Section 5

Proposed Project: Affected Environment and Environmental Effects

SECTION 5

Proposed Project: Affected Environment and Environmental Effects

This section describes the impacts of the proposed project. A side-by-side comparison of the proposed project to other alternatives is provided in Section 6. The proposed City of Waukesha water supply project is a Lake Michigan water supply with return flow to Underwood Creek. A Lake Michigan water supply would be obtained from one of three potential suppliers: the Cities of Milwaukee, Oak Creek, or Racine. The final water supplier will be determined through contract negotiations, currently in progress and will determine the project that will be implemented. The unsuccessful suppliers will then become alternatives to the proposed project; they will not be implemented. The proposed project includes return flow to Underwood Creek for the selected water supplier.

The impact of the proposed project on the physical and biological environment falls into three main categories:

- Aquatic resource impacts
- Terrestrial resource impacts
- Air quality

The environmental impacts of the proposed project are compared side by side for each resource category documented in this section. A summary table of overall resource impacts is included at the end of this section. The resource impacts were developed for individual water supply and return flow components.

Resource impacts for proposed project system alternative, where a Lake Michigan water supply alternative is combined with a return flow to the Lake Michigan basin, are estimated by adding the water supply impact with the return flow impact to obtain an overall system alternative impact. This approach conservatively estimates proposed project system impacts because portions of the water supply and return flow pipeline corridors are shared which leads to double counting some resource impacts, such as impacts to wetlands. Proposed project system impacts are summarized in Attachment 5-1.

5.1 Aquatic Resources

Aquatic resources have been further subdivided into: Lake Michigan, inland waterways, wetlands, and groundwater. Each of these resources is discussed sequentially.

5.1.1 Lake Michigan

Lake Michigan will be affected by the proposed project.

5.1.1.1 Physical Description

5.1.1.1.1 Affected Environment

Lake Michigan is bordered by four states and is connected through the other Great Lakes to the eight Great Lakes states and two Canadian provinces. Lake Michigan is the second largest of the Great Lakes and is the only Great Lake entirely within the borders of the U.S.[1] Lake Michigan is 307 miles long, up to 118 miles wide, and up to 925 feet deep. Lake Michigan has a surface area of 22,300 square miles, an average depth of 279 feet, and a volume of 1,180 cubic miles (1,300,000,000,000,000 gallons), and a retention time of 99 years.[2]

In recent years, nuisance algae (genus *Cladophora*) growth has been observed along the Lake Michigan shoreline. The algae grow underwater attached to rocks, are dislodged by waves, and then washed up on shore. The decaying algae create nuisance odors. Similar algae growths were observed in the mid-1950s and again during the 1960s and 1970s, before this most recent occurrence. The cause of this latest resurgence in algae growth is uncertain, but it may be due in part to changes in water clarity and phosphorous availability brought on by the prevalence of invasive zebra and quagga mussels.[3]

The Milwaukee Harbor estuary is designated a Great Lakes Area of Concern because of the presence of legacy contaminants and other impairments. The harbor suffers from urban stresses similar to those experienced in other highly urban areas at the other 42 areas of concern throughout the Great Lakes. Priorities for the Milwaukee Area of Concern include remediation of contaminated sediments in tributaries and nearshore waters of Lake Michigan, prevention of eutrophication, non-point-source pollution control, improvement of beach water quality, enhancement of fish and wildlife populations, and habitat restoration.[4] Even though the Milwaukee Harbor estuary has these stresses, the fishery is reported to contain a high abundance and diversity of species because the fishery is connected to the rest of Lake Michigan and the parts of the Milwaukee, Menomonee, and Kinnickinnic Rivers that achieve full fish and aquatic life standards (SEWRPC, 2007, p. 205).

5.1.1.1.2 Environmental Effects

A Lake Michigan water supply and return flow, regardless of supply and return flow locations, will not affect the physical features of Lake Michigan, except for small changes as described below in Lake Michigan Geomorphology and Sediment. Flooding in the Lake will not be altered because, as discussed in Section 5 of the Application, a Lake Michigan water supply with return flow will provide a water balance. A water balance will prevent excess volume from being transferred into Lake Michigan, eliminating flooding impacts in the lake. No change to the size, volume, or floodplain of Lake Michigan occurs with the proposed project.

5.1.1.2 Water Quality

5.1.1.2.1 Affected Environment

SEWRPC and the Milwaukee Metropolitan Sewerage District (MMSD) have been measuring water quality in the Greater Milwaukee area since the 1960s (SEWRPC, 2007, p. 149). Notable

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1 http://www.dnr.state.wi.us/org/water/greatlakes/discover/lakemichigan.htm. Accessed March 4, 2010.

2 *The Great Lakes: An Environmental Atlas and Resource Book.* United States Environmental Protection Agency/Environment Canada ISBN 0-662-23441-3. http://www.epa.gov/greatlakes/atlas/ Accessed January 16, 2012.

3 http://www.dnr.state.wi.us/ORG/water/greatlakes/cladophora/. Accessed March 3, 2010.

4 http://www.epa.gov/glnpo/aoc/milwaukee.html. Accessed March 3, 2010.

water quality improvements have been documented since the MMSD's deep tunnel system came online in 1994 to reduce the number of combined sewer overflows (CSOs). Water quality trends at sampling stations in the Milwaukee outer harbor and nearshore Lake Michigan areas over this historical monitoring period have indicted (SEWRPC, 2007, p. 155):

- Fecal coliform concentration has trended down.
- Biological oxygen demand has trended down.
- Dissolved oxygen concentration has trended down or stayed the same and generally meets standards.
- Total suspended solids concentration trends varied with some stations increasing and others staying the same.
- Total phosphorus concentration has trended down in the outer harbor and up in the nearshore area. Since 1986, average annual concentrations have been less than 0.1 mg/L, except for 1 year. The recently developed phosphorous standard for the near shore and open waters of Lake Michigan is 0.007 mg/L (NR 102.06(5)(b)), however, an interim effluent limit for discharge to Lake Michigan was set at 0.6 mg/L (NR 217.13(4)) for all dischargers.

Table 5-1 summarizes the water quality data.

TABLE 5-1
Average Water Quality Data at Select Locations in Lake Michigan near the Greater Milwaukee Watersheds

Dissolved oxygen	9.6 to 11.5 mg/L
Phosphorus	0.062 to 0.087 mg/L
Fecal coliform summer season geometric mean	603 to 770 per 100/mL
Total suspended solids	10.3 to 19.4 mg/L

Annual pollutant loadings to Lake Michigan from the Greater Milwaukee watersheds are documented in SEWRPC's *A Regional Water Quality Management Plan Update for the Greater Milwaukee Watersheds* (2007). Average annual loadings for select parameters are as follows:

- Fecal coliform: 83,435 trillion cells
- Total phosphorus: 767,230 pounds
- Total suspended solids: 184,435,700 pounds

Additional detail on these and other water quality parameters is found in SEWRPC's *A Regional Water Quality Management Plan Update for the Greater Milwaukee Watersheds* (2007).

5.1.1.2.2 Environmental Effects

Water quality environmental effects will occur during both construction as well as during operation and maintenance. Potential impacts to aquatic resources generally associated with construction can be both direct and indirect. They will depend primarily upon the physical characteristics of Lake Michigan and time of year.

The primary temporary construction impacts to surface waters can be associated with elevated loads of suspended sediment resulting from trenching activities and with erosion of cleared banks and rights-of-way from pipeline construction. Impact severity is a function of sediment load, particle size, and duration of construction activities. Since the construction near Lake Michigan will require appropriate environmental permits and the construction contractor will be required to use BMPs designed to reduce the impact on turbidity and erosion, construction impacts will be minimized.

Without mitigation by implementing BMPs, temporary construction impacts can also elevate suspended sediment levels that increase turbidity and consequently reduce primary photosynthetic production, flocculate plankton, decrease visibility and food availability, and produce effects that are aesthetically displeasing (USFWS, 1982). However, Long (1975) concluded that most fish avoid turbid water and can survive for several days in waters where construction in a stream has caused turbidity. Since the construction impacts will be temporary and river crossings will use BMPs designed to reduce the impact, turbidity and erosion created by construction will be minimal.

Example construction best management practices are described in Section 5, Attachment 5-2, "Example Wetland and Waterway Pipeline Construction Crossing Impact Minimization Techniques."

Operational and maintenance effects on water quality could include changes in storm water runoff quality from new above ground construction and changes in water quality from discharge to Lake Michigan or to a Lake Michigan tributary.

The WDNR commonly provides allowances for permitted discharges in the form of interim limits, variances, or other allowances when background levels are higher than water quality standards, when the water quality constituent cannot be removed by municipal WWTP best available technology permitted in Wisconsin, or water quality standards can be met after mixing or other processes in the receiving water.

The Waukesha WWTP currently discharging to the Fox River has an allowance for chloride discharge in the form of an interim limit governed by NR 106.83(2)(b). A significant source of chloride in the Waukesha WWTP is residential water softening. The allowance for an interim chloride limit would also consequently be needed. The Waukesha WWTP also currently has an allowance for mercury in the form of an interim limit governed under NR 106.145(4) which requires a mercury minimization plan that Waukesha is implementing. The water supply source is not expected to have an effect on mercury at the WWTP. Other water quality parameters may be addressed by similar regulatory approaches for allowances under current or future regulations.

The WDNR has adapted new thermal rules (NR 102 and 106) for the protection and propagation of aquatic life that applies to WPDES permit holders discharging to surface waters. In preparation for this new rule, the City has been collecting effluent temperature data for over a year. The City will meet WDNR thermal discharge requirements following the rules and applicable guidance regardless of a discharge location.

Potential operational changes to Lake Michigan water quality are described below and are used as the primary comparison of relative impacts.

Lake Mchigan Water Supply (Cities of Mllwaukee, Oak Creek, and Racine)

A Lake Michigan supply, regardless of the water source includes new aboveground impacts limited to only a new pump station less than a quarter acre in size located far from Lake Michigan. Consequently, operational stormwater quality impacts to Lake Michigan will be insignificant. All Lake Michigan supply options will include return flow water quality impacts, which are described below.

Underwood Creek to Lake Mchigan Return Flow

All water returned to the Lake Michigan watershed will meet WDNR water quality permit requirements. A summary of proposed discharge limits from the WDNR and a comparison to historical Waukesha WWTP performance are detailed in Return Flow Alternatives Summary (Appendix F of the Application). It is important to note that the Waukesha WWTP historical effluent (October 1, 2002, to August 31, 2009) already consistently produces an effluent quality better than the proposed permit limits. A comparison of historical WWTP discharge quality to other Lake Michigan tributary dischargers is shown in Table 5-18 in the Inland Waterways section below.

Water softening no longer would be needed with a Lake Michigan water supply source. Consequently, a reduction in chloride concentration in return flow over time is expected. The same approach to permit allowances for existing chloride discharge to the Fox River would be expected to be required for return flow.

Return flow will switch discharge up to a maximum amount from the Fox River to the Lake Michigan watershed. The return flow management plan is discussed in Section 5 of the Application. In general, the return flow management plan provides return flow up to a value of 115 percent of the average day water demand if sufficient water is available at the WWTP. Water at the WWTP in excess of this amount will continue to be discharged into the Fox River and meet permit limits as discussed in Section 5.1.2.3.

Flow from return flow ultimately ends up in Lake Michigan. Water quality information was reviewed for overall water quality parameter loadings from the greater Milwaukee watersheds tributary to Lake Michigan. SEWRPC compiled total annual water quality parameter loadings for all the greater Milwaukee watersheds (SEWRPC, 2007, Tables 54–56). The contribution of the City of Waukesha return flow loadings was calculated using the information from the water quality modeling documented in Appendix I of the Application and then compared to the SEWRPC annual average load findings. The analysis indicates the following:

- Fecal coliform contribution in the return flow under very conservative, worst-case conditions is only 0.20 percent of all fecal coliform loading from the greater Milwaukee watersheds.
- Total suspended solids contribution in the return flow under very conservative, worst-case conditions is only 0.21 percent of all total suspended solids loading from the greater Milwaukee watersheds.
- Phosphorus contribution in the return flow is only 1.23 percent of all phosphorus loading under worst-case conditions and only 0.62 percent of all phosphorus loading given the City of Waukesha's WWTP historic performance. These contributions could be even less, because the WDNR has adopted phosphorus regulations that could require more stringent phosphorus discharge limitations. For example, the WWTP historic annual phosphorus discharge is 0.16 mg/L while Underwood Creek and the Fox River both now have a phosphorus water quality standard of 0.075 mg/L.

5.1.1.2.3 Environmental Effects Comparison: Lake Mchigan Water Quality

Level of relative impact (no adverse impact, minor adverse impact, etc.) in water quality was developed to compare impacts. Impacts were compared based upon Table 5-2.

For water quality in Lake Michigan only, a discussion of relative impact is included below. Section 5.1.2.3 contains a comparison for water quality for inland waterways.

TABLE 5-2
Environmental Impact Category Description: Water Quality

No adverse impact	Temporary impacts from construction; during operation water quality numeric standards compliance improves or stays approximately the same based upon expected water quality from historical wastewater treatment plant performance. Contributes a de minimis change (< 1%) in total water quality parameter average annual loading to Lake Michigan near Milwaukee based upon expected water quality from historical wastewater treatment plant performance. Operational changes in stormwater runoff quality occur due to new above ground structures.
Minor adverse impact	Water quality numeric standards compliance improves or stays approximately the same based upon expected water quality from historical wastewater treatment plant performance and recognizing allowances commonly provided in other municipal discharge permits. Contributes a minor change (> 1% but < 10%) in total water quality parameter average annual loading to Lake Michigan near Milwaukee based upon expected water quality from historical wastewater treatment plant performance.
Moderate adverse impact	Lowering of in-stream water quality, but no numeric water quality standard exceedences for water quality parameters that were not exceeded without return flow based upon historical wastewater treatment plant performance and recognizing allowances commonly provided in other municipal discharge permits. Numeric water quality standard exceedences for water quality parameters that were already exceeded without return flow based upon historical wastewater treatment plan performance. Contributes a moderate change (>10% but < 25%) in total water quality parameter average annual loading to Lake Michigan near Milwaukee based upon expected water quality from historical wastewater treatment plant performance.
Significant adverse impact	New exceedence of numeric water quality standards occurs for water quality parameters that were not exceeded without return flow based upon historical wastewater treatment plant performance and recognizing allowances commonly provided in other municipal discharge permits. Contributes a substantial change (> 25%) in total water quality parameter average annual loading to Lake Michigan near Milwaukee based upon expected water quality from historical wastewater treatment plant performance.

Table 5-3 compares the water quality impact on Lake Michigan.

Lake Mchigan Water Supply (Cities of Mlwaukee, Oak Creek, and Racine)

TABLE 5-3
Proposed Project Environmental Impact Comparison Summary: Lake Michigan Water Quality

Proposed Project	Water Quality
Water Supply	
Lake Michigan (City of Milwaukee)	No adverse impact
Lake Michigan (City of Oak Creek)	No adverse impact
Lake Michigan (City of Racine)	No adverse impact
Return Flow for Lake Michigan Water Supply	
Underwood Creek to Lake Michigan	Minor adverse impact

The Lake Michigan water supply would not change water quality in Lake Michigan or adversely affect other surface water resources. Use of Lake Michigan water would eliminate the need for water softening, which still would be necessary under both groundwater supply alternatives. Over time, the use of water softener salts would cease and chloride discharged from the WWTP to the environment would reduce. The Lake Michigan water supply consequently would produce no adverse impact on water quality.

Underwood Creek to Lake Mchigan Return Flow

Water quality loading to Lake Michigan from the watersheds around greater Milwaukee was reviewed and found to be only 0.2 percent of all fecal coliform loading and only 0.21 percent of all total suspended solids loading under conservative, worst-case conditions. Phosphorus loading was found to be only 0.62 percent of all phosphorous loading under past historical performance and only 1.23 percent of all phosphorus loading under worst-case conditions. These phosphorus contributions could be even less in the future, because the WDNR has new phosphorus regulations that could require more stringent phosphorus discharge limitations. Consequently, the water quality impacts to Lake Michigan would be expected to have minor adverse impacts.

5.1.1.3 Geomorphology and Sediments

5.1.1.3.1 Affected Environment

The geomorphology of surface waters is assessed based on the impact to the surface water geomorphic stability, change in erosion potential, or change in vertical or lateral stability. The geology of Lake Michigan was developed during the Pleistocene Epoch as continental glaciers repeatedly advanced across the Great Lakes region and Lake Michigan. The repeated advancement and glacial retreat deepened and enlarged the basins of the Great Lakes.[5] Near Milwaukee, the near-shore geomorphology is varied. Example lakebed substrates include: rock, cobble and sand, sand, and clay outcrops.[6]

Groundwater flow into Lake Michigan is a significant component of overall flow. Direct and indirect groundwater inflow contribute 33.8 percent of Lake Michigan water (USGS 2000).

The deep aquifer currently used as a water supply for the City of Waukesha extends east from Waukesha under Lake Michigan. A report by the United State Geological Survey (USGS) estimated 30 percent of the 33 mgd of water pumped by the deep aquifer wells in southeastern Wisconsin originate from inside the Lake Michigan Basin (USGS, 2006).

5.1.1.3.2 Environmental Effects

Lake Mchigan Water Supply and Return Flow

Flow within Lake Michigan will not be affected by a Lake Michigan water supply or return flow, because the City of Waukesha's return flow management plan goal is to return 100 percent of the withdrawn water (see Section 5 of the Application). In general, the return flow management plan provides return flow up to 115 percent of the average day water demand if sufficient water is available at the WWTP. Water at the WWTP in excess of this amount will continue to be discharged into the Fox River and meet permit limits.

The geomorphology and sediment of Lake Michigan will not be adversely affected by a Lake Michigan water supply because, the supply will use the treatment plant intakes in the lake, and no construction is expected to occur within the lake for a water supply.

For an Underwood Creek return flow, the geomorphology of these streams has been shown to be stable, as documented in Section 5.1.2.4.

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[5] *The Great Lakes: An Environmental Atlas and Resource Book.* United States Environmental Protection Agency/Environment Canada ISBN 0-662-23441-3. http://www.epa.gov/greatlakes/atlas/ Accessed January 17, 2012.

[6] *Final Environmental Impact Statement Elm Road Generating Station*, Wisconsin Public Service Commission, July 2003.

5.1.1.3.3 Environmental Effects Comparison: Lake Michigan Geomorphology and Sediments

Level of relative impact (no adverse impact, minor adverse impact, etc.) in geomorphology and sediment quality was developed to compare impacts. Impacts were compared based upon Table 5-4. For geomorphology and sediment impacts in Lake Michigan only, the relative impact is discussed below. The comparison for geomorphology and sediments for inland waterways is included in Section 5.1.2.3. Table 5-5 summarizes the Lake Michigan geomorphology and sediment impact.

TABLE 5-4
Environmental Impact Category Description: Geomorphology and Sediments

No adverse impact	With return flow, channel is stable for flows up to the 2-year return where the channel is currently stable. No substrate change to Lake Michigan from construction.
Minor adverse impact	With return flow, channel has some instability for flows up to the 2-year return where the channel is currently stable. Substrate change to Lake Michigan of fewer than 10 acres.
Moderate adverse impact	With return flow, channel has frequent instability for flows up to the 2-year return where the channel is currently stable. Substrate change to Lake Michigan of greater than 10 but less than 20 acres.
Significant adverse impact	With return flow, channel is unstable at most flows where the channel is currently stable. Substrate change to Lake Michigan of greater than 20 acres.

TABLE 5-5
Proposed Project Environmental Impact Comparison Summary: Geomorphology and Sediments

Proposed Project	Geomorphology and Sediments
Water Supply	
Lake Michigan (City of Milwaukee)	No adverse impact
Lake Michigan (City of Oak Creek)	No adverse impact
Lake Michigan (City of Racine)	No adverse impact
Return Flow for Lake Michigan Water Supply	
Underwood Creek	No adverse impact

Lake Michigan Water Supply (Cities of Milwaukee, Oak Creek, and Racine)

A Lake Michigan water supply prevents the need for baseflow reduction to inland waterways from groundwater pumping. The changes in geomorphology are dependent upon only the return flow location. Thus, a Lake Michigan water supply would have no adverse impacts on geomorphology.

Underwood Creek to Lake Michigan Return Flow

A geomorphic study was conducted analyzing channel stability of return flow to Underwood Creek and found that the increased baseflows do not adversely impact the channel stability. There are no direct impacts upon Lake Michigan with Underwood Creek to Lake Michigan return flow. Return flow to Underwood Creek consequently would have no adverse impact on the geomorphology of Lake Michigan.

5.1.1.4 Flora and Fauna

5.1.1.4.1 Affected Environment

Wildlife species require adequate food, water, cover, and living space for the survival of individuals and to maintain population viability. Aquatic resources affected by the proposed project consist generally of streams and wetlands but also include Lake Michigan. Aquatic areas can provide habitat to a diverse wildlife population, and some common species (beaver, muskrat, herons) depend on aquatic habitats for food and shelter. Others (e.g., raccoon) are less restricted but prefer to be close to water. Amphibians and many reptiles favor aquatic habitats; representative species include bullfrog and northern water snake. The Lake Michigan shoreline is an essential ecological area for migratory birds.

Lake Michigan is primarily cold water and relatively infertile. Historically, the fish fauna consisted mostly of lake trout, whitefish, and sculpins. Over the last century, the fisheries of Lake Michigan have experienced dramatic alterations because of fishery exploitation, overharvesting, and nutrient loading changes stimulating algae or plant growth (typically tolerant species). Invasive, or exotic, species, such as the sea lamprey, have caused a significant decline in the population of native species, such as lake herring. The biota is dominated by such introduced or invasive species as the Pacific salmon and trout, alewife, rainbow smelt, ruffe, white perch, goby, zebra mussel (*Dreissena polymorpha*), quagga mussel (*Dreissena bugensis)*, and exotic zooplankton.[7]

The main source of pollution in Lake Michigan is human activity such as habitat alteration, which has affected water quality within the lake. The habitats in Lake Michigan have been altered by increased shoreline degradation, as most of the coastline and wetlands along it have been permanently affected. The loss of natural shoreline habitat has allowed increased urban and agricultural runoff into the lake, the alteration of watershed hydrology, the increase of the water temperature, and led to a reduction of open space.[8] Increased algae (genus *Cladophora*) growth has been observed along the shoreline in the last few years. The cause of the latest resurgence in algae growth is not known with certainty, but it could be from changes in water clarity and phosphorous availability resulting from the increased dominance of invasive zebra and quagga mussels.[9]

The Milwaukee Harbor estuary within Lake Michigan is designated a Great Lakes Area of Concern because of legacy contaminants present and other impairments. The harbor suffers from urban stresses similar to those experienced in other highly urban areas at the other 42 areas of concern throughout the Great Lakes. Even though the Milwaukee Harbor estuary has these stresses, the fishery is reported to contain a high abundance and diversity of species, because the fishery is connected to the rest of Lake Michigan and to parts of the Milwaukee, Menomonee, and Kinnickinnic Rivers that achieve full fish and aquatic life standards (SEWRPC, 2007, p. 205).

The near-shore areas along Lake Michigan are within the southern Lake Michigan coastal ecological landscape and are characteristic mainly of glacial lake influence, along with ridge and swale topography, clay bluffs, and lake plains. Ground moraine inland from the lakeshore is the dominant landform, with soils generally consisting of silt-loam surface overlying loamy and clayey tills. Most of the near-shore areas along the lake are dominated by agriculture and urban development. Very few forested areas exist, but the remaining stands are dominated by maple and beech trees and also contain oak, hickory, and lowland hardwood species. There are also areas of wet-mesic and wet prairie, but they are limited and occur only in small preserves because of the landscape being heavily disturbed and

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[7] http://dnr.wi.gov/org/land/er/communities/index.asp?mode=detail&Code=C9&Section=overview. Accessed December 7, 2011.

[8] *Final Environmental Impact Statement: U.S. Coast Guard Rulemaking for Dry Cargo Residue Discharges in the Great Lakes*, U.S. Coast Guard and USEPA, August 2008.

[9] http://www.dnr.state.wi.us/ORG/water/greatlakes/cladophora/. Accessed March 3, 2010.

fragmented. Because of fragmentation and significant disturbance, non-native plants are abundant in those areas.

The USFWS and the WDNR were contacted to determine where federal- or state-listed species occur along the project corridor in Lake Michigan. The species identified by these agencies as potentially occurring within the project corridors are summarized for all alternatives in Section 6.3.3 on Wetlands, since most of the potential impacts involve federal- or state-listed species associated with wetlands. A summary discussion of listed species potential habitat impacts for the proposed project is included in Section 5.1.2.5.

A literature review of historical information on biological components of Lake Michigan indicates the following represent typical biological components in the project area.

Benthic Invertebrates

A survey of the Great Lakes in 1998 identified 20 taxa of benthic macroinvertebrates in Lake Michigan with an average of about 7 taxa per sampling site (Barbiero et al., 2000). The amphipod *Diporeia* (formerly *Pontoporeia),* tubificid oligochaetes, and sphaeriid snails dominate the Lake Michigan benthic macroinvertebrate community. However, in near-shore areas, oligochaetes are the dominant taxonomic group. The density of benthic macroinvertebrates typically ranges from 1,500 to 6,500 organisms per square meter. Surveys performed in 2002 near the Great Lakes Water Institute with headquarters in Milwaukee revealed that oligochaetes and chironomidae are present, as are freshwater sponges, *Ectoprocta,* mayflies, leeches, isopods, and amphipods. Dreissenid mussel infestations (zebra and quagga) were confirmed on most suitable habitat (USGS, 2011).

Over the past several decades, the southern basin of Lake Michigan has been invaded by the zebra (*Dreissena polymorpha*) and quagga (*Dreissena bugensis)* mussels and has undergone major shifts in nutrient loading.

Reductions in nutrient loadings have reduced the overall productivity of the lake and produced a decline in the density of benthic macroinvertebrate fauna, particularly oligochaetes and snails, observed between 1980 and 1987 (Nalepa et al., 1998). The year 1988 marked the beginning of colonization of southern Lake Michigan by the zebra mussel and the beginning of a decline in the abundance of *Diporeia.* Filter feeding by zebra mussels in near-shore waters was thought to have decreased the amount of food available to the amphipod (Nalepa et al., 1998).

Plants

Macrophytes

The outfall for return flow discharge to Underwood Creek is not in Lake Michigan. Consequently, there will be no direct impact to Lake Michigan aquatic vegetation with the proposed project.

Algae

Free-floating or planktonic algae are present in Lake Michigan, dominated by the diatoms (represented by *Synedra, Fragilaria, Tabellaria, Asterionella, Melosira, Cyclotella* and *Rhizosolenia)*, among others. Concentrations of free-floating algae fluctuate during the year, subject to the availability of sunlight, water temperatures, and in the cases of diatoms, bioavailability of silicon (WPSC, 2003).

Algae typically found attached to substrate are also present in Lake Michigan. These include *Cladophora, Ulothrix, Tetraspora, Stigeoclonium,* and red algae *Asterocytis.*

Fish

The following fish species occur in near-shore waters of Lake Michigan (WPSC 2003).

Common Name	Scientific Name	Common Name	Scientific Name
Alewife	*Alosa pseudoharengus*	Round whitefish	*Prosopium cylindraceum*
Bowfin	*Amia calva*	Bloater	*Coregonus hoyi*
Brook trout	*Salvelinus fontinalis*	Rainbow smelt	*Osmerus mordax*
Brown trout	*Salmo trutta*	Gizzard shad	*Dorosoma cepedianum*
Common carp	*Cyprinus carpio*	Lake chub	*Couesius plumbeus*
Freshwater drum	*Aplodinotus grunniens*	Emerald shiner	*Notropis atherinoides*
Lake sturgeon	*Acipenser fulvescens*	Spottail shiner	*Notropius hudsonius*
Longnose sucker	*Catostomus catostomus*	Longnose dace	*Rhinichthys cataractae*
Muskellunge	*Esox masquinongy*	Bluntnose minnow	*Pimephales notatus*
Northern pike	*Esox lucieus*	Sand shiner	*Notropis stramineus*
Pumpkinseed	*Lepomis gibbosus*	Fathead minnow	*Pimephales promelas*
Rainbow trout	*Oncorhynchus mykiss*	Burbot	*Lota lota*
Rock bass	*Ambloplites rupestris*	Slimy sculpin	*Cottus cognatus*
Smallmouth bass	*Micropterus dolomieui*	Largemouth bass	*Micropterus salmoides*
White bass	*Morone chrysops*	Walleye	*Stizostedion vitreum*
White sucker	*Catostomus commersoni*	Johnny darter	*Etheostoma nigrum*
Yellow perch	*Perca flavascens*	Trout-perch	*Percopsis omiscomaycus*
Lake trout	*Salvelinus namaycush*	Three spine stickleback	*Gasterosteus aculeatus*
Chinook salmon	*Oncorhynchus tshawytscha*	Nine spine stickleback	*Pungitius pungitius*
Coho salmon	*Oncorhynchus kisutch*	Brook stickleback	*Culaea inconstans*
Lake whitefish	*Coregonus clupeaformis*	Round goby	*Neogobius melanpostomus*

5.1.1.4.2 Environmental Effects

Impacts to Lake Michigan aquatic flora and fauna pertain to overall potential aquatic habitat impacts in Lake Michigan. There are no direct impacts to Lake Michigan with return flow to Underwood Creek. Discussion of how the project will protect against the spread of invasive species is included in Section 5.1.2.5.

Evaluation of Potential Impacts to Invertebrates, Plants, and Fish. Given the discharge water quality requirements for return flow to Lake Michigan, no significant permanent impacts to the common invertebrates, plants, and fish in the lake are expected.

The WDNR informed the City of Waukesha that the City will have to meet future water quality effluent standards at least as stringent as those imposed on discharge to the Fox

River.[10] Water quality of the proposed return flow has been analyzed (see Section 5 and also Appendix I of the Application, Water Quality Model of Proposed Discharge to Underwood Creek (CH2M HILL 2010). Given the conclusions of the water quality modeling, and that future WPDES discharge requirements (likely no less stringent than those currently in place) will be designed to protect receiving waters, water quality is not expected to have a significant permanent pollutant loading or other effects upon invertebrates, plants, or fish in Lake Michigan. The City of Waukesha will work with the WDNR and regulatory community to avoid, minimize, and mitigate potential temporary and permanent impacts.

An evaluation of Lake Michigan wildlife, endangered resources, and natural communities impacts has been included as part of a comprehensive evaluation for all affected environments in Wetlands (Section 5.1.3), because most of the sensitive natural communities and endangered resources identified are associated with wetlands. A summary of listed species habitat impacts for the proposed project is included in Section 5.1.3.2.

TABLE 5-6
Environmental Impact Category Description: Aquatic Habitat

No adverse impact	Temporary impacts from construction; neutral or improved habitat creation and frequency of availability from operation.
Minor adverse impact	Reduced baseflow in warm water streams of up to 25%, causing habitat loss. Substrate change to Lake Michigan of fewer than 10 acres.
Moderate adverse impact	Reduced baseflow in warm water streams of greater than 25% but less than 50%, causing habitat loss. Reduced baseflow to cold water streams, but less than 25%. Substrate change to Lake Michigan of greater than 10 but less than 20 acres.
Significant adverse impact	Reduced baseflow in cold water streams of 25% or more or reduced baseflow in warm water streams of 50% or more, causing habitat loss. Substrate change to Lake Michigan of greater than 20 acres.

Environmental Effects Comparison: Lake Michigan Flora and Fauna

Level of relative impact in aquatic habitat was developed to compare impacts. Impacts were compared based upon Table 5-6. The comparison for aquatic habitat for inland waterways and wetlands is included in Section 5.1.2 and Section 5.1.3 and summarized in Table 5-7.

TABLE 5-7
Proposed Project Environmental Impact Comparison Summary: Lake Michigan Aquatic Habitat

Proposed Project	Aquatic Habitat
Water Supply	
Lake Michigan (City of Milwaukee)	No adverse impact
Lake Michigan (City of Oak Creek)	No adverse impact
Lake Michigan (City of Racine)	No adverse impact
Return Flow for Lake Michigan Water Supply	
Underwood Creek to Lake Michigan	No adverse impact

Impacts to aquatic habitat resulting from the operations (i.e., post-construction) of a Lake Michigan water supply and return flow are described below.

Lake Michigan Water Supply (Cities of Milwaukee, Oak Creek, and Racine) Lake Michigan water supply from Milwaukee, Oak Creek, or Racine would have negligible effect on the lake's aquatic habitat. No new infrastructure is needed in Lake Michigan to provide water to Waukesha, so no construction impacts to aquatic habitat in the lake will occur. In addition,

10 WDNR letter from Duane Schuettpelz. October 16, 2008.

because of the return flow management plan, as discussed in Section 5 of the Application, "Return Flow Management Plan," no change in Lake Michigan volume will result in no habitat changes.

Underwood Creek to Lake Mchigan Return Flow A geomorphology analysis of Underwood Creek (Appendix G of the Application) indicated return flow would not cause a change in channel stability. Because the waterways potentially receiving return flow are stable with return flow, there would be no significant increases in sediment flowing to Lake Michigan. Thus, there would be no adverse impacts to Lake Michigan aquatic habitat with return flow to either stream.

5.1.2 Inland Waterways

Inland waterways are differentiated from Lake Michigan for the purposes of the affected environment analysis. Inland waterways are affected by the proposed project through pipeline crossings and discharge of return flow. Inland waterways are affected by the proposed pipeline crossings and continued discharge of effluent. The types of information included within each of these affected environments vary because the effects water supply and return flow have on these surface waters also vary. Consequently, detailed information on water quality and aquatic habitat is provided for surface waters potentially receiving the return flow while such information is not provided for surface waters where new discharge does not occur. Streams crossed by pipelines will only experience pipeline construction related impacts, which are described below and is applicable to all inland waterways affected by the project.

According to the Wisconsin Administrative Code (WAC), Chapter NR 102 Water Quality Standards for Wisconsin Surface Waters, Wisconsin categorizes surface waters per five fishery "use" subcategories (WDNR, 2010d). Stream use is determined by fish species or other aquatic organisms capable of being supported by a natural stream system. The designation of an appropriate use class is based on the ability of a stream to supply habitat and water quality requirements for a class of organisms:

- Cold water communities (COLD)—capable of supporting cold water sport fish
- Warm water sport fish communities (WWSF)—capable of supporting warm water sport fish
- Warm water forage fish communities (WWFF)—capable of supporting an abundant, diverse community of warm water forage fish
- Limited forage fish communities (LFF)—capable of supporting limited tolerant or very tolerant forage or rough fish, or tolerant macroinvertebrates
- Limited aquatic life (LAL)—capable of supporting very tolerant macroinvertebrates or no aquatic life

Wisconsin NR Code 104 classifies all LFF and LAL water bodies as "variance" waters. Streams without a known designation by default are classified warm water sport fisheries and are considered WWSF or WWFF waters (WDNR, 2010e).

An Outstanding Resource Water is "a lake or stream having excellent water quality, high recreational and aesthetic value, high-quality fishing and is free from point source or nonpoint source pollution." An Exceptional Resource Waters is "a stream exhibiting the same high quality resource values as outstanding waters, but may be impacted by point source pollution or have the potential for future discharge from a small sewer community."

According to Wisconsin NR Code 102.10 and 102.11, none of the inland waters affected by the project (Underwood Creek, Menomonee River, and Fox River) are Outstanding or Exceptional Resource Waters. Genesee Creek in Waukesha County west of Vernon Marsh is an Exceptional Resource Water upstream of State Highway 59, but that area is outside the influence of the project.

5.1.21 Location, Existing Designations/Classifications

5.1.21.1 Affected Environment

Inland waterways that receive effluent are described below. The following inland waters are discussed:

- Fox River
- Underwood Creek and Menomonee River

Tables 5-8 through 5-10 list surface waters that are crossed with a water supply or return flow pipeline and receive only temporary construction impacts.

The following inland waterways are not affected by the proposed project. However, they are affected by alternatives to the proposed project, the impacts of which are discussed in Section 6.

- Pebble Brook
- Pebble Creek
- Mill Brook
- Root River

Fox River

The Fox River will be affected by the project. It is classified for WDNR fish and aquatic life standards and is a WWSF community. The Fox River currently receives the flow from the Waukesha Wastewater Treatment Plant (WWTP) discharge. A change in discharge location will affect the Fox River.

Just downstream of the City of Waukesha are several perennial Fox River tributaries—Genesee Creek, Mill Brook, Pebble Creek, and Pebble Brook—all listed as supporting cold water communities. The potential sources of impairments in the watershed are non-point-source discharges, contaminated sediments, and discharges from municipal separate storm sewer systems (WDNR, 2010f).

TABLE 5-8
Water Body Crossings

Pipeline Route	Water Body/ Stream No.	Water Body Name	Water Body Type	Approximate Crossing Width (ft)	Crossing Area (acres)	Fisheries Classification[a]
Lake Michigan Water Supply						
Lake Michigan (City of Milwaukee)	1845	Poplar Creek	Perennial	16.8	0.03	Unknown
	3294	Unnamed	Intermittent/ephemeral	—	0.002	—
	3305	Unnamed	Intermittent/ephemeral	—	0.005	—
	3315	Deer Creek	Perennial	—	0.019	WWSF
	4310	Honey Creek	Perennial	26	0.04	—
	21136	Deer Creek	—	77.4	0.02	—
	22799	North Branch Root River	—	23.2	0.04	—
	22800	North Branch Root River	—	23.2	0.04	—
Lake Michigan (City of Oak Creek)	1845	Poplar Creek	Perennial	16.8	0.0	Unknown
	3294	Unnamed	Intermittent/ephemeral	1.7	0.003	—
	3305	Unnamed	Intermittent/ephemeral	2.9	0.005	—
	3315	Deer Creek	Perennial	11.6	0.02	WWSF
	4671	East Branch Root River	—	81.6	0.06	—
	4887	North Branch Root River	—	93.3	0.04	—
	5210	Oak Creek	Perennial	77.9	0.10	—
	6272	North Branch Root River	—	89.9	0.06	—
	6929	North Branch Oak Creek	—	75.0	0.05	—
	21136	Deer Creek	—	77.4	0.02	—
	22799	North Branch Root River	—	220.3	0.08	—
Lake Michigan (City of Racine)	1845	Poplar Creek	Perennial		0.03	Unknown
	3280	Poplar Creek	Perennial	—	1.09	Unknown
	3333	Unnamed	Intermittent/ephemeral	—	0.07	—
	3335	Unnamed	Intermittent/ephemeral	—	0.05	—
	3408	Unnamed	Intermittent/ephemeral	—	0.02	—
	3413	Unnamed	Intermittent/ephemeral	—	0.08	—
	3432	Muskego Drainage Canal	Perennial	—	0.51	Unknown

TABLE 5-8
Water Body Crossings

Pipeline Route	Water Body/ Stream No.	Water Body Name	Water Body Type	Approximate Crossing Width (ft)	Crossing Area (acres)	Fisheries Classification[a]
	3459	Unnamed	Intermittent/ephemeral	—	0.20	—
	3484	Unnamed	Intermittent/ephemeral	—	0.02	—
	3486	Unnamed	Intermittent/ephemeral	—	0.06	—
	8339	Unnamed	Intermittent/ephemeral	—	0.24	—
	210	Husher Creek	—	164.9	0.03	—
	668	Hoods Creek	—	81.5	0.04	—
	1827	Goose Lake Branch Canal	—	4411.8[b]	2.23	—
	2282	Root River Canal	—	75.3	0.07	—
	20172	Mill Creek	—	98.0	0.01	—
Return for a Lake Michigan Water Supply						
Underwood Creek to Lake Michigan	1738	Unnamed	Intermittent/ephemeral	—	0.002	—
	1845	Poplar Creek	Perennial	—	0.032	Unknown
	3052	Unnamed	Intermittent/ephemeral	—	0.012	—
	3054	Unnamed	Intermittent/ephemeral	—	0.082	—
	3055	Unnamed	Intermittent/ephemeral	—	0.001	—
	3294	Unnamed	Intermittent/ephemeral	—	0.003	—
	3305	Unnamed	Intermittent/ephemeral	—	0.005	—
	3315	Deer Creek	Perennial	—	0.02	WWSF
	21136	Deer Creek	—	77.4	0.02	

[a] WDNR (2010f).

[b] The current theoretical project alignment for Lake Michigan–Racine Supply is parallel to the Goose Lake Branch Canal, but the actual construction corridor would be narrowed to avoid impacts to the water body.

TABLE 5-9
Summary of Acres of Water Body Crossings

Name	Lake Michigan–Milwaukee Supply	Lake Michigan–Oak Creek Supply	Lake Michigan–Racine Supply	Underwood Creek to Lake Michigan Return Flow
Deer Creek	0.02	0.02	—	0.02
Lake Michigan	—	—	—	—
Muskego Drainage Canal	—	—	0.51	—
Fox River	—	—	—	—
Pebble Brook	—	—	—	—
Poplar Creek	0.03	0.03	1.12	0.03
Honey Creek	—	—	—	—
North Branch Root River	—	—	—	—
East Branch Root River	—	—	—	—
Husher Creek	—	—	—	—
Hoods Creek	—	—	—	—
Oak Creek	—	—	—	—
North Branch Oak Creek	—	—	—	—
Goose Lake Branch Canal	—	—	—	—
Root River Canal	—	—	—	—
Mill Creek	—	—	—	—
Unnamed	0.01	0.01	0.72	0.11
Grand Total	**0.06**	**0.06**	**2.35**	**0.16**

Underwood Creek and Menomonee River

Underwood Creek and the Menomonee River would be affected only by return flow to Underwood Creek for a Lake Michigan water supply.

TABLE 5-10
Number of Water Body Crossings

Water Supply	
Lake Michigan (City of Milwaukee)	8
Lake Michigan (City of Oak Creek)	11
Lake Michigan (City of Racine)	16
Return Flow for Lake Michigan Water Supply	
Underwood Creek to Lake Michigan	9

Underwood Creek is tributary to the Menomonee River, which in turn flows to Lake Michigan. Return flows would be discharged to Underwood Creek in Waukesha County, near the crossing of Underwood Creek and Bluemound Road. At that location, Underwood Creek flows about 2.6 river miles to its confluence with the Menomonee River in Wauwatosa. All of Underwood Creek is lined with concrete except for a 2,400-foot reach that was rehabilitated in 2009 to a natural channel. Future concrete channel rehabilitation to create a natural channel has been proposed for sections of the stream. The Menomonee River from the Underwood Creek confluence flows another 10 river miles to Lake Michigan in the City of Milwaukee.

Underwood Creek is designated for WDNR fish and aquatic life standards and are WWSF communities. Underwood Creek also has a variance in Milwaukee County for dissolved oxygen and fecal coliform. The Menomonee River downstream of Underwood Creek is classified for WDNR fish and aquatic life standards, but it has the same dissolved oxygen and fecal coliform variances from Honey Creek to the mouth of the river (about 5 miles downstream of the proposed return flow location).

Other Surface Waters

Other surface waters within the affected environment are those that are crossed with a water supply or return flow pipeline and receive only temporary construction impacts. These surface waters are listed in Tables 5-8 through 5-10.

5.1.21.2 Environmental Effects

There are no changes to the designations or classifications of inland waterways with the proposed project. Impacts to stream crossings will be temporary during construction, the impacts of which are discussed below. Streams crossed only by a pipeline are not evaluated further as a result.

5.1.22 Size, Flows, and Floodplain

5.1.22.1 Affected Environment

Fox River

The Fox River receives the WWTP discharge and drains 151 square miles at the southern end of the City of Waukesha. The upper Fox River, flowing through the City of Waukesha, is a perennial stream (WDNR, 2002a). At the USGS Fox River stream gage 05543830 in the City of Waukesha, average annual stream flow is 110 cfs (71 mgd) over the period of record, 1963 to 2009.[11] The WDNR designates Fox River a WWSF with the following uses: fish and aquatic life, recreation, public health and welfare, and fish consumption.

[11] http://waterdata.usgs.gov/wi/nwis/rt, gage number 05543830 accessed April, 2010.

Underwood Creek and Menomonee River

Underwood Creek is a tributary stream to the Menomonee River, which in turn flows to Lake Michigan. Discharge of return flow to Underwood Creek is expected to occur in Waukesha County, near the crossing of Underwood Creek and Bluemound Road. At that location, Underwood Creek flows about 2.6 river miles to its confluence with the Menomonee River in Wauwatosa. Underwood Creek is lined with concrete except for the 2,400-foot reach that was rehabilitated in 2009 to a natural channel. Future rehabilitation of other concrete-lined sections has been proposed. The Menomonee River from the Underwood Creek confluence flows another 10 river miles to Lake Michigan in the City of Milwaukee.

The Underwood Creek and Menomonee River watersheds in the Milwaukee area are highly developed, with residential and commercial buildings very near, sometimes within, the 100-year flood plain. To protect public and private property, there have been significant and ongoing investment in flood control projects. For example, downstream of the return flow location, the MMSD has invested $48 million in the Hart Park flood control project, completed in 2007,[12] and $99 million in the County Grounds flood control project, completed in 2010.[13] Other projects have been completed or are planned elsewhere in the watershed. Each project contributes to providing flood protection to neighboring and downstream residents.

During a flood in the watershed, floodwaters rise and then subside quickly. For example, to protect downstream properties, conveying floodwaters to the Milwaukee County Grounds floodwater management facility is estimated to last only 6 hours for the 100-year return period storm.[14]

At the USGS Underwood Creek stream gage 04087088 in the City of Wauwatosa downstream of the return flow location, the average annual stream flow is 15.1 cfs (9.8 mgd) over the period of record from 1974 to 2009.[15]

At the USGS Menomonee River stream gage 04087120 in the City of Wauwatosa downstream of the return flow location, the average annual stream flow is 108 cfs (69 mgd) over the period of record from 1961 to 2009.[16]

5.1.2.2.2 Environmental Effects

There is no long-term change to inland waterways size, although pipeline stream crossings will cause temporary aquatic habitat impacts. Lake Michigan water supply and return flow pipelines cross surface waters. Tables 5-8 through 5-10 list the extents of the perennial and intermittent surface water crossings. Refer to the maps found in Attachment 3-1 of Section 3 for maps associated with the proposed project. All crossings would have temporary impacts during construction. Once construction is complete, the surface water crossing will be restored. Operational and maintenance impacts are expected to be negligible.

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[12] MMSD. http://v3.mmsd.com/hartparkproject.aspx. Accessed January 13, 2010.

[13] MMSD. http://v3.mmsd.com/milwaukeecogrounds.aspx. Accessed January 13, 2010.

[14] HNTB. 2006. *Environmental Assessment Milwaukee County Grounds Floodwater Management Facility and Underwood Creek Rehabilitation Projects.*

[15] http://waterdata.usgs.gov/wi/nwis/rt, gage number 04087088 accessed April, 2010.

[16] http://waterdata.usgs.gov/wi/nwis/rt, gage number 04087120 accessed April, 2010.

Temporary construction impacts on in-stream and shoreline vegetative cover may include alteration or temporary loss at pipeline water crossings. Submergent and emergent vegetation, in-stream logs and rocks, and undercut banks provide cover for fish and other aquatic biota. Fish that live in these areas may be displaced during construction, this habitat alteration will be insignificant because of the small area affected at each crossing location and because the streambanks will be restored to promote regrowth of riparian vegetation. During design, the City of Waukesha will work with the resource agencies to determine the appropriate construction techniques for each crossing to minimize and mitigate temporary impacts. Techniques that could be used are discussed in Attachment 5-2, Example Wetland and Waterway Pipeline Construction Crossing Impact Minimization Techniques.

Impacts to aquatic habitat resulting from post-construction operation are described below.

There are two kinds of operational flow changes to inland waterways: baseflow changes and flooding changes. Baseflow changes can affect aquatic habitat by changing the water depth and wetted surface area available to aquatic species, and also water temperature. For example, if flow decreases in cold water streams in the summer, the water temperature increases. The potential effect the proposed project on baseflow is evaluated for each inland waterway.

Flooding is a concern in urbanized communities, especially in southeastern Wisconsin where extensive flood mitigation projects have been constructed and more are planned. A Lake Michigan water supply and return flow were evaluated based on their impact on flooding along affected surface water resources. Each major water resource analyzed is discussed below. The proposed project would have no significant baseflow or flooding changes to any other inland waterways.

Fox River

Baseflow Changes

Impacts to aquatic habitat in the Fox River are discussed below. As noted, the average annual stream flow is 110 cfs (71 mgd) over the period of record.

Lake Mchigan Water Supply (Cities of MIlwaukee, Oak Creek, and Racine)

A Lake Michigan water supply would have an effect on the aquatic habitat in the Fox River. As discussed in Section 5 of the Application, a Lake Michigan supply would return flow from the City of Waukesha WWTP to the Lake Michigan basin. A Lake Michigan supply also would affect the Fox River, regardless of the return flow location.

A Lake Michigan supply and cessation of shallow groundwater pumping would improve the subsurface flow to the Fox River, and allow the baseflow to be restored at least partially to conditions similar to pre-well conditions, because the groundwater would contribute more baseflow to the river. This would improve the baseflow under current shallow groundwater pumping conditions and have the greatest benefit in the future when water demand is projected to be greater.

A Lake Michigan supply will require a shift of most of the WWTP discharge from the Fox River to the Lake Michigan basin, but a return flow will not eliminate discharge to the Fox River. As discussed in Section 5 of the Application, "Return Flow Management Plan," flow to the Fox River will occur when the WWTP flow exceeds the maximum return flow rate or during extreme flooding conditions in a Lake Michigan tributary (for a tributary return flow location). Because the WWTP flow to the Fox River will be reduced with a Lake Michigan supply, less water will be available in the river, reducing the amount of aquatic habitat. However, removal of the WWTP flow from the Fox River does not cause drawdown in smaller Fox River tributary streams that are sensitive to changes in baseflow from groundwater pumping. The Compact requires that the minimum return flow be at least the water withdrawn less an allowance for consumptive use. The Compact also requires that the return flow minimize out-of-basin water sent into the Great Lakes basin. These two requirements established minimum and maximum return flow rates to provide the water balance between the withdrawal and return, as described in the return flow management plan in Section 5 of the Application. As a result, WWTP flow will still occur at times to the Fox River with any Lake Michigan water supply.

A study by the USGS and University of Milwaukee reports that wastewater flows from Sussex, Brookfield, and Waukesha contribute 40 percent of the total Fox River flow during annual low flows.[17] The City of Waukesha's average annual WWTP flow is about 10 mgd, or 50 percent of the WWTP flow from the 3 communities. Using this percentage, the City of Waukesha WWTP contributes about 25 percent of the Fox River flow during annual low flow conditions. Thus, during low flow periods, when the WWTP return flow likely would be entirely to the Lake Michigan basin, Fox River annual low flow would be reduced by roughly 25 percent. Lower flows change the amount of aquatic habitat available, however as described in Appendix H to the Application, water depth change is expected to be less than 2 inches. Consequently, significant habitat change is not expected. The reduction in flow, and thus in aquatic habitat, would have a minor adverse impact on the river during annual low flow conditions.

Underwood Creek to Lake Michigan Return Flow

Because a Lake Michigan supply would also include return flow, any impacts to the Fox River are assigned to the Lake Michigan water supply. Impacts with return flow are described in the following subsections.

Flooding Changes

Lake Michigan Water Supply (Cities of Milwaukee, Oak Creek, and Racine)

A Lake Michigan water supply would not affect flooding on the Fox River, because Lake Michigan is in a different watershed.

Underwood Creek to Lake Michigan Return Flow

Return flow would not affect flooding on the Fox River. As discussed in the return flow management plan in Section 5 of the Application, return flow to the Lake Michigan basin would be temporarily paused during flooding events downstream of the return flow discharge location, and flow from the WWTP would be conveyed to the Fox River. This would maintain the same flow in the Fox River during flooding events as currently occurs. Therefore, a Lake Michigan water supply with the return flow would not adversely change flooding on the Fox River.

A small aboveground pump station is associated with this alternative: one at the Waukesha WWTP for return flow. The facility would be located and designed so there would no damage from a 100-year return period flood.

[17] Doug Cherkauer, D. Feinstein, T. Grundl, W. Kean. "Is riverbank filtration a viable means of extending groundwater supplies?" Presentation to the Compact Implementation Coalition and Sweet Water NGO Team, February 18, 2010, Great Lakes Water Institute, Milwaukee, Wisconsin.

Underwood Creek and Menomonee River

Baseflow Changes

Lake Michigan Water Supply (Cities of Milwaukee, Oak Creek, and Racine)

Change in flow would be documented under return flow, since there is no change in surface water flow based solely upon a Lake Michigan supply.

Underwood Creek to Lake Michigan Return Flow

The average annual stream flow is 15.1 cfs (9.8 mgd) for Underwood Creek and 108 cfs (69 mgd) for the Menomonee River over the period of record.

Appendixes G and H of the Application contain a detailed analysis of the flow and geomorphic conditions of these waterways. In summary, return flow to Underwood Creek will increase the flow in the creek and river downstream of the return flow location. Underwood Creek has periods of no flow, and so a return flow could constitute 100 percent of the creek flow at such times and create year-round aquatic habitat. During less frequent high flow events, such as a 2-year flow, a return flow is less than 2 percent of the creek flow and even a lower percentage of the river flow. Because of the small percentage of return flow in the creek and river, a return flow will increase baseflow but not adversely affect flow or geomorphic conditions in either watercourse. Instead, it will benefit Underwood Creek flow during low and no-flow periods, because the return flow will provide a baseflow in the creek at all times and create year-round aquatic habitat.

Flow changes in Underwood Creek with return flow for 2005 and 2008 were simulated as documented in Appendix J of the Application. The year 2005 was selected because it is a relatively dry year in recent past, and 2008 was a relatively wet year. The analysis found the change in baseflow throughout the year, with the maximum increase in baseflow of 13.8 cfs (8.9 mgd) in 2005 and 12.3 cfs (8.0 mgd) in 2008. This compares to average annual flows in Underwood Creek without return flow of 9.1 cfs (5.9 mgd) in 2005 and 26.1 cfs (16.9 mgd) in 2008. Return flow represents an increase in annual average flow of approximately 50 to 150 percent in these years.

Flooding Changes

Lake Michigan Water Supply (Cities of Milwaukee, Oak Creek, and Racine)

Change in flow would be documented under return flow, since there is no change in surface water flow based solely upon a Lake Michigan supply. No Lake Michigan water supply would affect flooding in inland waterways because the water intake in all cases would be in Lake Michigan.

Underwood Creek to Lake Michigan Return Flow

Return flow to any watercourse would not affect flooding or floodplain delineations. Return flow is less than 2 percent of the creek flow during a 2-year frequency storm and would be an even a smaller percentage of flow during a flood. But if an extreme flood condition threatens personal property or public investments, return flow would be paused temporarily, as discussed in the return flow management plan in Section 5 of the Application. The return flow management plan has proposed to temporarily pause return flow when flow in Underwood Creek is above a 2-year recurrence interval flow (1,000 cfs). As described in Section 5 of the Application, the Compact requirements for return flow will still be met. The 2-year flood flow is much less than the 100-year flood flow. Even though return flow is a very small percentage of the flow in the creek during a flood, by temporarily pausing the return flow during flood events greater than a 2-year recurrence interval, the return flow will not cause flood damage downstream of the return flow discharge.

When return flow is paused, flow from the City of Waukesha WWTP would be conveyed through the existing outfall to the Fox River, and would not adversely affect flood levels in either Underwood Creek or the Fox River. An example of the operation of the return flow management plan in the historically wet year 2008 is detailed in Appendix J of the Application. The analysis demonstrated the return flow did not affect the flood flows in Underwood Creek, and the City was still able to meet its goal of 100 percent return flow that year. Therefore, there would be no increase in the flood elevation with return flow in either Underwood Creek or the Fox River. With the planned return flow operational methodology to trigger a temporary pause in return flow, there is no increased flooding potential.

The Wastewater Treatment Plant Facility Plan Amendment (Appendix E of the Application) discusses potential outfall structure designs. The outfall structure will be designed to blend in with the streambanks along Underwood Creek and not to affect regional flood elevations adversely.

5.1.2.2.3 Environmental Effects Comparison: Inland Waterways Size, Flows, and Floodplain

Adverse impacts from changes in the size, flow, and floodplain of inland waterways relate directly to aquatic habitat impacts and flooding. Level of relative impact for both aquatic habitat and flooding were developed to compare impacts. Impacts were compared based upon Table 5-11. The impact on aquatic habitats and flooding is discussed below. The inland waterway aquatic habitat and flooding impacts are summarized in Table 5-12. The comparison for aquatic habitat impacts for Lake Michigan is included in Section 5.1.1.

TABLE 5-11
Environmental Impact Category Description: Inland Waterways – Aquatic Habitat and Flooding

Category	Aquatic Habitat	Flooding
No adverse impact	Temporary impacts from construction; neutral or improved habitat creation and frequency of availability from operation.	No increase in flooding depth for the 100-year return period storm.
Minor adverse impact	Reduced baseflow in warm water streams of up to 25%, causing habitat loss. Substrate change to Lake Michigan of fewer than 10 acres.	Causes an increase in flooding depth of greater than 0.01 but less than 0.1 foot at buildings for the 100-year return period storm.
Moderate adverse impact	Reduced baseflow in warm water streams of greater than 25% but less than 50%, causing habitat loss. Reduced baseflow to cold water streams, but less than 25%. Substrate change to Lake Michigan of greater than 10 but less than 20 acres.	Causes an increase in flooding depth of greater than 0.1 but less than 1.0 foot at buildings for the 100-year return period storm.
Significant adverse impact	Reduced baseflow in cold water streams of 25% or more or reduced baseflow in warm water streams of 50% or more, causing habitat loss. Substrate change to Lake Michigan of greater than 20 acres.	Causes an increase in flooding depth of greater than 1.0 foot at buildings for the 100-year return period storm.

TABLE 5-12
Proposed Project Environmental Impact Comparison Summary: Inland Waterway Aquatic Habitat and Flooding

Proposed Project	Aquatic Habitat	Flooding
Water Supply		
Lake Michigan (City of Milwaukee)	Minor adverse impact	No adverse impact
Lake Michigan (City of Oak Creek)	Minor adverse impact	No adverse impact
Lake Michigan (City of Racine)	Minor adverse impact	No adverse impact
Return Flow for Lake Michigan Water Supply		
Underwood Creek to Lake Michigan	No adverse impact	No adverse impact

5.1.2.2.4 Aquatic Habitat

Lake Michigan Water Supply (Cities of Milwaukee, Oak Creek, and Racine)

A Lake Michigan water supply would change annual low flows in the Fox River by approximately 25 percent. Consequently, the impact to the Fox River would be a minor adverse impact.

Underwood Creek to Lake Michigan Return Flow

Return flow to Underwood Creek would increase baseflow and also the quantity and availability of aquatic habitat. The greatest habitat benefits would occur during low flow conditions. Return flow to Underwood Creek would improve the aquatic habitat.

5.1.2.2.5 Flooding

Lake Michigan Water Supply (Cities of Milwaukee, Oak Creek, and Racine)

A Lake Michigan supply would not affect flooding in any surface waters, so it would cause no adverse impact to flooding.

Underwood Creek to Lake Michigan Return Flow

The return flow to any location would not affect flooding. Return flow would be paused during flooding downstream of the return flow discharge location, and flow from the WWTP would be conveyed to the Fox River. This would maintain the same flow in the Fox River during flooding as what currently occurs. Return flow does not cause an adverse impact to flooding.

5.1.2.3 Water Quality

5.1.2.3.1 Affected Environment

Fox River

The Fox River will be affected by the project. The river receives the flow discharged from the Waukesha WWTP, so a change in discharge location would affect the river.

Water quality data gathered by the WDNR about 7 miles downstream of the Waukesha WWTP at County Highway I provides background information on Fox River water quality. Grab samples were taken for total suspended solids, dissolved oxygen, total phosphorus, and fecal coliform in February, April, July and October of 2011. The results are shown in Table 5-13 for WDNR Station numbers 683206 and 683096.

The Fox River near the WWTP outfall is on the 303(d) list for several impairments, including PCBs for fish consumption advisories, phosphorous for low dissolved oxygen concentration, and sediment for habitat impairment.[18] The WWTP operates under a chloride variance for discharge to the Fox River. New phosphorus water quality standards indicate the Fox River in the City of Waukesha has a phosphorus water quality standard of 0.075 mg/L (NR 102.06(3)(b)).

TABLE 5-13
Water Quality Data: Fox River

Parameter[a]	Average
Total suspended solids	19.75 mg/L[b]
Dissolved oxygen	10.46 mg/L
Total phosphorus	0.17 mg/L
Fecal coliform	230 MPN/100 ML[b]

[a] Samples were gathered on 2/22/11, 4/12/11, 7/21/11, and 10/11/11.

[b] Some samples received were not iced, or the ice had melted.

Underwood Creek and Menomonee River

Underwood Creek is designated for WDNR fish and aquatic life standards. Underwood Creek also has a variance in Milwaukee County for dissolved oxygen and fecal coliform. The Menomonee River downstream of Underwood Creek is classified for WDNR fish and aquatic life standards, but it has the same dissolved oxygen and fecal coliform variances from Honey Creek to the mouth of the river (about 5 miles downstream of the proposed return flow location).

A reach of Underwood Creek upstream of the discharge in Waukesha County is included on the 2010 303(d) list for fecal coliform as a recreational restriction.[19] The proposed 2012 303(d) list includes the South Branch of Underwood Creek, which is upstream of the proposed return flow location, for phosphorous.[20] The last 2.67 miles of the Menomonee River are included on the 2010 303(d) list for fecal coliform as recreational restrictions. The Menomonee River is on the 303(d) list in the same stretch of river for PCBs from contaminated sediment, *E. coli* bacteria for recreational restrictions, total phosphorus for low dissolved oxygen, and unspecified metals for chronic aquatic toxicity. These listings were made in 1998. A total maximum daily load (TMDL) is under development for Underwood Creek and the Menomonee River for phosphorus, total suspended solids, and bacteria.[21] The City of Waukesha is an active stakeholder in the TMDL development.

Water quality information is gathered by a number of organizations in the Underwood Creek and Menomonee River watersheds. The USGS and the MMSD have obtained water quality data, and SEWRPC has done extensive water quality modeling of the watersheds.

Water quality standards for dissolved oxygen are 5.0 milligrams per liter (mg/L) and recreational use fecal coliform standards are 200 counts/100 mL monthly geometric mean and are not to exceed 400 counts/100 mL in more than 10 percent of all samples during any month.[22] Dissolved oxygen variances are also applicable to these waters in some areas. The dissolved oxygen variance is 2.0 mg/L and the fecal coliform variances are 1,000 counts/100

18 http://dnr.wi.gov/org/water/wm/wqs/303d/303d.html. Accessed January 19, 2010.

19 http://dnr.wi.gov/org/water/wm/wqs/303d/303d.html accessed January 19, 2010.

20 http://dnr.wi.gov/water/impairedSearch.aspx accessed December 28, 2011.

21 http://v3.mmsd.com/Report.aspx accessed December 28, 2011.

22 WDNR NR 102.04(4).

mL monthly geometric mean and is not to exceed 2,000 counts/100 mL in more than 10 percent of all samples during any month.[23]

There are recent numeric phosphorus water quality standards in Wisconsin, with Underwood Creek having a standard of 0.075 mg/L and the Menomonee River having a standard of 0.10 mg/L (NR 102.06(3)(b)). There are no numeric total suspended solids standards in Wisconsin, however a reference background concentration of 17.2 mg/L was used in SEWRPC's Regional Water Quality Management Plan Update.[24]

The USGS conducted water quality sampling at USGS gage 04087088 on Underwood Creek at Wauwatosa with data obtained from February 2004 through August 2005.[25] Table 5-14 lists concentration ranges for dissolved oxygen, phosphorus, and fecal coliform.

TABLE 5-14
Underwood Creek Water Quality Data

Parameter	Samples	Minimum	Maximum	Mean
Dissolved oxygen	12	8.3 mg/L	14.2 mg/L	11.8 mg/L
Phosphorus (P) of unfiltered water	12	0.02 mg/L	0.35 mg/L	0.114 mg/L
Fecal coliform	12	120 per 100 mL	16,000 per 100 mL	3,018 per 100 mL

Source: USGS 2004, 2005.

The MMSD (2008) water quality sampling produced a report Underwood Creek Water Quality Baseline Report. Generally, eight samples were taken annually from 2003 through 2005. The sampling was conducted for a variety of parameters and throughout the Underwood Creek watershed. The average of annual sample results at locations downstream of the expected return flow location is summarized in Table 5-15.

TABLE 5-15
Average Water Quality Range in Underwood Creek: 2003–2005

Dissolved oxygen	11.8 to 17.8 mg/L
Phosphorus	0.102 to 0.203 mg/L
Fecal coliform	1,915 to 23,677 per 100 mL)

The USGS water quality sampling occurred at USGS gage 04087120 on the Menomonee River at Wauwatosa with data obtained primarily from 1991to 1993 and again from 2004 to 2009.[26] Table 5-16 lists concentration ranges for dissolved oxygen, phosphorus, and fecal coliform.

23 WDNR NR 102.06.

24 SEWRPC. 2008. *A Regional Water Supply Plan for Southeastern Wisconsin.* Planning Report No. 52.

25 http://waterdata.usgs.gov/wi/nwis/rt, gage number 04087088 accessed February 2010.

26 http://waterdata.usgs.gov/wi/nwis/rt, gage number 04087120 accessed February 2010.

TABLE 5-16
Menomonee River Water Quality Data

Parameter	Samples	Minimum	Maximum	Mean
Dissolved oxygen	429	7.5 mg/L	16 mg/L	11.7 mg/L
Phosphorus (P) of unfiltered water	380	0.02 mg/L	1.4 mg/L	0.228 mg/L
Fecal coliform	47	10 per 100 mL	800,000 per 100 mL	21,793 per 100 mL

Source: USGS 1991–1993, 2004–2009.

Note: Dissolved oxygen samples are from gage operation; phosphorus and fecal coliform are from field samples

Water quality in Underwood Creek and the Menomonee River was extensively studied in SEWRPC's (2007) *A Regional Water Quality Management Plan Update for the Greater Milwaukee Watersheds*. Findings for the 11-year period of record simulation under SEWRPC's existing condition scenario are summarized in Table 5-17 for three points closest to the proposed return flow location (SEWRPC, 2007, Appendix N).

TABLE 5-17
Average Annual Water Quality Data Downstream of Underwood Creek Return Flow Location

Dissolved oxygen	11.0 to 11.1 mg/L
Phosphorus (mg/L)	0.066 to 0.111 mg/L
Fecal coliform summer season geometric mean	351 to 496 per 100 mL
Total suspended solids	15.6 to 16.8 mg/L

5.1.2.3.2 Environmental Effects

Water quality environmental effects will occur both during construction as well as during operation and maintenance. Potential impacts to aquatic resources generally associated with construction can be both direct and indirect. They will depend primarily upon the physical characteristics of the streams and time of year.

The primary temporary construction impacts to surface waters can be associated with elevated loads of suspended sediment resulting from in-stream trenching activities and erosion of cleared streambanks and rights-of-way from pipeline construction. Impact severity is a function of sediment load, particle size, streambank and streambed composition, flow velocity, turbulence, and duration of construction activities. Since the impacts will be temporary and will be crossed using BMPs designed to reduce the impact, turbidity and erosion created by construction will be minimal.

Without mitigation by implementing BMPs, temporary construction impacts can also elevate suspended sediment levels that increase turbidity and consequently reduce primary photosynthetic production, flocculate plankton, decrease visibility and food availability, and produce effects that are aesthetically displeasing (USFWS, 1982). However, Long (1975) concluded that most fish avoid turbid water and can survive for several days in waters where construction in a stream has caused turbidity. Since the construction impacts will be temporary and river crossings will use BMPs designed to reduce the impact, turbidity and erosion created by construction will be minimal.

Construction effects on water quality will be minimized by using BMPs as described in Attachment 5-2, "Example Wetland and Waterway Pipeline Construction Crossing Impact Minimization Techniques."

Operational and maintenance effects on water quality that are applicable regardless of the discharge location as first described and then operational and maintenance effects are described below for each inland waterway.

The WDNR commonly provides allowances for permitted discharges in the form of interim limits, variances, or other allowances when background levels are higher than water quality standards, when the water quality constituent cannot be removed by municipal WWTP best available technology permitted in Wisconsin, or water quality standards can be met after mixing or other processes in the receiving water.

The Waukesha WWTP currently discharging to the Fox River has an allowance for chloride discharge in the form of an interim limit governed by NR 106.83(2)(b). A significant source of chloride in the Waukesha WWTP is residential water softening. The allowance for an interim chloride limit would also consequently be needed. The Waukesha WWTP also currently has an allowance for mercury in the form of an interim limit governed under NR 106.145(4) which requires a mercury minimization plan that Waukesha is implementing. The water supply source is not expected to have an effect on mercury at the WWTP. Other water quality parameters may be addressed by similar regulatory approaches for allowances under current or future regulations.

The WDNR has adapted new thermal rules (NR 102 and 106) for the protection and propagation of aquatic life that applies to WPDES permit holders discharging to surface waters. In preparation for this new rule, the City has been collecting effluent temperature data for over a year. The City will meet WDNR thermal discharge requirements following the rules and applicable guidance regardless of a discharge location.

Fox River

Lake Mchigan Water Supply (Cities of MIlwaukee, Oak Creek, and Racine)

A Lake Michigan supply regardless of the water source includes new aboveground impacts that are limited to only a new pump station less than a quarter acre in size; consequently, operational stormwater quality impacts will be insignificant and none to the Fox River.

Underwood Creek to Lake-Mchigan Return Flow

Return flow will switch discharge up to a maximum amount from the Fox River to the Lake Michigan watershed. The return flow management plan is discussed in detail in Section 5 of the Application. In general, the return flow management plan provides return flow up to a value of 115 percent of the average day water demand if sufficient water is available at the WWTP. Water at the WWTP in excess of this amount will continue to be discharged into the Fox River and meet permit limits. The Wisconsin Pollutant Discharge Elimination System (WPDES) values are intended to protect receiving streams. Consequently, significant water quality impacts to the Fox River are not anticipated with return flow to the Lake Michigan watershed instead of continuous discharge to the Fox River.

Underwood Creek and Menomonee River

Lake Mchigan Water Supply (Cities of MIlwaukee, Oak Creek, and Racine)

A Lake Michigan supply regardless of the water source includes new aboveground impacts that are limited to only a new pump station less than a quarter acre in size; consequently, operational stormwater quality impacts will be insignificant to Underwood Creek and the Menomonee River.

Underwood Creek to Lake Mchigan Return Flow

All water returned to the Lake Michigan watershed, will meet WDNR water quality permit requirements. A summary of proposed discharge limits from the WDNR and a comparison to historical Waukesha WWTP performance are detailed in the Return Flow Alternatives Summary (Appendix F of the Application). It is important to note that the Waukesha WWTP historical effluent (October 1, 2002, to August 31, 2009) already consistently produces an effluent quality better than the proposed permit limits. A comparison of the proposed WWTP limits[27] and historical performance is shown in Table 5-18. The table also includes a comparison to two other discharge permits to Lake Michigan tributaries as a comparison.

TABLE 5-18
Comparison of WDNR-Proposed WPDES Limits to
Historical WWTP Performance and Other Lake Michigan Tributary Dischargers

	City of Waukesha Potential Return Flow			
Water Quality Parameter	WDNR-Proposed Limit for Lake Mchigan Tributary Return	Waukesha Historic Average[a]	Lake Mchigan Tributary WWTP Discharger #1[b]	Lake Mchigan Tributary WWTP Discharger #2[c]
Biological oxygen demand	≤ 5.0 to ≤ 10.0 mg/L	1.8 mg/L	≤ 10.0 to ≤ 15 mg/L	≤ 30.0 mg/L monthly avg.
Total suspended solids	≤ 5.0 to ≤ 10.0 mg/L	1.2 mg/L	≤15.0 mg/L	≤ 30.0 mg/L monthly avg.
Dissolved oxygen	≥ 7.0 mg/L	9.2 mg/L	≥ 6.0 mg/L	≥ 6.0 mg/L
Phosphorus	≤ 1.0 mg/L	0.16 mg/L	≤ 1.0 mg/L	≤ 1.0 mg/L
Ammonia (NH_3-N)	Likely lower than current range of 2.0 to 6.0 mg/L	< 1.0 mg/L	3.3 to 6.4 mg/L monthly avg.	6.3 to 12.0 mg/L monthly avg.

[a] October 1, 2002, to August 31, 2009.
[b] WPDES Permit No. WI-0020222-08-0
[c] WPDES Permit No. WI-0020184-08-0

Water softening would no longer be needed with a Lake Michigan water supply source. Consequently, a reduction in chloride concentration in return flow over time is expected. The same approach to permit allowances for existing discharge to the Fox River would be expected to be required for return flow.

Return flow will switch discharge up to a maximum amount from the Fox River to the Lake Michigan watershed. Water at the WWTP in excess of this amount will continue to be discharged into the Fox River and meet permit limits.

Return flow ultimately ends up in Lake Michigan. Water quality impacts to Lake Michigan have been previously covered under Section 5.1.1.2.

The Underwood Creek to Lake Michigan return flow considered water quality changes to Underwood Creek and downstream reaches of the Menomonee River.

Water quality modeling was conducted for return flow to Underwood Creek. Modeling included existing conditions in Underwood Creek with expected Waukesha return flow concentration and also a "worse case" scenario having high flows and higher concentrations

27 WDNR letter from Duane Schuettpelz. October 16, 2008.

in the discharge (but still within permit limits). Appendix I of the Application contains the detailed water quality modeling conclusions.

The water quality modeling found that average water quality improved or continued to meet water quality standards or background reference concentrations for three of four water quality parameters (fecal coliform, dissolved oxygen, and total suspended solids). For the fourth water quality parameter (phosphorus), concentrations increased and were more frequently higher than the planning level goal used in the SEWRPC modeling (0.1 mg/L), which is now the Menomonee River phosphorus water quality standard. However, the modeling results indicate that with return flow, nuisance algae growth will decrease in Underwood Creek and Menomonee River. The phosphorus TMDL currently underway, which the City of Waukesha is a stakeholder in, may lead to reduced phosphorus discharge concentration in the return flow. However, it is not expected to be lower than the 0.075 mg/L water quality standard in Underwood Creek. The 0.075 mg/L is also the phosphorus water quality standard in the Fox River. The City of Waukesha will provide return flow with water quality that meets effluent requirements, regardless of the discharge location.

The 303(d) listing for Underwood Creek and the Menomonee River will not become worse with return flow. The fecal coliform recreational restriction 303(d) listing for Underwood Creek will not be exacerbated with return flow because the fecal coliform concentration in the discharge has averaged between 2 and 49 cells/100 mL during the recreational season, which is well below the standard of 400 cells/100 mL. The proposed 2012 303(d) phosphorus listing for the South Branch of Underwood Creek is not affected by the return flow because return flow is downstream of the South Branch, however, phosphorous discharge to Underwood Creek will meet WDNR phosphorus requirements.

The 303(d) listings on the last 2.67 miles of the Menomonee River will not be exacerbated with return flow. The proposed fecal coliform listing will not be exacerbated with return flow because the fecal coliform concentration in the discharge has averaged between 2 and 49 cells/100 mL during the recreational season, which is well below the standard of 400 cells/100 mL.

The listing for PCBs from contaminated sediment will not become worse because the return flow does not include this chemical. The listing for *E. coli* bacteria for recreational restrictions will not become worse because disinfection at the WWTP works so well that only between 2 and 49 cells/100 mL of fecal coliform occur during the recreational season, and a similar high quality would be expected for other bacteria such as *E. coli*.

The listing of total phosphorus for low dissolved oxygen does not appear accurate because this listing goes all the way back to 1998, and a more-recent SEWRPC detailed analysis of water quality in the Menomonee River found that the dissolved oxygen variance standard was always met for the 11-year period of record analyzed (SEWRPC, 2007, Appendix N).

The water quality modeling of the Menomonee River found no change in dissolved oxygen standard compliance with return flow. No change in dissolved oxygen standard compliance is in part due to the very good performance of the Waukesha WWTP which produces effluent with a very low biological oxygen demand (BOD) concentration. As described in Appendix I of the Application, historical WWTP performance has produced a BOD concentration less than 2 mg/L on average.

Finally, the listing of unspecified metals for chronic aquatic toxicity will not be exacerbated because the WWTP WPDES permit process has analyzed metals concentrations and found that they are below toxic levels.

Water quality analysis for Underwood Creek is summarized in Return Flow Alternatives (Appendix F of the Application) with additional detailed modeling found in Appendix I to the Application.

Root River

5.1.2.3.3 Environmental Effects Comparison: Inland Waterways Water Quality

Adverse impacts from changes in inland waterways water quality were compared based upon Table 5-19. For water quality impacts in inland waterways, a discussion of relative impact is included in Table 5-20. The comparison for water quality impacts for Lake Michigan is included in Section 5.1.1.2.

TABLE 5-19
Environmental Impact Category Description: Water Quality

No adverse impact	Temporary impacts from construction; during operation water quality numeric standards compliance improves or stays approximately the same based upon expected water quality from historical wastewater treatment plant performance. Contributes a de minimis change (<1%) in total water quality parameter average annual loading to Lake Michigan near Milwaukee based upon expected water quality from historical wastewater treatment plant performance. Operational changes in stormwater runoff quality occur due to new above ground structures.
Minor adverse impact	Water quality numeric standards compliance improves or stays approximately the same based upon expected water quality from historical wastewater treatment plant performance and recognizing allowances commonly provided in other municipal discharge permits. Contributes a minor change (>1%, but less than 10%) in total water quality parameter average annual loading to Lake Michigan near Milwaukee based upon expected water quality from historical wastewater treatment plant performance.
Moderate adverse impact	Lowering of in-stream water quality, but no numeric water quality standard exceedences for water quality parameters that were not exceeded without return flow based upon historical wastewater treatment plant performance and recognizing allowances commonly provided in other municipal discharge permits. Numeric water quality standard exceedences for water quality parameters that were already exceeded without return flow based upon historical wastewater treatment plan performance. Contributes a moderate change (>10%, but less than 25%) in total water quality parameter average annual loading to Lake Michigan near Milwaukee based upon expected water quality from historical wastewater treatment plant performance.
Significant adverse impact	New exceedence of numeric water quality standards occurs for water quality parameters that were not exceeded without return flow based upon historical wastewater treatment plant performance and recognizing allowances commonly provided in other municipal discharge permits. Contributes a substantial change (>25%) in total water quality parameter average annual loading to Lake Michigan near Milwaukee based upon expected water quality from historical wastewater treatment plant performance

Lake Michigan Water Supply (Cities of Milwaukee, Oak Creek, and Racine)

A Lake Michigan water supply would not change water quality in Lake Michigan and have no adverse impact to other surface water resources. A Lake Michigan water supply source would eliminate the need for water softening. Consequently, discharge of chlorides in the WWTP from water softener salts would be eliminated from discharge to the environment over time. The Lake Michigan water supply consequently would produce no adverse impact on water quality.

TABLE 5-20
Proposed Project Environmental Impact Comparison Summary: Inland Waterways Water Quality

Proposed Project	Water Quality
Water Supply	
Lake Michigan (City of Milwaukee)	No adverse impact
Lake Michigan (City of Oak Creek)	No adverse impact
Lake Michigan (City of Racine)	No adverse impact
Return Flow for Lake Michigan Water Supply	
Underwood Creek to Lake Michigan	Minor adverse impact

Underwood Creek to Lake Michigan Return Flow

Return flow to Underwood Creek would take flow currently discharged to the Fox River and send it to Underwood Creek instead. The current Fox River discharge includes a permit allowance for chloride, which would no longer be discharged daily to the Fox River. Consequently, changes to Fox River water quality would occur, but because WDNR discharge permits are designed to protect receiving waters, no significant change in impacts to the Fox River is expected.

Potential discharge permit requirements provided by the WNDR for return flow discharge have been reviewed, and the WWTP would currently meet these requirements based upon historical performance. The water quality modeling found that average water quality improved or continued to meet water quality standards or background reference concentrations for three of four water quality parameters (fecal coliform, dissolved oxygen, and total suspended solids). For the fourth water quality parameter (phosphorus), concentrations increased and were more frequently higher than the planning level goal used in the SEWRPC modeling (0.1 mg/L), which is now the Menomonee River phosphorus water quality standard. However, the modeling results indicate that with return flow, nuisance algae growth will decrease in Underwood Creek and Menomonee River.

The phosphorus TMDL currently underway, which the City of Waukesha is a stakeholder in, may lead to reduced phosphorus discharge concentration in the return flow. However, it is not expected to be lower than the 0.075 mg/L water quality standard in Underwood Creek. The 0.075 mg/L is also the phosphorus water quality standard in the Fox River. The City of Waukesha will provide return flow with water quality that meets effluent requirements, regardless of the discharge location.

The allowances in the current WDNR discharge permit are expected to continue under this water supply source. Consequently, the water quality impacts to Underwood Creek would be expected to have minor adverse impacts.

Water quality loading to Lake Michigan from the watersheds around greater Milwaukee was reviewed and return flow was found to be only 0.2 percent of all fecal coliform loading and only 0.21 percent of all total suspended solids loading under conservative, worst-case conditions. Phosphorus loading was found to be only 0.62 percent of all phosphorous loading under past historical performance and only 1.23 percent of all phosphorus loading under worst-case conditions. These phosphorus contributions could be even less in the future because the WDNR's new phosphorus regulations could require more stringent phosphorus discharge limitations. Consequently, the water quality impacts to Lake Michigan would be expected to have minor adverse impacts.

5.1.2.4 Geomorphology and Sediments

5.1.2.4.1 Affected Environment

Fox River

In the vicinity of the City of Waukesha, the Fox River has reaches that are natural channel with minimal modifications, while other reaches are significantly altered by development. Within the City center upstream of the WWTP, the Fox River has been dammed to create the Barstow Impoundment, where the river banks consist of sheetpile, concrete, rock reinforcements, and vegetation. Upstream of the dam, large sediment depositions are reported to include pollutants that may cause human and aquatic health concern.[28] Farther upstream, the Fox River meanders through developed landscapes including residential, golf course, commercial and transportation development. The river has mostly vegetated banks, with erosion and bank failures common in urban areas. The river generally has a wide floodplain with connected wetlands and some encroachments from development. The river is generally low gradient and primarily consists of glides and pools. The sediments are primarily silts and sands in the pools and sand and gravel in glides.

Downstream of the Barstow Impoundment, the river is confined by development. The river banks are primarily placed rock and concrete retaining walls. The river is fairly narrow and higher gradient than upstream reaches, where the river is primarily riffles with gravel and cobble. Farther downstream of the City near the WWTP, the river returns to a low gradient meandering river. Similar to the upstream reaches, the banks are mostly vegetated with some erosion and bank failures typical of a developing watershed. Farther downstream, the river has a fairly low gradient river, with sediments consisting primarily of silt and sand in pools, and sand in the glides. Occasional areas of gravel are also present. In the downstream reaches, sediment point bars, primarily consisting of sand have formed due to natural sediment transport dynamics and likely from agricultural land runoff.

Underwood Creek and Menomonee River

Downstream of the Underwood Creek return flow location, the creek flows about 2.6 miles to its confluence with the Menomonee River. This section of creek includes mostly concrete-lined channels with a 2,400-foot section that was recently rehabilitated.[29] The downstream 4,400 feet of creek (immediately downstream of the rehabilitated reach) to the confluence with Menomonee River is mostly concrete-lined, with a short segment that has a concrete low-flow channel and vegetated floodplain and a natural 300-foot segment at the end of the reach. That reach is expected to be rehabilitated in the future, but final design has not yet

[28] Fox River, Upper Fox River - Illinois Watershed (FX07). http://dnr.wi.gov/water/waterDetail.aspx?key=296926. Site Accessed January 24, 2012.

[29] Milwaukee Metropolitan Sewerage District (MMSD). 2008. "Watercourse: Underwood Creek Rehabilitation and Flood Management—Phase 1." Designed by Short Elliott Hendrickson, Inc.

been completed.[30] With the exception of the 2,400-foot section of rehabilitated reach, the creek has been straightened and there are no significant natural geomorphic features. There are also no sediments within the concrete lined portions of the creek. Within the rehabilitated reach, however, the creek meanders through constructed pools and riffles that include a gravel and cobble bed and a cobbled lower creek bank. The banks are low, and the creek has been reconnected with its floodplain. A similar channel is likely in the downstream section, when rehabilitation design and construction of the 4,400-foot section is completed in the future.

Downstream of the confluence of Underwood Creek and the Menomonee River, the river flows about 10 miles to Lake Michigan in the City of Milwaukee. Over that distance, the river is confined on both banks between commercial, parkland, parking lot, and industrial land uses. The sediments range from sands and silts in pool areas, to cobble, gravel, and bedrock in riffle areas. The bank materials range from steel sheetpile in the lower sections of the reach in the City of Milwaukee, to rock, earthen, and some concrete retaining walls in the middle section. The banks are generally earthen or rock in the sections in Wauwatosa nearest the confluence with Underwood Creek. In these sections with earthen banks, grasses, shrubs, and trees provide bank stability, however there are erosion and bank failures in some areas, as is typical of urban waterways.

5.1.2.4.2 Environmental Effects

Geomorphology impacts to the surface waters potentially affected by a Lake Michigan water supply and return flow are discussed below. The geomorphology of the surface waters are assessed based on the impact to the surface water geomorphic stability, change in erosion potential, or change in vertical or lateral stability.

Fox River

Impacts to the Fox River for a Lake Michigan water supply and return flow are discussed below. As described in the background information on the Fox River, the average annual stream flow is 110 cfs (71 mgd) over the period of record.

Lake Mchigan Water Supply (Cities of Mlwaukee, Oak Creek, and Racine)

A Lake Michigan water supply, regardless of supply location, would not adversely affect the Fox River with respect to geomorphology because groundwater pumping would cease. A Lake Michigan supply and cessation of shallow groundwater pumping would improve the subsurface flow to the Fox River and allow the baseflow to be restored at least partially to conditions similar to pre-well conditions, by allowing the groundwater to contribute more baseflow to the river. This would improve the baseflow under current shallow groundwater pumping conditions and have the greatest benefit in the future when projected water demands are greater. The Lake Michigan supply would affect the Fox River the same, regardless of returning flow to Underwood Creek or Root River or direct to Lake Michigan. A Lake Michigan supply would require a shift of most of the WWTP discharge from the Fox River to the Lake Michigan basin, but the return flow will not eliminate discharge to the Fox River.

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30 Short Elliot Hendrickson, Inc. (SEH). 2009. “Underwood Creek Effluent Return Evaluation”. Technical memorandum dated July 23, 2009, page 2.

The Compact requires that the minimum return flow be at least the water withdrawn less an allowance for consumptive use. It also requires that the return flow minimize out-of-basin water sent into the Great Lakes basin. These two requirements established minimum and maximum return flow rates to provide the water balance between the withdrawal and return, as described in Section 5 of the Application. As a result, WWTP flow to the Fox River would still occur at times.

A study by the USGS and University of Milwaukee reports that wastewater flows from Sussex, Brookfield, and Waukesha contribute 40 percent of the total Fox River flow during annual low flows.[31] The City of Waukesha's average annual WWTP flow is about 10 mgd, or 50 percent of the WWTP flow from the 3 communities. Using this percentage, the City of Waukesha WWTP contributes about 25 percent of the Fox River flow during annual low flow conditions. Thus, during the low flow periods when return flow (WWTP flow) would likely be entirely to the Lake Michigan basin, a 25 percent reduction in the Fox River annual low flow would occur. Annual low flow conditions generally do not adversely affect the geomorphic conditions in the river, so no significant impacts are expected to the geomorphic conditions of the Fox River with this change.

During higher river flows, the Waukesha WWTP discharge is even a smaller fraction of the total river flow. For example, over the period of record for the USGS stream gage near the Waukesha WWTP (Gage ID 05543830 for water years 1964–2008), the average annual river flow was 71 mgd and the average annual peak river flow 644 mgd. With an average annual Waukesha WWTP discharge of 10 mgd, the WWTP discharge represents 14 percent of the annual average river flow and only 1.6 percent of the average annual peak river flow. This small amount of flow reduction in the river would not have a significant adverse affect on the flow or geomorphic conditions in the river. When the Fox River has these higher flows, the Waukesha WWTP effluent likely would exceed the maximum return flow rate, as discussed in Section 5 of the Application, and WWTP would temporarily pause return flow to the Lake Michigan basin and instead discharge to the Fox River. During these times, the impact to the Fox River would be even less, because the WWTP would continue to supplement the Fox River flows.

Underwood Creek to Lake Michigan Return Flow

Because a Lake Michigan supply would require return flow, impacts to the Fox River are assigned to the Lake Michigan water supply. Impacts of return flow Underwood Creek are described below.

Underwood Creek and Menomonee River

Lake Michigan Water Supply (Cities of Milwaukee, Oak Creek, and Racine)

Impacts of a Lake Michigan water supply, regardless of supply location, are described below under return flow.

Underwood Creek to Lake Michigan Return Flow

The average annual stream flow is 15.1 cfs (9.8 mgd) over the period of record for Underwood Creek and 108 cfs (69 mgd) for the Menomonee River over the period of record.

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31 Doug Cherkauer, D. Feinstein, T. Grundl, W. Kean. "Is riverbank filtration a viable means of extending groundwater supplies?" Presentation to the Compact Implementation Coalition and Sweet Water NGO Team, February 18, 2010, Great Lakes Water Institute, Milwaukee, Wisconsin.

A detailed analysis of the flow and geomorphic conditions is included in the Return Flow Alternatives Summary (Appendix F of the Application), Appendix G (Underwood Creek Effluent Return evaluation), and Appendix H (Return Flow Effects on Habitat in Underwood Creek and Menomonee River. The purpose of Appendix G was to evaluate the hydraulic and geomorphic effects that a return flow would have on the rehabilitated portions of Underwood Creek and to determine if adding additional flow (i.e. return flow) would adversely affect the recently rehabilitated 2,400-foot reach of the creek by MMSD. The study determined that the return flow would not contribute significantly to sediment transport. That conclusion was made based on this study evaluating the hydraulic, geomorphic and fisheries impacts of adding return flow.

The purpose of Appendix H was to document habitat impacts. The analysis was performed after additional surveying and analysis of fisheries data for Underwood Creek were completed as part of the return flow evaluation. The purpose of the evaluation was to determine if the return flow would affect the habitat in the parts of the creek downstream of the proposed return flow discharge location. Hydraulic modeling of the return flow showed increases in average velocity and shear stress, which can reduce embeddedness. From the perspective of habitat, reduced embeddedness is beneficial for organisms that prefer coarser substrate. Return flow to Underwood Creek provides this habitat benefit with an increase in flow in the creek through relatively constant return flow. The velocity and shear stress increases calculated as part of the habitat analysis are very small and, as concluded in the geomorphic analysis (Appendix G), the increases will have a negligible effect on the hydraulic and geomorphic conditions in the creek. (That is, the small increases will have a negligible effect on the geomorphic stability of the creek.)

Underwood Creek experiences periods of no flow, and so a return flow could constitute 100 percent of the creek flow at those times. During less frequent high flow events, such as a 2-year flow, a return flow is less than 2 percent of the creek flow and a lower percentage of the Menomonee River flow. Because of the small percentage of return flow in the creek and river during channel forming flows, a return flow would not affect geomorphic conditions adversely. Instead, the return flow would benefit Underwood Creek habitat during low and no-flow periods, because the return flow would provide a baseflow in the creek at all times.

5.1.2.4.3 Environmental Effects Comparison: Inland Waterway Geomorphology and Sediments

Adverse impacts from changes in inland waterway geomorphology and sediments are compared based upon Table 5-21.

TABLE 5-21
Environmental Impact Category Description: Flow and Sediments

No adverse impact	With return flow, channel is stable for flows up to the 2-year return where the channel is currently stable. No substrate change to Lake Michigan from construction.
Minor adverse impact	With return flow, channel has some instability for flows up to the 2-year return where the channel is currently stable. Substrate change to Lake Michigan of fewer than 10 acres.
Moderate adverse impact	With return flow, channel has frequent instability for flows up to the 2-year return where the channel is currently stable. Substrate change to Lake Michigan of greater than 10 but less than 20 acres.
Significant adverse impact	With return flow, channel is unstable at most flows where the channel is currently stable. Substrate change to Lake Michigan of greater than 20 acres.

Table 5-22 summarizes the impacts on geomorphology and sediments impacts in inland waterways. Section 5.1.1.3 contains a comparison of geomorphology impacts to Lake Michigan.

TABLE 5-22
Proposed Project Environmental Impact Comparison Summary: Inland Waterways Geomorphology and Sediments

Proposed Project	Geomorphology and Sediments
Water Supply	
Lake Michigan (City of Milwaukee)	No adverse impact
Lake Michigan (City of Oak Creek)	No adverse impact
Lake Michigan (City of Racine)	No adverse impact
Return Flow for Lake Michigan Water Supply	
Underwood Creek to Lake Michigan	No adverse impact

Lake Michigan Water Supply (Cities of Milwaukee, Oak Creek, and Racine)

The Lake Michigan water supply would prevent baseflow reduction in inland waterways from groundwater pumping. Because geomorphology changes to the environment would depend only on the return flow location, the Lake Michigan water supply would have no adverse impacts on geomorphology.

Underwood Creek to Lake Michigan Return Flow

Return flow to Underwood Creek would reduce the baseflow in the Fox River by approximately 10 mgd, based upon historical WWTP operation. Geomorphic changes with reduced baseflows could result in channel change over time, but because channel stability is associated less with baseflow and is influenced more by larger channel-forming flows, baseflow reduction is not expected to cause a significant change in channel stability from existing conditions. Consequently, geomorphology changes to the Fox River would have no adverse impact.

Flow that formerly had been discharged to the Fox River would instead increase baseflow in Underwood Creek and the Menomonee River. A geomorphic study analyzing channel stability with return flow to Underwood Creek found that the increased baseflows would not adversely impact the channel stability. Therefore, return flow to Underwood Creek would have no adverse impact on geomorphology.

5.1.2.5 Flora and Fauna

5.1.2.5.1 Affected Environment

Wildlife species require adequate food, water, cover, and living space for the survival of individuals and to maintain population viability. Aquatic resources affected by the proposed project consist generally of streams and wetlands, which include all inland waterways. Aquatic areas can provide habitat to a diverse wildlife population, some common species (beaver, muskrat, herons) are dependent on aquatic habitats for food and shelter. Others (e.g., raccoon) are less restricted, but prefer to be close to water. Amphibians and many reptiles favor aquatic habitats; representative species include bullfrog and northern water snake.

Many of the Wisconsin's richest and most diverse streams and rivers were in the southeastern part of the state, but many have been degraded from nonpoint pollution sources from agriculture and urbanization. Most streambeds, banks, and channels within the project area have been modified by changes in land cover and have lost varying degrees of their biological productivity and diversity.[32]

The rivers and streams within the project area are a combination of cold water communities and warm water communities. Cold water streams are capable of supporting cold water sport fish, such as trout, and other aquatic life, or serving as a spawning area for cold water fish species. Cold water streams, such as Pebble Creek and Mill Brook, contain relatively few fish species and are dominated by trout and sculpins. Warm water fisheries are capable of supporting sport fish such as bass, walleye, and northern pike, and forage fish such as, suckers, minnows, and darters. Warm water rivers include large rivers such as the Fox River, as well as smaller streams such as Underwood Creek and the Root River.

Most of the warm water streams and rivers within the project area are on the 303(d) list for impairments, such as, PCBs, fecal coliform, *E. coli* bacteria, phosphorous for low dissolved oxygen concentration, construction erosion, non-point-source contamination, sedimentation, beaver dams, and unspecified metals for chronic aquatic toxicity.[33] These impairments result in a loss of habitat within the waterway and water temperature fluctuations.[34]

The USFWS and the WDNR were contacted to determine where federal- or state-listed species occur along the project corridor in Lake Michigan. The species identified by these agencies as potentially occurring within the project corridors are summarized for all alternatives in Section 6.3.3 on Wetlands, since most of the potential impacts involve federal- or state-listed species associated with wetlands. A summary discussion of listed species potential habitat impacts for the proposed project is included in Section 5.1.3.2.

Background information for inland waterways affected by the project is given below.

Fox River

Fisheries information for the Fox River downstream of the WWTP was obtained from the WDNR (2011). The data were collected along roughly 2 miles of the Fox River between County Highway I and the confluence of Genesee Creek, about 6 miles downstream of the Waukesha WWTP discharge (Table 5-23). Figure 5-1 shows the sampling locations relative to the WWTP. Fishery surveys were conducted in 1999, 2000, 2003, 2004, and 2006 (Table 5-24).

The surveys identified 36 species of fish (Table 5-24). The most abundant species collected were golden redhorse, common carp, bluegill, channel catfish, largemouth bass, white bass, northern pike, rock bass, common shiner, sand shiner, bluntnose minnow, emerald shiner, longnose gar, white sucker, and creek chub. Most are considered warm water species, although they may also be found in cool water habitats. The greater redhorse, a designated threatened species, also was collected in this stream reach. Several coldwater species (brook and brown trout) were noted at the confluence of Genesee Creek (a cold water fishery) and Fox River but were only present in small numbers.

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32 http://dnr.wi.gov/master_planning/land_legacy/documents/seglacial.pdf. Accessed December 19, 2011.

33 http://dnr.wi.gov/org/water/wm/wqs/303d/303d.html. Accessed January 19, 2010.

34 *The State of the Southeast Fox River Basin*, a report by the WDNR in cooperation within the Southeast Fox River Basin Land and Water Partners Team, February 2002, PUBL WT-701-2002.

TABLE 5-23
Location of WDNR Fox River Fishery Survey Site Numbers and Year of Survey

WDNR Site Number	Survey Number	Year	Location
62121	2664	1999	At confluence with Genesee Creek.
62129	2663	1999	0.6 river mile east of Site #62121.
62245	2608	1999	Upstream of County Hwy I.
62605	2609	2000	
	52059	2003	
	92051	2004	
	92253	2006	

Note: The WDNR lists Genesee Creek as an exceptional resource water and cold water fishery (WDNR, 2002).

A separate fish survey was conducted at the confluence of the Fox River and Pebble Creek, 1.65 miles downstream of the Waukesha WWTP (Waukesha County Department of Parks and SEWRPC, 2008). Many species were the same as those collected in the WDNR surveys, but species not found farther downstream in the Fox River were collected. These were brook stickleback, spottail shiner, banded killifish, golden shiner, longear sunfish, orange-spotted sunfish, starhead topminnow, and tadpole madtom, all warm water species except for the brook stickleback, a cool water species. The longear sunfish is a designated threatened species in Wisconsin. The starhead topminnow and banded killifish are special species of concern.

FIGURE 5-1
Approximate Fish Sampling Locations Relative to the Waukesha WWTP

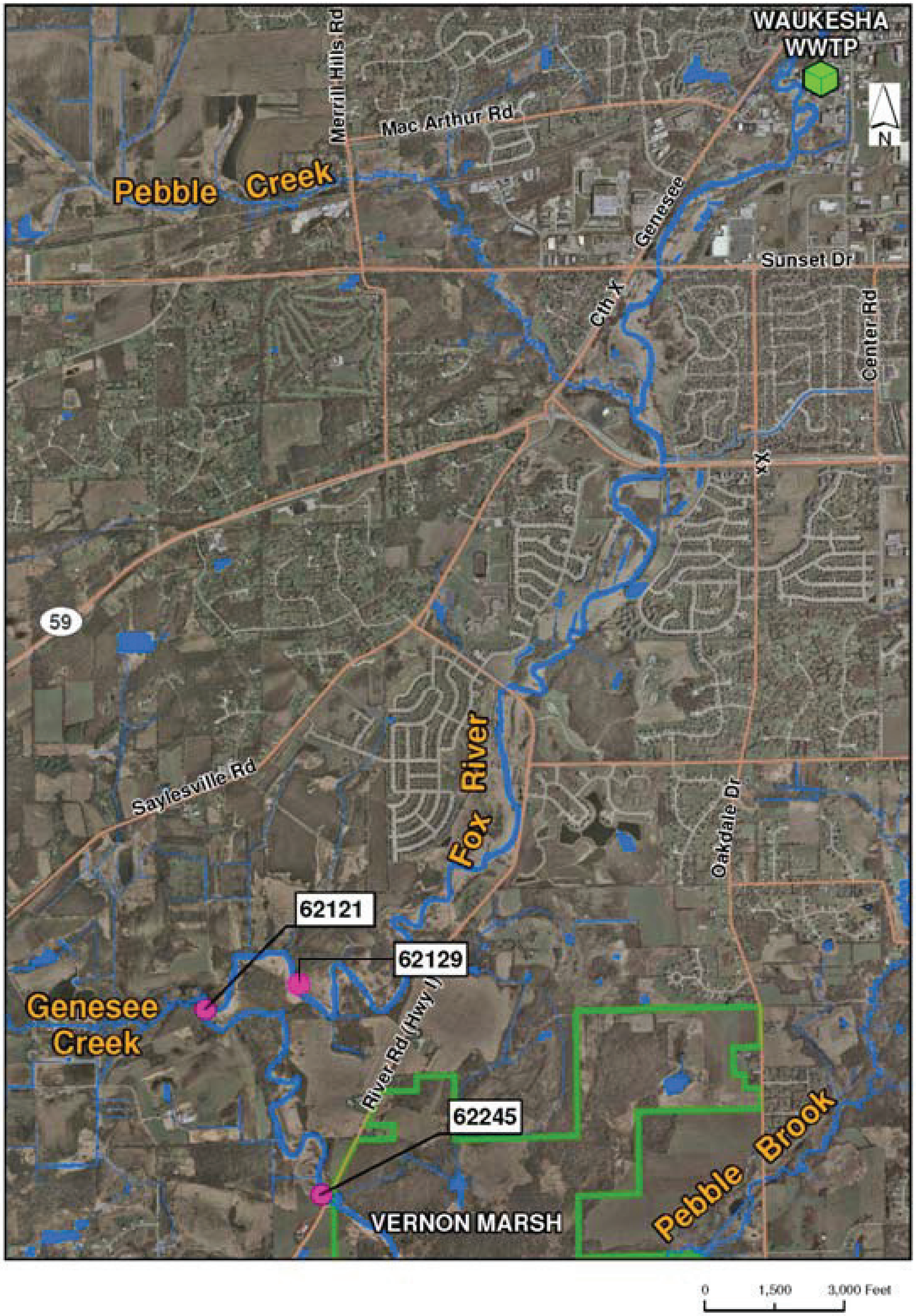

TABLE 5-24
Fisheries Data from WDNR Surveys in the Fox River Downstream of the Waukesha WWTP

	WDNR Site Numbers			
Species	**62121**	**62129**	**62245**	**62605**
Bigmouth shiner				X
Black bullhead			X	
Black crappie			X	
Blackstripe topminnow				X
Bluegill			X	X
Bluntnose minnow				X
Bowfin				X
Brook silverside				X
Brook trout	X	X		
Brown trout	X	X		
Central mudminnow	X	X		X
Central stoneroller				X
Channel catfish			X	X
Common carp			X	X
Creek chub	X	X		X
Emerald shiner				X
Golden redhorse			X	X
Grass pickerel	X			X
Greater redhorse			X	X
Green sunfish				X
Johnny darter				X
Largemouth bass	X			X
Longnose gar				X
Mottled sculpin	X	X		
Northern pike			X	X
Pumpkinseed			X	X
Quilback				X
Rock bass			X	X
Sand shiner				X
Spotfin shiner				X
Walleye				X
White bass				X
White sucker	X	X		X
Yellow bass				X
Yellow perch				X

Underwood Creek and Menomonee River

Fisheries and habitat information for Underwood Creek and the Menomonee River is summarized in the Return Flow Alternatives Summary (Appendix F of the Application) and below.

Underwood Creek, along with the Menomonee River, is a WWSF. The imbalance in number and type of species is indicative of a poor-quality fishery. Although macroinvertebrate communities within the watershed have improved substantially since 1993, the USGS macroinvertebrate data collected in 2007 concluded that Underwood Creek and the Menomonee River range from fairly poor to fair–to-good, based on the presence of specific macroinvertebrates. Fish and macroinvertebrate communities are listed in Appendix H of the Application. Table 5-25 lists the dominant fish species.

TABLE 5-25
Summary of Preferred Habitat Characteristics for Dominant Fish Species in the Menomonee River Watershed

Dominant Fish Species	Found in Underwood Creek 2004 or 2007	Preferred Current Velocity Range	Stream Gradient	General Habitat Characteristics	Dominant Substrate Preference
Pearl dace	X			Pools	Sand, gravel
Creek chub	X	< 0.98 ft/sec	3–23 m/km	Pools	Sand, gravel
White sucker	X	1.31 ft/sec	Wide range	Wide range	Gravel, sand
Long nose dace	X	> 1.48 ft/sec	1.9–18.7 m/km	Riffles	Gravel, rubble
Blunt nose minnow	X			Wide range	Gravel, sand
Black nose dace	X	0.49–1.48 ft/sec	11.4–23.3 m/km	Rocky runs and pools	Gravel, sand
Central stoneroller	X			Rocky riffles, runs, and pools	Gravel, sand, rubble
Common shiner	X			Rocky pools near riffles	Hard bottom, gravel, sand, rubble
Fathead minnow	X			Muddy pools	Sand, rubble, gravel
Largemouth bass	X	> 0.33 ft/sec			Vegetated areas, sand, gravel, mud
Green sunfish	X	< 0.33 ft/sec	0.2–5.7 m/km	50% pools	Vegetated cover
Johnny darter				Pools	Sand/mud
Bluegill	X	< 0.33 ft/sec	≤ 0.5 m/km	60% pool areas	Submerged vegetation, logs, brush
Central mud minnow				Quiet areas	Soft mud bottom, dense vegetation

Fisheries data for the Menomonee River watershed show an apparent net gain of fish species within the watershed. For example, 10 new species have been identified since 1986, and the most recent fishery surveys conducted by the USGS in 2004 and 2007 noted that 12 of the 20 species found in the Menomonee River watershed occurred within Underwood Creek (SEWRPC, 2007, pp. 200–214). Underwood Creek is predominantly a concrete channel with little habitat for fish, but the creek provides minimal substrate for macroinvertebrates.

The part of the concrete channel removed in 2009 and rehabilitated to a meandering stream channel has numerous pools and riffles, and a substrate composed of gravel, sand, and silt.

With the potential presence of two state-listed threatened fish species in the Menomonee River watershed, there appear to be areas of good river quality within limited parts of the watershed. The poor quality of the fish communities in the watershed is caused mostly by habitat loss. The rehabilitated channel of Underwood Creek contains habitat features that fish and macroinvertebrates can use. Although habitat conditions in Underwood Creek are limiting for the fish and benthic communities, those conditions could be improved by providing more or higher quality habitat.

5.1.2.5.2 Environmental Effects

Environmental effects of the proposed project on the flora and fauna of inland waterways consist of impacts from construction and operational impacts from flow changes, including from groundwater drawdown.

The primary temporary construction impacts can be associated with elevated loads of suspended sediment resulting from in-stream trenching activities and erosion of cleared streambanks and rights-of-way from pipeline construction. The severity of impact would be a function of sediment load, particle size, streambank and streambed composition, flow velocity, turbulence, and duration of construction activities. Turbidity and erosion created by construction would be minimal, because the construction period will be brief and BMPs will be employed to reduce the impact.

Without mitigation by implementing BMPs, temporary construction impacts can also elevate suspended sediment levels that increase turbidity and consequently reduce primary photosynthetic production, flocculate plankton, decrease visibility and food availability, and produce effects that are aesthetically displeasing (USFWS, 1982). However, Long (1975) concluded that most fish avoid turbid water and can survive for several days in waters where construction in a stream has caused turbidity. Since the construction impacts will be temporary and river crossings will use BMPs designed to reduce the impact, turbidity and erosion created by construction will be minimal.

Because these impacts are expected to be temporary and the crossings will be restored following construction, temporary impacts to flora and fauna are not discussed further.

It is not anticipated that a Lake Michigan supply and return flow would have a significant impact on mammals and birds in the various inland waterways discussed in this document. Mammals and birds that normally live in areas undergoing pipeline construction may be temporarily displaced during construction. However, habitat alteration will be relatively insignificant because of the small area affected and post-construction restoration efforts used to promote habitat recovery. Operational changes in water levels are anticipated to be less than 2 inches in the Fox River and also minimal in the Root River and Underwood Creek. Because potential habitat affected by these small water depths is immediately adjacent to the ordinary high water mark, mammal, vegetative, and bird species associated with inland waterways are well adapted to withstand minor fluctuations in water elevation resulting from typical seasonal conditions, flood events, or drought. Consequently, the operational impacts to these species are expected to be insignificant.

Operational impacts to inland waterway flora and fauna occur from flow conditions in the waterways that can affect flora and fauna. Operational impacts would be ongoing and permanent. Consequently, the remainder of this impact evaluation focuses upon operational impacts due to flow changes.

Evaluation of impacts to wildlife, endangered resources, and natural communities in inland waterway is part of the comprehensive evaluation for all affected environments. It is included under Wetlands (Section 5.1.3) because wetland species are most affected by the project. Impacts to individual inland waterways are summarized below.

Fox River

Lake Mchigan Supply (Cities of Mlwaukee, Oak Creek, and Racine)

A Lake Michigan supply, regardless of the return flow location, would have its primary discharge location in the Lake Michigan basin instead of to the Fox River. Consequently, these impacts are listed under the return flow.

Underwood Creek to Lake Mchigan Return Flow

A Lake Michigan supply, regardless of return flow location, would not have in its primary discharge location on the Fox River at the Waukesha WWTP. Consequently return flow would change the flow in the Fox River (see Section 5.1.2). The return flow requirement would change discharge to the Fox River for a Lake Michigan water supply.

Change in water depth and habitat available for fisheries is discussed in Appendix H of the Application. Flow in the Fox River for 2005, a dry year, and 2008, a wet year, was analyzed to determine the change in flow in the Fox River and to estimate water depth change. The water depth change in both years was always less than 2 inches at the USGS flow gage in Waukesha.

The small reduction in depth is not expected to have a significant impact on the fishery. The individual fish habitat requirements for dominant species (Table 5-26) and threatened and endangered species (Tables 5-27 and 5-28) generally would still be met. Table 5-27 includes cold water and threatened and endangered species found during surveys used for this analysis. Table 5-28 includes threatened and endangered species not found during the surveys but included in the NHI list of species potentially in the vicinity. With such a small change in flow depth, aquatic vegetation and macroinvertebrate habitat would not be expected to change significantly. No significant adverse impacts to these species or the Fox River fishery are expected.

TABLE 5-26
Summary of Return Flow Effects on Habitat Characteristics for Dominant Fish Species in the Fox River

Dominant Fish Species	Preferred Current Velocity Range[a]	Stream Gradient[a]	General Habitat Characteristics[a]	Dominant Substrate Preference[a]	Potential Changes to Habitat with Return Flow
Channel catfish	Wide range	Not documented in reviewed literature	Wide range	Mud, sand, clay, gravel	With the wide range of preferred velocities, habitat characteristics, and substrate preference, no significant changes are expected.
Creek chub	< 0.98 ft/sec	3–23 m/km	Pools	Sand, gravel	Slightly less pool depth, but because pools are by definition deeper areas no significant changes expected. No significant changes expected to preferred substrate.
White sucker	1.31 ft/sec	Wide Range	Wide range	Gravel, sand	With the wide range of preferred habitat characteristics and substrate preference, no significant changes are expected.
Golden redhorse	Not documented in reviewed literature	Not documented in reviewed literature	Pools in river bends	Sand, gravel	Slightly less pool depth, but because pools are by definition deeper areas no significant changes expected. No significant changes expected to preferred substrate.
Bluntnose minnow	Not documented in reviewed literature	Not documented in reviewed literature	Wide range	Gravel, sand	With the wide range of preferred habitat characteristics and substrate preference, no significant changes are expected.
Common carp	Not documented in reviewed literature	Not documented in reviewed literature	Wide range	Sand, gravel, clay	With the wide range of preferred habitat characteristics and substrate preference, no significant changes are expected.
White bass	Moderate currents	Not documented in reviewed literature	Generally occurs in waters 6m in depth or less	Sand, mud, rubble, gravel	With the wide range of preferred habitat characteristics and variety of substrate preference, no significant changes are expected.
Common shiner	Not documented in reviewed literature	Not documented in reviewed literature	Rocky pools near riffles	Hard bottom, gravel, sand, rubble	Slightly less pool depth, but because pools are by definition deeper areas no significant changes expected. No significant changes expected to preferred substrate.
Northern pike	Not documented in reviewed literature	Not documented in reviewed literature	Shallow vegetated areas	Vegetated areas	Shallow areas will become shallower on average, but less than 2 inches water depth change would occur. With critical spawning times for northern pike during early spring when flows are high, water depth change would be even less. Consequently, no significant changes are expected.

TABLE 5-26
Summary of Return Flow Effects on Habitat Characteristics for Dominant Fish Species in the Fox River

Dominant Fish Species	Preferred Current Velocity Range[a]	Stream Gradient[a]	General Habitat Characteristics[a]	Dominant Substrate Preference[a]	Potential Changes to Habitat with Return Flow
Largemouth bass	> 0.33 ft/sec	Not documented in reviewed literature	Not documented in reviewed literature	Vegetated areas, sand, gravel, mud	With the wide range of preferred substrate preference, no significant changes are expected.
Rock bass	Not documented in reviewed literature	Not documented in reviewed literature	Preference for clear cool to warm water	Sand, gravel	No significant changes expected to general habitat characteristics or preferred substrate.
Emerald shiner	Not documented in reviewed literature	Not documented in reviewed literature	Wide range	Sand, gravel	With the wide range of preferred habitat characteristics and substrate preference, no significant changes are expected.
Bluegill	< 0.33 ft/sec	≤ 0.5 m/km	60% pool areas	Submerged vegetation/ logs, brush	Slightly less pool depth, but because pools are by definition deeper areas no significant changes expected. No significant changes expected to preferred substrate.
Longnose gar	Not documented in reviewed literature	Not documented in reviewed literature	Backwaters, quiet currents	Gravel, sand	No significant changes expected to general habitat characteristics or preferred substrate.

TABLE 5-27
Return Flow Effects on Preferred Habitat for State Threatened, Endangered, Special Concern, and Cold Water Species Recorded Since 1999 within the Fox River

Fish Species	Preferred Current Velocity Range[a]	Stream Gradient[a]	General Habitat Characteristics[a]	Dominant Substrate Preference[a]	Potential Changes to Habitat with Return Flow
Greater redhorse (threatened)	Not documented in reviewed literature	Not documented in reviewed literature	Pools and runs of medium to large rivers	Sandy to rocky pools	Slightly less pool depth, but because pools are by definition deeper areas no significant changes expected. No significant changes expected to preferred substrate.
Longear sunfish (threatened)	Not documented in reviewed literature	Not documented in reviewed literature	Slow moving rivers and streams	Shallow dense vegetation	Shallow areas will become shallower on average, but less than 2 inches water depth change would occur. Consequently, no significant changes are expected.
Banded killifish (special concern)	Not documented in reviewed literature	Not documented in reviewed literature	Shallow sluggish streams	Sand/mud/near vegetation.	Shallow areas will become shallower on average, but less than 2 inches water depth change would occur. No significant changes are expected to the preferred substrate. Consequently, no significant changes are expected.
Starhead topminnow (special concern)	Not documented in reviewed literature	Not documented in reviewed literature	Quit pools and backwaters	Vegetated areas	Slightly less pool depth, but because pools are by definition deeper areas no significant changes expected. No significant changes expected to preferred substrate.
Brook trout (cold water species)	Not documented in reviewed literature	Not documented in reviewed literature	Clear, cool, well oxygenated streams	Sand/ gravel/rubble	Lower flow in the Fox River could extend cool water influence from Genesee Creek. No significant changes are expected to the preferred substrate. Consequently, no significant changes expected.
Brown trout (cold water species)	Not documented in reviewed literature	Not documented in reviewed literature	Cold, well oxygenated waters	Submerged rocks, undercut banks, overhanging vegetation	Lower flow in the Fox River could extend cool water influence from Genesee Creek. No significant changes are expected to the preferred substrate. Consequently, no significant changes expected.

TABLE 5-28
Return Flow Effects on Habitat Characteristic for Fish Species Identified in the WDNR Online NHI Database as State Threatened, Endangered, and Species of Special Concern in the Vicinity of the Fox River, but not Documented as Present in Recent Fish Surveys

Fish Species[a]	Preferred Current Velocity	Stream Gradient	General Habitat Characteristics	Dominant Substrate Preference	Potential Changes to Habitat with Return Flow
Striped shiner (endangered)	Not documented in reviewed literature.	Not documented in reviewed literature.	Clear to slightly turbid waters of runs and shallow pools, with dense aquatic vegetation.	Cobble, boulders, silt, sand, mud or bedrock	Slightly less pool depth, but because pools are by definition deeper areas no significant changes expected. No significant changes expected to preferred substrate.
Slender madtom (endangered)	Not documented in reviewed literature.	Not documented in reviewed literature.	Prefers clear, moderate to swift currents of streams and wide rivers.	Gravel and boulders interspersed with fine sand	Reduction in current velocity could occur during low periods, but no significant changes are expected. No significant changes expected to preferred substrate.
River redhorse (threatened)	Not documented in reviewed literature.	Not documented in reviewed literature.	Prefers moderate to swift currents in large rivers systems, including impoundments and pools.	River bottoms of clean gravel.	The preferred habitat for this species likely does not exist in the Fox River because it is not a large river.
Pugnose shiner (threatened)	Not documented in reviewed literature	Not documented in reviewed literature	Prefers weedy shoals of glacial lakes and low-gradient streams	Mud, sand, cobble, silt, and clay	Some weedy areas may be exposed under low flow conditions, however no significant changes are expected. No significant changes expected to preferred substrate.
Lake chubsucker (special concern)	Not documented in reviewed literature.	Not documented in reviewed literature.	Prefers moderately clear lakes, oxbow lakes, sloughs of weedy lakes and their associated marshy streams.	Organic debris over bottoms of cobble, sand, boulders, mud or silt.	The preferred habitat for this species likely does not exist in the Fox River because it is not a lake.
Least darter (special concern)	Not documented in reviewed literature	Not documented in reviewed literature	Prefers clear, warm, quiet waters of overflow ponds, pools, lakes and streams.	Gravel, silt, sand, boulders, mud or clay with dense vegetation or filamentous algal beds	Slightly less pool depth, but because pools are by definition deeper areas no significant changes expected. No significant changes expected to preferred substrate.
Weed shiner (special concern)	Not documented in reviewed literature	Not documented in reviewed literature	Prefers sloughs, lakes, and still to sluggish sections of medium streams to large rivers	Sand, mud, clay, silt, detritus, gravel or boulders	Some slough areas may have less water in them under low flow conditions. No significant changes expected. No significant changes expected to preferred substrate.

[a] WDNR. Online Natural Heritage Inventory Database: http://dnr.wi.gov/org/land/er/nhi/CountyElements/

Impacts to flora and fauna are closely associated with baseflow changes. Consequently, the information below is consistent with that found in Section 5.1.2.2 discussing the size, flow, and floodplain of inland waterways.

Underwood Creek and Menomonee River

Lake Michigan Water Supply (Cities of Milwaukee, Oak Creek, and Racine)

No Lake Michigan supply itself would affect Underwood Creek or the Menomonee River.

Underwood Creek to Lake Michigan Return Flow

An analysis of potential Underwood Creek habitat changes from an increase in flow from return flow was documented in Appendix H. The analysis found that the estimated increase in water surface elevation with a return flow of 20 cubic feet per second (ft^3/sec) (12.9 mgd) was 0.78 foot at 2 cross section survey sites (Appendix H). The estimated average velocity at base flow for these locations was 0.85 ft/sec. With a return flow range of 11.6 to 20 ft^3/sec, the estimated velocities increase to 1.11 to 1.32 ft/sec. The flow difference in Underwood Creek with and without return flow in 2005 (a dry year in the recent past) and 2008 (a wet year in the recent past) is shown in graphical and tabular format in Appendix J of the Application.

According to the literature, the slightly higher velocity generally still would be within the preferred velocity range for the dominant fish species in Underwood Creek. Consequently, the slightly higher velocity is not expected to adversely affect the dominant fish species in Underwood Creek. Table 5-29 summarizes the habitat preferences and potential changes to habitat with return flow for the dominant fish species in Underwood Creek.

A search of the Wisconsin Natural Heritage Working List (Wisconsin Department of Natural Resources, 2009) and the WDNR Animals, Plants, and Natural Communities Database identified several threatened, endangered, or species of special concern in Underwood Creek area (Table 5-30). Because of the physical habitat limitation within Underwood Creek noted in Section 5.1.2, it is unlikely any of these species would be present.

Return flow will increase the base flow, which will have positive effects on water availability, amount of habitat, and also the fish species that depend upon Underwood Creek. These anticipated positive effects are summarized in Appendix H and as follows:

- The habitat for fish could be improved with additional flow, especially in the rehabilitated segment of the creek and during periods when with current conditions low base flows limit habitat availability.
- Underwood Creek often experiences extended periods when there is little precipitation and thus no flow in the creek because of ice or dry conditions. At those times, return flow would provide the greatest habitat improvement because periods of no flow could be eliminated, allowing aquatic habitat to always be available instead of having intermittent periods when habitat features provide no function because of lack of water.
- Under base flow and low-flow conditions, return flow would provide additional water depth to improve fish passage through the riffle and concrete parts of the creek, to deepen pools within the restored reach, and to provide more wetted perimeter habitat near the creek banks and overhanging vegetation.

TABLE 5-29
Habitat Characteristic for Dominant Fish Species in Underwood Creek and Menomonee River Near Underwood Creek

Dominant Fish Species	Preferred Current Velocity[a]	Stream Gradient[a]	General Habitat Characteristics[a]	Dominant Substrate Preference[a]	Potential Changes to Habitat with Return Flow
Pearl dace	Not documented in reviewed literature	Not documented in reviewed literature	Pools	Sand, gravel	Improved pool depth, especially during low-flow periods. Additional substrate habitat could become available.
Creek chub	Less than 0.98 ft/sec	3 to 23 meters per kilometer (m/km)	Pools	Sand, gravel	Improved pool depth, especially during low-flow periods. Preferred velocity is out of range, but larger pools should offer more refuge. More substrate habitat could become available.
White sucker	1.31 ft/sec	Wide range	Wide range	Gravel, sand	Improved preferred current velocity. More substrate habitat could become available.
Long nose dace	More than 1.48 ft/sec	1.9 to 18.7 m/km	Riffles	Gravel, rubble	Improved preferred current velocity. More substrate habitat could become available.
Blunt nose minnow	Not documented in reviewed literature	Not documented in reviewed literature	Wide range	Gravel, sand	More substrate habitat could become available.
Black nose dace	0.49 to 1.48 ft/sec	11.4 to 23.3 m/km	Rocky runs and pools	Gravel, sand	Improved pool depth, especially during low-flow periods. Improvement in preferred current velocity. More substrate habitat could become available.
Central stoneroller	Not documented in reviewed literature	Not documented in reviewed literature	Rocky riffles, runs, pools	Gravel, sand, rubble	Improved pool depth, especially during low-flow periods. More substrate habitat could become available.
Common shiner	Not documented in reviewed literature	Not documented in reviewed literature	Rocky pools near riffles	Hard bottom, gravel, sand, rubble	Improved pool depth, especially during low-flow periods. More substrate habitat could become available.
Fathead minnow	Not documented in reviewed literature	Not documented in reviewed literature	Muddy pools	Sand, rubble, gravel	Improved pool depth, especially during low-flow periods. More substrate habitat could become available.
Largemouth bass	More than 0.33 ft/sec	Not documented in reviewed literature	Not documented in reviewed literature	Vegetated areas, sand, gravel, mud	Improved preferred current velocity. More substrate habitat could become available.

TABLE 5-29
Habitat Characteristic for Dominant Fish Species in Underwood Creek and Menomonee River Near Underwood Creek

Dominant Fish Species	Preferred Current Velocity[a]	Stream Gradient[a]	General Habitat Characteristics[a]	Dominant Substrate Preference[a]	Potential Changes to Habitat with Return Flow
Green sunfish	Less than 0.33 ft/sec	0.2 to 5.7 m/km	50 percent pool areas	Vegetated cover	Improved pool depth, especially during low-flow periods. Preferred velocity is out of range, but larger pools should offer more refuge. No change in vegetated cover habitat expected.
Johnny darter	Not documented in reviewed literature	Not documented in reviewed literature	Pools	Sand, mud	Improvement pool depth, especially during low-flow periods. More substrate habitat could become available.
Bluegill	Less than 0.33 ft/sec	≤ 0.5 m/km	60 percent pool areas	Submerged vegetation, logs, brush	Improved pool depth, especially during low-flow periods. Preferred velocity is out of range; however, larger pools should offer more refuge. No change in vegetated cover habitat expected.
Central mud minnow	Not documented in reviewed literature	Not documented in reviewed literature	Quiet areas	Soft mud bottom/ dense vegetation	More substrate habitat could become available.

[a] Main sources of information were Froese and Pauly (2009), Becker (1983), Stuber et al. (1982a and 1982b), McMahon (1982), McMahon and Terrell (1982), Twomey et al. (1984), Trial et al. (1983), Clark (1943), Copes (1978), Hardin and Bovee (1978), Mraz et al. (1961), Page and Burr (1991), Inskip (1982), Hamilton and Nelson (1984).

TABLE 5-30
Summary of Return Flow Effects on Habitat Characteristic for Fish Species Identified in WDNR Online Database as State Threatened, Endangered, and Species of Special Concern near Underwood Creek, but not Documented as Present in Recent Fish Surveys

Fish Species[a]	Preferred Current Velocity	Stream Gradient	General Habitat Characteristics	Dominant Substrate Preference	Potential Changes to Habitat with Return Flow
Striped shiner (endangered)	Not documented in reviewed literature.	Not documented in reviewed literature.	Clear to slightly turbid waters of runs and shallow pools, with dense aquatic vegetation.	Cobble, boulders, silt, sand, mud or bedrock	Preferred habitat for this species is unlikely in this reach of Underwood Creek; therefore no change expected.
Redfin shiner (threatened)	Not documented in reviewed literature.	Not documented in reviewed literature.	Prefers turbid waters of pools in low-gradient streams.	Boulders, cobble, sand, silt or detritus	Preferred habitat for this species is unlikely in this reach of Underwood Creek; therefore no change expected.
Redside dace (special concern)	Not documented in reviewed literature.	Not documented in reviewed literature.	Prefers cool water pools and quiet riffles of small streams (usually adjacent to meadows or pastures).	Cobble, sand, clay silt or bedrock	Preferred habitat for this species is unlikely in this reach of Underwood Creek; therefore no change expected.
Lake chubsucker (special concern)	Not documented in reviewed literature.	Not documented in reviewed literature.	Prefers moderately clear lakes, oxbow lakes, sloughs of weedy lakes and their associated marshy streams.	Organic debris over bottoms of cobble, sand, boulders, mud or silt.	Preferred habitat for this species does not exist in this reach of Underwood Creek; therefore no change expected.
Least darter (special concern	Not documented in reviewed literature.	Not documented in reviewed literature.	Prefers clear, warm, quiet waters of overflow ponds, pools, lakes and streams.	Gravel, silt, sand, boulders, mud or clay with dense vegetation or filamentous algal beds	Preferred habitat for this species is unlikely in this reach of Underwood Creek; therefore no change expected.

[a] WDNR. Online Natural Heritage Inventory Database: http://dnr.wi.gov/org/land/er/nhi/CountyElements/.

- Return flow is expected to slightly increase shear stresses in the creek, which are insignificant to the geomorphic stability of the creek, but could improve the bottom substrate habitat by reducing embeddedness (fine sediment accumulation in coarse substrates) to support coarse sediment habitat, such as gravel.
- An increase in wetted perimeter would provide additional substrate for the production of macroinvertebrates, thus improving the quantity of the food base for fish. Where suitable habitat is available, the macroinvertebrate community in Underwood Creek might change with return flow, but it would change to one that is more sustainable and adapted to the increased flows. The macroinvertebate community with return flow would likely be more diverse since periods of no flow would no longer occur.
- As a result of this analysis, return flow to Underwood Creek is expected to have a positive impact to fisheries in Underwood Creek.

Return flow is not expected to have a significant adverse effect upon natural communities or wetlands adjacent to the waterway downstream of the return flow location. Because floodplain forest and emergent marsh habitats or similar habitats that may exist near return flow locations are immediately adjacent to the ordinary high water mark, mammal, vegetative, and bird species associated with floodplain forest and emergent marsh are well adapted to withstand minor fluctuations in water elevation resulting from typical seasonal conditions, flood events, or drought. Based upon the small water level changes expected to occur with return flow, all of which are within the ordinary high water mark, no significant adverse impacts to emergent marsh, riparian species, or floodplain forests or the species that depend upon these habitats is expected.

Potential For Invasive Species

The City of Waukesha will use practices to reduce the potential of introducing or spreading invasive species and viruses (e.g. VHS) through the use of construction best management practices and ongoing operation practices.

During the construction phase of the water supply and return flow pipelines, best management practices will be used to reduce the potential introduction or spread of invasive species. The recently developed NR 40 *Invasive Species Identification, Classification and Control*, will be consulted and followed where applicable to implement best practices to control the spread of invasive species. Example practices that will be considered include washing equipment and timber mats before entering wetlands/water bodies, removing aquatic vegetation from equipment leaving waterways, steam cleaning and disinfecting equipment used in waterways where invasive species may exist, utilizing non-invasive construction techniques, and others. Post construction restoration methods will only use native species and it will consider methods to encourage existing native species to thrive to reduce the potential of the invasive species establishing a foothold. Using these approaches will reduce the potential for spreading invasive species during construction.

During the operation phase of the water supply and return flow pipelines, a Lake Michigan water supply source would have multiple barriers that would prevent the spread of invasive species through water delivered to the City of Waukesha. Drinking water treatment at any of the three potential Lake Michigan suppliers includes filters and disinfection procedures to remove and inactivate viruses. This level of treatment will not allow transfer of invasive species through the water distribution system. Once the water is distributed in pipelines, an on-going disinfectant residual will be maintained, as required, to prevent microbial growth within the pipelines.

Once the drinking water is used and is collected in the sanitary sewer collection system, the City of Waukesha WWTP provides treatment before being discharged to the Fox River or as return flow. The WWTP is an advanced facility with settling and biological treatment systems, dual media sand filters, and ultraviolet light disinfection designed to meet WDNR water quality requirements. The treated wastewater is contained within the WWTP before being discharged as return flow. Consequently, there are no opportunities for invasive species or VHS from the Mississippi Basin to be introduced to the Lake Michigan basin from the return flow discharge.

5.1.2.5.3 Environmental Effects Comparison: Inland Waterways Flora and Fauna

Adverse impacts from changes in inland waterways flora and fauna are captured by impacts to aquatic habitat from base flow changes. Base flow changes have been previously documented in the Section 5.1.2.2 documenting baseflow changes. The threatened and endangered species identified regualtory agencies as potentially occurring within the project corridors are summarized in Section 5.1.3 on Wetlands, since most of the potential impacts involve federal- or state-listed species associated with wetlands.

5.1.3 Wetlands

Federally jurisdictional wetlands are classified as "waters of the United States" and are protected under Section 404 of the Clean Water Act (34 USC 1344). The term "waters of the United States" covers both deepwater aquatic habitats and six categories of special aquatic sites (of which wetlands are one category) designated by the EPA in its Section 404(b)(1) guidelines (EPA, 2010b). The USACE and EPA jointly define wetlands as "areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that in normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." Wetlands generally include swamps, marshes, bogs, and similar areas.

Wetland quality is decreased by various disturbances, including agricultural activities, silviculture, residential development, transportation and utility easements, drainage modifications (ditches, dams, drain tiles, stream channelization, etc.), and the invasion of exotic or nuisance plants. These disturbances usually alter the plant species composition or hydrological regime of an area, which in turn alter wetland quality.

For an area to be defined as a jurisdictional wetland, it must, under normal circumstances, possess positive indicators of each of three parameters: hydrophytic vegetation, hydric soils, and wetland hydrology.

- *Hydrophytic vegetation.* The prevalent vegetation must consist of plants adapted to life in hydric soils. These species, because of morphological, physiological, or reproductive adaptations, can and do persist in anaerobic soil conditions.

- *Hydric soils.* Soils in wetlands must be classified as hydric, or they must possess characteristics that are associated with reducing soil conditions. Hydric soils are soils that are "saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions that favor the growth and regeneration of hydrophytic vegetation" (USACE, 1987).

- *Wetland hydrology.* The area must be permanently or periodically inundated or have soils that are saturated to the surface for some time during the growing season.

5.1.3.1 Location, Type, Size

5.1.3.1.1 Affected Environment

Wetlands crossed by the Lake Michigan supply and return flow routes were identified from the 2005 Wetlands Inventory provided by SEWRPC and WDNR (2005) to produce an accurate and comprehensive desktop wetlands inventory.

Table 5-31 lists the wetlands crossed by the Lake Michigan supply and return flow routes. Refer to the maps found in Attachment 3-1 of Section 3 for maps associated with the proposed project. Table 5-32 lists wetlands that would be affected by the pipeline or aboveground structure construction.

5.1.3.1.2 Environmental Effects

Wetland effects caused by the proposed project fall into two categories: impacts from construction, and impacts from groundwater drawdown. Impacts from construction may be temporary construction impacts or operational impacts from new facilities, such as buildings or roads. Groundwater drawdown impacts are operational impacts caused by lowering water tables when aquifers are pumped. Wetland loss from pipeline construction impacts are expected to be temporary in nature, whereas operational impacts will be ongoing permanent impacts. Some changes in wetland type from pipeline corridor maintenance are expected only where the pipeline corridor is not already maintained.

Wetland crossing acreages associated with the project are discussed below and summarized in Table 5-32. A pipeline crossing a forested or scrub/shrub wetland would have a permanent wetland type change across the pipeline maintenance width. Maintenance would include managing woody vegetation. Consequently, pipeline maintenance would cause a shift from forested or scrub/shrub wetland to emergent marsh or wet meadow wetland type. Additional analysis on the significance of wetland acreages affected by the proposed project compared to other land use types can be found in Section 5.2.1.2, "Land Use."

Before the City of Waukesha obtains a construction permit for the proposed project, the City will coordinate with the WDNR pursuant to the requirement of NR 103 to seek ways to reduce wetland impacts, whether temporary construction or long-term operational impacts. Such an analysis will look for ways to further reduce impacts, including adjustments to pipeline routes or construction methods to further minimize impacts.

Effects of Groundwater Drawdown on Wetlands

Groundwater drawdown impacts to wetlands are not associated with the proposed project. However, drawdown impacts to wetlands from groundwater water supply pumping are associated with alternatives to the proposed project as detailed in Section 6.

Impacts by Water Supply and Return Flow

The impacts to wetlands from a Lake Michigan water supply and return flow are described below.

TABLE 5-31
Wetland Crossings

Proposed Project	Wetland No.	Wetland Type	Crossing Width (ft)	Crossing Area (acres)
Lake Michigan Water Supply				
Lake Michigan (City of Milwaukee)	4965	Scrub/shrub	216.7	0.38
	7962	Emergent/wet meadow	—	0.37
	8145	Scrub/shrub	—	0.16
	8239	Scrub/shrub	—	0.13
	8290	Scrub/shrub	—	0.49
	8465	Forested	—	0.12
	8723	Emergent/wet meadow	—	0.08
	8909	Scrub/shrub	—	0.30
	8911	Scrub/shrub	—	0.17
	8915	Scrub/shrub	—	0.001
	8920	Scrub/shrub	—	0.11
	8921	Scrub/shrub	—	0.14
	8923	Scrub/shrub	—	0.07
	9184	Forested	—	0.01
	9306	Open water	—	0.01
	10454	Emergent/wet meadow	—	0.02
	11047	Emergent/wet meadow	313.4	0.50
	11672	Scrub/shrub	—	0.02
	11796	Forested	637.4	1.08
	11799	Forested	1,286.9	2.53
	11973	Forested	—	0.002
	12645	Forested	—	0.02
	12650	Forested	—	0.15
	12660	Forested	—	0.01
Lake Michigan (City of Oak Creek)	4965	Scrub/shrub	—	0.38
	7962	Emergent/wet meadow	—	0.37
	8145	Scrub/shrub	—	0.16
	8239	Scrub/shrub	—	0.13
	8290	Scrub/shrub	—	0.49
	8465	Forested	—	0.12
	8723	Emergent/wet meadow	—	0.08
	8909	Scrub/shrub	—	0.30
	8911	Scrub/shrub	—	0.17
	8915	Scrub/shrub	—	0.001

TABLE 5-31
Wetland Crossings

Proposed Project	Wetland No.	Wetland Type	Crossing Width (ft)	Crossing Area (acres)
	8920	Scrub/shrub	—	0.11
	8921	Scrub/shrub	—	0.14
	8923	Scrub/shrub	—	0.07
	9184	Forested	—	0.01
	9306	Open water	—	0.01
	10454	Emergent/wet meadow	—	0.02
	10748	Emergent/wet meadow	—	0.03
	10753	Emergent/wet meadow	—	0.52
	10810	Emergent/wet meadow	—	0.17
	10822	Emergent/wet meadow	—	0.13
	10931	Emergent/wet meadow	—	0.72
	11026	Emergent/wet meadow	—	0.04
	11030	Emergent/wet meadow	—	0.07
	11031	Emergent/wet meadow	—	0.28
	11047	Emergent/wet meadow	—	0.50
	11273	Scrub/shrub	—	0.01
	11346	Scrub/shrub	—	0.09
	11363	Scrub/shrub	—	0.10
	11381	Scrub/shrub	—	0.04
	11433	Scrub/shrub	—	0.15
	11437	Scrub/shrub	—	0.001
	11548	Scrub/shrub	—	0.19
	11564	Scrub/shrub	—	1.82
	11586	Scrub/shrub	—	0.02
	11638	Scrub/shrub	—	0.01
	11672	Scrub/shrub	—	0.02
	11772	Forested	—	0.40
	11796	Forested	—	0.01
	11799	Forested	—	2.49
	11970	Forested	—	0.16
	11972	Forested	—	1.14
	11973	Forested	—	0.002
	12265	Forested	—	0.09
	12285	Forested	—	0.04
	12294	Forested	—	0.47

TABLE 5-31
Wetland Crossings

Proposed Project	Wetland No.	Wetland Type	Crossing Width (ft)	Crossing Area (acres)
	12299	Forested	—	0.26
	12384	Forested	—	0.43
	12505	Forested	—	0.09
	12645	Forested	—	0.02
	12650	Forested	—	0.15
	12660	Forested	—	0.01
	13168	Open water	—	0.03
	13185	Open water	—	0.02
Lake Michigan (City of Racine)	3	Emergent/wet meadow	—	0.61
	4965	Scrub/shrub	—	0.38
	7512	Scrub/shrub	—	0.02
	7895	Open water	—	0.39
	7962	Emergent/wet meadow	—	0.37
	8050	Emergent/wet meadow	—	1.94
	8126	Scrub/shrub	—	0.51
	8139	Scrub/shrub	—	0.09
	8145	Scrub/shrub	—	0.16
	8168	Scrub/shrub	—	0.43
	8183	Scrub/shrub	—	0.96
	8188	Scrub/shrub	—	0.54
	8192	Scrub/shrub	—	0.70
	8239	Scrub/shrub	—	0.13
	8290	Scrub/shrub	—	0.49
	8338	Forested	—	1.14
	8382	Forested	—	0.03
	8383	Forested	—	0.05
	8436	Forested	—	0.20
	8465	Forested	—	0.12
	8625	Filled/drained wetland	—	0.17
	8632	Filled/drained wetland	—	0.37
	8766	Emergent/wet meadow	—	3.23
	8872	Scrub/shrub	—	3.46
	8873	Scrub/shrub	—	2.72
	8901	Scrub/shrub	—	0.47
	9139	Forested	—	0.06

TABLE 5-31
Wetland Crossings

Proposed Project	Wetland No.	Wetland Type	Crossing Width (ft)	Crossing Area (acres)
	9184	Forested	—	0.01
	9309	Scrub/shrub	—	2.25
	9336	Emergent/wet meadow	—	0.22
	9337	Emergent/wet meadow	—	0.36
	9345	Emergent/wet meadow	—	0.40
	9353	Emergent/wet meadow	—	0.81
	9358	Emergent/wet meadow	—	0.001
	9366	Emergent/wet meadow	—	0.43
	9378	Emergent/wet meadow	—	1.85
	9381	Emergent/wet meadow	—	0.12
	9382	Emergent/wet meadow	—	0.10
	9395	Emergent/wet meadow	—	0.26
	9396	Emergent/wet meadow	—	0.55
	9406	Emergent/wet meadow	—	0.45
	9408	Emergent/wet meadow	—	0.15
	9423	Flats/unvegetated wet soil	—	0.21
	9432	Flats/unvegetated wet soil	—	0.61
	9434	Flats/unvegetated wet soil	—	0.44
	9450	Flats/unvegetated wet soil	—	1.84
	9451	Flats/unvegetated wet soil	—	0.63
	9457	Scrub/shrub	—	1.26
	9459	Scrub/shrub	—	0.54
	9461	Scrub/shrub	—	0.42
	9464	Scrub/shrub	—	1.22
	9477	Scrub/shrub	—	0.75
	9503	Forested	—	0.51
	9531	Forested	—	0.03
	9552	Open water	—	0.20
	9556	Open water	—	0.50
	9559	Open water	—	0.22
	9561	Open water	—	0.05
	9592	Emergent/wet meadow	—	0.46
	9597	Emergent/wet meadow	—	0.26
	10058	Emergent/wet meadow	—	0.72
	10090	Emergent/wet meadow	—	0.26

TABLE 5-31
Wetland Crossings

Proposed Project	Wetland No.	Wetland Type	Crossing Width (ft)	Crossing Area (acres)
	10164	Scrub/shrub	—	0.02
	10195	Forested	—	1.31
	13701	Filled/drained wetland	—	0.05
	13719	Filled/drained wetland	—	0.07
	14241	Emergent/wet meadow	—	0.02
	14301	Emergent/wet meadow	—	0.23
	14655	Flats/unvegetated wet soil	—	0.12
	15492	Emergent/wet meadow	—	0.21
	15519	Emergent/wet meadow	—	0.32
	15593	Emergent/wet meadow	—	0.12
	15606	Emergent/wet meadow	—	0.26
	15748	Emergent/wet meadow	—	0.36
	15821	Emergent/wet meadow	—	0.73
	16339	Flats/unvegetated wet soil	—	0.05
	16468	Flats/unvegetated wet soil	—	0.66
	16601	Scrub/shrub	—	2.03
	16870	Scrub/shrub	—	0.68
	16945	Scrub/shrub	—	0.86
	16956	Scrub/shrub	—	0.001
	16957	Scrub/shrub	—	0.26
	16973	Scrub/shrub	—	0.14
	17124	Scrub/shrub	—	0.72
	17253	Scrub/shrub	—	0.18
	17860	Forested	—	0.85
	18252	Forested	—	0.30
	18661	Forested	—	0.02
	18669	Forested	—	0.75
	18679	Forested	—	1.47
	20167	Open water	—	0.26
Return Flow for Lake Michigan Water Supply				
Underwood Creek to Lake Michigan	6807	Emergent/wet meadow	187.0	0.30
	6934	Forested	20.0	0.04
	6937	Forested	1,380.9	2.52
	7003	Forested	—	0.05

TABLE 5-31
Wetland Crossings

Proposed Project	Wetland No.	Wetland Type	Crossing Width (ft)	Crossing Area (acres)
	7962	Emergent/wet meadow	—	1.38
	7970	Emergent/wet meadow	—	0.00
	8015	Emergent/wet meadow	—	0.17
	8125	Scrub/shrub	—	0.75
	8145	Scrub/shrub	—	0.16
	8239	Scrub/shrub	—	0.13
	8290	Scrub/shrub	—	0.49
	8463	Forested	—	0.11
	8723	Emergent/wet meadow	—	0.08
	8909	Scrub/shrub	—	0.30
	8911	Scrub/shrub	—	0.17
	8915	Scrub/shrub	—	0.00
	8920	Scrub/shrub	—	0.11
	8921	Scrub/shrub	—	0.14
	8923	Scrub/shrub	—	0.07
	9184	Forested	—	0.01
	9306	Open water	—	0.01
	12683	Forested	1,454.2	2.38

Lake Mchigan Water Supply (City of MIlwaukee)

Four PEM, 11 PSS, and 11 PFO wetlands are located along this route and affected by the pipeline construction. As shown in Table 5-32, this supply route may temporarily affect 8 acres of wetlands; additionally 1 acre of permanent impact in the form of a wetland type change is anticipated.

Lake Mchigan Water Supply (City of Oak Creek)

Twelve PEM, 21 PSS, 20 PFO, and 3 open-water wetlands along this route could be affected by pipeline construction. As shown in Table 5-32, the supply route could affect 13 acres of wetlands additionally 1 acre of permanent impact in the form of a wetland type change is anticipated.

Lake Mchigan Water Supply (City of Racine)

Twenty-nine PEM, 29 PSS, 16 PFO, 4 filled/drained, 8 flat/unvegetated soil, and 6 open-water wetlands along this route could be affected by pipeline construction. As shown in Table 5-32, the supply route could affect 52 acres of wetlands, additionally 6 acres of permanent impacts in the form of a wetland type change are anticipated.

Underwood Creek to Lake Mchigan Return Flow

Five PEM, 10 PSS, and 6 PFO wetlands along this route could be affected by pipeline construction. As shown in Table 5-32, the return flow route could affect 9 acres of wetlands, additionally 1 acre of permanent impact in the form of a wetland type change is anticipated.

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oject (Acres)

	Wetlands									
	Emergent/Wet Meadow		Scrub/Shrub		Forested		Open Water		Other[3]	
	Temporary Land Affected[1] (ac)	Permanent Land Affected[2] (ac)	Temporary Land Affected[1] (ac)	Permanent Land Affected[2] (ac)	Temporary Land Affected[1] (ac)	Permanent Land Affected[2] (ac)	Temporary Land Affected[1] (ac)	Permanent Land Affected[2] (ac)	Temporary Land Affected[1] (ac)	Permanent Land Affected[2] (ac)
	1	0	2	<1	4	1	<1	0	0	0
	3	0	4	1	6	1	<1	0	0	0
	16	0	22	4	7	1	2	0	6	0
ter										
n[4]	2	0	2	0	5	1	<1	0	0	0

ily impacted by the construction of the supply and return flow routes. Total values are slightly different due to rounding.

permanently for groundwater drawdowns and the operation, which includes new access roads, new aboveground structures, and pipeline maintenance corridors. Total values are slightly different due t

nd flats/unvegetated wet soil areas.

s follow previously disturbed areas and maintained utility corridors. Forested wetlands are generally not present in maintained utility corridors. Potential permanent wetland impacts are consequently co
mental Report are consequently estimated to be less than 5 acres, minor adverse impact.

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Avoidance and Minimization

The construction areas for supply and return flow pipelines are co-located with existing infrastructure to the greatest extent feasible to minimize wetland impacts by using previously disturbed land and reducing habitat fragmentation.

Temporary construction impacts in wetlands may include loss of herbaceous and scrub-shrub vegetation, wildlife habitat disruption, soil disturbance associated with grading, trenching, and stump removal, sedimentation and turbidity increases, and hydrological profile changes. Impacts will be minimized by adherence to BMPs developed by coordination among the City and agency stakeholders, and state and local permit requirements.

5.1.3.1.3 Environmental Effects Comparison: Wetlands—Location, Type, and Size

Adverse impacts from changes to wetlands are summarized below. Impacts were compared based upon Table 5-33. Table 5-34 summarizes the impacts to wetlands.

TABLE 5-33
Environmental Impact Category Description: Wetlands

No adverse impact	No temporary or operational impacts to existing wetlands greater than 0.1 acre.
Minor adverse impact	Temporary construction impacts to wetlands. Operational impacts of greater than 0.1 acre but less than 5 acres of existing wetlands.
Moderate adverse impact	Operational impacts of greater than 5 but less than 10 acres of existing wetlands.
Significant adverse impact	Operational impacts of more than 10 acres of existing wetlands.

Lake Michigan Water Supply (Cities of Milwaukee and Oak Creek)

There would be approximately 1 acre of permanent wetland impacts in the form of wetland type changes (i.e. forested to emergent) associated with these routes. This would be a minor adverse impact.

Lake Michigan Water Supply (City of Racine)

There would be approximately 6 acres of permanent wetland impacts in the form of wetland type changes (i.e. forested to emergent) associated with this route. This would be a moderate adverse impact.

TABLE 5-34
Water Supply and Return Flow Alternative Environmental Impact Comparison Summary: Wetlands

Alternative	Wetlands
Water Supply	
Lake Michigan (City of Milwaukee)	Minor adverse impact
Lake Michigan (City of Oak Creek)	Minor adverse impact
Lake Michigan (City of Racine)	Moderate adverse impact
Return Flow Alternatives for Lake Michigan Water Supplies	
Underwood Creek to Lake Michigan	Minor adverse impact

Underwood Creek to Lake Michigan Return Flow

For return flow to Underwood Creek, there would be approximately 1 acre of permanent wetland impacts in the form of wetland type changes. This would be a minor adverse impact.

5.1.3.2 Flora and Fauna

5.1.3.2.1 Affected Environment

The regional landscape around the project originally was a combination of hardwood forest, prairie, savanna, and wetlands. Only parts of the hardwood forests and wetlands remain, because most of the project area has been converted to urban, suburban, and agricultural land. Wet prairies, southern sedge meadows, emergent marshes, calcareous fens, shrub-carr, northern wet forests, and floodplain forests might be found within the project area. Sedge meadows and wet prairies are dominated by grasses and sedges. Fens support grasses, sedges, and a diversity of other herbaceous plants. Emergent marshes occur along the edges of lakes and streams, and consist of emergent and submergent vegetation. Shrub swamps are dominated by various wet shrubs, but they also may occur as a successional stage that follows herbaceous vegetation found in sedge meadows, fens or floodplains. Forested wetlands may be dominated by conifers or hardwoods.[35]

The spatial arrangement of wetlands can provide essential habitat for wildlife. Wetlands form links between aquatic and upland areas, and can be a connection among upland communities. They provide water, food, and shelter for wildlife, and supply unique habitat conditions for many plant species. Wetlands have a higher rate of biological productivity than other types of ecosystems, partly because of the natural functions they provide. This allows them to support abundant plant and animal life and also rare species. Almost half of all federal-listed threatened and endangered species use wetlands at some point in their life cycles. In Wisconsin, about 32 percent of the state's listed species are wetland dependent.[36]

Many bird and mammal species rely on wetlands, especially during migration and breeding. The large marshes throughout southeastern Wisconsin provide critical feeding, nesting, and resting habitat for numerous waterfowl. Natural, periodic flood flows, usually spurred by spring snowmelt and heavy rains, are important to the health of floodplain forests and wetlands, and to the maintenance of self-sustaining populations of wetland-spawning fish, such as walleye and northern pike. Aquatic life that is dependent upon rivers and floodwaters supports a variety of mammal and avian species. Unfortunately, most wetlands within the area have experienced widespread draining, ditching, grazing, and infestation by invasive plants, such as reed canary grass.

Natural Communities

According to correspondence from the USFWS (2010), no vegetation communities of special concern or critical habitat occur within the construction workspaces associated with the Lake Michigan supply and return flow routes.

WDNR (2010c) identified vegetation communities of special concern (referred to as "natural communities") that may occur within the Lake Michigan supply and return flow corridors. The pipeline alignments follow streets, alleys, bike paths, active and abandoned railroad corridors, utility corridors, city and county lands, and previously disturbed areas, so few impacts to natural communities are expected. Impacts to natural communities will be coordinated with the appropriate state and federal agencies, avoided, and minimized.

Natural communities include Lake Michigan, inland waterways, wetlands, and terrestrial habitats. However, discussion of all natural communities is included under "wetlands" because most of the natural community types are wetland communities.

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35 http://dnr.wi.gov/landscapes/pdfs/Wet.pdf. Accessed December 19, 2011.

36 http://dnr.wi.gov/org/land/er/communities/index.asp?mode=group&Type=Wetland. Accessed December 19, 2011.

The WDNR identified the following natural communities that could exist along the pipeline corridors in response to the Natural Heritage Inventory Environmental Review Request submitted by the Waukesha Water Utility (WDNR, 2010a):

Southern dry mesic forest	Calcareous fen
Southern mesic forest	Shrub-carr
Southern dry forest	Southern tamarack swamp
Mesic prairie	Northern wet forest
Wet prairie	Floodplain forest
Emergent marsh	Springs and spring runs
Southern sedge meadow	Warm-water stream
Oxbow lake	Bird rookery

A habitat assessment was completed in July 2010 (CH2M HILL 2010c, Attachment 6-7) along the pipeline corridors which provided field verification of potential habitat types. The field observations noted specific natural communities at or immediately downstream of discharge locations are limited to floodplain forests, emergent marsh, and warm-water streams. Impacts to natural communities were evaluated using the results of the field work and available spatial data. Descriptions of the communities affected and how they were evaluated include:

Bird Rookery

Bird rookeries require trees in or adjacent to open water or wetlands. Consequently, the relative potential occurrence of bird rookery habitat was compared by determining the total of all wetlands and all woodlands adjacent to bodies of water affected by the alternative. With the absence of a GIS data set specific to bird rookeries, the relative ranking of low, moderate, or high potential suitability was used. There has been no confirmed presence of a bird rookery for any of the alternatives. Attachment 6-5, Exhibit 2 compares potential bird rookery impacts.

Wet Prairie

Wet prairie shares characteristics with emergent aquatic communities. Thus, the relative occurrence of potential wet prairie impacts utilized the WWI emergent marsh GIS data set to evaluate potential wet prairie impacts. With the absence of a GIS data set specific to a wet prairie, the relative ranking of low, moderate, or high potential suitability was used. There has been no confirmed presence of wet prairie for any of the alternatives. Attachment 6-5, Exhibit 2 compares potential wet prairie impacts.

Springs and Spring Runs

The Wisconsin Geological and Natural History Survey (WGNHS) maintains an inventory of springs that was consulted to determine potential impacts to them. None was found within the construction footprint of the Lake Michigan water supply alternatives or the return flow alternatives. An analysis of springs potentially affected by groundwater drawdown had been done previously (see maps in Attachment 6-3 at the end of this Section). Another analysis was conducted to determine the number of WGNHS-documented springs within the project area for all alternatives. With the availability of a specific GIS data set addressing springs, a comparison to the WGNHS data set was conducted. A ranking of low, moderate, or high suitability was developed using the number of springs, instead of the number of acres, affected. Springs and spring runs have been confirmed based upon literature documentation for the groundwater supply alternatives within the groundwater drawdown areas. Attachment 6-5, Exhibit 2 compares potential springs and spring run impacts.

Streams

Stream data are available through GIS data sets. A comparison was conducted using the data, and the relative ranking of low, moderate, or high potential suitability based upon acres impacted was used to evaluate impacts to streams listed as (slow, hard warm) by the WDNR. There has been no confirmed presence of a slow, hard warm stream within any of the alternatives. Attachment 6-5, Exhibit 2 compares potential stream impacts.

Oxbow Lake

No GIS data were available for oxbow lakes. The analysis for the potential of an oxbow lake was conducted by observing the location of bodies of water on aerial maps and through the habitat field survey conducted in 2010. There has been no confirmed presence of an oxbow lake within any of the alternatives. Attachment 6-5, Exhibit 2 compares potential oxbow lake impacts.

Emergent Marsh

Information on the presence and extent of emergent marshes was available through the WWI. The relative comparison of the potential for an alternative to impact emergent marsh habitat was conducted using GIS analysis. With the availability of a specific GIS data set, a numeric comparison of acres was made. Attachment 6-5, Exhibit 3 compares potential emergent marsh impacts.

Shrub-Carr Wetlands

Information on the presence and extent of the shrub-carr natural community is available through the WWI which identifies shrub-carr as "scrub-shrub" wetland. The relative comparison of the potential for an alternative to impact shrub-carr wetlands was conducted using GIS analysis. With the availability of a GIS data set specific to shrub-carr communities, a numeric comparison of acres impacted was made to conduct the relative comparison. Attachment 6-5, Exhibit 3 compares potential shrub-carr impacts.

Forested Floodplain

Information on the potential location of the forested floodplain natural community was analyzed using available GIS data sets for SEWRPC woodlands, WWI forested wetlands, and Federal Emergency Management Agency (FEMA) floodplains. All areas of woodlands and forested wetlands located within the mapped 100-year floodplain were assumed to represent forested floodplain. The calculated numeric acreages were used as the basis determining whether an alternative could affect a forested floodplain. Attachment 6-5, Exhibit 3 compares potential forested floodplain impacts.

Mesic Prairie

A mesic prairie is an open grassland habitat. Because a mesic prairie GIS data set was unavailable, information on the potential location of the mesic prairie natural community was analyzed using available GIS data sets for the SEWRPC open lands and observations made during the summer 2010 habitat assessment. The presence of open lands does not necessarily mean mesic prairie would exist but using the SEWRPC open lands data set provides insight into the potential existence for this habitat type. With the absence of a GIS data set specific to the mesic prairie, the relative ranking of low, moderate, or high potential suitability based on open lands acreage and field observations was used. There has been no confirmed presence of a mesic prairie for any of the alternatives. Attachment 6-5, Exhibit 2 contains the relative comparison of potential mesic prairie impacts.

Southern Sedge Meadow

A southern sedge meadow is an open wetland community. Because a southern sedge meadow GIS data set was unavailable, information on the potential location of the southern sedge meadow natural community was analyzed using available GIS data sets for WWI emergent marsh. Southern sedge meadow is often found adjacent to emergent marsh; consequently, emergent marsh is a good indicator of the potential presence of southern sedge meadow. With the absence of a GIS data set specific to southern sedge meadow, the relative ranking of low, moderate, or high potential suitability based on emergent marsh acreage was used. There has been no confirmed presence of a southern sedge meadow for any of the alternatives. Attachment 6-5, Exhibit 4 compares potential southern sedge meadow impacts.

Calcareous Fen

Calcareous fens occur in areas receiving carbonate-enriched groundwater. Because a GIS data set for calcareous fen was unavailable, information on the potential location of the calcareous fen natural community was analyzed using available GIS data sets for WWI emergent marsh supplemented with 2010 field observations and communication with the Vernon Marsh Wildlife Area manager, who is aware of known calcareous fen locations in the Vernon Marsh Wildlife Area. Calcareous fens are often found adjacent to emergent marshes; consequently, emergent marsh is a good indicator of potential presence of calcareous fen. With the absence of a GIS data set specific to calcareous fen, the relative ranking of low, moderate, or high potential suitability based on emergent marsh acreage and field observations was used. There has been no confirmed presence of a calcareous fen for any of the alternatives. Attachment 6-5, Exhibit 4 compares potential calcareous fen impacts.

Northern Wet Forest

The potential presence of northern wet forest was analyzed using WWI forested wetlands, because a GIS data set specific to northern wet forest was unavailable. The presence of forested wetlands does not necessarily mean a northern wet forest would exist but using the WWI forested wetlands data set provides insight into the potential existence of this habitat type. With the absence of a community-specific specific GIS data set, the relative ranking of low, moderate, or high potential suitability based on forested wetlands acreage was used. There has been no confirmed presence of a northern wet forest for any of the alternatives. Attachment 6-5, Exhibit 5 compares potential northern wet forest impacts.

Southern Dry Forest

The potential presence of southern dry forest was analyzed using SEWRPC woodlands, because a GIS data set specific to southern dry forest was unavailable. The presence of woodlands does not necessarily mean a southern dry forest would exist but using the SEWRPC woodlands data set provides insight into the potential existence for this habitat type. With the absence of a GIS data set specific to southern dry forest, the relative ranking of low, moderate, or high potential suitability based on woodlands acreage was used. There has been no confirmed presence of a southern dry forest for any of the alternatives. Attachment 6-5, Exhibit 5 compares potential southern dry forest impacts.

Southern Dry Mesic Forest

The potential presence of southern dry mesic forest was analyzed using SEWRPC woodlands, because a GIS data set specific to southern dry mesic forest was unavailable. The presence of woodlands does not necessarily mean a southern dry mesic forest would exist but using the SEWRPC woodlands data set provides insight into the potential existence of this habitat type. With the absence of a GIS data set specific to southern dry mesic forest, the relative ranking of low, moderate, or high potential suitability based on woodlands acreage was used. There has been no confirmed presence of a southern dry mesic forest for any of the alternatives. Attachment 6-5, Exhibit 5 compares potential southern dry mesic forest impacts.

Southern Mesic Forest

The potential presence of southern mesic forest was analyzed using SEWRPC woodlands, because a GIS data set specific to a southern mesic forest was unavailable. The presence of woodlands does not necessarily mean a southern mesic forest would exist but using the SEWRPC woodlands data set provides insight into the potential existence for this habitat type. With the absence of a GIS data set specific to southern mesic forest, relative ranking of low, moderate, or high potential suitability based on woodland acreage was used. There has been no confirmed presence of a southern mesic forest for any of the alternatives. Attachment 6-5, Exhibit 5 compares potential southern mesic forest impacts.

Southern Tamarack Swamp

The potential presence of southern tamarack swamp was analyzed using WWI forested wetlands, because a GIS data set specific to southern tamarack swamp was unavailable. The presence of forested wetlands does not necessarily mean a southern tamarack swamp would be present but using the WWI forested wetlands data set provides insight into the potential existence of this habitat type. With the absence of a community-specific GIS data set, the relative ranking of low, moderate, or high potential suitability based on forested wetland acreage was used. There has been no confirmed presence of a southern tamarack swamp for any of the alternatives. Attachment 6-5, Exhibit 5 contains the relative comparison of potential southern tamarack swamp impacts.

Natural Communities Near Return Flow Discharge Location

At the Underwood Creek discharge location, the stream is contained within a concrete-lined channel designed to restrict the flow of water to adjacent areas and its floodplain. As a result, the only natural community directly affected at the outfall is warm-water stream. Floodplain forest areas are present in the downstream reaches of Underwood Creek and below its confluence with Menomonee River.

Natural communities other than floodplain forest, emergent marsh, and warm-water streams may exist along the various alternatives and near the proposed return flow outfall locations, but because of their topographical location within the southeastern Wisconsin landscape and distance from the discharge location, they are not likely to be affected by minor changes in water elevations and flow. They could, however, be affected by pipeline construction or groundwater drawdown, the impacts of which are described in Attachment 6-5 with a relative comparison summary in Table 5-35.

Endangered and Threatened Species

Endangered and threatened species are described for all habitat types (Lake Michigan, inland waterways, wetlands, and terrestrial habitats) under "Wetlands," because the project would have the greatest environmental impact on the wetland habitat type.

The Endangered Species Act of 1973 (16 U.S. Code (USC) 1531-1543, Public Law 93-205) states that threatened and endangered plant and animal species are of aesthetic, ecological, educational, historic, and scientific value to the U.S., and that those species and their habitats must be protected. The Act protects fish, wildlife, plants, and invertebrates that are federally listed as endangered or threatened.

A federally endangered species is one that is in danger of extinction throughout all or a significant part of its range, with the exception of certain insect pests. A federally threatened species is one that is likely to become endangered in the foreseeable future throughout all or a significant part of its range. Species likely to become endangered or threatened in the foreseeable future may be listed as proposed endangered or threatened, or of special concern. Federal regulatory protection is also afforded to certain rare, natural vegetation communities, or critical habitats.

In Wisconsin, WDNR describes threatened and endangered species as one of three categories. An "endangered" species is one whose continued existence as a viable component of the state's wild animals or wild plants is determined by WDNR to be in jeopardy on the basis of scientific evidence. A "threatened" species is one that appears likely, within the foreseeable future and on the basis of scientific evidence, to become endangered. A "special concern" species is one for which some problem of abundance or distribution is suspected but not yet proved. The main purpose of the last category is to focus attention on certain species before they become endangered or threatened.

Endangered and threatened species are characteristically in jeopardy because of ecosystem disruptions, including destruction, alteration, or curtailment of habitats; overexploitation; and the effects of disease, pollution, and predation. An individual species may be both state and federally listed.

The USFWS and the WDNR were contacted to determine federal- or state-listed species known to occur within the project corridor.

Federal-Listed Species

According to correspondence from the USFWS (2010), no federally listed threatened or endangered species occur near the supply and return flow routes being evaluated. The City plans to consult with the USFWS before construction to verify that no new federal-listed species have been identified within the selected construction workspace.

State-Listed Species

The City initiated consultation with WDNR Office of Energy, which assumes responsibility for the review of endangered resources for utility projects and works closely with the Bureau of Endangered Resources to implement the WDNR's policies and regulations regarding protection of endangered resources. WDNR (2010c) identified several State listed species as potentially occurring near the proposed Lake Michigan supply and return flow.

The City also consulted SEWRPC at the WDNR's request to inquire about threatened or endangered species or species of concern. The information obtained from SEWRPC is available in several reports, by watershed, and is consistent with information on listed species received from the WDNR.

Once a final water supplier has been negotiated and return flow location has been approved, field surveys will be completed along the selected route to confirm the presence or absence of the species listed by the WDNR.

The tables in Attachment 6-6 summarize the listed species associated with the supply and return flow routes. The attachment also documents correspondence with the WDNR and USFWS in regards to threatened and endangered species.

5.1.3.2.2 Environmental Effects

Potential impacts to wildlife, natural community, and endangered resources fall into three categories:

- **Temporary—**Temporary impacts are those that result only from construction. Use of construction techniques that minimize impacts and that restore the construction area is expected to limit temporary impacts to the duration of the construction period (typically less than a year). Areas temporarily disturbed by pipeline construction would be restored to the same or better condition than what had existed initially. Temporary impacts would occur for a Lake Michigan water supply and return flow.

- **Permanent, associated with long-term groundwater drawdown that results in habitat-type changes—**An example of such an impact is groundwater drawdown in an emergent marsh that causes the marsh habitat to decrease in areal extent and at least partially transition to upland habitat.

- **Permanent, associated with new aboveground infrastructure or aboveground pipeline maintenance—**Aboveground infrastructure includes access roads and other aboveground structures. Pipeline corridor maintenance is a long-term impact in areas where routine mowing may result in a permanent habitat type change. Habitat type changes could occur in areas of natural vegetation where active maintenance is not currently performed. The only above ground structure is a quarter acre pump station associated with the Lake Michigan water supply and return flow. Section 5.1.2 discusses potential impact minimization and avoidance measures for the major permanent impacts.

Impacts to Natural Communities

A natural community is an assemblage of different plants and animal species within a specific habitat. Attachment 6-5, Exhibit 1 contains the WDNR's description of each natural community identified by the NHI inventory potentially near the project and therefore potentially affected by the water supply and return flow routes. Exhibit 1 is provided separately because of the sensitive nature of potential habitat locations for threatened and endangered species.

An analysis of the NHI GIS data received from the WDNR, supplemented by the findings from the 2010 field observations, was conducted for each natural community to produce a relative comparison of impacts for the water supply and return flow routes. Impacts were evaluated based on the assumption of a conventional excavation installation technique without considering construction BMPs that could minimize impacts, such as directional drilling for pipelines. The City of Waukesha will work with the WDNR and other resource agencies to minimize natural community impacts with the proposed project. The process for evaluating the natural communities is described below, with the relative comparison for each route presented in Attachment 6-5, Exhibits 2 through 5 summarized below.

Relative Comparison Method

Because natural community-specific data in acres were not directly available in GIS data sets for all natural communities, general habitat information was used to generate a relative comparison of the potential impact. For example, no GIS layer specific for the bird rookery is available, so a relative comparison was conducted using other habitat-type information. Conversely, the estimated acreage impact to the emergent marsh natural community is available from the WWI GIS layer, and so the specific data were used for the analysis. The procedure for evaluating each natural community is described below.

The following suitability rating scale is meant to provide a measure of the potential of a given route to contain the natural communities listed by the WDNR:

- Absent—habitat is not present
- Low potential suitability—Up to 10 acres
- Moderate potential suitability—10 to 20 acres
- High potential suitability—More than 20 acres

Summary of Natural Community Relative Comparisons

Evaluation of Attachment 6-5, Exhibits 2 through 5, indicated that alternatives to the proposed project have the highest overall potential impact to natural communities. Impacts to wetland areas and other natural communities from the Lake Michigan water supply and return flow routes are largely temporary or several orders of magnitude less than those associated with alternatives to the proposed project. Table 5-35 summarizes the relative impact ratings ranked "high," whereby impacts would occur for each water supply and return flow route.

TABLE 5-35
Summary of Natural Community High Suitability Ratings

Proposed Project	High Suitability Ratings (Out of 16 Natural Communities)
Water Supply	
Lake Michigan Supply	
Lake Michigan (City of Milwaukee)	0
Lake Michigan (City of Oak Creek)	1
Lake Michigan (City of Racine)	3
Return Flow for Lake Michigan Water Supply	
Underwood Creek to Lake Michigan	0

The comparison of impacts to natural communities was not carried forward because the analysis was similar that for the wetland and aquatic habitat categories already documented.

The actual impacts to natural communities may vary from those presented here, depending upon the final pipeline route, field verification of natural resources, and efforts to avoid, minimize, and mitigate impacts to natural communities, but the analysis conducted accurately depicts the relative impacts of the pipeline routes. The City of Waukesha will work with the WDNR and resource agencies to avoid, minimize, and mitigate impacts resulting from the project.

Impacts to Endangered and Threatened Species

Based on the consultation response from USFWS (2010), no impacts to federally listed species or critical habitat are expected. USFWS stated that "if there is a lag between plan completion and construction this office should be contacted for updated species and critical habitat information [which is] updated every 6 months." The City will resume consultation with the USFWS before construction to comply with its request and to meet requirements to protect federal-listed species or critical habitat.

The City selected pipeline routes through areas already developed or disturbed to minimize impacts to endangered and threatened species. The City will work with regulatory agencies to identify locations where such species could be affected and take measures to minimize impacts. Most of the project footprint for all alternatives is associated with pipeline construction, and the impacts of construction will be temporary.

Operational impacts are associated with the aboveground structures. The Lake Michigan water supply and return flow routes have insignificant operational surface impacts. Land Use Section 5.2.1.2, Table 5-41, summarizes the temporary construction and operational surface impacts.

The City coordinated with the WDNR to conduct a habitat assessment at locations along alternative infrastructure alignments in the summer of 2010. The information obtained was incorporated into identifying natural communities at locations along the alternative alignments and incorporated qualitatively in the analysis below. The habitat assessment report is included as Attachment 6-7.

Relative Comparison of Endangered Species Impacts

The Lake Michigan water supply and return flow routes were analyzed for the impacts they could have on preferred habitat for threatened, endangered, or species of special concern.

Habitat Comparison

The preferred habitat for threatened species, endangered species, and species of special concern was summarized. SEWRPC land use data were used to document habitat affected. A 15 foot wide permanent pipeline maintenance corridor was assumed to calculate permanent impacts where land was not already developed or within existing utility or transportation right-of-ways.

Temporary impacts for pipelines assumed a larger impact area to compensate for machinery and material staging for installing the pipeline. A 75 foot wide temporary pipeline construction easement was assumed to calculate temporary impacts. After the pipeline is constructed, the construction area will be restored to a condition similar to or better than what existed prior to construction in accordance with recommendations from the WDNR and applicable resource agencies. Permanent impacts for pipelines exist only where long-term pipeline maintenance requires a change in land use. For example, existing transportation and utility corridors are already routinely maintained, so no additional maintenance of those areas would be needed. Long-term impacts from pipeline corridors are associated mainly with forest and scrub-shrub habitat areas, where new tree growth would conflict with maintenance goals.

Attachment 6-5, Exhibit 6, summarizes the temporary and permanent impacts. The tabulated data indicate that the dominant land uses affected by the Lake Michigan water supply and return flow routes are utility corridors, transportation, and agriculture.

Table 5-36 summarizes the permanently affected acres of wetlands and all land uses.

TABLE 5-36
Summary of Permanent Land Impacts to Wetlands and Total Acreage

Proposed Project	Wetland Impacts[a] (acres)	Total Impacts (acres)
Lake Michigan Water Supply		
Lake Michigan (City of Milwaukee)	1	2
Lake Michigan (City of Oak Creek)	1	2
Lake Michigan (City of Racine)	6	6
Return Flow for Lake Michigan Water Supply		
Underwood Creek to Lake Michigan	1	1

[a] Wetland types include emergent/wet meadow, scrub/shrub,. forested, open water, other (filled/drained and flats/unvegetated wet soil areas), and no surface water.

Endangered Resource Inventory

The endangered resources are reviewed together in this wetlands section for all habitat types (wetland, aquatic, and terrestrial) because the species most affected by the proposed project are species with wetland habitat preferences.

Preferred habitat requirements for each of the threatened, endangered, and species of special concern, based upon NHI information, was summarized and correlated with SEWRPC land use types. For example, species listed by NHI as requiring forest habitat were categorized as woodland species according to the SEWRPC land use designations. It should be noted, that depending upon NHI habitat requirements, a particular species may be associated with multiple SEWRPC land use designations. The list of species, their habitat preferences, and the corresponding SEWRPC land use designation assignments are included in Attachment 6-5, Exhibits 7 and 8. Exhibits 7 and 8 are provided separately due to the sensitive nature of the potential habitat locations for threatened and endangered species. Each water supply and return flow route has a separate list of species.

Once each listed species was assigned to a SEWRPC land use, the number of occurrences for each land use type was calculated and used to determine which land use types are more likely to represent habitat for listed species. Attachment 6-5, Exhibit 9 compares rare species habitat occurrences by land use type. Individual wetlands types (emergent marsh, forested wetland, etc.) were used to designate habitat requirements for individual species, but all wetlands types were added together to simplify comparison.

Table 5-37 lists the land uses that scored highest for habitat requirements, the relative occurrence of habitat requirements for the top four habitat types (accounting for more than 90 percent of all listed species), and the total number of NHI species by route.

TABLE 5-37
Relative Occurrence of State- and Federal-Listed Species per Land Use for the Proposed Project
Relative Comparison of Wildlife, Natural Community, and Endangered Resources

Proposed Project	Open Lands	Woodlands	Surface Water	Wetlands[a]	Total Listed Species per Route
Lake Michigan (City of Milwaukee)	10%	14%	14%	57%	36
Lake Michigan (City of Oak Creek)	11%	14%	14%	57%	52
Lake Michigan (City of Racine)	11%	17%	13%	55%	62
Return Flow for Lake Michigan Water Supply					
Underwood Creek to Lake Michigan	12%	15%	14%	52%	38

[a] Includes all wetland types, including, emergent/wet meadow, scrub-shrub, forested, open water, and other. See Exhibit 6, Attachment 6-5.

Sources: SEWRPC Land Use Data and Wisconsin Dept. of Natural Resources, Natural Heritage Inventory Results

Summary of Potential Listed Species Impacts

Attachment 6-5, Exhibit 9 and Table 5-37 show that wetlands habitat is needed for more than half the listed species habitat requirements along the supply and return flow routes. Of all habitats affected by the supply and return flow routes, wetlands have the greatest potential to provide habitat for listed species. A comparison of the amount of wetland habitat acres permanently affected by pipeline route varies from 1 to 6 acres. As such, a Lake Michigan water supply and return flow would be expected to have minor adverse impacts to listed species habitat.

The comparison of impacts to listed species was not carried forward, because the listed species impact analysis is similar to the wetland impacts and aquatic habitat impacts and the listed species predominantly require wetland habitats. Once a final water supplier has been negotiated and return flow location approved, further field surveys will be completed to confirm the presence or absence of the species listed by the WDNR. The City will work closely with the WDNR to avoid, minimize, or mitigate impacts to threatened or endangered species.

Should a threatened or endangered species be positively identified within the construction workspace, the City will:

- Avoid or minimize impacts to the species wherever feasible
- Stage construction to limit disturbance during sensitive time periods
- Conduct temporary removal by an approved scientist following established protocols

5.1.3.2.3 Functional Values

Until the latter half of the 20th century, wetlands often were viewed as wastelands, useful only when drained or filled. Wetlands are now known to provide critical habitat for wildlife, water storage to prevent flooding and improve water quality, and recreational opportunities for wildlife watchers, anglers, hunters, and boaters. These are known as "wetland functional values." Wetlands provide the following different functions:

- Biodiversity of plants for food and shelter for many animal species at critical times during their life cycles
- Creating critical habitat for feeding, breeding, resting, nesting, escape cover, or travel corridors
- Essential habitat for smaller aquatic organisms in the food web, including crustaceans, mollusks, insects, and plankton
- Retention of stormwater to prevent rain and melting snow from rushing toward rivers and lakes, and reducing floodwater from rising streams
- Capacity in plants and soils to store and to filter pollutants, ranging from pesticides to animal wastes
- Protection against erosion by absorbing the force of waves and currents and by anchoring sediments. Roots of wetland plants bind lakeshores and streambanks, providing further protection.
- Wetlands can provide a valuable service of replenishing groundwater supplies.
- Open space in landscapes which are under development pressure, and have rich potential for hunters, anglers, scientists, and students[37]

Affected Environment

The proposed project has impacts upon wetlands. The wetland impacts, summarized in Section 5.1.3, vary from 2 acres for the Lake Michigan–City of Milwaukee water supply with return flow to Underwood Creek, to 7 acres for Lake Michigan – City of Racine water supply with return flow to Underwood Creek.

All water supply and return flow routes follow utility and transportation corridors to minimize disturbance to wetlands. These existing utility and transportation corridors make use of previously disturbed areas that are developed or actively maintained in order to minimize impacts. Some utility corridors have paved or gravel access roads; unpaved corridors generally are maintained by removing woody vegetation and mowing. Most impacts to wetland functional values will be temporary.

Environmental Effects

Wetland impacts will be temporary during construction of pipelines. Impacts will be avoided or mitigated by constructing pipeline within previously disturbed areas and employing post-construction restoration techniques. During construction, only the trench line will be excavated, taking care to segregate topsoil from subsoil to the extent possible.

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[37] (Wetland Functional Values, WDNR, http://dnr.wi.gov/wetlands/function.html, Accessed January 20, 2012)

When crossing wetlands, construction techniques will be agreed upon with regulators to minimize impacts. Potential approaches could include building a temporary travel lane using timber mats or other similar materials, unless equipment can be supported without rutting that causes soil mixing. Subsoil and topsoil will be replaced to cover the installed pipeline in the correct order. Seed-free mulch or erosion control matting will be applied with appropriate seeding to meet restoration goals and to minimize the duration of temporary impacts.

5.1.4 Groundwater

The impact of groundwater withdrawals on surface water is a concern in Wisconsin, and human-induced and natural groundwater shortages occur. Regional aquifers and groundwater resources were identified for the areas underlying the supply and return flow routes. Aquifer data from published reports are provided by county. Groundwater quality data are provided by region and should be considered summary data.

The USEPA designates sole-source aquifers as part of its Wellhead Protection Program. There are no designated sole-source aquifers in the State of Wisconsin (EPA, 2010a).

5.1.4.1 Aquifers and Water Use

5.1.4.1.1 Affected Environment

The major aquifers in Waukesha and Milwaukee counties are the Quaternary and Late Tertiary unconsolidated sand and gravel aquifer, and Cambrian-Ordovician sandstone aquifer. Historical use of the aquifers is summarized below and discussed further in the Water Supply Service Area Plan, Appendix B of the Application.

Shallow Aquifer

The unconsolidated sand-and-gravel aquifer consists of layers and lenses of sand and gravel interspersed with fine-grained or other low-permeability deposits. Well yields vary and are dependent on the permeability and thickness of the sand and gravel at any give location. Recharge occurs through infiltration through surface soils and directly into the aquifer. The shallow aquifer is known locally as the Troy Bedrock Valley Aquifer. The formation contains up to 500 feet of glacial deposits in its deepest parts.[38] It is a source of water supply for the Villages of Mukwonago and East Troy, and the Cities of Waukesha and Muskego. The aquifer is hydraulically connected to sensitive environmental resources, including the Vernon Wildlife AreaWA, Pebble Brook (a Class II trout stream), and Pebble Creek. The City currently obtains 13 percent of their annual water supply from this aquifer. The Water Supply Service Area Plan, (Appendix B of the Application) provides additional detail on the use of the shallow aquifer for water supply in the City of Waukesha.

Deep Aquifer

The sandstone aquifer consists of alternating sequences of Cambrian- and Ordovician-age sandstone and dolomite, along with some shale. The sandstone aquifer underlies a low permeability layer called the Maquoketa shale. Due to the thickness of the sandstone aquifer, large water quantities can be produced from wells within the aquifer. The City's deep aquifer wells are constructed to depths greater than 2,100 feet and withdraw water

[38] SEWRPC. January 2010. Southeastern Wisconsin Regional Planning Commission Report No. 188.

from 800 to 1,000 feet below ground. Since the nineteenth century,[39] the deep aquifer has been drawn down 500 to 600 feet, with continued drawdown in recent years of 5 to 9 feet per year.[40]

Near Waukesha, recharge of this aquifer occurs further west where the Maquoketa shale does not exist. Figures 5-2 through 5-4 illustrate the constraints limiting recharge of the deep aquifer near the City of Waukesha.

The Precambrian aquifer is present throughout Wisconsin. The Precambrian crystalline bedrock aquifer consists of all rocks of Precambrian age that underlie Wisconsin, primarily granitic and metamorphic rocks. The crystalline bedrock aquifer directly underlies the sandstone aquifer (Deep Aquifer). Groundwater comes from fractures that exist in the crystalline rocks and yield small quantities of water (USGS, 2000, 2010; WDNR, 2010a).

Springs

Springs are known to exist in Waukesha County. The Wisconsin Geological and Natural History Survey maintains an inventory of springs (WGNHS, 2010). Wisconsin regulates groundwater pumping that may affect large springs under Act 310. Act 310 requires an environmental review of wells that may have a significant impact on springs that have a flow of at least 1 cubic feet per second at least 80 percent of the time. Potential impacts to springs were evaluated under Natural Communities in Section 5.1.3.2.

[39] SEWRPC. 2008. Draft Planning Report on Regional Water Supply Plan for Southeastern Wisconsin. pp. 102–103.

[40] Waukesha Water Utility operating data.

FIGURE 5-2
Flow of Groundwater in the St. Peter Sandstone Deep Aquifer

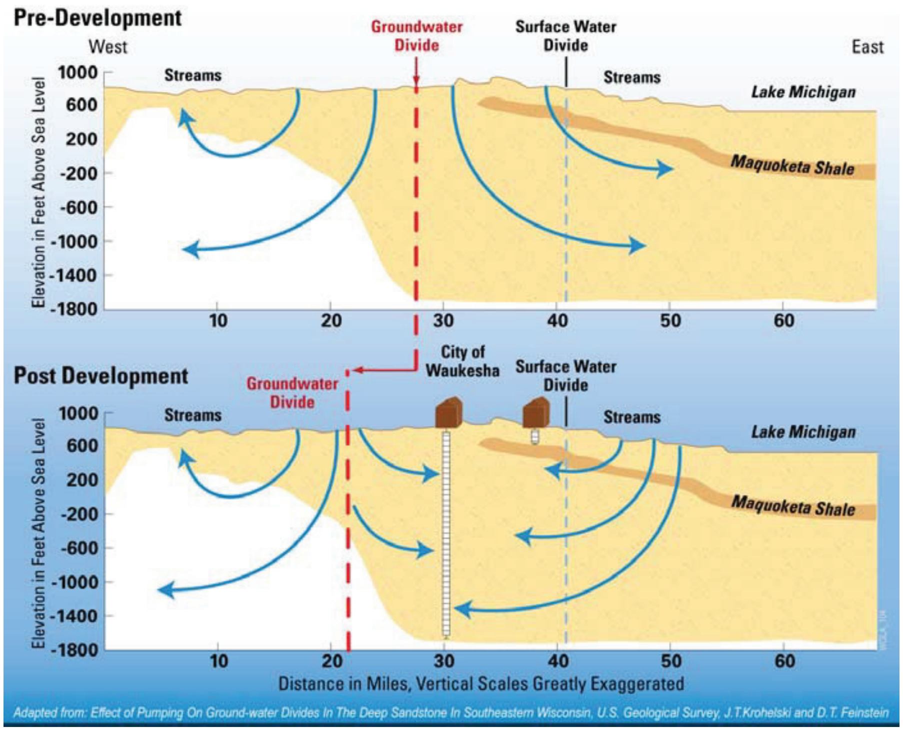
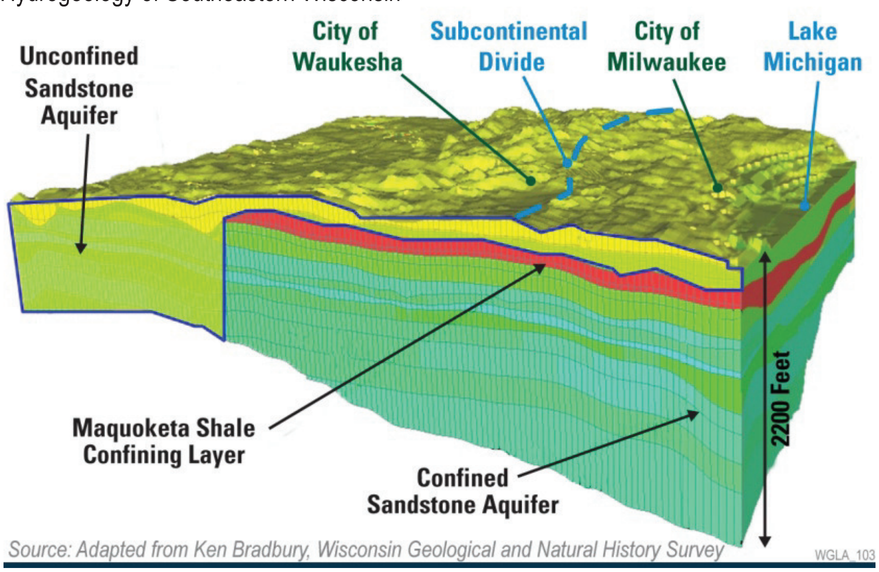


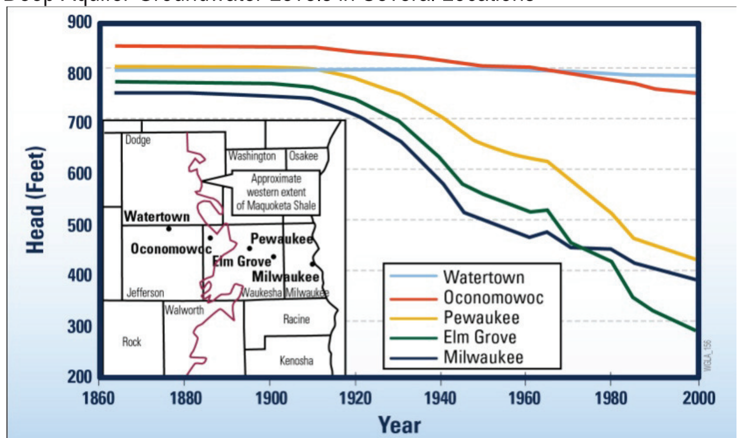
FIGURE 5-3
Hydrogeology of Southeastern Wisconsin



5.1.4.1.2 Environmental Effects

Potential impacts to the aquifers present near the supply and return flow routes being considered can be divided in to two categories: temporary construction-related impacts and long-term operational impacts.

FIGURE 5-4
Deep Aquifer Groundwater Levels in Several Locations



Water levels in the deep sandstone aquifer at selected locations. Curves represent simulated hydraulic heads (in feet above sea level) near the top of the deep aquifer (St. Peter Formation).
Source: SEWRPC Regional Water Supply Study

Temporary construction impacts to shallow aquifers resulting from construction and placement of a 36-inch water main to the City generally less than 10 feet deep are not expected to be significant. Temporary impacts may include short-duration trench-dewatering efforts. It is anticipated that the shallow aquifers would return to preconstruction conditions following construction.

Long-term impacts related to the operation of a Lake Michigan supply and return flow will cause natural replenishment of the deep aquifer system since the deep aquifer will no longer be used by Waukesha as a water supply source.

Shallow Aquifer

Lake Mchigan Water Supply (City of MIwaukee)

Withdrawal from Lake Michigan would not involve groundwater withdrawals, except for the emergency purposes described in the Water Supply Service Area Plan. As a result, no adverse impacts to aquifers would occur. Withdrawal from Lake Michigan with return flow would have an insignificant change in lake water levels because of the volume of water present, and thus is not expected to result in adverse affects to regional aquifer supplies influenced by Lake Michigan.

Lake Mchigan Water Supply (City of Oak Creek)

The Lake Michigan–Oak Creek Supply will have the same effects on groundwater resources as the Milwaukee Supply.

Lake Mchigan Water Supply (City of Racine)

The Lake Michigan–Racine Supply will have the same effects on groundwater resources as the Milwaukee Supply.

Underwood Creek to Lake Mchigan Return Flow

The impacts of the Underwood Creek return flow on groundwater are expected to be insignificant. Because of the small change in Lake Michigan tributary water depth from return flow, significant adverse affects are not expected to regional aquifer supplies that are influenced by a Lake Michigan tributary.

Deep Aquifer

Lake Mchigan Water Supply (Cities of MIwaukee, Oak Creek, Racine)

A water supply from Lake Michigan would involve discontinuing use of the deep aquifer except for emergency conditions when the Lake Michigan supply was temporarily unavailable. Thus, no adverse impacts to groundwater aquifers would occur. No longer using the deep aquifer would have the benefit of a partial rebound of the deep aquifer groundwater level.

Underwood Creek to Lake Mchigan Return Flow

Groundwater impacts from Underwood Creek to Lake Michigan return flow are expected to be insignificant. Because of the small change in a Lake Michigan tributary water depth from return flow, no adverse effects to regional deep aquifer supplies are expected.

Springs

Lake Mchigan Water Supply (Cities of MIwaukee, Oak Creek, Racine)

A water supply from Lake Michigan would not affect springs. As a result, no adverse impacts to springs would occur. Springs are absent from the Lake Michigan pipeline routes based upon the WGNHS spring inventory.

Underwood Creek to Lake Mchigan Return Flow

The Underwood Creek to Lake Michigan return flow impacts to springs are expected to be insignificant. Springs were absent from the pipeline corridor based upon the WGNHS spring inventory.

5.1.4.1.3 Environmental Effects Comparison: Groundwater—Aquifers and Water Use

Adverse impacts from changes to groundwater are summarized below. Impacts were compared based upon Table 5-38. Table 5-39 summarizes the impacts to groundwater.

TABLE 5-38
Environmental Impact Category Description: Groundwater Resources

No adverse impact	Causes rebound of the deep aquifer in City of Waukesha and no drawdown of the shallow aquifer or temporary impacts from construction. Does not reduce stream at any time.
Minor adverse impact	Stabilizes draw down of the deep aquifer in City of Waukesha and shallow aquifer draw down of 5 feet or less affects fewer than 5 acres of wetlands. Reduced baseflow in warm water streams of up to 25% causing habitat loss.
Moderate adverse impact	Drawdown of the deep aquifer continues, and shallow aquifer drawdown of 5 feet or more affects greater than 5 but less than 10 acres of wetlands. Reduced baseflow in warm water streams of greater than 25% but less than 50%, causing habitat loss. Reduced baseflow to cold water streams, but less than 25%.
Significant adverse impact	Drawdown of the deep aquifer continues or shallow aquifer drawdown of 5 feet or more affects greater than 10 acres of wetlands. Reduced baseflow in cold water streams of 25% or more or reduced baseflow in warm water streams of 50% or more.

TABLE 5-39

Proposed Project Environmental Impact Comparison Summary: Groundwater Resources

Proposed Project	Groundwater Resources
Water Supply	
Lake Michigan (City of Milwaukee)	No adverse impact
Lake Michigan (City of Oak Creek)	No adverse impact
Lake Michigan (City of Racine)	No adverse impact
Return Flow for Lake Michigan Water Supply	
Underwood Creek to Lake Michigan	No adverse impact

Lake Mchigan Water Supply (Cities of MIlwaukee, Oak Creek, and Racine) The Lake Michigan water supply would eliminate the need for pumping the deep aquifer, which would cause a partial rebound in the deep aquifer in the City of Waukesha. Due to the volume of water present, withdrawal from Lake Michigan with return flow would result in no changes in lake volume, and therefore it is not anticipated that withdrawal from the lake would result in adverse effects to regional aquifer supplies influenced by Lake Michigan. Lake

Michigan water supply consequently produces no adverse impact on groundwater resources.

Underwood Creek to Lake Mchigan Return Flow Because of the small change in the Lake Michigan tributary water depth with return flow, no significant adverse impacts to regional aquifer supplies that are influenced by a Lake Michigan tributary are expected. Return flow to Underwood Creek consequently would have no adverse impact on groundwater resources.

5.1.4.2 Groundwater Quality

5.1.4.2.1 Affected Environment

Aquifer Water Quality

Shallow Aquifer.

The unconsolidated sand-and-gravel aquifer consists of layers and lenses of sand and gravel interspersed with other fine-grained or low-permeability deposits. Well yields vary and are dependent on the permeability and thickness of the sand and gravel at a particular location. Recharge occurs through infiltration through surface soils and directly into the aquifer.

Groundwater from the shallow aquifer may contain iron, manganese, and arsenic.

Deep Aquifer

The sandstone aquifer consists of alternating sequences of Cambrian- and Ordovician-age sandstone and dolomite, along with some shale. The sandstone aquifer underlies a low permeability layer called the Maquoketa shale. Due to the thickness of the sandstone aquifer, large water quantities can be produced from wells within the aquifer.

The City of Waukesha's groundwater supply has radium levels up to three times the USEPA's drinking water maximum contaminant level (MCL) of 5 picocuries per liter (piC/L). The naturally occurring radioactive isotopes radium-226 and radium-228 are present in the aquifer because of parent elements in the sandstone. The radioactive isotopes are known to be carcinogenic[41]. The concentration of radium in the City's groundwater supply is as high as 15 piC/L, among the highest in the country for a potable water supply.

City of Waukesha deep wells have observed high total dissolved solids (TDS). One well had TDS concentrations greater than 1,000 mg/L and was rehabilitated by blocking part of the well hole to reduce TDS, but in doing so well capacity was reduced more than 35 percent. Well capacity is also expected to decrease from the deep wells because the groundwater elevation continues to drop. Currently it is now more than 600 feet below predevelopment levels. The declining water level causes water quality problems in the form of increased TDS, radium, and gross alpha levels. As a result, treatment would be installed at the three largest deep wells (No. 6, 8, 10) to reduce TDS, as described in the Water Supply Service Area Plan.

Existing Contamination Sites

Areas in Wisconsin where groundwater is most susceptible to contamination are those where most of the groundwater is stored in shallow aquifers (Schmidt, 1987). The WDNR Bureau of Remediation and Redevelopment oversees the Remediation and Redevelopment (RR) Program and has a Web-based mapping system—RR Sites Map[42]—that contains information about contaminated properties and other activities related to the investigation and cleanup of contaminated soil or groundwater in Wisconsin. The RR Sites Map GIS registry layers contain groundwater contamination sites and groundwater and soil contamination sites. The GIS registry (WDNR, 2010b) yielded the following information about contaminated sites along the various pipeline routes:

- Lake Michigan–Milwaukee Supply—one open groundwater-contamination site and four closed groundwater- and soil-contamination sites
- Lake Michigan–Oak Creek Supply—three closed groundwater and soil contamination sites
- Lake Michigan–Racine Supply—one closed groundwater and soil contamination site
- Underwood Creek to Lake Michigan return flow—one closed groundwater-contamination site and four closed groundwater- and soil-contamination sites

According to the WDNR's online tracking system, which is part of the WDNR Contaminated Lands Environmental Action Network (CLEAN), Milwaukee County has approximately 5,070 environmental repair (ERP) and leaky underground storage tank (LUST) sites, Racine County has approximately 792 ERP and LUST sites, and Waukesha County has approximately 1,616 ERP and LUST sites (WDNR, 2010c).

5.1.4.2.2 Environmental Effects

Environmental effects on groundwater quality could occur either from the construction process or from operation and maintenance.

Potential groundwater impacts from spills of heavy equipment fuel, lubrication oil, or hydraulic oil as a result of construction will be minimized by implementing BMPs for

41 http://dnr.wi.gov/org/water/dwg/radium.htm accessed Feb 4, 2012.

42 http://www.dnr.state.wi.us/org/aw/rr/gis/.

storing such materials, refueling equipment, developing and implementing a spill prevention plan, and cleaning up lost materials that may present a danger to the aquifer. Preventive measures will be implemented to avoid such spills, including compliance with refueling zone practices. While BMPs will be used to prevent spills from occurring, if a spill were to occur, the material will be cleaned up to meet WDNR requirements. The volumes of petroleum-based fluids used during construction are likely to be minor, and so construction is not expected to represent a significant impact to regional aquifers. Prior to construction, the City will work with the applicable resource and municipal agency stakeholders to identify any high-risk areas for petroleum spills and coordinate the development of appropriate BMPs to protect important resources.

Aquifer Water Quality

Because the deep aquifer has had increasing TDS and gross alpha concentrations, continued pumping of the deep aquifer would continue to cause water quality to decline. A Lake Michigan water supply and return flow would lead to a partial recovery of the deep aquifer water level, which in turn could lead to better water quality.

Existing Contamination Sites

Because of the significant number of ERP and LUST sites along the pipeline routes, contaminated groundwater could be encountered during construction and operation. For final design, the City will work with WDNR to manage the crossing of contaminated-groundwater areas. If groundwater contamination is encountered, the City will work with the appropriate agencies to handle it appropriately.

5.1.4.2.3 Environmental Effects Comparison: Groundwater Quality

Operational impacts upon groundwater quality are associated with whether the deep aquifer continues to be used as a groundwater supply. Consequently, no additional comparison of groundwater quality is provided.

5.2 Terrestrial Resources

Terrestrial resource evaluations include considering impacts to geomorphology and soils as well as flora and fauna. Each is discussed below.

5.2.1 Geomorphology and Soils

This section provides information about the geomorphology and soils for water supply and return flow routes. The pipeline alignments overlaid onto a USGS map are found in Attachment 3-1 of Section 3.

5.2.1.1 Surficial and Bedrock Geology

5.2.1.1.1 Affected Environment

The maps in Attachment 6-8 show bedrock geology and surficial deposits for the State of Wisconsin and were the basis for preparation of this section.

Installation of water mains will require trenching to shallow depths of less than 10 feet. As a result, the supply and return flow routes are not expected to encounter significant bedrock and will have negligible temporary impacts to surficial geology during construction.

Aboveground structures, will not involve construction or excavation deeper than 10 feet. Therefore will have only minor impacts on surficial geology.

Waukesha County exhibits the following types of bedrock: Silurian dolomite, Ordovician Maquoketa Formation of shale and dolomite, and Ordovician Sinnipee Group of dolomite, along with some limestone and shale. The project traverses only the Silurian dolomite bedrock areas, while the Ordovician Maquoketa Formation and Sinnipee Group exist in the western portion of the county (UW-Ext, 2005). The same depths to bedrock in Milwaukee County that are described above also exist within Waukesha County. Surficial deposits within Waukesha County are as follows: the very eastern edge of the county has clay deposits, similar to Milwaukee County, but further west of the county, a mixture of sand and sand/gravel deposits become dominant, with small, isolated areas of clay (WDNR, 2010b).

Bedrock within Milwaukee County is dominated by Silurian dolomite, which is a sedimentary carbonate rock, but it also has very limited areas of Devonian dolomite and shale in the northeastern corner of the county (UW-Ext, 2005). The west central portion of the county, where the project is located, ranges in depth to bedrock from 100 feet to 50 feet, and 50 feet to 5 feet below the surface (WDNR, 2010a). All of Milwaukee County exhibits clay deposits, except for the northeast corner and the southern edge, where there are very small areas of sand and gravel surficial deposits (WDNR, 2010b).

Bedrock within the Racine County portion of the Lake Michigan–Racine water supply route is entirely Silurian dolomite, which is a sedimentary carbonate rock (UW-Ext, 2005). Depth to bedrock within the Racine County is generally 100 feet to 50 feet below ground, with limited areas of 50 to 5 feet below the surface and greater than 100 feet below the surface. The potential for 70 percent of the bedrock to be 5 feet below the surface is very minimal (WDNR, 2010a).

Racine County is dominated by clay deposits, with narrow strips of sand/gravel deposits streaking the county (WDNR, 2010b).

There are no known geologic faults within Milwaukee, Racine, or Waukesha counties, and no known faults in Wisconsin have moved in millions of years. There are no recent faults or folds in Wisconsin (USGS, 2010a, b, c).

5.21.1.2 Environmental Effects

All water supply and return flow pipeline routes would cross similar geology. Information obtained from the geologic resources present will be used to develop the detailed design of the pipeline material, trench, and construction approaches. Construction within these geologic features is commonplace in southeastern Wisconsin. The WDNR has design review practices in place under the water supply review and wastewater plan review for design drawings and specifications for pipeline projects. No significant impacts to the local geology are expected from the proposed project.

5.21.2 Land Use

This section discusses land uses within corridors that could be affected by construction or operation. It identifies sensitive land uses near the routes, including residential areas, hospitals, public lands, recreation areas, and other similar special use areas. Except for the pump station for the Lake Michigan supply and return flow, all land will revert to existing land use after construction and consequently, little change and no adverse impact is anticipated.

5.21.21 Affected Environment

Land use data was assembled from the 2000 SEWRPC Digital Land Use Inventory and 2005 SEWRPC Park and Open Space Sites, both produced by SEWRPC's Land Use and GIS Divisions. The following descriptions were used in classifying land use in this section:

- *Residential*. Two-family and multifamily low-rise (up to three stories) and multifamily high-rise (four or more stories) buildings and low-, medium-, and high-density areas.
- *Commercial and Industrial*. Retail sales and service intensive areas; manufacturing, wholesaling and storage areas; and unused lands designated commercial or industrial.
- *Transportation and Communication Utilities.* Freeways, expressways, streets, and truck terminals; off-street parking areas; rail-related rights-of-way; and communication and utility areas/structures.
- *Government and Institutional.* Administrative, safety, or assembly areas, both local and regional; educational areas (local and regional); and cemeteries.
- *Recreational Areas*. Land-related recreational areas, both public and nonpublic.
- *Agricultural Lands.* Cropland, pasture, lowland pasture, farm buildings, and other agricultural areas.
- *Open Lands*. Urban and rural open areas.
- *Woodlands*. Open lands that are forested.
- *Surface Water*. Open lands that are bodies of water.
- *Wetlands*. Wetland areas in designated open land, transportation, and communication/utility areas.

Table 5-40 summarizes the total land impacts expected by the Lake Michigan supply and return flow routes.

TABLE 5-40
Summary of Land Acreage Impacts

Proposed Project	Land Affected (acres)	
	Overall[a]	During Operation[b]
Lake Michigan Water Supply		
Lake Michigan (City of Milwaukee)	122.4[c]	0
Lake Michigan (City of Oak Creek)	230.2[c]	0
Lake Michigan (City of Racine)	341.6[c]	0
Return Flow for Lake Michigan Water Supply		
Underwood Creek to Lake Michigan	104.8	0[d]

[a] Includes areas affected by the supply and return flow routes, both temporary and permanent.
[b] Includes land disturbed during construction also regarded as permanent workspace, including new aboveground structures and new access roads .
[c] A pump station may be required from the water provider. If required, it is expected to only be approximately 0.25 acres of impact and will be sited to minimize impacts.
[d] Aboveground structures may include a pump station, to be constructed within the Waukesha WWTP site in a previously disturbed area.

5.21.2.2 Environmental Effects

Table 5-41 (see next page) provides quantitative data for land use types affected by temporary construction impacts and the operational impacts of the supply and return flow routes. Most of the land affected is categorized as transportation and communication utilities, most of which is made up of the roadways affected by the routes. This emphasizes the fact that the pipelines associated with this project primarily use public rights-of-way or utility corridors. Impacts are evaluated assuming a 75-foot right-of-way for construction. Note that Table 5-41 uses SEWRPC landuse data. The SEWRPC wetland landuse data is different from the WWI wetland data. Consequently, wetland acreage is different between Table 5-32 and Table 5-41. WWI wetland data was used for wetland analysis while SEWRPC wetland data was used for landuse analysis.

TABLE 5-41
Land Use Impacts in Acres

Route	Residential	Commercial & Industrial	Transportation & Communication/ Utilities	Government. & Institutional	Recreational Areas	Agricultural Lands	Open Lands	Woodlands	Surface Water	Wetlands	Total[a]
Supply Routes											
Lake Michigan (City of Milwaukee) [b]	3.03	3.29	97.86	0.04	2.35	0.00	7.97	0.45	0.00	7.21	**122.2**
Lake Michigan (City of Oak Creek) [b]	10.25	2.60	160.16	0.59	5.16	4.24	31.37	2.12	0.16	13.54	**230.19**
Lake Michigan (City of Racine)	9.31	4.24	33.85	0.04	3.75	213.05	30.70	7.74	0.26	38.67	**341.61**
Return Flow for Lake Michigan Water Supply											
Underwood Creek to Lake Michigan[b]	2.38	3.92	74.85	0.92	3.08	0.00	6.03	0.00	0.17	13.44	**104.79**

Source: SEWRPC (2000).
[a] Represents the total land that had a specific land use designation within the SEWRPC Digital Land Use Inventory.
[b] Lake Michigan supply and return flow routes share the same workspace for about 6 miles. Actual land use totals would be less than reported if a Lake Michigan Supply and Return flow option were selected.

The return flow route follows streets, alleys, bike paths, active and abandoned railroad corridors, utility corridors, city and county lands, and previously disturbed areas. Table 5-42 includes the percentage of alignment closely associated with utility or transportation corridors. Some utility corridors have paved or gravel access roads. Unpaved corridors generally are maintained by mowing and removal of woody vegetation. Consequently, using previously disturbed areas that are developed or actively maintained minimizes disturbance to land uses and natural resources. Most of the alignment for the Racine water supply route follows utility corridors even though much of the land use is designated agricultural rather than utility. Consequently, the Racine water supply percentages listed in Table 5-42 consider agriculture in the estimate for utility corridor use.

TABLE 5-42
Use of Existing Utility and Transportation Corridors

Water Supply or Return Flow Route	Percent Existing Utility Corridor	Percent Existing Utility or Transportation Corridors
Lake Michigan (City of Milwaukee)	25	80
Lake Michigan (City of Oak Creek)	26	70
Lake Michigan (City of Racine)	59	69
Underwood Creek to Lake Michigan	50	74

The second largest land use category that could be affected under some individual routes is agricultural lands. Even though the Lake Michigan Supply–Milwaukee and Underwood Creek return flow routes cross prime farmland, they would not affect active agricultural lands. Transportation, communication utilities, and agricultural lands combined account for the majority of the area affected by the various supply and return flow routes.

Once the proposed project has been constructed, land with temporary impacts from pipeline construction will be restored to or allowed to revert to its previous use.

5.21.2.3 Access Roads

Existing roads and highways would be used to gain access to workspaces along the supply and return flow routes, for both construction crews and delivery of pipe and equipment. Equipment would be moved across public roads that intersect workspaces as work progresses. This would be done in accordance with applicable safety requirements and with due regard for maintenance of existing road surface conditions. Use of access roads during the construction period would have a similar effect as other construction activities on adjacent land uses.

No new access roads would be required for the Lake Michigan supply or return flow. Existing public or private roads would be used. Table 5-43 summarizes proposed new access roads for each route.

TABLE 5-43
Access Roads

Proposed Project	New Access Roads	Acreage Affected by New Roads
Lake Michigan Water Supply		
Lake Michigan (City of Milwaukee)	None proposed[a]	—
Lake Michigan (City of Oak Creek)	None proposed[a]	—
Lake Michigan (City of Racine)	None proposed[a]	—
Return Flow for Lake Michigan Water Supply		
Underwood Creek to Lake Michigan	None proposed[a]	—

[a] Access is anticipated to be from existing municipal roadways and trails.

5.21.2.4 Aboveground Structures

Under the supply and return flow routes, all water main pipelines would be installed underground through Milwaukee, Racine, or Waukesha counties.

Table 5-44 summarizes the proposed aboveground structures and acreages associated with each of the route.

TABLE 5-44
Aboveground Structures

Proposed Project	Structures	Acres
Lake Michigan Water Supply		
Lake Michigan (City of Milwaukee)	1 proposed[a]	—
Lake Michigan (City of Oak Creek)	1 proposed[a]	—
Lake Michigan (City of Racine)	1 proposed[a]	—
Return Flow for Lake Michigan Water Supply		
Underwood Creek to Lake Michigan	Pump station[b]	—

[a] If the water provider requires a pump station, it will be sited to minimize impacts. If required, it is expected to only be approximately 0.25 acres of impact.
[b] Will be constructed within the Waukesha WWTP site, in a previously disturbed area.

5.21.2.5 Residential and Commercial Areas

The supply and return flow routes would affect no private residences. A single private building in Waukesha County is located within the proposed 75-foot-wide construction corridor at the terminus of the Lake Michigan supply route. Based on a review of aerial photography, it appears to be used as a storage structure. The City will coordinate with the owner of the building if a Lake Michigan supply is approved and minimize or avoid this impact if possible. Appropriate mitigation measures will be taken to restore properties disturbed during construction.

Public or Conservation Land and Natural, Recreational, or Scenic Areas

The routes were evaluated to identify Public or Conservation Land and Natural, Recreational, or Scenic Areas within 0.10 mile of the respective routes. Table 5-45 summarizes the Public or Conservation Land and Natural, Recreational, or Scenic Areas within or adjacent to proposed workspaces. Public or Conservation Land and Natural, Recreational, or Scenic Areas may include the following:

- Federal or state wild and scenic rivers
- USFWS designated areas, USDA Forest Service areas
- U.S. National Parks
- National Wilderness Areas
- National Trails System

TABLE 5-45
Public or Conservation Lands within or Adjacent to the Proposed Project

Route Name	Name of Resource	Acres within Proposed 75-ft Construction Workspace
Lake Michigan Water Supply		
Lake Michigan (City of Milwaukee)	Greenfield Park	0.17
	Hillcrest Park	1.16
	New Berlin Golf Course	1.51
	Root River Parkway	21.28
Lake Michigan (City of Oak Creek)	Former North Shore ROW	9.38
	Greenfield Park	0.17
	Greenlawn Park	0.05
	Hillcrest Park	1.16
	Milwaukee Metropolitan Sewerage District Conservation Plan area	0.54
	New Berlin Hills Golf Course	1.51
	Oak Creek Parkway	1.10
	Root River Parkway	39.40
	Whitnall Park	5.41
Lake Michigan (City of Racine)	WDNR designated Big Muskego Lake Wildlife Area	2.64
	Cheska Farms Riding Stables WDNR site	2.29
	WDNR designated area	5.66
	Hillcrest Park	1.16
	Minooka Park	8.64
Return Flow for Lake Michigan Water Supply		
Underwood Creek to Lake Michigan	Bethesda Springs Park	0.30
	Carroll College athletic fields	0.28
	Fox River Sanctuary	2.48
	Greenfield Park	0.17

TABLE 5-45
Public or Conservation Lands within or Adjacent to the Proposed Project

Route Name	Name of Resource	Acres within Proposed 75-ft Construction Workspace
	Krueger Park (which becomes Rainbow Park on the south side of Interstate 94)	0.89
	Underwood Creek Parkway and Corridor	3.83

Source: Google Earth (2009); SEWRPC (2005).

- National Historic Landmarks
- Critical habitat areas of NOAA Fisheries
- State designated natural areas and state managed lands
- State, county, and/or city parks
- Golf courses and athletic fields
- Designated greenspace corridors
- School properties

A review of Google Earth (2009) and the SEWRPC Land Use Division and GIS Division , Park and Open Spaces Sites data (2005) indicated no federally designated or managed Public or Conservation Land and Natural, Recreational, or Scenic Areas would be affected by the supply and return flow routes.

Temporary construction impacts may occur to state and local Public or Conservation Land and Natural, Recreational, or Scenic Areas as a result of construction, depending on the final route. Impacts to state and local resources can be divided into two main categories: temporary and permanent construction-related impacts. Temporary construction-related impacts will be short in duration and minimized by implementing BMPs designed to reduce impacts to sensitive resources. At this time, no permanent aboveground structures are envisioned within areas designated as state or local Public or Conservation Land and Natural, Recreational, or Scenic Areas. Depending upon the final booster pump station location, a local public park could be affected, however the extent of impact would be limited to approximately 0.25 acres and would be coordinated with local public officials and the public.

Coastal Zone Management Areas

Coastal Zone Management Areas are enforced within Wisconsin counties that border the Great Lakes, including Milwaukee County. The Lake Michigan supply and Underwood Creek return flow routes are within Milwaukee County but do not affect coastal areas.

5.21.2.6 Environmental Effects Comparison: Terrestrial Resources – Land Use

Adverse impacts from changes to land use are summarized below. Level of relative impact to land use were developed to compare impacts. Impacts were compared based upon Table 5-46. Table 5-47 summarizes the impacts to land use.

Pipeline routes are in areas that have been already developed or disturbed to minimize impacts to Public or Conservation Land and Natural, Recreational, or Scenic Areas. The pipeline routes would be restored after construction. Consequently, all routes are similar and would have no significant adverse operational impacts to public or conservation land or to natural, recreational, or scenic areas.

TABLE 5-46
Environmental Impact Category Description: Land Use

No adverse impact	Temporary construction impacts and operational impacts that result in land use changes already frequently occurring in the area.
Minor adverse impact	Operational impacts result in land use changes to Public or Conservation Land and Natural, Recreational, or Scenic Areas less than 5 acres.
Moderate adverse impact	Operational impacts result in land use changes to Public or Conservation Land and Natural, Recreational, or Scenic Areas greater than 5, but less than 50 acres.
Significant adverse impact	Operational impacts result in land use changes to Public or Conservation Land and Natural, Recreational, or Scenic Areas greater than 50 acres.

5.21.3 Soil

Prime farmland soils crossed by the supply and return flow routes were identified and characterized using the Natural Resource Conservation Service (NRCS) 2009 Soil Survey Geographic (SSURGO) database. The prime farmland soils series were identified in a linear progression along the proposed routes.

TABLE 5-47
Proposed Project Environmental Impact Comparison Summary: Land Use

Proposed Project	Land Use
Water Supply	
Lake Michigan (City of Milwaukee)	No adverse impact
Lake Michigan (City of Oak Creek)	No adverse impact
Lake Michigan (City of Racine)	No adverse impact
Return Flow for Lake Michigan Water Supply	
Underwood Creek to Lake Michigan	No adverse impact

Prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is available for such use. It has the soil quality, growing season, and moisture supply needed to produce economically sustained high yields of crops when treated and managed according to acceptable farming methods, including water management. Prime farmlands have an adequate and dependable water supply from precipitation or irrigation, a favorable temperature and growing season, acceptable acidity or alkalinity, acceptable salt and sodium content, and few or no rocks.

Prime farmlands are not excessively erodible or saturated with water for long periods. They do not flood frequently or are protected from flooding. Not all areas designated prime farmland are active agriculturally. There may be locations that exhibit extensive historical disturbance from development, such as residential or roadway construction. The presence of active agricultural areas for each water supply and return flow route is discussed below.

5.21.3.1 Affected Environment

Soil series descriptions were obtained through SSURGO (NRCS, 2009). The descriptions provided are based on information available at the county level for soil series. Table 5-48 through Table 5-51 contain specific information on soil characteristics and limitations for the supply and return flow routes.

5.21.3.2 Environmental Effects

Construction will have short-term and permanent impacts to the soils within a given supply or return flow pipeline corridor. Impacts may include soil erosion on steep slopes by wind and water, mixing of topsoil and subsoil, soil compaction and rutting from construction equipment, and poor revegetation potential. These impacts will be mitigated by sustainable construction techniques and an ambitious revegetation program.

Because the pipeline routes follow previously disturbed areas (streets, alleys, bike paths, active and abandoned railroad corridors, utility corridors, and city and county lands), few impacts would occur to active agricultural lands, even if the soil is classified as prime agricultural land. Potential impacts to active agricultural lands are listed in Section 5.2.1.2 on Land Use, Table 5-41. As noted in the table, the Lake Michigan Supply–Milwaukee and return flow routes cross lands classified as prime farmland, but they have no impacts on active agricultural lands.

If a route has impacts on active agricultural lands, crop production may be lost in the temporary workspaces if construction takes place during the growing season. Losses would be short term, because the land would be returned to production for the growing season following completion of construction. Topsoil would be carefully managed during construction to ensure that the productive capacity of the land would be retained after construction.

The land disturbed during construction would be restored as practicable to pre-construction conditions. The City would employ BMPs, such as topsoil segregation, sediment and erosion control measures, and site restoration, to minimize long-term impacts to construction areas. Information regarding specific BMPs and restoration measures proposed to be used will be provided to the appropriate agency stakeholders during the design process should active agricultural areas be impacted.

Acreage impacts are listed in the discussion below. Impacts are evaluated assuming a 75-foot right-of-way for construction.

Lake Mchigan Water Supply (City of MIwaukee)

This route would affect prime farmland (Table 5-48), but the actual land use of such land is other than agricultural.

TABLE 5-48
Prime Farmlands Crossed by the Lake Michigan (City of Milwaukee) Route

Prime Farmland Soil Series	Soil Series Description	Acres Crossed
AsA	Ashkum silty clay loam, 0 to 3 percent slopes	5.37
AzB	Aztalan loam, 2 to 6 percent slopes	1.08
FoB	Fox loam, 2 to 6 percent slopes	1.07
FsB	Fox silt loam, 2 to 6 percent slopes	1.00
FsC2	Fox silt loam, 6 to 12 percent slopes, eroded	0.10
HmB	Hochheim loam, 2 to 6 percent slopes	0.93
HmB2	Hochheim loam, 2 to 6 percent slopes, eroded	0.91
HmC2	Hochheim loam, 6 to 12 percent slopes, eroded	3.63

TABLE 5-48
Prime Farmlands Crossed by the Lake Michigan (City of Milwaukee) Route

Prime Farmland Soil Series	Soil Series Description	Acres Crossed
HtA	Houghton muck, 0 to 2 percent slopes	13.24
LmB	Lamartine silt loam, 1 to 4 percent slopes	1.49
Lo	Lawson silt loam	8.70
MgA	Martinton silt loam, 1 to 3 percent slopes	0.75
MmA	Matherton silt loam, 1 to 3 percent slopes	2.93
MtA	Mequon silt loam, 1 to 3 percent slopes	20.41
Mzb	Montgomery silty clay loam	1.23
Na	Navan silt loam	0.08
Oc	Ogden muck	5.07
OuB	Ozaukee silt loam, 2 to 6 percent slopes	8.96
OuB2	Ozaukee silt loam, 2 to 6 percent slopes, eroded	9.38
OuC2	Ozaukee silt loam, 6 to 12 percent slopes, eroded	1.68
Ph	Pella silt loam	2.32
PrA	Pistakee silt loam, 1 to 3 percent slopes	0.31
ShC2	Saylesville silt loam, 6 to 12 percent slopes, eroded	0.08
Sm	Sebewa silt loam	9.42
ThB	Theresa silt loam, 2 to 6 percent slopes	0.33
Wa	Wallkill silt loam	0.35
Ww	Wet alluvial land	7.58
	Total	**108.42**

Lake Mchigan Water Supply (City of Oak Creek)

There are few facilities that alter the land use associated with this route. Impacts to active agricultural lands would be from pipeline construction, and thus temporary in nature. This alternative would affect soil classified as prime farmland (Table 5-49), but land in actual active agricultural use is much less. Land uses other than agricultural exist on most of the remaining soil that is prime farmland.

TABLE 5-49
Prime Farmlands Crossed by the Lake Michigan (City of Oak Creek) Route

Prime Farmland Soil Series	Soil Series Description	Acres Crossed
AsA	Ashkum silty clay loam, 0 to 3 percent slopes	7.58
AzB	Aztalan loam, 2 to 6 percent slopes	5.17
BlA	Blount silt loam, 1 to 3 percent slopes	19.75
CeB	Casco loam, 2 to 6 percent slopes	0.06
Dt	Drummer silt loam, gravelly substratum	11.38
FoB	Fox loam, 2 to 6 percent slopes	1.91
FsB	Fox silt loam, 2 to 6 percent slopes	1.00
FsC2	Fox silt loam, 6 to 12 percent slopes, eroded	0.79
GrB	Grays silt loam, 2 to 6 percent slopes	1.79

TABLE 5-49
Prime Farmlands Crossed by the Lake Michigan (City of Oak Creek) Route

Prime Farmland Soil Series	Soil Series Description	Acres Crossed
HeB	Hebron loam, 2 to 6 percent slopes	1.21
HmB	Hochheim loam, 2 to 6 percent slopes	0.93
HmB2	Hochheim loam, 2 to 6 percent slopes, eroded	0.91
HmC2	Hochheim loam, 6 to 12 percent slopes, eroded	3.63
HtA	Houghton muck, 0 to 2 percent slopes	13.77
KwB	Knowles silt loam, 2 to 6 percent slopes	6.10
LmB	Lamartine silt loam, 1 to 4 percent slopes	1.49
Lo	Lawson silt loam	10.77
MgA	Martinton silt loam, 1 to 3 percent slopes	2.16
MmA	Matherton silt loam, 1 to 3 percent slopes	6.21
MtA	Mequon silt loam, 1 to 3 percent slopes	13.80
Mzb	Montgomery silty clay loam	1.23
MzdB	Morley silt loam, 2 to 6 percent slopes	6.82
MzdB2	Morley silt loam, 2 to 6 percent slopes, eroded	41.90
MzdC2	Morley silt loam, 6 to 12 percent slopes, eroded	4.30
MzfA	Mundelein silt loam, 1 to 3 percent slopes	0.16
Na	Navan silt loam	1.80
Oc	Ogden muck	5.97
OuB	Ozaukee silt loam, 2 to 6 percent slopes	9.88
OuB2	Ozaukee silt loam, 2 to 6 percent slopes, eroded	5.54
OuC2	Ozaukee silt loam, 6 to 12 percent slopes, eroded	0.40
Ph	Pella silt loam	2.32
PrA	Pistakee silt loam, 1 to 3 percent slopes	0.31
RkB	Ritchey silt loam, 1 to 6 percent slopes	1.39
ShB	Saylesville silt loam, 2 to 6 percent slopes	1.17
ShC2	Saylesville silt loam, 6 to 12 percent slopes, eroded	0.08
Sm	Sebewa silt loam	14.26
ThB	Theresa silt loam, 2 to 6 percent slopes	0.33
Wa	Wallkill silt loam	0.35
Ww	Wet alluvial land	8.89
	Total	**217.51**

Lake Mchigan Water Supply (City of Racine)

Few facilities that would alter land use are associated with this route. Impacts to active agricultural lands would be from pipeline construction, which would all be temporary. This route would affect soil classified as prime farmland (Table 5-50), but actual active agricultural is much less. Land uses other than agricultural exist on most of the remaining soil classified as prime farmland.

TABLE 5-50
Prime Farmlands Crossed by the Lake Michigan (City of Racine) Route

Prime Farmland Soil Series	Soil Series Description	Acres Crossed
Am	Alluvial land	0.11
AsA	Ashkum silty clay loam, 0 to 3 percent slopes	6.01
AtA	Ashkum silty clay loam, 0 to 3 percent slopes	21.08
AzB	Aztalan loam, 2 to 6 percent slopes	2.44
BcA	Beecher silt loam, 1 to 3 percent slopes	13.17
BlA	Blount silt loam, 1 to 3 percent slopes	14.36
BnB	Boyer sandy loam, 2 to 6 percent slopes	0.33
BsA	Brookston silt loam, 0 to 3 percent slopes	4.17
CeB	Casco loam, 2 to 6 percent slopes	0.02
Cw	Colwood silt loam	0.92
EtA	Elliott silty clay loam, 0 to 2 percent slopes	7.77
EtB	Elliott silty clay loam, 2 to 6 percent slopes	6.80
FoB	Fox loam, 2 to 6 percent slopes	1.07
FrB	Fox loam, clayey substratum, 2 to 6 percent slopes	1.08
FsB	Fox silt loam, 2 to 6 percent slopes	1.00
FtB	Fox silt loam, loamy substratum, 2 to 6 percent slopes	0.41
GrB	Grays silt loam, 2 to 6 percent slopes	0.18
HeA	Hebron loam, 0 to 2 percent slopes	0.69
HeB	Hebron loam, 2 to 6 percent slopes	0.34
HeB2	Hebron loam, 2 to 6 percent slopes, eroded	0.64
HeC2	Hebron loam, 6 to 12 percent slopes, eroded	0.09
HmB	Hochheim loam, 2 to 6 percent slopes	10.72
HmB2	Hochheim loam, 2 to 6 percent slopes, eroded	7.70
HmC2	Hochheim loam, 6 to 12 percent slopes, eroded	11.35
HoC3	Hochheim soils, 6 to 12 percent slopes, severely eroded	0.20
Ht	Houghton muck	5.12
HtA	Houghton muck, 0 to 2 percent slopes	17.75
HtB	Houghton muck, 2 to 6 percent slopes	1.16
JuA	Juneau silt loam, 1 to 3 percent slopes	0.20
KaA	Kane loam, 1 to 3 percent slopes	0.95
KhA	Kane silt loam, clayey substratum, 1 to 3 percent slopes	7.01
LmB	Lamartine silt loam, 1 to 4 percent slopes	6.52
MeB	Markham silt loam, 2 to 6 percent slopes	21.10
MeB2	Markham silt loam, 2 to 6 percent slopes, eroded	9.56
MeC2	Markham silt loam, 6 to 12 percent slopes, eroded	0.34
MgA	Martinton silt loam, 1 to 3 percent slopes	6.13

TABLE 5-50
Prime Farmlands Crossed by the Lake Michigan (City of Racine) Route

Prime Farmland Soil Series	Soil Series Description	Acres Crossed
MkA	Matherton loam, 1 to 3 percent slopes	2.35
MmA	Matherton silt loam, 1 to 3 percent slopes	2.24
MoB	Mayville silt loam, 2 to 6 percent slopes	2.83
Mzb	Montgomery silty clay loam	3.17
Mzc	Montgomery silty clay	4.35
MzdB	Morley silt loam, 2 to 6 percent slopes	33.02
MzdB2	Morley silt loam, 2 to 6 percent slopes, eroded	14.62
MzdC2	Morley silt loam, 6 to 12 percent slopes, eroded	12.51
MzfA	Mundelein silt loam, 1 to 3 percent slopes	0.28
Na	Navan silt loam	4.07
Oc	Ogden muck	18.37
Ph	Pella silt loam	3.56
PrA	Pistakee silt loam, 1 to 3 percent slopes	1.81
RaA	Radford silt loam, 0 to 3 percent slopes	0.92
ScB	St. Charles silt loam, 2 to 6 percent slopes	0.28
Sg	Sawmill silt loam, calcareous variant	0.62
ShA	Saylesville silt loam, 0 to 2 percent slopes	1.36
ShB	Saylesville silt loam, 2 to 6 percent slopes	4.93
ShB2	Saylesville silt loam, 2 to 6 percent slopes, eroded	1.21
ShC2	Saylesville silt loam, 6 to 12 percent slopes, eroded	1.53
Sm	Sebewa silt loam	1.68
So	Sebewa silt loam, clayey substratum	0.38
ThA	Theresa silt loam, 0 to 2 percent slopes	0.55
ThB	Theresa silt loam, 2 to 6 percent slopes	6.03
ThB2	Theresa silt loam, 2 to 6 percent slopes, eroded	1.56
ThC2	Theresa silt loam, 6 to 12 percent slopes, eroded	0.51
VaB	Varna silt loam, 2 to 6 percent slopes	7.53
Wa	Wallkill silt loam	1.11
WgB	Warsaw loam, clayey substratum, 2 to 6 percent slopes	0.02
	Total	**321.89**

Underwood Creek to Lake Mchigan Return Flow

This route would affect soil classified as prime farmland (Table 5-51), but actual active agriculture is much less. Land uses other than agricultural exist on all the remaining soil classified as prime farmland.

TABLE 5-51
Prime Farmlands Crossed by the Underwood Creek to Lake Michigan Return Flow Route

Prime Farmland Soil Series	Soil Series Description	Acres Crossed
AsA	Ashkum silty clay loam, 0 to 3 percent slopes	4.88
CeB	Casco loam, 2 to 6 percent slopes	0.54
FoA	Fox loam, 0 to 2 percent slopes	0.08
FsC2	Fox silt loam, 6 to 12 percent slopes, eroded	0.10
GrB	Grays silt loam, 2 to 6 percent slopes	0.43
HmB	Hochheim loam, 2 to 6 percent slopes	8.97
HmB2	Hochheim loam, 2 to 6 percent slopes, eroded	0.57
HmC2	Hochheim loam, 6 to 12 percent slopes, eroded	0.73
HtA	Houghton muck, 0 to 2 percent slopes	17.74
KeA	Kane silt loam, 1 to 3 percent slopes	0.66
LmB	Lamartine silt loam, 1 to 4 percent slopes	0.66
LyB2	Lorenzo loam, 2 to 6 percent slopes, eroded	0.92
MgA	Martinton silt loam, 1 to 3 percent slopes	0.75
MmA	Matherton silt loam, 1 to 3 percent slopes	3.82
MtA	Mequon silt loam, 1 to 3 percent slopes	12.36
Mzb	Montgomery silty clay loam	1.23
MzfA	Mundelein silt loam, 1 to 3 percent slopes	0.79
Oc	Ogden muck	5.07
OuB	Ozaukee silt loam, 2 to 6 percent slopes	9.34
OuB2	Ozaukee silt loam, 2 to 6 percent slopes, eroded	4.93
OuC2	Ozaukee silt loam, 6 to 12 percent slopes, eroded	1.01
Ph	Pella silt loam	13.14
PrA	Pistakee silt loam, 1 to 3 percent slopes	0.31
Sm	Sebewa silt loam	2.37
WeB	Warsaw loam, 2 to 6 percent slopes	9.08
WeC2	Warsaw loam, 6 to 12 percent slopes, eroded	0.33
Ww	Wet alluvial land	1.93
	Total	**102.75**

5.21.3.3 Environmental Effects Comparison: Soils

Adverse impacts from changes to soils are summarized below. Level of relative impact (no adverse impact, minor adverse impact, etc.) to soils were developed to compare impacts. Impacts were compared based upon Table 5-52. The impacts to soils are summarized in Table 5-53.

Temporary construction-related impacts to soils are associated with the proposed project. All have pipeline routes that run through areas that have been already developed or disturbed to minimize impacts to vegetation and species of concern. This summary focuses upon operational impacts to soils that would occur from aboveground structures.

TABLE 5-52
Environmental Impact Category Description: Soils

No adverse impact	No operational impacts and only temporary construction impacts.
Minor adverse impact	Operational impacts are limited to soil types frequently found in the area.
Moderate adverse impact	Operational impacts occur to soil types infrequently occurring in the area.
Significant adverse impact	Operational impacts occur to soil types rarely occurring in the area.

Lake Mchigan Water Supply (Cities of MIwaukee, Oak Creek, and Racine)

Other than a pump station approximately 0.25 acres in size which is not expected to be located in active agricultural areas, there would be no significant aboveground structures with these routes and thus insignificant impacts to prime farmland. Consequently, there would be no adverse impacts.

TABLE 5-53
Water Supply and Return Flow Alternative
Environmental Impact Comparison Summary: Soils

Alternative	Soils
Water Supply	
Lake Michigan (City of Milwaukee)	No adverse impact
Lake Michigan (City of Oak Creek)	No adverse impact
Lake Michigan (City of Racine)	No adverse impact
Return Flow Alternatives for Lake Michigan Water Supplies	
Underwood Creek to Lake Michigan	No adverse impact

Underwood Creek to Lake Mchigan Return Flow

There would be no significant aboveground structures with this route and thus insignificant impacts to prime farmland. Consequently, there would be no adverse impacts.

5.22 Flora and Fauna

Game and nongame wildlife species are regulated and protected under various legislation including the State of Wisconsin's wild game regulations, Wisconsin's Endangered and Threatened Species regulations (NR 27), the federal Fish and Wildlife Conservation Act of 1980 (16 U.S.C. 2901-2911), the Endangered Species Act, and the Fish and Wildlife Coordination Act of 1958.

5.22.1 Affected Environment

Wildlife species require adequate food, water, cover, and living space for the survival of individuals and to maintain population viability. The various habitats within the project area support a variety of widespread and tolerant mammals, birds, reptiles, amphibians, and invertebrates. Refer to the maps found in Attachment 3-1 of Section 3 for maps associated with the proposed project. The wildlife habitats along the proposed workspace fall into four categories and several subcategories:

- *Open Unforested Areas* that will be affected by the project generally include cropland (fallow and active), undeveloped nonforested areas, and scrub-shrub land. Farm crops may serve as a food source for certain species, including whitetail deer and Canada goose. Uncultivated grasslands, pasture, scrub-shrub land, and maintained rights-of-way may support herbaceous and low-level woody vegetation, offering protective cover and forage food sources. Open areas may function as travel corridors where adjacent land is wooded or developed. Open, uncultivated areas may sustain abundant populations of small mammals, such as deer mouse and meadow vole, larger herbivorous mammals, such as woodchuck and eastern cottontail rabbit, and predatory omnivores or carnivores, such as opossum, striped skunk, and red fox. Open areas may provide suitable habitat for bird species, including red-winged blackbird, Canada goose, meadowlark, mourning dove, American crow, American robin, European starling, common grackle, and various sparrows. Open areas bordered by woodland habitats or hedgerows are of particular value to birds and other wildlife because of the nesting and refuge opportunities they afford. Reptiles and amphibians that frequent open grassy areas include the eastern garter snake, blue racer, and American toad.

- *Wooded Areas* that will be affected by the project generally consist of deciduous upland forests. Forested areas exhibit a more complex structure than open areas and generally provide a higher-quality wildlife habitat. Large unfragmented tracts of forested land can provide important habitat for larger, territorial mammals (coyote, deer) and may provide habitat for migratory birds. Food sources from mature trees, as well as berries and other fruits from some understory shrubs and woody vines, are an important wildlife food source. Secondary canopy shrubs and saplings, brush piles, and fallen logs provide cover for various small- to medium-sized mammals. There will be little change in permanent forested riparian areas affected by the proposed aboveground structures, as shown in the maps found in Attachment 3-1 of Section 3. Impacts to forested riparian areas and wetlands may occur as a result of pipeline installation, but such impacts would be temporary and would be managed by avoidance, minimization, and mitigation measures developed in coordination with the appropriate regulatory agencies. As a result, temporary impacts do not represent a significant concern.

- *Aquatic Areas* that will be affected by the project consist generally of streams and wetlands from pipeline construction and return flow receiving waters, including Lake Michigan and its tributaries. Aquatic areas can provide habitat to a diverse wildlife population, and several common species (beaver, muskrat, herons, etc.) are dependent on aquatic habitat for food and shelter. Animals and birds such as beaver, muskrat, and herons depend on aquatic habitats for food and shelter. Others, such as raccoon, are less restricted but prefer to be close to water. Amphibians and many reptiles favor aquatic habitats. Representative species include bullfrog and northern water snake.

- *Developed Areas* that will be affected by the project generally consist of residential, commercial, and industrial land, and active recreational parks. These areas generally have asphalt and concrete surfaces, maintained turf grass, and landscape trees and shrubs. In general, they provide poor wildlife habitat, but opportunistic species such as raccoon, opossum, squirrel, American crow, American robin, European starling, common grackle, various sparrows, and others have adapted well and thrive in urban and suburban settings.The landscape of the project area originally was a combination of hardwood forest, prairie, savanna, and wetlands. Today, most of the area is dominated by agriculture and urban development. Forests dominated by maple and beech trees are common forest types, along with oak-hickory dominated and lowland hardwood forest types. There are also some areas of wet-mesic and wet prairie, but only small preserves remain since the landscape is heavily disturbed and fragmented. Because of isolation, fragmentation, and disturbance, nonnative plants are abundant throughout the project area.[43]

The USFWS and WDNR were contacted to determine federal- or state-listed species known to occur in the terrestrial areas along the project corridor. The species identified by the agencies as potentially occurring within all proposed project corridor alignments are summarized in Section 5.1.3, Wetlands, since most of the impacts would be to wetlands.

The maps found in Attachment 3-1 of Section 3 show an aerial view of the pipeline alignments, portraying land use and general vegetation along each route. Table 5-41 lists the land uses affected by each route.

U.S. Department of Agriculture's *Descriptions of the Ecoregions of the United States* (1995) contains a hierarchical classification system for ecological units on national and regional scales. Areas are described as being within a specific domain, division, province, section, subsection, and landscape. Southeast Wisconsin is within the Humid Temperate Domain, Hot Continental Division, and Eastern Broadleaf Forest Province (USDA, 2010). Descriptions of these ecoregions are as follows.

5.2.2.1.1 Humid Temperate Domain

The Humid Temperate Domain, located in the middle latitudes (30° to 60°N), has a climate governed by both tropical and polar air masses. The middle latitudes are subject to cyclones. Much of the precipitation in this belt comes from rising moist air along fronts within the cyclones. Pronounced seasons are the rule, with strong annual cycles of temperature and precipitation. Climates of the middle latitudes have a distinctive winter season, which tropical climates do not.

The Humid Temperate Domain contains forests of broadleaf deciduous and needleleaf evergreen trees. The variable importance of winter frost determines six divisions: warm continental, hot continental, subtropical, marine, prairie, and Mediterranean (USDA, 2010).

5.2.2.1.2 Hot Continental Division

The Hot Continental Division is characterized by hot summers and cool winters. The frost-free, or growing, season lasts 5 to 6 months in the division's warmer sections, and only 3 to 5 months in the colder sections. Snow cover is deeper and lasts longer in the northerly areas.

Vegetation in this climate division is winter deciduous forest, dominated by tall broadleaf trees that provide a continuous dense canopy in summer but shed their leaves completely in winter. Lower layers of small trees and shrubs are weakly developed. In spring, a ground cover of herbs develops quickly, but it is greatly reduced after trees reach full foliage and shade the ground.

Soils are chiefly inceptisols, ultisols, and alfisols, which are rich in humus and moderately leached, with a distinct light-colored leached zone under the dark upper layer. The ultisols have a low supply of bases and a horizon in which clay has accumulated. Where topography is favorable, diversified farming and dairying are the most successful agricultural practices.

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[43] http://dnr.wi.gov/landscapes/index.asp?mode=detail&Landscape=12. Accessed December 19, 2011

Rainfall decreases with distance from the ocean. Therefore, this division is subdivided into moist oceanic and dry continental provinces (USDA, 2010).

5.2.2.1.3 Eastern Broadleaf Forest Province

Most of the Eastern Broadleaf Forest Province has rolling hills, but some parts have close to flat topography. In Wisconsin the province has been glaciated. Broadleaf deciduous forests dominate the province and, because of lower precipitation, the province supports the oak-hickory association. The Eastern Broadleaf Forest in northern states such as Wisconsin also supports the maple-basswood association (USDA, 2010).

5.2.2.1.4 Vegetation Communities of Special Concern

According to correspondence from the USFWS (2010), no vegetation communities of special concern or critical habitat occur within the construction workspaces associated with the supply and return flow routes.

WDNR (2010c) identified several vegetation communities of special concern (referred to in Wisconsin as "natural communities") that may be in the area of the supply and return flow routes. Because most of the natural communities that will be affected by the project are associated with wetland habitats, natural communities are discussed under Section 5.1.3.

5.2.2.2 Environmental Effects

In general, impacts to wildlife resources from constructing supply and return flow pipelines will be minor and limited to temporary impacts during construction to tolerant opportunistic species. Clearing and grading the construction areas will result in loss of vegetative cover and may result in the mortality of less mobile fauna, such as small rodents, reptiles, and invertebrates, which may be unable to escape the construction area.

Construction likely will cause the temporary displacement of more mobile wildlife from workspaces and adjacent areas. Wooded habitat removed by construction will be replaced initially by nonwoody vegetation, which may provide food, shelter, and breeding space for small mammals and birds. Trees will be allowed to grow back on cleared workspace beyond the maintained maintenance corridor. Surface restoration will include coordination with regulatory agencies to provide preferred habitat vegetation applicable to adjacent land use and operational considerations.

After construction, wildlife is expected to return and recolonize. Because the pipeline routes follow streets, alleys, bike paths, active and abandoned railroad corridors, utility corridors, city and county lands, and other disturbed areas, long-term impacts to wildlife resources are only associated with the permanent aboveground structures (see Table 5-44). Plans will accommodate general and site-specific protective measures for sensitive wildlife habitats and species identified during the course of detailed design and permitting. Seasonal construction scheduling to accommodate reproductive and migratory patterns will be coordinated with state and federal agencies.

Siting for the pipeline routes was chosen to minimize the overall land use impact by using roadways, utility corridors, or previously disturbed areas.

Stream crossings will be constructed as quickly as possible and stream habitats restored upon completion of construction. State-approved BMPs will be used to minimize sedimentation, turbidity, and other impacts that may temporarily affect stream vegetation and wildlife.

The City will continue to work with local, state, and federal agencies, landowners, and soil conservation authorities so that construction and mitigation procedures are compatible with both site-specific and regional environmental protection objectives.

5.3 Air Quality

5.3.1 Affected Environment

The project area is located in an attainment area for carbon monoxide, lead, and sulfur dioxide. The project area is in a non-attainment area for particulate matter ($PM/PM_{2.5}$) and moderate non-attainment category for 8-hour ozone.[44]

5.3.2 Environmental Effects

Particulate air emissions (fugitive dust) are expected to be generated by construction associated with the project. The emissions will be temporary and last only during the construction period. The impact of emissions will be highly localized and limited to areas where restoration of the construction corridor has not yet been completed. Fugitive dust will be minimized by requiring restoration as construction proceeds along the pipeline corridor. The City of Waukesha will take reasonable precautions to prevent fugitive dust from construction work from becoming airborne, such as by applying water as appropriate. Therefore, it is not anticipated that the construction-related emission will have a significant impact on air quality.

During operation, energy use to pump water to the City of Waukesha and to discharge treated wastewater effluent will release emissions. Table 5-54 compares the energy use and the greenhouse gas emissions.

TABLE 5-54
Estimated Energy Use and Greenhouse Gas Emissions

Proposed Project	Estimated Annual Energy Usage (MWh)	Estimated Annual GHG Emissions (tons CO_2)
Water Supply		
Lake Michigan (City of Milwaukee)	14,600	13,500
Lake Michigan (City of Oak Creek)	18,700	17,300
Lake Michigan (City of Racine)	17,400	16,100
Return Flow for Lake Michigan Water Supply		
Underwood Creek to Lake Michigan	2,200	2,100

The Lake Michigan water sources with return flow would contribute fewer greenhouse gas emissions than what occurs currently.

44 http://www.epa.gov/oaqps001/greenbk/ancl3.html accessed January 24, 2012.

Other emissions could come from backup electrical generators at the water supply and return flow pump stations. Backup generators would operate only when primarily electrical supply from the regional electrical utility is unavailable; that is, rarely. Emissions from a backup electrical generator therefore would be minimal.

5.4 Socioeconomic Environment

This section describes socioeconomic resources that could be affected by Lake Michigan water supply and return flow and also the potential impacts.

The University of Wisconsin–Milwaukee (UWM) prepared an evaluation of the socioeconomic implications of water supply alternatives in support of SEWRPC's regional water supply plan.[45] Based on recommendations by SEWRPC's Environmental Justice Task Force, SEWRPC contracted with the UWM Center for Economic Development (CED) in 2009 as a nonpartisan agency to evaluate the recommendations set forth in the regional water supply plan and the socioeconomic impact of the recommendations. *A Socio-Economic Impact Analysis of SEWRPC's Regional Water Supply Plan* was finalized and released in July 2010. The analysis included extensive interviews with planners and utility personnel from the communities, and considered a wide range of socioeconomic attributes. The analysis in this section summarizes the findings of the report. The alternatives evaluated as part of this environmental report are consistent with SEWRPC's regional water supply plan, the CED evaluation, SEWRPC's Environmental Justice Task Force recommendations, and *A Socio-Economic Impact Analysis of SEWRPC's Regional Water Supply Plan.*

This section summarizes data where reported in the SEWRPC Socio-Economic Impact Analysis report (UWM, 2010) using 2000 census data because the SEWRPC report was published prior to 2010 census data becoming available. For population information not readily available in the SEWRPC Socio-Economic Impact Analysis report, 2010 census data was used.

5.4.1 Population

5.4.1.1 Population Affected

Waukesha county population more than doubled between 1960 and 2007. This growth is much greater than that in the 7 county SEWRPC planning region. Whereas Waukesha accounted for only 10 percent of the regional population, it now represents almost 20 percent (Table 5-55). The City of Waukesha has experienced a similar population growth, increasing from 30,000 in 1960 to more than 64,000 in 2000. The rate of growth in the City is expected to decline over the next 25 years, reaching a projected total of 88,500 in 2035 (36 percent increase). The water supply needs for the City are partially based on these population projections, but the water needs include an enlarged water supply service area beyond the City and changes in manufacturing, commercial, industrial and other water-consuming sectors (see the Water Supply Service Area Plan, Appendix B of the Application).

[45] SEWRPC. 2010. *A Regional Water Supply Plan for Southeastern Wisconsin.* Planning Report No. 52

TABLE 5-55
Waukesha and Southeastern Wisconsin Regional Population

	1960		2007		Change	
County	**Number**	**% of Region**	**Number**	**% of Region**	**Number**	**%**
Waukesha	158,249	10.1	376,978	18.9	218,729	138.2
Southeastern Wisconsin	1,573,614	100.0	1,995,901	100.0	422,287	26.8

Source: US Census Bureau as reported in UWM, 2010

5.4.1.1.1 Age

Based on the results of the 2010 census, the median age in Waukesha County is 42 (USCB, 2010a). Table 5-56 summarizes age statistics for the state, Waukesha County, and the City of Waukesha.

TABLE 5-56
Waukesha and Southeastern Wisconsin Regional Population Age Statistics: 2010

State of Wisconsin		Waukesha County		City of Waukesha	
Age Group	**% of Total**	**Age Group**	**% of Total**	**Age Group**	**% of Total**
Under 5 years	6.3	Under 5 years	5.5	Under 5 years	7.1
5 to 9 years	6.5	5 to 9 years	6.7	5 to 9 years	6.8
10 to 14 years	6.6	10 to 14 years	7.2	10 to 14 years	6.1
15 to 19 years	7.0	15 to 19 years	6.8	15 to 19 years	6.7
20 to 24 years	6.8	20 to 24 years	4.7	20 to 24 years	7.8
25 to 29 years	6.5	25 to 29 years	5.1	25 to 29 years	8.6
30 to 34 years	6.1	30 to 34 years	5.2	30 to 34 years	8.1
35 to 39 years	6.1	35 to 39 years	6.0	35 to 39 years	7.0
40 to 44 years	6.7	40 to 44 years	7.3	40 to 44 years	6.7
45 to 49 years	7.7	45 to 49 years	8.8	45 to 49 years	7.0
50 to 54 years	7.7	50 to 54 years	8.8	50 to 54 years	6.8
55 to 59 years	6.8	55 to 59 years	7.5	55 to 59 years	5.8
60 to 64 years	5.5	60 to 64 years	6.1	60 to 64 years	5.1
65 to 69 years	4.0	65 to 69 years	4.2	65 to 69 years	3.2
70 to 74 years	3.1	70 to 74 years	3.1	70 to 74 years	2.2
75 to 79 years	2.5	75 to 79 years	2.7	75 to 79 years	1.9
80 to 84 years	2.1	80 to 84 years	2.2	80 to 84 years	1.6
85 and over	2.1	85 and over	2.0	85 and over	1.7
Median age	**38.5**	**Median age**	**42**	**Median age**	**34.2**

Source: USCB 2010a

5.4.1.1.2 Race and Ethnicity

The City of Waukesha is predominately white, but racial diversity has risen since 1960. The percent of nonwhites increased from 0.5 percent in 1960 to almost 9 percent in 2000, more than 5,500 nonwhite residents moved into the City over the period. The percent increase in nonwhites is similar to that in other communities in the southeastern Wisconsin region. The Waukesha County nonwhite population is projected to almost double by 2035, to almost 17 percent of the total population.

5.4.1.1.3 Heath and Disabilities

In 2000 the national average of persons reporting one or more disabilities was 19.3 percent (UWM, 2010). Wisconsin reported a lower percentage at 14.7 percent of the state's population. Waukesha County provided an even lower percentage than the national and state average, with only 10.8 percent of the population reporting one or more disabilities. The City of Waukesha was slightly higher than the state average, with 14.9 percent of the population reporting one or more disabilities.

5.4.1.1.4 Population Trends

Changes in population are based on three variables: birth and death rates, migration of people moving into and out of the community, and the ability of a community/town to annex neighboring lands, which increases the size and population.

The birth and death rate, or the balance between births and deaths in a given area, is considered a population's "natural increase." According to SEWRPC, the region experienced a population increase of 120,800 people between 1990 and 2000. It is estimated that, of the 120,800 people, 116,900 were attributed to natural increase.

Based on *The Economic State of Milwaukee's Inner City: 2006* (Levine and Williams) and numerous SEWRPC technical reports[46] the general trend over the past 50 years has been an outward population and job migration from larger cities along the lakeshore to outlying towns and counties. The reduction in manufacturing jobs in the historically larger cities and the increased economic development within inland areas has reduced jobs in the large lakeshore cities and increased jobs in inland areas.

It is possible for population growth to be constrained by the unavailability of adjacent land for development. Unless a community has the capability to annex adjacent, developable land, it may experience "buildout" or near buildout conditions. Milwaukee, which is bordered by Lake Michigan, is an example of a community facing buildout conditions. Milwaukee has exhibited a population decline, which SEWRPC projects to continue partially because of the lack of available adjacent developable land. On the contrary, the City of Waukesha has developable land that will support population growth.

5.4.1.2 Population Effects

The water demand projections used to specify the water supply quantities for all sources (groundwater and Lake Michigan) were based partially on the population projections discussed above, and all alternative sources can meet the projected demand. Thus, meeting the demand using any alternative source would not have any constraints on population.

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[46] SEWRPC Technical Report No. 10 *The Economy of Southeastern Wisconsin* (July 2004) and SEWRPC Technical Report No. 11 *The Population of Southeastern Wisconsin* (July 2004).

Any of the water supply sources also can support the projected increase in nonwhite population in the City of Waukesha. This is consistent with conclusions in the CED socioeconomic study, in which planners and utilities managers reported that the water supply source will not affect population growth or distribution.

5.4.2 Economy

5.4.2.1 Existing Economic Conditions

The economy in Waukesha County also has grown over the last 20 years. Economic growth in the City of Waukesha has been much greater than the overall southeastern Wisconsin region, increasing from nearly 5 percent of the total in 1960 to more than 22 percent in 2000 (Table 5-57). This is consistent with the regional trend of employment migration from the urban areas to the more suburban areas and the shift from manufacturing to service sector jobs in the southeastern Wisconsin region. Table 5-58 provides an overview of state, regional, and local leading industries (historic and present).

TABLE 5-57
Waukesha and Regional Economy

	1960		1970		1980		1990		2000	
County	**Jobs**	**%**	**Jobs**	**%**	**Jobs**	**%**	**Jobs**	**%**	**Jobs**	**%**
Waukesha	32,600	4.8	81,000	10.3	132,800	14.0	189,700	16.6	270,800	22.1
Southeastern Wisconsin	673,000	100.0	784,900	100	948,200	100	1,143,700	100	1,222,800	100

Source: Bureau of Labor Statistics and the US Census Bureau as reported in UW Milwaukee 2010.

The economy in Waukesha County is projected to increase by 67,000 jobs, or 25 percent, by 2035. This is considerably higher than for Milwaukee County (7 percent increase) but similar to the surrounding counties.

Much of the industry in the southeastern Wisconsin region is considered to be water-intensive, but many large industrial water users rely on private high-capacity groundwater wells rather than municipal water. A review of the large businesses in Waukesha County indicates there are no known major water-intensive businesses or industries using municipal supplies (UW Madison 2010).[47]

5.4.2.1.1 Employment and Industry

As shown in Table 5-58, the leading industry in Wisconsin shifted from manufacturing in 2000 to educational services by 2010. In Waukesha County, educational services remained the leading industry from 2000 to 2010. Similar to the Wisconsin trend, the City of Waukesha experienced a shift in leading industries, from manufacturing in 2000 to educational services in 2010 (USCB 2000 and 2010b).

47 University of Wisconsin Milwaukee, Center for Economic Development. 2010. Chapter 3, page 15.

TABLE 5-58
Leading Industries in 2000 and 2010

	Industries											
	Manufacturing		Educational Services		Retail Trade		Recreation & Entertainment		Professional, Scientific, & Management		In Labor Force (population 16 years and older)	
Geography	**2000**	**2010**	**2000**	**2010**	**2000**	**2010**	**2000**	**2010**	**2000**	**2010**	**2000**	**2010**
Wisconsin	22.2%	17.9%	20.0%	23.0%	11.6%	11.6%	7.3%	9.1%	6.6%	7.9%	69.1%	68.3%
Milwaukee County	18.5%	14.3%	22.4%	27.1%	10.4%	10.4%	7.7%	9.6%	9.3%	10.7%	65.4%	66.8%
City of Milwaukee	18.5%	13.6%	23.4%	27.7%	9.9%	11.0%	8.6%	10.4%	8.9%	11.2%	63.9%	66%
Waukesha County	14.1%	16.5%	19.9%	23.3%	11.7%	12.1%	7.9%	7.1%	9.3%	10.6%	63.9%	70.3%
City of Waukesha	22.0%	16.6%	20.5%	22.3%	12.0%	14.2%	6.8%	10.7%	9.2%	9.6%	73.2%	74.8%

Source: 2010 Census (USCB, 2010b); 2000 American Community Survey (USCB, 2000)

5.4.21.2 Unemployment

Unemployment throughout the southeastern Wisconsin region has increased over the past decade. In 2000, Wisconsin's unemployment rate was 3.2 percent. It had risen to 6.1 percent in 2010; and in November of 2011, the Bureau of Labor Statistics (BLS, 2011) reported the state average at 7.3 percent.

Waukesha County and the City of Waukesha reported similar unemployment trends over the past decade. The County's unemployment rate in 2000 was 3.7 percent. It had risen to 5.4 percent in 2010, and by November 2011 it had slightly increased to 5.7 percent (BLS, 2011).The City of Waukesha's unemployment rate was 2.5 percent in 2000. It had risen to 5.9 percent in 2010; and by November 2011 to 7.6 percent, which is slightly higher than the state average and nearly 2 percent higher than the surrounding county average (BLS, 2011).

5.4.21.3 Trends

As described in the report *A Socio-Economic Impact Analysis of the Regional Water Supply Plan for Southeastern Wisconsin* (UWM, 2010), Waukesha County experienced a significant increase in jobs from 1960 to 2000 by approximately 5.4 percent annually. Before 1960, less than 5 percent of the regional distribution of jobs was from Waukesha County. However, by 2000, Waukesha County provided 22 percent of the jobs in the southeastern Wisconsin region. Percent increases and decreases in the number of jobs in a specific area is considered separately from changes in employment and unemployment rates, which are based on the total number of employable persons in an area.

A similar increase was reflected in the historic labor force pattern. Before 1960, most of the regional labor force, about 68 percent, resided in Milwaukee County. Although Milwaukee County's labor force continued to grow through 1990, its share of the regional labor force decreased to 46.5 percent by 2000. Meanwhile, Waukesha County's share of the regional labor force grew from 9.1 percent in 1960 to 19.9 percent in 2000. Waukesha experienced an average annual growth rate of 3.15 percent from 1960 to 2000, whereas Milwaukee County experienced an annual growth rate of only 0.21 percent. These changes in labor force percentages throughout the southeastern Wisconsin region show that, percentagewise, more workers are migrating to Waukesha County than Milwaukee County.

Table 5-58 provides a 10-year overview of leading industries and labor force records for the State, Milwaukee and Waukesha counties, and the cities of Milwaukee and Waukesha.

5.4.21.4 Tax Base

Municipal tax rates, known as tax base, are based on the total value of all taxable property in a particular municipality. To compare tax bases accurately across multiple municipalities, the State of Wisconsin equalizes assessed values by using tools such as market sales analysis, random appraisals, and local assessors' reports to bring all values to a uniform level. Tax base analysis uses equalized values determined by the Wisconsin Department of Revenue. An overview of relevant equalized values for 2010 (Table 5-59), shows that, within the 7-county region of southeastern Wisconsin, Milwaukee County comprises 35 percent of the tax base and Waukesha County 28 (Public Policy Forum, 2011).

In recent years, property values in southeast Wisconsin have declined by at least 3 percent in each of the 7 counties (Public Policy Forum, 2011). Milwaukee County has seen the greatest decline. Figure 5-5 provides a visual representation of property value trends in southeast Wisconsin from 2005 to 2010.

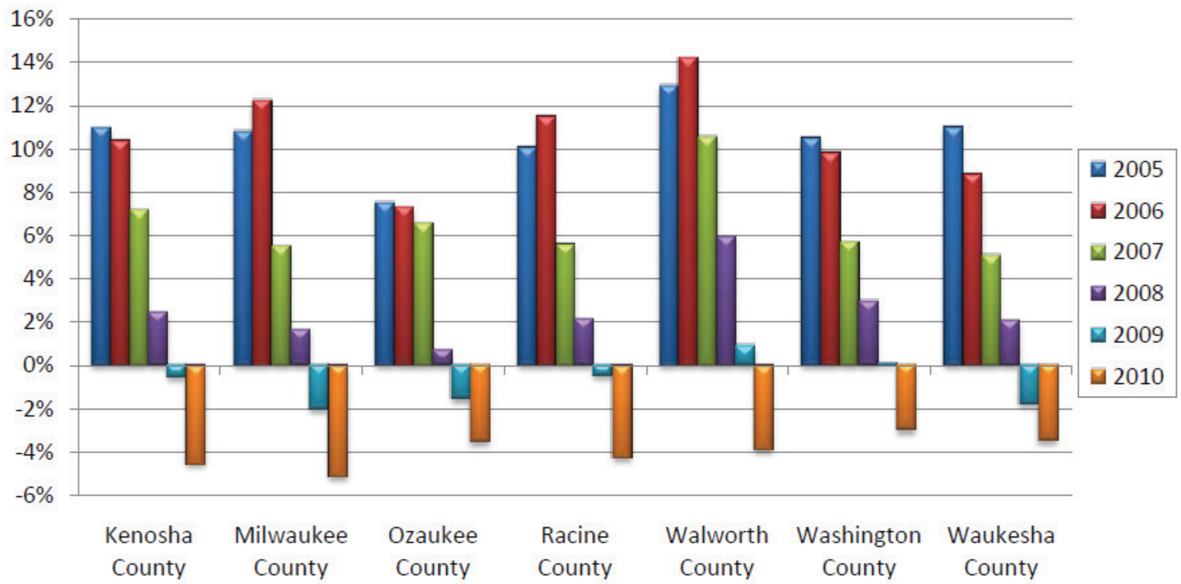
TABLE 5-59
2010 Total Equalized Value: Southeastern Wisconsin

Geography	2010 Total Equalized Value	1 Year Change in Property Value
Milwaukee County	$63,403,508,200	-4.9%
City of Milwaukee	$29,500,535,100	-5.6%
Waukesha County	$50,270,294,500	-2.9%
City of Waukesha	$5,904,933,100	-3.2%
SE Wisconsin (7 counties)	$182,621,628,700	-4.2%

Source: Public Policy Forum, 2011

The Public Policy Forum (2011) reported that the major factors contributing to the decline in property values in southeast Wisconsin were the economic change in real estate values and the slowed growth of new construction in the region. Table 5-60 summarizes real estate values and money spent on new construction over the seven county region in 2009 and 2010. The noticeable decline of 5 percent is believed to be a result of declining property values. New construction is an important criterion in measuring real estate values, as “new construction drives total value growth because as parcels are used more intensively, they generate a higher land utility and thus a higher value” (PPF, 2011).

FIGURE 5-5
County Aggregate Changes in Property Values: 2005–2010



Source: Public Policy Forum, 2011

5.4.2.2 Potential Changes in Economy

Projections of water demand take into account the City of Waukesha’s economy and associated water demand as it relates to the City’s water supply service area (see the Water Supply Service Area Plan, Appendix B of the Application). By serving the projected demand, water supply would not constrain or otherwise affect economic growth and thus be consistent with all land use planning. The source of the supply does not affect the quantity; thus, all supply source alternatives are similar with respect to quantity and do not affect the economy.

TABLE 5-60
Changes in Aggregate Real Estate Values: 2009–2010 (USD)

County	2009 Real Estate Value	Economic Change	New Construction	Other Change	2010 Real Estate Value
Kenosha	$14,641,117,700	($885,124,100)	$237,637,200	($56,119,800)	$13,937,511,000
Milwaukee	$64,849,423,300	($3,611,491,400)	$398,632,100	($213,156,700)	$61,423,407,300
Ozaukee	$11,053,112,400	($459,394,700)	$89,167,800	($40,538,800)	$10,642,346,700
Racine	$15,584,722,400	($713,582,400)	$69,673,000	($39,075,600)	$14,901,737,400
Walworth	$15,450,442,800	$738,054,200)	$134,579,100	$1,621,600	$14,848,589,300
Washington	$13,857,974,100	($512,119,500)	$120,946,200	($26,570,000)	$13,440,230,800
Waukesha	$51,011,477,100	($2,182,165,900)	$394,097,100	($37,613,800)	$49,185,794,500
SE Wisconsin	**$186,448,269,800**	**($9,101,932,200)**	**$1,444,732,500**	**($411,453,100)**	**$178,379,617,000**
State of Wisconsin	**$499,856,206,900**	**($19,377,213,300)**	**$4,575,602,300**	**($1,087,907,700)**	**$483,966,688,200**

Source: Public Policy Forum, 2011

The CED study found that the source of water is not a differentiating factor on development within a municipal service area.[48] The only exception to this view is related to groundwater with radium exceeding allowable levels. The study found some planners and utility managers in the southeastern Wisconsin region understood groundwater quality problems to be associated with radium contamination, when the groundwater was withdrawn from deep aquifer sources. There were no contamination concerns expressed for surface water sources, because contamination, specifically by radium, is associated only with deep aquifer sources.

5.4.3 Land Use, Zoning, and Transportation

5.4.3.1 Affected Land Use, Zoning, and Transportation

The pipeline routes associated with the project primarily use existing public right-of-way or utility corridors (see Table 5-42).

The second largest land use category affected for some individual routes is agricultural lands. Even though the Lake Michigan—Milwaukee supply and all the return flow routes cross lands classified as prime farmland (Section 5.2.1.3, Soil), they will have no permanent impact on active agricultural lands. Combined, transportation and communication utilities and agricultural lands account for approximately 75 percent of the total area affected by the supply and return flow routes.

All proposed project routes offer access to potential construction areas on existing public roadways. Public roadways should be sufficient access points, with no need for improvements.

48 University of Wisconsin Milwaukee, Center for Economic Development. 2010. Chapter 3, page 19.

5.4.3.2 Land Use, Zoning, and Transportation Effects

5.4.3.2.1 Land Use

After construction, land with temporary impacts from pipeline construction will be restored to its previous use. Numerous land use types would be traversed by the supply and return flow routes. Existing transmission/right-of-way corridors and agricultural land are the most common land use types. Section 5.2.1.2 of this environmental report provides a more detailed examination of existing land use. Table 5-41 lists quantitative data for land use types affected by a combination of temporary construction impacts and operation impacts.

5.4.3.2.2 Zoning

Construction and operation of a Lake Michigan water supply and return flow would not require changes to zoning conditions. Construction will not affect any areas subject to federal visual resource management standards, and no designated sensitive viewpoints are known to occur along the supply or return flow routes.

As required by the State of Wisconsin under Chapters NR 115 and NR 116, environmental corridors and isolated natural resource areas may be subject to local and county zoning regulations. Shorelands and floodplains are subject to local or county regulation.

The project would be designed to avoid zoning or rezoning issues to the greatest extent practicable. Once designed, the project will meet all federal, state, and local requirements before applicable permits will be issued.

5.4.3.2.3 Transportation

The regional transportation system would be minimally affected by construction and by the travel of construction workers and equipment. Since construction would move sequentially along the pipeline routes, any transportation impacts on any given roadway would be temporary. An increased number of vehicles would be encountered during morning and evening peak times, corresponding to normal workday hours.

The pipelines would be installed by boring underneath all major paved roadway crossings wherever possible. Crossing of roadways with less traffic would likely be performed by open trenching, which may cause minor disruptions in local traffic patterns. Where construction follows a road, work schedules will be communicated with local residents and local authorities to minimize impacts. Access across these roadways will be maintained for emergency vehicles and passenger vehicles through the use of metal plates and other measures. If roads are temporarily closed to through traffic, information will be shared with local first responders regarding roadway conditions. Appropriate control measures will be used during construction, such as detouring of traffic where possible, flagmen, signage, and flashing lights. Roadways will be repaired to their preconstruction condition when installation of the pipelines is completed.

Traffic from commuter (worker) traffic and from the transportation of equipment and materials for the project is expected to increase. The initial staging, which would involve transporting the bulk of the construction equipment and materials and the daily transportation of additional equipment and materials, may temporarily affect local transportation systems. To minimize the effect, delivery routes will be required to minimize traffic disruption when delivering equipment and materials to the project site. As construction progresses, much of the equipment movement will occur along the construction right-of-way. When it is necessary for construction equipment and material to cross roadways, traffic flow may be interrupted. The transportation of equipment and materials will be minimized through planning and coordination with local road jurisdictions. For example, the scheduling of heavy loads and delivery of materials can be coordinated so that it does not conflict with commuting hours.

No significant impact of transportation infrastructure is expected for any water supply or return flow route. Temporary and minor disruptions of traffic flow and pattern are expected to result from construction of the project.

5.4.4 Energy Use

5.4.4.1 Affected Energy Use

Water intake, treatment, and distribution in Waukesha is accomplished from the existing power grid. The supply is adequate and expected to accommodate projected population and economic growth.

5.4.4.2 Energy Use Effects

As described in Table 5-54, energy use and greenhouse gas emissions are similar for the potential Lake Michigan suppliers.

5.4.5 Recreation and Aesthetics

5.4.5.1 Affected Recreation and Aesthetics

5.4.5.1.1 Recreation

According to a review of Google Earth (2009) and the SEWRPC Land Use Division and GIS Division , Park and Open Spaces Sites data (2005), no federally designated or managed Public or Conservation Land and Natural, Recreational, or Scenic Areas would be affected by the supply and return flow routes. See Table 5-45 for a list of public (nonfederal) parks, golf courses, and wildlife areas associated with the supply and return flow routes.

5.4.5.1.2 Aesthetics

There are no areas subject to federal visual resource management standards. No designated sensitive viewpoints are known to occur along the supply and return flow routes.

5.4.5.2 Recreation and Aesthetics Effects

5.4.5.2.1 Recreation

Limited temporary construction impacts may occur to state and local public or conservation land and natural, recreational, or scenic areas as a result of construction.

At this time, no permanent aboveground structures are envisioned within areas designated as state or local Public or Conservation Land and Natural, Recreational, or Scenic Areas. Depending upon the final booster pump station location, a local public park could be affected, however the extent of impact would be limited to approximately 0.25 acres and would be coordinated with local public officials and the public.

Impacts to state and local resources can fall into two main categories: construction-related impacts, and impacts resulting from groundwater table drawdown. Construction-related impacts to resources can be further divided into temporary and permanent impacts. Temporary construction-related impacts will be short in duration and minimized by implementing BMPs designed to reduce impacts to sensitive resources. No permanent aboveground structures are expected to be built within areas designated as state or local public or conservation land and natural, recreational, or scenic areas. As a result, there will be no permanent construction-related impacts.

Permanent impacts resulting from a drawdown of the groundwater table is not applicable for the proposed project.

5.4.5.2.2 Aesthetics

Construction will not affect any areas subject to federal visual resource management standards, and no designated sensitive viewpoints are known to occur along the supply and return flow routes.

The Lake Michigan supply and return routes would not require aboveground facilities or would be limited to a pump station and small service building at an existing treatment plant, water supply facility, or coordinated with local architectural requirements for a new site development. None of the proposed aboveground structures is located in any visually sensitive areas.

Visual impacts of the supply and return flow routes are expected to be minor and temporary. In agricultural areas, previously disturbed easements, roadway corridors, and residential properties, visual disturbance will be difficult to detect by the first growing season following completion of construction and surface restoration efforts.

5.4.6 Archeological and Historical Resources

5.4.6.1 Affected Resources

5.4.6.1.1 Archeological Resources

Archival investigations were conducted by The Public Service Archaeology & Architecture Program of the University of Illinois at Urbana-Champaign (PSAAP) to identify significant cultural resources within or adjacent to potential construction corridors of the proposed supply and return flow alternatives. The investigations included a review of the known archaeological sites and previous cultural resource surveys within 100 meters of each alternative's potential corridor. These findings contain archeologically sensitive and confidential information that is made available to necessary agencies for review. It is not summarized here, because it is not intended for public release.

Some of the alternatives evaluated share project corridors and thus have the potential to disturb the same cultural sites. Most alternatives corridors are separate, and therefore each alternative was investigated separately. The results of the archival investigations are summarized below.

Supply Alternatives

- Lake Michigan—Milwaukee Supply: 5 sites and 6 previous cultural resource surveys
- Lake Michigan—Oak Creek Supply: 11 sites and 11 previous cultural resource surveys
- Lake Michigan—Racine Supply: 2 sites and 7 previous cultural resource surveys

Return Flow for Lake Michigan Water Supply

- Underwood Creek to Lake Michigan: 6 sites and 7 surveys

Attachment 5-3 contains additional information regarding potential sites.

5.4.6.1.2 Historical Resources

The National Parks Service's National Register of Historic Places (NRHP) was authorized under the National Historic Preservation Act of 1966. The NRHP is the official list of historic places throughout the U.S. and is part of a national program to coordinate and support efforts to identify, evaluate, and protect historic and archeological resources (NRHP, 2010a).

No NRHP sites are located within 0.1 mile of the Lake Michigan–Milwaukee, Lake Michigan–Oak Creek, or Lake Michigan–Racine supply alternatives.

Thirteen NRHP sites were identified within 0.1 mile of the Underwood Creek to Lake Michigan return flow alternative, all within Waukesha County; no NRHP sites were identified within the Milwaukee County part of the Underwood Creek to Lake Michigan return flow.

5.4.6.2 Environmental Effects

5.4.6.2.1 Archeological Resources

The City will meet regulatory requirements regarding archeological resources during the design and construction phases to prevent any significant impacts and mitigate impacts to known or potential sites. During operation, there will be no ground disturbance, and no impacts will occur to archeological resources.

5.4.6.2.2 Historical Resources

No NRHP sites will be affected by permanent structures associated with the project. The City will follow regulatory requirements to prevent significant impacts and to mitigate impacts to known or potential NRHP sites. During operation, there will be no ground disturbance, and no impacts will occur to historical resources.

5.4.7 Public Water Supply and Uses

5.4.7.1 Affected Public Water Supply and Uses

5.4.7.1.1 Groundwater

The City of Waukesha currently obtains more than 87 percent of its water supply from the deep St. Peter Sandstone Aquifer. Near and east of the City, the aquifer is confined by a geological feature—the Maquoketa shale layer—that limits natural recharge of the aquifer. Continued use of the aquifer by the City and surrounding communities since the 19th century and the presence of the Maquoketa shale have led to the 500- to 600-foot decline in aquifer water levels.[49] These levels continue to drop 5 to 9 feet per year.[50] Reduced groundwater levels in southeastern Wisconsin have in turn affected regional surface waters, which now receive about 18 percent[51] less in groundwater contribution as water migrates toward the deep aquifer. Significant water quality issues occur with declining water levels

[49] *Draft Planning Report on Regional Water Supply Plan for Southeastern Wisconsin*, Southeastern Regional Planning Commission, 2008, pp.102–103.

[50] Waukesha Water Utility 2009 operating data.

[51] U.S. Geological Survey and Wisconsin Geological and Natural History Survey.

in the deep aquifer, including increased levels of salts and radium (a naturally occurring element in the deep aquifer that can cause cancer).

To provide drinking water with low levels of radium, the City treats some deep aquifer water to remove radium and mixes it with radium-free water from the shallow Troy Bedrock aquifer. The City obtains less than 13 percent of its water supply from the shallow aquifer. Increased pumping of the shallow aquifer will stress surface water resources by reducing base flows to local streams and wetlands.[52]

5.47.1.2 Surface Water

The City is seeking a water supply of 10.9 million gallons per day (mgd) to meet future average day water demand of the City's projected water service area as delineated by the SEWRPC. The City seeks sufficient water to serve customers within its delineated service area.

Lake Michigan, the preferred water supply alternative, is bordered by four states and connected through the other Great Lakes to four other Great Lakes states and two Canadian provinces. Lake Michigan is the second largest of the Great Lakes and the only one entirely within the borders of the U.S.[53]

5.47.1.3 Water Uses

The City of Waukesha actively tracks water use by customer class for the following:

- **Residential**. Residential water demand typically includes indoor water-using activities, such as those for bathroom, kitchen, and laundry, and outdoor water use, such as that for lawn irrigation, swimming pools, and car washing. Waukesha's four categories of residential customers were analyzed:
  - Single-family Residential
  - Two-family Residential
  - Three-family Residential
  - Multi-family Residential (multi-family is tracked separately as outlined below)

For summary purposes, residential water use is measured in accordance with requirements set forth by the Public Service Commission of Wisconsin.

- **Industrial.** Manufacturing, processing, warehouses, foundaries, dairies.
- **Commercial.** Commercial water use is presented by customers such as retail, restaurants, office buildings, medical facilities, private schools
- **Public.** Public water use includes water demands for municipal buildings, public facilities, parks, public schools and institutions
- **Unsold Accounted for Water.** Water uses that are measured (or estimated) but not included in sales. Examples of this water use include water used in annual water main flushing to maintain water quality and water used in fire fighting exercises.

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52 *Draft Planning Report on Regional Water Supply Plan for Southeastern Wisconsin*, SEWPRC, 2008, pp. 8–14.

53 http://www.dnr.state.wi.us/org/water/greatlakes/discover/lakemichigan.htm. Accessed March 4, 2010.

- **Unaccounted for Water.** The difference between total pumpage and total water sales is termed nonrevenue water and is usually expressed as a percentage. The portion of nonrevenue water attributed to leakage, meter inaccuracies, and other unknown losses is often termed *unaccounted-for water.*

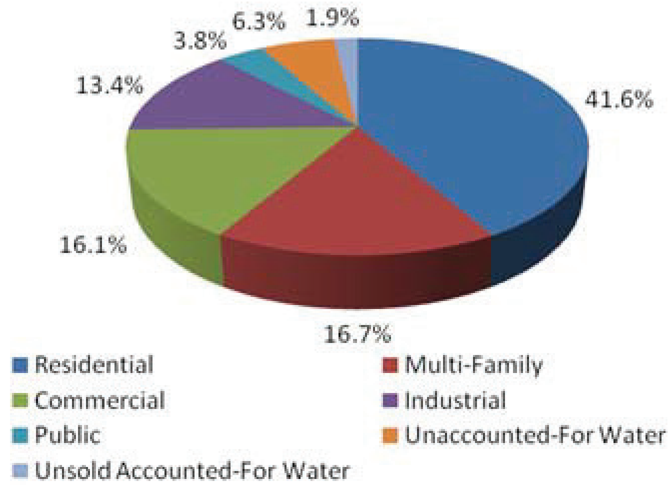
Water use categories aid the utility in effectively managing water, planning for future water demand, and in developing a strategic water conservation plan (CH2M HILL, 2012).

Water use by sector for 2010 is shown in Figure 5-6. Single family and multi-family residential water use accounts for nearly 60 percent of all water use in the City of Waukesha.

Unaccounted-for water in 2010 was 6.3 percent of all water use. The City's unaccounted-for water is below the American Water Works Association recommended value of 10 percent, and well below the Public Service Commission's recommended action level of 15 percent.

Trends in water use annually over the 1999 to 2010 period are shown in Figure 5-7. The figure combines multi-family water use with residential water use (one to three family buildings).

FIGURE 5-6
Water Use by Customer Class: Waukesha Water Utility



Seasonal water use patterns provide helpful information regarding the water use in the City's service area. Figure 5-8 presents monthly water use in 2005 and 2010. In 2006, the City restricted outdoor water use by municipal ordinance to conserve water. Since then, seasonal peak demands have declined significantly. The City must plan for a peak pumping season from May through September, but its water demand forecasts for the future assume the City will continue to restrict peak season outdoor water use. Additional information on water conservation can be found in the City of Waukesha Water Conservation Plan (CH2M HILL 2012).

FIGURE 5-7

Annual Water Use Trend by Customer Class: Waukesha Water Utility

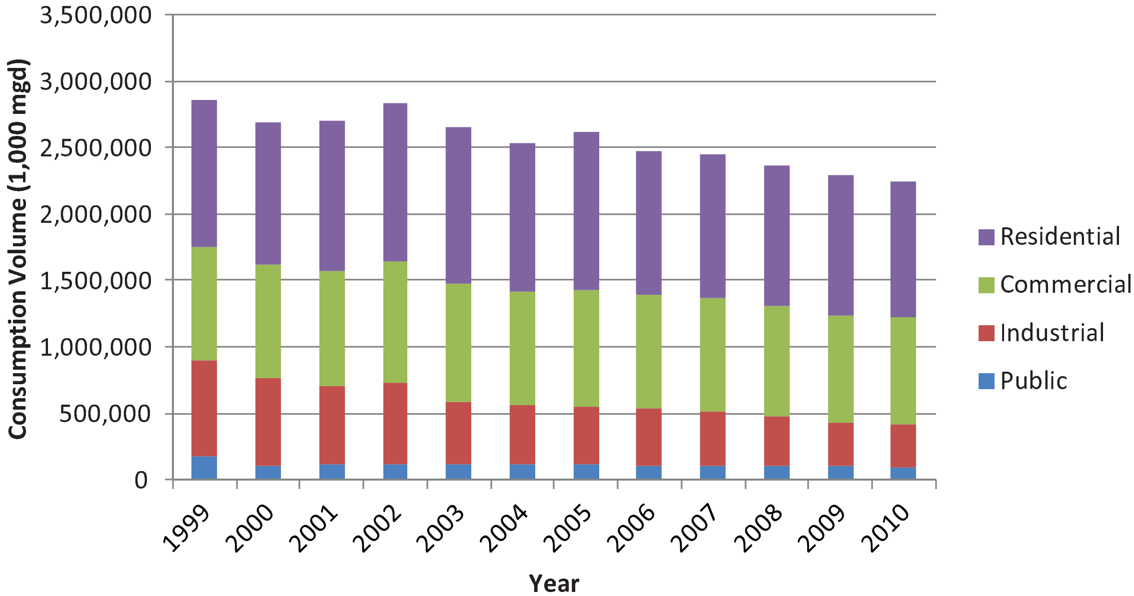
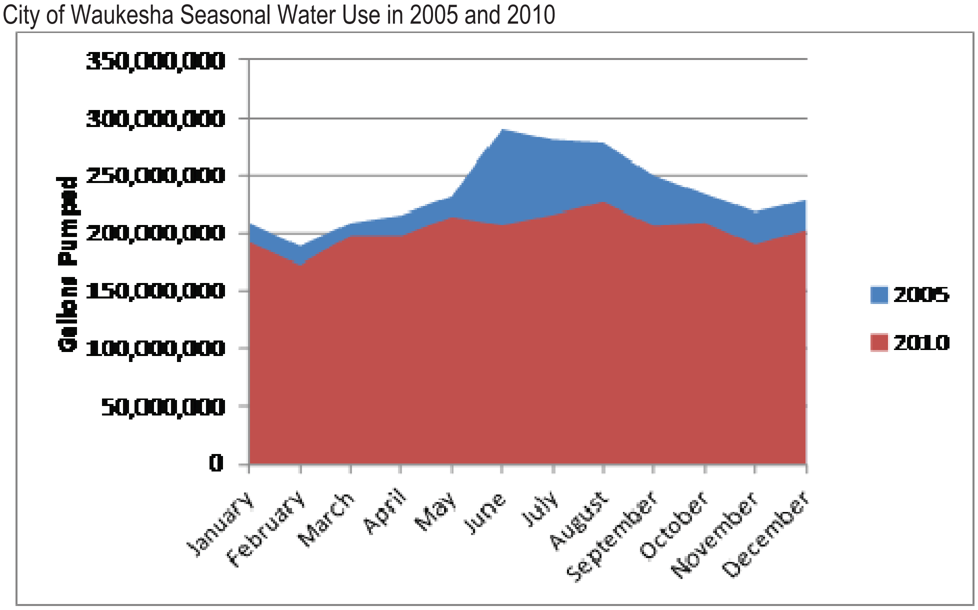


FIGURE 5-8

City of Waukesha Seasonal Water Use in 2005 and 2010



Source: City of Waukesha Annual Report to the Wisconsin Public Service Commission, 2010

5.4.7.2 Public Water Supply and Use Effects

5.4.7.2.1 Groundwater

A Lake Michigan water supply would eliminate the need to pump the deep aquifer, which would cause a partial rebound in the deep aquifer in the City of Waukesha. Because of the volume of water present, withdrawal from Lake Michigan with return flow would result in no changes in lake volume, and therefore it is not expected that withdrawal from the lake would result in adverse effects to regional aquifer supplies influenced by Lake Michigan. Lake Michigan water supply consequently produces no adverse impact on groundwater resources.

5.4.7.2.2 Surface Water

The inland waterways are not used as water supply sources. There would be no change to water supply sources with these changes, since none of the surface waters is used for water supply.

Because of the volume of water present, withdrawal from Lake Michigan with return flow would result in no changes in lake volume. Therefore, it is not expected that withdrawal from the lake would result in adverse effects to regional aquifer supplies influenced by Lake Michigan. Lake Michigan water supply consequently would have no adverse impact on existing water supplies.

5.4.7.2.3 Water Uses

No changes in water use sectors are expected with a change in water supply source. Water use by residential, commercial, and industrial sectors is not dependent upon water source. Instead, it will change over time due to varying factors such regional economic conditions, impacts from water conservation, and climatic conditions.

5.4.8 Environmental Justice

Executive Order (EO) 12898 stipulates that Federal actions, or projects funded by Federal monies may not result in disproportionately high and adverse impacts to low-income or minority populations. *Low-income* means a household income at or below the Department of Health and Human Services poverty guidelines. *Minority* indicates a person who is Black, Hispanic, Asian American, American Indian, or Alaskan Native. EO 12898 directs federal agencies to consider environmental justice by identifying and mitigating disproportionately high and adverse human health and environmental effects. This includes the interrelated social and economic benefits of their programs, policies, and activities on low-income and minority populations.

No residents would be displaced by the construction or operation of the project and economic development projections are consistent under all the water supply alternatives. Therefore, no environmental justice populations would be displaced by the project or any of the alternatives, and the project operation is not expected to cause any adverse impacts to low income or minority populations.

5.4.9 Safety

5.4.9.1 Construction

Access to the construction site would be prohibited to nonconstruction workers or contractors unless special circumstances warranted entry, which would require pre-approval from the Construction Contractor. Signage, temporary fencing, or other means as appropriate to the location will be put in place to prevent trespassing. Appropriate safety procedures will be implemented to protect workers and the public. As needed, traffic warning signs, detour signs and other traffic control devices will be used as required by federal, state, and local Departments of Transportation and other regulating bodies. Road crossings will be completed in accordance with the requirements of road crossing permits.

5.4.9.2 Operation

5.4.9.2.1 Protection of Children

Executive Order 13045, Protection of Children from Environmental Health Risks and Safety Risk (FR: April 23, 1997, Volume 62, Number 78), specifies guidelines for the protection of children. This EO requires that Federal agencies make it a high priority to identify and assess environmental health risks and safety risks that may disproportionately affect children and to ensure that policies, programs, and standards address disproportionate risks to children that result from environmental health or safety risks.

None of the alternatives associated with the project would impose health or security risks to children. Additionally, temporary emissions from the construction equipment would fall within federal and state air quality standards, including those established to protect sensitive populations, such as children. The project would not cause an environmental risk that would disproportionately affect the health of children.

5.4.9.2.2 Protection of Sensitive Populations

The National Ambient Air Quality Standards include standards to protect public health and to protect public welfare and the environment. The USEPA established the standards for protection of public health through an evaluation of environmental health effects, which included a margin of safety to protect children and other sensitive populations.

Temporary emissions from the construction equipment would fall within federal and state air quality standards, including those established to protect sensitive populations, such as children. Emissions from the activities associated with operation of the project would be associated with electrical supply from regional electrical utilities and consequently would be very low and would not adversely affect the elderly or other sensitive populations. Electrical usage as shown above decreases from existing conditions, leading to fewer greenhouse gas emissions from electrical usage by the Waukesha Water Utility. Additionally, exposure to hazardous conditions is extremely unlikely.

5.4.10 Environmental Effects Comparison: Socioeconomics

Socioeconomic impacts are summarized below. Level of relative impact (no adverse impact, minor adverse impact, etc.) to the socioeconomic environment were developed to compare impacts. Although more than four areas of consideration are discussed in this socioeconomics section, Tables 5-61 and 6-62 evaluate four key areas of concern. Based on an initial review of potential socioeconomic impacts, neither the proposed project nor alternatives to the proposed project would have significant adverse impacts to the socioeconomic environment. They are all similar and would all consistently have no adverse impact to the socioeconomic environment.

Once the impact parameters were determined, each alternative was considered individually for the potential for impacts.

Because no individual alternative will result in moderate or signifcant impacts to the socioeconomic environment, a comprehensive discussion of each alternative is not included in this section, and socioeconomic impacts will not continue to be compared side by side with other impacts.

TABLE 5-61
Matrix for Determining Level of Potential Adverse Impact for Socioeconomic Environment

Key Considerations	No Adverse Impact	Minor Adverse Impact	Moderate Adverse Impact	Significant Adverse Impact
Population & Housing	No permanent adverse impacts; and little to no minor temporary adverse impacts to population numbers and available housing. Potential for reduction in population and adjacent housing market.	Temporary adverse impacts to population numbers and available housing. Potential for reduction in population and area housing market.	Long term adverse impacts to population numbers and available housing. Probable reduction in population and area housing market. Increased rental vacancy rates.	Permanent adverse impacts to population numbers and available housing. Potential for reduction in population and regional housing market.
Local Economy & Employment	No permanent adverse impacts; little to no minor temporary adverse impacts to local economic conditions. No adverse impact to existing employment and unemployment rates.	Temporary adverse impact to local economic conditions. Short-term increase in unemployment rates on a local level.	Long-term adverse impact to local economic conditions. Moderate increase in unemployment rates on a local and regional level.	Permanent adverse impacts to local economic conditions. Long-term increase in local and regional unemployment rates.
Environmental Justice	No disproportionately high and adverse human health or environmental effects on low-income populations, minority populations, or Indian tribes.	No displacement, but siting of project in area of localized low-income populations, minority populations, or Indian tribes. Potential for short-term minor hazardous exposure.	Temporary displacement or relocation of low-income populations, minority populations, or Indian tribes.	Displacement of or hazardous exposure to low-income populations, minority populations, or Indian tribes.
Safety	No reduction in the existing level of safety and security (including health and protection of children) will occur.	Potential for temporary impacts to existing level of safety and security (including health and protection of children) will occur as a result of construction or operation or Project.	Potential for short-term dangerous conditions or minimal exposure to toxins from construction and operation of the Project.	Potential for long-term dangerous conditions or exposure to toxins from construction and operation of the Project.

TABLE 5-62
Anticipated Socioeconomic Impacts

	Key Socioeconomic Considerations			
Proposed Project	**Population & Housing**	**Local Economy & Employment**	**Environmental Justice**	**Safety**
Water Supply				
Lake Michigan (City of Milwaukee)	No adverse impact			
Lake Michigan (City of Oak Creek)	No adverse impact			
Lake Michigan (City of Racine)	No adverse impact			
Return Flow for Lake Michigan Water Supply				
Underwood Creek to Lake Michigan	No adverse impact			

5.5 Proposed Project Impact Summary

The side by side environmental impact comparison tables were compiled to have one overall comparison of the environmental impacts for the proposed project. Where resource impact tables occurred more than once (for example, water quality summary tables occur for both Lake Michigan and inland waterways), the impacts were added together to account for impacts to both resources. The side by side comparison of the environmental impacts is included in Table 5-63. A side by side comparison of system alternatives (water supply with return flow) is included in Attachment 5-1.

Once a water supplier and return flow location have been approved and the proposed project progresses into detailed design, the City of Waukesha will continue to work with the regulatory agencies during final design to conduct any necessary field surveys, location refinements, mitigation planning, and to obtain required construction permits.

TABLE 5-63
Proposed Project Environmental Impact Comparison Summary

Water Supply Alternative	Groundwater Resources	Geomorphology and Sediments	Flooding	Aquatic Habitat	Water Quality	Wetlands	Vegetation and Wildlife Resources	Soils	Land Use
Water Supply									
Lake Michigan (City of Milwaukee)	No adverse impact	No adverse impact	No adverse impact	Minor adverse impact	No adverse impact	Minor adverse impact	No adverse impact	No adverse impact	No adverse impact
Lake Michigan (City of Oak Creek)	No adverse impact	No adverse impact	No adverse impact	Minor adverse impact	No adverse impact	Minor adverse impact	No adverse impact	No adverse impact	No adverse impact
Lake Michigan (City of Racine)	No adverse impact	No adverse impact	No adverse impact	Minor adverse impact	No adverse impact	Moderate adverse impact	No adverse impact	No adverse impact	No adverse impact
Return Flow for Lake Michigan Water Supply									
Underwood Creek to Lake Michigan	No adverse impact	No adverse impact	No adverse impact	No adverse impact	Minor adverse impact	Minor adverse impact	No adverse impact	No adverse impact	No adverse impact

Attachment 5-1
System Alternative Summary Tables - Proposed Project

System Alternative Summary Tables –Proposed Project

This attachment contains system alternative tables that summarize impacts for various resource categories. The table numbers correspond to the table number in Section 5 with an “A” after the number. For example, the system alternative comparison table for “Table 5-7” in Section 5 is listed as “Table 5-7A” in this attachment.

Water supply and return flow alternatives were developed individually, while return flow alternatives were developed considering the Lake Michigan supply source. These individual water supply and return flow alternatives are combined to create a “system alternative”. A system alternative adds together the impacts from both water supply and treated wastewater discharge to provide the sum of the impacts with respect to the environment. An example “system alternative” for a Lake Michigan basin water supply includes connecting to the City of Milwaukee’s Lake Michigan water supply with wastewater treatment at the City of Waukesha WWTP and return flow of treated wastewater to Lake Michigan via Underwood Creek.

Impacts from individual water supply and return flow alternatives were added together to determine the system alternative impacts. This is a conservative approach because for resource impacts associated with the pipeline routes, the water supply pipeline route and the return flow pipeline route overlap, which creates some double counting of impacts.

Where impact categories are compared, the most severe impact was selected for the system alternative. For example, if a water supply had a “moderate adverse impact” designation and the return flow had a “no adverse impact” designation, the “moderate adverse impact” designation was assigned to the system alternative.

The following is a table listing for this attachment. Not all tables are directly applicable to system alternatives comparison. Consequently, not all tables in Section 5 are included below.

Tables

For Table 5-3A, the more conservative of the water supply alternative and water return alternative designations was used to define the system alternative impact.

TABLE 5-3A
System Alternatives Environmental Impact Comparison Summary: Lake Michigan Water Quality

Water Supply Alternative	Water Return Alternative	Water Quality
Lake Michigan (City of Milwaukee)	Underwood Creek to Lake Michigan	Minor adverse impact
Lake Michigan (City of Oak Creek)	Underwood Creek to Lake Michigan	Minor adverse impact
Lake Michigan (City of Racine)	Underwood Creek to Lake Michigan	Minor adverse impact

For Table 5-5A, the more conservative of the water supply alternative and water return alternative designations was used to define the system alternative impact.

TABLE 5-5A
System Alternatives Environmental Impact Comparison Summary: Lake Michigan Geomorphology and Sediments

Water Supply Alternative	Water Return Alternative	Geomorphology and Sediments
Lake Michigan (City of Milwaukee)	Underwood Creek to Lake Michigan	No adverse impact
Lake Michigan (City of Oak Creek)	Underwood Creek to Lake Michigan	No adverse impact
Lake Michigan (City of Racine)	Underwood Creek to Lake Michigan	No adverse impact

For Table 5-7A, the more conservative of the water supply alternative and water return alternative designations was used to define the system alternative impact.

TABLE 5-7A
System Alternatives Environmental Impact Comparison Summary: Lake Michigan Aquatic Habitat

Water Supply Alternative	Water Return Alternative	Aquatic Habitat
Lake Michigan (City of Milwaukee)	Underwood Creek to Lake Michigan	No adverse impact
Lake Michigan (City of Oak Creek)	Underwood Creek to Lake Michigan	No adverse impact
Lake Michigan (City of Racine)	Underwood Creek to Lake Michigan	No adverse impact

For Table 5-10A, the number of water body crossings of the water supply alternative was added to the number of water body crossings for the water return alternative to define the system alternative impact.

TABLE 5-10A
System Alternatives Environmental Impact Comparison Summary: Number of Water Body Crossings

Water Supply Alternative	Water Return Alternative	Number of Water Body Crossings
Lake Michigan (City of Milwaukee)	Underwood Creek to Lake Michigan	17
Lake Michigan (City of Oak Creek)	Underwood Creek to Lake Michigan	20
Lake Michigan (City of Racine)	Underwood Creek to Lake Michigan	25

For Table 5-12A, the more conservative of the water supply alternative and water return alternative designations was used to define the system alternative impact.

TABLE 5-12A
System Alternatives Environmental Impact Comparison Summary: Inland Waterway Flooding and Aquatic Habitat

Water Supply Alternative	Water Return Alternative	Aquatic Habitat	Flooding
Lake Michigan (City of Milwaukee)	Underwood Creek to Lake Michigan	Minor adverse impact	No adverse impact
Lake Michigan (City of Oak Creek)	Underwood Creek to Lake Michigan	Minor adverse impact	No adverse impact
Lake Michigan (City of Racine)	Underwood Creek to Lake Michigan	Minor adverse impact	No adverse impact

For Table 5-20A, the more conservative of the water supply alternative and water return alternative designations was used to define the system alternative impact.

TABLE 5-20A
System Alternatives Environmental Impact Comparison Summary: Inland Waterway Water Quality

Water Supply Alternative	Water Return Alternative	Water Quality
Lake Michigan (City of Milwaukee)	Underwood Creek to Lake Michigan	Minor adverse impact
Lake Michigan (City of Oak Creek)	Underwood Creek to Lake Michigan	Minor adverse impact
Lake Michigan (City of Racine)	Underwood Creek to Lake Michigan	Minor adverse impact

For Table 5-22A, the more conservative of the water supply alternative and water return alternative designations was used to define the system alternative impact.

TABLE 5-22A
System Alternatives Environmental Impact Comparison Summary: Inland Waterways Geomorphology and Sediments

Water Supply Alternative	Water Return Alternative	Geomorphology and Sediments
Lake Michigan (City of Milwaukee)	Underwood Creek to Lake Michigan	No adverse impact
Lake Michigan (City of Oak Creek)	Underwood Creek to Lake Michigan	No adverse impact
Lake Michigan (City of Racine)	Underwood Creek to Lake Michigan	No adverse impact

For Table 5-32A, the number of temporary and permanent wetland acres from the water supply alternative was added to the number of temporary and permanent wetland acres from the water return alternative to define the system alternative impact. This is a conservative approach because water supply and return flow routes share some common corridors, which would cause actual impacts to be less. Slight variations exist between alternatives due to rounding.

TABLE 5-32A
System Alternatives Environmental Impact Comparison Summary: Wetlands Crossed by the Proposed Project (acres)

Water Supply Alternative	Return Flow Alternative	Temporary Wetland Impacts (ac)	Permanent Wetland Impacts (ac)
Lake Michigan (City of Milwaukee)	Underwood Creek to Lake Michigan	16	2
Lake Michigan (City of Oak Creek)	Underwood Creek to Lake Michigan	23	2
Lake Michigan (City of Racine)	Underwood Creek to Lake Michigan	61	7

For Table 5-34A, the more conservative of the water supply alternative and water return alternative designations was used to define the system alternative impact.

TABLE 5-34A
System Alternatives Environmental Impact Comparison Summary: Wetlands

Water Supply Alternative	Water Return Alternative	Temporary and Permanent Wetland Impacts
Lake Michigan (City of Milwaukee)	Underwood Creek to Lake Michigan	Minor adverse impact
Lake Michigan (City of Oak Creek)	Underwood Creek to Lake Michigan	Minor adverse impact
Lake Michigan (City of Racine)	Underwood Creek to Lake Michigan	Moderate adverse impact

For Table 5-35A, the number of high suitability ratings from the water supply alternative was added to the number of high suitability ratings from the water return alternative to define the system alternative impact.

TABLE 5-35A
System Alternatives Environmental Impact Comparison Summary: High Natural Community Suitability Ratings

Water Supply Alternative	Water Return Alternative	Number of Natural Community HighSuitability Ratings (out of 16)
Lake Michigan (City of Milwaukee)	Underwood Creek to Lake Michigan	0
Lake Michigan (City of Oak Creek)	Underwood Creek to Lake Michigan	1
Lake Michigan (City of Racine)	Underwood Creek to Lake Michigan	3

For Table 5-39A, the more conservative of the water supply alternative and water return alternative designations was used to define the system alternative impact.

TABLE 5-39A
System Alternatives Environmental Impact Comparison Summary: Groundwater Resources

Water Supply Alternative	Water Return Alternative	Groundwater Resources
Lake Michigan (City of Milwaukee)	Underwood Creek to Lake Michigan	No adverse impact
Lake Michigan (City of Oak Creek)	Underwood Creek to Lake Michigan	No adverse impact
Lake Michigan (City of Racine)	Underwood Creek to Lake Michigan	No adverse impact

For Table 5-45A, the acres of land affected from the water supply alternative was added to the acres of affected by the water return alternative to define the system alternative impact.

TABLE 5-45A
System Alternatives Environmental Impact Comparison Summary: Public or Conservation Lands within or Adjacent to the Alternatives

Water Supply Alternative	Water Return Alternative	Number of Properties	Acres within Proposed 75ft Construction Workspace
Lake Michigan (City of Milwaukee)	Underwood Creek to Lake Michigan	10	32.07
Lake Michigan (City of Oak Creek)	Underwood Creek to Lake Michigan	15	66.67
Lake Michigan (City of Racine)	Underwood Creek to Lake Michigan	11	28.34

For Table 5-47A and Table 5-53A, the more conservative of the water supply alternative and water return alternative designations was used to define the system alternative impact.

TABLE 5-47A
System Alternatives Environmental Impact Comparison Summary: Land Use

Water Supply Alternative	Water Return Alternative	Land Use
Lake Michigan (City of Milwaukee)	Underwood Creek to Lake Michigan	No adverse impact
Lake Michigan (City of Oak Creek)	Underwood Creek to Lake Michigan	No adverse impact
Lake Michigan (City of Racine)	Underwood Creek to Lake Michigan	No adverse impact

TABLE 5-53A
System Alternatives Environmental Impact Comparison Summary: Soils

Water Supply Alternative	Water Return Alternative	Soils
Lake Michigan (City of Milwaukee)	Underwood Creek to Lake Michigan	No adverse impact
Lake Michigan (City of Oak Creek)	Underwood Creek to Lake Michigan	No adverse impact
Lake Michigan (City of Racine)	Underwood Creek to Lake Michigan	No adverse impact

For Table 5-54A, the water supply alternative and water return alternative values were added together to define the system alternative impact.

TABLE 5-54A
System Alternatives Environmental Impact Comparison Summary: Estimated Energy Use and GHG Emissions

Water Supply Alternative	Water Return Alternative	Estimated Annual Energy Usage (MWh)	Estimated Annual GHG Emissions (tons CO_2)
Lake Michigan (City of Milwaukee)	Underwood Creek to Lake Michigan	16,800	15,600
Lake Michigan (City of Oak Creek)	Underwood Creek to Lake Michigan	20,900	19,400
Lake Michigan (City of Racine)	Underwood Creek to Lake Michigan	19,600	18,200

For Table 5-63A, the more conservative of the water supply alternative and water return alternative designations was used to define the system alternative impact.

TABLE 5-63A
Water Supply and Return Flow Alternative Environmental Impact Comparison Summary

Water Supply Alternative	Water Return Alternative	Groundwater Resources	Geomorphology and Sediments	Flooding	Aquatic Habitat	Water Quality	Wetlands	Vegetation and Wildlife Resources	Soils	Land Use
Lake Michigan (City of Milwaukee)	Underwood Creek to Lake Michigan	No adverse impact	No adverse impact	No adverse impact	Minor adverse impact	Minor adverse impact	Minor adverse impact	No adverse impact	No adverse impact	No adverse impact
Lake Michigan (City of Oak Creek)	Underwood Creek to Lake Michigan	No adverse impact	No adverse impact	No adverse impact	Minor adverse impact	Minor adverse impact	Minor adverse impact	No adverse impact	No adverse impact	No adverse impact
Lake Michigan (City of Racine)	Underwood Creek to Lake Michigan	No adverse impact	No adverse impact	No adverse impact	Minor adverse impact	Minor adverse impact	Moderate adverse impact	No adverse impact	No adverse impact	No adverse impact

Attachment 5-2
Example Wetland and Waterbody Pipeline Construction and Mitigation Procedures

ATTACHMENT 5-2

Example Wetland and Waterbody Pipeline Construction and Mitigation Procedures

This appendix outlines common practices that can be used to minimize the impact of constructing long pipelines through waterways or wetlands. The process of providing Lake Michigan water to the City of Waukesha, as discussed in the Environmental Report, will require the construction of pipelines crossing water bodies and wetlands. All of the preliminary design alternatives analyzed in the study have shown that they will cross a wetland or waterway of some kind (wetland, stream, etc.).

The list below provides examples of the techniques that may be used during construction of the pipeline. These techniques were identified from typical practices used for prior long pipeline construction projects in Wisconsin, including Federal Energy Regulatory Commission pipeline projects, among others. The actual procedures that will be implemented during construction will be agreed upon by the regulatory agencies during the final design of this project and may include some of these techniques as well as others.

1.01 INSTALLATION OF WATERBODY CROSSINGS

A. General Crossing Procedures:

1. Comply with the Corps of Engineers (COE), or its delegated agency, permit terms and conditions.
2. Construct crossings as close to perpendicular to the axis of the waterbody channel as engineering and routing conditions permit.
3. If the pipeline parallels a waterbody, attempt to maintain at least 15 feet of undisturbed vegetation between the waterbody (and any adjacent wetland) and the construction right-of-way.
4. Where waterbodies meander or have multiple channels, route the pipeline to minimize the number of waterbody crossings.
5. Maintain adequate flow rates to protect aquatic life, and prevent the interruption of existing downstream uses.
6. Waterbody buffers (extra work area setbacks, refueling restrictions, etc.) must be clearly marked in the field with signs and/or highly visible flagging until construction-related ground disturbing activities are complete.

B. Spoil Pile Placement and Control:

1. All spoil from minor and intermediate waterbody crossings, and upland spoil from major waterbody crossings, must be placed in the construction right-of-way

at least 10 feet from the water's edge or in additional extra work areas as described in section V.B.2.

2. Use sediment barriers to prevent the flow of spoil or heavily silt laden water into any waterbody.

C. Equipment Bridges:

1. Only clearing equipment and equipment necessary for installation of equipment bridges may cross waterbodies prior to bridge installation. Limit the number of such crossings of each waterbody to one per piece of clearing equipment.

2. Construct equipment bridges to maintain unrestricted flow and to prevent soil from entering the waterbody. Examples of such bridges include:

   a. Equipment pads and culvert(s).
   b. Equipment pads or railroad car bridges without culverts.
   c. Clean rock fill and culvert(s); and
   d. Flexi-float or portable bridges.

3. Additional options for equipment bridges may be utilized that achieve the performance objectives noted above. Do not use soil to construct or stabilize equipment bridges.

4. Design and maintain each equipment bridge to withstand and pass the highest flow expected to occur while the bridge is in place. Align culverts to prevent bank erosion or streambed scour. If necessary, install energy dissipating devices downstream of the culverts.

5. Design and maintain equipment bridges to prevent soil from entering the waterbody.

6. Remove equipment bridges as soon as possible after permanent seeding unless the COE, or its delegated agency, authorizes it as a permanent bridge.

7. If there will be more than 1 month between final cleanup and the beginning of permanent seeding and reasonable alternative access to the right-of-way is available, remove equipment bridges as soon as possible after final cleanup.

D. Dry-Ditch Crossing Methods:

1. Unless approved otherwise by the appropriate state agency, install the pipeline using one of the dry-ditch methods outlined below for crossings of waterbodies up to 30 feet wide (at the water's edge at the time of construction) that are state-designated as either coldwater or significant coolwater or warmwater fisheries.

2. Dam and Pump:

   a. The dam-and-pump method may be used without prior approval for crossings of waterbodies where pumps can adequately transfer streamflow volumes around the work area, and there are no concerns about sensitive species passage.

   b. Implementation of the dam-and-pump crossing method

c. Must meet the following performance criteria:

1) Use sufficient pumps, including on-site backup pumps, to maintain downstream flows;

2) Construct dams with materials that prevent sediment and other pollutants from entering the waterbody (e.g., sandbags or clean gravel with plastic liner);

3) Screen pump intakes;

4) Prevent streambed scour at pump discharge; and

5) Monitor the dam and pumps to ensure proper operation throughout the waterbody crossing.

3. Flume Crossing: The flume crossing method requires implementation of the following steps:

a. Install flume pipe before any trenching;

b. Use sand bag or sand bag and plastic sheeting diversion structure or equivalent to develop an effective seal and to divert stream flow through the flume pipe (some modifications to the stream bottom may be required in to achieve an effective seal);

c. Properly align flume pipe(s) to prevent bank erosion and streambed scour;

d. Do not remove flume pipe during trenching, pipelaying, or backfilling activities, or initial streambed restoration efforts; and;

e. Remove all flume pipes and dams that are not also part of the equipment bridge as soon as final cleanup of the stream bed and bank is complete.

4. Horizontal Directional Drill (HDD): To the extent they were not provided as part of the pre-certification process, for each waterbody or wetland that would be crossed using the HDD method, provide a plan that includes:

a. Site-specific construction diagrams that show the location of mud pits, pipe assembly areas, and all areas to be disturbed or cleared for construction;

b. A description of how an inadvertent release of drilling mud would be contained and cleaned up; and

c. A contingency plan for crossing the waterbody or wetland in the event the directional drill is unsuccessful and how the abandoned drill hole would be sealed, if necessary.

E. Crossings of Minor Waterbodies: Where a dry-ditch crossing is not required, minor waterbodies may be crossed using the open-cut crossing method, with the following restrictions:

1. Except for blasting and other rock breaking measures (if applicable), complete instream construction activities (including trenching, pipe installation, backfill, and restoration of the streambed contours) within 24 hours. Streambanks and unconsolidated streambeds may require additional restoration after this period;

2. Limit use of equipment operating in the waterbody to that needed to construct the crossing; and

3. Equipment bridges are not required at minor waterbodies that do not have a state-designated fishery classification (e.g., agricultural or intermittent drainage ditches). However, if an equipment bridge is used it must be constructed as described.

F. Crossings of Intermediate Waterbodies: Where a dry-ditch crossing is not required, intermediate waterbodies may be crossed using the open-cut crossing method, with the following restrictions:

1. Complete instream construction activities (not including blasting and other rock breaking measures, if applicable) within 48 hours, unless site specific conditions make completion within 48 hours infeasible;

2. Limit use of equipment operating in the waterbody to that needed to construct the crossing; and

3. All other construction equipment must cross on an equipment bridge as specified.

G. Crossings of Major Waterbodies: Before construction, the project sponsor shall develop a plan for each major water body crossing. This plan should be developed in consultation with the appropriate state and Federal agencies and should include extra work areas, spoil storage areas, sediment control structures, etc., as well as mitigation for navigational issues.

1.02 INSTALLATION OF WETLAND CROSSINGS

A. Extra Work Areas and Access Roads:

1. Locate all extra work areas (such as staging areas and additional spoil storage areas) at least 50 feet away from wetland boundaries, unless site constraints require a narrower buffer, except where the adjacent upland consists of actively cultivated or rotated cropland or other disturbed land.

2. The project sponsor shall develop a site-specific construction plan for each extra work area with a less than 50-foot setback from wetland boundaries (except where adjacent upland consists of actively cultivated or rotated cropland or other disturbed land) and a site-specific explanation of the conditions that will not permit a 50-foot setback.

3. Limit clearing of vegetation between extra work areas and the edge of the wetland to the certificated construction right-of-way.

4. The construction right-of-way may be used for access when the wetland soil is firm enough to avoid rutting or the construction right-of-way has been appropriately stabilized to avoid rutting (e.g., with timber riprap, prefabricated equipment mats, or terra mats). In wetlands that cannot be appropriately stabilized, all construction equipment other than that needed to install the

wetland crossing shall use access roads located in upland areas. Where access roads in upland areas do not provide reasonable access, limit all other construction equipment to one pass through the wetland using the construction right-of-way.

5. The only access roads, other than the construction right-of-way, that can be used in wetlands, are those existing roads that can be used with no modification and no impact on the wetland.

B. Crossing Procedures:

1. Comply with COE, or its delegated agency, permit terms and conditions.
2. Assemble the pipeline in an upland area unless the wetland is dry enough to adequately support skids and pipe or pipe material necessitates a different implementation approach.
3. Use "directional drill” or “floating mat” techniques to place the pipe in the trench where water and other site conditions allow.
4. Minimize the length of time that topsoil is segregated and the trench is open.
5. Limit construction equipment operating in wetland areas to that needed to clear the construction right-of-way, dig the trench, fabricate and install the pipeline, backfill the trench, and restore the construction right-of-way.
6. Cut vegetation just above ground level, leaving existing root systems in place, and remove it from the wetland for disposal.
7. Limit pulling of tree stumps and grading activities to directly over the trenchline. Do not grade or remove stumps or root systems from the rest of the construction right-of-way in wetlands unless safety-related construction constraints require grading or the removal of tree stumps from under the working side of the construction right-of-way.
8. Segregate the top 1 foot of topsoil from the area disturbed by trenching, except in areas where standing water is present or soils are saturated or frozen. Immediately after backfilling is complete, restore the segregated topsoil to its original location.
9. Do not use rock, soil imported from outside the wetland, tree stumps, or brush riprap to support equipment on the construction right-of-way.
10. If standing water or saturated soils are present, or if construction equipment causes ruts or mixing of the topsoil and subsoil in wetlands, use low-ground-weight construction equipment, or operate normal equipment on timber riprap, prefabricated equipment mats, or terra mats.
11. Do not cut trees outside of the approved construction work area to obtain timber for riprap or equipment mats.
12. Attempt to use no more than two layers of timber riprap to support equipment on the construction right-of-way.

13. Remove all project-related material used to support equipment on the construction right-of-way upon completion of construction.

Attachment 5-3
Archeological and Historical Resources

ATTACHMENT 5-3

Archeological and Historical Resources

The City of Waukesha (the City) needs a long-term water source that can meet water supply demands, is protective of human health and the environment, and is sustainable. The water supply source will be used for public water supply and consider year 2035 and ultimate build-out water demand.

A variety of water supply alternatives have been evaluated for adverse impacts to cultural resources, including groundwater, surface water sources in the Mississippi River basin, and Lake Michigan. The Great Lakes–St. Lawrence River Basin Water Resources Compact regulates Lake Michigan as a water supply as a diversion for the City of Waukesha and requires return flow back to the Great Lakes Basin. Consequently, the Lake Michigan water supply alternative also has included an evaluation of return flow alternatives.

Section 106 of the National Historic Preservation Act (NHPA; 16 USC 470)) and its implementing regulations (36 CFR 800) require federal agencies (such as the U.S. Army Corps of Engineers [USACE] when issuing a Section 404 permit) to take into account the effects of their undertakings on historic properties listed in or eligible for listing in the National Register of Historic Places (NRHP; 36 CFR 60). Each of the water supply alternatives being considered will likely trigger federal permit requirements and subsequent Section 106 compliance. The NHPA and the regulations also require federal agencies to consult with the appropriate State Historic Preservation Officers (SHPOs) and federally-recognized Native American tribes for undertakings with the potential to affect NRHP-listed or -eligible properties. In order to comply with NHPA, the City will initiate the necessary consultations and conduct cultural resources surveys once the construction workspace has been determined. The construction workspace will be determined once the water supply provider and return flow alternative have been determined and approved.

In addition, if the City applies for a Chapter 30 Wetland Water Quality Certification and/or a Wisconsin Pollutant Discharge Elimination System (WPDES) permit from the WDNR, then a cultural resource review will also be triggered. The permit review process involves a preliminary desktop cultural resources review by the WDNR to identify cultural resources or sites potentially impacted by the proposed supply and return flow alternatives. A request for cultural resource surveys may be initiated and required by the WDNR if the preliminary review results in cultural resources or sites being located along or within the construction workspace. If cultural resource surveys are required by the WDNR or SHPO in order to be in compliance with Section 106 of the National Historic Preservation Act, the City will work with an archeologist to conduct the necessary cultural resource surveys.

A majority of each alternative co-locates along previously disturbed utility corridors, roadways, railroad ROWs, or recreational trails, which is likely to minimize impacts to previously undisturbed resources. The City will follow any applicable requirements to protect cultural resources regardless of what alternative is chosen, and the City will implement minor adjustments to alignments or other disturbance minimization measures, if necessary, in order to avoid potential impacts. Consequently, no significant impacts to known cultural resources will occur.

A. Identified Archeological and Historical Resources

1. Archeological Resources

Archival investigations were conducted by The Public Service Archaeology & Architecture Program of the University of Illinois at Urbana-Champaign (PSAAP) to identify significant cultural resources within or adjacent to potential construction corridors of the proposed supply and return flow alternatives. The investigations included a review of the known archaeological sites and previous cultural resource surveys within 100 meters of each alternative's potential corridor. These findings contain archeologically sensitive and confidential information that is made available to necessary agencies for review, but is not summarized here because the information is not intended for public release.

Although some of the alternatives evaluated share project corridors and thus have the potential to disturb the same cultural sites, most alternatives' corridors are separate, and therefore each alternative was investigated separately. The results of the archival investigations are listed below and summarized below.

Supply Alternatives

- Deep and Shallow Aquifers: 9 sites
- Shallow Aquifer and Fox River Alluvium: 10 sites
- Lake Michigan—Milwaukee Supply: 5 sites
- Lake Michigan—Oak Creek Supply: 11 sites
- Lake Michigan—Racine Supply: 2 sites

Return Flow Alternatives

- Underwood Creek to Lake Michigan: 6 sites
- Root River to Lake Michigan: 9 sites
- Direct to Lake Michigan: 17 sites

Details regarding each of the sites are available in Tables 1 and 2.

2. Previous Cultural Resource Surveys

The archival investigations of the supply and return flow alternatives involved an evaluation of previous cultural resource surveys within 100 meters of the proposed alignments. Documentary research was conducted using a variety of historical references. Due to the fact that the results of the archival investigations are based on existing records the number of sites identified along each alternative does not reflect potential resources that may be present in previously unsurveyed areas. The results of the archival investigations for previous cultural resource surveys are summarized below by study location.

Supply Alternatives

- Deep and Shallow Aquifers: 2 previous surveys conducted
- Shallow Aquifer and Fox River Alluvium: 2 previous surveys conducted
- Lake Michigan—Milwaukee Supply: 6 previous surveys conducted

- Lake Michigan—Oak Creek Supply: 11 previous surveys
- Lake Michigan—Racine Supply: 7 previous surveys

Return Flow Alternatives

- Underwood Creek to Lake Michigan: 7 previous surveys
- Root River to Lake Michigan: 2 previous surveys
- Direct to Lake Michigan: 7 previous surveys

3. Historical Resources

The National Parks Service's (NPS) National Register of Historic Places (NRHP) was authorized under the National Historic Preservation Act of 1966. The NRHP is the official list of historic places throughout the United States and is part of a national program to coordinate and support efforts to identify, evaluate, and protect historic and archeological resources (NRHP, 2010a).

The NRHP database, which can be used through Google Earth©, provides the locations of NRHP sites for the Midwest Region, including Wisconsin. No NRHP sites are located within 0.10 mile of the Lake Michigan—Milwaukee Supply, Lake Michigan—Oak Creek Supply, or Lake Michigan—Racine Supply alternatives.

There are 25 NRHP sites within 0.10 mile of the Deep and Shallow Aquifers and Shallow Aquifer and Fox River Alluvium supply alternatives in Waukesha County (Google Earth, 2010; NHRP, 2010b). Thirteen NRHP sites were identified within 0.10 mile of the Underwood Creek to Lake Michigan return flow alternative, all within Waukesha County; no NRHP sites were identified within the Milwaukee County portion of the Underwood Creek to Lake Michigan return flow alternative. There are 10 NRHP sites within 0.10 mile of the Root River to Lake Michigan return flow alternative, of which all are within Waukesha County. There are 10 NRHP sites within 0.10 mile of the Direct to Lake Michigan return flow alternative within Waukesha County and two NRHP sites within Milwaukee County (Google Earth, 2010; NHRP, 2010b).

B. Archeological and Historical Resources Effects

1. Archeological Resources

Regardless of the alternatives selected, the City will meet regulatory requirements regarding archeological resources during the design and construction phases to prevent any significant impacts and mitigate impacts to known or potential sites. During operation, there will be no ground disturbance and no impacts will occur to archeological resources.

2 Historical Resources

No NRHP sites will be impacted by permanent structures associated with the project. Regardless of the alternatives selected, the City will follow regulatory requirements to prevent any significant impacts and mitigate impacts to known or potential NRHP sites. During operation, there will be no ground disturbance and no impacts will occur to historical resources.

3. Status of Native American Consultation

Research regarding the various supply and return flow alternatives was based on a desktop-level analysis using available survey data in order to preliminarily quantify the extent and nature of cultural resources that may be present. In order to comply with Section 106 of the NHPA, and to determine whether or not the Project affects any cultural properties of a Native American Nation or Tribe, consultation will be conducted with Native American groups. Coordination will occur once a Lake Michigan water supplier has been determined and a return flow location has been approved.

4. Consultation with the SHPO and Cultural Resources Surveys

The City will conduct comprehensive field surveys of all proposed work spaces as required by Section 106 of the NHPA, to protect archeological resources and coordinate appropriately with the SHPO regarding potential impacts from construction once a defined Lake Michigan water supplier has been determined and a return flow location has been approved. At that time, should eligible historic properties be identified in association with the alternative to be implemented the City will work with a qualified archeologist to prepare the appropriate evaluation reports and corresponding SHPO-approved cultural resource protection plan.

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TABLE 1
Archeological Sites within 100m of Centerline of City of Waukesha Water Supply Alternatives

Site Name	Township	Range	Description	Consultation Requirements
Supply Alternative: Deep and Shallow Aquifers[a]				
Ludy Jan Site	6N	19E	Unknown Historic Indian campsite/ village/workshop. A large amount of archaeological material is distributed on a sandy ridge. It appears to be a multicomponent site with a variety of material ranging from Archaic to Historic.	Update 1979: Following Phase II investigations, the site was determined *not* to be eligible for listing on the National/State Register of Historic Places. Current recommendations may differ from the original findings, and site status should be confirmed with WHS.
Gienke #3	6N	19E	Unknown prehistoric campsite/village/ workshop adjacent to the Fox River.	The current status is unknown, and additional investigations may need to be completed. Consultation with WHS is necessary.
Gienke #1	6N	19E	Unknown prehistoric campsite/village/ workshop. This site consists of a scatter of fire-cracked rock, debitage, and nondiagnostic lithic tools.	Update 2007: Intensive surface survey failed to relocate this site. The extended cultivation of this land has likely disturbed and deflated the site. The current status is unknown and additional investigations may be necessary. Consultation with WHS is necessary.
Gienke #2	6N	19E	Late Archaic to Middle Woodland campsite/village/workshop. The distribution of material was widely scattered.	The current status is unknown, and additional investigations may need to be completed. Consultation with WHS is necessary.
Stephen Peet's Mounds	6N	19E	A group of mounds. Due to the vague nature of the report, the site is not mapped. No other information is available.	This burial site is not catalogued, but is protected under Wis. Stats 157.70. Consultation with WHS is required.
Prairie Home Cemetery	6N	19E	A Historic Euro-American cemetery/ burial. This site consists of a marked Euro-American cemetery established 1841 and possibly as early as 1835. The site occupies an 8-acre parcel and has expanded to 80 acres, due to transfers from other, smaller cemeteries. Prairie Home also has a potter's field.	This burial site is catalogued and subject to the provisions of Wis. Stats 157.70. Consultation with WHS is required.
Tcheegascoutak	6N	19E	Historic Indian campsite/village. The Potawatomi settlement of Tcheegascoutak is reported for this location. Historic records indicate that the large village may have been inhabited by as many as 4,000 people around 1827.	This site is listed on the National/State Register of Historic Places and may be afforded special consideration pursuant to state and/or federal law. Consultation with WHS is necessary.
Main Street Mounds	6N	19E	Late Woodland mounds–conical, effigy, linear. The site consists of a group of one panther effigy, one linear, and one conical mound. No other information is available.	This burial site is not catalogued, but is protected under Wis. Stats 157.70. Consultation with WHS is required.

TABLE 1
Archeological Sites within 100m of Centerline of City of Waukesha Water Supply Alternatives

Site Name	Township	Range	Description	Consultation Requirements
Court House Mounds	6N	19E	Late Woodland mounds–conical, effigy, linear, and historic Indian, historic Euro-American trading/fur post. The Waukesha Museum was erected over the location of the turtle mound, and two mounds were located in the middle of modern Main St. This site consists of a group of mounds. A postcontact grave had been excavated into one of the turtle mounds.	Update 2000: The Vieau-Juneau Trading Post has been reported at this location. This Burial Site is not catalogued, but is protected under Wis. Stats 157.70. Consultation with WHS is required.
Supply Alternative: Shallow Aquifer and Fox River Alluvium[a]				
Dreger Site	6N	19E	Unknown prehistoric campsite/ village/workshop.	Current status unknown and additional investigations may need to be completed. Consultation with WHS is necessary.
Ludy Jan Site	6N	19E	Unknown Historic Indian campsite/village/workshop. It appears to be a multicomponent site with a variety of material ranging from Archaic to Historic.	Update 1979: Following Phase II investigations, the site was determined *not* to be eligible for listing on the National/State Register of Historic Places. Current recommendations may differ from the original findings, and site status should be confirmed with WHS.
Gienke #3	6N	19E	Unknown prehistoric campsite/village/ workshop.	The current status is unknown and additional investigations may need to be completed. Consultation with WHS is necessary.
Gienke #1	6N	19E	Unknown prehistoric campsite/village/ workshop. This site consists of a scatter of fire-cracked rock, debitage, and nondiagnostic lithic tools.	Update 2007: Intensive surface survey failed to relocate this site. The extended cultivation of this land has likely disturbed and deflated the site. The current status is unknown and additional investigations may be necessary. Consultation with WHS is necessary.
Gienke #2	6N	19E	Late Archaic to Middle Woodland campsite/ village/workshop. The distribution of material was widely scattered.	Current status is unknown and additional investigations may need to be completed. Consultation with WHS is necessary.
Stephen Peet's Mounds	6N	19E	A group of mounds. Due to the vague nature of the report, the site is not mapped. No other information is available.	This Burial Site is not catalogued, but is protected under Wis. Stats 157.70. Consultation with WHS is required.

TABLE 1
Archeological Sites within 100m of Centerline of City of Waukesha Water Supply Alternatives

Site Name	Township	Range	Description	Consultation Requirements
Prairie Home Cemetery	6N	19E	Historic Euro-American cemetery/burial. This site consists of a marked Euro-American cemetery established 1841 and possibly as early as 1835. The site occupies an 8-acre parcel and has expanded to 80 acres, due to transfers from other, smaller cemeteries. Prairie Home also has a potter's field.	This Burial Site is catalogued and subject to the provisions of Wis. Stats 157.70. Consultation with WHS is required.
Tcheegascout ak	6N	19E	Historic Indian campsite/ village. The Potawatomi settlement of Tcheegascoutak is reported for this location. Historic records indicate that the large village may have been inhabited by as many as 4,000 people around 1827.	Listed on the National/State Register of Historic Places and may be afforded special consideration pursuant to state and/or federal law. Consultation with WHS is necessary.
Main Street Mounds	6N	19E	Late Woodland mounds–conical, effigy, linear. The site consists of a group of one panther effigy, one linear and one conical mound. No other information is available.	This Burial Site is not catalogued, but is protected under Wis. Stats 157.70. Consultation with WHS is required.
Court House Mounds	6N	19E	Late Woodland mounds–conical, effigy, linear, and historic Indian, historic EuroAmerican trading/fur post. The Waukesha Museum was erected over the location of the turtle mound, and two mounds were located in the middle of modern Main St. This site consists of a group of mounds. A postcontact grave had been excavated into one of the turtle mounds.	Update 2000: The Vieau-Juneau Trading Post has been reported at this location. This Burial Site is not catalogued, but is protected under Wis. Stats 157.70. Consultation with WHS is required.
Supply Alternative: Lake Michigan—Milwaukee Supply[a]				
Calhoun Mounds	6N	20E	This site was located on the J. Elger property south of Calhoun Station and consists of two conical mounds (Woodland Mounds-Conical). They had disappeared through cultivation of the land by July 8, 1903.	This Burial Site is not catalogued, but is protected under Wis. Stats 157.70. Consultation with WHS is required.
Highland Memorial Park	6N	20E	Historic Euro-American cemetery/ burial. Records for this cemetery are complete but are not available to the public.	This Burial Site is not catalogued, but is protected under Wis. Stats 157.70. Consultation with WHS is required.
Root River Parkway	6N	21E	Unknown prehistoric isolated finds.	The current status is unknown and additional investigations may need to be completed. Consultation with WHS is necessary.

TABLE 1
Archeological Sites within 100m of Centerline of City of Waukesha Water Supply Alternatives

Site Name	Township	Range	Description	Consultation Requirements
Beloit Corners Burials	6N	21E	Middle Archaic cemetery/burial.	This burial site is not catalogued, but is protected under Wis. Stats 157.70. Consultation with WHS is required.
Blessed Sacrament Cemetery	6N	21E	Historic Euro-American cemetery/burial. This is a very small cemetery, with many fallen stones.	This burial site is not catalogued, but is protected under Wis. Stats 157.70. Consultation with WHS is required.
Supply Alternative: Lake Michigan Supply—Oak Creek[a]				
Calhoun Mounds	6N	20E	Consists of two conical mounds (Woodland Mounds–Conical). They had disappeared through cultivation of the land by July 8, 1903.	This Burial Site is not catalogued, but is protected under Wis. Stats 157.70. Consultation with WHS is required.
Highland Memorial Park	6N	20E	Historic Euro-American cemetery/ burial. Records for this cemetery are complete, but are not available to the public.	This Burial Site is not catalogued, but is protected under Wis. Stats 157.70. Consultation with WHS is required.
Root River Parkway	6N	21E	Unknown prehistoric isolated finds.	Current status is unknown, and additional investigations may need to be completed. Consultation with WHS is necessary.
Beloit Corners Burials	6N	21E	Middle Archaic cemetery/burial.	This burial site is not catalogued, but is protected under Wis. Stats 157.70. Consultation with WHS is required.
Jungblut Gravel Pit	6N	21E	Campsite/ village, cemetery/burial. This site consists of a Menominee habitation area and a cemetery.	The site may or may not be on the Jungblut farm. Current status is unknown and additional investigations may need to be completed. Consultation with WHS is necessary.
Whitnall Park Burial	6N	21E	Late Archaic, Early Woodland cemetery/burial.	This Burial Site is not catalogued, but is protected under Wis. Stats 157.70. Consultation with WHS is required.
Unnamed Site #1	5N	21E	Located along the banks of the Root River. Culture unknown.	Current status is unknown and additional investigations may need to be completed. Consultation with WHS is necessary.
Unnamed Site #2	5N	21E	The site, an unknown Prehistoric campsite/ village.	Current status site is unknown and additional investigations may need to be completed. Consultation with WHS is necessary.
Chicago Short	5N	21E	Unknown Prehistoric campsite/ village.	Determined not eligible. Current status is unknown and additional investigations may need to be completed. Consultation with WHS is necessary.

TABLE 1
Archeological Sites within 100m of Centerline of City of Waukesha Water Supply Alternatives

Site Name	Township	Range	Description	Consultation Requirements
Unnamed Site #3	5N	22E	Unknown Prehistoric site. Contains lithics scatter. Patricia B. Richards investigated the site in 1993. No artifacts were recovered within the survey corridor.	Due to previous road construction and maintenance activities, all deposits within the right-of-way probably have been extensively disturbed.
St. Matthews Cemetery	5N	22E	The site is a Euro-American cemetery/burial.	This Burial Site is not catalogued, but is protected under Wis. Stats 157.70. Consultation with WHS is required.
Supply Alternative: Lake Michigan—Racine[a]				
Tews Site	5N	20E	Unknown Prehistoric campsite/village/workshop.	Current status is unknown and additional investigations may need to be completed. Consultation with Wisconsin Historical Societyis necessary.
Heinrich	5N	20E	Middle-Late woodland campsite/village/ workshop.	Current status is unknown and additional investigations may need to be completed. Consultation with Wisconsin Historical Society is necessary.

[a]To protect cultural resources, section and quarter section locations have been omitted.
WHS, Wisconsin Historical Society.
Sources: Lapham (1836, 1855); Brown (1906b, 1906c, 1923b, 1923d, 1925, 1930a, 1930b); Overstreet and Brazeau (1978a, 1978b, 1978c, 1978d, 1979); Becker (1988); Holliday (1989); Goldstein (1994); Van Dyke (2008).

TABLE 2
Archaeological Sites within 100m of Centerline of Flow Return Alternatives

Site Name	Township	Range	Description	Consultation Requirements
Flow Return Alternative: Underwood Creek[a]				
Stephen Peet's Mounds	6N	19E	A group of mounds. Due to the vague nature of the report, the site is not mapped. No other information is available.	This Burial Site is not catalogued, but is protected under Wis. Stats 157.70. Consultation with WHS is required.
Industrial School Mound	6N	19E	This site consists of a single conical mound 40 feet in diameter and one and a half feet high.	Updated 1995: No surface indications of a mound were found during a 1994 field check. This Burial Site is not catalogued, but is protected under Wis. Stats 157.70. Consultation with WHS is required.
Dwell's Cornfields	6N	19E	Historic Indian campsite/village/corn hills/garden beds. The site is associated with the early 19th century Potawatomi occupation of Waukesha.	Current status is unknown and additional investigations may need to be completed. Consultation with WHS is necessary.
Charles Street Mounds	6N	19E	Woodland, Late Woodland conical and linear mounds. This site consists of a group of five conical mounds and one linear mound, destroyed prior to 1906.	This Burial Site is not catalogued, but is protected under Wis. Stats 157.70. Consultation with the Wisconsin Historical Society is required.
Calhoun Mounds	6N	20E	This site consists of two conical mounds (Woodland Mounds-Conical). They had disappeared through cultivation of the land by July 8, 1903.	This Burial Site is not catalogued, but is protected under Wis. Stats 157.70. Consultation with the Wisconsin Historical Society (WHS) is required.
Highland Memorial Park	6N	20E	Historic Euro-American cemetery/burial. Records for this cemetery are complete, but are not available to the public.	This Burial Site is not catalogued, but is protected under Wis. Stats 157.70. Consultation with WHS is required.
Flow Return Alternative: Root River[a]				
Stephen Peet's Mounds	6N	19E	A group of mounds. Due to the vague nature of the report, the site is not mapped. No other information is available.	This Burial Site is not catalogued, but is protected under Wis. Stats 157.70. Consultation with WHS is required.
Industrial School Mound	6N	19E	Consists of a single conical mound forty feet in diameter and one and a half feet high.	Updated 1995: No surface indications of a mound were found during a 1994 field check. This Burial Site is not catalogued, but is protected under Wis. Stats 157.70. Consultation with WHS is required.
Dwell's Cornfields	6N	19E	Historic Indian campsite/village/ cornhills/garden beds. The site is associated with the early 19th century Potawatomi occupation of Waukesha.	Current status is unknown and additional investigations may need to be completed. Consultation with WHS is necessary.

TABLE 2
Archaeological Sites within 100m of Centerline of Flow Return Alternatives

Site Name	Township	Range	Description	Consultation Requirements
Charles Street Mounds	6N	19E	Woodland, Late Woodland conical and linear mounds. This site consists of a group of five conical mounds and one linear mound, destroyed prior to 1906.	This Burial Site is not catalogued, but is protected under Wis. Stats 157.70. Consultation with the Wisconsin Historical Society is required.
Calhoun Mounds	6N	20E	Consists of two conical mounds (Woodland Mounds–Conical). They had disappeared through cultivation of the land by July 8, 1903.	This Burial Site is not catalogued, but is protected under Wis. Stats 157.70. Consultation with the Wisconsin Historical Society (WHS) is required.
Highland Memorial Park	6N	20E	Historic Euro-American cemetery/burial. Records for this cemetery are complete, but are not available to the public.	This Burial Site is not catalogued, but is protected under Wis. Stats 157.70. Consultation with WHS is required.
Root River Parkway	6N	21E	Unknown prehistoric isolated finds.	Current status is unknown and additional investigations may need to be completed. Consultation with WHS is necessary.
Beloit Corners Burials	6N	21E	Middle Archaic cemetery/burial.	This burial site is not catalogued, but is protected under Wis. Stats 157.70. Consultation with WHS is required.
Jungblut Gravel Pit	6N	21E	Campsite/village, cemetery/burial. This site consists of a Menominee habitation area and a cemetery.	The Jungblut farm is listed in Section 29 on archival plats. However, the site may or may not be on the Jungblut farm.
Flow Return Alternative: Direct to Lake Michigan[a]				
Stephen Peet's Mounds	6N	19E	A group of mounds. Due to the vague nature of the report, the site is not mapped. No other information is available.	This Burial Site is not catalogued, but is protected under Wis. Stats 157.70. Consultation with WHS is required.
Industrial School Mound	6N	19E	Consists of a single conical mound forty feet in diameter and one and a half feet high.	Updated 1995: No surface indications of a mound were found during a 1994 field check. This Burial Site is not catalogued, but is protected under Wis. Stats 157.70. Consultation with WHS is required.
Dwell's Cornfields	6N	19E	Historic Indian campsite/village/corn hills/garden beds. The site is associated with the early 19th century Potawatomi occupation of Waukesha.	Current status is unknown and additional investigations may need to be completed. Consultation with WHS is necessary.
Charles Street Mounds	6N	19E	Woodland, Late Woodland conical and linear mounds. This site consists of a group of five conical mounds and one linear mound, destroyed prior to 1906.	This Burial Site is not catalogued, but is protected under Wis. Stats 157.70. Consultation with the Wisconsin Historical Society is required.

TABLE 2
Archaeological Sites within 100m of Centerline of Flow Return Alternatives

Site Name	Township	Range	Description	Consultation Requirements
Calhoun Mounds	6N	20E	This site consists of two conical mounds (Woodland Mounds–Conical). They had disappeared through cultivation of the land by July 8, 1903.	This Burial Site is not catalogued, but is protected under Wis. Stats 157.70. Consultation with WHS is required.
Highland Memorial Park	6N	20E	Historic Euro-American cemetery/burial. Records for this cemetery are complete, but are not available to the public.	This Burial Site is not catalogued, but is protected under Wis. Stats 157.70. Consultation with WHS is required.
Indian Fields	6N	21E	Consists of a habitation area and a large group of mounds. In 1836, the site was described as showing “recent signs of Indian occupancy and cultivation.” The mounds were probably segregated into several distinct groups, but the site is so vaguely described that little can be said about its structure.	Current status is unknown and additional investigations may need to be completed. Consultation with WHS is necessary.
Pilgrims’ Rest Cemetery	6N	21E	Historic Euro-American cemetery/burial. Pilgrims’ Rest Cemetery was established in 1880 by St. Stephen's Congregation and was managed by a church cemetery committee. It was sold in June 1996 to Good Hope Pilgrims Rest Cemetery corp.	This Burial site is not catalogued, but is protected under Wis. Stats 157.70. Consultation with WHS is required.
Jackson Park Burial	6N	21E	Unknown Prehistoric campsite/village, Woodland cemetery/burial.	This Burial site is not catalogued, but is protected under Wis. Stats 157.70. Consultation with WHS is required.
Jackson Park	6N	21E	Unknown Prehistoric isolated finds.	Current status is unknown and additional investigations may need to be completed. Consultation with WHS is necessary.
Unnamed Site #1	6N	22E	Unknown Prehistoric campsite/village.	Current status is unknown and additional investigations may need to be completed. Consultation with WHS is necessary.
Unnamed Site #2	6N	22E	Unknown enclosure/earthworks.	Current status is unknown and additional investigations may need to be completed. Consultation with WHS is necessary.
Greenwood Cemetery	6N	22E	Historic Euro-American cemetery.	This Burial site is not catalogued, but is protected under Wis. Stats 157.70. Consultation with WHS is required.
Forest Home Cemetery	6N	22E	Historic Euro-American cemetery. This is a large cemetery that has early burial records on microfilm.	This Burial site is not catalogued, but is protected under Wis. Stats 157.70. Consultation with WHS is required.

TABLE 2
Archaeological Sites within 100m of Centerline of Flow Return Alternatives

Site Name	Township	Range	Description	Consultation Requirements
Austin's Gravel Pit Burials	6N	22E	Unknown cemetery/burial. Various references place this site in different sections.	This Burial site is not catalogued, but is protected under Wis. Stats 157.70. Consultation with WHS is required.
Unnamed Site #3	6N	22E	Historic Euro-American cemetery/burial site.	This Burial site is not catalogued, but is protected under Wis. Stats 157.70. Consultation with WHS is required.
Unnamed Site #4	6N	22E	Unknown site.	Current status is unknown and additional investigations may need to be completed. Consultation with WHS is necessary.

[a]To protect cultural resources, section and quarter section locations have been omitted.
WHS, Wisconsin Historical Society.
Sources: Lapham (1836, 1855); Brown (1906b, 1906c, 1923b, 1923d, 1925, 1930a, 1930b); Overstreet and Brazeau (1978a, 1978b, 1978c, 1978d, 1979); Becker (1988); Holliday (1989); Goldstein (1994); Van Dyke (2008).