sustainable.
- The natural flow of groundwater toward the Great Lakes Basin is reversed to flow away from the Great Lakes Basin because the deep aquifer is hydrologically connected to the Great Lakes Basin (USGS, 2007). The USGS estimates that 30 percent of the water pumped by the deep aquifer wells in Southeast Wisconsin originates from inside the Lake Michigan Basin (WGNHS and USGS, 10/2006). This reduces the amount of water available to the waters and water-dependent resources of the Great Lakes Basin, causing adverse environmental impacts.
- Radium treatment, which is required because the deep aquifer water exceeds drinking water regulations for radium, releases radium into the environment and increases water use due to high volumes of water wasted during the radium treatment process (AWWA Research Foundation, 2005).
- The water in the deep and shallow aquifers is hard, requiring home water softening. This results in Waukesha residents discharging over 7 million pounds of salt into the environment every year (CH2M HILL, 2002 and SEWRPC, 12/2010). Discharge water quality requirements could be met, although continued discharge to the Fox River requires a water quality variance for chloride with home water softening being a significant source (Volume 5 City of Waukesha Environmental Report for Water Supply Alternatives, Section 6.4.2.3).
- From a water balance perspective, every gallon pumped from shallow wells will come at the expense of surface water, either from reduced baseflow discharge or from induced recharge from surface water. Water extracted from the ground reduces the water that would naturally flow to wetlands, lakes and streams (baseflow). Two lakes, 7 springs in the 5- to 50-gpm range, and more than 3,000 acres of wetlands in the 1-foot and greater drawdown area could be adversely affected by pumping the deep and shallow wells (see Volume 5, City of Waukesha Environmental Report for Water Supply Alternatives, Section 6.4.4.1 for springs and lakes, and Section 6.4.3 for wetlands).
- Baseflow would be reduced more than 60 percent in segments of streams from the shallow aquifer groundwater pumping. Sensitive environmental areas are adversely affected, such as the Vernon Marsh Wildlife Area and Pebble Brook, a class II trout stream (see Volume 5, City of Waukesha Environmental Report for Water Supply Alternatives, Section 6.4.2.2).

Long-Term Sustainability

- Deep and shallow aquifer water is not returned to its source. Rather, it is discharged into the Fox River and eventually into the Gulf of Mexico (Exhibit 4-4). Continuing to pump the deep confined aquifer is an unsustainable use of water resources (Volume 2, City of Waukesha Water Supply Service Area Plan, Section 7).

EXHIBIT 4-3

Facilities for Alternative 1: Deep and Shallow Aquifers

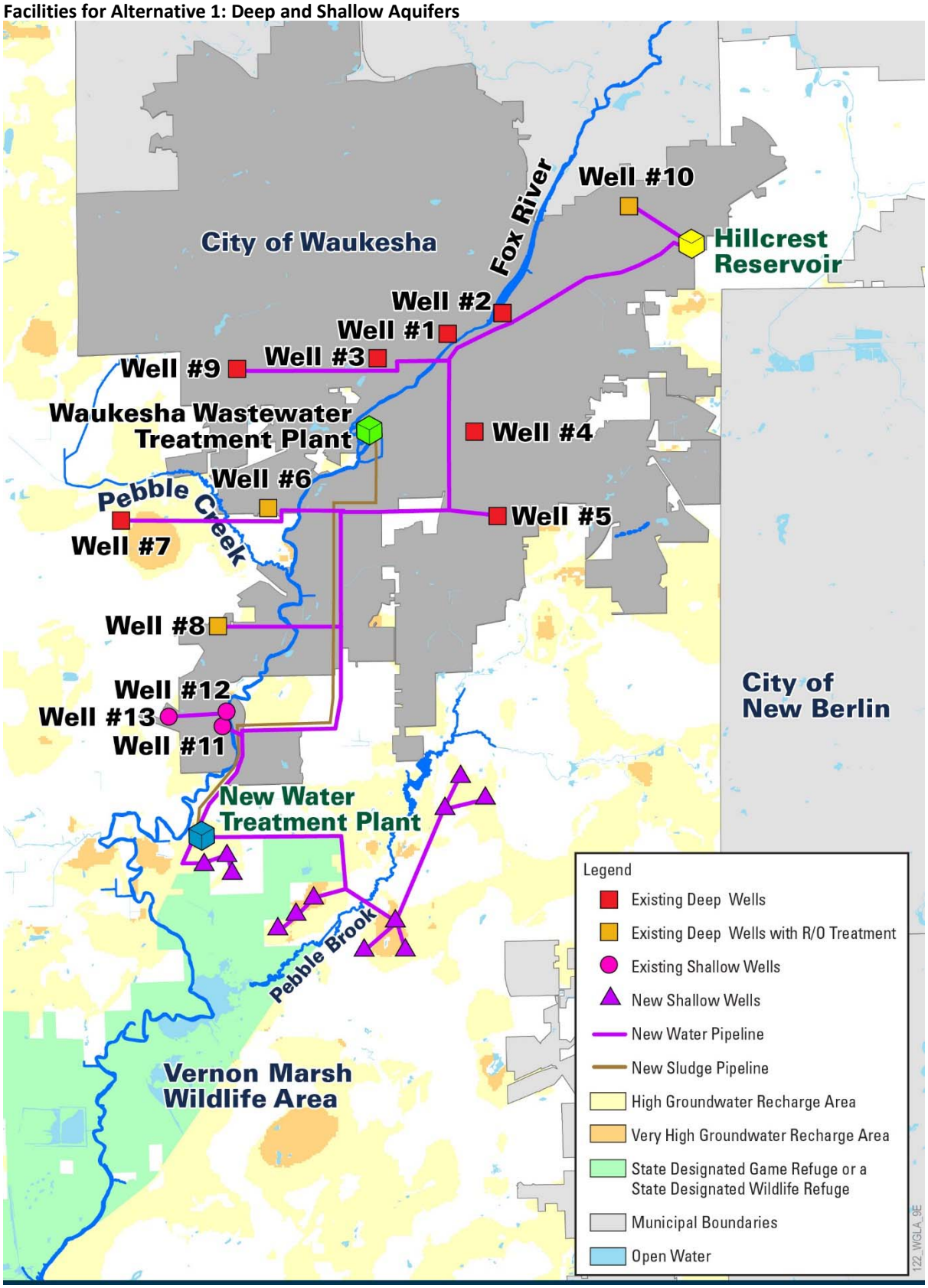
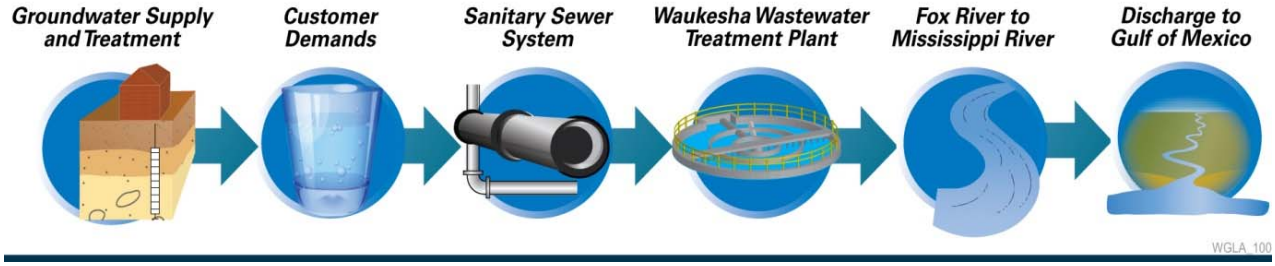


EXHIBIT 4-4
Groundwater Supply Water Cycle



- As the shallow aquifer depends directly on rainwater for recharge, it is less reliable during drought conditions, when water supply is needed most. The City's shallow well capacity was reduced about 20 percent during the 2012 drought (Waukesha Water Utility pumpage data, 2012).

Public Health

- There is greater risk to public health because deep aquifer radium levels exceed drinking water regulations and there are many other sources of potential contamination (Volume 2, City of Waukesha Water Supply Service Area Plan, Section 11.4.1.4).
- Contaminants can pass quickly through sand and gravel aquifers. There are 254 potential sources of contamination in the deep and shallow aquifer wells within a 1-mile radius or 1-foot drawdown contour (WDNR, 07/2012). Shallow aquifers are also susceptible to contamination from agricultural chemicals, septic tanks, road salt, and runoff (Volume 2, City of Waukesha Water Supply Service Area Plan, Section 11.4.1.4).
- Test wells in the shallow aquifer south of the City (Lathers property) contained arsenic at levels above drinking water standards (Davy Laboratories, 2007).

Implementability

- There are more than 1,300 private and municipal wells in the 5-foot and greater drawdown area that could be affected by pumping the deep and shallow wells. Volume 2, City of Waukesha Water Supply Service Area Plan, section 11.4.1.4)

In addition to the technical basis for determining that the shallow aquifer supply may not be implementable due to its unreliability as a supply source, relying on the shallow aquifer is uncertain from a legal perspective. For example, the following may cause confusion or conflict regarding protection of shallow groundwater resources: high capacity well statutes and regulations (see, for example, Wisconsin Statutes section 281.34 and Wisconsin Administrative Code chapter NR 820); competing interests due to natural resource impacts and other water resource uses (see, for example, Wis. Stat. § 281.34(5m)("No person may challenge an approval, or an application for approval, of a high capacity well based on the lack of consideration of the cumulative environmental impacts of that high capacity well together with existing wells") and *Family Farm Defenders, Inc. v. DNR,* 1012AP001882, Court of Appeals District 4(pending case)); and, the Wisconsin Supreme Court decision on waters held in public trust (*Lake Beulah Management District v. State of Wisconsin Department of Natural Resources,* 2011 WI 54 (July 6, 2011)(any party can challenge a new well permit if there is a credible case that groundwater withdrawal will adversely affect surface water held in public trust)).

EXHIBIT 4-5
Summary of Evaluation Criteria for Deep and Shallow Aquifer Alternative

Major Criteria	Overall
Environmental Impacts	●
Long-Term Sustainability	●
Public Health	●
Implementability	●

○ No adverse impact or risk
◉ Moderate adverse impact or risk
⊙ Minor adverse impact or risk
● Significant adverse impact or risk

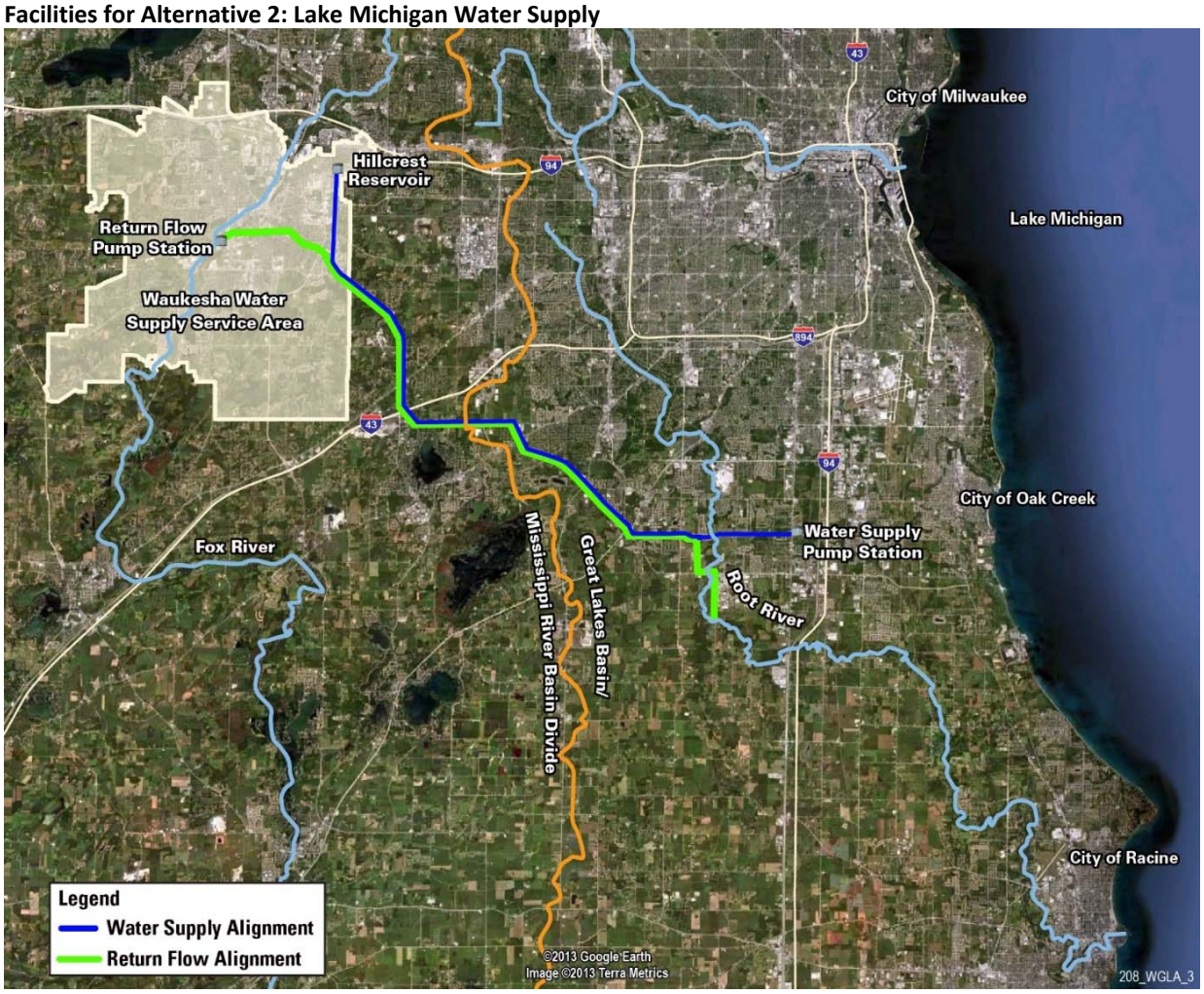
Exhibit 4-5 summarizes the Alternative 1 evaluation.

4.3.2 Alternative 2—Lake Michigan with Return Flow

Alternative 2 consists of a Lake Michigan water supply (the City of Oak Creek, Wisconsin) and return flow to a Lake Michigan tributary (Root River). The City discussed the purchase of potable water from Lake Michigan with the City of Milwaukee, the City of Oak Creek, and the City of Racine, all of which are within the Great Lakes Basin and operate public water utilities that withdraw water from Lake Michigan. Following discussions with the potential suppliers, a Letter of Intent for water supply was signed with the City of Oak Creek.

Several options for a return flow pipeline were evaluated, all starting with a pump station at the Waukesha wastewater treatment plant. Discharge location options include tributaries to Lake Michigan, through Underwood Creek and Root River, through the Milwaukee Metropolitan Sewerage District collection system and direct discharge to Lake Michigan through an outfall. The Root River location was selected based on benefits to the Great Lakes Basin and implementability. See Volume 2, City of Waukesha Water Supply Service Area Plan (Section 11) and Volume 4, City of Waukesha Return Flow Plan, for additional information on and analysis of selection of the water supplier and return flow location. Exhibit 4-6 shows the facilities associated with Alternative 2.

EXHIBIT 4-6
Facilities for Alternative 2: Lake Michigan Water Supply



A summary of the Alternative 2 evaluation based on the water supply evaluation criteria follows. Detailed evaluations and analysis are in Volume 2, City of Waukesha Water Supply Service area Plan, Section 11.4.2 and Volume 5, City of Waukesha Environmental Report on Water Supply Alternative, Sections 2 and 6.

Environmental Impacts

- A Lake Michigan water supply will allow the City to cease pumping the deep aquifer (the City's current water source), which will help restore the natural flow regime of the groundwater toward the Great Lakes Basin

instead of away from it, since the deep aquifer is hydrologically connected to the waters of the Great Lakes Basin (USGS, 2007). "[S]ubstantive consideration will also be given to whether or not the Proposal can provide sufficient scientifically based evidence that the existing water supply is derived from groundwater that is hydrologically interconnected to Waters of the Basin." Compact section 4.9.3. See also Wis. Stat. § 281.346(4)(e)2. Ceasing to pump the deep and shallow aquifer water will reverse the adverse environmental impacts of using groundwater by the City and improve the water and water-related ecosystems in the Great Lakes and Mississippi River basins (USGS, 03/2007). This issue is also discussed in section 2.2.1.

- Radium in waste streams from treatment of deep aquifer water will be eliminated, thus radium will not be released into the environment.
- Because Lake Michigan water is much softer than groundwater, home water softening will be reduced substantially, eliminating millions of pounds of salt from being discharged into the environment every year (CH2M HILL, 2002 and SEWRPC, 12/2010). Implementing a chloride reduction plan shows chloride water quality standards in the Root River would be met (see Volume 5, City of Waukesha Environmental Report for Water Supply Alternatives, Section 6.4.2.3).
- The increase in tributary flow for higher flow events is a minor change (less than 1 percent) (see Volume 5, City of Waukesha Environmental Report for Water Supply Alternatives, Section 5.1.2.2).
- The City's shallow aquifer pumping will cease with a Lake Michigan water supply. Therefore, the significant drawdown of the shallow aquifer and adverse impacts on surface water systems described in Alternative 1 would be eliminated (RJN Environmental Services, 04/2010; RJN Environmental Services, 08/2013).
- After use and treatment, no less than 100 percent of the withdrawn water volume will be returned to Lake Michigan, so there will be no impact on lake levels (See Volume 4, City of Waukesha Return Flow Plan, Section 2).
- Return flow ensures that the City's use of Lake Michigan water will not result in an adverse individual or cumulative impact to the water dependent industries of the Great Lakes, such as shipping or hydropower generation (Volume 4, City of Waukesha Return Flow Plan, Section 2).
- Return flow to the Root River will enhance the water and water-dependent resources of this Great Lakes tributary. Most notably, return flow will enhance operations at the Root River Steelhead Facility by improving baseflow and egg harvesting operations, which will benefit the Great Lakes Basin. Returning the water to a tributary creates a positive precedent for using treated wastewater as a beneficial environmental resource. For details, see Volume 4, City of Waukesha Return Flow Plan.
- Return flow management and the City's efforts to reduce sewer system infiltration and inflow will minimize introduction of out-of-basin water to the Great Lakes. Return flow will meet all applicable water quality discharge standards and in fact meet requirements that are more stringent than those for other dischargers to Lake Michigan or Lake Michigan tributaries. With a wastewater treatment process that includes filtration and ultraviolet light disinfection, there are no opportunities for invasive species from the Mississippi River Basin to be introduced to the Great Lakes Basin. There will be no significant adverse impacts to the quality or quantity of water in the Great Lakes (see Volume 5, City of Waukesha Environmental Report for Water Supply Alternatives, Section 6.4.2.3).
- Baseflow in the Fox River will be reduced, since deep and shallow aquifer water will not be supplementing the Fox River flow (see Volume 5, City of Waukesha Environmental Report for Water Supply Alternatives, Section 6.4.2.2).

Long-Term Sustainability

- All the water volume withdrawn will be returned to its original source in this alternative, providing the City with adequate quantities of high quality water indefinitely (Exhibit 4-7). This is an example of water reuse that is sustainable and protective of the environment.

Public Health

- Contamination is possible, as with all supplies, but the large size, intake locations and high quality of Lake Michigan water makes this a rare occurrence.
- With a Lake Michigan water supply, the deep aquifer would no longer be used and public exposure to radium would be eliminated.

Implementability

- No wells would be affected under this alternative, because no groundwater drawdown occurs.
- Public concerns over impacts to groundwater levels and long-term wetland and stream impacts from groundwater drawdown are also eliminated because no groundwater is pumped.
- Approval from the Regional Body is required, in accordance with the Compact.

EXHIBIT 4-7
Lake Michigan Water Supply Cycle

Exhibit 4-8 summarizes the Alternative 2 evaluation.

EXHIBIT 4-8
Summary of Evaluation Criteria for Lake Michigan with Return Flow Alternative

Major Criteria	Overall
Environmental impacts	⦿
Long-term sustainability	○
Public health	⦿
Implementability	◉

○ No adverse impact or risk
⦿ Minor adverse impact or risk
◉ Moderate adverse impact or risk
● Significant adverse impact or risk

4.3.3 Alternative 3—Shallow Aquifer and Fox River Alluvium

Alternative 3 uses the shallow aquifer south of Waukesha, consisting of additional wells in the Troy Bedrock Valley and wells near the Fox River (Fox River alluvium). To meet a future maximum day demand of 16.7 mgd, infrastructure would be built for 4.5 mgd of firm capacity through 4 new wells along the Fox River south of Waukesha, in what is called the Fox River alluvium. This is also referred to as “riverbank inducement,” since some of the water pumped by the wells comes from, or is induced from, the Fox River. Another 11.0 mgd firm capacity would be obtained through 12 new wells in the Troy Bedrock Valley south of Waukesha and adjacent to Vernon Marsh. The remaining 1.2 mgd firm capacity would be obtained from the City’s shallow wells 11 through 13.

The wells would pump water to a central treatment plant south of Waukesha. The water would be treated to remove iron, manganese, hardness, arsenic, and microorganisms. A pump station and pipelines would convey treated water to the Hillcrest reservoir in Waukesha and through the distribution system. Exhibit 4-9 shows the facilities associated with Alternative 3.

A summary of the Alternative 3 evaluation based on the water supply alternative evaluation criteria follows. Detailed evaluations and analysis are in Volume 2, City of Waukesha Water Supply Service area Plan, Section 11.4.3 and Volume 5, City of Waukesha Environmental Report on Water Supply Alternatives, Sections 2 and 6.

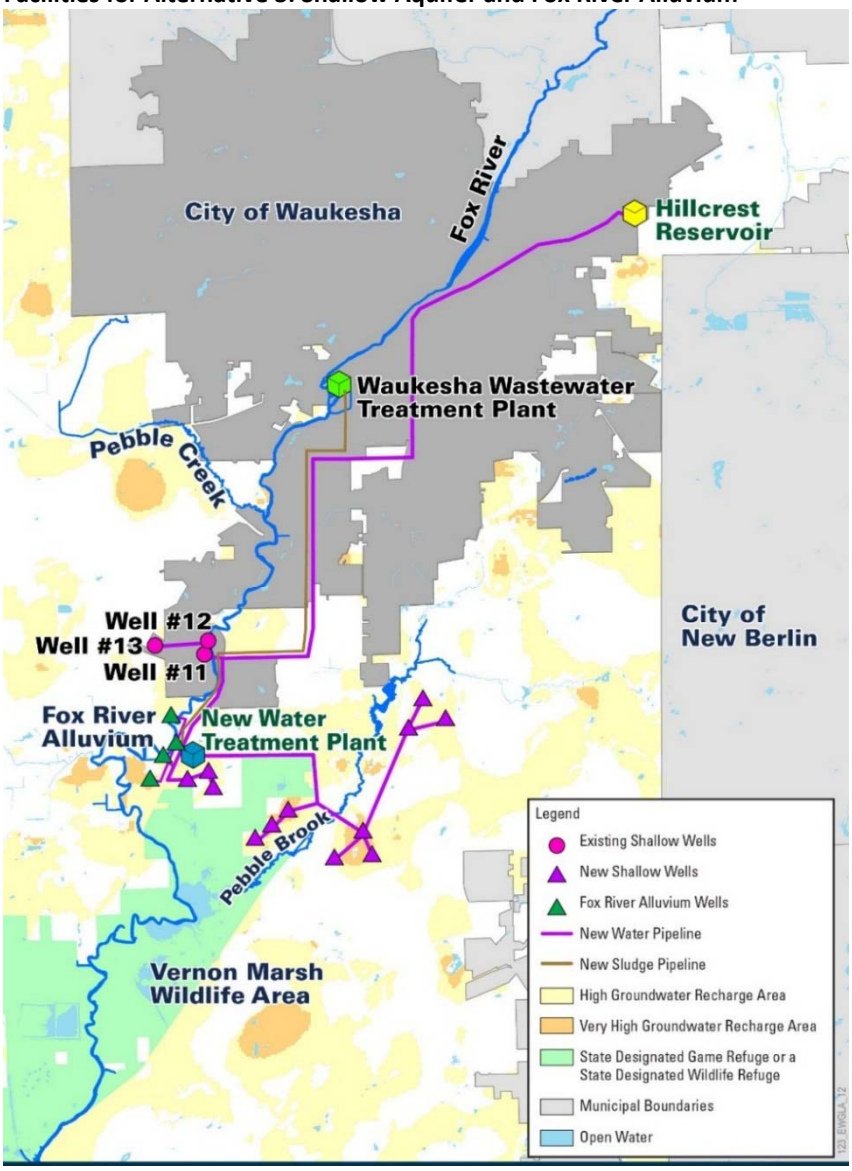
Environmental Impacts

- From a water balance perspective, every gallon pumped from shallow wells will come at the expense of surface water, either from reduced baseflow discharge or from induced recharge from surface water. Water extracted from the ground reduces the water that would naturally flow to wetlands, lakes, and streams (baseflow). Two lakes, 12 springs in the 5- to 50-gpm range, and more than 4,000 acres of wetlands in the 1-foot and greater drawdown area could be adversely affected by pumping the shallow wells and Fox River alluvium wells (see Volume 5 City of Waukesha Environmental Report for Water Supply Alternatives, Section 6.4.4.1 for springs and lakes, and Section 6.4.3 for wetlands).

- Water quality standards would be met.
- There is significant shallow aquifer drawdown (over 90 feet) near the wells (RJN Environmental Services, 04/2010; RJN Environmental Services, 08/2013).
- Baseflow is reduced more than 60 percent in segments of streams. The adverse environmental impact to sensitive environmental areas is greater than in Alternative 1 since much more shallow aquifer water volume is being pumped (see Volume 5 City of Waukesha Environmental Report for Water Supply Alternatives, Section 6.4.2.2).
- A shallow aquifer water supply will allow the City to cease pumping the deep aquifer, which will help restore the natural groundwater flow regime toward the Great Lakes Basin instead of away from it (RJN Environmental Services, 02/2011; CH2M HILL and Ruekert-Mielke, 2003).
- Ceasing deep aquifer pumping will eliminate the diversion of this water from the Lake Michigan groundwatershed to the Mississippi River Basin (USGS, 03/2007).

EXHIBIT 4-9

Facilities for Alternative 3: Shallow Aquifer and Fox River Alluvium



Long-Term Sustainability

- As the shallow aquifer depends directly on rainwater for recharge, it is less reliable during drought conditions, when water supply is needed most.
- The shallow aquifer water is not returned to its source. Rather, it is discharged into the Fox River and eventually into the Gulf of Mexico. Since some of the wells in the Fox River alluvium draw water from the Fox River and the wastewater is discharged to the Fox River upstream of the wellfield, that portion of water is returned (RJN Environmental Services LLC, 04/2010; RJN Environmental Services, 08/2013).
- Riverbank filtration wells can plug over time as the ground filters water and particles collect. This adds an element of risk to the long-term sustainability of riverbank filtration wells (Hubbs, 2003).

Public Health

- Contaminants can pass quickly through sand and gravel aquifers. There are 19 potential sources of contamination in the shallow aquifer wells within a 1-mile radius or 1-foot drawdown contour (WDNR, 07/2012). Shallow aquifers also are susceptible to contamination from agricultural chemicals, septic tanks, road salt and runoff (Volume 2, City of Waukesha Water Supply Service Area Plan, Section 11.4.1.4).
- Test wells in the shallow aquifer south of the City in the Lathers property contained arsenic at levels above drinking water standards (Davy Laboratories, 2007).

- Recycling treatment plant effluent through Fox River alluvial wells poses increased public health risk from concentrating contaminants (Volume 2, City of Waukesha Water Supply Service Area Plan, Section 11.4.3.4).

Implementability

- There are more than 1,600 private and municipal wells in the 5-foot and greater drawdown area that could be affected by pumping the shallow wells (Volume 2, City of Waukesha Water Supply Service Area Plan, section 11.4.3.5).

In addition to the technical basis for determining that the shallow aquifer supply may not be implementable due to its unreliability as a supply source, relying on the shallow aquifer is uncertain from a legal perspective as described under Alternative 1 (page 4-6).

Exhibit 4-10 summarizes the Alternative 3 evaluation.

EXHIBIT 4-10
Summary of Evaluation Criteria for Shallow Aquifer and Fox River Alluvium

Major Criteria	Overall
Environmental impacts	●
Long-term sustainability	●
Public health	●
Implementability	●

○ No adverse impact or risk
⦿ Minor adverse impact or risk
◉ Moderate adverse impact or risk
● Significant adverse impact or risk

4.3.4 Alternative 4—Lake Michigan and Shallow Aquifer

Alternative 4 consists of obtaining about 45 percent the City's required potable water (4.5 mgd average day demand, 7.6 mgd maximum day demand) from a Lake Michigan water utility (Oak Creek, Wisconsin) and the other 55 percent (5.6 mgd average day demand, 9.1 mgd maximum day demand) from the shallow aquifer in the Mississippi River Basin. The water is returned to the Great Lakes Basin through a tributary, the Root River. Exhibit 4-11 shows the facilities for this alternative.

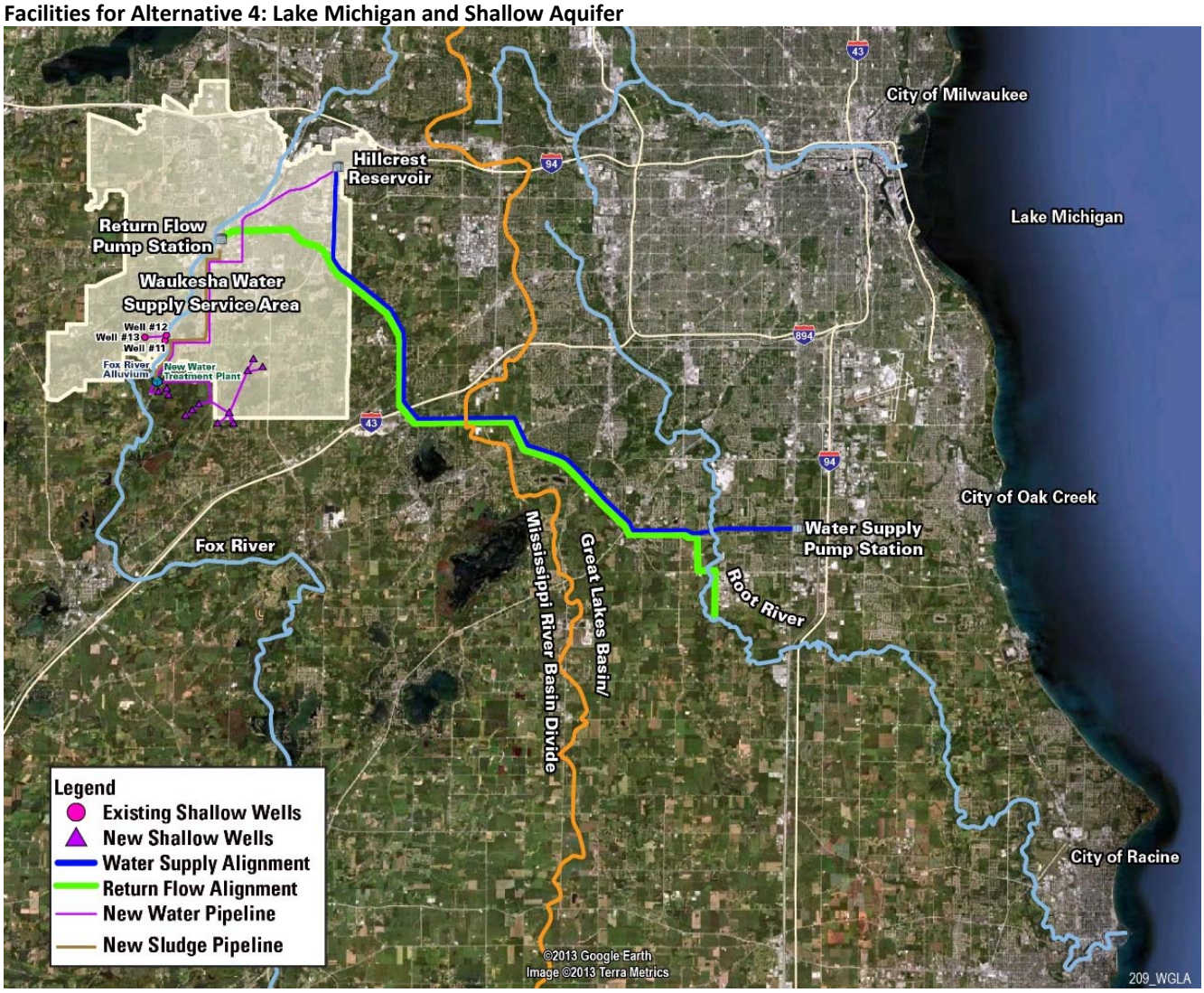
A summary of the Alternative 4 evaluation based on the water supply alternatives evaluation criteria follows. Detailed evaluations and analysis are in Volume 2, City of Waukesha Water Supply Service area Plan, Section 11.4.4 and Volume 5, City of Waukesha Environmental Report on Water Supply Alternatives, Sections 2 and 6.

Environmental Impacts

- The impacts for this combination alternative would be similar to the groundwater drawdown impacts of the Deep and Shallow Aquifer alternative, since the shallow aquifer pumping rate is similar between the two alternatives, as are the impacts from constructing a Lake Michigan water supply and return flow pipeline. Consequently, the impacts will be more than either of the sources considered independently (see Volume 5, City of Waukesha Environmental Report for Water Supply Alternatives, Section 2.2.2.6).
- A shallow aquifer and Lake Michigan water supply will allow the City to cease pumping from the deep aquifer, which will help restore the natural flow regime of the groundwater toward the Great Lakes Basin instead of away from it (RJN Environmental Services LLC, 02/2011; CH2M HILL and Ruekert-Mielke, 2003).
- Ceasing deep aquifer pumping will eliminate the diversion of water from the Lake Michigan groundwatershed to the Mississippi River Basin (USGS, 03/2007).
- Baseflow is reduced more than 60 percent in segments of streams (see Volume 5, City of Waukesha Environmental Report for Water Supply Alternatives, Section 6.4.2.2, Deep and Shallow Aquifer Alternative, which has the same shallow aquifer water demand as this alternative).
- Water extracted from the ground reduces the water that would naturally flow to wetlands, lakes, and streams (baseflow). Two lakes, 7 springs in the 5- to 50-gpm range, and more than 3,000 acres of wetlands in the 1-foot and greater drawdown area could be adversely affected by pumping the shallow wells (see Volume 5, City of Waukesha Environmental Report for Water Supply Alternatives, Section 6.4.4.1 for springs and lakes, and Section 6.4.3 for wetlands for the Deep and Shallow Aquifer alternative, which has the same shallow aquifer water demand as this alternative).

EXHIBIT 4-11

Facilities for Alternative 4: Lake Michigan and Shallow Aquifer



Long-Term Sustainability

- The shallow aquifer water is not returned to its source. Rather, it is discharged into the Fox River and eventually into the Gulf of Mexico.
- As the shallow aquifer depends directly on rainwater for recharge, it is less reliable during drought conditions, when water supply is needed most.

Public Health

- Contaminants can pass quickly through sand and gravel aquifers. There are 19 potential sources of contamination in the shallow aquifer wells within a 1-mile radius and 1-foot drawdown contour (WDNR, 07/2012). Shallow aquifers are also susceptible to contamination from agricultural chemicals, septic tanks, road salt, and runoff.
- Test wells in the shallow aquifer south of the City in the Lathers property contained arsenic at levels above drinking water standards (Davy Laboratories, 2007).

Implementability

- There are more than 3,000 private and municipal wells in the 5-foot and greater drawdown area that could be affected by pumping the shallow wells (Volume 2, City of Waukesha Water Supply Service Area Plan, section 11.4.4.5).

- Approval from the Regional Body, in accordance with the Compact, is required.
- Return of water from outside the Great Lakes basin is not minimized (Compact section 4.9.3.b).

Moreover, in addition to the technical basis for determining that the shallow aquifer supply may not be implementable because of its unreliability as a supply source, relying on the shallow aquifer is uncertain from a legal perspective as described under Alternative 1 (page 4-6).

Exhibit 4-12 summarizes the Alternative 4 evaluation.

EXHIBIT 4-12
Summary of Evaluation Criteria for Lake Michigan and Shallow Aquifer

Major Criteria	Overall
Environmental impacts	●
Long-term sustainability	◉
Public health	◉
Implementability	●

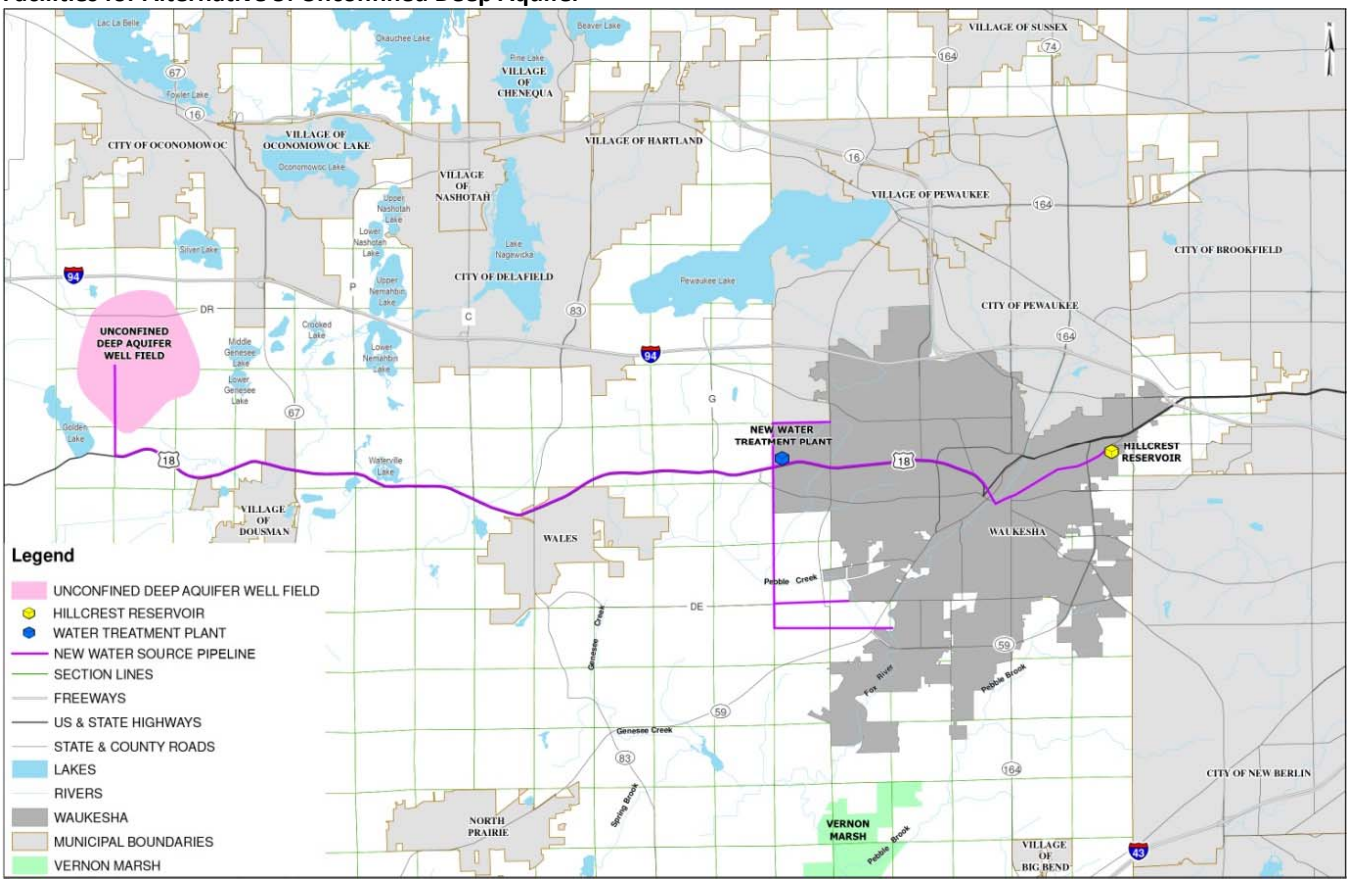
○ No adverse impact or risk
⊙ Minor adverse impact or risk
◉ Moderate adverse impact or risk
● Significant adverse impact or risk

4.3.5 Alternative 5—Deep Unconfined Aquifer

Alternative 5 consists of wells in the deep unconfined sandstone aquifer about 12 miles west of the City. The deep sandstone aquifer under the City extends west. The confining shale layer subsides 10 to 12 miles west of the City. Therefore, the deep sandstone aquifer is unconfined at that point. In Alternative 5, on an annual average 10.1 mgd would be pumped from the unconfined deep aquifer. The maximum day capacity would be 16.7 mgd with the largest well out of service. Assuming a well capacity of 1.5 mgd each (CH2M HILL and Ruekert-Mielke, 03/2002), 12 wells would be required for firm capacity. The water would be extracted from the ground, treated, and pumped to Waukesha. Exhibit 4-13 shows the facilities associated with Alternative 5.

A summary of the Alternative 5 evaluation based on the water supply alternatives evaluation criteria follows. Detailed evaluations and analysis are in Volume 2, City of Waukesha Water Supply Service Area Plan, Section 11.4.5 and Volume 5, City of Waukesha Environmental Report on Water Supply Alternatives, Sections 2 and 6.

EXHIBIT 4-13
Facilities for Alternative 5: Unconfined Deep Aquifer



Environmental Impacts

- Water extracted from the unconfined deep aquifer intercepts natural recharge of the deep confined sandstone aquifer near Waukesha. Removing the water will not eliminate adverse environmental impacts from drawdown in the deep confined aquifer (see Alternative 1) and will still adversely affect the amount of groundwater recharging the Lake Michigan basin (RJN Environmental Services LLC, 02/2011).
- The water in the deep unconfined aquifer is hard, requiring home water softening. This results in Waukesha residents discharging over 7 million pounds of salt into the environment every year (CH2M HILL, 2002 and SEWRPC, 12/2010). Continued discharge to the Fox River currently requires a water quality variance for chloride with home softening being a significant source (see Volume 5 City of Waukesha Environmental Report for Water Supply Alternatives, Section 6.4.2.3).
- Four hundred eighty acres of wetlands are adversely affected by groundwater drawdown (Volume 2, City of Waukesha Water Supply Service Area Plan, Section 11.4.5.2).
- Some of the water pumped from the unconfined deep aquifer is induced from surface waters. The water is diverted from the Rock River watershed to the Fox River watershed. Transferring water from one watershed to another raises concern about diversions and diminished flow in the Rock River system (Volume 2, City of Waukesha Water Supply Service Area Plan, Section 11.4.5.2).
- Groundwater modeling indicates that drawdown in the sandstone aquifer is greater than 150 feet (RJN Environmental Services, 08/2013), an amount high enough to designate a groundwater management area (Wis. Stat. § 281.34(9)(a)).
- The groundwater drawdown affects a large land area, with many wetlands, lakes and streams. Baseflow is reduced 4 to 9 percent in segments of streams (RJN Environmental Services, 08/2013).

Long-Term Sustainability

- None of the water extracted from the unconfined deep aquifer would be returned to its source. The water would be diverted from the Rock River watershed to the Fox River watershed, and ultimately to the ocean.
- The unconfined deep aquifer is less susceptible to drought than shallow aquifers but will still be affected by limited recharge.

Public Health

- Like all aquifers, the unconfined deep aquifer is susceptible to contamination, but to a lesser degree than the shallow aquifer because surface contamination would have to travel farther.
- Preventing contamination will be more difficult because the wellfield is outside the City limits, and, as a result, the City will not have zoning authority to enforce a wellhead protection ordinance to protect the wells.

Implementability

- There are 158 private wells in the 1-foot groundwater drawdown contour (WDNR, 04/2009).
- There are 11 municipal wells in the 50-foot drawdown contour. There are 177 non-private, non-municipal wells within the 70-foot groundwater drawdown contour (WDNR, 04/2009). The capacity of the wells also would be affected by this water supply alternative.

Moreover, in addition to the technical basis for determining that the deep unconfined aquifer supply may not be implementable due to its unreliability as a supply source, relying on the deep unconfined aquifer is uncertain from a legal perspective as described under Alternative 1 (page 4-6).

Exhibit 4-14 summarizes the Alternative 5 evaluation.

EXHIBIT 4-14
Summary of Evaluation Criteria for Deep Unconfined Aquifer Alternative

Major Criteria	Overall
Environmental impacts	●
Long-term sustainability	◉
Public health	⊙
Implementability	●

○ No adverse impact or risk
⊙ Minor adverse impact or risk
◉ Moderate adverse impact or risk
● Significant adverse impact or risk

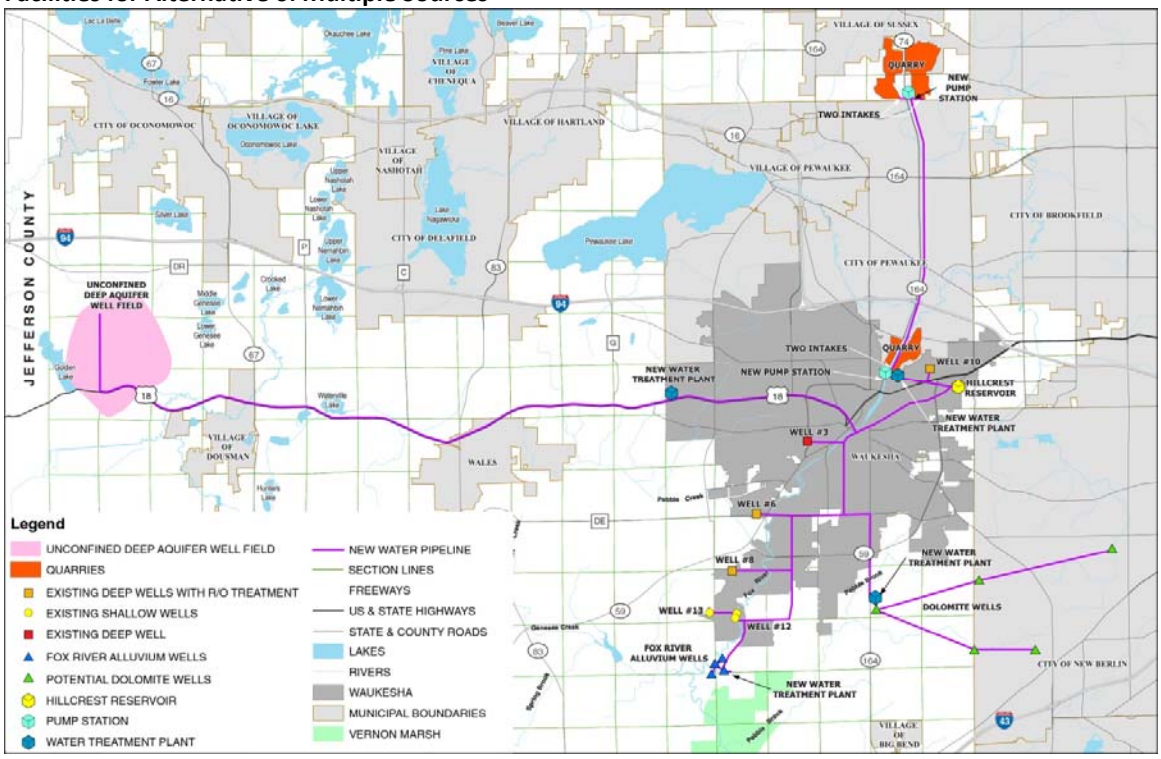
4.3.6 Multiple Water Supply Sources

A multiple source water supply alternative was developed based on the available water resources in the area. The six water supplies in this multiple source alternative are:

- Existing deep aquifer wells in the City of Waukesha
- Existing shallow aquifer wells outside the City of Waukesha limits to the south
- New wells in the Fox River alluvium (riverbank inducement wells) outside the City of Waukesha limits to the south
- Quarries north of the City of Waukesha
- New wells in the unconfined deep aquifer west of the City of Waukesha
- New wells in the Silurian dolomite aquifer outside the City of Waukesha limits to the Southeast

Exhibit 4-15 shows the facilities associated with Alternative 6.

EXHIBIT 4-15
Facilities for Alternative 6: Multiple Sources



A summary of the Alternative 6 evaluation based on the water supply alternatives evaluation criteria follows. Detailed evaluations and analysis are in Volume 2, City of Waukesha Water Supply Service Area Plan, Section 11.4.6 and Volume 5, City of Waukesha Environmental Report on Water Supply Alternatives, Sections 2 and 6.

Environmental Impacts

- Reducing pumpage from the deep aquifer lessens the adverse environmental impact of the current pumping rate. However, pumping water from the deep aquifer still reduces the amount of water that would flow to the waters of the Lake Michigan Basin if no pumping occurred (WGNHS and USGS, 10/2006).
- Reducing the City's deep confined aquifer pumping to 2 mgd could create a rebound in the deep aquifer water level of about 50 feet near Waukesha (RJN Environmental Services LLC, 02/2011). Water levels are currently down 400 to 600 feet and would still greatly exceed the 150 feet of drawdown for a groundwater management area (Wis. Stat. § 281.34(9)(a)).
- Radium treatment releases radium into the environment and increases water use, although to a lesser degree than Alternative 1.

- All the water sources are hard, requiring home water softening. This results in Waukesha residents discharging more than 7 million pounds of salt into the environment every year. Although water quality requirements would be met, continued discharge to the Fox River requires a water quality variance for chloride with home softening being a significant source (see Volume 5, City of Waukesha Environmental Report for Water Supply Alternatives, Section 6.4.2.3).
- More than 1,000 acres of wetlands are adversely affected by shallow aquifer groundwater drawdown.
- Diverting water from the deep unconfined aquifer (Rock River watershed) to the Fox River watershed would raise regulatory concerns and diminish flow in the Rock River watershed (Volume 2, City of Waukesha Water Supply Service Area Plan, Section 11.4.5.2).
- Groundwater drawdown in the unconfined deep aquifer would be near 150 feet from predevelopment (RJN Environmental Services, 08/2013), and could trigger Wisconsin regulations for a groundwater management area (Wis. Stat. § 281.34(9)(a)).
- In the unconfined deep aquifer, baseflow reductions ranged from 1 to 5 percent in surface water bodies when pumping at 2 mgd (RJN Environmental Services, 08/2013). More than five lakes are affected, but the drawdown would be less than that under Alternative 5.

Long-Term Sustainability

- Most of the water is not returned to its source. Rather, it is discharged into the Fox River and eventually into the Gulf of Mexico.
- Although each individual water supply source in this alternative can be affected by drought, having multiple water supply sources make this alternative less susceptible to drought than Alternative 3, which relies on one source that is significantly affected by drought.

Public Health

- There are 400 potential sources of contamination in the deep aquifer (241), shallow aquifer (12), quarries (127), and Silurian dolomite aquifer (20) (WDNR, 07/2012).
- The risk of contamination in the shallow aquifers and Fox River Alluvium are as described previously for other alternatives.
- Using an open surface water quarry as a water supply source increases the potential for contamination from surface water, groundwater, or activities in the quarry and will require treatment.
- The Silurian dolomite contains numerous fractures, voids, and bedding plane enlargements that often act as open conduits for groundwater contaminant migration (Ruekert-Mielke, 02/2011).

Implementability

- This alternative would affect 237 private wells within the 5-foot groundwater drawdown contour line. Eight municipal wells would be affected within the 10-foot groundwater drawdown contour line and 105 nonmunicipal, nonprivate wells affected within the 15-foot groundwater drawdown contour (Volume 2, City of Waukesha Water Supply Service Area Plan, Section 11.4.6.4).
- This is the most complex water supply alternative, with 6 water sources, 4 wellfields, 4 quarries, 7 treatment plants, 5 pump stations, and 51 miles of pipelines. Operation and maintenance of the water system would be difficult, and the risk of failure of any one component is greater.

In addition to the technical basis for determining that the groundwater supply may not be implementable because of its unreliability as a supply source, relying on groundwater is uncertain from a legal perspective as described under Alternative 1 (page 4-6).

Exhibit 4-16 summarizes the evaluation of Alternative 6.

EXHIBIT 4-16
Summary of Evaluation Criteria for the Multiple Source Alternative

Major Criteria	Overall
Environmental impacts	●
Long-term sustainability	●
Public health	●
Implementability	●

○ No adverse impact or risk
⦿ Minor adverse impact or risk
◉ Moderate adverse impact or risk
● Significant adverse impact or risk

4.3.7 Cost Estimates

The City's evaluation of water supply alternatives included analyzing the cost-effectiveness of the various water supply alternatives (Volume 2, City of Waukesha Water Supply Service Area Plan, sections 11 and 10), return flow discharge locations (Volume 4, City of Waukesha Return Flow Plan), and water conservation measures (Volume 3, City of Waukesha Water Conservation Plan).

Exhibit 4-17 summarizes the conceptual-level cost estimates for the construction, operation, and maintenance of water supply alternatives, including wells, treatment plants, pump stations, and pipelines. Volume 2, City of Waukesha Water Supply Service Area Plan (Section 10) contains additional details on the cost estimates. Capital and annual costs of each water supply alternative were evaluated on an equal basis. Alternative 6 had the highest cost. The Lake Michigan alternative with return flow had the lowest capital cost.

EXHIBIT 4-17
Water Supply Alternative Cost Estimates

Water Supply Alternative	Capital Cost[a] ($ million)	Annual O&M Cost ($ million)	20-Year Present Worth ($ million, 6%)	50-Year Present Worth ($ million, 6%)
Deep and shallow aquifers	211	7.2	294	325
Lake Michigan[b] with return flow to Root River	207	8.0	299	334
Shallow aquifer and Fox River alluvium	217	8.9	320	358
Lake Michigan[b] and shallow aquifer	329	8.2	424	459
Unconfined deep aquifer	234	6.4	308	335
Multiple source (deep aquifers, shallow aquifers, quarries)	323	7.3	407	439

[a] Includes direct construction cost, contractor administrative costs (insurance, bonds, supervision etc.), 25% contingency, and permitting, legal, engineering, and administrative costs.
[b] Assumes Oak Creek water supply and Root River return flow discharge.

4.4 Summary of Water Supply Alternative Analyses

4.4.1 Water Supply Alternatives Comparison

Exhibit 4-18 summarizes the water supply alternatives evaluation results based on the water supply alternatives evaluation criteria. The Lake Michigan water supply alternative has the least adverse environmental impacts, is the most sustainable, and is the most protective of public health. A Lake Michigan water supply with return flow is clearly the most environmentally sustainable alternative for the City's long-term water supply needs.

Exhibit 4-19 compares some of the key environmental impacts of groundwater supply alternatives to a Lake Michigan supply alternative. Volume 5, City of Waukesha Environmental Report for Water Supply Alternatives, contains greater detail.

According to scientific evidence and studies, the adverse environmental impacts of the City pumping the deep and shallow aquifers are much greater than those likely to result from the proposed Great Lakes diversion.

EXHIBIT 4-18
Summary of Water Supply Alternatives Evaluation

Water Supply Alternatives	Major Criteria			
	Environmental	Long-Term Sustainability	Public Health	Implementability
1. Deep and shallow aquifers	●	●	●	●
2. Lake Michigan with return flow	⦿	○	⦿	◉
3. Shallow aquifer and riverbank inducement	●	●	●	●
4. Lake Michigan and shallow aquifer	●	◉	◉	●
5. Unconfined deep aquifer	●	◉	⦿	●
6. Multiple sources	●	●	●	●

○ No adverse impact or risk
⦿ Minor adverse impact or risk
◉ Moderate adverse impact or risk
● Significant adverse impact or risk

EXHIBIT 4-19
Summary of Key Impacts of Groundwater versus Lake Michigan Water Supplies

	Groundwater Alternatives	Lake Michigan Alternative with Return Flow
Wetland area permanently adversely affected	480 to greater than 4,000 acres	Less than 0.1 acre
Water returned to its source	0 to 25%	100%
Groundwater drawdown	90 to 600 feet	Groundwater level recovery
Existing wells affected	170 to greater than 3,400	0
Water quality in streams or lake	Chloride variance required for some alternatives	Meets water quality requirements
Baseflows	Stream segment baseflow reduction in three to five rivers, lakes, and streams	Stream segment baseflow reduction in one river

The comparative analysis of water supply alternatives (Volume 2, City of Waukesha Water Supply Service Area Plan, Section 11) shows that eliminating the pumping of the deep and shallow aquifers would eliminate several adverse environmental impacts and improve groundwater resources of the Great Lakes Basin; assist the recovery of both surface and groundwater resources; assist in the restoration of the natural flow system wherein the deep aquifer feeds the Waters of the Great Lakes; benefit habitat restoration and fisheries of Great Lakes tributaries through the return flow; and eliminate the diversion of water from the Lake Michigan Basin to the Mississippi River Basin. Switching from groundwater to a Lake Michigan supply will result in a positive net benefit to the environment versus continued or increased adverse impacts resulting from the City's use of groundwater.

The scientific evidence, technical studies, and evaluation of environmental impacts support the diversion exception criterion: that the City lacks an adequate supply of potable water (Volume 2, City of Waukesha Water Supply Service Area Plan, Section 7). The groundwater supply in the deep aquifer is severely depleted, exceeds radium regulations and is not a reliable source to meet future needs (Volume 2, City of Waukesha Water Supply Service Area Plan, Section 11). The quantity of water that can be withdrawn from the shallow aquifer for potable water supply is limited, because increased pumping would severely reduce the quantity of water available for local streams, brooks, and wetlands and thus harm the environment (Volume 5, City of Waukesha Environmental Report for Water Supply Alternatives). The City lacks a water supply that is sustainable in the long term to meet reasonable demands for a water supply in the quantity and quality that complies with applicable drinking water standards, is protective of public health, and does not have adverse environmental impacts greater than those likely to result from the proposed Great Lakes diversion.

4.4.2 Reasonable Water Supply

"'Reasonable water supply alternative' means a water supply alternative that is similar in cost to, and as environmentally sustainable and protective of public health as, the proposed new or increased diversion and that does not have greater adverse environmental impacts than the proposed new or increased diversion." Wis. Stat. § 281.346(1)(ps).

Compared to a Lake Michigan water supply with return flow, the other water supply alternatives create greater adverse environmental impacts, are less environmentally sustainable, and are less protective of public health. None of the other water supply alternatives are reasonable (Section 2.4).

A Lake Michigan supply also complies with the Compact decision-making standard for reasonable use. See Compact section 4.11.5; see also Wis. Stat. § 281.346(6)(e) and Exhibit 4-20. Exhibit 4-20 summarizes each water supply alternative's compliance with Compact section 4.11.5 and with Wisconsin Statutes on reasonable use. It is not intended to be an all-inclusive listing of the pros and cons of the evaluated water supply alternatives. None of the groundwater supply alternatives comply with this decision-making standard. Therefore none of the groundwater supply alternatives are reasonable.

4.4.3 Proven Water Supply Planning Principles

The community water supplies planned for the long term (50 years or more) must use high quality, reliable, sustainable water sources. Failing to invest in water supply infrastructure that serves a community for the long-term results in paying for water supply development twice or more, the later investment coming due when water sources are depleted or cannot be accessed because of regulations or lawsuits.

A main principle of public drinking water supply planning is to obtain the water supply source with the highest quality and most reliability.

The American Water Works Association Statement of Policy on Public Water Supply Matters, Drinking Water Quality states: "All water utilities should deliver to the consumer drinking water that meets or surpasses all standards established by regulatory agencies. This objective is achieved most economically and effectively when the source water is taken from the highest-quality water source available. . . ."

Recommended Standards for Water Works, a well-known guide to drinking water system design published by the Great Lakes–Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers states: "Each water supply should take its raw water from the best available source which is economically reasonable and technically possible."

WDNR Administrative Code NR 811.21 states: "The source of water selected as a surface water supply shall be from the best available source which is practicable. The source shall provide the highest quality water reasonably available which, with appropriate treatment and adequate safeguards, will meet the drinking water standards in ch. NR 809."

Based on its extensive technical analyses conducted over many years, the City concludes that a Lake Michigan water supply adheres to the proven public water supply selection principles referred to above. A Lake Michigan water supply is the most reliable water supply alternative and the most protective of the environment and public health. Returning Lake Michigan water back to its original source is also the most environmentally sustainable and beneficial method for managing water resources. The other water supply alternatives are unreliable, cause significant adverse environmental impacts, increase public health risk, and are not environmentally sustainable.

4.4.4 Conclusions

Based on its extensive technical evaluation of the various water supply alternatives, the City determined that its current water supply is unsustainable and that it needs a new water supply. A Lake Michigan water supply with return flow for the City will benefit the environment and public health as follows:

- Termination of deep aquifer pumping, which will help restore both the severely depleted groundwater levels and the natural groundwater flow regime towards the Great Lakes Basin instead of away from it.

EXHIBIT 4-20

Compact Decision-Making Standard: Reasonable Use of Water

Compact Section 4.11.5	Water Supply Alternatives					
	1. Deep and Shallow Aquifers	2. Lake Michigan with Return Flow	3. Shallow Aquifers	4. Lake Michigan and Shallow Aquifers	5. Unconfined Deep Aquifer	6. Multiple Sources
a. Whether the proposed Withdrawal or Consumptive Use is planned in a fashion that provides for **efficient use of the water, and will avoid or minimize** the **waste of Water (*see also* Wis. Stat. § 281.346(6)(e)1.)**	● All water is **not** returned to source, resulting in inefficient use and waste.	○ All water is returned to source, resulting in efficient use and no waste.	● All water is **not** returned to source, resulting in inefficient use and waste.	● All water is **not** returned to source, resulting in inefficient use and waste.	● All water is **not** returned to source, resulting in inefficient use and waste.	● All water is **not** returned to source, resulting in inefficient use and waste.
c. The **balance between economic development, social development and environmental protection** of the proposed Withdrawal and use and other existing or planned withdrawals and water uses sharing the water source **(*see also* Wis. Stat. § 281.346(6)(e)3.)**	● Significant adverse environmental impacts on lakes, streams, springs, wetlands, aquifers.	○ **No** significant adverse environmental impacts.	● Significant adverse environmental impacts on lakes, streams, springs, wetlands, aquifers.	● Significant adverse environmental impacts on lakes, streams, springs, wetlands, aquifers.	● Significant adverse environmental impacts on lakes, streams, springs, wetlands, aquifers.	● Significant adverse environmental impacts on lakes, streams, springs, wetlands, aquifers.
d. The **supply potential of the water source, considering quantity, quality, and reliability and safe yield** of hydrologically interconnected water sources **(*see also* Wis. Stat. § 281.346(6)(e)4.)**	● Supply limited by environmental impacts, drought. Does not improve safe yield of hydrologically interconnected water sources.	○ Supply **not** limited by environmental impacts or drought. Improves safe yield of hydrologically interconnected water sources.	● Supply limited by environmental impacts, drought. Does not improve safe yield of hydrologically interconnected water sources.	● Supply limited by environmental impacts, drought. Does not improve safe yield of hydrologically interconnected water sources.	● Supply limited by environmental impacts. Does not improve safe yield of hydrologically interconnected water sources.	● Supply limited by environmental impacts, drought. Does not improve safe yield of hydrologically interconnected water sources.
e. The probable degree and duration of any **adverse impacts** caused or expected to be caused by the proposed Withdrawal and use under foreseeable conditions, **to other lawful consumptive or non-consumptive uses of water** or to the quantity or quality of the Waters and Water Dependent Natural Resources of the Basin, and the proposed plans and arrangements for avoidance or mitigation of such impacts **(*see also* Wis. Stat. § 281.346(6)(e)5.)**	● Other drinking water wells affected, significant adverse environmental impacts on lakes, streams, springs, wetlands, aquifers.	○ No other drinking water wells affected, **no** significant adverse environmental impacts.	● Other drinking water wells affected, significant adverse environmental impacts on lakes, streams, springs, wetlands, aquifers.	● Other drinking water wells affected, significant adverse environmental impacts on lakes, streams, springs, wetlands, aquifers.	● Other drinking water wells affected, significant adverse environmental impacts on lakes, streams, springs, wetlands, aquifers.	● Other drinking water wells affected, significant adverse environmental impacts on lakes, streams, springs, wetlands, aquifers.

EXHIBIT 4-20

Compact Decision-Making Standard: Reasonable Use of Water

Compact Section 4.11.5	Water Supply Alternatives					
	1. Deep and Shallow Aquifers	2. Lake Michigan with Return Flow	3. Shallow Aquifers	4. Lake Michigan and Shallow Aquifers	5. Unconfined Deep Aquifer	6. Multiple Sources
f. If a Proposal includes **restoration of hydrologic conditions and functions of the Source Watershed**, the Party may consider that **(*see also* Wis. Stat. § 281.346(6)(e)6.`)**	● Deep aquifer pumping reduced but **not** eliminated. Hydrologic conditions and functions of the Great Lakes basin adversely affected.	○ Deep aquifer pumping eliminated to help restore hydrologic conditions and functions of the Great Lakes Basin.	○ Deep aquifer pumping eliminated to help restore hydrologic conditions and functions of the Great Lakes Basin.	○ Deep aquifer pumping eliminated to help restore hydrologic conditions and functions of the Great Lakes Basin.	● Deep aquifer pumping **not** eliminated. Hydrologic conditions and functions of the Great Lakes basin adversely affected.	● Deep aquifer pumping reduced but **not** eliminated Hydrologic conditions and functions of the Great Lakes basin adversely affected.

○ Meets decision-making standard ● Does not meet decision-making standard

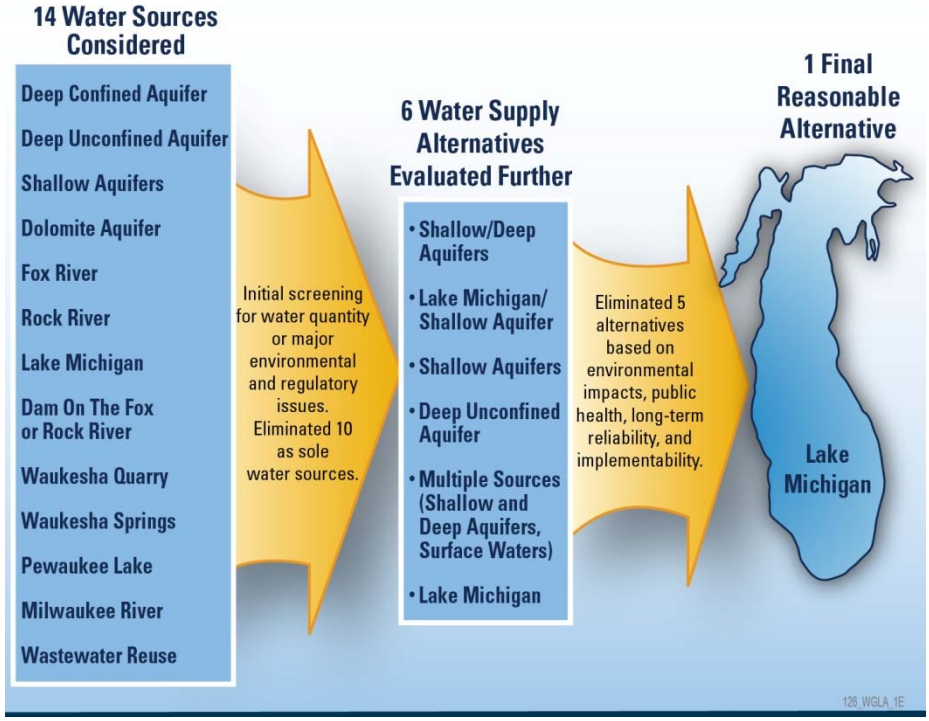
- Adverse environmental impact on lakes, streams, wetlands, and springs from using groundwater will be eliminated.
- The water volume will be returned continuously to the Great Lakes, so there will be no impact on lake levels. Recycling the water in an environmentally sustainable manner through a Great Lakes tributary will enhance aquatic habitat and fisheries, and minimize the waste of water. Returning the water to a Lake Michigan tributary creates a positive precedent for using treated wastewater as a beneficial environmental resource and minimizes introduction of out-of-basin water to the Great Lakes. There will be no adverse impacts to the quality or quantity of water in the Great Lakes.
- The amount of radium and salt released into the environment will be reduced or eliminated because radium containing groundwater will no longer compose the City's water supply and because water softener use will no longer be necessary on a wide scale.
- A Lake Michigan water supply for the City is sustainable, protective of the environment, and protective of public health. Switching from groundwater to a Lake Michigan supply results in more effective management and improvement of the waters and water-dependent natural resources of the Great Lakes Basin.

In contrast, the other water supply alternatives are not reasonable because they have greater adverse environmental impacts, are not sustainable, and are less protective of public health.

An extensive analysis of the City's water supply alternatives demonstrates that a Lake Michigan water supply with return flow and continued conservation in accordance with the Compact is the only reasonable water supply alternative for the City (Compact Article 4, Section 4.9.3.d and § 281.346(4)(e)1.d., Wis. Stats.). A Lake Michigan supply also complies with the Compact's decision-making standard for reasonable use (Compact Article 4, Section 4.11.5). None of the other water supply alternatives comply with this standard and are therefore not reasonable.

The Lake Michigan alternative provides a net environmental benefit for the waters and water dependent natural resources of the Mississippi River and Lake Michigan Basins, is the most reliable and environmentally sustainable in the long term and provides the most public health protection.

EXHIBIT 4-21
One Reasonable Water Supply Alternative



5. Summary: Compliance with Compact and Related Wisconsin Statutes

The following text summarizes why the City's Proposal satisfies the Compact and Wisconsin Statutes section 281.346 conditions for an exception to the prohibition against Diversions of Great Lakes Water. Compact and Wisconsin Statutes sections are set forth in italics, followed by an explanation of how the City's Proposal meets the requirements. Following the text, Exhibit 5-1 lists the applicable Compact and Wisconsin Statutes sections/volumes and the Application sections that address each requirement.

5.1 Eligible Applicant, Allowable Use, and Need for Supply

The following sections of the Compact and Wisconsin Statutes sections address which communities are eligible to apply for a diversion. As a community within a straddling county, the City is eligible to submit this Application.

- *A Proposal by a Community within a Straddling County to divert Great Lakes water is excepted from the prohibition against Diversions, provided that the Proposal satisfies all of the requirements of the Compact and Wisconsin Statute section 281.346(4). Compact section 4.9.3.; Wis. Stat. § 281.346(4)(e).*
    - *"Community within a Straddling County means any incorporated city, town or the equivalent thereof, that is located outside the Basin but wholly with a County that lies partly within the Basin and that is not a Straddling Community". Compact section 1.2. See also Wis. Stat. § 281.346(1)(d)("Community within a straddling county" is defined as "any city, village or town that is not a straddling community and that is located outside the Great Lakes basin but wholly within a county that lies partly within the Great Lakes "). A "'[s]traddling county' means a county that lies partly within the Great Lakes basin." Wis. Stat. § 281.346(1)(tm). See also Wis. Stat. § 281.348(3).*
    - *"Basin" and "Great Lakes " mean the watershed of the Great Lakes and the St. Lawrence River upstream from Trois-Rivières, Québec within the jurisdiction of the Parties. Compact section 1.2.; Wis. Stat. § 281.346(1)(je).*

The City is located 1.5 miles west of the Great Lakes watershed surface water divide and thus is outside the Great Lakes basin (Exhibit 1.1). However, the City is located wholly within Waukesha County. Because Waukesha County lies partly within the Great Lakes basin, it is a straddling county (CGLG, 12/2005). Therefore, the City is a community within a straddling county and is eligible to submit this application for Lake Michigan water.

The following Compact and Wisconsin Statutes sections address the requirement that applicants for a Diversion must operate a public water supply system. As the operator of a public water supply, the City's use of water is eligible to receive a Diversion.

- *"The Water shall be used solely for the Public Water Supply Purposes of the Community within a Straddling County. . . ." Compact section 4.9.3.a. A person may apply for approval of a new or increased diversion only if the person operates a public water supply system that receives or would receive water from the new or increased diversion. Wis. Stat. § 281.346(4)(b)2.*
    - *A "public water supply" means water distributed to the public through a physically connected system of treatment, storage and distribution facilities serving a group of largely residential customers and that may also serve industrial, commercial, and other institutional operators. Compact section 1.2; Wis. Stat. § 281.346(1)(pm).*

The City is the applicant for the diversion.

As the applicant, the City is responsible for providing information demonstrating that the application meets the requirements for a diversion. *See* Wis. Stat. § 281.346(4)(b), (e), (f).

The City operates a public water supply system through the Waukesha Water Utility, which is a public water supplier governed by Wisconsin Statutes chapter 196. The Waukesha Water Utility is regulated by the WDNR and the Wisconsin PSC. The City is requesting a Diversion of Lake Michigan water solely to serve the City's public water system within the water supply service area determined by the regional water quality planning agency under the provisions of state's water supply plan law, Wis. Stat. § 281.348(2)(cm). (Volume 1, City of Waukesha Application Summary, Section 3.1, Water Supply Service Area). Currently, the City provides water service to the following customer classes (Volume 2, City of Waukesha Water Supply Service Area Plan, Section 5): residential (58 percent), commercial (16 percent), industrial (13 percent) and public (4 percent). Therefore, the requested Diversion will be used solely for the public water supply of a community in a straddling county.

The following Compact and Wisconsin Statutes sections address the requirements that: the applicant be without adequate supplies of potable water; there be no reasonable water supply alternative within the basin or watershed; and, the proposed use of water be reasonable, considering the balance between economic development, social development and environmental protection. Because it does not have an adequate supply of potable water, because there is no reasonable water supply alternative, and because the water use is reasonable based on consideration of the stated factors, the City needs a Lake Michigan water supply.

- *The diverted water shall be used solely for public water supply purposes of a community within a straddling county that is without adequate supplies of potable water. Compact section 4.9.3.a.; Wis. Stat. §§ 281.346(4)(e)1, 281.346(4)(e)1.a.*
  - *"'Without adequate supplies of potable water' means lacking a water supply that is economically and environmentally sustainable in the long term to meet reasonable demands for a water supply in the quantity and quality that complies with applicable drinking water standards, is protective of public health, is available at a reasonable cost, and does not have adverse environmental impacts greater than those likely to result from the proposed new or increased diversion." Wis. Stat. § 281.346(1)(zm).*
- *There is no reasonable water supply alternative within the basin/watershed in which the community is located, including conservation of existing water supplies. Compact section 4.9.3.d.; Wis. Stat. §§ 281.346(4)(e)1.d. See also Wis. Stat. § 281.346(5m)(c)("The applicant has assessed other potential water sources for cost−effectiveness and environmental effects.).*
  - *"'Reasonable water supply alternative' means a water supply alternative that is similar in cost to, and as environmentally sustainable and protective of public health as, the proposed new or increased diversion and that does not have greater adverse environmental impacts than the proposed new or increased diversion." Wis. Stat. § 281.346(1)(ps).*
- *The proposed use of the water must be reasonable, based upon a consideration of the balance between economic development, social development and environmental protection of the proposed Withdrawal and use and other existing or planned withdrawals and water uses sharing the water source. Compact section 4.11.5.c.; Wis. Stat. § 281.346(6)(e)3.*

Extensive physical evidence and scientific and technical studies (Volume 2, City of Waukesha Water Supply Service Area Plan, Section 11) demonstrate that the City of Waukesha is without an adequate supply of potable water: the City's supply of deep aquifer groundwater is not environmentally sustainable (Volume 5, City of Waukesha Environmental Report on Water Supply Alternatives, Section 6; Volume 2, Water Supply Service Area Plan, Section 11).

The City currently withdraws about 85 percent of its water supply from the deep St. Peter Sandstone aquifer, but the deep aquifer is not an adequate source of supply for the long term because the aquifer has been drawn down 400 to 600 feet. The groundwater mining that is taking place cannot be sustained indefinitely and is not a reliable source of supply for the near future (SEWRPC, 12/2010).

Furthermore, the cumulative adverse impact of continued deep aquifer pumping illustrate that the waters of the Great Lakes basin will be better preserved and more effectively managed if regional deep aquifer pumping is reduced. This is because the deep aquifer is hydrologically connected to the Great Lakes basin (USGS, 03/2007). (Volume 1, City of Waukesha Application Summary, Section 4, Water Supply Alternatives and Section 4, Summary of Water Alternatives Analysis.) These cumulative environmental impacts of continued deep aquifer pumping include:

- Groundwater level decline.
- Reversal of the natural flow system: groundwater that once flowed east toward Lake Michigan through the deep aquifer in southeastern Wisconsin now is drawn to the groundwater pumping centers west of the surface water divide and diverted to the Mississippi River basin.
- Reduced baseflows to surface water resources, as water is drawn toward deep wells. An estimated 30 percent of the water pumped by deep aquifer wells in southeastern Wisconsin originates from surface water inside the Lake Michigan Basin (WGNHS and USGS, 10/2006).
- Release of salt and radium into the environment from treatment of the deep aquifer water.

(Volume 1, City of Waukesha Application Summary, Section 4, Water Supply Alternatives, Alternative 1, Deep Confined Aquifer and Shallow Aquifer); (Volume 2, Water Supply Service Area Plan, Section 11); (Volume 5, City of Waukesha Environmental Report for Water Supply Alternatives, Sections 5 and 6.)

The City's continued pumping of the deep aquifer withdraws groundwater (a portion of which is from the Great Lakes basin) and diverts it eventually to the ocean, thereby reducing the amount of water available to the waters and water dependent resources of the Great Lakes basin (USGS, 03/2007).

Moreover, the City's shallow aquifer supply cannot be expanded to meet future demands sustainably, because additional withdrawal will cause significant adverse environmental impacts to local surface water resources. Risk to public health also increases because shallow groundwater is at greater risk from contaminant sources. The City draws about 15 percent of its current water supply from the shallow Troy Bedrock Valley aquifer. This shallow aquifer is the source of water supply for Village of Mukwonago, the Village of East Troy, the City of Waukesha and the City of Muskego; it is also the home of sensitive environmental resources including the Vernon Marsh Wildlife Area, Pebble Brook (a Class II trout stream), and Pebble Creek. (Volume 1, City of Waukesha Application Summary, Section 4, Water Supply Alternatives, Alternative 1, Deep Confined Aquifer and Shallow Aquifer; Volume 2, City of Waukesha Water Supply Service Area Plan, Section 11.)

Expanded use of the shallow aquifer, in conjunction with the deep aquifer, to meet the City's needs is not environmentally sustainable. The estimated cumulative impacts of increased shallow aquifer pumping include 1-foot groundwater drawdown across thousands of acres of wetlands, which may significantly impact vegetation root structures; significant reduction of baseflow to parts of Vernon Marsh and Pebble Creek; and potential to impact thousands existing private wells (RJN Environmental Services LLC, 4/2010; RJN Environmental Services LLC, 08/2013; Volume 2, City of Waukesha Water Supply Service Area, Section 11).

Expansion of the shallow Troy Bedrock Valley aquifer supply to meet the City's needs does not constitute a reasonable water source because withdrawing the quantity of water needed by the City will have a significant adverse impact on water resources that are designated for protection by the state and the regional water quality and land use planning authority (Volume 5, City of Waukesha Environmental Report for Water Supply Alternatives, Section 5).

Pumping the deep unconfined aquifer west of Waukesha as a water supply also creates significant adverse environmental impacts to water resources and diverts water from the Rock River basin to the Fox River basin (Volume 2, City of Waukesha Water Supply Service Area Plan, Section 11).

A Lake Michigan water supply eliminates the significant adverse impacts from using groundwater, helps restore the natural flow of groundwater toward the Great Lakes basin instead of away from it, and improves

the aquatic habitat and fisheries of a Lake Michigan tributary (Volume 5, City of Waukesha Environmental Report for Water Supply Alternatives, Section 5).

The City has no reasonable water supply alternative that is as environmentally sustainable and protective of public health as the use of Lake Michigan water. Section 4.4 Summary of Water Supply Alternative Analyses This conclusion is based on the adverse environmental impacts of continued pumping of the deep aquifer and expanded pumping of the shallow aquifer. It is also based on a comparison of the water supply alternatives' environmental impacts, sustainability, public health protection and relative costs. Section 4.3 Water Supply Alternatives, Section 4.4 Summary of Water Supply Alternative Analyses.

A Lake Michigan supply complies with the Compact decision-making standard for reasonable use. See Compact section 4.11.5; see also Wis. Stat. § 281.346(6)(e) and Volume 1, City of Waukesha Application Summary, Exhibit 4-20. None of the groundwater supply alternatives comply with this decision-making standard; therefore, they are not reasonable.

A Lake Michigan water supply with continued and increased water conservation and return flow is the only water supply that balances the inherent social and economic development benefits of a reliable source of drinking water with stewardship of environmental resources for future generations. A Lake Michigan supply for the City is sustainable, protective of public health, and results in more effective management, and improvement, of the waters and water dependent resources of the Great Lakes basin (Volume 1, City of Waukesha Application Summary, Section 4.4 Summary of Water Supply Alternative Analyses; Volume 5, City of Waukesha Environmental Report for Water Supply Alternatives, Sections 5 and 6).

5.2 Source of Water

The following Compact and Wisconsin Statutes sections address the requirement that applicants provide evidence of support from the entity that will directly withdraw water; and, that the existing water supply is derived from groundwater hydrologically interconnected to waters of the Great Lakes basin. The City has provided evidence of the City of Oak Creek's support and the current groundwater supply's hydrological interconnection to waters of the Great Lakes basin.

- *"If a person who applies . . . will not directly withdraw the water proposed to be diverted, the person shall identify any entities that may withdraw the water and provide evidence of support from each of those entities in the form of a letter or resolution." Wis. Stat. § 281.346(4)(b)4m.*

The City evaluated the purchase of potable Lake Michigan water with the City of Milwaukee, the City of Oak Creek, and the City of Racine, all of which are located within the Great Lakes basin and operate public water utilities that withdraw water from Lake Michigan. Following extensive discussions with these potential suppliers, the City signed a letter of intent with the City of Oak Creek in 2012 (Volume 2, City of Waukesha Water Supply Service Area, Appendix F).

"Further, substantive consideration will also be given to whether or not the Proposal can provide sufficient scientifically based evidence that the existing water supply is derived from groundwater that is hydrologically interconnected to Waters of the Basin." Compact section 4.9.3. See also Wis. Stat. 281.346(4)(e)2 ("The department may not use a lack of hydrological connection to the waters of the Great Lakes basin as a reason to disapprove a proposal.").

The City's groundwater supply is derived in substantial part from groundwater that is interconnected hydrologically to the Lake Michigan Basin (USGS, 03/2007**;** Volume 1, City of Waukesha Application Summary, Section 2, City of Waukesha Background, City Water Sources). Consequently, the City is currently pumping groundwater that is hydrologically connected to the Great Lakes basin and discharging it to the Mississippi River basin.

The following Compact and Wisconsin Statutes sections address the requirement that the proposed use be reasonable based on supply potential. The City's use of Lake Michigan water will be reasonable because a

Lake Michigan supply provides sustainable sufficient quantity of water and is a high quality, reliable, and safe source.

- *The proposed use of the water must be reasonable, based upon a consideration of the supply potential of the water source, considering quantity, quality, and reliability and safe yield of hydrologically interconnected water sources. Compact section 4.11.5.d.; Wis. Stat. § 281.346(6)(e)4.*

The groundwater alternatives have limited supply potential due to significant adverse environmental impacts from pumping groundwater, reduced supply capacity during drought or as the result of existing aquifer decline, and hydrological connection of the deep confined aquifer with the Great Lakes basin. In addition to water quantity and environmental impact considerations, there is greater risk of water quality contamination with the groundwater alternatives (Volume 2, City of Waukesha Water Supply Service Area Plan, Section 11; Volume 5, City of Waukesha Environmental Report for Water Supply Alternatives, Section 6; Volume 1, City of Waukesha Application Summary, Exhibit 4-20).

5.3 Amount of Request

The following Compact and Wisconsin Statutes sections address the requirement that the Diversion be limited to reasonable quantities in amounts needed to meet the projected needs of the water user, which determination is related to the approved water supply service area plan. The City is requesting a reasonable amount of Lake Michigan water, based on the City's projected needs and the City's water supply service area.

- *The diversion shall be limited to quantities that are reasonable for the purposes for which it is proposed. Compact section 4.9.4.b.; Wis. Stat. § 281.346(4)(f)2. See also Wis. Stat. § 281.346(4)(i).*
- *"The amount of the withdrawal or increase in the withdrawal is needed to meet the projected needs of the person who will use the water." Wis. Stat. § 281.346(5m)(a).*
- *For the purposes of applying the statutory requirements, "the department shall use, as appropriate, the current or planned service area of the public water supply system receiving water under the proposal. The planned service area is the service area of the system at the end of any planning period authorized by the department in the approved water supply service area plan . . . that covers the public water supply system." Wis. Stat. § 281.346(4)(bg)2. See also Wis. Stat. § 281.346(4)(e)1.em (to be approved, a proposal must be consistent with an approved water supply service area plan under Wisconsin Statute section 281.348 that covers the public water supply system).*

The City's Water Supply Service Area Plan, Volume 2, has been approved by the City's governing body and is consistent with the findings and recommendations of the SEWRPC Planning Report on Regional Water Supply Plan in Southeastern Wisconsin. Volume 2, City of Waukesha Water Supply Service Area, Section 8. The requested amount of Lake Michigan water is based upon extensive water supply planning and the proposed quantity of water needed to supply the projected City water service area population as delineated by SEWRPC (Volume 2, City of Waukesha Water Supply Service Area Plan, Section 6). Under Wisconsin Administrative Code chapter NR 121, SEWRPC is designated by the State to delineate proposed water supply service areas for all public water supply systems in the southeastern Wisconsin planning area. The delineated water supply service area for the City is consistent with the SEWRPC 2008 regional water supply study (Volume 1, City of Waukesha Application Summary, Exhibits 3-1, 3-2).

In keeping with sound planning practices, and as required by Wisconsin's water supply plan law and regulation, the WSSA is consistent with the wastewater service area, ensuring that the return of Great Lakes water is maximized and the return of out-of-basin water is minimized.

The City's proposed withdrawal amount of an average of 10.1 mgd from Lake Michigan will serve the public water system needs of the City for the ultimate water supply service area population of 97,400, projected to be reached sometime after 2035 (Volume 1, City of Waukesha Application Summary, Section 2, Water System Overview).

For the WDNR 20-year planning period (2010–2030) for the City water service area, the average day demand of the proposed supply is 9,700,000 gallons per day, and the proposed maximum day demand is 16,100,000 gallons per day (Volume 2, City of Waukesha Water Supply Service Area Plan, Appendix C).

5.4 Conservation of Existing Supplies

The following Compact and Wisconsin Statutes sections address the requirement that conservation of existing water supplies is not a reasonable alternative to the Diversion and that the need for the Diversion cannot be reasonably avoided through efficient use and conservation of existing water supplies. The City's need for a Lake Michigan water supply is not avoided by the City's efficient use of water and water conservation efforts.

- *There is no reasonable water supply alternative within the basin/watershed in which the community is located, including conservation of existing water supplies. Compact section 4.9.3.d.; Wis. Stat. § 281.346(4)(e)1.d.*
- *The need for the diversion cannot be reasonably avoided through the efficient use and conservation of existing water supplies. Compact section 4.9.4.a.; Wis. Stat. § 281.346(4)(f)1.*

The City's conservation program demonstrates its commitment to the efficient use and conservation of existing water supplies (Volume 1, City of Waukesha Application Summary, Section 3.4, Water Conservation Planning). The City's water conservation plan identifies practical near-term, mid-term, and long-term goals and actions to evaluate and implement. The effectiveness of the conservation practices being used is measured so that the City can adapt the plan and target investment to maximize water savings (Volume 3, City of Waukesha Water Conservation Plan).

Nevertheless, the City cannot reasonably avoid the need for the proposed use of Lake Michigan water through the efficient use and conservation of existing water supplies. Water savings from conservation is an important element in the City's long-range water supply plan, but the additional 10 percent water savings (1 mgd) that may be gained through conservation (based on the effectiveness of current water conservation measures and projected water use across various customer classes over the water supply planning period, and beyond) is not sufficient to offset the need for a new adequate supply of potable water.

5.5 Conservation of Lake Michigan Water

The following Compact and Wisconsin Statutes sections address the requirements that: environmentally sound and economically feasible water conservation measures be implemented; water be efficiently used; and, waste be avoided or minimized. The City will continue and increase its water conservation and efficiency measures, and waste will be avoided.

- *The proposal will be implemented so as to incorporate environmentally sound and economically feasible water conservation measures to minimize water withdrawals and consumptive use. Compact sections 4.9.4.e., 4.11.3.; Wis. Stat. §§ 281.346(4)(f)6.,* 281.346(6)(c). *See also Wis. Stat. § 281.346(5m)(d) ("Cost−effective conservation practices will be implemented to ensure efficient use of the water, for a new withdrawal, or of the increased amount of an existing withdrawal").*[1]
- *"Environmentally Sound and Economically Feasible Water Conservation Measures" mean those measures, methods, technologies or practices for efficient water use and for reduction of water loss and waste or for reducing a Withdrawal, Consumptive Use or Diversion that i) are environmentally sound, ii) reflect best practices applicable to the water use sector, iii) are technically feasible and available, iv) are economically feasible and cost effective based on an analysis that considers direct and avoided economic*

[1] *"The department shall promulgate rules . . . including requiring the applicant to document the water conservation planning and analysis used to identify the water conservation and efficiency measures that the applicant determined were feasible." Wis. Stat. § 281.346(4)(g); see also Wis. Stat. § 281.346(8)(d) (The department is required to promulgate rules specifying water conservation and efficiency measures).*

and environmental costs and v) consider the particular facilities and processes involved, taking into account the environmental impact, age of equipment and facilities involved, the processes employed, energy impacts and other appropriate factors. Compact section 1.2. See also Wis. Stat. § 281.346(1)(i) (citing four factors for consideration).

- *The proposed use of the water must be reasonable, based upon a consideration of whether the proposed Withdrawal or Consumptive Use is planned in a fashion that provides for efficient use of the water, and will avoid or minimize the waste of Water. Compact section 4.11.5.a.; Wis. Stat. § 281.346(6)(e)1.*

In 2012, the City revised its 2006 water conservation plan to conform to the Wisconsin Water Conservation and Water Use Efficiency regulation, Wisconsin Administrative Code chapter NR 852, adopted by the State in 2010 to comply with the Compact. The City's revised water conservation plan establishes the measurable water savings goal of a 10 percent reduction in water use. Further, the revised plan documents the process the City is using to develop, implement and monitor its portfolio of environmentally sound and economically feasible water conservation measures to meet the standards of the Compact (Volume 1, City of Waukesha Application Summary, Section 3.4, Water Conservation Planning; Volume 3, City of Waukesha Water Conservation Plan). Highlights of the City's successful water conservation and efficiency measures are presented below.

Customer Metering. The City of Waukesha routinely meters all water customers and monitors water use with accurate automatic flowmeters that can be read remotely. If a dramatic change in water use is observed, the City contacts a customer to promptly address potential water waste issues.

Limiting Unaccounted-for Water. All water utilities have unavoidable water loss through their distribution systems. This water loss, called unaccounted-for water, is used for fighting fires and flushing mains or is lost through leaks in water pipes. To minimize unaccounted-for water, the City monitors the system for leaks and estimates water used for routine system flushing. Historically, the City averages 4 to 8 percent unaccounted-for water, which is less than the American Water Works Association-recommended benchmark of 10 percent (Volume 2, City of Waukesha Water Supply Service Area, Appendix C). Moreover, there will be no water loss with the Lake Michigan supply alternative, and the termination of groundwater treatment for radium removal will result in termination of back wash water loss in the existing well water treatment system.

Restrict Outdoor Sprinkling. The City's 2006 conservation initiative included a sprinkling ordinance that affected all customer classes and reduced the average and maximum day water demand. Comparisons show an 18 to 28 percent reduction in summer (June through August) watering season water use from 2005 to 2010 (Waukesha Water Utility water supply, water use, and consumptive use records, 2005–2010)**.**

Conservation Water Rates. Waukesha adopted a conservation (inclining) rate structure for residential customers in 2007, becoming the first city in the state to charge customers more per gallon as water use increases.

Toilet Rebate Program. Toilets account for about 30 percent of the water used in an average home (USEPA, 11/2010)**.** Toilet replacement is one of the most effective ways to reduce indoor water use. The City's toilet rebate program was launched in October 2008, with a goal of saving 500,000 gallons per day by replacing old high-flow toilets with new high-efficiency toilets. To help meet this goal, the City is providing rebates for fixture replacement.

Water Conservation Education in Public Schools. Waukesha Water Utility staff has taught more than 17,000 fifth- and ninth-grade students about water conservation through visits to water facilities, operating tabletop groundwater models, and collaborating with teachers (Volume 3, City of Waukesha Water Conservation Plan).

5.6 No Significant Adverse Impacts from Diversion

The following Compact and Wisconsin Statutes sections address the requirements that the Diversion will not endanger the integrity of the basin ecosystem and will not result in significant adverse individual or cumulative impacts to the quantity or quality of the Great Lakes waters and water dependent natural resources. The proposed use of Lake Michigan water will not result in adverse individual or cumulative impacts to the waters of the Great Lakes Basin or to the Basin's water dependent natural resources. Rather, it will benefit the environment.

- *"This Exception should not be authorized unless it can be shown that it will not endanger the integrity of the Basin Ecosystem." Compact section 4.9.3.e. See also Wis. Stat. § 281.346(4)(e)1.e. ("The proposal will not endanger the integrity of the Great Lakes basin ecosystem based upon a determination that the proposal will have no significant adverse impact on the Great Lakes basin ecosystem.")*
- *A diversion must result in no significant adverse individual impacts or cumulative impacts to the quantity or quality of the waters of the Great Lakes Basin or to water dependent natural resources of the basin, including cumulative impacts that might result due to any precedent-setting aspects of the proposal, based upon a determination that the proposal will not have any significant adverse impacts on the sustainable management of the waters of the Great Lakes Basin. Compact section 4.9.4.d.; Wis. Stat. § 281.346(4)(f)5.*
- *The Proposal will result in no significant individual or cumulative adverse impacts to the quantity or quality of the Waters and Water Dependent Natural Resources and the applicable Source Watershed. Compact section 4.11.2.; Wis. Stat. § 281.346(6)(b)("or, if the withdrawal is from a stream tributary to one of the Great Lakes, to the watershed of that stream").*[2]
  - *"'Cumulative impacts' means the impacts on the Great Lakes Basin ecosystem that result from incremental effects of all aspects of a withdrawal, diversion, or consumptive use in addition to other past, present, and reasonably foreseeable future withdrawals, diversions, and consumptive uses regardless of who undertakes the other withdrawals, diversions, and consumptive uses, including individually minor but collectively significant withdrawals, diversions, and consumptive uses taking place over a period of time." Wis. Stat. § 281.346(1)(g); see also Compact section 1.2.*
  - *The Great Lakes Basin ecosystem means the interacting components of air, land, water and living organisms, including humankind, within the Basin. Compact section 1.2.; Wis. Stat. § 281.346(1)(ji).*
  - *"Waters of the Basin," "Basin Water," "Waters of the Great Lakes Basin" mean the Great Lakes and all streams, rivers, lakes, connecting channels and other bodies of water, including tributary groundwater, within the Basin. Compact section 1.2.; Wis. Stat. § 281.346(1)(x).*
  - *"Water Dependent Natural Resources" means the interacting components of land, water and living organisms affected by the Waters of the Basin. Compact section 1.2.; Wis. Stat. § 281.346(1)(w).*

Additionally, the following Compact and Wisconsin Statutes sections address the requirement that the proposed use of water be reasonable based on consideration of the degree and duration of adverse impacts. The Diversion will not result in adverse impacts. Rather, the Diversion will benefit the environment.

- *The proposed use of the water must be reasonable, based upon a consideration of the probable degree and duration of any adverse impacts caused or expected to be caused by the proposed Withdrawal and use under foreseeable conditions, to other lawful consumptive or non-consumptive uses of water or to the quantity or quality of the waters and water dependent natural resources of the Great Lakes Basin, and the proposed plans and arrangements for avoidance or mitigation of such impacts. Compact section 4.11.5.e.; Wis. Stat. § 281.346(6)(e)5.*

[2] If "[n]o significant adverse environmental impacts to the waters of the state will result from the new or increased withdrawal" the proposal meets one of the factors of the state decision-making standard. *Wis. Stat. § 281.346(5m)(e)1.*

And, the following Compact and Wisconsin Statutes sections address the requirement that applicants submit: information about potential impacts; an assessment of individual impact; and, documentation of how the receiving water will be protected and sustained. The City has submitted information and assessments relating to the Diversion's lack of impact and documented how the receiving water will be protected and sustained.

- *Applicants must provide: information about the potential impacts of the Diversion on the waters of the Great Lakes Basin and water dependent natural resources and any other information required by the department by rule; an assessment of the individual impacts of the proposal; documentation of how the physical, chemical, and biological integrity of the receiving water will be protected and sustained, considering the state of the receiving water before the proposal is implemented and considering potential adverse impacts due to changes in temperature and nutrient loadings. Wis. Stat. §§ 281.346(4)(b)4., 281.346(4)(b)5. (may also include a cumulative impact assessment), 281.346(4)(b)4s. ("If the receiving water is a surface water body that is tributary to one of the Great Lakes, the person shall include a description of the flow of the receiving water before the proposal is implemented, considering both low and high flow conditions.")*

The application assesses the potential impacts of the Diversion (Volume 1, City of Waukesha Application Summary, Section 4, Water Supply Alternatives: Water Supply Alternative 3: Lake Michigan with Return Flow; Volume 5, City of Waukesha Environmental Report on Water Supply Alternatives, Section 5). The application also assesses the potential impacts of the return flow in conjunction with the Lake Michigan water supply alternatives (Volume 4, City of Waukesha Return Flow Plan; Volume 5, Environmental Report for Water Supply Alternatives, Section 6). These assessments demonstrate that there will be no significant adverse impacts to the waters and water dependent natural resources or the chemical, physical, or biological integrity of the Great Lakes basin from this proposed use of Lake Michigan water (Volume 5, City of Waukesha Environmental Report for Water Supply Alternatives, Sections 5 and 6). Rather, converting the City's water supply from the deep aquifer to Lake Michigan water will benefit the environment, including groundwater level rebound benefits of stopping deep aquifer pumping and improving water dependent natural resources by improving the aquatic habitat and fisheries in the Great Lakes tributary receiving return flow, and lessen the risk to public health (Volume 1, City of Waukesha Application Summary, Section 4, Water Supply Alternatives Evaluation, Water Supply Alternatives, Alternative 2, Lake Michigan with Return Flow; Volume 4, City of Waukesha Return Flow Plan, Section 3).

Waters. The Lake Michigan withdrawal will cause no significant adverse impact to the quantity of water of the Great Lakes basin. The City will meet the return flow requirement of returning to Lake Michigan the volume of water withdrawn less consumptive use (Volume 4, City of Waukesha Return Flow Plan, Section 2). The City has further set a goal of returning at least 100 percent of the volume withdrawn from Lake Michigan and shown this is achievable (Volume 4, City of Waukesha Return Flow Plan, Section 2).

Chemical Integrity. The Lake Michigan withdrawal will cause no significant adverse impact to the chemical integrity of the Great Lakes basin. The chemical integrity of the Great Lakes basin will be protected because the quality of the return flow will meet all WDNR water quality permit requirements. In addition, return flow will improve in-stream water quality (Volume 4, City of Waukesha Return Flow Plan, Section 3).

Physical Integrity. The Lake Michigan withdrawal will cause no significant adverse impact to the physical integrity of the Great Lakes basin. The physical integrity of the Great Lakes basin is protected by implementing the Return Flow Management Plan and meeting the return flow requirement. The physical integrity of potential receiving waters is also protected from increased erosion and sediment scour (Volume 4, City of Waukesha Return Flow Plan, Section 3).

Biological Integrity. The Lake Michigan withdrawal will cause no significant adverse impact to the biological integrity of the Great Lakes basin. There is no opportunity for invasive species to be introduced through the return flow because the flow is confined to a pipe from a wastewater treatment plant, protecting biological integrity. In addition to conventional wastewater treatment processes, which consist of screening, primary

clarification, aeration, and secondary clarification, the City's wastewater treatment plant includes dual media filtration, ultra-violet light disinfection and post-aeration. Furthermore, the return flow will provide more, and higher-quality, functional in-stream habitat improvements to the biological integrity of the Great Lakes tributary receiving return flow, benefiting the fisheries and supporting water dependent natural resources in the Great Lakes tributary (Volume 4, City of Waukesha Return Flow Plan, Section 3).

No Cumulative Impacts. The City proposes to use Lake Michigan for its water supply source. After use and treatment, the City will return the water to the Basin. Therefore, not only will the proposed use of Lake Michigan water have no significant adverse individual impacts and no cumulative impacts to the quantity or quality of the waters and water dependent natural resources of the Basin, it will have a net positive impact on the waters and water dependent natural resources of Lake Michigan.

If the City switches to a Lake Michigan source of water, the City will discontinue its use of groundwater from the deep aquifer. Discontinuing the use of groundwater will stop the cumulative adverse impacts to the groundwater resources (Volume 1, City of Waukesha Application Summary, Section 4). Moreover, the City will return at least 100 percent of the volume of water withdrawn from Lake Michigan, resulting in no volume change to the Great Lakes basin and no significant cumulative impact to the water dependent industries (e.g. shipping and hydropower generation) in the Great Lakes (Volume 4, City of Waukesha Return Flow Plan, Section 2).

Switching to a Lake Michigan water supply and discontinuing the withdrawal of groundwater from the deep aquifer will benefit the waters of the Basin, because, historically, water from the deep aquifer flowed to Lake Michigan. After groundwater pumping of the deep aquifer began, water from the deep aquifer was drawn down and was not available to feed Lake Michigan. As pumping increased, the flow of groundwater was actually reversed and water that would have otherwise fed Lake Michigan was drawn to the groundwater wells. Currently, waters of the Great Lakes basin are flowing west into the deep aquifer rather than recharging Lake Michigan to the east. The USGS estimates that 30 percent of the 33 mgd of water currently pumped by the deep aquifer wells in southeastern Wisconsin originates from inside the Lake Michigan Basin (Volume 1, Application Summary, Section 4, Water Supply Alternatives, Alternative 1, Deep Confined Aquifer and Shallow Aquifer. Therefore, switching from the groundwater supply to a Lake Michigan surface water supply will contribute to aquifer recovery and will eliminate the transfer of water from the Lake Michigan watershed to the Mississippi River watershed.

Pumping the deep aquifer also pulls down water from the overlaying shallow aquifer to the deep aquifer. An estimated 18 percent of shallow aquifer baseflows are diverted toward deep wells and away from surface water resources. If groundwater supply is replaced with a Lake Michigan supply, Waukesha will no longer pull water from the shallow aquifer to the deep aquifer. Over time, this will improve critical baseflows to surface water resources, including wetlands, streams and lakes (USGS and WGNHS. 03/2007; SEWRPC, 12/2010).

The withdrawal of water from Lake Michigan will not endanger the integrity of the Lake Michigan ecosystem because at least 100 percent of the withdrawn volume will be returned. The return flow will also improve or maintain the physical and biological resources and improve or have a minor change to the chemical resources of the tributary stream and Lake Michigan Volume 4, City of Waukesha Return Flow Plan, Section3.

Finally there are few communities with significant populations that are outside the Great Lakes basin, within a straddling county, and as close to one of the Great Lakes as the City; consequently, the Compact exception standard is applicable to few communities of similar size to Waukesha, and communities further away will find a Diversion less economically feasible. Additionally, the City's goals exceed the Compact requirements. Therefore, when viewed separately or cumulatively with other diversions, the City's proposed Diversion will not have any significant adverse impacts on the sustainable management of the waters of the Great Lakes basin or on the quantity or quality of the water or water dependent natural resources of the basin. Rather, the Diversion will have a net positive impact on Lake Michigan's water and water dependent resources. *See also* No Significant Adverse Impacts From Return Flow section.

5.7 Return Flow to the Basin

The following Compact and Wisconsin Statutes sections address the requirements that withdrawn water be returned to the source watershed less an allowance for consumptive use, be treated to meet discharge standards and prevent introduction of invasive species, and minimize surface water and groundwater from outside the basin. The amount of water that the City returns to the source watershed will equal or exceed the withdrawn water volume less consumptive use, will be treated to meet applicable standards and eliminate invasive species, and will minimize non-basin water.

- *"All Water Withdrawn shall be returned, either naturally or after use, to the Source Watershed less an allowance for Consumptive Use. No surface water or groundwater from the outside the Basin may be used to satisfy any portion of this criterion except if it: i. Is part of a water supply or wastewater treatment system that combines water from inside and outside of the Basin; ii. Is treated to meet applicable water quality discharge standards and to prevent the introduction of invasive species into the Basin." Compact sections 4.9.4.c. and 4.11.1.; Wis. Stat. § 281.346(6)(a) ("All of the water withdrawn from the Great Lakes basin will be returned to the source watershed, less an allowance for consumptive use"). See also Wis. Stat. § 281.346(4)(f)3. ("An amount of water equal to the amount of water withdrawn from the Great Lakes basin will be returned to the source watershed, less an allowance for consumptive use"), Wis. Stat. § 281.346(4)(f)4. ("No water from outside the Great Lake basin will be returned to the source watershed unless all of the following apply: a. The returned water is from a water supply or wastewater treatment system that combines water from inside and outside the Great Lakes basin.")*
- *The Proposal maximizes the amount of water returned to the Source Watershed as Basin Water and minimizes the amount of surface water or groundwater from outside the Basin that will be returned to the source watershed. Compact section 4.9.3.b.; Wis. Stat. § 281.346(4)(e)1.c.*
    - *"Source watershed" means the watershed from which a withdrawal originates. If water is withdrawn directly from a Great Lake, then the source watershed is the watershed of that Great Lake. Compact section 1.2.; Wis. Stat. § 281.346(1)(r).*
    - *"Consumptive Use means that portion of the Water Withdrawn or withheld from the Basin that is lost or otherwise not returned to the Basin due to evaporation, incorporation into Products, or other processes." Compact section 1.2.; see also Wis. Stat. § 281.346(1)(e) ("'Consumptive use' means a use of water that results in the loss of or failure to return some or all of the water to the Basin from which the water is withdrawn due to evaporation, incorporation into products, or other processes").*

The City's goal is to exceed these requirements by returning not less than 100 percent of the withdrawn water over a management period. 9Volume 4, City of Waukesha Return Flow Plan, Section 2). However, at a minimum, the City will return the amount of water withdrawn from Lake Michigan, less consumptive use, to the source watershed (Lake Michigan) by managing return flow (Volume 4, City of Waukesha Return Flow Plan, Section 2).

Additionally, the City will minimize out-of-basin water in the return flow (Volume 4, City of Waukesha Return Flow Plan, Section 2). Some out-of-basin water will be returned to the Lake Michigan watershed; however, the out-of-basin water that will be discharged to the Lake Michigan watershed will be minimized and treated to WDNR standards by the City's wastewater treatment system. The return flow will have an approved effluent discharge permit under Wisconsin Statutes section 283.31. The return flow will prevent the introduction of invasive species by returning only treated wastewater conveyed in a pipe directly from the WWTP to the return flow location. The applicable permits and associated operating requirements for the discharge, under Wisconsin Statutes sections 30.12, will be obtained before the return flow outfall is constructed.

The following Compact and Wisconsin Statutes sections address the requirement that water be returned as close as practicable to the place where it is withdrawn. The City meets these requirements, because it will return water to Lake Michigan via a Lake Michigan tributary (the Root River).

- *"The place at which the water is returned to the source watershed is as close as practicable to the place at which the water is withdrawn, unless the applicant demonstrates that returning the water at that place is one of the following: a. Not economically feasible. b. Not environmentally sound. c. Not in the interest of public health." Wis. Stat. § 281.346(4)(f)3m.*

The City considered return flow alternatives that discharged directly to Lake Michigan, to Lake Michigan tributaries in the Greater Milwaukee watersheds, and to the MMSD. The preferred return flow location is to the Root River, a tributary that is as close as practicable to the place where the water is withdrawn and will return flow to Lake Michigan. Return flow to Underwood Creek is not implementable at this time because the WDNR is in the process of preparing a TMDL and there is no a return flow TMDL allocation established. Return flow to MMSD and directly to Lake Michigan are not cost-effective and do not provide the aquatic habitat benefits available in the Root River (Volume 4, City of Waukesha Return Flow Plan, Section 3).

The following Compact and Wisconsin Statutes sections address the requirement that when water is returned via a stream tributary, the receiving water integrity is protected and sustained. The City's return flow via the Root River will protect and enhance the Root River.

- *If water will be returned to the source watershed through a stream tributary to one of the Great Lakes, the applicant shall provide documentation of how the physical, chemical, and biological integrity of the receiving water will be protected and sustained, considering the state of the receiving water before the proposal is implemented and considering potential adverse impacts due to changes in temperature and nutrient loadings. If the receiving water is a surface water body that is tributary to one of the Great Lakes, the applicant shall include a description of the flow of the receiving water before the proposal is implemented, considering both low and high flow conditions. Wis. Stat. §§ 281.346(4)(b)4s and(4)(f)4m.*

A discharge of return flow to the Root River will protect and sustain the river's physical (geomorphology), chemical, and biological integrity in accordance with Wisconsin Statutes sections 30.12, 281.15, and 283.31 (Volume 4, City of Waukesha, Return Flow Plan, Attachment M). In addition, the return flow will prevent the introduction of invasive species by only returning treated wastewater conveyed in a pipe directly from the WWTP to the return flow location. Temperature of the return flow has been considered and is consistent with other municipal wastewater discharges (Volume 4, City of Waukesha, Return Flow Plan, Section 3 Return Flow Alternatives: Return Flow to Root River: Water Quality). Changes in nutrient loadings were evaluated and found to be less than 1 percent of expected annual loadings to Lake Michigan in the Greater Milwaukee area (Volume 4, City of Waukesha, Return Flow Plan, Attachment M).

5.8 No Significant Adverse Impacts from Return Flow

The following Compact and Wisconsin Statutes sections address the requirement that use of water be reasonable based on the restoration of hydrologic conditions and functions of the source watershed. Additionally, the return flow must also meet the Compact and statute sections requiring that there be no significant adverse impacts (*see above*, Section 5.6). The City's return flow will meet the no significant adverse impact requirements and will result in a benefit to the environment.

- *The proposed use of the water must be reasonable, based upon a consideration of restoration of hydrologic conditions and functions of the Source Watershed. Compact section 4.11.5.f.; Wis. Stat. § 281.346(6)(e)6 ("or, if the withdrawal is from the stream tributary to one of the Great Lakes, of the watershed of that stream").*

The City will return flow to ensure that no significant individual or cumulative adverse impacts result to the quantity and quality of Lake Michigan's waters and water dependent natural resources. Moreover, the proposal maintains or improves the chemical, physical, and biological integrity of the Great Lakes basin (Volume 4, City of Waukesha Return Flow Plan, Section 3).

The City exceeds the return flow requirements and the flow will benefit the waters and water dependent natural resources of the Basin in the following ways:

- The City will return no less than 100 percent of the water volume withdrawn and thus will not impact the water level of Lake Michigan. Returning the withdrawn water will help stop the transfer of Great Lakes groundwater out of the Great Lakes basin. Also, the City will minimize the volume of out-of-basin water returned (Volume 4, City of Waukesha Return Flow Plan, Section 2).
- Return flow will benefit habitat, fisheries, and water quality in a Lake Michigan tributary. Return flow to the Root River could eliminate reported low flow conditions and improve the operation of the Steelhead Facility which will improve angling opportunities in the Root River and the Great Lakes (Volume 4, City of Waukesha Return Flow Plan, Section 3 and Appendix M**;** Volume 5, City of Waukesha Environmental Report for Water Supply Alternatives, Section 5).
- Return flow to the Root River will provide an environmental benefit to the Great Lakes fisheries by augmenting flow in the river. This will allow more fish to reach the Root River Steelhead Facility where the WDNR will collect eggs for spawning and hatchery operations that provide stocking of trout and salmon to Lake Michigan (Volume 4, City of Waukesha Return Flow Plan, Section 3.2.3 and Appendix L).
- Return flow water quality limits are more stringent than other direct and tributary Lake Michigan tributary dischargers. As a result, the City's return flow will improve the water quality in Root River for some parameters like phosphorus, and it will protect water quality for others because return flow will meet all water quality limits (Volume 4, City of Waukesha Return Flow Plan, Section 3.2.6 and Appendix M).
- The return flow to Lake Michigan will not endanger the integrity of the Lake Michigan ecosystem, because the return flow water quality will meet all USEPA and WDNR requirements and the City has a goal to return no less than 100 percent of the withdrawn volume. The return flow will also improve or maintain the physical and biological resources, and improve or have minor impact to the chemical resources of the tributary stream proposed for the return flow (Volume 3, City of Waukesha Return Flow Plan, Section3).

The net positive environmental benefits will improve, not endanger, the integrity of the Great Lakes basin ecosystem. The return flow will protect and sustain the physical, chemical, and biological integrity of the Great Lakes basin, and for some parameters, the return flow will beneficially improve these systems.

5.9 Other Provisions

Additional Compact and statute sections are set forth below, followed by a summary of how the City complies with the requirements.

- *The proposal is implemented so as to ensure that it is in compliance with all applicable municipal, State and federal laws as well as regional interstate and international agreements, including the Boundary Waters Treaty of 1909. Compact sections 4.9.4.f., 4.11.4; Wis. Stat. §§ 281.346(4)(f)7., 281.346(6)(d).*

The City will meet all applicable municipal, state, and federal laws as well as regional interstate and international agreements. The requirements of the Boundary Waters Treaty of 1909 are not triggered by this proposal.

- *The proposal shall be subject to management and regulation by the Originating Party. Compact section 4.9.3.c. An Originating Party is the Party within whose jurisdiction an Application is made or required. Compact section 1.2. A Party is a state that is a party to the Compact. Compact section 1.2., Wis. Stat. § 281.346(1)(n).*

The WDNR is the Originating Party and it will manage and regulate the Diversion.

- *The WDNR conducts a technical review. Wis. Stat. § 281.346(4)(e)1.f.*

- *The WDNR notifies the regional body; the proposal undergoes regional review; and the WDNR considers the regional declaration of finding in determining whether to approve the proposal. Compact sections 4.5, 4.9.3.f.; Wis. Stat. § 281.346(4)(e)1.g.–i.*
- *The proposal is approved by the Great Lakes Council. Compact sections 4.7., 4.9.3.g.; Wis. Stat. § 281.346(4)(e)1.j.*

The City's application has triggered this review process.

EXHIBIT 5-1
Compact and Related Wisconsin Statute Compliance Summary

Compact	State Statute	Resources
Article 1		
Proposal means a Withdrawal, Diversion or Consumptive Use of Water that is subject to this Compact. Section 1.2. **Diversion** means a transfer of Water from the Basin into another watershed, or from the watershed of one of the Great Lakes into that of another by any means of transfer, including but not limited to a pipeline, canal, tunnel, aqueduct, channel, modification of the direction of a water course, a tanker ship, tanker truck or rail tanker but does not apply to Water that is used in the Basin or a Great Lake watershed to manufacture or produce a Product that is then transferred out of the Basin or watershed. **Divert** has a corresponding meaning. Section 1.2.	"Diversion" means a transfer of water from the Great Lakes basin into a watershed outside the Great Lakes basin. . . by any means of transfer. . . . Wis. Stat. § 281.346(1)(h). "Divert" means to transfer water from the Great Lakes basin into a watershed outside the Great Lakes basin . . . by any means of transfer. . . . Wis. Stat. § 281.346(1)(hm).	
Article 4		
The Water shall be used solely for the Public Water Supply Purposes of the Community within a Straddling County that is without adequate supplies of potable water. Section 4.9.3.a. **Community within a Straddling County** means any incorporated city, town or the equivalent thereof, that is located outside the Basin but wholly with a County that lies partly within the Basin and that is not a Straddling Community. Section 1.2.	A person may apply . . . for approval of a new or increased diversion under par. (c) or (e) only if the person operates a public water supply system that receives or would receive water from the new or increased diversion. Wis. Stat. § 281.346(4)(b)2.[3] [T]he water diverted will be used solely for public water supply purposes in a community within a straddling county and "the proposal is consistent with an approved water supply service area plan under s. 281.348 that covers the public water supply system." § 281.346(4)(e)1.em. "Public water supply" means water distributed to the public through a physically connected system of treatment, storage, and distribution facilities that serve a group of largely residential customers and that may also serve industrial, commercial, and other institutional customers. Wis. Stat. § 281.346(1)(pm).	Volume 1, City of Waukesha Application Summary, 1.1 Eligibility to Apply, and 2.1 City Public Water System Volume 2, City of Waukesha Water Supply Service Area Plan, Sections 3, 11

[3] Paragraph (c) governs straddling communities. Paragraph (e) governs straddling counties.

EXHIBIT 5-1
Compact and Related Wisconsin Statute Compliance Summary

Compact	State Statute	Resources
Public Water Supply Purposes means water distributed to the public through a physically connected system of treatment, storage and distribution facilities serving a group of largely residential customers that may also serve industrial, commercial, and other institutional operators. Water Withdrawn directly from the Basin and not through such a system shall not be considered to be used for Public Water Supply Purposes. Section 1.2.	"Community within a straddling county" means any city, village, or town that is not a straddling community and that is located outside the Great Lakes basin but wholly within a county that lies partly within the Great Lakes basin. Wis. Stat. § 281.346(1)(d). *See also* Wis. Stat. § 281.348(3). "Straddling county" means a county that lies partly within the Great Lakes basin. Wis. Stat. § 281.346(1)(tm). The community is without adequate supplies of potable water. Wis. Stat. § 281.346(4)(e)1.a. "Without adequate supplies of potable water" means lacking a water supply that is economically and environmentally sustainable in the long term to meet reasonable demands for a water supply in the quantity and quality that complies with applicable drinking water standards, is protective of public health, is available at a reasonable cost, and does not have adverse environmental impacts greater than those likely to result from the proposed new or increased diversion. Wis. Stat. § 281.346(1)(zm).	
	If a person who applies . . . will not directly withdraw the water proposed to be diverted, the person shall identify any entities that may withdraw the water and provide evidence of support from each of those entities in the form of a letter or resolution. Wis. Stat. § 281.346(4)(b)4m.	Volume 2, City of Waukesha Water Supply Service Area Plan, Section
The Proposal meets the Exception Standard, maximizing the portion of water returned to the Source Watershed as Basin Water and minimizing the surface water or groundwater from outside the Basin. Section 4.9.3.b. **Exception Standard** means the standard for Exceptions established in Section 4.9.4. Section 1.2. **Exception** means a transfer of Water that is excepted under Section 4.9 from the prohibition against Diversions in Section 4.8. Section 1.2. **Source Watershed** means the watershed from which a Withdrawal originates. If Water is Withdrawn directly from a Great Lake or from the St. Lawrence River, then the Source Watershed shall be considered to be the watershed of that Great Lake or the watershed of the St. Lawrence River, respectively. . . . Section 1.2. **Basin** . . . means the watershed of the Great Lakes and the St. Lawrence River upstream from Trois-Rivières, Québec within the jurisdiction of the Parties. Section 1.2.	The proposal meets the exception standard under par. (f). Wis. Stat. § 281.346(4)(e)1.b. The proposal maximizes the amount of water withdrawn from the Great Lakes basin that will be returned to the source watershed and minimizes the amount of water from outside the Great Lakes basin that will be returned to the source watershed. Wis. Stat. § 281.346(4)(e)1.c. No water from outside the Great Lake basin will be returned to the source watershed unless all of the following apply: a. The returned water is from a water supply or wastewater treatment system that combines water from inside and outside the Great Lakes basin. b. The returned water will be treated to meet applicable permit requirements under s. 283.31 and to prevent the introduction of invasive species into the Great Lakes basin and the department has approved the permit under s. 283.31. c. If the water is returned through a structure on the bed of a navigable water, the structure is designed and will be operated to meet the applicable permit requirements under s. 30.12 and the department has approved the permit under s. 30.12. Wis. Stat. § 281.346(4)(f)4. "Source watershed" means the watershed from which a withdrawal originates. If water is withdrawn directly from a Great Lake or from the St. Lawrence River, then the source watershed is the watershed of that Great Lake or the watershed of the St. Lawrence River, respectively. If water is withdrawn from the watershed of a stream that is a direct tributary to a Great Lake or a direct tributary to the St. Lawrence River, then the source watershed is the watershed of that Great Lake or the watershed	Volume 1, City of Waukesha Application Summary, Section 4 Volume 4, City of Waukesha Return Flow Plan, Section 2

EXHIBIT 5-1
Compact and Related Wisconsin Statute Compliance Summary

Compact	State Statute	Resources
All Water Withdrawn shall be returned, either naturally or after use, to the Source Watershed less an allowance for Consumptive Use. No surface water or groundwater from the outside the Basin may be used to satisfy any portion of this criterion except if it: i. Is part of a water supply or wastewater treatment system that combines water from inside and outside the Basin; ii. Is treated to meet applicable water quality discharge standards and to prevent the introduction of invasive species into the Basin. Section 4.9.4.c. **Consumptive Use** means that portion of the Water Withdrawn or withheld from the Basin that is lost or otherwise not returned to the Basin due to evaporation, incorporation into Products, or other processes. Section 1.2. Proposals . . . may be approved as appropriate only when . . . All Water Withdrawn shall be returned, either naturally or after use, to the Source Watershed less an allowance for Consumptive Use. Section 4.11.1.	of the St. Lawrence River, respectively. Wis. Stat. § 281.346(1)(r). "Consumptive use" means a use of water that results in the loss of or failure to return some or all of the water to the basin from which the water is withdrawn due to evaporation, incorporation into products, or other processes. Wis. Stat. § 281.346(1)(e). "Great Lakes basin" means the watershed of the Great Lakes and the St. Lawrence River upstream from Trois-Rivières, Quebec, within the jurisdiction of the parties. Wis. Stat. § 281.346(1)(je). An amount of water equal to the amount of water withdrawn from the Great Lakes basin will be returned to the source watershed, less an allowance for consumptive use. Wis. Stat. § 281.346(4)(f)3. All of the water withdrawn from the Great Lakes basin will be returned to the source watershed, less an allowance for consumptive use. Wis. Stat. § 281.346(6)(a). "Consumptive use" means a use of water that results in the loss of or failure to return some or all of the water to the basin from which the water is withdrawn due to evaporation, incorporation into products, or other processes. Wis. Stat. § 281.346(1)(e).	
The Proposal shall be subject to management and regulation by the Originating Party, regardless of its size. Section 4.9.3.c. **Originating Party** means the Party within whose jurisdiction an Application or registration is made or required. Section 1.2. **Party** means a State party to this Compact. Section 1.2.	"Party" means a state that is a party to the compact. Wis. Stat. § 281.346(1)(n).	Volume 2, City of Waukesha Water Supply Service Area Plan Volume 3, City of Waukesha Water Conservation Plan Volume 4, City of Waukesha Return Flow Plan, Section 8
There is no reasonable water supply alternative within the basin in which the community is located, including conservation of existing water supplies. Section 4.9.3.d. The need for all or part of the proposed Exception cannot be reasonably avoided through the efficient use and conservation of existing water supplies.	There is no reasonable water supply alternative within the watershed in which the community is located, including conser-vation of existing water supplies as determined under par. (g). Wis. Stat. § 281.346(4)(e)1.d. The applicant has assessed other potential water sources for cost−effectiveness and environmental effects. Wis. Stat. § 281.346(5m)(c). "Reasonable water supply alternative" means a water supply alternative that is similar in cost to, and as environmentally	Volume 1, City of Waukesha Application Summary, Sections 3 and 4 Volume 2, City of Waukesha Water Supply Service Area

EXHIBIT 5-1
Compact and Related Wisconsin Statute Compliance Summary

Compact	State Statute	Resources
Section 4.9.4.a.	sustainable and protective of public health as, the proposed new or increased diversion and that does not have greater adverse environmental impacts than the proposed new or increased diversion. Wis. Stat. § 281.346(1)(ps). The need for the proposed diversion cannot reasonably be avoided through the efficient use and conservation of existing water supplies as determined under par. (g). Wis. Stat. § 281.346(4)(f)1.	Plan, Section 7
This Exception should not be authorized unless it can be shown that it will not endanger the integrity of the Basin Ecosystem. Section 4.9.3.e. **Basin Ecosystem** . . . means the interacting components of air, land, Water and living organisms, including humankind, within the Basin. Section 1.2. The Exception will be implemented so as to ensure that it will result in no significant or cumulative adverse impacts to the quantity or quality of the Waters and Water Dependent Natural Resource of the Basin with consideration given to the potential Cumulative Impacts of any precedent-setting consequences associated with the Proposal. Sections 4.9.4.d. **Cumulative Impacts** mean the impact on the Basin Ecosystem that results from incremental effects of all aspects of a Withdrawal, Diversion or Consumptive Use in addition to other past, present, and reasonably foreseeable future Withdrawals, Diversions and Consumptive Uses regardless of who undertakes the other Withdrawals, Diversions and Consumptive Uses. Cumulative Impacts can result from individually minor but collectively significant Withdrawals, Diversions and Consumptive Uses taking place over a period of time. Section 1.2. **Waters of the Basin or Basin Water** means the Great Lakes and all streams, rivers, lakes, connecting channels and other bodies of water, including tributary groundwater, within the Basin. Section 1.2. **Water Dependent Natural Resources** means the interacting components of land, Water and living organisms affected by the	The proposal will not endanger the integrity of the Great Lakes basin ecosystem based upon a determination that the proposal will have no significant adverse impact on the Great Lakes basin ecosystem. Wis. Stat. § 281.346(4)(e)1.e. "Great Lakes basin ecosystem" means the interacting components of air, land, water, and living organisms, including humans, within the Great Lakes basin. Wis. Stat. § 281.346(1)(ji). The diversion will result in no significant adverse individual impacts or cumulative impacts to the quantity or quality of the waters of the Great Lakes basin Great Lakes basin or to water dependent natural resources, including cumulative impacts that might result due to any precedent-setting aspects of the proposed diversion, based upon a determination that the proposed diversion will not have any significant adverse impacts on the sustainable management of the waters of the Great Lakes basin. Wis. Stat. § 281.346(4)(f)5. One of the following applies: 1. No significant adverse environmental impacts to the waters of the state will result from the new or increased withdrawal. 2. If the withdrawal is from a surface water body, the applicant demonstrates that the withdrawal will not result in the violation of water quality standards under s. 281.15 or impair fish populations. 3. The department has issued a permit under s. 30.18 for the new or increased withdrawal or has issued a permit under s. 30.12 for a structure that will be used for the new or increased withdrawal. 4. The department has issued an approval under s. 281.34, or s. 281.17, 2001 stats., for the new or increased withdrawal. Wis. Stat. § 281.346(5m)(e). The withdrawal will result in no significant adverse individual impacts or cumulative impacts to the quantity or quality of the waters of the Great Lakes basin, to water dependent natural resources, to the source watershed, or, if the withdrawal is from a stream tributary to one of the Great Lakes, to the watershed of that stream. Wis. Stat. § 281.346(6)(b). "Cumulative impacts" means the impacts on the Great Lakes basin ecosystem that result from incremental effects of all aspects of a withdrawal, diversion, or consumptive use in addition to other past, present, and reasonably foreseeable future withdrawals, diversions, and consumptive uses regardless of who	Volume 1, City of Waukesha Application Summary, Section 4 Volume 2, Water Supply Service Area Plan, Section 11 Volume 4, City of Waukesha Return Flow Plan, Section 3 Volume 5, City of Waukesha Environmental Report on Water Supply Alternatives, Sections 5 and 6

EXHIBIT 5-1
Compact and Related Wisconsin Statute Compliance Summary

Compact	State Statute	Resources
Waters of the Basin. Section 1.2. Proposals . . . may be approved as appropriate only when . . . The Withdrawal or Consumptive Use will be implemented so as to ensure that the Proposal will result in no significant individual or cumulative adverse impacts to the quantity or quality of the Waters and Water Dependent Natural Resources and the applicable Source Watershed. Section 4.11.2.	undertakes the other withdrawals, diversions, and consumptive uses, including individually minor but collectively significant withdrawals, diversions, and consumptive uses taking place over a period of time. Wis. Stat. § 281.346(1)(g). "Waters of the Great Lakes basin" means the Great Lakes and all streams, rivers, lakes, connecting channels, and other bodies of water, including tributary groundwater, within the Great Lakes basin. Wis. Stat. § 281.346(1)(x). "Water dependent natural resources" means the interacting components of land, water, and living organisms affected by the waters of the Great Lakes basin. Wis. Stat. § 281.346(1)(w). A person who applies . . . shall provide information about the potential impacts of the diversion on the waters of the Great Lakes basin and water dependent natural resources and any other information required by the department by rule. Wis. Stat. § 281.346(4)(b)4. If the proposal for which a person applies . . . Is subject to the exception standard under par. (f), the person shall provide an assessment of the individual impacts of the proposal for the purposes of par. (f) 5. The person may also include a cumulative impact assessment. Wis. Stat. § 281.346(4)(b)5. If the proposal for which a person applies . . . . is subject to the exception standard under par. (f), the person shall provide documentation of how the physical, chemical, and biological integrity of the receiving water under par. (f) 3. will be protected and sustained as required under ss. 30.12, 281.15, and 283.31, considering the state of the receiving water before the proposal is implemented and considering potential adverse impacts due to changes in temperature and nutrient loadings. If the receiving water is a surface water body that is tributary to one of the Great Lakes, the person shall include a description of the flow of the receiving water before the proposal is implemented, considering both low and high flow conditions. Wis. Stat. § 281.346(4)(b)4s. If water will be returned to the source watershed through a stream tributary to one of the Great Lakes, the physical, chemical, and biological integrity of the receiving water under subd. 3. will be protected and sustained as required under ss. 30.12, 281.15, and 283.31, considering the state of the receiving water before the proposal is implemented and considering both low and high flow conditions and potential adverse impacts due to changes in temperature and nutrient loadings. Wis. Stat. § 281.346(4)(f)4m. The place at which the water is returned to the source watershed is as close as practicable to the place at which the water is withdrawn, unless the applicant demonstrates that returning the water at that place is one of the following: a. Not economically feasible. b. Not environmentally sound. c. Not in the interest of public health. Wis. Stat. § 281.346(4)(f)3m.	

EXHIBIT 5-1
Compact and Related Wisconsin Statute Compliance Summary

Compact	State Statute	Resources
The Proposal undergoes Regional Review. Section 4.9.3.f. *See also* Section 4.5.	The proposal undergoes regional review. Wis. Stat. § 281.346(4)(e)1.h. "Regional review" means review by the regional body as described in s. 281.343(4h). Wis. Stat. § 281.346(1)(qm). The department conducts a technical review. Wis. Stat. § 281.346(4)(e)1.f. The department notifies the regional body . . . . The proposal undergoes regional review. The department considers the regional declaration of finding in determining whether to approve the proposal. Wis. Stat. § 281.346(4)(e)1.g.–i.	
The Proposal is approved by the Council. Council approval shall be given unless one or more Council Members vote to disapprove. Section 4.9.3.g. *See also* Section 4.7.	The proposal is approved by the Great Lakes Council. Wis. Stat. § 281.346(4)(e)1.j.	
[S]ubstantive consideration will also be given to whether or not the Proposal can provide sufficient scientifically based evidence that the existing water supply is derived from groundwater that is hydrologically interconnected to Waters of the Basin Section 4.9.3.	"[T]he department shall give substantive consideration to whether the applicant provides sufficient scientifically based evidence that the existing water supply is derived from groundwater that is hydrologically interconnected to waters of the Great Lakes basin. The department may not use a lack of hydrological connection to the waters of the Great Lakes basin as a reason to disapprove a proposal." Wis. Stat. § 281.346(4)(e)2.	Volume 1, City of Waukesha Application Summary, Section 2.2.1 Deep Confined Aquifer Volume 2, City of Waukesha Water Supply Service Area Plan, Section 7
The Exception will be limited to quantities that are considered reasonable for the purposes for which it is proposed. Section 4.9.4.b. Proposals . . . may be approved as appropriate only when . . . The propose use is reasonable, based upon a consideration of . . . Whether the proposed Withdrawal or Consumptive Use is planned in a fashion that provides for efficient use of the water, and will avoid or minimize the waste of Water. Section 4.11.5.a.	The diversion is limited to quantities that are reasonable for the purposes for which the diversion is proposed. Wis. Stat. § 281.346(4)(f)2. In an approval issued under this subsection . . . the department shall specify a diversion amount equal to the quantity of water that is reasonable for the purposes for which the diversion is proposed. Wis. Stat. § 281.346(4)(i). The proposed use of the water is reasonable, based on a consideration of . . . Whether the proposed withdrawal is planned in a way that provides for efficient use of the water and will avoid or minimize the waste of water. Wis. Stat. § 281.346(6)(e)1. The amount of the withdrawal or increase in the withdrawal is needed to meet the projected needs of the person who will use the water. Wis. Stat. § 281.346(5m)(a).	Volume 1 City of Waukesha Application Summary, Section 3 Volume 2, City of Waukesha Water Supply Service Area Plan, Section 6
Proposals . . . may be approved as appropriate only when . . . The proposed use is reasonable, based upon a consideration of . . . The supply potential of the water source, considering quantity, quality, and reliability and safe yield of hydrologically interconnected water sources	The proposed use of the water is reasonable, based on a consideration of . . . The supply potential of the water source, considering quantity, quality, reliability, and safe yield of hydrologically interconnected water sources. Wis. Stat. § 281.346(6)(e)4.	Volume 1, City of Waukesha Application Summary, Section 3 Volume 2, City of Waukesha Water

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Compact and Related Wisconsin Statute Compliance Summary

Compact	State Statute	Resources
Section 4.11.5.d.		Supply Service Area Plan, Section 6
Proposals . . . may be approved as appropriate only when . . . The proposed use is reasonable, based upon a consideration of . . . If a Proposal includes restoration of hydrologic conditions and functions of the Source Watershed, the Party may consider that. Section 4.11.5.f.	The proposed use of the water is reasonable, based on a consideration of . . . Any provisions for restoration of hydrologic conditions and functions of the source watershed or, if the withdrawal is from the stream tributary to one of the Great Lakes, of the watershed of that stream. Wis. Stat. § 281.346(6)(e)6.	Volume 1, City of Waukesha Application Summary, Section 3 Volume 2, City of Waukesha Water Supply Service Area Plan, Section 6
Proposals . . . may be approved as appropriate only when . . . The proposed use is reasonable, based upon a consideration of . . . The probable degree and duration of any adverse impacts caused or expected to be caused by the proposed Withdrawal and use under foreseeable conditions, to other lawful consumptive or non-consumptive uses of water or to the quantity or quality of the Waters and Water Dependent Natural Resources of the Basin, and the proposed plans and arrangements for avoidance or mitigation of such impacts. Section 4.11.5.e.	The proposed use of the water is reasonable, based on a consideration of . . . The probable degree and duration of any adverse impacts caused or expected to be caused by the proposed withdrawal and use, under foreseeable conditions, to other lawful consumptive uses or nonconsumptive uses of water or to the quantity or quality of the waters of the Great Lakes basin and water dependent natural resources, and the proposed plans and arrangements for avoidance or mitigation of those impacts. Wis. Stat. § 281.346(6)(e)5.	Volume 1, City of Waukesha Application Summary, Section 4 Volume 5, City of Waukesha Environmental Report for Water Supply Alternatives
[Proposals . . . may be approved as appropriate only when . . .] The [Exception] [Withdrawal or Consumptive Use] will be implemented so as to incorporate Environmentally Sound and Economically Feasible Water Conservation Measures to minimize Water Withdrawals or Consumptive Use. Sections 4.9.4.e., 4.11.3. **Environmentally Sound and Economically Feasible Water Conservation Measures** mean those measures, methods, technologies or practices for efficient water use and for reduction of water loss and waste or for reducing a Withdrawal, Consumptive Use or Diversion that i) are environmentally sound, ii) reflect best practices applicable to the water use sector, iii) are technically feasible and available, iv) are economically feasible and cost effective based on an analysis that considers direct and avoided economic and environmental costs and v) consider the particular facilities and processes involved, taking into account the environmental impact, age of equipment and facilities involved, the processes employed, energy impacts and other appropriate factors.	The applicant commits to implementing the applicable water conservation measures under sub. (8) (d) that are environmentally sound and economically feasible for the applicant. Wis. Stat. § 281.346(4)(f)6. *Water conservation and efficiency measures*. The department shall promulgate rules specifying water conservation and efficiency measures for the purposes of implementing par. (b). In the rules, the department may not require retrofitting of existing fixtures, appliances, or equipment. The department shall specify measures based on all of the following: 1. The amount and type of diversion, withdrawal, or consumptive use and whether the diversion, withdrawal, or consumptive use exists on December 8, 2008, is expanded, or is new. 2. The results of any pilot water conservation program conducted by the department in cooperation with the regional body. 3. The results of any assessments under sub. (11) (d). Wis. Stat. § 281.346(8)(d). "Environmentally sound and economically feasible water conservation measures" is defined as "those measures, methods, or technologies for efficient water use and for reducing water loss and waste or for reducing the amount of a withdrawal, consumptive use, or diversion that are, taking into account environmental impact, the age and nature of equipment and facilities involved, the processes employed, the energy impacts, and other appropriate factors, all of the following: 1. Environmentally sound. 2. Reflective of best practices applicable to the water use section. 3. Technically feasible and available. 4. Economically feasible and cost-effective based on an analysis that considers direct and avoided economic and environmental costs."	Volume 1, City of Waukesha Application Summary, Section 3 Volume 3, City of Waukesha Water Conservation Plan

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Compact	State Statute	Resources
Section 1.2.	Wis. Stat. § 281.346(1)(*i*). The withdrawal will be implemented in a way that incorporates environmentally sound and economically feasible water conservation measures. Wis. Stat. § 281.346(6)(c). The department shall promulgate rules specifying the requirements for an applicant for a new or increased diversion subject to par. (f) to demonstrate the efficient use and conservation of existing water supplies for the purposes of pars. (d) 2. b. and 3. b., (e) 1. d., and (f) 1., including requiring the applicant to document the water conservation planning and analysis used to identify the water conservation and efficiency measures that the applicant determined were feasible. Wis. Stat. § 281.346(4)(g). The proposed use of the water is reasonable, based on a consideration of . . . If the proposal would result in an increased water loss, whether efficient use is made of existing water supplies. Wis. Stat. § 281.346(6)(e)2. Cost−effective conservation practices will be implemented to ensure efficient use of the water, for a new withdrawal, or of the increased amount of an existing withdrawal. Wis. Stat. § 281.346(5m)(d).	
[Proposals . . . may be approved as appropriate only when . . .] The [Exception][Withdrawal or Consumptive Use] will be implemented so as to ensure that it is in compliance with all applicable municipal, State and federal laws as well as regional interstate and international agreements, including the Boundary Waters Treaty of 1909. Sections 4.9.4.f., 4.11.4.	The [diversion][withdrawal] will be in compliance with all applicable local, state, and federal laws and interstate and international agreements, including the Boundary Waters Treaty of 1909. Wis. Stat. §§ 281.346(4)(f)7., 281.346(6)(d).	Volume 2, City of Waukesha Water Supply Service Area Plan, Section 8
Proposals . . . may be approved as appropriate only when . . . The proposed use is reasonable, based upon a consideration of . . . The balance between economic development, social development and environmental protection of the proposed Withdrawal and use and other existing or planned withdrawals and water uses sharing the water source. Section 4.11.5.c.	The proposed use of the water is reasonable, based on a consideration of . . . The balance of the effects of the proposed withdrawal and use, and other existing or planned withdrawals and water uses from the water source, on economic development, social development, and environmental protection. Wis. Stat. § 281.346(6)(e)3.	Volume 1, City of Waukesha Application Summary, Section 4 Volume 2, City of Waukesha Water Supply Service Area Plan, Section 11
	The proposal is consistent with an approved water supply service area plan under s. 281.348 that covers the public water supply system. Wis. Stat. § 281.346(4)(e)1.em. The planned service area is the service area of the system at the end of any planning period authorized by the department in the approved water supply service area plan under s. 281.348 that covers the public water supply system. Wis. Stat. § 281.346(4)(bg)2.	Volume 1, City of Waukesha Application Summary, Section 4 Volume 2, City of Waukesha Water Supply Service Area Plan, Section 11

6. Conclusions

The City has prepared this Application in accordance with the Compact and implementing Wisconsin Statutes, which were developed to protect the water and water dependent resources of the Great Lakes basin and to regulate diversions of water from the basin.

The City's current sources of water supply include the deep St. Peter Sandstone aquifer and the shallow Troy Bedrock Valley aquifer. However, the continued withdrawal of water from the deep confined aquifer at rates that exceed the rate at which the aquifer is replenished is an unsustainable practice. Moreover, the deep confined aquifer is contaminated with radium. Increased pumping from the shallow aquifer also is unsustainable due to the resulting significant adverse environmental impacts to wetlands, creeks, streams, and lakes in the area.

Because the City's current water supply is contaminated with radium and is not sustainable, the City evaluated fourteen water supply sources and combinations of sources and concluded that a Lake Michigan water supply with return flow *is sustainable*, as demonstrated by the detailed scientific evidence and extensive modeling studies that are incorporated in this Application. Moreover, a Lake Michigan supply with return flow is the only alternative that meets the Compact requirement for reasonable use of water. The reasons for this conclusion include, but are not limited to, the following:

- **The City's water use is reasonable.** The City is requesting a reasonable amount of water to be used for public water supply purposes. The City's service area plan provides for the efficient use of water and the minimization of water waste. Land within the service area is 85 percent developed or preserved and population growth is estimated at a rate of 0.5 percent per year. The water supply service area is consistent with the sewer service area. The City's withdrawal balances social considerations, economic development, and environmental protection; protects public health; and provides a sustainable water supply.
- **The City's water use will incorporate environmentally sound and economically feasible water conservation measures.** Because the City's water supplies are limited in quantity and quality, water conservation and water use efficiency are integral parts of City water system planning, design, and operation. The City implemented a water conservation program in 2006, resulting in lower water use and heightened community awareness. The City updated the plan in 2012. Despite the City's commitment to minimizing water waste and its maintenance of an aggressive and effective water conservation program with water savings goals that are consistent with Wisconsin's Compact implementing statute, water use efficiency and conservation alone cannot provide the City with a sustainable water supply.
- **The City will return the water it withdraws to the source watershed.** The City proposes to return to the Lake Michigan watershed no less than 100 percent of the water volume withdrawn; therefore, there will be no net loss of Lake Michigan water, and the City's plan will not adversely affect other users of Lake Michigan.
- **The City will implement the withdrawal and return flow so as to ensure that there are no significant individual or cumulative adverse impacts to the waters and water-dependent resources of the Lake Michigan watershed.** The City's use of Lake Michigan water will not have adverse impacts on the Great Lakes. Moreover, the City's return of the water it withdraws to the source watershed will not cause adverse impacts. Rather, the Great Lakes basin will benefit from the City's return of high quality water to the Root River, a tributary to Lake Michigan, which will provide water flows that are beneficial to habitat restoration, support the steelhead trout population in the Great Lakes, and restore highly valued flow to the watercourse during dry periods. Additionally, eliminating deep aquifer pumping will help restore the flow of groundwater toward Lake Michigan instead of away from it.
- **Hydrologic conditions and function of the source watershed are restored.** Reducing the withdrawal of water from the deep aquifer will help to restore the hydrologic integrity of the Great Lakes by reducing groundwater flow away from Lake Michigan. In addition to supporting aquifer recovery, the regional benefits to the environment of ceasing deep aquifer pumping for the City's water supply include increased availability of shallow aquifer flows to surface water resources in both the Mississippi River and Great Lakes basins.

- **No other reasonable water supply.** Scientific evidence and modeling studies performed by regional, state, national, and academic professionals support the City's conclusion that a Lake Michigan water supply with return flow is the only reasonable alternative for the City's public water supply. The other water supply alternatives have greater adverse environmental impacts and are less protective of public health.

Because this Application meets all the requirements of the Compact and protects the water and water-dependent natural resources of the Great Lakes Basin, the City respectfully requests that its Application for Lake Michigan water be approved.

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